

# MATTER THAT MATTERS

A study of household routines in a process of changing  
water and sanitation arrangements

Helena Krantz

**Linköping Studies in Arts and Science**

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## CHAPTER 1

# Do changes in technical arrangements make households ecologically sustainable?

Our society has changed, but the urban water and sanitation system of today is roughly the same as it was 100 years ago. The present urban water and sanitation system of piped water supply and sewerage is perceived as hygienic, easy to use and robust, and the water resources are abundant. The system is designed for, developed from and sustained by human activities, and has since its introduction affected household pattern of routine activities.

The urban water and sanitation system is now being criticised for not being sustainable due to excessive material, energy and chemical use, and failure to recycle and reuse resources. For a long period, industries were blamed for polluting the environment and forced to improve their practices. Today, households are pointed out as one of the major culprits, estimated to contribute about 50% of the unwanted chemicals and metals ending up in wastewater (Eksvärd 1999). The polluted household wastewater is treated in wastewater treatment plants, where most of the solids and nutrients are removed. However, many chemical substances and metals cannot be treated and are released to water recipients. Some also end up in the wastewater treatment sludge, making the nutrient-rich sewage sludge impossible to use on farmland. Furthermore, the national environmental goals<sup>1</sup> require household water to be used in an (more) efficient way. Economising use is a way to secure the supply of water and to decrease the energy consumption in dwellings (Boverket 1999). Minimising hot water use is of particular interest, since it represents 15% of the households' overall energy use (Berndtsson 1999; Boverket 2002).

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<sup>1</sup> The Swedish Parliament has established 15 national environmental goals, which serve society's work towards a sustainable Sweden. The "A Good Built Environment" states that: *"Buildings and amenities must be located and designed in accordance with sound environmental principles and in such a way as to promote sustainable management of land, water and other resources"* (Miljömålsrådet 2004).

## Aim of the study

In this study, two changes in water and sanitation arrangements<sup>2</sup> at the household level are analysed: individual meters for volumetric billing of hot and cold water, and dry toilets with separate collection of urine and faeces. These arrangements increase system transparency, and their proponents believe that the arrangements enhance resource recycling and/or resource savings. However, success in this regard can only be achieved if accompanied by appropriate household routines. The extent to which such appropriate routines come about and why (not) is the focus of attention in this study.

*The aim of this thesis is to describe and analyse the interaction between householder routines and changes in water and sanitation arrangements.*

The analysis is guided by two operational questions:

- In what way do the changes in arrangements impact on householder routines?
- How can the new routines be evaluated in terms of social and ecological sustainability?

Two questions will be dealt with in the two case studies:

- How and why do household members change their water consumption when volumetric billing is introduced?
- How and why do household members change their routines for use and management when dry diverting toilets are introduced?

In this study, implications will be drawn for future planning of sustainable urban water and sanitation systems.

## SUSTAINABLE URBAN WATER AND SANITATION SYSTEMS

Households have come to play a passive role in urban water and sanitation systems (SUWM 2001). Household members engage in paid work and part of the money is used to pay for water and sanitation services. Previously, household members themselves provided these services, but today, as a result of technical developments, they are being provided by *automation*<sup>3</sup>, with an *unclear*

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<sup>2</sup> The concept arrangement is used here instead of system, since it allows discussing technical devices and management aspects of water and sanitation.

<sup>3</sup> Automation is a way of getting the same services but with the use of considerably less resources, especially time (Hallin 1989) (p.65).

*relation to nature*, and have become *taken for granted* (Hallin 1989; Hultman 1993; Wärneryd et al. 2002).

This alienation of households from nature became problematic when political interest in altering resource management in society (to achieve an ecologically sustainable development) increased. The part of the system that residents see has remained almost the same over the last 100 years, and user practices have become routinised. Specialised organisations were given the full responsibility for provision and treatment, and thus for the environmental impact. Furthermore, the installations work well (robust), they rarely make us ill (hygienic), and we know how to use them (easy).

This arrangement has contributed to shaping a user behaviour that may put our common future at risk, but we lack studies of how residents respond to and also change the performance of the arrangement. The urban water and sanitation arrangement effectively hides the environmental consequences of hot baths, teeth-brushing, laundry washing and paint thinner disposal in the toilet, and such routines are difficult to both alter and study since they are routines (performed without reflection), physically possible to perform and perceived as normal and necessary. What makes the issue of ecological sustainability complicated is that everyone carries out ecologically critical routines regularly, merely by living an everyday life.

Removal of nutrients and organic material from wastewater has essentially been solved by means of technology, and since the mid-1970s water consumption has steadily decreased by means of water-saving installations (Drangert et al. 2004). In the past, when deteriorating environmental conditions necessitated improvements, professionals in the urban water and sanitation sector applied technology to solve the problems. In order to solve the present sustainability problems, however, professionals in both the urban water and sanitation sector and the scientific community point to the necessity of increased user responsibility. A major reason is the emerging “chemical society” with an ever-increasing number of products being used and disposed of in the wastewater, etc. by households. Improved user routines are seen as an additional “treatment-step” (Drangert et al. 2004), or “barrier” (Malmqvist and Palmqvist 2004).

Mainly Swedish studies are referred to here, firstly since the cases in the present study share contextual factors and provide comparative material. Secondly, sorting toilets are not common anywhere worldwide, and Sweden is one of few developed countries where such technical arrangements are installed and running (Larsen et al. 2001). Swedish research on such

arrangements is also comparably plentiful and internationally recognized<sup>4</sup>. Studies of ecological sanitation in developing countries are more plentiful than studies carried out in industrial countries, but they are almost exclusively carried out in rural areas. In the European Union interest in metering and billing household use of water has increased lately, and in Denmark, for instance, it is already a fact (Berndtsson 2003). Still, both Swedish and international studies of the impact of billing on consumption are scarce, and I have not found any study taking a user perspective.

## 1. Ecologically sustainable routines – decreased water use

Saving hot water entails saving scarce energy and reducing carbon dioxide emissions (depending on heating source)<sup>5</sup>. Efficient cold water use is also ecologically beneficial, since less water needs to be transported and treated in water and wastewater treatment plants. More concentrated wastewater requires less energy and chemicals when treated, which, in turn, decreases the polluting discharges to recipients (SWWA 2000). Furthermore, fresh water resources are saved (Henze 1997).

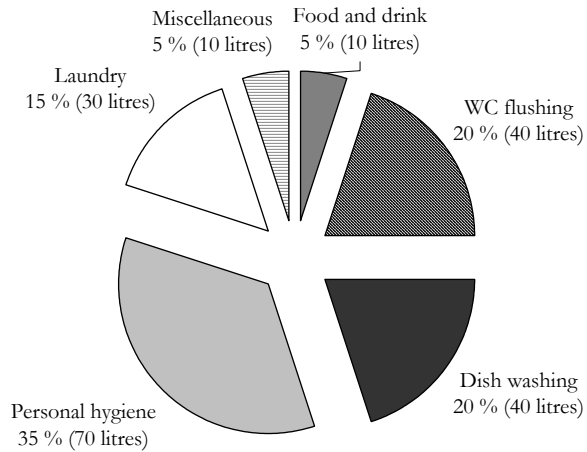
The household sector uses 57% of the municipal potable water supply (Boverket 1999), and on average, every Swede uses about 200 l/p/d in his or her household (SWWA 2000), of which some 70 litres (35%) is hot water. Hot water constitutes 15% of the total energy use in dwellings (Boverket 2002). Figure 1.1 illustrates the daily average water use per activity and person in litres and the percent of total use (without separating between hot and cold water).

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<sup>4</sup> Ecological sanitation research is also carried out by e.g. the Denmark Technical University, the Technical University of Hamburg-Harburg in Germany and The Swiss Federal Institute for Environmental Science and Technology (EAWAG) in Switzerland.

<sup>5</sup> The EU-SAVE directive encourages the member countries to introduce volumetric billing in all types of housings as a tool for decreasing carbon dioxide emissions. However, this is a less valid argument in Sweden since most apartment buildings (the only buildings without volumetric billing of water today) have their hot water heated by district heating – a heating source mainly based on bio-fuel (Berndtsson 2003).

**Figure 1.1 Household water usage per person and day (in litres and percent)**



*Source: The Swedish Water and Wastewater Association (SWWA 2000)*

Only 5% is used for food preparation and drinking, while the main volume is used for personal hygiene and other cleaning activities, and so these activities will be of particular concern in the following.

Per capita use in private houses is about 170 litres a day, whereas residents in flats use 230 litres/p/d. Cost sharing of water and the longer pipes, which require more flushing to achieve sufficiently high water temperature and quality, are thought to be the cause of the higher use in flats than in private houses (Boverket 2002). Older people often use low volumes of water, many using only some 100 litres/day (Boverket 1999).

Accordingly, there are differences in water use patterns (Carlsson-Kanyama and Lindén 2002) (Berndtsson 2003), but these have not been at the centre of attention and have only been sparsely researched. Saving water has not been regarded as an important environmental act. The low energy price compared to other EU countries, high water quality, and large water resources, have made water savings a low concern (Lindén 2001). The importance of water use routines, however, is pointed out by Gaunt (Gaunt 1985), who showed that the different water use routines in private houses accounted for the main difference in energy use between different households. Differences in shower habits was the single most important factor. As in Gaunt's study, household

water use is sometimes included in studies of household energy consumption<sup>6</sup>, and here differences between household energy (and water) consumption are attributed to family or household type (household size and composition, socio-economy, education), and lifestyle (relationship between values, attitudes and acts). Other important, but not widely studied parameters are age group, gender and culture (Carlsson-Kanyama and Lindén 2002). A literature study by Carlsson-Kanyama and Lindén (Carlsson-Kanyama and Lindén 2002) found that men's shower habits are more energy saving since they shower on fewer occasions and for shorter times than do women. Hot water is used mostly for personal hygiene and, therefore, does not offer any benefits of scale, while cold water does to some extent, since large households may fill their dishwashers and washing machines more readily. Teenagers shower longer and more often than small children. Households with children and teenagers wash more laundry in weight per person than households with no children, albeit often in more modern washing machines (often using less water than old ones) than in, for instance, households with older people. Households with a higher education level and where the woman works outside the home wash less than households where one adult is at home. A new norm for how long clothes should be used before being washed was developed. Furthermore, earlier studies cannot establish evidence of households with 'green values' behaving more ecologically than others. Nor is there any evidence that younger people behave 'better' than older persons; rather, elderly people may have energy-efficient behaviour out of habit (Carlsson-Kanyama and Lindén 2002).

The studies referred to in Carlsson-Kanyama and Lindén (Carlsson-Kanyama and Lindén 2002) were mainly conducted with households in private houses, but considering the higher use in flats, studies of such households are vital. The households in flats lack control over the effects of saving water and this is thought to decrease motivation for reduction of use (Carlsson-Kanyama and Lindén 2002). The introduction of metering and billing per household is recognised as a tool for achieving reductions in use (SOU 1996; Berndtsson 1999; Berndtsson 2003). Besides visualising the real cost for water, the arrangement is also motivated out of fairness – there would be no more cross subsidizing of wasteful use (Boverket 2002). It is also in line with increased flexibility in setting rents promoted by the Swedish Tenant's Association (Hyresgästernas Riksförbund 2000; SKOP 2000; Berndtsson 2003).

What is considered wasteful use may alter over time, however, and Boverket (Boverket 2002) defines "reasonable use" as the smallest amount needed for

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<sup>6</sup> According to Carlsson-Kanyama and Lindén (2002) also a research area of relative recent concern, affecting the quantity of studies negatively.

preserving human health, used for activities such as drinking water, preparing food, personal hygiene, washing dishes and clothes, and cleaning. “Wasteful use” is all water use exceeding reasonable use, resulting from either technical deficiencies (not having the latest water-saving technology, or a piping system that leads to large amount of water being flushed away to achieve the right temperature), or from human behaviour, e.g. having the tap running while brushing teeth and the shower on while soaping. Boverket does not indicate what reasonable volumes of daily water usage would be.

The interest in metering and billing of hot and cold water per household is increasing – in 2003 about 7 300 flats were provided with metering, a figure expected to rise to 15 000 by 2006 (Berndtsson 2003). The actual impact of household metering on household water use is still uncertain. Hot water usage may decrease by about 15-30% (Berndtsson 2003) and the total water saving is estimated at about 10-25% in a West European context (Lallana et al. 2001). However, the latter study points out that the impact of metering is difficult to separate from the impact of other measures, which are often introduced simultaneously, such as instalment of water-saving devices, information campaigns, and a changed tariff arrangement (Ibid.).

Van Vugt (Van Vugt 2001) claims, in a social dilemma analysis (conflict between public and private interests), that payment according to use is effective in promoting water saving in a situation of water scarcity. People with a strong sense of community identification may be motivated to save water by information or community campaigns, while individuals with a weak sense of community identification are more motivated to save by payment according to use. The argument of water scarcity is not applicable in most of Sweden for most of the time, since we are blessed with an abundant supply of water in nearly all regions<sup>7</sup>. The abundant water supply in Sweden is even used as an argument against water-saving measures, both by professionals in the sector as well as by people in general (SWWA 2000; Axelsson et al. 2001; Drangert et al. 2004).

There has not been any thorough investigation of how households reduce their water use and why some do not, and why use varies between different households. Boverket (Boverket 2002) identifies the need for development and demonstration projects to develop the measurement technology and systems for information and administration, and to demonstrate *the effects on user behaviour*. The board suggests that volumetric billing could be a way of

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<sup>7</sup> South-eastern Sweden, the islands Öland and Gotland, and archipelago islands may experience water shortages (SWWA 2000). The problem is most pressing during the summer months due to the combination of small water supplies and a seasonal population increase.

reducing “wasteful” water use since it makes water cost visible, but also that the same awareness perhaps could be achieved in other (cheaper) ways. For instance, by changing the design of the rent invoice, e.g. combining information about how to save water and general consumption goals with promises of general rent reductions if the consumption goals are reached, or simply defining the proportion of the total rent accounted for by water costs. Van Vugt’s findings, however, indicate that it is difficult to get at all households this way, compared to introducing volumetric billing.

The arrangement involving metering and billing per household links human behaviour to economic resources and the assumption is that an increase in water price reduces use (Lallana et al. 2001). This creates an incentive to reduce the low-value use – its use not considered being worth the money. However, the expenditure for water is marginal for households and, according to economic theory, the cost must be high enough to motivate households to alter their use. According to Hjerpe (Hjerpe 2005), the low-use households would be unaffected while high-use consumers would change the most. It is generally recognized that the charge cannot be too high – no one should be forced to put hygiene and health at risk to be able to pay the water bills (Lallana et al. 2001). Internationally, there is a discussion about more vulnerable households in terms of metering and billing per household, e.g. households consisting of large families and individuals with medical conditions (Lallana et al. 2001), and about financial incentives being less appropriate in poor areas (Van Vugt 2001). However, in Sweden we have no similar discussion due to the (hitherto) low price of water and a government ensuring financial support for people without an income.

Studies of household water use and the impact of introducing volumetric billing are rare. Such studies are also limited in their approach, relating use to just a few important variables at an aggregate level. However, there are many and interrelated variables to consider when explaining household water usage and the logic behind it. The present study aims at contributing a detailed investigation of household aspects of volumetric billing by means of interviews of 11 household members among some 900 households in the Ringdansen district in Norrköping with metering and billing per household.

## **2. Ecologically sustainable routines – enabling nutrient recycling**

*“It is in no way prestigious or scientifically rewarding to deal with toilets, but it is one of the most important questions for the survival of man on earth in the long run.” (Otterpohl et al. 1999:155)*



Household wastewater reflects what the residents consume, and therefore changes over time. In the current consumer society and chemical society it contains a wide range of substances, and wastewater today may contain as many as 30 000 different chemical substances (Palmquist 2001). Household wastewater is a mix of nutrients (e.g. phosphorus, nitrogen and potassium), other chemicals (e.g. metals and anthropogenic organic substances), various solids and pathogens (e.g. bacteria and viruses). The nutrients originate mainly from food<sup>8</sup>, and some of the phosphorous from detergents<sup>9</sup>. Metals originate from several sources such as food, tobacco and snuff (cadmium), amalgam tooth fillings (mercury), wear and tear of objects (cutlery, zippers, casseroles, etc) and pipes, etc. (Naturvårdsverket 1995). In addition, residents dispose of a wide range of products and substances in toilets and drains.

Most of the above-mentioned substances end up in the sludge in the wastewater treatment plant, together with chemicals used in the treatment process, and the rest proceeds to the receiving water. Nutrient-rich sludge has been used on farmland since the introduction of the biological treatment step in the 1970s. This practice has been the subject of debate from the time it was introduced, with concern focusing on the content of heavy metals and some organic substances. In the mid-1980s, food manufacturers started to reject agricultural products that had been fertilised with sewage sludge, and the Swedish Farmers Association (LRF) launched the first sludge boycott in 1988 (Agustinsson 2003).

In 1999, LRF launched yet another sludge boycott that reduced sludge application to practically zero. The decisive factor this time was alarming news about the health risk of bromated flame-retardants<sup>10</sup>, adding to existing warnings about hygienic risks and silver content in sludge (Agustinsson 2003). The sludge boycott is still (2005) in effect and at present nutrient-rich sewage sludge is either stored in landfills or incinerated. Deposition of organic waste on landfills is prohibited since January 1<sup>st</sup> 2005 (Olofsson 2004).

This situation has been the driving force behind finding new ways of recovering nutrients. Solutions for retrieving valuable products can either be at the end-of-pipe, by sludge fractionation (see, for instance, Stark 2002), or at

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<sup>8</sup> 90% of the nitrogen comes from human excreta (80% urine/10% faeces), phosphorus 75% (50/25) and potassium 85% (60/25) (Naturvårdsverket 1995).

<sup>9</sup> The proportion of phosphorus from detergents has decreased since manufacturers have replaced phosphorus in detergents with other chemicals (Naturvårdsverket 1995).

<sup>10</sup> Bromated flame-retardants contain the toxic chemical brome. They are used in electrical appliances, building material and textiles to make them fire resistant. Their effects on the environment and human health are unclear, but animal testing shows negative effects on liver and thyroid gland function (Naturvårdsverket 2000).

the beginning of pipe by e.g. diverting the nutrient-rich fraction of urine and faeces in the toilet.

The urine-diverting toilet is an important technical arrangement for transforming a potential waste product into a resource with optimum composition for further treatment, reuse and recycling (Henze 1997). What we ingest in the form of food and drink comes out as urine and faeces, containing plant nutrients directly available for plant uptake. In wastewater treatment plants, nutrients are removed to avoid over-fertilising rivers and lakes. Most of the phosphorus ends up in the sludge, while most of the potassium goes right through the treatment process and out to recipients. Some of the nitrogen ends up in the sludge but a large proportion is transformed into atmospheric nitrogen (Jönsson et al. 2000)<sup>11</sup>. Agriculture, the main provider of nutrients to the household, uses artificial fertilizers. The finite resources phosphorus and potassium are extracted from mines, and nitrogen is recovered from air and requires large energy resources to be produced.

Reuse of human excreta on farmland without forgoing hygienic aspects is becoming a viable option, and is referred to as ecological toilets or ecological sanitation<sup>12</sup>. The purpose is to contain excreta, save resources, and reuse nutrients and greywater. Collecting and composting urine and faeces together produces a good soil conditioner (humus), but results in considerable nutrient loss due to the composting process (Winblad 1998).

Keeping urine and faeces separate has several advantages. Firstly, it facilitates nutrient recovery efficiency since urine - the most nutrient-rich fraction - can be reused with minimal nutrient loss (Winblad and Simpson-Hébert 2004). Secondly, faeces and urine have different hygienic qualities; urine normally contains only a few pathogenic organisms<sup>13</sup> whereas faeces normally contain high concentrations of pathogens (Jönsson et al. 2000). Faeces are sanitised through dehydration or decomposition, and dehydration is easier to achieve if

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<sup>11</sup> According to Håkan Jönsson, Swedish University of Agricultural Sciences (SLU), it is important to focus on plant nutrients in general rather than merely on the sludge, since more nutrients are recovered in diverting systems than remain in the sludge. A considerable proportion of the nutrients - 65% of the nitrogen, 90% of the potassium and 30% of the sulphur - is lost in the activated sludge process (Johansson 2002).

<sup>12</sup> In IWA (International Water Association) there is a special division or specialist group for sustainable sanitation, which also arranges international conferences on the subject, of which the last one, *The 2<sup>nd</sup> International Symposium on Ecological Sanitation*, was held in Lübeck, Germany, 2003.

<sup>13</sup> Urine from healthy individuals is sterile in the urinary bladder, but bacteria are added during transport out of the body. However, only few diseases are transmitted via urine and most of them are rare in temperate climates (Jönsson et al. 2000).

the urine fraction is excluded (Winblad and Simpson-Hébert 2004). Urine is normally sterile, but since faecal matter may contaminate urine by mistake, six months of storage is recommended for systems including more than one household (pathogen die-off through temperature and elevated pH in combination with ammonia) (Schönning and Stenström 2004). Thirdly, smell is reduced compared to mixing urine and faeces, and with some ventilation the toilet can thus be indoors (Hallin 1885 in Drangert and Hallström 2002).

Apart from enhancing nutrient recovery, ecological toilets also save water compared to conventional WCs<sup>14</sup>. The water-saving argument is emphasised in water-scarce parts of Sweden. A completely dry system is optimal for saving water, but also urine-diversion reduces the water used for toilet flushing markedly. A British study shows that more than 70% of the WC toilet flushing takes place after only having urinated (Friedler et al. 1996). Larsen et al (Larsen et al. 2001) states that a urine-diverting toilet saves 80% of the water used for flushing a conventional WC. Some studies indicate that urine-diverting toilets may have some 'spill-over' effects by making residents perform more environmentally friendly acts in a broad sense, which is explained as an outcome of the reduced distance between act and environmental consequence (Mårtensson and Fuehrer 1999) or of the 'recycling technology' itself, seemingly stimulating reflection and care (Widahl et al. 1999).

Urine is regarded as the most important fraction to recover due to its high nutrient content. The first urine-diverting toilets in sanitary porcelain were introduced on the Swedish market at the beginning of the 1990s<sup>15</sup> and a few years later, the toilet was a hot and even controversial topic in Sweden (Naturvårdsverket 1998; Bygghälsömrådet 2000). Proponents pleaded for large-scale implementation, whereas opponents pointed to the problems with increased transport, untested technology, hygienic risks and the fact that phosphorus could be recycled by using wastewater treatment sludge on farmland (Bygghälsömrådet 2000).

The debate about the ecological systems called for increased knowledge, and most studies are from the late 1990s. At this time, ecological toilets were mostly found in summer cottages and in residential areas with an ecological profile. The fact that most studies of these systems were carried out in the early days, when the technical arrangement was underdeveloped and hampered by technical shortcomings, meant that they were often considered

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<sup>14</sup> Urine contains most of the nutrients in household wastewater, but only constitutes 1% of the total fluid flow. The corresponding figure for faeces (excluding flushing water) is less than 1% (Jönsson et al. 2000).

<sup>15</sup> The first urine-diverting toilet in porcelain entered the market as long ago as in the 1860s, however, it had its renaissance in the 1990s (Drangert and Hallström 2002).

to be deficient in terms of hygiene, economy and use, in comparison with conventional solutions (see, for instance, Haglund and Olofsson 1997). Technical development is ongoing and, in addition, new organisational and institutional structures are emerging that make possible closed loops between sanitation systems and agriculture. Agreements with farmers or other potential users of urine are part of the arrangements. Urine can be applied on farmland as well as golf courses and parks. Some institutional obstacles exist. For instance, EU and KRAV<sup>16</sup> have regulations that prohibit the use of urine and faeces (and sewage sludge) on farmland for organic products for human consumption (Olofsson 2004).

User aspects are considered to be of critical importance when it comes to ecological sanitation. Acceptance is considered to be essential if individuals are to be persuaded to change habits and life-styles (Naturvårdsverket 1997), as a prerequisite of effective sorting and system survival (Jönsson et al. 2000), and as a necessity for overall system sustainability (Hellström et al. 2000). There are few studies of socio-cultural aspects of ecological sanitation (Drangert 2004). Earlier studies either deal with users' *practical experiences of use and management* (Fittschen and Niemczynowicz 1997; Haglund and Olofsson 1997; Haglund et al. 1999), or users' *attitudes and acceptance* (Naturvårdsverket 1997), or both aspects (Widahl 1997; Mårtensson and Fuehrer 1999; Widahl et al. 1999; Jönsson et al. 2000) since acceptance or attitudes are often seen as being related to the technical problems.

Commonly reported technical problems with urine-diverting toilets are urine-pipe blockages caused by urine crystallisation (e.g. Widahl 1997; Jönsson et al. 2000), incorrect installation and smell (e.g. Jönsson et al. 2000; Haglund et al. 1999). Problems related to the faeces fraction are the insufficient composting process, heavy, inconvenient, and disgusting manual handling of faeces (e.g. Fittschen and Niemczynowicz 1997; Haglund et al. 1999), occurrence of flies (e.g. Fittschen and Niemczynowicz 1997; Haglund et al. 1999), and smell (e.g. Haglund et al. 1999). Diverting toilets are often considered to be more difficult to clean and/or in more frequent need of cleaning (depending on material and type of solution) (Fittschen and Niemczynowicz 1997; Widahl 1997; Haglund et al. 1999). Problems with smell and technical problems are likely to cause user repugnance (feelings of uneasiness and disgust) towards the toilet (Mårtensson and Fuehrer 1999). However, most of these studies are

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<sup>16</sup> KRAV is an incorporated organisation representing farmers, processors, trade and consumers as well as environmental and animal welfare interests. Only companies that have signed a contract with KRAV may use their label indicating that the product is organically produced (KRAV 2004). KRAV is the controlling body for the observance of the EU regulation on organic production, but also has its own regulations that producers must comply with if aspiring to mark their products with the KRAV label (Olofsson 2004).

related to early designs of ecological sanitation. Today, most of the technical problems have been reduced. There is little risk of blockages of pipes, and it is easy to dissolve the blockages. The manual handling of faeces has been reduced by the introduction of biodegradable bags made of maize.

Mårtensson and Fuehrer (Mårtensson and Fuehrer 1999) take cultural aspects into consideration when looking for differences in practices and attitudes towards urine-diverting toilets. When relating the degree of repugnance to toilets in general with acceptance (practical problems) of urine-diverting toilets, they found out that high repugnance correlates with low acceptance of the practical problems with urine-diverting toilets. Although the 'conventional' households score a lower degree of repugnance than the households with urine-diverting toilets in the Mårtensson and Fuehrer study, other studies show that there is a low acceptance of practical problems related to toilets in general. Any toilet solution must look and function like the water closet. It must not smell, be noisy or bulky, or difficult to clean (Naturvårdsverket 1997).

Urine-diverting toilets require a sitting position for all users for optimal sorting, even for men who like to stand while urinating. Studies show that men who do not like to compromise on this point are also less inclined to accept urine-diverting toilets (Mårtensson and Fuehrer 1999). Usually, adult men eventually get used to sitting down, but studies at schools have shown that children may find it difficult to use the diverting toilet properly (Haglund et al. 1999). The sitting position and 'unusual' design also make it necessary to instruct guests – how to sit, where to flush and where to put the toilet-paper (Widahl 1997).

## TECHNICAL ARRANGEMENTS AND ROUTINES

This study is about the interrelationship between a technical arrangement and its user. Several theoretical approaches have been developed in the social sciences to address this interrelationship from the viewpoint that all technical systems and networks are *socio-technical* (Summerton 1998). A technological system consists of (firmly) interconnected parts, of which some are technologies and others are actors, who develop, operate and use technology, and institutions regulating the activity (Balslev Nielsen 1998). Acknowledging the social basis of technology also entails recognition of technology as socially biased; it represents values, considerations and negotiations (Summerton 1998). The word 'socio' in socio-technical systems has essentially included the macro level (organisations and entrepreneurs, goal-oriented professional actors) rather than the micro level, i.e. the development of technology in everyday contexts where the technology is used (Andersson-Skog 1998).

One social theory, however, that takes everyday life as its starting point is the *domestication theory* (Lie and Sorensen 1996). Domestication is a process where technology (or artefacts) are characterised and placed in a certain context (not only households). When technology is used practically, a variety of local routines are developed, but not necessarily in accordance with the intentions of the designers. In this process, alterations of routines and practices may be necessary. Domestication also takes place on a symbolic level, becoming attached to the user's identity and social relations or the identity and relations of the larger social unit (Lie and Sorensen 1996).

The two arrangements studied in this thesis have been introduced in households in order to affect the household members' routines so as to be more in accordance with (ecological) sustainability goals. Spaargaren and Van Vliet (Spaargaren and Van Vliet 2000) talk about the ecological modernisation of domestic consumption; the reconstruction of domestic practices by the introduction of environmental innovations – techniques, procedures, financial arrangements and other production/consumption institutions that potentially reduce the environmental impact in a given context. However, the households must recognise the innovations as relevant: “... *domestic agents will only accept more sustainable devices in the field of energy and water under the condition that the devices ‘fit’ into the overall organisation of their households and lifestyles*” (Spaargaren and Van Vliet 2000:65). They point to two factors as conditional on any household routine: time-space structures - it should increase (or at least not decrease) personal availability, i.e. time-flexibility - and the cultural standards of comfort, cleanliness and convenience.

The social science theories generally fail to acknowledge the physical world in which routines take place. It is either not present or treated as having little or no relevance for social analysis (Ellegård and Wihlborg 2001)<sup>17</sup>. I argue that it is impossible to carry out a comprehensive analysis of household water and sanitation routines without including the physical resources and constraints in place and time. Individuals must be somewhere when performing daily activities involving water, such as cooking, taking care of personal hygiene and doing the laundry. The essence of all everyday life is the development and maintenance of routines and habits, but its place and content is unique for

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<sup>17</sup> For instance, environmental sociologists focus on peoples' actions as e.g. consumers, decision-makers, politicians, employees, and their role in societal development. They assume that peoples' values and attitudes about nature, society and environmental lifestyles affect everyday actions. Also, values and attitudes seemingly influence peoples' membership of organisations and participation in organisational work, and ethical and political positions. Societal structures could enhance or hinder a trend towards a better environmental adjustment between the individual, society and nature (Lindén 2001). Physical structures are, however, not an issue.

every individual (Wihlborg 2001). Explanations of routines and processes of change must be understood in their social, cultural *and* physical context (Ellegård and Nordell 1997).

Spaargaren and Van Vliet (Spaargaren and Van Vliet 2000) maintain the importance of time-space, but their time-space is too limited. I believe a more comprehensive time-space is needed in order to explain and analyse human routines; one that includes the physical meaning of 'space'. *Time-geography* provides both a method and an approach for assessing and explaining everyday living in an all-embracing sense, with the physical space and time as fundamental constraints, forming a united time-space where processes and activities go on. With this approach, it is possible to take into account every aspect that interrelates with human routines locally in a certain time-space, such as physical, socio-cultural and economic arrangements. In a time-geographical sense, changes in technical arrangements can be understood as altered time-space relations in society, as it may alter constraints and make time-use more effective. New potentials and hindrances may emerge (Åquist 1992) (after Hägerstrand).

As regards the ambition to alter household routines so that they become more 'ecological', the issue is what new routines that develop. A new technical arrangement is introduced, but the domestication theory shows that households do not just passively react and respond to the change, but actively make it fit into their everyday life. Thus, the new routines are not necessarily the ones expected by arrangement implementers. However, a time-geographical approach does not provide explanations of intentions behind routines, or of why household members organise their physical and social environment the way they do. Such questions are the domain of cultural analysts.

According to Ehn (Ehn and Löfgren 2001), culture analysis is especially useful in studies of everyday living. He argues that it is in everyday life that one can see what is behind normative statements of how we are supposed to live, expressed as ideals, utopias and higher values. Culture is continuously created as new experiences and questioning of prevailing ideas recreates people's lifestyles and ways of thinking. Alternative ways of looking at things and counter-cultures are created this way. There is a constant struggle to determine which view of reality is most valid. In this struggle one can see how imagination and creativity are used, either to defend a way of living or to establish other ways of thinking. Culture is a multi-faceted concept and I will use the definition of culture used by Mary Douglas, the theorist behind the culture theoretical ideas used to assess and explain household routines in this study. She defines culture as *the public, standardised values of a community* (Douglas 1984, 1966). Culture is conceptions and meanings constructed by humans to be able to communicate and to form *societies*, groups of people. Culture is the

individually perceived social environment, sometimes supporting, sometimes disregarding. The foundation of cultures is conceptions about the human world, conceptions that are represented in some way, e.g. language, symbols, and texts. The meanings are created in a certain historical (time) and spatial/material (place) context (Douglas 1984, 1966).

Shove (Shove 2003a; Shove 2003b) claims that culture is the main obstacle in achieving a sustainable use of resources, but is not acknowledged or questioned in sociological research, merely taken for granted. She discards talks about ecological footprints, calculations of how much resources each human can spend and decreased resource use by a factor of 10; since they all assume continuation of the present way of living. It is our ideas of how everyday living should be that must be in centre of attention. Even if we make our freezers "green" and less energy-intensive, we still have a product that can freeze our food. Even though we make taps economical, they still provide easy access to water. In this way, technology and culture co-evolve; technology is developed from our perceived needs and, in turn, it affects our behaviour and makes us want more. Instead of focusing on resource use, we should focus on the services they provide. The *escalating* and *standardised* need of water and energy in the world is caused by our perceived need for more and more of the three Cs: Comfort, Cleanliness and Convenience (Shove 2003a). The study of sustainable routines from an ecological as well as a social perspective gives reason to pay attention to different expressions of the three Cs.

In combination, time-geography and cultural analysis explain household routines as being dependent on available resources and constraints in time-space; a time-space formed in a certain socio-cultural context.

## METHODOLOGICAL CONSIDERATIONS

Householders' routines where water and sanitation arrangements are vital resources are focused on in this study. Apart from the household being the physical base for use of water and sanitation arrangements, a focus on the household rather than on the individual would acknowledge the importance of the social context; the negotiations that take place between household members and the effect this may have on the routines. Commonly, household members are family members, but a household is by definition a production and consumption unit. Its members share an address and economy, but do not need to be related by marriage or kinship (Carlsson-Kanyama and Lindén 2002).

Nevertheless, the starting point is the individual and his/her relation to surrounding structures (Wihlborg 2001). All individuals lead an everyday life, and everyday life is a process that changes and differs depending on when and



where we study it, and from whose perspective. The starting point is everyday living rather than the technical arrangement itself - it is about how users express the meaning and use of everyday technical arrangements (used every day by many people) by their actions and statements (Östlund 1999).

According to Ellegård and Nordell (Ellegård and Nordell 1997), the essential features to study in everyday life are what one does and why, where activities take place and with whom. Other variables could also be important, depending on study focus. Everyday life is often taken for granted, but even the most insignificant aspects, seemingly unimportant, influence our lives and our action space. The individual freedom to act is constrained, but often she or he is able to choose between different options to act (Ellegård 2001).

The earlier studies referred to were focused on mapping practical experiences and/or attitudes towards ecological toilets for which interviews (often with residential area representatives or key persons) or questionnaires are valid methods. Studies of water metering and billing per household are more or less restricted to before and after analysis of aggregated consumption statistics. This study, however, has a wider scope: to describe and explain water and sanitation routines from a user perspective in a process of change. Accordingly, I also need partly other methods.

The combination of self-reported data, interviews and quantitative measurement of routine outcome has been tried out fruitfully in studies of environmental behaviour in households (Shanahan 2003). Only relying on user statements would not result in satisfactory empirical material in terms of validity, since attitudes and what people say they do may not reflect actual practices. As noted previously, time-geography is not only an ontology or theoretical approach, it also provides methodological tools. One such tool is time-diaries, where respondents write down their activities during a certain time period. By so doing, their statements may be correlated with their written information. Some even claim that time-diaries are a valid alternative to observation methods when such methods are not possible due to privacy issues such as in the bathroom. Also, time-diaries are believed to enhance the respondent's awareness of his/her own routines to a varying extent (Nordell 2002), which is also beneficial considering the subject under scrutiny. Despite our dependence on technical arrangements they are taken for granted and are often used routinely (Blomkvist and Kaijser 1998). Likewise, the needs they aim to fulfil are taken for granted and are seldom questioned (Shove 2003b). Thus, I have developed a methodological combination of interviews, time-diaries, simple observations and physical measurements, which are further explained in chapter three.

## MOTIVATION FOR THE STUDY

What we already know makes it hard to think outside the framework of the ideas we are used to, what we have already “normalised”. Ideas are fairly robust owing to the fact that it is hard to see or to understand things in other ways than how they are represented (Massey et al. 1999). The fact that treatment of water and wastewater is taken care of by someone else in remote and sometimes unknown places is likely to affect householders’ routines. The lack of a physical residual product in the household possibly affects households’ perception of their environmental responsibility (Axelsson et al. 2001; Drangert and Krantz 2002). The cost of water and wastewater treatment is also hidden for households in flats since it is included in the rent.

This study mainly deals with the impact on household routines of measures increasing system transparency in terms of physical appearance and cost. The ambition is to present and discuss the tension between ecological sustainability (creation of ecological routines) and social sustainability (creation of routines in accordance with cultural standards of cleanliness, comfort and convenience). A working hypothesis is, that if the new arrangement involves aspects or routines that conflict with socio-cultural ideas of order, households would actively arrange their physical and social environment to hinder disorder and/or to re-establish order.

## THESIS OUTLINE

This introduction is followed by the theoretical and methodological outlines. Although intimately related, they are separated into two chapters. This choice is motivated by the fact that I had to develop both a theory and a methodology to fit the subject of study. The theory (chapter 2) is truly inter-disciplinary; combining geographical and anthropological/sociological approaches, and the methodology (chapter 3) is a combination of various social science research strategies. Furthermore, each part is of considerable length, largely due to an ambition to make the thesis as transparent as possible since it makes it easier for the reader to evaluate the study’s validity and reliability. Chapters 4 and 5 contain the empirical material in the two case studies; the case of individual metering and billing per household (chapter 4) and the case of dry-diverting toilets (chapter 5). The analysis of the empirical material is presented in two separate chapters; chapter 6 for individual metering and billing per household and chapter 7 for dry-diverting toilets. Chapter 8 consists of a comparison between the two case-study areas with respect to water use and waste disposal in toilets. The study’s central findings and recommendations for future planning of sustainable urban water and sanitation management are presented and discussed in the final chapter (chapter 9).

## CHAPTER 2

# Theoretical framework

In this chapter, I will outline my theoretical understanding of prerequisites for human activities and routines and what role technical arrangements play in explaining everyday life activities.

Everyday life has become an appealing research topic in social sciences such as human geography, economics, and sociology, as well as in interdisciplinary research. Everyday life may appear to be a self-evident concept, but scholars approach the research area in different ways and with different perspectives. In general, social scientists regard everyday life as a socio-cultural construction and more or less disregard the physical and material dimension of everyday living (Ellegård 2001). In a *time-geographical* analysis, however, the physical and material dimension is essential and the interest lies in the total set of human activities and projects constituting everyday life. Since they all require time and space to be performed, they are all equally important. In addition to time and space, activities and projects also need other resources, but time-space may also contain constraints hampering a certain activity or project. To be able to carry out activities and projects smoothly and undisturbed, actors need to develop a *pocket of local order* - a physically limited place with an order and ruling system maintained by actors by means of their continuous engagement in activities and projects that are in accordance with the prevailing order (Hägerstrand 1985; Ellegård 2001).

Time-geography is physical in character, and does not explain intentions, meanings and perceptions behind the development of a pocket of local order. To address such questions, we need to complement our analysis with other theories.

*Culture analysis* focuses on the socio-cultural<sup>18</sup> reality, and will provide the required complement to time-geography. Time and space are fundamental elements in all cultures; they provide time and place for activities, relationships and objects. Cultural analysts maintain that places are more than physical sites;

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<sup>18</sup> A concept used to avoid sociological or cultural determinism, signifying the inseparability of social and cultural aspects of human organisation (Seymour-Smith 1986:263).

they are endowed with meanings and values (Ehn and Löfgren 2001). Anthropological studies of space deal with issues such as in what way the use and distribution of space reflect features of social order, in what ways it reflects philosophical or cosmological conceptions, and the way in which space is manipulated intentionally or unintentionally for communication purposes (Seymour-Smith 1986). A social order may be revealed in space in terms of closeness and distance, private and public and high and low. Hence, our analysis of space must go beyond the visible and also include what it does to us and what we do with it (Ehn and Löfgren 2001). What time-space is filled with and what is excluded from it is a result of socio-cultural considerations. Some phenomena in space are in order, whereas others are perceived as *matter out of place*. What is considered as matter out of place in one circumstance could be matter in place somewhere else; how it is perceived depends on current cultural values at a certain time and place (Lidskog et al. 1997).

In this chapter, I develop a complementary theory building on time-geography and culture analysis. The combination entails both a theoretical development of time-geography – the socio-cultural imprint on time-space orders – and a tool for comprehensive analysis of household routines, taking into account both physical and socio-cultural aspects. The first part of the chapter deals with time-geography. Thereafter, culture analysis and matter out of place are introduced. The way the two theories/approaches are combined in the analysis concludes the chapter.

## TIME-GEOGRAPHY

Torsten Hägerstrand aimed at creating a contextual research approach where physical, mental and socio-cultural aspects and their mutual interrelationship are part of the analysis of human action (Hägerstrand 1985). This approach evolved from his reflections on context-(dis)embeddedness of human action<sup>19</sup>, and time and space are the principal variables in his social analysis. The research group, led by Torsten Hägerstrand, that developed time-geography as an approach in geography was initially called “*The research group in human geographical process- and system analysis*”<sup>20</sup>, which in a sense is more illustrative of what time-geography is about. Still, “time-geography” was considered to be a more practical concept (Ellegård, pers com). Time-geography is process-oriented and processes are rooted in space (Ellegård and Wihlborg 2001).

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<sup>19</sup> Giddens has also treated the subject of disembedding as part of modernity, referring to: “the *“lifting out” of social relations from local contexts of interaction and their restructuring across indefinite spans of time-space*” (Giddens 1990:21). Expert systems and symbolic tokens (e.g. money) are two examples of disembedding mechanisms (Giddens 1990).

<sup>20</sup> In Swedish: Forskargruppen i kulturgeografisk process- och systemanalys.

The context Hägerstrand refers to is first and foremost physical, but socio-cultural and mental factors in time and space are also acknowledged as relevant. In disciplinary research, however, a holistic view is difficult to apply since disciplines tend to focus on one set of aspect when analysing a phenomenon. Disciplinary studies of environmental behaviour centre the analysis on either social factors (e.g. Lindén 2001; Lindén and Carlsson-Kanyama 2003), or psychological factors (e.g. Verplanken et al. 1997). Physical factors may be recognised, but are rarely a variable in their own right.

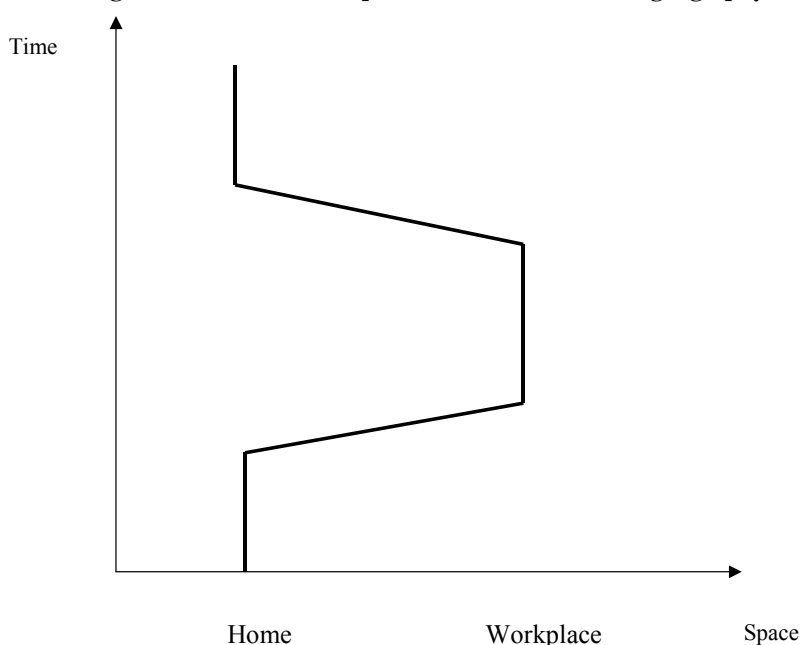
In this study, physical, socio-cultural as well as mental factors are acknowledged parts in analysing water and sanitation activities. Water and sanitation arrangements are situated and used at a certain time and space. How water and sanitation activities in households are conducted depends on mental aspects (e.g. knowledge of treatment capabilities, experience of comfort), physical aspects (e.g. technical arrangements), and socio-cultural aspects (e.g. hygienic norms, perceptions of wasteful behaviour). My ambition is to embrace such aspects to the fullest extent possible, because they all play a role in the use of water and sanitation services in everyday life. However, in order to make the research manageable it will be necessary to concentrate more on some aspects, and this is possible when taking a time-geographical perspective.

Time-geography is not really a theory, but a way of relating to and describing reality (Åquist 1992; Ellegård and Wihlborg 2001), and it provides an outlook, a platform, from which it is possible to pick out, observe and describe fragments of reality (possibly with an emphasis on either mental or socio-cultural aspects) without losing touch with the total context. It provides a basis for theory building, knowledge examination, analysis and synthesis (Hallin 1989; Lenntorp 1998).

### **Time-geography and its application in this study**

Time and space are joined in a 2-dimensional *time-space* where events and processes go on (Ellegård and Nordell 1997). Hägerstrand developed and applied concepts for registration and management of observations during an ongoing process, which also enhance the analysis of space and time-dependent relations (Hägerstrand 1985). Every individual (existent), in any population has a lifeline - a *path*, illustrated in Figure 2.1.

Figure 2.1 An individual path as illustrated in time-geography



*A time-geographical illustration is always read from the bottom up, since the vertical axis illustrates time processing in this direction. The horizontal axis denotes the geographical location. Together, the two dimensions show where the individual is in place and time and in relation to other existents (if extended to include several paths). The path in this example is a simple illustration of a common weekday activity pattern; home-based activities in the mornings and evenings, periods of transportation to and from the workplace, and work-based activities for a substantial part of the day. A path can never be entirely horizontal since every activity takes time.*

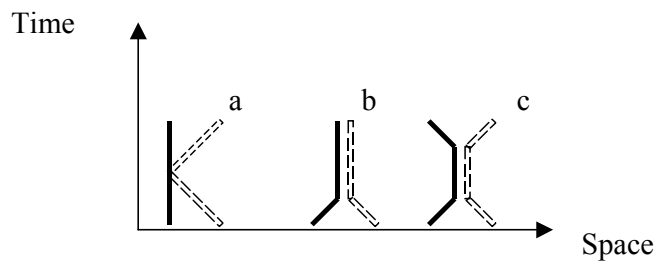
This path is unbroken during the individual's lifetime and during this time, unions and separations will take place, leaving a history behind them (Hägerstrand 1985).

Every physical object matters according to time-geographical thinking. The world is made up of "grains" existing next to one another. When grains, or *existents* as Hägerstrand calls them, are of the same kind and are treated collectively, they are called *populations*. All physical objects – whether they are manufactured goods, humans or objects in nature – are given the same status since any object occupies a space in time, and thereby excludes other objects in that particular time-space. The competition for space creates constant conflicts, since different objects and events cannot exist in exactly the same time-space. However, space is dynamic and over time an object may be maintained, removed or destroyed (Hägerstrand 1985).

Water is an object with a specific character. It is a *thing with many units*<sup>21</sup>, and lacks a defined grain structure, but is clearly an object in time and space. When we use water, we must divide it into parts in order to be able to use it (Hägerstrand 1991a). For example, we drink water in gulps and turn the tap off when we had enough of water.

All individual paths form a *web of paths*, which constantly develops through time, leaving an imprint of populations' histories. The web of paths illustrates and helps us to understand how a population or individuals in a population are *packed* side by side, adopting various constellations in space for a specific duration of time. Individual paths meet and separate, as illustrated in Figure 2.2. Such events are called *elementary events* and can, for instance, illustrate the interaction between humans, or between humans and other existents such as water, detergents, dirt/pathogens (Hägerstrand 1974).

**Figure 2.2** Examples of elementary events



These elementary events illustrate how a human path (left bold path) and a water path (right dotted path) interact. They are read bottom up. The horizontal axis marks the spatial position. The elementary event when the person turns on the water tap for some seconds to rinse a plate is visualised in (a). In (b) the person takes a bath and water is stored for some time, and (c) could illustrate a person washing the dishes and afterwards the water is released to the sewer and the person leaves the room. The possible combinations are countless. Note that these illustrations are very simplified and could be complemented with additional paths for plates, bathtubs, taps, dirt, pathogens, chemicals, etc.

Since the web of paths is restricted by available resources including space and time, it could be seen as a budget for scarce resources (Hägerstrand 1985).

An empirical web of human paths often displays a recurrence of individuals' relations to other individuals and objects, and forms a repetitive activity pattern – everyday routines (Åquist 1992). Routine behaviour is stable for

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<sup>21</sup> In Swedish the word for “thing with many units” is “myckenhetsting”. The word is difficult to translate directly into English and it is hardly ever used in the Swedish language nowadays. The meaning according to the dictionary Svenska Akademiens Ordbok is “things that are defined only according to type and quantity” (SAOB 2003).

some time and thus is the key to identifying *pockets of local order* (Ellegård and Wihlborg 2001).

Humans differ from other existents in that we can carry out goal-oriented actions. The elementary events of the web are subjected to conditions of a physical, biological as well as psychological and political character (Hägerstrand 1974; Hägerstrand 1985). Human everyday life consists of a set of *activities*, constantly carried out more or less intentionally<sup>22</sup>. The activities are part of *projects*, which in turn aim at certain goals in life. The projects could have a short duration (doing the dishes), be long-term (bringing up children), or go on for a lifetime (living one's life). Everyday life is made up of activities related to different projects, and may appear rather chaotic since activities relating to the same project do not always follow in time (Ellegård and Nordell 1997; Ellegård and Wihlborg 2001). How activities and projects turn out varies depending on the time-space context:

*“... irrespective of the naked logical structure of a project its practical realization depends on the micro-geography of the place or area where somebody tries to carry it out. There is in other words an inescapable relation between the situation in space and the actions and experiences people are able to make – and partly are forced to make – over time.”* (Hägerstrand 1984:18)

The simple project to bake a loaf of bread entails various activities. How the activities are carried out depends on the kind of bread, available machinery, available ingredients and individual skills. Sourdough bread requires a number of activities over some days, while scones can be prepared in a short time. The dough may be prepared with an electric mixer or by hand, depending on e.g. individual preferences and availability of electrical appliances. The necessary ingredients must also be in place, be bought or be borrowed from a neighbour (who must be at home and have a friendly attitude...). The concepts of activities and projects allow for any level of detail in the description, and the chosen level depends on the purpose of the study.

How projects come into being, how they can be carried out, who has the power to push them through, and how different projects compete for space and resources is of vital importance (Lenntorp 1998). Available *resources* and *constraints* in a given time-space define restrictions on how activities and projects can be carried out. Similar activities and projects may therefore be conducted in different ways depending on the varying context. To some extent, time-space is inert. Existing buildings and technical arrangements, actors' understanding of what is possible and legislation are examples of

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<sup>22</sup> In time-geography, every human action that takes time and occupies space is considered an activity. Consequently, doing nothing is also an activity (it needs both time and space).



constraints on certain activities. They may also represent examples of resources for the facilitation of human activities; what is a constraint for one individual could be a resource for another. The car parked on the street on a snowy morning is a resource for its user to go to work, but a constraint for the work of the snowplough operator. Once the owner moves the car, the snowplough operator can complete his task. The snow is a constraint in different ways on the car owner and the driver of the snowplough.

Many constraints are in the form of general and abstract rules of behaviour, but they can be given a physical meaning in terms of location in space and time. In time-geography, constraints are divided into three categories:

*Capability constraints* – limit the activities of the individual because of his/hers biological nature, such as the vital need to eat and sleep regularly, and/or because of the tools she or he controls. The reachable time-space depends on the ability to move or communicate and on the conditions under which she or he is tied to a rest place (Hägerstrand 1991b). Constraints such as the individual's knowledge and economic capability are not part of this group of constraints, but since they may be decisive for what tools the individual controls, they are difficult to separate from it (Hallin 1989). Thus, aspects such as knowledge, physical strength, equipment, economy, social and medical aspects also are regarded as capability constraints by contemporary time-geographers (Ellegård and Nordell 1997).

*Coupling constraints* – define where, when and for how long the individual has to join other individuals, tools and materials to produce, consume and transact. The clock and the calendar are examples of resources of importance to connect individual paths (Hägerstrand 1991b). Everyday activities and projects need coordination between individuals and other existents to be carried out, and couplings are formed according to e.g. timetables, working hours, formal appointments, promises, trust and obligations. We have expectations on each other as to how to act (Ellegård 2001).

*Steering or authority constraints* – relate to time-space aspects of authority. A certain individual or group form a time-space domain where he/she/it controls things and events – to protect resources, to hold down population density and to protect an efficient arrangement of path couplings. These domains are protected by e.g. customs or legislation, and can be more or less permanent or temporary (Hägerstrand 1991b). A domain is a social construction developed to maintain a certain social order (Hallin 1989). Opening hours, working hours, theatre tickets, and timetables are some examples of steering and authority constraints (Ellegård and Wihlborg 2001).

Different kinds of constraints are often present simultaneously in the same situation and they could also strengthen each other (Åquist 1992).

Consequently, a study of the interrelationship between water and sanitation arrangements and human activities must embrace as much of the total time-space context as possible. The technical arrangement for water and sanitation is only one of many factors affecting householders' routines. Every activity involves an actor, space, time and material, and activities must be adjusted according to current resources and constraints (Ellegård and Wihlborg 2001). The total context also involves socio-cultural and other factors.

Resources and constraints are dynamic; they develop in transformation processes (Ellegård 2001). The change in arrangements for water and sanitation is one example of how the set of resources and constraints for households can be altered in a time-space where humans carry out activities. Such changes have the potential to change human activities, since everyday life (all activities) is formed by the struggle between the aims of the individual and existing constraints (Ellegård 2001).

Individuals may impact on resources and constraints in time-space to some extent. Steering and authority constraints created by organisations and institutionalised by rules, jurisdiction and decrees, are difficult to influence in public spaces or in spaces where someone else is in charge. In a household, however, members can apply their own steering and authority constraints, e.g. that dinner is served at a certain time and that children only can play video-games for one hour a day. Such constraints are sometimes combined and strengthened by coupling constraints; perhaps the game unit is put away. Coupling constraints could also appear as a result of factors over which the individual has little or no control. The plumber not coming as agreed, or water services being cut for maintenance work, are two examples. Coupling constraints could also depend on capability constraints. If the tools needed are not available, we cannot link up with them. Unemployment (not individually controlled) and low purchasing power could result in a lack of tools; it may be difficult to have a car, restricting flexible travelling and the number of couplings in a given time. Capability constraints (e.g. the lack of monetary funds) could also result in rules being set up (steering and authority constraints) in a household preventing the members from linking up with certain costly resources. Thus, constraints are important for understanding different activity outcomes for different households, and I will use this concept in my analysis of routine change in processes of altered time-space conditions.

With this focus on constraints, we realise that only some practices are within *reach* in a given time-space (Carlestam 1991). Hägerstrand argues that the concept of reach helps us to keep the individual in focus, to see him/her in his/her place in the total context from an intimate to a global scale. It should not only be understood as an individual's physical reach; matters of

knowledge, economy and emotions also determine the size of the space within reach. What the individual may reach thus depends on individual capacity and life story (inner world), but also what the surrounding environment offers (outer world) (Hägerstrand 1991c). Nordell (Nordell 2002), for instance, introduces the subject of perceived action space and its importance for which activities are perceived to be within reach. My focus is on householders' active development of a time-space order that includes a new water and sanitation arrangement, but which is still compatible with cultural categorisations of order – the arrangements of resources to keep some paths within reach and others at a distance (Hägerstrand 1985). When resources in a certain time-space are arranged in an orderly and controlled fashion so as to facilitate the realisation of a certain project, a *pocket of local order* is developed (Lenntorp 1998).

### *Pocket of local order*

The presence of resources in time-space is not enough to carry out activities and projects. Resources must be arranged in time-space pockets, which are secured against external disorder and at the same time allow essential resource flows to come through (Lenntorp 1998).

*“In order to carry out any project smoothly and undisturbed an actor needs access to room and periods of time that are sufficiently free from encroachment emanating from processes in the vicinity. He needs, technically speaking, one or more space/time pockets where a local order (from the actor’s point of view) can be maintained.” (Hägerstrand 1985:207)*

A pocket of local order has a spatial location, and life within the pocket is governed and maintained by conventions, norms and formal rules (Lenntorp 1998; Ellegård 2001). Actors in the pocket develop an order in relation to the resources and constraints that they experience *there*, locally, at that time and place (Wihlborg 2000), but not necessarily in a conscious way (Hägerstrand 1985). Furthermore, the pocket can be of different sizes and be included in a larger pocket of local order, although it is always physically restricted. Experience of general orders emanating from larger pockets of local order is important, since such experience could affect actors' activities and must be considered in the analysis (Wihlborg 2000). Of similar importance is the fact that individuals also move between different pockets of local order; individuals can act according to diverse pockets of local order depending on the circumstances they experience themselves to be in (Ellegård 2001).

The concept of pocket of local order has been defined to support the analysis of time-space organisation, function and interaction (Lenntorp 1998) and has, for instance, been used to explain everyday life contexts (Ellegård and Wihlborg 2001). Every individual's everyday life is unique, which must be

recognised, but among human beings sharing a similar physical and socio-cultural environment everyday life also has elements that can be labelled as widespread. One example is daily activities that are repeated more or less without reflection (Ellegård and Nordell 1997). They are called habits or routines.

*“Some everyday life projects have become completely routinized; they are carried out repeatedly time and again over long periods of time.” (Hägerstrand 1985:201)*

Hallin (Hallin 1989) maintains that routines could be explained by a restricted time-space. Several activities compete in a limited time-space and from time to time there is a problem of ‘packing’ so that all activities cannot be carried out. However, when people develop efficient ways of carrying out certain activities, time-space congestion is avoided since repetition saves time during activity planning and even thinking.

The projects carried out routinely form an activity pattern stable over time, and since a pocket of local order is maintained by individuals repeatedly acting in accordance with the order, it is by means of such routinised activity patterns that we can identify pockets of local order (Ellegård 2001).

Pocket of local order is a useful analytical tool when studying local processes of change, but despite its all-embracing ambition, like all theories, it includes *and* excludes various perspectives. Intentions, motives and driving forces that cause the path’s dwindling pattern are not explained, neither are intentions, motives and driving forces behind the development of a pocket of local order.

In early time-geographical work from the 1970s, mental and cultural impact on human activities was hardly considered. Later time-geographical studies acknowledge the importance of the so called ‘inner world’, and use the time-geographical approach as a foundation for comprehensive studies, although the inner world cannot be illustrated in the same manner (Lenntorp 1998). Still, the approach excludes too many socio-cultural aspects to go beyond the ‘visible’ constraints in time-space. In order to include a wider range of socio-cultural issues, we must combine time-geography with other social theories (Åquist 1992; Ellegård and Wihlborg 2001).

Pocket of local order is about actors’ *arrangement* of resources to facilitate *wished for* activities and projects, but cannot explain why some activities and projects are wished for and other overlooked, or the interrelationship between such wishes and the character of the pocket of local order. Not surprisingly, there are divergent opinions about the benefit, or even possibility, of combining time-geography with other approaches or theories. The challenge lies in not losing the material ontology (Lenntorp 1998; Gren and Hallin 2003).

Åquist (Åquist 1992) maintains that time-geography has never had the ambition to develop an inside perspective, which she regrets:

*“This kind of issues, namely which explanatory potential time-space constraints have in relation to what is perceived as important and meaningful, should be important issues for time-geography.” (Åquist 1992:63)<sup>23</sup>*

By the inclusion of a cultural perspective on arrangements of space, pocket of local order is understood as a cultural product – created from human practices, intentions, values and meanings. This broadens the analysis from how the pocket of local order is arranged to also include why it is arranged the way it is. The interrelationship between culture and physical arrangements makes time-space somewhat inert. Sartre<sup>24</sup> maintains that the material world (and especially the produced objects) can only be understood in relation to human projects. Human activities are manifested in technological equipment, buildings, roads, pencils, hairbrushes, etc. All things take place and therefore are *inert*; even if not being used, they make demands on human action. When produced matters are used they are *practically inert* – i.e. only relevant to an individual at a certain time and place. The total complexity of worked matter and the demands and directions it gives to human practices when we relate to it, Sartre calls *the practical-inert field*. Sartre separates used and non-used matter, and emphasises the importance of the human agent for how the material world turns out (Jensen and Vestergaard 1979).

Sartre claims that worked matter acts as an intermediary between members of a society; and reflects earlier practices and put constraints on current actions. Thus, human actions can never be understood as isolated from other human beings. Human actions are developed in a common field of practices, and our feelings, values and actions are interwoven in the worked matter (Jensen and Vestergaard 1979). Consequently, the way we understand technical arrangements really are social constructions, created when people meet in a social and cultural world where mutual understanding is generated and technical arrangements are integrated in activities (Wihlborg 2000).

Changes in water and sanitation arrangements alter pockets of local order. The change can be induced by actors in the pocket, or be superimposed by actors in larger pockets that the household is also part of. New or modified arrangements are often received with scepticism, since such changes translate into multifaceted social and political processes (Summerton 1998). New arrangements and the ensuing potential routine change may not even be

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<sup>23</sup> Original text in Swedish, my translation. The underlined text is in italics in the original.

<sup>24</sup> I refer to Sartre's work as interpreted by Inger Jensen and Flemming Vestergaard in *Trøghet and praxis (Inertia and praxis, my translation)* (Jensen and Vestergaard 1979).

compatible with the general socially agreed order of things. Actions, objects and ideas deviating from that order are condemned (Lidskog et al. 1997); they are considered to be *matter out of place*.

Matter out of place is disorder and no society with a social order can accept that; therefore, matter out of place calls for change (Lidskog et al. 1997). A combination of the concept 'matter out of place' and that of 'pocket of local order', provides an analytical tool for investigating why a pocket of local order is arranged the way it is, and what effect it has on routines.

## MATTER OUT OF PLACE

Mary Douglas, a British anthropologist, was the first to launch the concept 'matter out of place'<sup>25</sup>. In *Purity and Danger* (Douglas 1984, 1966), she analyses perceptions of taboos and rules surrounding purity. She emphasizes similarities between so-called primitive cultures and the supposedly modern ones in terms of rituals concerning hygiene and impurity:

*"Are our ideas hygienic where theirs are symbolic? Not a bit of it: I am going to argue that our ideas of dirt also express symbolic systems and that the difference between pollution behaviour in one part of the world and another is only a matter of detail."* (Douglas 1984, 1966:34f)

According to Douglas, culture is the public standardised values of a community and it mediates the experience of individuals. Culture provides in advance some basic categories, a positive pattern, in which ideas and values are ordered. Culture is authoritarian, since every individual is induced to assent because of the assent of others (Douglas 1984, 1966). The cultural categories are negotiated within a community and sustain the pattern of interaction in the group – the social order. A social order involves issues of solidarity and job sharing; it is a system of trustfulness involving controversial issues of justice and moral. The negotiating of values is the cognitive basis of social order, and the whole system of knowledge is a collective good that the community is jointly constructing (Douglas 1987; Lidskog et al. 1997). Hence, every social group forms shared values and beliefs, which include classifications such as what is normal/abnormal, natural/unnatural, masculine/feminine, nature/culture, etc. The most essential classification is between order and disorder; it encircles the individual's own way of life and marks off the outside disorder (Ehn and Löfgren 2001). Matter out of place is anomalies that do not conform to the established classifications within a cultural order (ibid.). The relation between order and disorder involves an

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<sup>25</sup> Actually, the concept was used with the same meaning as early as in 1876 by Krepp (Krepp 1867), but it was Mary Douglas who made it known to a wider public.

interplay between social and cognitive factors; ideas of pollution create common experiences and become mediating for how order and disorder are perceived. The social order is mirrored in the cognitive – a defence of a definition of the relation between purity/impurity becomes a defence and a sanctioning of a certain social order (Lidskog et al. 1997).

Every culture has its own way of dealing with anomalies (Douglas 1984, 1966). Douglas argues that in the same way as a ritual of purity in a primitive culture is a way of re-establishing order, cleaning of the bathroom, decorating our homes and hanging wall-paper are done for the same purpose. Religious reasons for rituals may have disappeared in our culture and been replaced by rituals of purity influenced by our views of pathogens. People in the western world are not particularly concerned about the health effects of dirt – what is perceived as dirt varies – but removal of dirt is an act designed to organise the environment in congruence with our perceptions of how it should be:

*“...our pollution behaviour is the reaction which condemns any object or idea likely to confuse or contradict cherished classifications.” (Douglas 1984, 1966:36)*

The word ritual is often used in a religious context but can also mean a habit; something that is done in a special order, repeatedly, in a specific situation (SAOB 2004). I will use the word routine to disconnect it from religion and to underline its unreflected nature. In time-geography routines were perceived as activities that could save time and thereby avoid packing problems in time-space. The ‘time-economy’ of routines is also acknowledged in psychology, since it makes the individual spend less time on selecting a functional way of acting to achieving a certain goal. Routines or habits are viewed as learned sequences of acts that are automatically followed in specific situations. However, routines may also be set off consciously (Verplanken et al. 1997). Short term and limited habits could be totally subconscious and unreachable for the mind. It is, however, possible to be aware of more complex habitual patterns, especially if a change in the surrounding environment forces the habit to be altered (Johansson 1988).

By learning where things should be, to place them in the right place at the right time, we can orientate effectively. Mary Douglas emphasises the crucial role that social institutions<sup>26</sup> play in prescribing routine behaviours:

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<sup>26</sup> Institution is a concept with many interpretations and understandings attached. Mary Douglas understands social institutions as socially legitimised groups in the form of e.g. a family, ceremony or game. The legitimating authority may be personal (e.g. a father, judge, referee), or diffused (e.g. based by common assent on some general founding principle) (Douglas 1987:46ff). Thus, the concept includes both the social organisation as well as its regulating conventions, norms and rules.

*“... social institutions encode information. They are credited with making routine decisions, solving routine problems, and doing a lot of regular thinking on behalf of individuals.” (Douglas 1987:47)*

Routines are developed from the common cognitive pattern, and individual motives do not exist (Douglas 1987). Routines make life predictable and create order. Rituals, be they religious acts or related to routines such as the morning shower, are often supported by a risk associated with violations of the ritual. Impurity, according to Douglas, is an issue of aesthetics, hygiene or good manners, and only becomes significant if it causes social chaos (Douglas 1984, 1966)<sup>27</sup>.

The urban water supply and sewerage has facilitated our rituals to create order and be routinised. Matters out of place can easily be removed or flushed away to a place out of sight and vaguely known, but a place where dirt is perceived to be in place — the wastewater treatment plant. Douglas maintains that one needs to see beyond the practical use of goods or materials in order to be able to analyse their cultural importance (Layton 1999). Our deeds and manufactured goods are also symbolic. A symbol refers to iconic relations with inner experience, it is a complex representation, and Douglas's interest in symbols centres on their motivation (Seymour-Smith 1986).

Routines, technical arrangements and culture are intimately connected. Schwarz and Thompson (Schwarz and Thompson 1990) maintain that:

*“Culture, rather, becomes the essence, the universal solvent through which politics, technology and social choice are all dissolved into one another.” (Schwarz and Thompson 1990:2)*

The technical arrangement rationalises, promotes and justifies a certain way of life and defines what is socially preferred. All technical developments are *social processes* and go through a stage of uncertainty, indicated by disagreement between experts who argue from different perspectives with different institutional origins (Schwarz and Thompson 1990).

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<sup>27</sup> Later on, Mary Douglas together with Aaron Wildavsky (Douglas and Wildavsky 1982) developed a cultural theory of risk based on this conception; events of an atypical kind are judged as dangerous, thus we define them as risks. Opinions of risks are dependent on the social and cultural context, and thus are constructed and selected rather than just perceived. Douglas and Wildavsky put two variables together to identify different social contexts; individuals' sense of belonging to and identification with a certain group (Who am I?), and their understanding of which norms are valid in this group (How should I behave?). Put together, the two dimensions form four fields – four different cultures – with various views of how the world should be organised and additional understandings of risk.



What goods are manufactured and how people structure their environment depend on ideas and world views in a certain time and place. In turn, cultural forms and identities are established in time and space (Ehn and Löfgren 2001). A cultural perspective of the physical world adds meaning and purpose. For instance, a door is not only an intentional obstacle to moving freely in and out of a room and for shutting out noise, smell and people, but also a symbol for intention. Doors are placed at the entrance to most rooms. They are usually possible to lock, but the key needed is often not directly available, and doors are seldom locked. The bathroom door is an exception, with a lock on the inside and red sign indicating occupied on the outside. The lock signifies that activities behind it are of a private nature, and the lock also symbolises and maintains this cultural norm<sup>28</sup>.

Changes in technical arrangements necessarily touch upon culture. A general presumption in culture analysis is that the unknown is often met with distrust (Ketola 2001), since the fusion of a technical arrangement with culture has unpredictable consequences. Shove (Shove 2003a), investigating the constitution of normality and the dynamics of habits and routines in everyday life, points to the significance of the concepts *comfort*, *cleanliness* and *convenience*.

*“Such cross cutting terms encompass a variety of inter-linked conventions and habits and as such offer a vocabulary with which to explore and follow the evolution of routine, and with which to show how new arrangements become normal.” (Shove 2003a:3)*

Furthermore, these complexes of practices seem to change in ways that challenge established theories of consumption and technology; they are subjected to escalation (wanting more) and standardisation (what counts as normal becomes more widespread); and they encompass practices labelled as environmental hot spots of consumption. Nevertheless, in research as well as in the environmental debate, normal and socially necessary standards of comfort and cleanliness are taken for granted (Shove 2003a). I will use Shove’s definition of the concepts in my analysis to explain the motivation behind households’ change in water and sanitation arrangements and routines (to make them fit normality).

*Comfort* is a state of mind related to the body’s relationship (and self-conscious satisfaction) with the immediate physical environment. In modern times, the concept has been bound to objects that may enhance this state of mind: comfortable clothes, comfortable furniture and comfortable baths. It has, in turn, resulted in standardised and restricted definitions of normality.

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<sup>28</sup> The fact that many activities using water and sanitation systems take place in this private sphere makes them difficult to study, an issue further discussed in the next chapter (Chapter 3).

For example, instead of a range of individual comfortable indoor temperatures, it is standardised at 22 degrees in tropical areas as well as in arctic climates all year round. However, Shove believes that comfort should not be viewed as an attribute, but rather as an achievement – a creative process of trading, juggling and manipulating clothes, activity, daily routine or building technologies. In this way, conventions surrounding the arrangements come in focus rather than the physical human body (Shove 2003a).

In contrast to comfort, *cleanliness* touches upon the moral and symbolic significance of practice. It is important in making social distinctions and reproducing order. Cleaning often includes some kind of work that can be arranged in different ways; as comfort, cleanliness has been commodified (e.g. washing machines, dishwashers), which in turn has shaped the business of cleaning as well as the ideas of what cleanliness is. Cleanliness also generally involves the use and synchronisation of a variety of socio-technical systems. Technical objects and arrangements have made us reassess the meaning of cleaning, since they contain definitions of dirt, disorder and appropriateness in the way they are constructed: “...*changing concepts of cleanliness reflect changes in actions, tools, and techniques deployed when people do what they think of as cleaning*” (p.160). If cleanliness is to be used to understand changing practices, it should be regarded as a complex service, shaped and given meaning by the activities carried out to achieve it (Shove 2003a).

*Convenience* is associated with the ability to shift and reorder activities and events; the scheduling and coordination of people and objects in time and space. It is more about being able to do something at short notice than about saving time; thus, a convenient technical arrangement should facilitate sudden changes and reordering of activities in everyday life. However, each convenient technical arrangement relates to an everyday life split into smaller and smaller activity pieces, and to a reliance of individual modes of coordination (the shared socio-temporal order is weakened). This, in combination with redefinition of convention, obligation and normal practice, calls for even more convenient arrangements (Shove 2003a).

Changes in water and sanitation arrangements are thus likely to ‘disturb’ conventions of normality in terms of comfort, cleanliness, and convenience. Potentially, they are perceived as dirt themselves – if they confuse our cherished classifications:

*“The most acceptable cues are those which fit most easily into the pattern that is being built up.” (Douglas 1984, 1966:36)*

Changing household water and sanitation arrangements for the sake of the environment is a fairly recent phenomenon. Sorting of solid waste into different fractions has been emphasised for a longer time, and it is easy to find

similarities between changes in technical arrangements for water and sanitation and for solid waste. Nowadays, many Swedes sort their household solid waste, and 'refuse chutes' have been shut off and replaced by 'recycling stations'. This development can be analysed in terms of the three Cs. Comfort is lessened since residents have to walk to the collection point in the basement or even outside away from the house. The additional small activities, such as maintaining different fractions in the kitchen cupboard, have to be squeezed into daily routines, which challenge convenience. Sorting routines may compromise standards of cleanliness if places where fractions are stored are considered untidy, smelly and dirty. The necessary change in culture to support this change in collection of solid waste is enhanced by using words that do not evoke the idea of matter out of place.

Disharmonic arrangements are usually rejected, but if accepted, the structure in assumptions has to be modified. Consequently, disorder could mean both danger and a force for change (Douglas 1984, 1966).

Douglas maintains that the role of ideas involving separating, purifying, demarcating and punishing transgressions is to systematise an untidy experience:

*"It is only by exaggerating the difference between within and without, above and below, male and female, with and against, that a semblance of order is created."*(Douglas 1984, 1966:4)

Households' development of pockets of local order marks such dichotomies and establishes what is considered matter out of place. The concept of matter out of place is first and foremost associated with cleanliness, but conventions of comfort (discomfort) and convenience (inconvenience) are also of relevance for the subject of study, since the experience of them most likely affects routines and the character of the pockets of local order.

## MY ANALYTICAL FRAMEWORK

The concept pocket of local order provides a valuable analytical tool for identifying the physical and social prerequisites of human projects. Culture analysis, on the other hand, helps to analyse the meanings and intentions behind the development of a pocket of local order, which otherwise is not part of a time-geographical analysis.

The analytical tool developed above combines approaches from time-geography and culture analysis, and will be used to describe and analyse routines in the context in which they take place. Such a combination is possible since the two theoretical parts are complementary and do not overlap more than marginally, and since the basic assumptions do not clash.

The challenge is, rather, to introduce a methodology that can cope with the width of this approach, which is dealt with in the next chapter.

In this study, household is the unit of analysis. According to Hägerstrand, the household is a fruitful unit for analysis of human activities and projects, since it is one of the more crucial institutions that have come into being for initiation and control of routinised projects:

*“Each institution forms a space/time tube, inside which custodians of internal projects try to draw together internal and external resources at suitable times and in suitable numbers and sizes.”(Hägerstrand 1985:209)*

Each household forms a pocket of local order. Household members order their resources to perform activities and projects. The context varies over time and, for example, residents tend to spend less time in their dwellings and public places are used to an increasing extent for eating, recreation, and body hygiene. Nevertheless, many people still carry out, and must provide suitable arrangements for, activities and projects in the household.

A bottom-up perspective is required to identify the contextual prerequisites of household routines. Households as pockets of local orders are studied through their members’ *everyday routines*, since they manifest and maintain the created order. A new technical arrangement alters household pockets of local order, but routines other than those anticipated may emerge as a result of the rearrangement of available resources (Ellegård 2001). To understand what actually happens with household routines and why they come about as they do is the main ambition of the present study, and the analytical chapters (Chapter 6 and 7) deal with different sets of pockets of local order for householders’ water and sanitation-related routines.

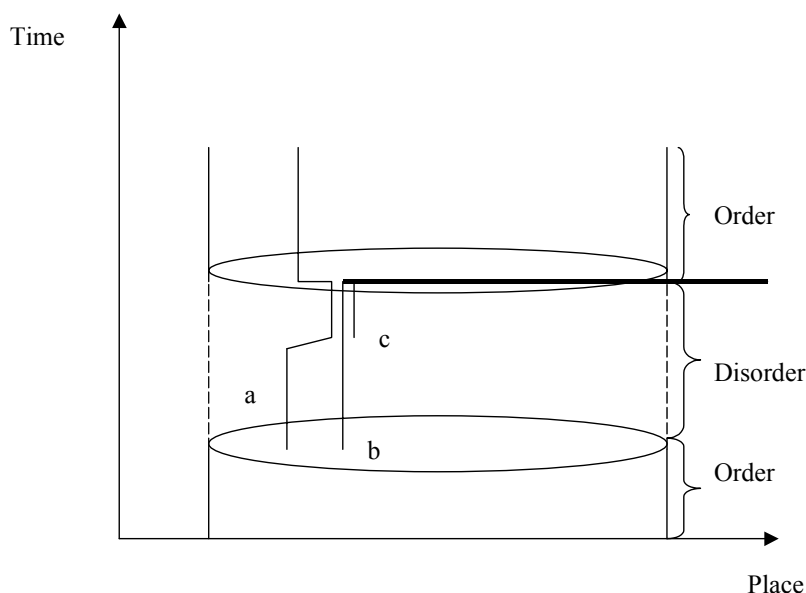
A pocket of local order is created in time-space by actors from the resources they experience are present. This is done to keep certain paths within reach for activity and project enhancement, and to keep other paths at a distance. The socio-cultural classifications delineate what paths to exclude and include, to keep inside or outside, to endorse or oppose, and which also make up each individual’s cognitive pattern. These cognitive patterns, which also include comfort, cleanliness and convenience considerations, both affect what actors perceive as resources and constraints, and what activities and projects are desired. The organisation of everyday life is about linking necessary objects and individuals to allow routines that are perceived as socially and symbolically appropriate.

The cultural imprint on pockets of local order is identified by routines, and by objects and their placement in time and space. Unwanted matter is dealt with by certain routines; cleaning and scrubbing are not done only to avoid illness:

*“We are separating, placing boundaries, making visible statements about the home that we are intending to create out of the material house.” (Douglas 1984, 1966:68)*

I will use matter out of place as an analytical tool. Households perceive some events and objects to be in order, while others cause debate and conflict (disorder). Some routines are ‘rituals’ of purity for re-establishing order, illustrated in Figure 2.3.

**Figure 2.3 Example of disorder management**



*The figure illustrates how resources (a, c) are joined in time and place to remove matter out of place (b) and re-establish order. For instance, (a) is a household member who has noticed food residuals (b) on the kitchen floor for some time, creating a disorder. He or she eventually decides to clean up with water (c). When finished, the food residuals leave the household with the scrubbing water (now also a matter out of place) via the toilet, illustrated by the thick path (b and c). Order has been re-established.*

The study is process-oriented, and the changes in water and sanitation arrangements change household pockets of local order. However, when including socio-cultural reasons for physical arrangements, one challenging question emerges; when is a pocket of local order replaced by another and when is it merely changed? The traditional time-geographical standpoint is that physical order is the essential order, and therefore a new pocket of local order can only be developed by changing places, by moving, renting a cabin for the vacation, etc. However, Wihlborg (Wihlborg 2000) maintains that in each case we have to evaluate whether a pocket of local order is new or changed by analysing the essential orders in the pocket. The physical place is one essential order, but since socio-cultural- and physical orders are related, cultural change could also cause new pockets of local order to develop.

The next chapter deals with how to study everyday routines in a process of change.

## CHAPTER 3

# Methodology: How to study the private, un contemplated and taken for granted

The choice of methodology is intimately connected to the aim of the study. Likewise, methodology is intimately connected to theory, since theory and methodology determine how the empirical material should be interpreted and analysed. Both culture analysis and time-geography are used in studies of everyday life, and I will combine these two theories to benefit from their different perspectives.

This chapter deals with the methodological challenge of studying everyday life, and it provides the motive for a mix of methods – time-diaries, interviews, metering data and simple observations - for information gathering. The use of case studies is also accounted for, and comments about method experiences end the chapter.

## METHODS FOR STUDYING WATER AND SANITATION USE IN HOUSEHOLDS

Studying everyday life in households is challenging since it is well-known to all; it is taken for granted, perceived as normal and performed without reflective thought (Valentine 1999; Ellegård and Wihlborg 2001). The methodology applied must capture *routinised activities*, many of which are *uncontemplated* and/or considered as *private*.

The methodological tools should assist in increasing respondents' awareness of their own routinised activities, and enable the researcher to recognize prevailing routines also when they are part of his or her own routines. Most water-related routines are easy to explore. However, some activities are considered more private than others, and some taking place in the bathroom remain unreported in our culture. In such a case, there is an increased risk of discrepancy between actual and related behaviour. More generally, respondents may be unwilling to reveal the 'true' actions in order to cover up routines known to be questionable from e.g. an environmental or cultural point of view.

Consequently, the study calls for methods beyond the interview. Culture analysis is applied to investigate tensions between what is said and what is done, and the discrepancy between saying and doing can be overcome by employing various empirical sources (Ehn and Löfgren 2001). Time-geography provides empirical data concerning the processes of change in physical arrangements and the ensuing routine changes.

## Methods chosen

A methodological combination of quantitative and qualitative methods has been chosen to allow for crosschecking of information. If a qualitative method such as interviewing points to the same results as a quantitative one, such as metered data, the result gains in credibility (Kvale 1989). Interview methods are appropriate for collecting empirical data for qualitative social research, but since people may have difficulties articulating routine activities, and that related routines or attitudes and actual routines may deviate, the interviews can be coordinated with time-diaries and observations (Ellegård and Wihlborg 2001). The combination of interviews and time-diaries is considered to be a method similar to participatory observation, but is easier to employ where observation is not possible for e.g. ethical or economical reasons (Bell 2000). Here, in-depth interviews are combined with time-diaries, water metering data and simple observations. The final themes are presented in the empirical and analytical chapters (chapter 4-7).

### *Time-diaries*

Time-diaries are generally used for evaluating consequences of change, both of individual and social conditions (Ellegård 1993). The method and its theoretical base are thoroughly described in (Ellegård and Nordell 1997), where also its 'awareness-raising' ability is emphasised (see also Nordell 2002). The time-diary method has been frequently used in studies of everyday life conditions, for instance, of women's organisation of everyday life (Friberg 1990), and the role of technology in everyday life (Östlund 1995; Östlund 1999; Sjöberg 2000; Wihlborg et al. 2003; Thulin 2002).

Routines are normally not reflected on, as long as we face situations with 'standard operating procedures'. For reflection to occur, we need some disturbance of the normal everyday order of things (Östlund 1995). In the present study, the changes in water and sanitation arrangements and the writing of a time-diary constitute the 'disturbances'. Time-diaries can provide valuable insights into how, and partly why, changes in the surrounding environment (time-space) affect human activity patterns. Also, the respondent's enhanced awareness about his or her routines facilitates discussions about the how and why of routines (Nordell 2002).



The researcher-initiated time-diary covers all activities in everyday life, but is at the same time concerned with defined aspects among all these activities. All kinds of pre-specifications such as type of activity, specific times, etc. should be avoided in order to stimulate the respondent to give his or her version (Ellegård and Nordell 1997). In order to direct the respondent to report correctly, short definitions specify what is asked for. What finally is recorded or excluded from the time-diary is entirely in the hands of the respondent, and individuals may emphasise different activities in addition to which individual awareness of daily activities varies. Consequently, every time-diary is, and should be, a subjective document (Ellegård and Nordell 1997).

The structure of the time-diary depends on the study objective, and determines what essential data about everyday life activities should be included, while basic variables are what one does and why, when, where and with whom (Ellegård and Nordell 1997). Activities related to the quantity of hot and cold water and quality of wastewater dominate the time-diary used in this study (see appendix 1). Writing a time-diary with this objective is time-consuming<sup>29</sup>. There is a fine balance between the need to gather enough information and the risk of respondents perceiving the time-diary to be too structured and artificial, potentially causing a decline in motivation and even respondent defection.

If possible, all everyday activities should be recorded for several days, preferably one week (Ellegård and Nordell 1997). Since activities including water use may be frequent, there was a risk of respondents deciding that the effort was too much for them. Writing a time-diary is an additional activity in everyday life since it takes time and space, but it must not be so demanding that it results in the exclusion of 'normal' everyday activities. Consequently, a shorter period was considered feasible. Respondents wrote time-diary for three to five days in a row, including both weekdays and weekend days. They were instructed to record as many activities as possible (preferably all of them), and to concentrate on their water-using activities and recording when they leave home and return.

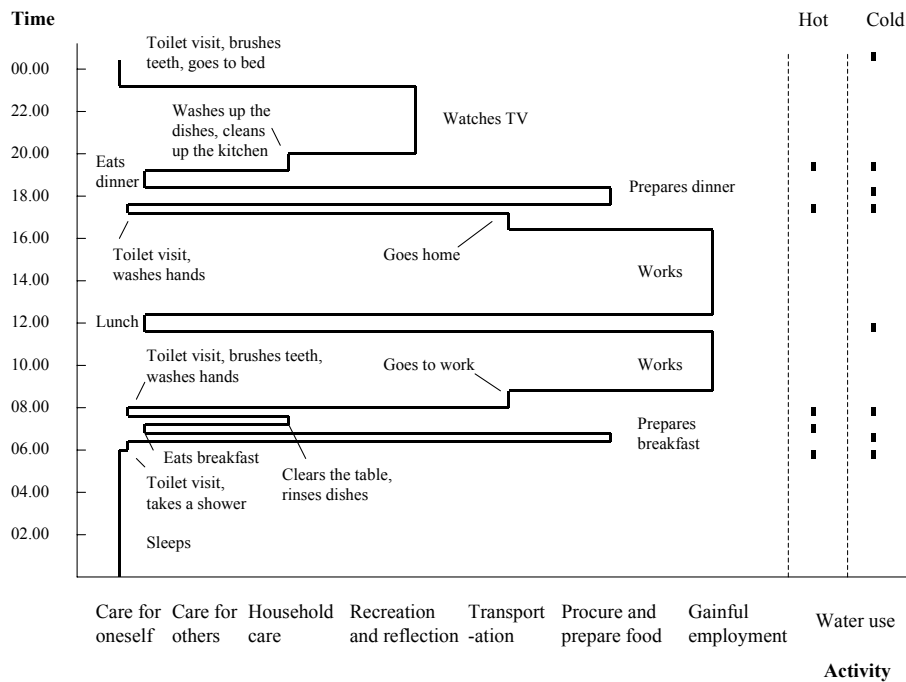
All the time-diaries have been analysed 'manually', enhanced by the previous simple observations, and some have also been analysed by entering the information in the computer program Vardagen<sup>®</sup>, in which activities are visualised in terms of time and space and together with whom. The program has not been used in full, since its illustrative capacity is based on all activities

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<sup>29</sup> Some colleagues at my department tried out the method before the actual study was conducted. They wrote a water-activity based time-diary for one day according to my instructions. They reported that it was fairly demanding, and they were surprised at how frequently water is used.

being noted. Since mainly water using activities were recorded, large ‘information-loopholes’ occurred in the presentation. Nevertheless, the computer programme has been helpful since it makes clear that water use is never an activity in its own right but is always related to some other activity or project. Also, the diagrams created by the program show how many times water is used in a day, for how short periods in time and when the use is concentrated. All this is illustrated in Figure 3.1.

**Figure 3.1 Diagram of water use according to time-diary information**



*The diagram should be read from the bottom and up. The horizontal axis shows the activity spheres and the vertical axis time of the day.*

It should be noted that the introspective effect in my study is achieved solely through respondents writing time-diaries, while other scholars have also confronted their respondents with the diagrams produced in Vardagen® to get reactions to the activity patterns as displayed there (see, for instance, Ellegård and Nordell 1997; Nordell 2002). Apart from the problem of making complete diagrams as described above, reading a diagram is not a matter of course and may cause respondent confusion rather than providing additional information.

## *Interviews*

Interviewing is a way of approaching another human being and of getting to know about her from her point of view (Ehn and Löfgren 1996; Kvale 1997), and makes possible follow-up questions; obtaining more details and clarifying the respondent's answers. I have used a thematic interview guide with main questions and possible follow-up questions to ensure that all relevant issues are covered in the structured conversation (see appendix 2-5). One advantage of this method is that the situation where empirical interview material is collected resembles an everyday situation, and the interview may be similar to a normal conversation (Holme and Krohn Solvang 1997). Holme and Krohn Solvang (Holme and Krohn Solvang 1997) point to four decisive issues for achieving a good result; the theme of the study, expectations that interviewee and interviewer have of each others' behaviour (roles), the interplay between actors and the interview environment.

Familiarity and involvement with the subject to be studied make it challenging to formulate interesting interview questions. They can be developed from theoretical concepts, by approaching the problem from different angles and by formulating unconventional questions (Ehn and Löfgren 2001). La Fontaine (La Fontaine, pers com) suggests that interview questions should be tried out on friends and colleagues, and if they find a question awkward, it is probably a good one!

The first interview included questions about the respondents' own routines as read from the time-diaries. Questions and scenarios about routines among other people may reveal aspects of the respondent's views that cannot be reached with questions about the individual's routines. The individual may feel that some routines are somewhat suspect and therefore does not reveal them. The first interview also included questions relating to the water and sanitation arrangement under scrutiny.

Qualitative interviews often take from one to a few hours, in my case from about 40 minutes to three hours. The amount of information provided is extensive, and therefore one has to strike a balance between the number of respondents (Holme and Krohn Solvang 1997). All interview information is 'learned' by reading the interviews in their entirety, with a focus on special issues. Notes are taken in this process and mind-maps are created.

## *Metered data*

The usefulness of metered data is, firstly, that in combination with other empirical material they show the magnitude of resources used in various routines. Secondly, quantitative data can be used to check the accuracy of

qualitative information and vice versa, and mismatches should be attended to. Taking into account both qualitative and quantitative data strengthens the analysis.

Gebers has a single meter for aggregate data on the incoming cold water for all households. A gauge on the heating device meters the total amount of heated water. The resident in charge of the heating system reads off and notes the cold and hot water use weekly. Notes are lacking for long periods, however, since it is not a compulsory task, and averages are calculated, based on subsequent data, for the period with missing data. Cold water usage is checked against the Stockholm Water Company's records, while hot water use is based solely on the resident's notes. The data was fed into the computer program Excel<sup>®</sup> to calculate weekly usage (see chapters 5 and 8).

Ringdansen has a meter in each flat, placed in the bathroom ceiling and sealed for protection as well as detection of any manipulation. Household-specific data on the use of energy (heating and electricity) and hot and cold water are transmitted to a central computer from where the housing company collects the data for billing (Siemens 2001) (Bergman 2004). Hot and cold water data from participating households have been provided in Excel<sup>®</sup> files by the housing company energy coordinator. The raw data have been recalculated (also in Excel<sup>®</sup>) to show hourly use (during the time-diary period), monthly use (see chapter 4) and weekly aggregated average use (see chapter 8). In Ringdansen, metered data and time-diary information could be compared for three households.

### Other methods considered but discarded

The theoretical perspective may enable more than one method to be used. A study of household routines could be made by observation, which, according to Andersen, is a useful first stage when in need of new research ideas and when initiating research on vaguely known social phenomena (Andersen 1994). Participatory observation investigates social acting, and the researcher is a recognized party in the process. The method may be useful when communication is impossible, e.g. for language reasons or when a small culturally divergent group is studied (Andersen 1994). Participatory observation is time-consuming, and is vulnerable to the risk of affecting what is being studied. It also poses ethical difficulties and raises issues of personal integrity. This method would not cover the needs of my study, and therefore I have limited myself to random observation to corroborate information gathered in other ways.

Non-participatory observation, for instance, by means of cameras installed in the bathroom, kitchen and other relevant areas in the household, is also a

potential option. Korvela (Korvela 2000) used video recordings in three households. The cameras were activated by the household members themselves as soon as someone was at home and awake. The result was 426 hours of video recording, which would require about 10 working weeks just to watch the tapes once. This method can provide detailed information, but the time-constraint would limit the number of respondents too much in my case. There are also difficulties involving personal integrity in my study since a substantial part of the water use takes place in the bathroom. Korvela avoided shooting in bathrooms and bedrooms. In a way, metering may be considered as a non-participatory observation method.

The questionnaire method is similar to interviews, but without the personal encounter that makes possible interaction and follow-up questions (Andersen 1994). Here, the interviewer effect is reduced and time is possibly saved. However, issues of a personal or intimate nature are more rarely answered compared with other question-based methods (Andersen 1994). The un contemplated or taken-for-granted routines would have been difficult to communicate. The aim of my study requires answers to why questions, and questionnaires would not provide information over and above what is gathered in the selected combination of methods.

## TWO CASE STUDIES

Empirical data have been gathered from two residential areas, where the arrangements for water and sanitation had recently been changed. The potential of using the data for analysis is elaborated in this section. The case study research method is a way of investigating an issue or subject by means of pre-specified procedures. Contemporary phenomena can be investigated in the everyday context. The demarcations between the phenomena itself and the surrounding context may be blurred, and several sources of evidence are used for clarification (Yin 1989). Here, the case study method is used to investigate the response to and effect on household routines when changing water and sanitation arrangements.

Case studies are recommended if questions like “how” and “why” are asked about contemporary events and when relevant behaviour cannot be controlled (Yin 1989). My research question satisfies all these requirements. The events in my study take place over time, and historical, contemporary and ongoing events are included. Apart from how and why questions, I am also interested in *where* and *when*, which are most relevant when explaining the how and why of a process of change in progress at a place and time. Time-geography’s contextual approach and case studies are well suited, since the case study preserves the holistic aspect of everyday events and actions (Yin 1989).

The multiple-case study chosen enables comparison of supposedly altered household routines when introducing a new arrangement for water and sanitation. The context of the two cases chosen is different in many respects: technical arrangements, terms of occupancy, social structure, etc. (see Table 3.1). The changes in the water and sanitation arrangements are, as we will see, also different in character, but possible to compare as regards their relative effect on household routines.

The issue of generalising results from case studies is often discussed. On the one hand, it is not possible to generalise statistically from a case study, since it is only a special case. On the other hand, it is possible to make analytical generalisations related to the theoretical framework by referring to other cases, even though this must be done with caution (Yin 1989). Flyvbjerg (Flyvbjerg 1991) repudiates the alleged lack of generalisation possibilities of a single case, and he also rejects the generalisation ambitions in science as the only way for scientific development. He argues that generalisation is just one of many ways of making science, and that the power of the good example is often not given the credit that it deserves. Single cases also contribute to the collective knowledge in a discipline or a society. He maintains that the choice of making a case study depends on the research question, and whether generalisation is possible depends on the case and how it has been selected. Findings from more than one case strengthen the results, since the evidence is more convincing (Yin 1989).

### Selection of case-study sites

Three factors have been decisive when selecting the two sites. Firstly, the changes in water and sanitation arrangements have *increased system transparency*. In Ringdansen, water usage is given a monetary indicator – the amount of water used becomes a ‘visible’ item in the household economy. In Gebers, the new technical arrangement requires increased user responsibility for operation and maintenance, and the nutrient fraction is not flushed away but taken care of. The enhanced transparency is physical and possibly mental.

Secondly, the two arrangements are *believed to change user’s routines* and, as a result, overall system sustainability. Both cases imply incentives to behave differently, or even require that new routines be developed, but they provide very different contexts for change. In Ringdansen, the change in arrangement was decided on and installed by the housing company, whereas the decision and introduction were initiated by the residents in Gebers. The economic change in Ringdansen is substantial, while the physical change is negligible, whereas in Gebers the physical change is dramatic and the economic incentives are small. The social contexts differ: in Ringdansen, the context is household-based (individual) and in Gebers it is collective. Consequently, the

two cases enable comparison and analysis of important factors (social, economical and physical) for routine change, i.e. analytical generalisations.

Thirdly, the two cases make it *possible to analyse important sustainability issues relating to households*: the amount of water used (hot water in particular) and pollution of water affecting nutrient recycling. Each study site is presented in detail in the empirical chapters (4 and 5). Table 3.1 gives an overview of what aspects are similar and what are different.

**Table 3.1 Basic information about the case study sites**

	Gebers	Ringdansen
<i>Drinking water</i>	Water supplied by the municipal water company. The cost is shared equally between the residents (included in the rent). Water heated by solar panels and pellets/oil.	Water supplied by a private water company. Individual metering and billing of hot and cold tapwater. Water heated by district heating and geothermal heating.
<i>Greywater</i>	To wastewater treatment plant. Flats prepared for a local system with partly treated water e.g. recirculated grey water, lake water and rainwater.	To wastewater treatment plant.
<i>Toilet management</i>	Dry urine-diverting toilets. Residents take faeces to a composting station. A farmer collects stored urine to fertilize fields. Three communal WCs to wastewater treatment plant.	WCs connected to wastewater treatment plant.
<i>Terms of occupancy</i>	Tenant owners' association (HSB).	Rented flats (Hyresbostäder AB).
<i>The residential area</i>	Country-like area in the vicinity of Stockholm. Collective living. Residents maintain the premises. Residents considered to be environmentally aware above average.	Refurbished 'Million Programme area' on the outskirts of Norrköping. Residents considered to be environmentally aware at or below average.
<i>The households in general</i>	Middle-income area. Mostly middle-aged couples with small children and/or teenagers. Some old-age pensioners, couples and single households.	Low-income area. All kinds of household types. The proportion of families with children is 45% (2002), 12% is 65 years or older. 44% is of foreign descent (2003) <sup>30</sup> .
<i>The selected households</i>	Families with children and/or teenagers. Single-person households, ages 30< of both sexes, and an upper middle-aged couple.	Families with children and/or teenagers, both of Swedish and foreign descent. Single-person households (young male/older females), and an upper middle-aged couple with children no longer living at home.

<sup>30</sup> The figures are for the larger area Navestad (Norrköpings kommun 2002; Norrköpings kommun 2003a; Norrköpings kommun 2003b).

Gebers is studied for several reasons. 'Pipe-less' local systems are future alternatives for residential areas situated at a distance from existing wastewater treatment plants, where extensions to existing grids could not be economically justified e.g. weekend cottage areas made permanent, and new residential areas. Sanitary systems that separate flows at the source also are considered to be superior when it comes to nutrient recycling (Jönsson et al. 2000).

Gebers was converted into a tenant owners' association with 32 apartments in the late 1990s, and about 80 people reside here. It is organised as a collective, and the housing is arranged to enhance social relations between residents and an ecological way of living. Residents rebuilt Gebers themselves and chose to install dry urine-diverting toilets (Thornblad 1998). Even though a conventional solution was possible, residents decided for ecological and technical reasons on a source-separating system that requires resident involvement in operation and maintenance. The fact that users themselves must engage in work otherwise carried out 'automatically' highlights various issues. How do households make room (in time and space) for additional activities in their everyday life, what new routines are required and how are they performed and why? An altered physical and social order may also impact on cultural issues such as cleanliness/dirtiness, normality/abnormality, etc, which in turn have implications for routines. The study of the Gebers arrangement thus touches on the tension between ecological and social sustainability, and the challenge to address both aspects of sustainability in attempts to achieve (more) sustainable urban water and sanitation systems.

Gebers could be considered an "extreme" case, especially with respect to the residents' above-average environmental dedication. Advocates of generalisations may find the selection of extreme cases especially disturbing. The argument would be that the results could not apply to "normal" people. However, Yin (Yin 1989) argues that unique cases can be justified by their relative unusualness, and that the interesting subject matter can be so rare that it justifies documentation and analysis in order to learn more about it. Also Flyvbjerg (Flyvbjerg 1991) argues for extreme cases. He maintains that extreme cases, especially those that are either successful or full of problems, may contain more information about a research question than the representative ones, since they often activate more actors and more basic mechanisms in the studied situation. In Flyvbjerg's terminology, Gebers could also be said to be a *critical case*; a case that enables conclusions to be made in terms of "if it is (not) valid for this case, it is (not) valid for any other case".

My choice is based on the unique opportunity to study a technical arrangement that, apart from being interesting from an environmental point of view, is fundamentally different from the conventional system.



Many ‘conventional’ routines do not apply here, thus cultural perceptions and norms are being challenged.

Ringdansen was selected for several reasons. Metering and billing of heating and hot water in flats is steadily increasing in popularity; and is expected to encompass about 15,000 flats in 2006 (Berndtsson 2003). An EU directive recommends metering and billing as a means of reducing carbon dioxide emissions. The arrangement is intended to reduce the use of primarily hot water. There are no studies of how and why householders’ routines change or remain the same.

Ringdansen was built in the late 1960s and beginning of the 1970s by the public housing company Hyresbostäder (Ketola 2000). Ringdansen soon became a housing reserve for households with social and/or economical problems and for immigrants. Apart from a short period in the late 1980s, it has never been fully occupied. At the end of the 1990s, Ringdansen underwent a major refurbishment including ecological solutions. Resident participation was intended to improve the social status of the area.

The refurbishment included introduction of volumetric billing per household of hot and cold water, heating energy and electricity. Simultaneous installation of low-flush toilets, one-grip mixers, and new mixer taps and thermostats is expected to save water without changes in routines.

I have already pointed out the possibility of making generalisations from single and even extreme cases, and also that generalisations are not the only valid way of creating new knowledge. However, I have chosen to contrast a perceived extreme case (Gebers) with a perceived common case (Ringdansen). Residents in flats in Ringdansen share circumstances with many Swedes; of a total of 4.3 million dwellings in Sweden more than half (2.35 million) are flats in apartment buildings (2002) (SCB 2004). Public housing companies own about 835,000 flats<sup>31</sup>, in which about every sixth Swede lives (SABO 2005). Gebers was created because a group of people did not comply with the social and ecological context provided in common residential areas such as Ringdansen. Contrasting the “extreme” households in Gebers with the “normal” households in Ringdansen, different physical and social arrangements for water and sanitation activities will make it possible to discuss and analyse in terms of existing constraints and resources in the two areas and their impact on routines. Similarities and differences between the cases would be the basis of analytical generalisations. The two cases are special, but if

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<sup>31</sup> Public housing companies affiliated to SABO (Swedish Association of Municipal Housing Companies). Other public housing companies own an additional 30,000 apartments (SABO 2005).

certain behavioural patterns and routines are common or similar for several individuals in both areas, we have a strong case of overarching cultural implications for routines.

## Selection of case-study respondents

This study is about households, not families. A household comprises one or more individuals living in the same flat in an organisational context regulating each member's daily life (Ellegård and Wihlborg 2001). Household members depend on each other, are involved in common projects, and divide tasks among themselves in different ways. Consequently, the analysis must alternate between the individual level and the household level, but must not lose individual-related information when focusing on the household (Ellegård and Wihlborg 2003). The household is also a spatial category, which connects people to a particular place (Muncie et al. 1997), where many everyday activities requiring water and sanitation arrangements take place.

Households are studied from a bottom-up perspective, which means that the researcher takes a position within the locality where activities are carried out (Wihlborg 2000). Preferably, all the members of a household participate voluntarily in the study, write a time-diary and are interviewed. Due to young age or reluctance to participate, some adjustments had to be made by treating participating members as 'spokespersons' for other household members (see also Table 3.2, and *Getting hold of respondents*).

In order to make comparisons possible, I have tried to recruit respondents from households with a similar composition in the two areas. Also, households that are 'area-typical' in terms of age, sex and household composition have been included. The selected households are as follows:

- Single-person households (males/females, 30-75 years)
- Households with children and/or teenagers
- Upper middle-aged couples (without children or where the children have left home)

About 40% of the households in Sweden were single-person households in 1990 (SCB 2004)<sup>32</sup>. Single persons do not need to negotiate, and are not restricted by other household members' needs and wants. On the other hand, they have to cope with all the household chores themselves, unless they ask

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<sup>32</sup> The figure is fairly old but considering the strong trend of a steadily increasing number of single-person households since the 1960s, it is probably on the low side.

for outside assistance. It is likely that this category is more heterogeneous than others. In the case of young single persons, a lot of the water use and wastewater production takes place elsewhere. Older single persons generally face more physical restrictions limiting their freedom of action.

The high water usage in households with children and teenagers, is only partly caused by more people in the household, they also tend to use more water than average for laundry, bathing, showering, etc (Carlsson-Kanyama and Lindén 2002). Older people are thought to use less water than average. Table 3.2 shows the categories of respondents<sup>33</sup>.

**Table 3.2 Selected respondents in categories**

	Ringdansen	Gebers
<i>Single-person households</i>	*Male (+30). Three ‘part-time’ children <sup>34</sup> *Female (+65) *Female (+65)	*Male (+40). ‘Part-time’ child/teenager <sup>35</sup> *Female (+50) *Female (+40) *Female (+30) *Male (+30)
<i>Households with children/ teenagers</i>	*Couple (+40), foreign descent, two children, one teenager <sup>36</sup> . *Couple (+50), one teenager, one adult child. *Couple (+40), foreign descent, one teenager <sup>37</sup> .	*Couple (+40) ~ two children/teenagers <sup>38</sup> . *Couple (+40) ~ two children/teenagers <sup>39</sup> *Couple (+40) ~ two children/teenagers <sup>40</sup>
<i>Upper middle-aged couples</i>	*Couple (+55)	*Couple (+55) <sup>41</sup>

### *Getting hold of respondents*

Initially, four households were selected in Gebers. ‘Recruitment mail’ was sent out to all households, with information about the aim of study, what kinds of households I wanted to recruit, and what their contribution would be. Interested ‘matching’ households were invited to contact me, and only one

<sup>33</sup> Ages are approximations. The smallness of the community justifies the number of children/teenagers in Gebers also being presented as approximations in order to ensure respondent anonymity.

<sup>34</sup> Children do not take part in the study.

<sup>35</sup> Ibid.

<sup>36</sup> The male and the children do not take part.

<sup>37</sup> The male and teenager do not take part.

<sup>38</sup> One teenager takes part.

<sup>39</sup> The children/teenagers do not take part.

<sup>40</sup> Ibid.

<sup>41</sup> The female did not participate.

household was recruited in this way (a single woman)<sup>42</sup>. After consultation with the resident who provided the contact list, I contacted matching households by phone. They had seen my mailed invitation and all but one agreed to participate in the study. A household with a similar composition replaced the missing one. In the selected households, all the adults participated as well as a teenager in one household - a total of seven people.

I intended to recruit households in Ringdansen corresponding to the ones selected in Gebers, and to add some that were typical for Ringdansen, such as families with immigrant origin and elderly people. An important condition was to get households that had not yet been informed about their own water usage, but still had working meters. Representatives of the housing company, Hyresbostäder, provided me with contact information on households fitting my requirements. A similar letter to the one e-mailed to the Gebers households was sent out before making contact over the phone.

It turned out to be difficult to recruit Ringdansen households in this way. My first attempt was made at the beginning of June, 2002, but out of some five contacts, only one (a single male) agreed to participate. Personal problems, going away on vacation and disinterest (or, rather, general discontent with the refurbishment and the view that I was representing Hyresbostäder's interests) were the reasons given for not joining. After the summer vacations, the procedure was repeated – and so were the problems. This time, language problems, a busy time-schedule (e.g. single mothers and recent mothers) or a combination of both were additional reasons given for not joining. In case the contacted persons spoke sufficiently good Swedish so as not to require an interpreter, I tried to convince them to participate. An older single woman agreed to participate.

I then asked Hyresbostäder to give me the opportunity to present my study and myself at a resident meeting. The meeting took place in the end of November, 2002, and was about the outdoor environment in a part of the area. All the residents in that area had been invited, and about 10 people attended the meeting. This recruitment method was a success - six people from five households announced their interest to take part. They, in turn, recruited other household members and in all, eleven respondents from seven households were finally selected.

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<sup>42</sup> One reason for the meagre response was given by one of the respondents. His reason for not making contact was that he did not think he fitted the specification of households. He did not regard himself as single since he had a child/teenager living with him at times and a partner (not a co-habitee).

The households represented the dominating groups in the area (immigrants, families with children/teenagers, older people) and corresponded sufficiently well with the households selected in Gebers<sup>43</sup>. The fact that 10 residents out of some 1,000 attended the resident meeting in Ringdansen, indicates that they are more involved and interested than the average tenant. I argue that the selection outcome supports a comparison between the two cases.

The recruitment procedure for additional respondents in the second phase of interviews was conducted in a similar way to the first, apart from the introductory letter. Another five households were added from Gebers, making a total of nine households with 13 residents. In Ringdansen, the households from the first phase were contacted and all agreed to participate once more.

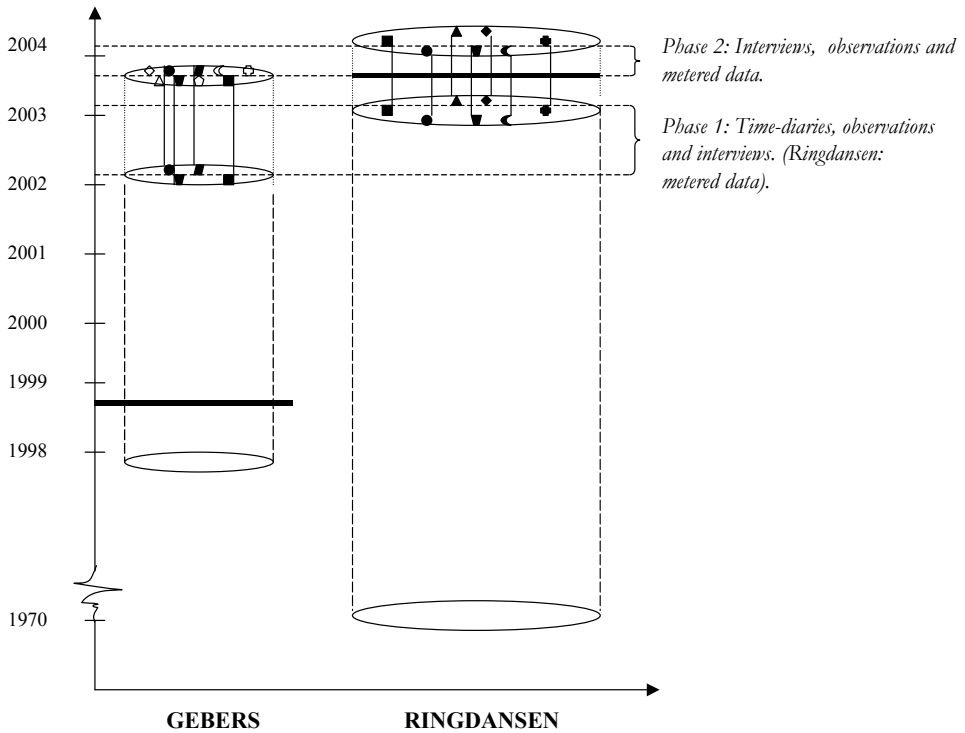
## STRUCTURE OF THE STUDY

The role of a household or a family as a social centre for an individual's everyday life, and the role of the dwelling as a centre for many everyday activities, can be explored by means of a process-oriented methodology (Ellegård and Wihlborg 2001). Time-diaries uncover routines during the course of the day, and the two interview phases designed to collect empirical data uncover changes in routines over time. Figure 3.2 shows when the empirical studies were carried out for the two cases and what methods that were used.

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<sup>43</sup> Five additional households were selected in Gebers later on, with the aim of "matching" with Ringdansen households.

**Figure 3.2 Study structure**

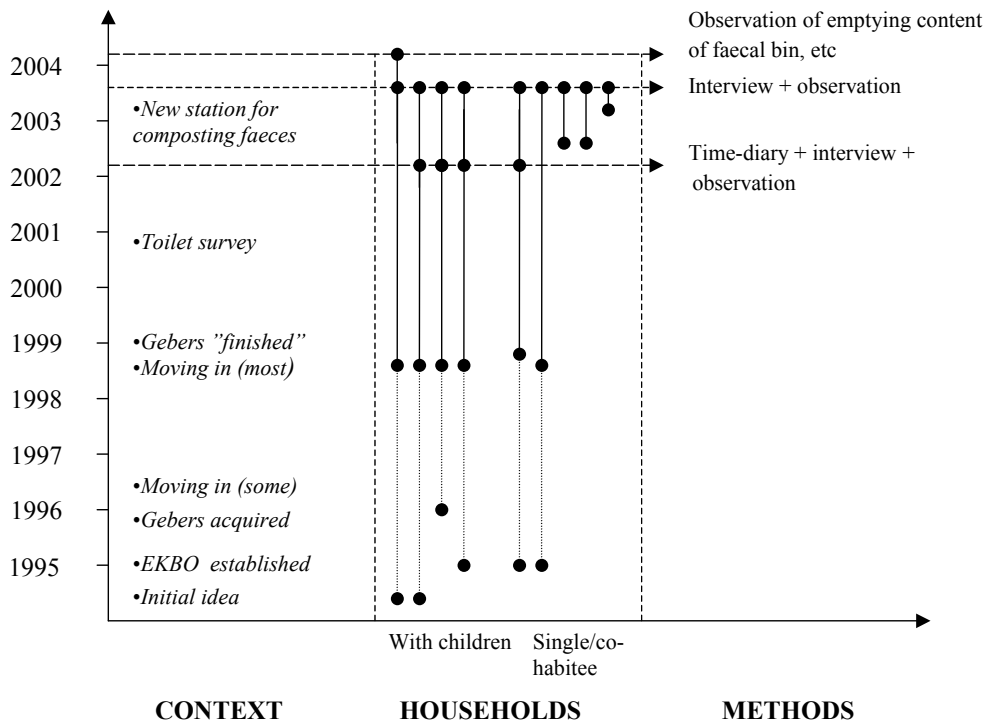


*The ellipses and dots represent the time and place for empirical construction. Each dot in the ellipses corresponds to a participating household. They have different shapes to mark their separation in space and different colour to mark their separation in time (white dots in Gebers only took part once). The thick black lines denote the time of altered technical arrangements, which, in the case of Ringdansen, is longer in reality since the new arrangement is gradually introduced in different parts of the area.*

## Methods used in Gebers

Figure 3.3 gives an overview of the history of the collective in Gebers and the nine households participating in the study - their composition and length of residence in Gebers - and finally my own involvement and methods used.

Figure 3.3 Gebers overview



Each line in the household column represents one participating household. The dotted line starts when the household was first involved in the EKBO project, and the solid line indicates the period when they lived in Gebers.

#### Phase 1: Observations, time-diaries and interviews

The first meeting, to introduce the time-diary and to provide instructions about how to fill in the time-diary, took place in the home of the respondent. I assured the respondent that all information would be anonymous, and explained my interest in everyday living and my disinterest in controlling the environmental standard in the household. The respondents were also invited to raise issues of concern. This first meeting also gave the opportunity to ask about the household's planned activities during the time-diary days and to observe water-related equipment in the apartment. When this was not possible, I simply asked the respondent if such equipment was available.

Each of the seven members of four households in Gebers wrote a time-diary for five consecutive days, Wednesday-Sunday in January, 2002. They returned the time-diaries in a stamped and addressed envelope.

The next step was to develop an interview protocol, partly influenced by the time-diaries and containing both general and individual questions. The interviews were conducted within two weeks of the time-diaries were written. All interviews but one<sup>44</sup> took place in the home of the respondent and lasted for 1.5-2 hours. Interviews were audiotaped and transcribed unabridged.

The first interview focused on individual routines related to water and sanitation and, in particular, use, experience and management of the dry toilet arrangement. A sample of the interview protocol is given in appendix 2.

### *Phase 2: Observations and interviews*

The second round of interviews was conducted in August-September, 2003, with all but one in the home of the respondent. The interviews lasted between 1-2 hours, and were audiotaped and transcribed unabridged. The justification for this was firstly that the analysis of the material from phase one raised new questions and, secondly, the questions about water and sanitation routines were detailed in the first phase, and there was little room for discussion about other issues such as how to choose between possible alternative actions and about social norms in Gebers concerning household resource use. Thirdly, the process approach required (at least) two separate collections of empirical material. A final reason was to achieve better congruence in terms of composition of respondents from the two cases and to complement this with new households in order to better reflect the social structure in Gebers. 'Latecomers', i.e. Gebers residents who had not participated in toilet system selection and planning, were identified as an interesting category since their perspectives on use and maintenance might differ from those of residents involved early on. The additional five households were asked partly the same questions as those in the first phase (see appendix 3).

The time-diary did not cover the emptying of the faecal bin. This routine is carried out once a month or more seldom, and did not coincide with the time-diary days in any of the households. However, it was included in the interviews, and an observation in March, 2004, of one household emptying their bin, complemented the information.

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<sup>44</sup> One interview took place at the respondent's workplace during working hours.



## Methods used in Ringdansen

All eleven members from seven households participated in both phases of the study.

### *Phase 1: Observations, time-diaries, metered data and interviews*

The methods used in Ringdansen resemble the ones used in Gebers with some exceptions. Household meters registered every 10 litres to match with the time-diaries. A technician from Siemens joined me for the first meeting with each household, when the time-diary was introduced. The introduction was conducted in the same way as in Gebers, but in two households where all household members participated, it was held with household representatives, and in one household, a respondent from another household mediated the information. The same structure of the time-diary was used, despite some changes suggested by some Gebers respondents (that some products and activities are so common that they could be pre-specified and just marked with a cross), since an altered structure would have interfered with the comparison between the two cases and overly structured time-diaries should be avoided. An important difference from Gebers is that the duration of time-diary writing was shortened to three days in Ringdansen – two weekdays and one weekend day. It was decided to do so after finding that in Gebers, five days were too demanding and occasionally lead to a low quality of recorded data.

In Ringdansen, the time-diaries could be checked against metered data. Inconsistencies between the two could be checked further in the ensuing interviews, which thus also included clarifying questions in order to ascertain which method had failed – for instance, if the respondent had forgotten to write down an activity, or if there had been a leakage problem.

Metered data for the time-diary days were available for three out of seven households. Despite considerable effort, technical problems made it impossible to obtain metered data for four households; three failures were caused by a major breakdown of the central computer<sup>45</sup> and one by a meter not able to provide data<sup>46</sup>.

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<sup>45</sup> The central computer had not been provided data for eleven days, including the time-diary days. For the households involved, I had to use metering values from corresponding weekdays the week after the time-diary week in order to obtain indicative data on water use in these households.

<sup>46</sup> The meter was about to be connected to the central network at the time of the time-diary study. The timing was critical, but the representative from Siemens thought it would be

The Ringdansen interviews were conducted between June, 2002 and March, 2003, with a duration of 45 minutes to 2.5 hours. The eleven interviews took place in the home of the respondents shortly after the time-diary had been written, usually the following week or the week after. Interviews were taped and transcribed unabridged, except for longer digressions in some of the more extensive interviews, which have only been noted. The interviews related to the time-diary and the volumetric billing. The interview protocol with the general questions and themes for individual questions can be found in appendix 4.

### *Phase 2: Metered data and interviews*

A follow-up interview was conducted in January-February, 2004, with all eleven respondents and lasted for 1 to 3 hours. By then, the individual measurement and billing per household had been effective for 5-17 months and their account had been settled at least once. The interviews dealt with the subject of metered data and, as in Gebers, also included questions about how to choose between alternative actions (see appendix 5). All interviews were taped, but not transcribed. Instead, careful notes were typed directly after each interview, or later the same day – on some occasions while listening through the tape. Two interviews were conducted over the phone, and were not taped although notes were taken during the course of the interviews.

## **EXPERIENCE OF USING TIME-DIARIES AND INTERVIEWS**

Before heading to the empirical chapters, I will present the respondents' stated experiences of writing a time-diary, and my reflections concerning the interview method.

### **Respondents' experiences of the time-diary method**

Part of the first interview was devoted to a respondent evaluation of the time-diary method. The respondents state that they succeeded in noting all water-using activities. If they missed out, it was due to sheer forgetfulness, perhaps a toilet visit or product used when activities had to be recalled<sup>47</sup>. The accuracy

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fixed in time. I had previously delayed this household because of the uncertainty concerning the metered data, so when I was given the go-ahead, I decided to proceed. However, on my way to this household with the Siemens representative, he warned me again about the uncertainty of obtaining metered data. I decide to go through with it anyhow, since it was a bit late to call it off and it was possible that things would work out.

<sup>47</sup> In my instructions about how to write the time-diary, I emphasised the importance of writing continuously, since the character of routines makes them difficult to recall. Many respondents, however, did not take the time-diary with them when leaving home. Some

of Ringdansen statements in the time-diary was confirmed in cases where metering data was available for checking. Other activities than those related to water have been more infrequently recorded and are also more difficult to check.

Respondents who maintain that time-diary writing was a demanding task were mainly those who wrote for five days (Gebers). Also, it became a demanding activity when it conflicted with many other activities, and for those respondents who wrote comprehensively and tried to include more activities than just those related to water. Time-diary writing was a new and non-routinised activity, which also made it difficult to remember to write, according to three respondents.

In general, respondents maintain that they have noted all activities, even the private ones, but left out the details. One respondent, hesitated to write down the activity of inserting a tampon, but did anyhow since she wanted to perform 'well' for the sake of the study.

Half of the respondents in Ringdansen maintained that they had not changed their way of thinking about their own routines, whereas only one respondent in Gebers gave a similar answer. The respondents in Gebers who acknowledged the introspective effect, maintained that writing the time-diary made them aware of how often water really is used, and that their use was either more or less than initially anticipated. They did not begin to think in terms of being careful with water. Reflections among respondents in Ringdansen also concern the likelihood of higher water use than anticipated. Also, four respondents claimed they had become more aware or begun to think about items flushed down the drain.

Even if the introspective effect was not present or was negligible in some cases, the time-diary still helped to improve the information, since it facilitates the formulation of interview questions. Also, the time-diary prepared the respondents for the questions to be asked in the subsequent interview.

Time-diary writing affects the routines it is supposed to uncover in three ways. Firstly, writing becomes an additional activity in time and space, which may hinder other activities from being performed. Secondly, routines may be altered since they are under scrutiny (consciously or subconsciously). Thirdly, routines may be altered since respondents become aware of them. In terms of being an additional activity, it was, rather, the time-diary writing that was

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forgot and wrote in the time-diary from memory, whereas others made simple notes, which were later transferred to the time-diary. I conclude that the time-diary must be smaller and easier to carry, than the one I used (A4 format).

affected; it was left until later, several activities were combined into one activity (requiring writing on fewer occasions), and sometimes it was even neglected completely. One respondent even avoided water use on some occasions in order to avoid writing in the time-diary.

In Ringdansen, four respondents claimed to be affected by the volumetric billing rather than the time-diary. Some admitted that they might possibly have tried to be better than they really were, for instance, that they turned off the tap more quickly than was actually the case. However, this is not only an effect of being ‘controlled’ but it also facilitates writing the time-diary. Being more aware of one’s own routines could reduce the duration of water use. Also, it was considered to be easier to write and estimate the water amount/time of use, if water was not used in a routine manner.

### **My experience of the interview method**

Every interview is a meeting between (at least) two people, and each interview comes out differently since each individual and interview situation is unique. Generally, respondents in Gebers seemed more used to being interviewed and most of them provided detailed answers to most questions. I was able to concentrate on asking for clarification and follow-up questions. In Ringdansen, on the other hand, it was harder to get more detailed descriptions. Compared with Gebers, I needed more often to rephrase the question or in other ways stimulate the respondent to expound on his or her views. I believe that I perhaps did not fully succeed in framing the question in the right way, and I sometimes got the feeling that the respondents were looking for the “appropriate” answer instead of being spontaneous.

The fact that the residents in Gebers have more to say about water and sanitation issues may be due to their active selection of a specific water and sanitation arrangement. In contrast, Ringdansen residents have merely been provided with one. In the selection process of the toilet solution in Gebers, residents at least to some extent had to familiarise themselves with the different options available. The outcome was also a clear physical and organisational change, compared to the change in water and sanitation arrangements in Ringdansen, where it was solely a new way of setting the rent. Questions about, for instance, washing-up routines, shower habits and product use, may be perceived as more awkward in a place where the respondent might assume that the researcher has more or less the same routines at home. It may be easier to understand why someone takes an interest in a unique toilet arrangement, and asks questions about user experiences not likely to be common knowledge.

The educational level of the respondents has not been systematically studied, but there seems to be a relation between respondents who work/have worked in trades requiring a higher level of education and 'straightforward' answers. Having a higher education means being familiar with how research is conducted, for instance, that the researcher benefits from being given information about the real routines rather than about the seemingly 'correct' ones. In addition, it may be easier to trust in the promised discretion if one is aware of research ethics. Different respondents thus have different expectations of our roles as interviewer and interviewee. Of the two study areas, the Gebers selection contains more respondents with professions requiring higher education.

All the interviews but two were conducted in the home of the respondent. In most cases, we were able to sit undisturbed, but on occasion there were disruptions in the form of small children needing attention, telephone calls and other household members being invited to answer or interrupting. In most cases, these disruptions have not had any negative effect on the interview; on the contrary, a dialogue between, for instance, husband and wife can improve the interview dynamics. Only in one case did the interview quality deteriorate due to such disruptions, caused by a child constantly calling for attention.

The two interviews conducted outside the home, at a café and at one respondent's workplace, were held there in order to fit them in with our respective time schedules. I conclude, however, that interviews in the home environment are preferable; partly because the interview involved routines taking place there, but also because it was easier to create a relaxed atmosphere. The interview at the café was successfully conducted, but a noisy coffee machine made it difficult to hear everything on the tape. The interview at the workplace also turned out satisfactorily, but the respondent seemed to be a bit stressed and worried about colleagues finding out what was going on during working hours.

The next two chapters show what have been learned about households' water and sanitation routines by using this combination of methods.



## CHAPTER 4

### Ringdansen –the case of a water-saving arrangement

*Caroline is on her way home after having attended one of the many resident meetings held in her housing area. She attends as many meetings as possible, and today the meeting was about the outdoor environment. However, while walking between the two rings of flats it is not the outdoor environment that occupies her thoughts. At the end of the meeting, a female researcher talked about her study of household water use and the impact of volumetric billing in Ringdansen. The researcher was in need of households willing to participate in her study, and she said that many previous attempts had been in vain. Caroline was not surprised at this information, since so few residents had bothered to attend residential meetings. Caroline immediately volunteered to join the study. It hit her on her stroll back home that she actually was quite eager to participate. Initially, she was one of the critics of the individual metering and billing per household since she thought the solidarity of sharing costs and helping each other out was good and worthwhile preserving. She expressed her thoughts at one of the resident meetings, but the housing company representative argued that: “Why should you, living in a single-person household, pay for households of ten or households using water in a wasteful way”. Such a fairness argument also appeals to Caroline, and she now believes that it is a good arrangement, more so because reduced water consumption is beneficial from an environmental point of view. The water fee has always been included in the rent, but she has overheard conversations among neighbours about water as if it was provided for free.*

Ringdansen is a residential area in Norrköping city, built in the late 1960s as part of a national housing programme to build a million homes (1964-1974). The area underwent a major refurbishment in the late 1990s and the beginning of the 2000s, when billing of cold and hot water, heating energy and electricity according to individual consumption was introduced. The purpose was to give the residents an economic incentive to use less of these environmentally significant resources.

This chapter investigates how seven selected households in Ringdansen have responded to volumetric billing of water. Empirical material is in the form of time-diaries, interviews, measured use and observations collected during two phases. The first collection of data was performed after respondents had been informed about the new arrangements, and the second when the new billing

arrangement was in use and respondents had received information on their usage for (at least) a few months and had settled their first account. The analysis and conclusions are presented in chapter 6.

This chapter begins with a short historic account about the housing area and its geographical and communal context. The area's arrangements for solid waste management, energy provision and water and sanitation management are described, and the individual metering and billing per household is given some attention. The chapter is dominated by the respondents' descriptions of their water-use routines.

## RINGDANSEN – RENTED FLATS IN THE SUBURB

Ringdansen is part of the housing area, Navestad, in the southern part of Norrköping (Figure 4.1). Navestad was built in 1969-1973 in an attempt to provide good housing (Ketola 2000). Housing conditions in Norrköping were considered to be among the worst in Swedish cities (HNAB 2004a), and earlier renovations and construction in the 1950s and 1960s had not changed this view (Ketola 2000). Ringdansen adjoins a nature reserve, Vrinneviskogen (Vrinnevi-forest) with recreational areas, jogging tracks, etc. Lake Ensjön is close by with weekend cottages and permanent private houses. Public transport to the city centre is good.<sup>48</sup>

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<sup>48</sup> Buses run from Ringdansen to Norrköping City every 10 minutes during weekdays. Also some regional buses, such as the bus to the neighbouring town of Söderköping, stops at Ringdansen. The motorway E22, going in a north-south direction, is also easily accessible from Ringdansen.



**Figure 4.1 Ringdansen geographical location**



*Ringdansen (marked in a red checked pattern) in the lower right corner is situated southeast of central Norrköping. (Source: Norrköping municipality, GIS-office).*

Navestad was built on municipal land some four kilometres away from the city centre by the public housing company Hyresbostäder i Norrköping AB (HNAB) (HNAB 2004a). Ringdansen consisted of two large blocks of rental flats forming two circles, Guldringen (The Gold Ring) and Silverringen (The Silver Ring), with in all 1,754 flats. 70% of the flats had three rooms and the rest had one or two rooms<sup>49</sup>.

Between the two pairs of residential rings there are commercial and communal services such as a shopping centre with a supermarket, a bakery, a hairdresser, a library, a restaurant and a swimming hall. An information centre

<sup>49</sup> In addition to the flats in Ringdansen, an area with one-storey buildings called the Atrium houses was built. The Atrium houses contained 630 flats, most with four rooms, and were thought to satisfy the need for larger living space (Ketola 2000; Lövgren 2002).

and the housing company's local office are also situated here. There are also health care services with a district nurse and a child health centre. There are two schools with pupils up to the 9<sup>th</sup> grade and music classes. There is also a youth recreation centre (HNAB 2004c).

Navestad was completed at a time when large industries in Norrköping were closing down<sup>50</sup>. Unemployment was increasing, fewer young people were moving to the city, and tax revenues were decreasing. The central government supported the socially difficult switch from an industrial to a service economy by relocating government agencies to Norrköping (Lövgren 2002). However, industrial workers and employees in government agencies differed in residential preferences and economic status. Public servants and their families were not expected to be content with flats in high-rise buildings, but were offered ground-level housing. In the later part of the national housing programme, the government also steered a larger share of the governmental loans to the construction of private houses. The housing shortage in Norrköping turned into a surplus in the early 1970s, and the number of people intended to inhabit Navestad dwindled even before the area was completed (Kvarnström et al. 2000). Apart from a short period in 1989, Ringdansen has never been fully occupied (HNAB 2004a).

Early on, Navestad was regarded as a housing area with problems, synonymous with low-income earners, unemployment, single mothers, families with many children and many immigrants (Kvarnström et al. 2000). Lövgren describes Navestad's problem as (translated from Swedish):

*"Navestad has regularly been stigmatised; the area has been "a matter out of place", i.e. the area has been "too large" for Norrköping, but it has also been "a matter out of time", i.e. Navestad was built at the wrong time and, as a result, has been stigmatised."* (Lövgren 2002:97)

The many vacant flats in combination with the social responsibility of the public housing company resulted in Navestad becoming the housing reserve and regulator for the city. Families with social and/or economic problems were provided with flats here. About 40% of the residents were of foreign descent (1977) compared to an average of 6% in the municipality as a whole. Furthermore, the residential area was densely populated and dominated by concrete and asphalt, which contributed to a negative reputation. Few elderly people lived in Ringdansen, and resident turnover was exceptionally high – about 40% per year in the early 1970s (Ketola 2000; HNAB 2004a).

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<sup>50</sup> In the period 1961 to 1975, some 22,000 new flats were built and almost 7,000 were demolished, so some 15,000 new dwellings were added in a town with some 100,000 inhabitants (HNAB 2004a).

## Physical and social change 1976–2003

Already in 1976, some measures were taken to make Navestad a more attractive residential area and ever since, various projects with the same purpose have succeeded each other (Ketola 2000; Lövgren 2002)<sup>51</sup>. In 1976, *The Navestad project* with governmental support aimed at improving the physical and social environment was begun. The composition of flat sizes, presented in Table 4.1, was thought to contribute to the area's age structure with many children and youths and few elderly people. To meet the demand for larger living space for families with children and to attract smaller households and elderly people, about 300 3-room flats were transformed into 2 and 4-room flats. Also, 2 and 3-room flats were merged into 5-room flats, and the number of flats decreased from 1,754 to about 1,650 (Ketola 2000; HNAB 2004a).

**Table 4.1 Flat sizes in Ringdansen in 1972–2003 in per cent of total number**

Flat size	1972	1998	2003
Total number of flats	1,754	1,599	Ca 900
1 room and a kitchenette	<1%	<1%	<1%
1 room and a kitchen	4%	4%	4%
2 room and a kitchenette	6%	6%	6%
2 room and a kitchen	23%	29%	30%
3 room and a kitchen	67%	48%	41%
4 room and a kitchen	-	11%	11%
5 room and a kitchen	-	2%	2%
6 room and a kitchen	-	-	<1%
Senior housing	-	-	5%

*Source: Hyresbostäder (HNAB 2004a; HNAB 2004b)*

In 1989, Ringdansen was fully occupied for the first time as a result of the economic boom and more people moving to Norrköping (Ketola 2000; HNAB 2004a). The housing company believes that the measures to improve the social environment may have contributed to the decrease in vacancies, but also that it is evident that Ringdansen is the housing regulator; the last choice when people are looking for a place to live in Norrköping (HNAB 2004a).

Sweden went through a recession in the first part of the 1990s and the central government as well as Norrköping municipality faced economic difficulties.

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<sup>51</sup> Whether Ringdansen is a less attractive area or not is, of course, contested, not least by the residents themselves (see, for instance, Sallander 1999; Lövgren 2002). Nevertheless, it is evidently so that the negative picture is the reason for the many 'improvement' projects, and I have chosen to give an account of the process as such without evaluating whether it was necessary.

In the early 1990s, the number of empty flats increased again from 130 in January, 1992, to 249 a year later, partly caused by increased unemployment as a result of the recession (HNAB 2004a). In 1992, rents in Navestad went up, first by 10.7% and later by another 6%, and an agreement between HNAB and the tenants' association to have no more rent increases until 31<sup>st</sup> of December 1996 followed. Some earlier initiatives, such as the area newspaper and the council for the associations in Navestad, ceased to exist (Ketola 2000). Also, the housing welfare officer was withdrawn in 1990 (HNAB 2004a).

In 1993, 71 flats in Ringdansen were set aside for refugees from the war in the former republic of Yugoslavia. The housing company had to strike a balance between humanitarian aspects and bringing in more revenue while running the risk of adding to the impression of Navestad as a problematic area. Long-term residents in Navestad began to move out, and in January, 1994, there were 483 vacant flats in Ringdansen (Kvarnström et al. 2000; HNAB 2004a)<sup>52</sup>.

The neighbourhood council for southern Norrköping initiated a new development project in Navestad, *New Navestad*, in 1994. The ambition was to create a more varied Navestad with an attractive indoor and outdoor environment, more workplaces, support for culture and non-profit organisations and opportunities for alternative terms of occupancy (Ketola 2000).

The aim was to involve a broad spectrum of actors, including the residents. It was thought that by involving the residents in various activities, isolation and dependency on social welfare would decrease and contacts between neighbours would improve. The inhabitants would be encouraged to be active and committed (Lövgren 2002). The idea was to work with small projects as part of a larger long-term programme. Meetings were arranged for small sections of the rings (three in each ring) and residents were invited to meetings by means of a door-to-door approach (Ketola 2000).

As early as in 1995, there were discussions about the need to do something about the dwellings. The project plan for New Navestad was outlined in an application for government LIP funding<sup>53</sup> (Ketola 2000). The application was inspired by the small-scale ecological refurbishment of a 3-storey building in Hageby, called "Ekoporten", which was built during the same period as

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<sup>52</sup> The refugee administration ceased to exist in June, 1995 (HNAB 2004a).

<sup>53</sup> The government earmarked SEK 6.2 billion for local investment programmes (LIP) for the period 1998-2003. The aim was to support a rapid transition of Sweden to an ecologically sustainable society. A secondary aim was to support employment. Municipalities in cooperation with local companies and organisations were eligible to apply for grants for investments that increased ecological sustainability (Naturvårdsverket 2005).

Ringdansen (Kvarnström et al. 2000). The house was fitted with urine-diverting toilets and separation of faeces and flush water using the Aquatrone technique. The faeces are composted together with organic food waste and sawdust, and the urine is collected in tanks for later use on farmland. The grey water is treated locally in a three-chamber septic tank followed by root-zone treatment. Storm water is also locally treated (Haglund et al. 1999).

Inspired by Ekoporten, the initial plan foresaw large investments in ecological solutions and a radical change in the rings, e.g. the buildings would be lowered, the number of flats reduced, urine-diverting toilets and food-waste grinders installed and storm water would be handled locally. The application finally submitted, however, was scaled down (Storbjörk and Söderberg 2003). The Building Research Council (BFR) advised against urine-diverting toilets and the Department for Environment and Health (Miljö- och hälsoskyddskontoret) in Norrköping opposed grinders for organic kitchen waste, because of the large number of households involved, uncertainty about the know-how involved, and whether the urine could be taken care of (Storbjörk and Söderberg 2003). Consequently, these technical arrangements were never included in the LIP application to the central government. In March, 1998, the municipality of Norrköping was granted SEK 260 million from the LIP fund to support a project estimated to cost SEK 635 million (Ketola 2000)<sup>54</sup>.

### *The Ringdansen project, 1998*

The project plan contained four basic components; social development, ecological adaptation of the buildings and living environment, renewal of architecture and city planning and reuse of building material for international cooperation (Projektbeskrivning 1998). Social development should result in reduced ill-health, unemployment and anonymity (Lövgren 2002). The building should not only be a place for rest (“sleeping areas”) but also a place for activity. Involving the residents in the changes made to the area was as important as the environmental aspects (Kvarnström et al. 2000).

Lövgren (Lövgren 2002) writes that housing politics with “green” ambitions – the creation of the green Swedish welfare state<sup>55</sup> mediated through projects such as the Ringdansen project are based on a certain attitude of the persons governed. However, Lövgren concludes that the social problems that Navestad and many other similar areas have are probably difficult to build away. The modification of Ringdansen emerged from the New Navestad

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<sup>54</sup> The final project cost is estimated at almost SEK 1.1 billion (HNAB 2004b)(2004-03-26).

<sup>55</sup> In Swedish: det gröna folkhemmet.

project, but soon the Ringdansen project was treated as a separate (more top-down) project, with no genuine resident involvement (Ketola 2000). The small working groups from the New Navestad project were disbanded in 1998 and, instead, information meetings were held with the residents. Ketola maintains that resident *involvement* seemed to be synonymous with resident *information* for the project management. The LIP application had to be quite detailed, and the politicians responsible and representatives from the housing company did not want to involve the residents before the application had paid dividends. According to the project management, there was nothing to inform about as long as issues concerning economy, cooperation partners and the content of the ecological profile were not settled. Rather, information would only risk causing disappointment (Ketola 2000). Consequently, experts outlined the ecological solutions in the LIP application (ibid.), and residents had no say in the selection of large system solutions.

### Ringdansen arrangements

The number of flats was reduced from 1,599 to about 900 in 2003, as shown in Table 4.1 (HNAB 2004b)<sup>56</sup>. The relative proportion of flat sizes had mostly been altered during previous refurbishments. The reduction in the number of flats was achieved partly by demolishing parts of the buildings, and partly by converting one building into a school and some buildings into offices. The reduction in the number of flats was in line with the idea of keeping the ring shape, while opening up the previously closed rings by removing segments. The idea was also to lower the rings by demolishing some floors so that no building had more than five floors. The exterior of the buildings, consisting of grey concrete slabs, were replaced by plastered walls in different colours and the balconies were enlarged (HNAB 2004b)(int. architect).

#### *Arrangements for solid waste, energy and water and sanitation*

The objective of the refurbishment was to make Ringdansen environmentally and socially sustainable. The application for government funds included ecological solutions for solid waste collection, energy production and use, and water management. What finally came out of these ambitions is described below, with special emphasis on water and sanitation.

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<sup>56</sup> Some of the building material removed was reused for student houses in the neighbouring town of Linköping.

*Solid waste system:* The household waste is sorted into 11 fractions<sup>57</sup> at 'environmental stations', and each household is assigned to a certain station. Every flat is equipped with three receptacles for sorting under the kitchen sink; one for organic waste and two for other fractions. Biodegradable bags for the organic waste are also handed out to the households (HNAB 2004b; Witt 2002). Grinders for organic waste were installed in the cellar under each environmental station, but due to poor sorting, metal and plastic were not separated, the grinders required too much service and were removed. Thus, the intention to use composted organic waste on flowerbeds in the area has so far not been put into practice. A contractor collects and transports the eleven fractions to the municipal stations for solid waste treatment (Gillberg, pers com).

*Energy system:* Of the SEK 260 million, SEK 30 million was earmarked for innovative energy solutions. The initial plan proposed geothermal heat to provide the area with a substantial proportion of the heating energy needed. The heat pumps would be driven by a local windmill, and the ambition was to purchase 70% less conventionally produced energy (from oil, coal and nuclear power). However, the communal energy company NME opposed this solution, since they had invested large sums in district heating. Also, the anticipated environmental gains in the LIP application were calculated on the basis of district heating being fuelled by coal, instead of a combination of coal and bio-fuel (Granehed 2001; Palm 2004)<sup>58</sup>. Today, the main heating source is from district heating, complemented with geothermal heating. Drilled holes are used for air conditioning in one of the schools and in two other buildings (HNAB 2004b). Due to the calculation error, the housing company did not receive the SEK 30 million subsidy for replacing district heating with other solutions. Instead, the municipality applied for, and was granted, SEK 30 million in subsidies to purchase modern district heating equipment (Palm 2004).

Energy for electricity and heating is bought from Sydkraft (a private company which has owned NME since 2001)<sup>59</sup>. A number of measures were taken to reduce energy use; improved insulation by adding material to the walls and triple-glazed windows, insulating doors and windows, replacing older white goods with new energy-saving ones, energy and water efficient washing machines in the communal laundry rooms, and offering energy-efficient

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<sup>57</sup> Organic waste, paper packaging, cardboard, coloured glass, transparent glass, metal, newspapers, hard plastic, soft plastic, batteries and waste for combustion. Bulky waste can also be disposed of in the area.

<sup>58</sup> Because taxes were more favourable, NME stated that coal was used solely in electricity production, while district heating was generated with 100% bio-fuel. However, these two processes cannot be separated for which reason, in practice, coal is used also for district heating. For a comprehensive account of the energy debate, see Palm (Palm 2004).

<sup>59</sup> The electricity bought is "green" (Engdahl, pers com).

domestic appliances (HNAB 2004b). Meters for hot and cold water, electricity and heating energy also were installed in each flat to enable individual billing of these services, which in turn would motivate households to save energy.

*Water and sanitation:* Of the granted SEK 260 million from the LIP fund for the ecological solutions, a substantial part, SEK 50 million or about SEK 55,000 per flat, was earmarked for water and sanitation (Storbjörk and Söderberg 2003).

One question was how to manage and use the storm water, and HNAB appointed a consultant firm to explore different kinds of storm water solutions and use. The consultants investigated the possibility of using storm water for laundry machines, car washing, for flushing hard surfaces and toilets, for irrigation, and for aesthetic use in ponds. Furthermore, they also looked into to what extent storm water could be redirected from hard surfaces to green areas, as well as infiltration by reducing the hard surface areas. The consultants presented a number of reservations; water from roofs was not suitable for washing machines due to possible contamination from the roof material and irregular supply, and ponds did not meet strict water quality requirements. WC-flushing was also considered less suitable due to the large amounts of water needed and extensive installation work. Despite the many options, the final result ended up in the well-known treatment method of infiltrating the storm water (Storbjörk and Söderberg 2003). However, an artesian well is used for car washing. This water is collected in a tank and, when empty, the supply consists of potable water. Since there is no quality control of this water, there is a sign saying that the water should not be used for drinking purposes (Gillberg, pers com).

The factual description of what made the installations for storm water less comprehensive than originally planned has been studied by Storbjörk and Söderberg (Storbjörk and Söderberg 2003). The project organisation for Ringdansen was homogeneous and consisted of representatives from the housing company, with a more or less common view of the order of things. They thought it was too uncertain to select relatively untried technologies, and they did not want to make it more difficult than it needed to be. There was no powerful actor, no enthusiast in the project management or leading politician or professional in the municipality, who tried to push new solutions through. Hence, suggestions put forward by various consultants were studied and the project management tried to make them simpler and cheaper. The large size of the project, involving existing buildings, contributed to the ambition to look for tried and cheap solutions. Even though they received funding for local treatment of storm water, the final solution was still strongly limited by financial considerations. The balance between the environmentally best option and economy was constantly present. It also became obvious that storm water



had a lower priority than other water and sanitation measures, such as the refurbishment of bathrooms, installation of low-flush water closets, and new sewers and water pipes.

Water-saving measures played a central part in the project; introduction of volumetric billing, installation of low-flush toilets and new mixers, and providing water and energy-efficient dishwashers and washing machines (Projektbeskrivning 1998). Previously, bathrooms had a water closet, bidet, bathtub, washbasin, a laundry bench with a sink and a drying cabinet. Many flats also had, and still have, a separate lavatory with a washbasin (HNAB 2004b).

The flats were fitted with most of the installations. Dual-flush toilets (6 and 3-litre flush) were installed<sup>60</sup>, and new taps with a thermostat blender for combined use with the washbasin/bathtub and shower. The bidet was removed together with the sink and the drying cabinet. Individual meters to measure energy and water use were installed. No changes were made in the kitchen, except for a water-saving tap with a one-grip mixer.

**Figure 4.2 Bathroom arrangements**



*The two first pictures (from the left) illustrate the combined thermostat and mixer in overview and close-up. Water is turned on with the left control, while the temperature is adjusted with the right one. The water mode (washbasin/bathtub or shower) is set with the button in the middle. The picture on the right shows the two options for toilet flushing, full and half flush.*

It is still possible for the household to install a washing machine and/or a dishwasher since the necessary piping is already in place. Such machines are not part of the standard equipment, but are optional and are paid for via a higher rent for a specified period or privately bought and installed.

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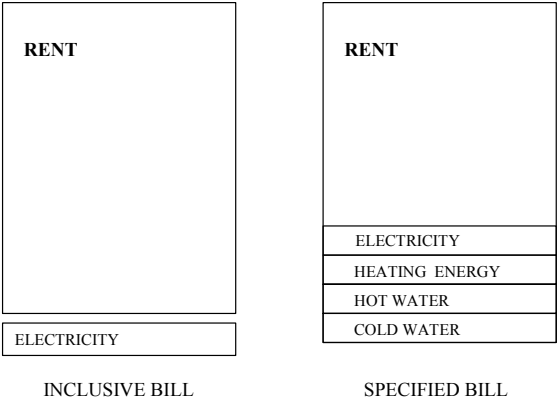
<sup>60</sup> Some toilets, which were fairly new and in good shape, were saved even though they lacked a low-flush option.

Residents using the communal laundry room have access to computerised washing machines, which automatically weigh the laundry and add water accordingly as well as the right amount of detergent. The detergent is of a kind recommended by the Swedish Asthma and Allergy Association<sup>61</sup>. Each wash costs SEK 4 (2003) and is added to the rent invoice as a separate item.

*Volumetric billing of hot and cold water, heating energy and electricity*

Electricity use in flats has always been metered and billed individually, while the cost of heating energy and water normally is included, and hidden, in the monthly rent. Each flat in Ringdansen is equipped with a meter for volumetric billing of hot and cold water, heating energy and electricity. The housing company markets the arrangement as fairer; *you* only pay for what *you* use. If successful, residents will save money and Nature will be saved from overexploitation. Figure 4.3 illustrates the difference between the two kinds of bills in Ringdansen before and after the refurbishment.

**Figure 4.3 Inclusive and specified billing**



The rent was increased SEK 55/m<sup>2</sup>/year following the renovation. However, at the same time the rent was reduced SEK 108/m<sup>2</sup>/year when heating energy and water were billed individually. This means that the residents can influence a sizable part of their cost of living by sensible use of energy and water (Olsson 2002).

Some energy and water is saved by built-in arrangements, such as Low-E glass windows, water-saving taps, and low-flush toilets. In addition, residents can actively choose their preferred indoor temperature in the range 18-24° C. Household members themselves can decide the temperature by adjusting a

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<sup>61</sup> The machine is estimated to use about 40 litres/wash (Engdahl, pers com).

control device placed in the hallway. The control device also has an OFF button, which, if pushed, turns the heating down to a minimum (18° C). Ideally, the OFF button is used when going to work in the morning or during lengthy trips away from home.

The tenant can also compare his actual usage each month with any previous month. A computer keeps a record of the household's usage each month (information provided by the meter), which is processed and coordinated with the housing company's property data system. Thereafter, the housing company transfers the information to the post office, which prints the use information on the rent invoice (Bergman 2004). The household pays an estimated amount each month and, at the end of the year or when moving out, the correct amount is regulated. An example of the utility invoice provided with the rent invoice is illustrated below (in Swedish; for an English translation, see appendix 6).

Figure 4.4 Utility invoice (sample)

**HYRESBOSTÄDER**  
Box 2302, 802 02 Norrköping

För ytterligare uppgifter kontakta:  
Förädlare/beräkningar: Guldbringan  
Guldbringan 48  
831-23 14 79

**Debiteringsunderlag**  
Individskild debitering av el, värme, fast- och varmvatten

Konto: 2825  
Anslutningspunkt: 1502-8829  
Mätare:  
Anders  
Allerhögsvägen  
43353 Mölndal SF 190

1. Debiteringsobjekt  
Adress: 52875 Guldbringan 94  
Startmånad: 2002-05  
Värme/beräkning: 82,8  
Debiteringsmånad: 2002-08

2. Preliminär månadsdebitering för augusti 2002 enligt hyresavtal.  
Den preliminära debiteringen baseras på beräknad normal förbrukning.

	Beräknad förbrukning	Totalt	Årsdebitering i kr	Pris per månad
EL	2640 kWh x 0,75 kr/kWh	1980	1980	154
VÄRMVATTEN	32,76 m <sup>3</sup> x 39,58 kr/m <sup>3</sup>	1294	1294	104
KÄLLVATTEN	81,96 m <sup>3</sup> x 37,08 kr/m <sup>3</sup>	3058	3058	247
VÄRME förbrukning	7646 kWh x 8,58 kr/kWh	6558	6558	525
avgift VÄRME tillgång	-1116 kWh x 8,58 kr/kWh	-958	-958	-77
<b>Totalt preliminär årsdebitering: 3786 eller per månad: 315</b>				

3. Verklig förbrukning under juni 2002 - avräknat mot prof. tillägg på hyresavtal.  
Den verkliga förbrukningen baseras på skiftetillräkade avläsningar av El-mätare vid följande månadsskifte.

	Månad	Totalt	Verklig kostnad	Preliminär	Er tilläggs
EL	1888 kWh x 0,75 kr/kWh	1416	-1564	Er tilläggs	13
VÄRMVATTEN	4,28 m <sup>3</sup> x 39,58 kr/m <sup>3</sup>	169	-108	Er tilläggs	58
KÄLLVATTEN	7,09 m <sup>3</sup> x 37,08 kr/m <sup>3</sup>	263	-316	Er tilläggs	3
VÄRME förbrukning	8 kWh x 8,58 kr/kWh	69	0	Er tilläggs	254
avgift VÄRME tillgång	0 kWh x 8,58 kr/kWh	0	-254	Er tilläggs	

4. Verklig kostnad tillräk (från startmånaden)  
När var 90 vad som höst sedan debiteringen startade och fram till och med senaste månadsskifte.

	Månad	Kostnad	Pris Årsdebitering		
EL	675 kWh	506	-562	Er tilläggs	22
VÄRMVATTEN	27,98 m <sup>3</sup>	1107	-124	Er tilläggs	283
KÄLLVATTEN	23,18 m <sup>3</sup>	865	-368	Er tilläggs	45
VÄRME förbrukning	353 kWh	303	-293	Er tilläggs	853
avgift VÄRME tillgång	-53 kWh	-45	-293	Er tilläggs	

5. Viktigt beträffande debiteringen av värme  
Förbrukningen av värme varierar med årstiden, medlen angivna är avseende tidigare per månad. Skulle det vid beräkning, detta gör att kostnad i månad beräknas. Verklig debitering och preliminär i mån av att utvärderas enligt avräkning eller för att kunna jämföras med avräkning. När debiteringsperioden är till ändra, eller då du flyttar, har du beaktat för vad du verkligt förbrukat i tilläggs.

**Totalt resultat sedan startmånad** **Er tilläggs 202**

In 2, the preliminary annual use in quantity, price/unit, and annual cost is listed to the left, and the debited price per month is shown to the right (same every month). In 3, the amount used the previous month is shown, and the actual cost is calculated by multiplying the volume by the cost per unit. The actual cost compared to the debited cost results in a credit/debt amount for this month in the far right column. In 4, the total actual use during the year, and a comparison between debited and actual cost, provide accumulated debit/credit in the right column. The sum of all four items— the debit/credit to date — is shown in the right lower corner. (Source: Hyresbostäder).

Before any actual reference values for use were available, the housing company introduced a norm according to flat size. The norm for cold water was 1 m<sup>3</sup>/m<sup>2</sup>/year, and for hot water 0.4 m<sup>3</sup>/m<sup>2</sup>/year<sup>62</sup>. This rough estimate has little to do with the amount of water used since the number of household members, time spent at home and individual behaviour influence the actual use. The norm suggests that 29% is hot water and 71% cold water. Compared to the Swedish average of 35% hot water and 65% cold water, the Ringdansen norm for hot water use is low<sup>63</sup>.

The residents can only buy the utility services from the housing company, which, in turn, has a contract with the supplier (Sydkraft). New tariffs are agreed upon every year. The unit costs for the various utility services in 2002-2004 are given in Table 4.2.

**Table 4.2 Unit price of hot and cold water, heating energy and electricity, 2002-2004**

	2002	2003	2004
Heating energy	0.50 SEK/kWh	0.52 SEK/kWh	0.53 SEK/kWh
Electricity	0.75 SEK/kWh	0.80 SEK/kWh	0.92 SEK/kWh
Cold water	17.00 SEK/m <sup>3</sup>	17.15 SEK/m <sup>3</sup>	18 SEK/m <sup>3</sup>
Hot water	39.50 SEK/m <sup>3</sup>	40.50 SEK/m <sup>3</sup>	43.40 SEK/m <sup>3</sup>

*Source: Hyresbostäder*

### *Debate and information*

The first accounts were settled at the end of 2002 for about 300 households. Some turbulence occurred since many residents were charged for large debts. About one household out of four had a debt exceeding SEK 1,000, and one out of ten over SEK 3,000 (Hjerpe, pers com; Hjerpe 2005). Hjerpe's study shows that the main cause behind the large debts was households exceeding the norm for hot water. The total debt, however, was in most cases offset by lower heating energy use than the norm (Hjerpe, pers com; Hjerpe 2005). The households have had problems keeping their hot water use to the norm level, while they have succeeded in keeping their heating at or below the norm.

The municipal welfare authority foresaw requests for support and had decided not to provide extra funds to cover any debts incurred. If a household on social welfare exceeds the norm for its use, it is not granted additional

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<sup>62</sup> The norms are based on statistics on usage (1993-2000) taken from Hyresbostäder's entire housing stock (Bokström, pers com). Variables such as family size, age structure and type of area have not been considered.

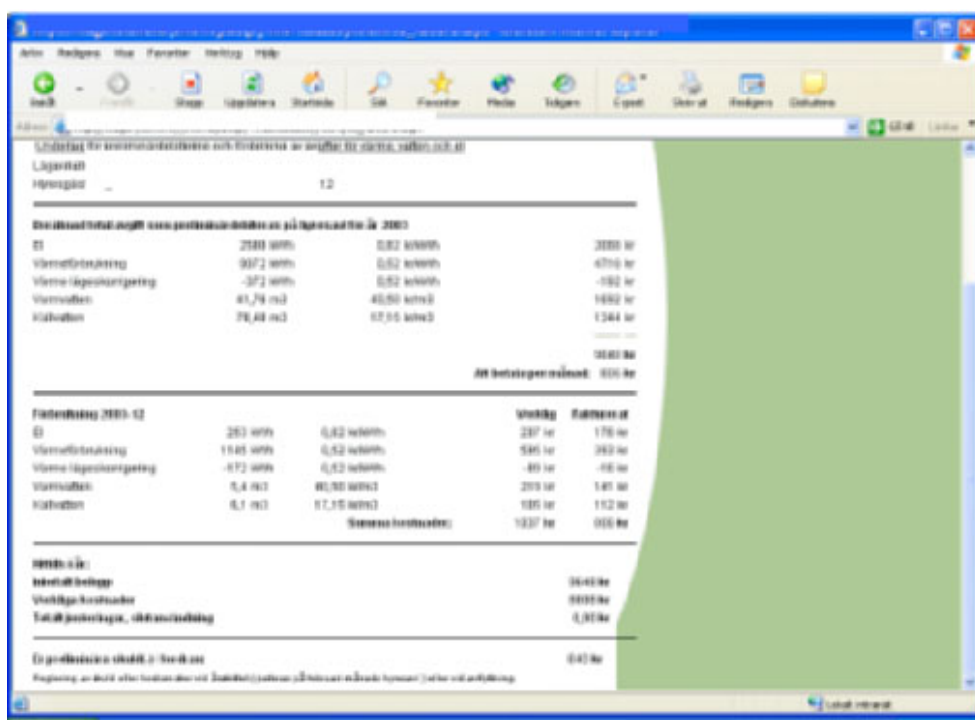
<sup>63</sup> Most likely, this is due to a miscalculation; that the norm was to be set at 40/60 (0.4 of 1 is 40% but 0.4 of 1.4 is only about 29%).

support, but the housing company works out a payment plan for them. On the other hand, if they manage to save they are allowed to keep the surplus as an incentive to save (Gillberg, pers com).

The housing company has been criticised for how it has handled the information given to residents about the new billing arrangement. Representatives of the housing company maintain, however, that every household has been informed and interpreters have been used at meetings. All households have also signed a special contract for individual metering and billing per household (in Swedish), and they are informed of debt and credit on the monthly bill. Nevertheless, some residents of foreign descent are critical, and maintain that they have not understood the billing system and that it is especially difficult for older illiterate immigrants. All written information is in Swedish. They believe that the usage norm should be related to family size. Some tenants say that they are considering moving from Ringdansen because of this billing arrangement (Josefsson 2003).

The households can also view their own usage on the Internet (all households are equipped with broadband, 10 Mbit). Figure 4.5 shows how the information is presented. This information, however, must be actively searched for.

Figure 4.5 Information on usage as displayed on the Internet



The Internet information on use is in principle the same as that provided on the rent invoice. The estimated use per year is shown at the top, both in volume and cost. Thereafter, usage during a specific month is shown, together with a calculation of the debited compared with the real cost. The last figure shows total debt/credit so far. (Source: Hysesbostäder).

Information about use is accessible and what is lacking is information about *how* to save water. No such information is available on the Ringdansen website, at least not on the public pages, but has been published twice in the HNAB's web paper *Hemsidan* (for all residents and is also available for the general public), once in 2002 and once in 2003. *Hemsidan* also exists in a printed version sent to every HNAB resident. Here, showers are recommended instead of baths, as well as spending a shorter time in the shower. Buying a washing-up bowl for the dishes is recommended, instead of rinsing dishes under running hot water. Residents are also encouraged to notify their janitor if they have a leaking toilet or tap (Witt 2002b; Witt 2003)<sup>64</sup>.

<sup>64</sup> According to HNAB policy, they do not cover for economic losses due to leaking taps or toilets – even though it is their own property that is out of order. They claim that it is the

## WATER USE IN THE PARTICIPATING HOUSEHOLDS

In this section, the data from metered water, time-diaries, observations and interviews are combined to describe water use in each household, and to relate routines to the amount used. This study focuses on individual households, and eleven respondents in seven households contributed valuable insights. The households are presented in Table 4.3 with the respondents in black text and the non-participating household members in greyish text.

**Table 4.3 Participating households in Ringdansen**

Phase 1 & 2				
<i>Household A</i>	Male 30+ (AM)		Child	Child
<i>Household B</i>		Female 65+ (BF)		
<i>Household C</i>		Female 65+ (CF)		
<i>Household D</i>	Male 55+ (DM)	Female 55+ (DF)		
<i>Household E</i>	Male 40+	Female 40+ (EF)	Child	
<i>Household F</i>	Male 40+	Female 40+ (FF)	Child	Child
<i>Household G</i>	Male 50+ (GM)	Female 50+ (GF)	Child (GCM)	Child (GCF)

The study is longitudinal and has been conducted in two phases. The first phase took place before the volumetric billing was in effect and households had no information about their water usage. The second phase was conducted 5-17 months after the introduction of volumetric billing, and when the first account had been settled. The effect of volumetric billing on household water use and on water-related routines is described.

The methodological procedure described in chapter 3 has been followed when collecting data from each participating household, but the quality and quantity of the accessed information vary. In four cases, households (D-G), the water meter connection to the database failed during the time-diary days, but for household D-F, indicative values were obtained by using metering values for corresponding weekdays the week following the time-diary week. In the case of household G, this was not possible, since Hyresbostäder decided to reset all the meters directly after the time-diary period, and this meter was out of order the following week.<sup>65</sup>

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resident's responsibility to instantly report such faults, and thus the resident must take responsibility for any financial loss (Gillberg, pers com).

<sup>65</sup> Hyresbostäder was having problems with extreme values. Some of the extreme values were believed to have been caused by this study, since the meters had been manipulated to

Table 4.4 summarises the information available for each household. X marks information collected in accordance with the study design, and O marks information that deviates in content and/or from study design.

**Table 4.4 Household information**

	Time-diary	Metered values		Interview	
		Time-diary period	Total period	1	2
Household A	X	X	X	X	X
Household B	X	X	X	X	X
Household C	X	X	X	X	X
Household D		O	X		
-David	X			X	X
-Doris	X			X	X
Household E		O	X		
-Elisabeth	O			X	X
Household F		O	X		
-Frida	X			X	X
Household G		–	X		
-George	X			X	X
-Gunnel	X			X	X
-Gustav	X			X	O
-Gisela	O			X	O

The information is complete for the single-person households A-C. The two time-diaries marked with an O deviate as follows: In household E, Elisabeth shared the writing task with her teenage daughter and in household G, the young daughter's time-diary is incomplete in that it does not cover all the water activities over the total period. The interviews marked with an O were conducted over the telephone and are of shorter duration.

Below, the households are presented one by one. Firstly, the household is presented, its members and what they do; e.g. age, sex, occupation, and spare-time activities. In order to ensure their anonymity, all names are invented, ages are approximations, workplaces and occupations vaguely described and distinguishing features are not revealed. Also, the householders' attitudes towards volumetric billing, their estimation of their own use, and the flat's water and sanitation equipment are accounted for. Data on water use for phase 1 and 2 are presented.

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report water use in tens of litres instead of the normal 100. The more detailed value means that 19.1 m<sup>3</sup> appears as 191.0 m<sup>3</sup> in the database.



## Household A

Adam, a single man in his 30s, lives in a flat with three rooms. His three children occasionally stay with him. Adam did not reside in Ringdansen before the refurbishment, but moved there in 2002 since he could get a flat quickly and have access to broadband. Being a 'Norrköping southerner' as a child, he liked the area despite its bad reputation. He also thought that it might become a desirable place to live in thanks to the activities of the Ringdansen project. Adam spends a lot of time at home, since he is on sick leave. Adam claims that he is interested in environmental issues, and he once attended a course on the subject. He is also keen on outdoor activities and dreams about a life in the countryside. He has not attended any of the resident meetings arranged in the area.

Adam was aware of the volumetric billing when he moved to Ringdansen, and he is in favour of it. He believes it is fair, since he does not have to pay for his neighbours' excessive use. He also believes it increases awareness among residents; when water is included in the rent it is possible to overuse – which people also do.

As regards his own use, he claims to have cut down somewhat on baths since moving to Ringdansen, from once every day to about once every second day. Furthermore, he usually turns off the tap nowadays when brushing his teeth, which he did not always do before. He also used to use more water when shaving. This, in combination with having a dishwasher and water-saving taps, he believes, make him use less water than ever. He has a washing machine in the flat, and he never uses the communal laundry room. The toilet has a low-flush option.

Adam's hot and cold water usage during the three time-diary days is presented in Table 4.5 together with the daily average for the same month.

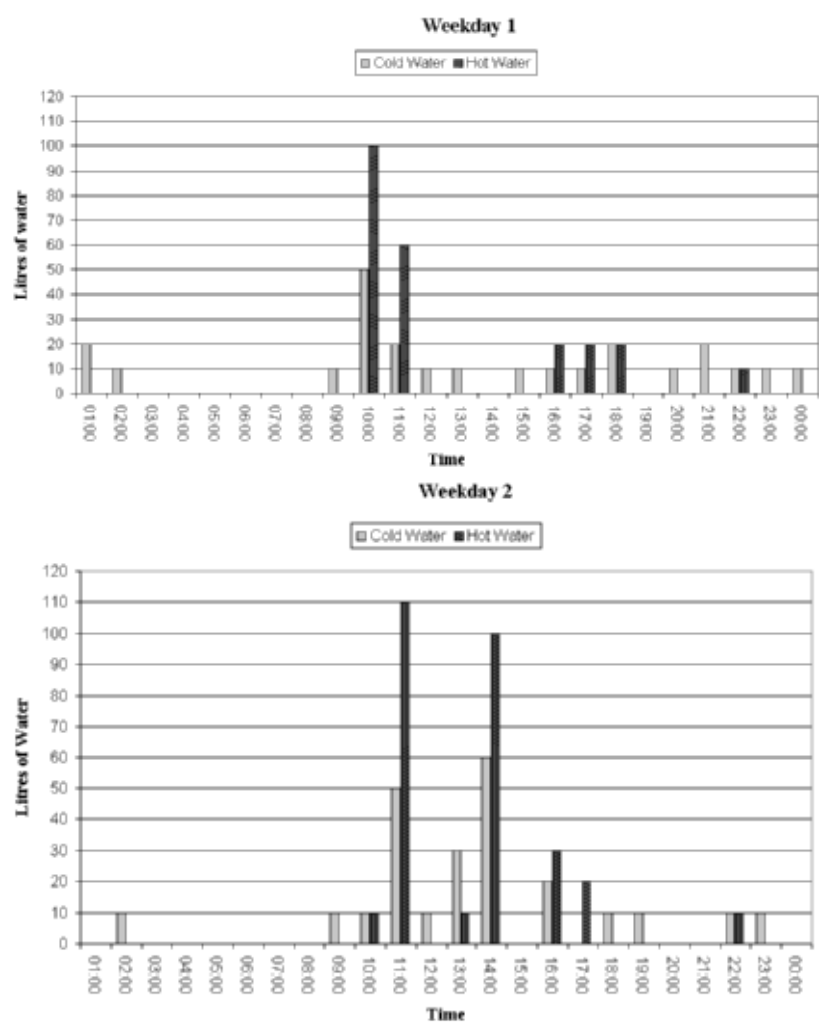
**Table 4.5 Water usage in household A (l/day)**

	Weekday 1	Weekday 2	Weekend day	June
Cold water	240 (51 %)	240 (45 %)	360 (60 %)	167 (58 %)
Hot water	230 (49 %)	290 (55 %)	240 (40 %)	120 (42 %)
Total	470	530	600	287
l/p/d	118	133	150	

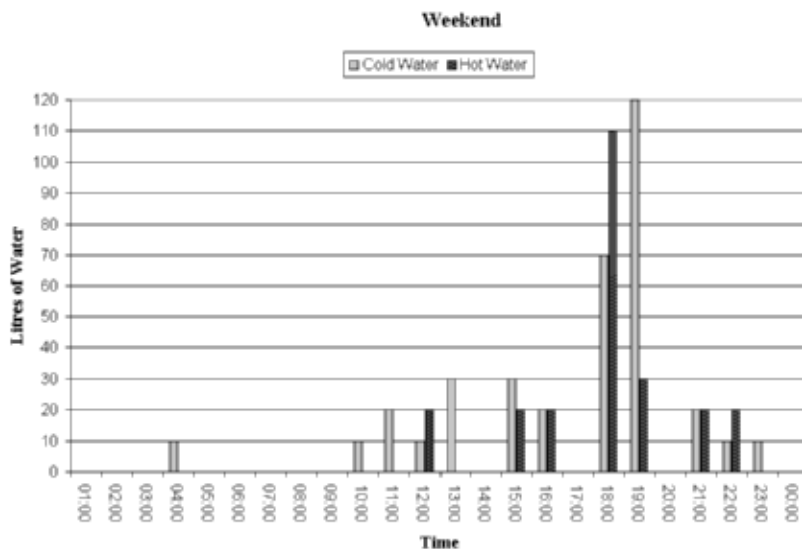
The table provokes a number of questions. Why is usage during the time-diary days so much higher than the average? How come that the proportion of hot

water almost equals cold water?<sup>66</sup> Why is cold-water usage higher during the weekend? Information from time-diaries and interviews will provide explanations and suggestions as to how to interpret the data. The diagrams in Figure 4.6 display the usage by the hour during the three time-diary days. The meter record indicates usage when more than 10 litres have been used.

Figure 4.6 Water usage by the hour in household A



<sup>66</sup> The share of hot water use is high, both in relation to the national average (35%) and the norm set in Ringdansen (29%) and also in view of the fact that this a summer month when hot water use tends to be lower.



The material is very detailed and the following excerpt from his first time-diary day (weekday 1) is a good illustration.

*Adam wakes up shortly after eight a clock in the morning, walks to the bathroom, urinates in the toilet, and flushes the urine away by using the low-flush button. He washes his hands with soap and lukewarm water. Then he makes the bed and tidies up for an hour. At about quarter past nine, he prepares a bath and sets the thermostat slightly over 38 °C and turns the water on. As long as he can remember, he has cherished taking a bath, and he does it at least every second day. Even when he started work early in the morning, he took a bath before going to work. Perhaps it is genetic, he ponders, since his father also used to take frequent baths. Of course, his old injury, which makes him so stiff, also contributes to the frequent baths.*

*It takes about 20 minutes to fill the bathtub from the water-saving tap, and Adam attends to other chores in the meantime. He moistens the kitchen rag and wipes off the kitchen table, rinses strawberries in cold water and rinses the coffee filter. He lets the water run for some seconds until it is cold, fills the coffee-machine and puts it on. He walks to the bathroom to turn the tap off. Now the bathtub is full, but before having a bath he will have breakfast with his children.*

*The children are soon finished and head off to other activities, and Adam remains at the kitchen table reading the newspaper. The bath is waiting, so he soon removes the dishes from the table and rinses the plates in lukewarm water. Before the bath, he urinates again and flushes the toilet. The bathtub was filled nearly an hour ago and the water has cooled off, and since Adam likes the bathwater to be fairly hot he soon adds additional hot water. Even when he takes a bath directly he usually adds more hot water after a while, since his body gets used to the heat and the bathwater feels cool.*

*He remains in the bath for about half an hour and leaves without taking a shower. He says that some people find it repulsive not to take a shower after the bath, but for him, bathing is both for comfort and cleaning. He moistens his toothbrush and brushes his teeth with the tap turned off.*

*Then he surfs on the Internet. Just before midday, he and two of the children take the car to pick up the third child at the nursery and they drive directly back home. Back home, Adam prepares some coffee for himself and fruit juice for the children. While waiting for the coffee to get ready, he urinates again. This time, he does not wash his hands since he did not think it was needed.*

*After drinking coffee he attends to some general chores, necessary with three children at home. If only the weather had been better, they would have spent more time outdoors, it being summer, but the rain just would not stop. The children also stayed indoors all day, two of them are too young to go out and play by themselves, and since Ringdansen is also new to them, the older child has no friends in the area yet.*

*Adam urinates again. While urinating he spits out his snuff into the toilet. He finds it convenient to put it there, since it is flushed away and does not smell. Normally, the snuff is disposed of like this, often in conjunction with using the toilet for other reasons. It is a routine behaviour.*

*The afternoon passes, and there is another toilet visit. Since they have not had a meal since breakfast, Adam starts to prepare dinner at about four o'clock. Before that, he clears the table and puts the dishes on the kitchen sink. He turns the one-grip mixer to get hot water and thereafter pushes it upwards to turn on the tap. The water runs at a full speed for a couple of minutes<sup>67</sup>. He takes one plate at a time and rinses it under the tap. He does not like leftovers on the plates so he is rather thorough. The rinsed dishes are piled on the other side of the sink, and as a final step in the process they are placed in the dishwasher. He prepares the coffee-machine as usual and puts on some coffee.*

*The family have dinner and afterwards the procedure of cleaning the table, rinsing dishes and filling the dishwasher is repeated. When he is by himself, he just has to use the dishwasher once or twice a week, but it has to be used daily when the children are at home. When everything in the kitchen has been taken care of, he sits down at the computer again for about half an hour. He is expecting guests, his brother and some friends are coming by, so he enters*

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<sup>67</sup> After the first interview, Adam and I conducted a simple test on how much water was used for different tasks. We turned on the water as much as Adam thinks is normal for different uses, such as when rinsing the dishes, peeling potatoes and shaving. With a litre measure and a stopwatch, we noted the time it took to fill up one litre. The test was done using the kitchen tap, but most likely the difference from the bathroom tap is negligible. The result for full speed (e.g. rinsing dishes) was 9 litres/minute, medium speed (e.g. peeling potatoes, shaving and brushing teeth) was 5 litres/minute.

*the toilet to urinate, flushes the toilet and walks out to the kitchen to prepare some coffee. While in the kitchen, he rinses some dishes in hot water.*

*His guests stay for a couple of hours and when they have left, Adam urinates and again he puts his snuff in the toilet before flushing. Then he starts making supper for the children and today it is pasta. He cleans a saucepan with some hot water and washing up liquid. Since he does not have many saucepans and they are too bulky for the dishwasher, he usually washes them by hand. The saucepan is filled with hot water from the tap, and put on the stove. He knows that there may be more foreign matter in hot water from the tap, but believes that it does not matter as it is boiled. He does not use hot tap water for fresh food such as potatoes or strawberries, but he cannot explain why he makes this distinction.*

*After dinner, he clears the table again and wipes it. Now it is bedtime for the children, and he helps them brush their teeth and get ready for the night. Depending on how they look, he sometimes helps them to wash, but not this time. After he has put the children to bed, he has dinner and when he has finished he rinses the plate in hot water. He spends the rest of the evening watching TV, only interrupted by some toilet visits. At 1.30 a.m. he prepares himself for the night by urinating, spitting out snuff and brushing his teeth.*

This story is told by using data from the time-diary and the interview, and explains the metering data for weekday 1. In this case, his individual time-diary explains most of the metered water usage, except the water used by his three children present during the time-diary days. Only two hot and cold water peaks could not be explained by his diary. In both cases, it was the children's baths (weekday 2, at 11.00 and 14.00), which were identified in the following interview. Apart from baths, the children's water use is too modest to cause water use to peak, e.g. toilet visits (3-6 litres), brushing teeth in the morning and evening, etc. Surely more water could have been used by them, but in actual fact this water is used for Adam's activities, when his children are visiting, involving food preparation, more frequent use of the dishwasher and washing machine, etc.

Adam says that he is a "bath maniac" and in three days he takes two baths (10.00 and 11.00 peaks on weekday 1, and 18.00 peak on the weekend day). About 100 litres of hot water and 50 litres of cold water are used per bath. Adam claims that his baths are both for comfort and for cleaning purposes. He does not take a shower during the three days and if there was no bathtub, he believes that he would have taken long showers instead. Shaving is often done under moderately running lukewarm water.

A considerable amount of hot water is used to rinse dishes, despite or perhaps because of having a dishwasher<sup>68</sup>. About this routine, he says:

*[...] I once had a girlfriend who wondered why I had a dishwasher, it was almost clean when I put it in [...]*

He finds food residue on the porcelain irritating and it complicates the dishwasher's cleaning process. The pre-rinsing also reduces the risk of the machine getting clogged. Nevertheless, he believes he saves water by having a dishwasher since manual washing would require having the water running continuously for up to 30 minutes. It is likely that the dishwasher is connected to the hot water tap and not to cold water, since only hot water is used the one time the dishwasher was on (17.00 on weekday 2).

Cold water is used to flush the WC, for preparing food, for the washing machine and for personal hygiene like brushing teeth. Cold water is mixed with hot water, for instance, for baths, to achieve comfortable temperature. Cold water peaks are noted for baths and when the washing machine is used. For reasons of convenience rather than for economic reasons, Adam never uses the communal laundry room. He says that that he does not have to be there at a special time, and he also believes clothes are stolen in the communal laundry room. He does not need a tumble drier. He estimates that he uses the washing machine three times a week, and during the three time-diary days, Adam used the washing machine once (18.00 and 19.00 on the weekend day). A bath taken at the same time made it difficult to estimate the water used by the washing machine, but subtracting the estimated amount of water used for the bath (100 litres of hot water, and 50 litres of cold water) from the metered 190 litres of cold water and 140 litres of hot water leaves us with about 40 litres of hot water and 140 litres of cold water for washing and other small tasks. After the bath, Adam shaves for ten minutes under running water (about 5 litres/minute) with lukewarm water – an estimated 50 litres of water is used. If 30 litres of the remaining hot water is used in this activity, 20 litres is cold water. Thus, the washing machine uses the remaining 120 litres of cold water. Considering other uncertainties, such as the children's whereabouts (also an 'unexplained' 10 litres hot water) and that two toilet visits also should be included, about 100 litres/wash would seem to be a reasonable estimate<sup>69</sup>.

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<sup>68</sup> The simple 'speed test' indicated that water runs at a speed of 9 l/min in this exercise. A reasonable assumption may be that this task takes a few minutes.

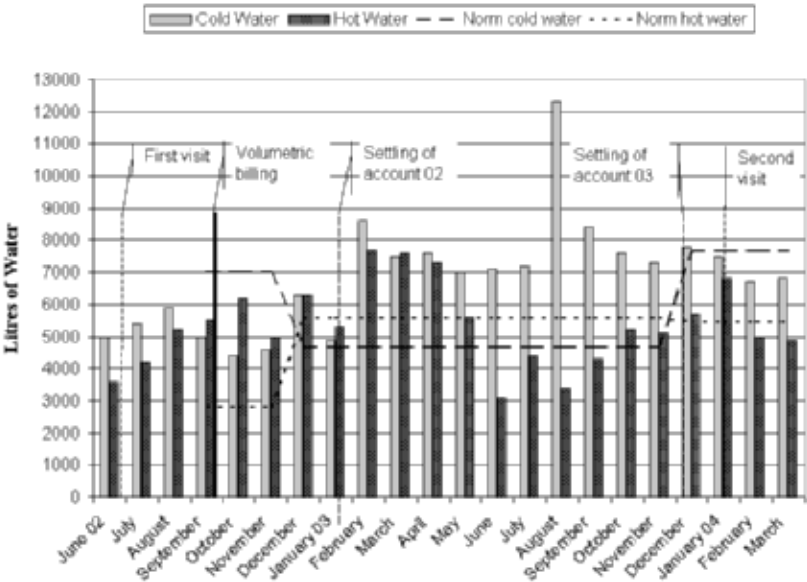
<sup>69</sup> A study of homepages of washing machine suppliers showed that most water-saving machines on the market use about 45 litres/wash. A visit to a store for white goods, however, showed that washing machines use anything from 45 litres/wash to 120 litres/wash. Råd & Rön, a magazine from the Swedish Consumer Agency, states that many suppliers are trying to reduce the washing machines' energy requirements (including water use) since the energy

What affects water usage the most is Adam’s frequent baths, all his laundry being done in the flat, his tendency to do many activities under running water – often including hot water, and the fact that he spends a lot of time at home. When comparing the time-diary days with the monthly average for the same month (June, 2002), the occasional presence of his children apparently impacts on water use. Also worth noting is that water use does not differ much between weekdays and weekend days, which is a result of Adam being on the sick list and spending most of his time at home. Also, the bad weather kept the household members indoors.

*Phase 2: Interview and metering*

One and a half years after our first encounter, Adam’s everyday life has not altered much. His sick leave has been replaced by unemployment so he still spends a lot of time at home. The presence of the children is irregular, just as before, and two of them attend the school in Ringdansen and can easily pop in. Adam now has a partner, although she does not live in the flat, but she spends enough time there to possibly influence water use.

**Figure 4.7 Monthly water usage in household A, June, 2002 – March, 2004**



declaration (A-G) has become an important sales argument. Medium-sized washing machines, which formerly used 90 litres of water/wash, now use about 50 litres/wash (Arndt 2003).

What is remarkable in Figure 4.7 is the sudden increase in cold water use from February, 2003 onwards and a reduction in hot water use. During the four months before volumetric billing, Adam used on average 4,800 litres of cold water and 4,400 litres of hot water. The same four months, the year after, with volumetric billing, Adam used on average 8,750 litres of cold water and 3,800 litres of hot water, the relation being 70-30.<sup>70</sup>

Part of the explanation may be ‘structural’; i.e. one additional individual spending time in the flat. Albeit not living there permanently, she spends time there and uses the toilet, showers, produces dirty tableware (requiring more frequent use of the dishwasher) and perhaps even washes her clothes there. However, this would increase hot as well as cold water use, but hot water use has decreased.

Nevertheless, Adam maintains that he has not altered his water use since the first study. He claims to have bad habits that he sometimes gives in to, such as brushing his teeth with the tap turned on. His comments do not distinguish between hot and cold water, but he regulates the temperature according to his needs – peeling potatoes needs neither freezing cold water nor hot water, a bath requires almost the hottest possible water, etc. The diagram’s summer-winter cycle for hot water confirms that Adam still takes frequent baths, more often in the winter than in the summer. He keeps track of how much each bath costs, but maintains that he would not reduce the frequency of his baths even if the price doubled.

He has read the utility invoice a couple of times, but thinks it is difficult to understand. There is too much information on one sheet of paper. Usually, he looks at it quickly, both the volume of water used and the cost, and then puts it away. He has never used the Internet option.

## Household B

Betty is in her 70s and has been living alone (except for some pets) in a one-room flat for the last seven years. She prefers living in a small flat in order to reduce costs, and she spends most of the summers in her summer cottage. Betty is an active individual, and spends much time outside the home. She has many spare-time occupations, is a member of several associations, is involved in a resident group and also attends many of the resident meetings held.

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<sup>70</sup> The variation in the number of members of this household makes it difficult to say anything about litre per capita and day. According to the norm for 2004 (based on his use the year before), he is estimated to use 7,600 litres of cold water and 5,400 litres of hot water each month, in total 13,000 litres, or about 430 litres a day, close to the average use in Sweden based on an average of two individuals living in a flat.



She is in favour of the volumetric billing, and says that everyone should pay for his or her use. She does not want to pay for wasteful neighbours and households with many members. She says that she has become more careful about water since she was informed about the volumetric billing, and she knows that hot water is more expensive than cold water. She considers herself to have been a normal user before, and did not waste any water, but since she was informed about the volumetric billing she has reduced her use further. For instance, she takes shorter showers and turns the shower off while soaping herself. One of her pets is also showered considerably less, from about 30 minutes every second day to just a short shower. She has also begun to use a washing-up bowl for rinsing the washed dishes. She believes the scope for further savings is limited:

*[...] I don't think ... that I'd be able to (save), then I'd have to go to the public baths to take a bath [...]*

She has no dishwasher or washing machine so she washes the dishes manually and uses the communal laundry room. There is a shower but no bathtub, and the toilet is dual-flush. Betty says she has difficulties understanding the new technology and meter, but is keen to learn. The heating-energy control in the hallway was explained and demonstrated to her on two separate occasions – once by the technician from Siemens and once by me. She is irritated about the “S” in the bathroom (the electrical towel heater) and wonders what it is for. It took her some time to figure out how to turn on the water in the shower, since the mixer-tap is combined for shower and washbasin. She learned from me that the toilet has a low-flush option:

*[...] well, yes, I never did understand that [...] I probably thought that you just ... press down there on the left ... because you can't press it down in the middle [...]*

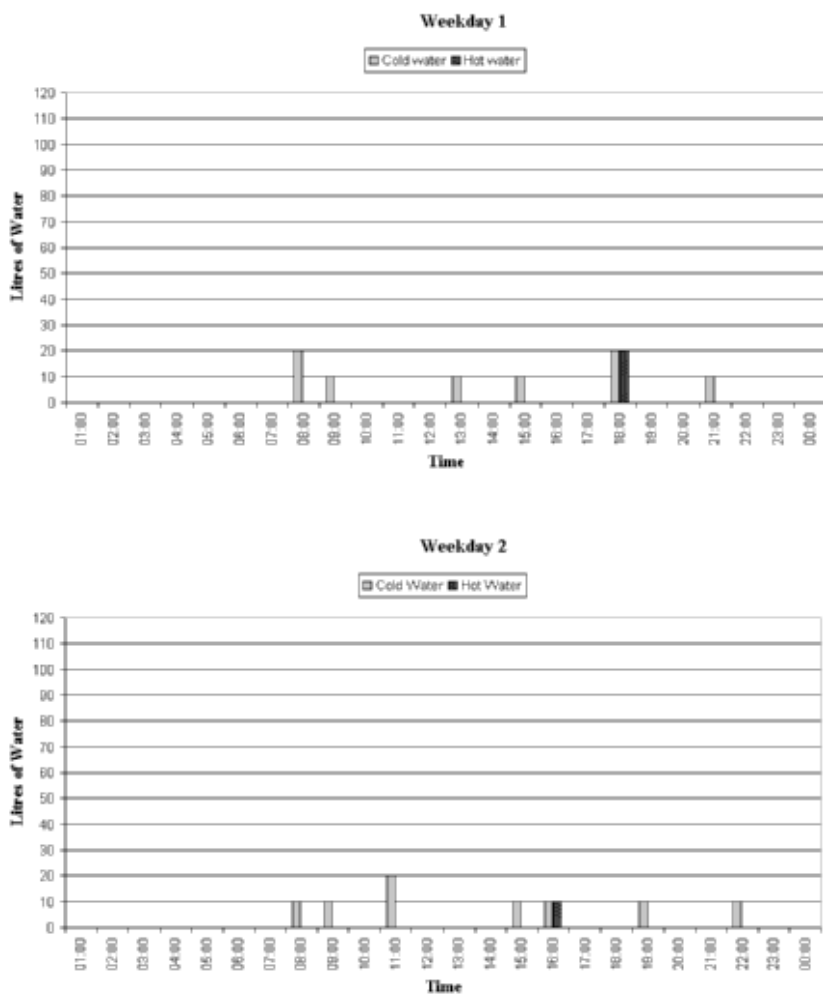
The left button gives a large flush. She only has a vague idea of how the volumetric billing works in practice, perhaps due to her difficulty in understanding the workings of technical arrangements. She is content with the fact that she can save money by saving on electricity and water and by lowering the room temperature. Resource saving is not new to her. The cost of heating her summer cottage is high (electricity) so she tries to save there, for instance, by using the wood stove instead of an electrical one.

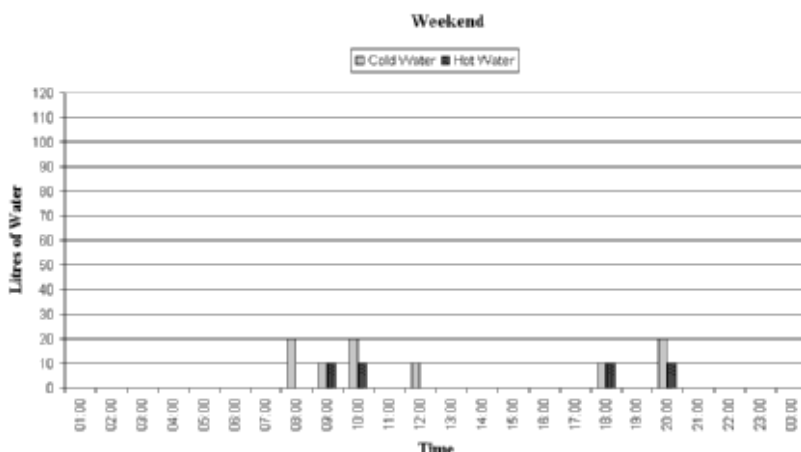
Table 4.6 shows Betty's water usage during the time-diary days and the average daily usage during the same month. The three diagrams in Figure 4.8 show usage by the hour during the three time-diary days.

Table 4.6 Water usage in household B (l/day)

	Weekday 1	Weekday 2	Weekend day	October
Cold water	80 (80 %)	80 (89 %)	90 (69 %)	65 (67 %)
Hot water	20 (20 %)	10 (11 %)	40 (31 %)	32 (33 %)
Total	100	90	130	97
l/p/d	100	90	65	

Figure 4.8 Water usage by the hour in household B





Betty says that the three time-diary days at the beginning of October mirror her everyday life quite well. Her water use during the time-diary days is between 90 and 130 litres, of which a large proportion is cold water. This, together with her monthly use, supports her opinion that she uses little water, especially hot water. On the weekend day, Betty used about 30 per cent more water: 90 litres of cold water and 40 litres of hot water, and that day she was babysitting one of her grandchildren. The grandchild visited the toilet a couple of times, washed her hands and brushed her teeth. Also, Betty cleaned the bathroom in the morning before the grandchild's arrival. The 'normality' of the three time-diary days is confirmed by the average daily use that month.

Water is used during the whole day, since she is retired. The diagrams show no large amount of water used during any single hour. One reason is that she does not have a bathtub or wash at home, and only takes a short hot shower about once every third day:

*[...] I shower every third day [...] because I have very dry skin [...] I don't get that dirty but sometimes [...] of course, if I get up in the morning and I'm sweating ... and think that ... it sort of depends on the situation ... I might have to shower every day ... then I wouldn't always use soap, just water [...]*

In the time-diary, she has recorded one five-minute shower (weekday 2 at 16.00), but the water runs for shorter time since she turns off the shower when she soaps herself. On the days when she does not take a shower, she washes her face and upper body at the washbasin and thus uses little water (e.g. weekday 1 at 8.00, also including two toilet visits and breakfast preparations). She says she does not need a bathtub. She finds bathing in a tub nice, but due to her age she is afraid of falling and not being able to get up, or

even drowning. She says it is possible to take long showers instead, and baths require a shower afterwards anyhow:

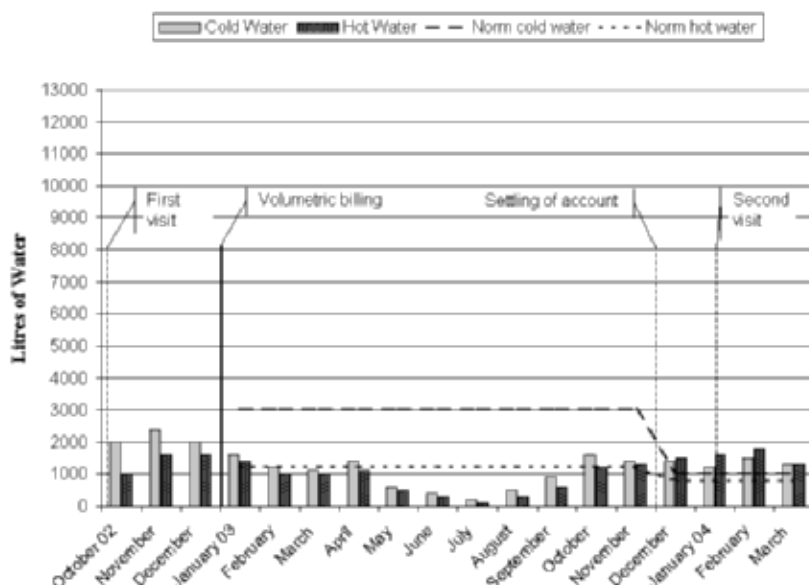
*[...] when I shower, the dirt just runs off [...] but if I'm lying in the bath so it's full of dirt and you get up with all this dirty water with all this dirty water and you dry yourself and you're not clean ... or at least not really clean ... all you've done is to loosen the dirt in some way [...]*

Another reason for no peaks in the diagram is that she does all her laundry in the communal laundry room. She goes there about every second week and does about four machines of launders. Washing the dishes is her most distinct hot water use peak (e.g. weekday 1 and weekend day at 18.00). Betty hand-washes her dishes every evening in the sink, filled with fairly hot water, after rinsing in either cold water or hot water depending on the dishes being greasy or not. Then she rinses the washed dishes in a washing-up bowl filled with lukewarm water so that the dishes become really clean, and because she likes water to be hot when having contact with it. Some of the water use is for pet care, for instance, to shower one of the pets and to clean up after the pets.

Cold water is used to flush the toilet, for cooking, drinking (self and pets) and brushing her teeth. Cold water is also used for mixing with hot water when cleaning, washing up the dishes, washing herself and taking a shower. Before our meeting, Betty did not know that her toilet has a low-flush option and used the normal flush every time. Still, on occasion, she felt that the bowl was not flushed sufficiently and then she flushed twice.

## *Phase 2: Interview and metering*

**Figure 4.9 Monthly water usage in household B, October, 2002 - March, 2004**



Betty spends most of the summer in her cottage, which explains the low water usage during the summer months (Figure 4.9). Now and then, she visits the flat to shower, etc., since the cottage washing facilities (in a washbasin or shower with lake water) is less comfortable and convenient.

A comparison between the three months in 2002, before volumetric billing, and the corresponding months the year after, shows a slight decrease in hot water usage and a considerable decrease in cold-water usage. Starting out with an average of 2,100 litres of cold water per month (68 l/p/d) and 1,400 litres of hot water per month (46 l/p/d) in October-December 2002, Betty lowered her usage to 1,500 litres of cold water per month (49 l/p/d) and 1,300 litres of hot water per month (42 l/p/d) for the corresponding months the year after.

Apart from the change of taps, from two taps to one-grip mixer taps, Betty believes everything works in the same way as before the refurbishment. The water-saving measures Betty talked about in the first interview are still practised, but she has made a few adjustments, such as using the first tap water in the morning (flushed to get cold and fresh water) for the dishes, and when she wants some luxury, she showers some extra minutes. If she only urinates, she does not always flush, especially not at night. She makes no distinction between cold and hot water, but adjusts the water to the

temperature she wants. The early months of 2004 (after the second interview), however, indicate an increase in water use, and in particular more hot water

The reduced number of toilet flushes could save some cold water, considering her low total use. Betty made most adjustments to her water use in the autumn of 2002, and the measures taken affecting cold water seems to have become routinised when looking at the metered data. For hot water, however, the metered data for 2004 as well as the interview data (luxury of longer showers) indicate a possible return to old routines.

Betty asked a housing company representative about how to read the utility invoice and he advised her just to look at the debt or credit; it was not necessary to read the other figures. She has followed these instructions and does not compare her usage from one month to the next because she finds it so boring. She has not used the Internet option. She considers her monthly payment for water – about SEK 50/month for cold water and SEK 50/month for hot water<sup>71</sup> - to be low. She maintains that she does not save water that much, which is mirrored in an actual increase in hot water use at the beginning of 2004.

She is more concerned about the room-heating costs. A neighbour has told her that maintaining a low room temperature is a money saver, and that the cost of water is low in comparison. Betty keeps the thermostat at the lowest alternative (18°C), and says that she would rather put on a sweater or a cardigan if she feels cold. The settlement of her account in January, 2004, resulted in the repayment of a total of SEK 1,636, most of which, SEK 1,488, was related to saving on heating energy<sup>72</sup>.

## Household C

Caroline is in her 70s and lives by herself in a two-room flat. She has lived in Ringdansen for about 10 years. Like Betty, Caroline is a very active individual, is a member of various voluntary associations, some of which are political. She has also frequently attended the residential meetings in Ringdansen.

Initially, Caroline was negatively inclined towards the volumetric billing. She believed that sharing costs was something worth preserving. The housing

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<sup>71</sup> According to the flat-size norm.

<sup>72</sup> According to the housing company, Betty was charged an additional SEK 200 for her hot water usage. The flat-size norm for hot water is very low (about 1,200 l/month), but still, most months she has used less than this norm. According to my calculation, she should have been repaid SEK 200. I have made the housing company aware of this error. It is not possible to establish what impact this miscalculation may have, and whether it is the reason for her higher hot water usage in the beginning of 2004.

company's arguments of fairness made her alter her position: payment according to use is more fair. Furthermore, she believes that it is difficult to make people aware and to save resources in a system that is not sensitive to use, and which does not display the effects of wasteful use:

*[...] I was about to say that you get more economical when you have to pay for it yourself ... actually, you have all the time ... but when sort of realise ... that it's more difficult to be environmentally aware, if that's what one should call it ... when there's nothing to show whether you are or not [...]*

She thinks the arrangement of individual metering and billing per household will be economically beneficial for her. She does not like a high indoor temperature and routinely turns off the light when leaving a room for longer periods. Volumetric billing has made her think about wasteful routines, such as brushing her teeth with the water running. Before writing the time-diary, she believed that she was rather careful with water. Her time-diary made her doubt she was; nevertheless, she believes she cannot use much less. She already employs water-saving routines as a matter of principle, among other things, for the sake of environment. Also, she believes childhood experiences are important:

*[...] I thought I was pretty ... good at economising on water [...] I guess it's quite possible that it's the sort of thing one's still influenced by, I ... all my childhood and so ... we had we had to fetch and take out water and that makes you economise in a different way [...]*

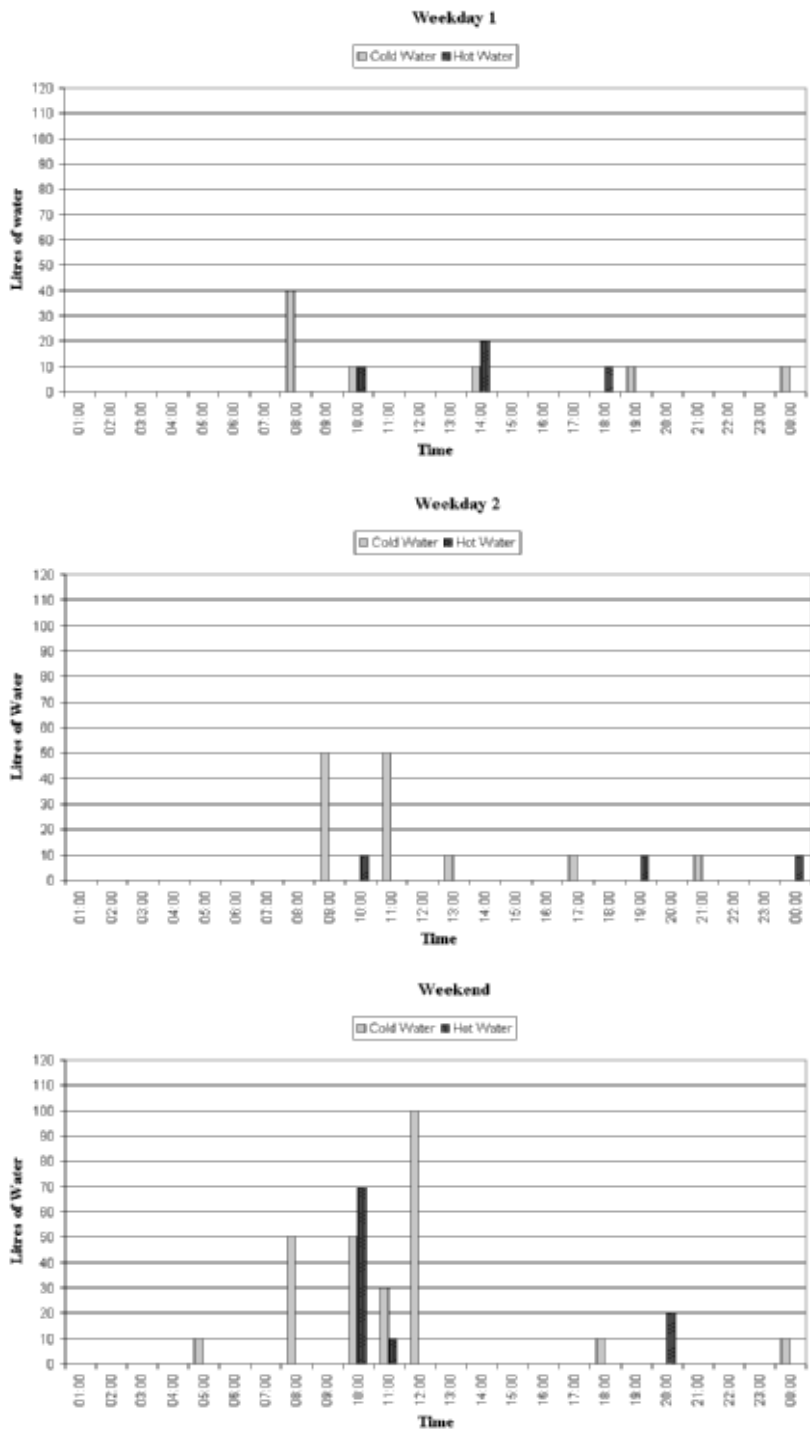
Caroline has no dishwasher, but she does have a washing machine she uses for all her laundry. The toilet does not have a low-flush option. The bathroom has a bathtub. When it comes to the "new" water equipment, Caroline has some difficulties understanding all the technicalities. She asked me about the "knob" (scald-block) on the thermostat during our first meeting, and during the first interview she also mentioned that she has problems with the mode-switch, for switching between shower and tap, on the combined mixer-tap.

Caroline's water usage during the three time-diary days and the daily average for the same month is shown in Table 4.7. The diagrams in Figure 4.10 show usage by the hour during the time-diary days.

**Table 4.7 Water usage in household C (l/day)**

	Weekday 1	Weekday 2	Weekend day	February
Cold water	80 (67 %)	130 (81 %)	260 (72 %)	152 (78 %)
Hot water	40 (33 %)	30 (19 %)	100 (28 %)	44 (22 %)
Total	120	160	360	196

Figure 4.10 Water usage by the hour in household C





Caroline has written a very informative time-diary which clearly shows her routinised activity pattern, such as the morning and evening routines of getting ready for the day and the night. Caroline wrote her time-diary for three days in February, and she felt that these three days were perhaps a bit calmer than her normal days.

Water-use peaks mainly occur for cold water when using the washing machine, for instance, the weekend day at 11.00 and 12.00. She washes about one (1.5 during the three time-diary days) machine per week, and believes she washes more often because the machine is in her flat.

*[...] doing the washing at home is very convenient ... I guess the disadvantage is that it's a bit ... how should I put it, luxury washing ... doing the washing more often than is really necessary because, well ... it's nice to get it out of the way [...]*

If the machine is not filled, she uses a programme for half a wash – using approximately 50 litres of water (e.g. weekday 2 at 11.00). The communal laundry room is close by, but she finds it more convenient to wash clothes at home, especially when her grandchildren are staying with her; they do not have to bring as much clothes since she can wash them as soon as they get dirty. She has heard stories about insufficient cleaning and ‘stealing’ of washing periods in the communal laundry room, but such stories are not unique for Ringdansen and this is not what has kept her from washing there.

She thinks that water that has been standing in the pipe is no good, and in order to get cold and fresh water from the kitchen tap, she lets the water run at fairly high speed for 4-5 minutes every morning. This ‘rinsing-the-pipe habit’ causes a daily cold water peak (see, for instance, weekday 1 at 8.00, weekday 2 at 9.00, although this also includes several toilet visits and breakfast preparations). At the time, she did not have as many neighbours, which, according to her, accentuated the need for flushing out the pipes:

*[...] at that time, I was the only person living in this part of the building,, now I have a neighbour living above me so now there's somebody else who flushes out the water in the pipes [...]*

An estimated 30-40 litres are flushed away each morning in this way and constitute a considerable portion of Caroline's daily use of cold water.

Like Betty, Caroline most of the time freshens herself up in the washbasin by washing her face and armpits, but she takes a bath about twice a week. Caroline uses some hot water for most activities, when washing her hands, freshening up and washing dishes. The only time hot water peaked (over 20 litres) during the time-diary days was when she took a bath at the weekend (10.00). Caroline has since long had a certain technique, which she believes

saves some water. She turns the thermostat up to the scald block (38° C) and turns on the water. She fills the bathtub half-full, steps into the water and washes her hair. The warm water for rinsing the hair fills the bathtub. Then she lies down in the warm water for a while.

Caroline is aware of the fact that a shower is more economical and takes less time, but since she does not find it comfortable (she freezes when showering) she prefers a bath. She claims to have problems with the shower, since it sometime turns itself off and directs the water into the bathtub or washbasin instead. This indicates that she does not turn on the tap all the way when she takes a shower, since the mode-switch needs a certain water pressure to keep in shower mode.

Caroline has no dishwasher. Her justification for this is an ambition to save hot water and it is difficult to fill the machine with dishes used by one person. It would take her several days to fill it, and would require rinsing the dishes to prevent leftovers from sticking to them. This, in turn, would require a lot of water. Next to bathing, washing dishes is her most important hot water use (e.g. weekend day at 20.00). She puts the rinsed dishes into the sink, turns on the hot water tap and starts washing up glasses while the sink slowly fills up. She likes the water to be fairly hot, and since it takes some time for her to do the dishes (partly because she dries the glasses with a towel immediately after washing them) and the water gradually cools, she adds hot water after a while. She rinses the dishes in a washing-up bowl (which she has had for several years) with a couple of litres of cold water.

Cold water is for flushing the WC, but she does not always flush after each use since she sometimes has to go very often (incontinence due to old age). She refrains from flushing at night when sleeping over at a friend's place, who has trouble sleeping, and saves on flushes at friends who have a septic tank, since it is costly to empty. Concerning the hygienic aspect of this practice, she says:

*[...] I don't know ... how other people feel about it, but I don't think it's very nice when it's unflushed (laughter), okay, when it's my own I know that it is but that ... I usually try to remember to look before opening when the doorbell rings, that I've flushed (laughter) [...]*

A large proportion of Caroline's water usage is cold water, which is even more remarkable considering this is a winter month. The elevated use during the weekend day was related to one bath, cleaning the bathroom and one wash in the washing machine.

*Phase 2: Interview and metering*

**Figure 4.11 Monthly water usage in household C, March, 2003 – March, 2004<sup>73</sup>**

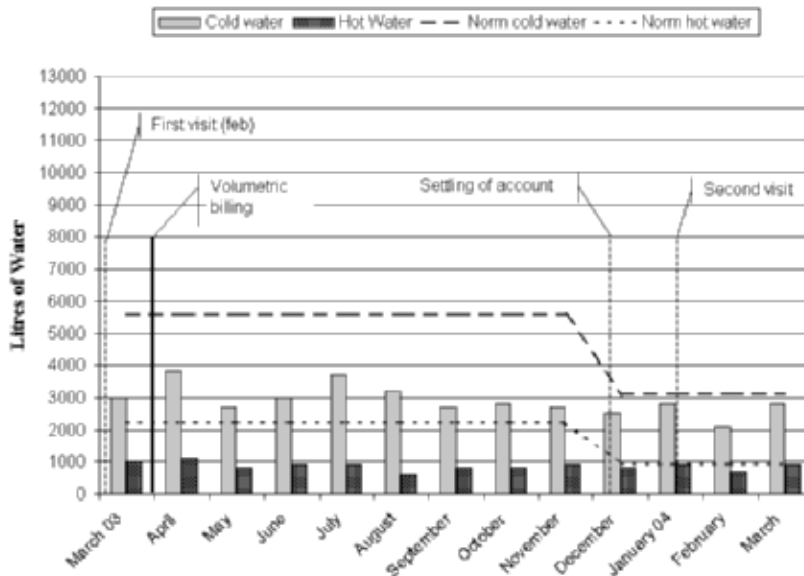


Figure 4.11 shows water use with small variations. Cold water usage ranges from 2,100 to 3,800 litres a month, with a peak in April (see note 73) and July. The summer months show an increase. Hot water usage ranges between 600 l/month and 1,100 l/month, peaking before and just after the introduction of the volumetric billing. Caroline is mainly a cold-water user. The relation between cold water and hot water is 77/23 during the period March, 2003 to March, 2004, and her average daily total use is 124 litres.

Caroline says that the introduction of volumetric billing has made her more careful about her water use, but she emphasises that she has not become stingy. She maintains that she perhaps is a little more careful with hot water, more out of principle than because of cost. This statement is corroborated by her discovery of the price of hot water on the utility invoice for the first time at our second meeting, almost a year after the volumetric billing came into force.

<sup>73</sup> Metered use is not available on a daily basis from 20 March, 2003 to 8 April, 2003. Her total use during this period (2 m<sup>3</sup> cold water and 0.6 m<sup>3</sup> of hot water) is simply divided and added to each of the two months. Thus, the values for these two months are approximations.

The slight decrease in her water use may be explained by some minor adjustments. She has altered her technique for washing up dishes somewhat, filling the largest saucepan to be washed with water and washing the rest of the dishes in it. She believes it may save a couple of litres. After a tip from a neighbour, she also has turned the thermostat on the combined mixer-tap in the bathroom to cold (previous always at a mixing position), so that hot water must be actively chosen each time the tap is turned on. She argues that it is possible both for her as well as her guests to stand cold water for minor uses, such as washing hands. She has not cut down on baths, even though she knows it makes the hot water use “hit the roof” (refers to one of the graphs I showed her during the first interview). She refers to taking a bath as one of her luxuries; it is nice and it softens stiff joints.

Caroline studies the utility invoice carefully, especially the debt and credit columns. She compares her use in monetary terms with what is normal and if it deviates, she thinks about what may have caused it. She has not used the Internet option. The settlement of her account in January, 2004, gave Caroline a total credit of SEK 1,554, of which the main part, SEK 999, was related to low water use compared to the preliminary norm (cold water SEK 445, and hot water SEK 554)<sup>74</sup>. The savings made according to the flat norm, are mirrored in the new much lower norms for cold and hot water in 2004.

## Household D

David and Doris are a middle-aged couple living in a three-room flat. Their children have left home. Ringdansen has been their home for about ten years. They thought of leaving Ringdansen before the refurbishment, but decided to stay since they like the view from the flat and thought it was an interesting project, especially regarding its ecological ambitions.

David has a managerial position and Doris is a student. They are both actively engaged in different community organisations of a political and special-interest nature, such as an environmental group. They are very active outside the home, especially on weekdays. Both David and Doris have attended many of the residential meetings held before and during the refurbishment.

They are in favour of volumetric billing. David thinks it may make people reflect over their water use and alter their behaviour. He also believes that he and Doris will benefit from it since they most likely use less water than other

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<sup>74</sup> It is worth noting that comparisons between households cannot be made by using credit or debit figures, since these figures are related to flat size. Although Betty and Caroline use about the same amount of hot water, Caroline gets a larger credit than Betty (although wrongly debited), since Betty has a much smaller flat.

residents in Ringdansen. Doris, on the other hand, is not as convinced. She believes that their water use is normal and, while hoping for economical benefits, she thinks they will pay more for these resources since the price of energy has gone up lately. She looks forward to being informed about their use, and thinks that it is necessary to have metering per household considering how differently water is used in households. It is fairer.

*[...] I know that ... how much water people use varies enormously and not and it's actually not fair ... because people said as long ago as in the '70s and '80s that people living in blocks of flats use much more water than people living in their own houses, for example [...] it's just luxury, that's what I think [...]* (DF)

They have not adjusted their water use after being informed about volumetric billing since they already have economical water routines, and have had for a long time, based on environmental principles. If it becomes necessary to save more, Doris suggests using so-called “miracle rugs” (cleaning without water) and shorter showers. Her husband also suggests shorter showers and perhaps reducing the number of toilet flushes, but also maintains that there are limits to how much one can save.

They do not have a dishwasher, but they do have a washing machine in the bathroom, which was out of order during the period studied. All the washing is done in the communal laundry room, but occasionally they use the tumble-drier in the flat. The flat has two dual-flush toilets and a bathtub. The bathtub is seldom used, maybe 4-5 times a year and it is only David who uses it to get warm when he is ill. Doris cannot relax in a bath and prefers to shower, and she says she is not a ‘water person’ and dislikes the idea of lying in one’s own dirty water and believes there is a risk of catching a urinal infection. She is content with the new mixer-tap, which, in contrast to the old one, maintains the same temperature when turned on again after being turned off.

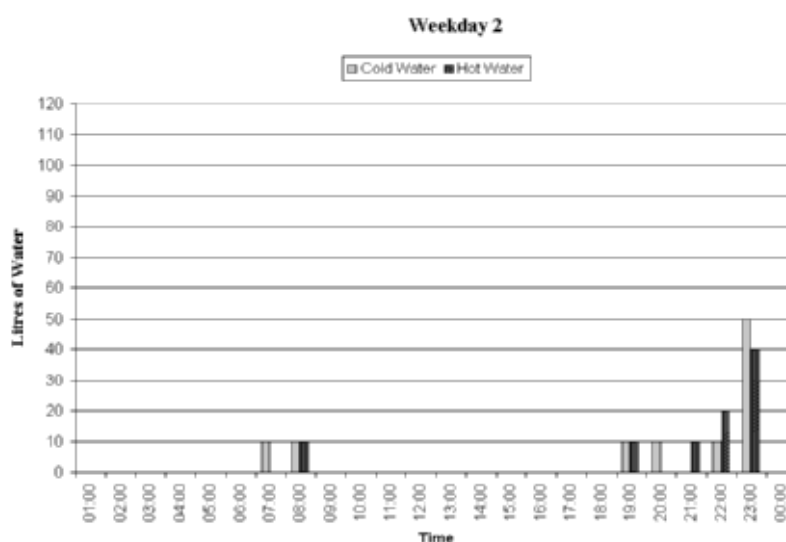
Table 4.8 shows their water usage from Thursday to Sunday, a week after the time-diary days due to metering problems. David and Doris wrote their time-diaries in December, and no correlation can be made between time-diary and actual water usage. The indicative values in the table and the diagrams in Figure 4.12 showing usage by the hour for two of the four days, are intended to illustrate the household’s water use pattern.

**Table 4.8 Water usage in household D (l/day)<sup>75</sup>**

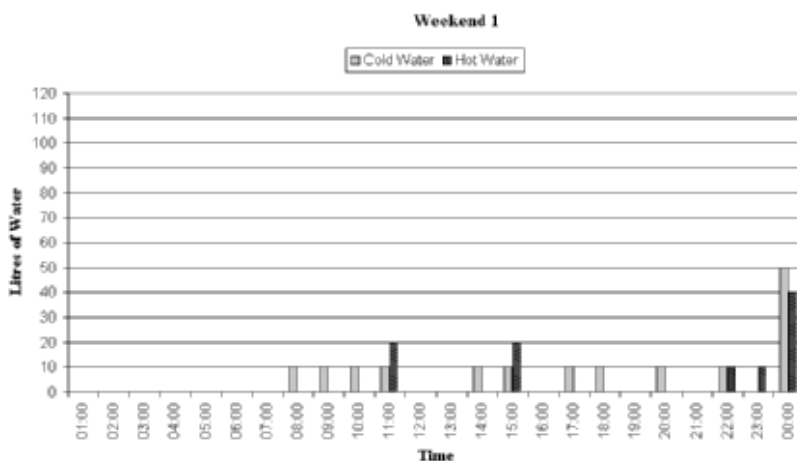
	Weekday 1	Weekday 2	Weekend day 1	Weekend day 2	January
Cold water	70 (58%)	100 (53 %)	150 (60 %)	150 (68%)	97 (60%)
Hot water	50 (42 %)	90 (47 %)	100 (40 %)	70 (32 %)	65 (40%)
Total	120	190	250	220	162
l/p/d	60	95	125	110	81

Per-capita use is quite low, while the proportion of hot water is above national average. It is normal to increase the amount of hot water used during a winter month. There is no washing machine to ‘dilute’ the hot water share. Also, Doris has a health problem that is alleviated by warmth.

**Figure 4.12 Water usage by the hour in household D**



<sup>75</sup> There are no monthly values for December and it is thus not possible to show the daily average use for the same month. Instead the January data is used.



More water is used at the weekends, due to more time spent in the home, while weekday use is concentrated to mornings and evenings. The water use pattern supports their stated pattern of everyday activities; they clean, wash, cook, bake bread, etc. at the weekends, but time is also spent on association work. Doris does most of the former and David most of the latter.

Hot as well as cold-water use peak late in the evening. They rarely shower in the morning, but prefer doing it every evening before going to bed for about five minutes (during the time-diary days). Doris usually showers for longer time and uses hotter water than David does. In the mornings, they both wash their hands and face and carefully flush the toilet, and their low use is indicated in Figure 4.12. Both are aware of the low-flush option.

They do not miss the former dishwasher, and say it is more suitable for larger households.

*[...] it's actually not that labour-saving at all ... because it has to be filled if you look at ... if you're really going to save energy ... so it has to be filled ... and you have to think about how to place things and I ruined it when a fork or a spoon fell through a crack somewhere there [...] it's hotter so it could be hygienic if there are a lot of people ... but another thing was that you couldn't put any old thing in it, you had to make sure that you didn't put in something that would melt and so [...]* (DF)

They wash the dishes once a day, usually in the evening on weekdays somewhat earlier and at the weekends. Neither of them gets irritated about unwashed dishes left next to the kitchen sink. Doris does the dishes most of the time, while David does it occasionally, and then he lets the tap run continuously.

*[...] I think that I try to be ... be pretty economical with the water I use except when I do the washing-up [...] I prefer to wash the dishes under running water, not that I turn on the water to the maximum, I keep it a bit warm [...] if you wash the dishes in the same water all the time, I don't think that you'll get them completely clean [...]* (DM)

David believes that Doris uses water more efficiently when she does the dishes. She rinses the dishes before washing them, puts the dishes in the sink, fills the sink with hot water and adds washing-up detergent. She rinses the washed dishes in a washing-up bowl, also in hot water.

David and Doris use the communal laundry room about once a week and wash 2-3 machines. David does most of the laundry, and on occasion they do it together. David mentions problems with double-booking, 'time-hijacking', and different cleanliness standards. Doris thinks the only advantage is the larger space in the communal laundry room.

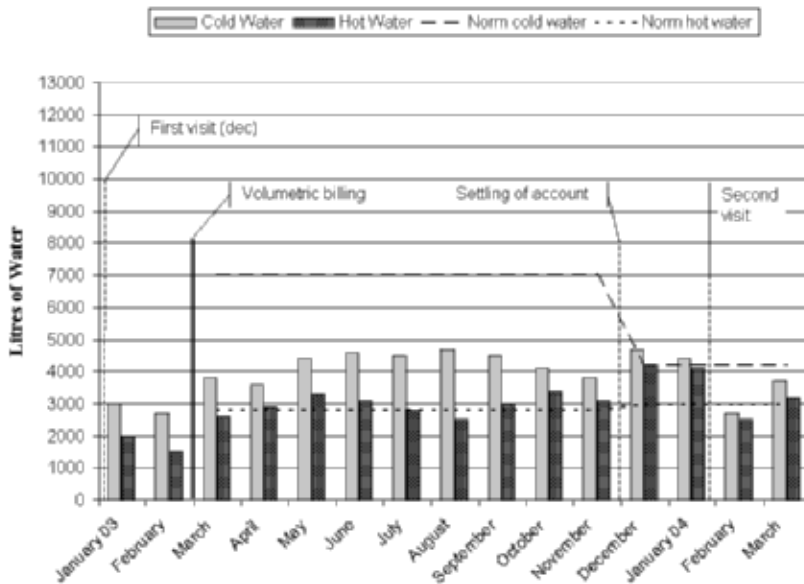
*[...] it's being able to hang up the sheets and that sort of thing in the drying room and stretching them and folding them neatly there [...]*

Otherwise, Doris does most of the household chores such as cooking, washing dishes and cleaning. David prepares the breakfast and also makes some preparations for dinner such as putting beans to soak, rinsing fruit and rinsing some cutlery. His water use consists mainly of flushing the toilet, washing his hands, brushing his teeth and showers. David also says that Doris uses much more water than he does.



## Phase 2: Interviews and metering

Figure 4.13 Monthly water usage in household D, January, 2003 – March, 2004



The couple's use of hot and cold water increases in the summer and then levels out after which cold-water use decreases while hot water use increases. The fact that Doris only worked part-time during the autumn of 2004, and thus spent more time at home, probably increased hot water use. The sharp increase in water usage in December and January, 2004, coincides with one of their children staying with them during the Christmas vacation. The relation between cold and hot water is 58/42 (January, 2003-March, 2004), and the average per capita daily use is 113 litres/p/d.

David and Doris both maintain that they have not altered their water use a lot. Doris thinks she cannot reduce her use further, even though she would like to. Altering routines is very difficult, she says. For instance, the habit of flushing the pipe before use water, since she knows that the water can contain unhealthy foreign matter, is not worth abandoning and thus risking their good health. She tries not to wash only a few dishes under running water. She sometimes puts in the bathtub plug to see how much water a shower requires. David thinks that the volumetric billing has only affected them marginally; they were already environmentally aware and are consequently low water users. Perhaps they rinse in running water a bit less, and are satisfied with less cold water to drink, which contradicts his partner's statement of the importance of not changing such routines. They do not let the water run and would notify Hyresbostäder about a leaking tap. They use what they need,

neither more nor less. The volumes of hot and cold water are higher after the first settlement of account than a year earlier.

The couple have not discussed their water use according to David. They have lived together for a long time and they have the same opinion on these matters. Doris confirms this, and adds that they have two toilets/bathrooms and thus seldom need to be in the bathroom at the same time, and therefore do not watch each other's water use. Nevertheless, she has noted that David has the water running while brushing his teeth, which surprises her, and she sometimes points it out to him.

David scrutinizes the water bill and checks their water usage, both the volumetric and monetary figures. Only rarely does he compare with bills from previous months. Doris also keeps track of the bill, and would react if an item is too high – but it has not been so far. They have not used the Internet option. Their total fee is in the black, and the balance for January, 2004, showed that David and Doris had a total credit of SEK 534, where heating and hot water were on the debit side and electricity and cold water on the credit side.

## Household E

The Edman household comprises a middle-aged couple, Eric and Elisabeth, and a teenage daughter, Elsa. They are of foreign descent but have lived in Sweden for about 20 years, and in the three-room flat in Ringdansen for about 15 years.

Elisabeth has irregular working hours, but she mostly works daytime. Eric is on sick leave. Elsa attends school, and spends most of her spare-time with friends and is rarely at home. Elisabeth is not actively engaged in environmental issues, but cares about nature and is especially concerned about the use of fertilizers and pesticides on vegetables grown in the nearby allotments. They do not have an allotment themselves, but relatives do and she refuses to eat over-fertilized vegetables. She has attended residential meetings before and during the refurbishment process.

Elisabeth is not in favour of individual metering and billing per household, since too restrictive use of water can cause unhygienic and unhealthy conditions.

*[...] It's not going to be good for people who are thrifty [...] I visited a woman who washed the dishes in cold water ... there are a lot of people who'll be doing like that and it's not good ... elderly people, you know [...] it can't be, it isn't hygienic not doing it properly [...]*

She says she will not change her water use; she does not use more than she needs.

*[...] I haven't used an exaggerated amount [...] I've never liked having the water just running ... it shouldn't, you should use the water [...]*

Perhaps it will cost her some money, she says, but she believes that the refurbishment has already made it more expensive to live in Ringdansen. This household has a washing machine, but it is rarely used. The dishes are done manually. The bathroom has a dual-flush toilet, a washbasin and a rarely used bathtub. There is also a lavatory with a washbasin and a dual-flush toilet.

Table 4.9 shows the Edmans' water usage from Thursday to Sunday the week after the time-diary days. Correlation between the time-diary and actual water usage cannot be made, but the indicative values in the table and the two diagrams in Figure 4.14 are intended to illustrate this household's water use pattern.

**Table 4.9 Water usage in household E (l/day)<sup>76</sup>**

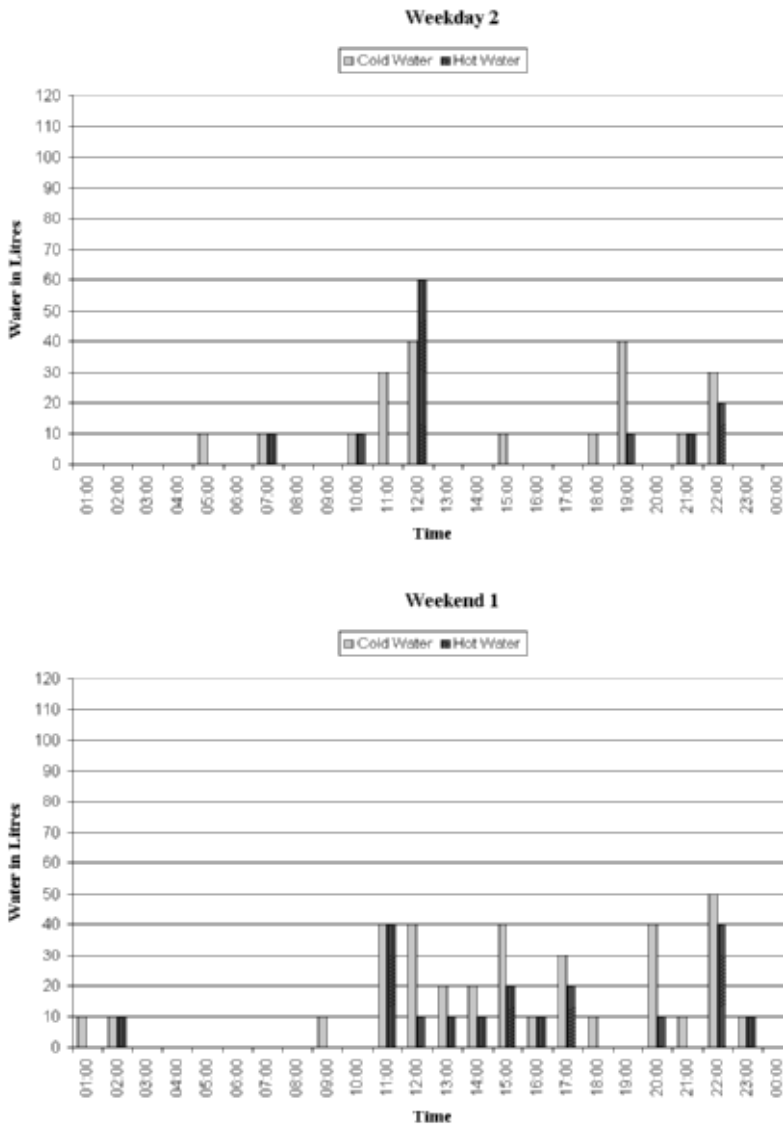
	Weekday 1	Weekday 2	Weekend day 1	Weekend day 2	January
Cold water	130 (46 %)	200 (63 %)	350 (65 %)	80 (80 %)	219 (60 %)
Hot water	150 (54 %)	120 (38 %)	190 (35 %)	20 (20 %)	145 (40 %)
Total	280	320	540	100	364
l/p/d	93	107	180	33	121

Per-capita use is average, but varies a lot between days. Elisabeth wrote her time-diary in December, which, being a winter month, usually means increased use of hot water. In this household, however, cold water constitutes the lion's share of the water used. Hot water is mainly used for showers and for washing dishes. Elisabeth says that her daughter uses a lot of hot water for her morning shower. Elisabeth's shower habits are not as regular, and the time spent in the shower differs between 5-15 minutes, depending on available time and whether she is suffering from aches (extended shower-time). Sometimes, she settles for a simple wash using the washbasin. Eric usually showers for some minutes. No one uses the bathtub, the reason for the females being to avoid urinary infection (they have a history of repeated infections).

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<sup>76</sup> There are no monthly values for December, and thus it is not possible to show the daily average use for the same month. Instead the January data is used.

Figure 4.14 Water usage by the hour in household E



Elisabeth does most of the cooking, cleaning, baking and washing-up. Her husband sometimes assists by preparing dough and washing dishes (if there are a lot of them). When she is at home at the weekend, she uses water continuously, as seen in the weekend diagram. She thinks her habit of washing hands frequently while cooking is one reason – which she thinks is somewhat of an obsession. She has a similar habit after reading the newspaper and when coming home after being outside. She also believes that her frequent toilet

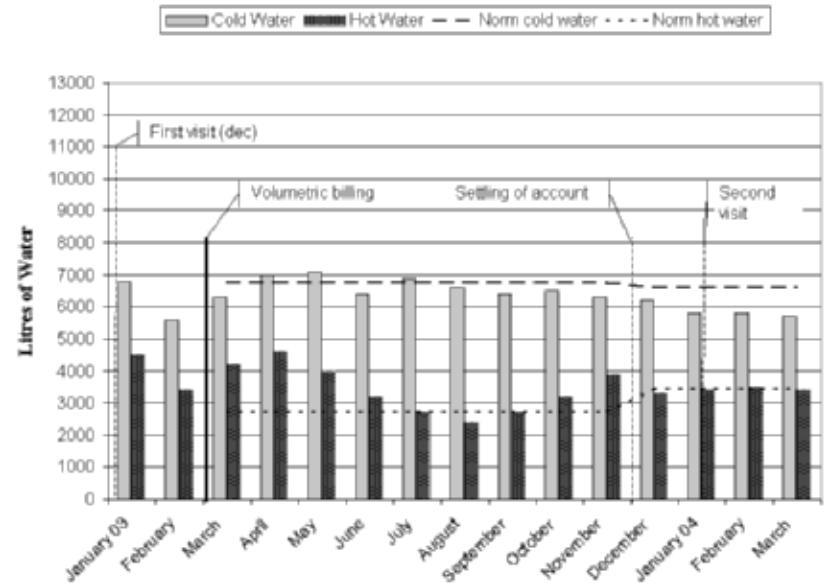
visits are an obsession - 15-20 times a day. However, she does not flush after each visit but perhaps after every third or fourth visit. Even though she has noticed that there are two knobs for flushing, she does not distinguish between them.

The dishes are usually done once a day or once every second day if there are not too many. They fill one of the sinks with hot water and washing-up detergent. The dishes are left to soak for some minutes, and after being washed up, they are rinsed under running water. Elisabeth dislikes doing the dishes, but a dishwasher is not considered an option since then she needs to empty it, which is not to her liking either. Elisabeth takes care of the weekly laundry, 4-5 machines, preferably in the communal laundry room since it is quicker there thanks to the many, larger and faster washing machines.

*Phase 2: Interview and metering*

Elisabeth says that they have done nothing to alter their water use, a statement also reflected in the diagram below. Their cold-water usage is fairly stable, while hot water usage decreases in the summer period, and stabilizes after settling the first account.

**Figure 4.15 Monthly water usage in household E, January, 2003 – March, 2004**



In January, 2003, before volumetric billing, both cold and hot water usage are slightly higher than in January, 2004, which could be an indication of reduced water use. February displays similar values between the two years (February,

2004, had 29 days), and the comparison between March, 2003, and March, 2004, shows the same trend as January<sup>77</sup>. The relation between cold and hot water is 65/35 in January, 2003 – March, 2004, and their average daily per-capita use is 108 litres. All their laundry is washed in the communal laundry room (they no longer have a washing machine in the flat).

Elisabeth does not want to look at the bill, and she throws it away after it has been paid. However, she glances at the total debit/credit at the end of the bill, and at the usage figures (primarily the monetary items). Her husband also looks at it. He also knows about the Internet, but they have never used the Internet option. The settlement of their account in January, 2004, gave the Edman family a total credit of 201 SEK, where heating and cold water were credited, while electricity and hot water appeared as a debts. Despite the small total credit, Elisabeth is not content with the new billing arrangement. She does not like the idea of the parents starting to nag the children, and of other household members' water use being monitored. She thinks it has become more stressful to constantly think about her water use, and the credit cannot compensate for the stress she feels. She says that she has done nothing to change, but it is likely that her awareness and stress have some (subconscious) impact on water use and have contributed to the slight decrease in use.

## Household F

The Franzén family consists of the couple Fabian and Frida and their three children. They have lived in Ringdansen for more than 10 years in a four-room flat, but at present (December, 2002) they are living in a smaller three-room evacuation flat waiting to return. They are of foreign descent, but have lived in Sweden since their early teens and their children were born here. Fabian is employed and works evenings (15-24). Frida is currently unemployed. All the children go to school. Frida has attended some of the residential meetings about the refurbishment. She is not actively engaged in environmental issues, but she gets upset when people throw litter on the street, etc.

They have an ambivalent opinion of volumetric billing; economically it could be a positive improvement, or the opposite. Other residents have told them that the rent has been raised so much that it is difficult to manage if you are unemployed. The housing company guaranteed an unchanged rent before the refurbishment; therefore, the increased rent irritates them. Concerning water use, Frida believes volumetric billing may make her use water more

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<sup>77</sup>Volumetric billing was introduced in March, and consequently the first indication of use is provided in mid-April.

economically but more likely she would use it as she is used to – simply because she does not know any other way. Up to now, she and the other household members have not made any adjustments in their water use.

*[...] I'm going to do exactly the same as I used to ... I haven't learnt ... but who will I learn, my children or me ... I'll have to learn first before I can teach my children [...]*

They have a dishwasher and a washing machine, but most of the laundry is washed in the communal laundry room. The bathroom has a dual-flush toilet and a bathtub. They did not understand the function of the dual-flush toilet at first, and they asked a representative for the housing company about the difference between the two options.

Table 4.10 shows the family's usage from Thursday to Sunday the week after the time-diary days. Correlation between time-diary and actual water usage is not possible, but the indicative daily values in the table, and the two diagrams in Figure 4.16 displaying usage by the hour, illustrate the water use pattern.

**Table 4.10 Water usage in household F (l/d)<sup>78</sup>**

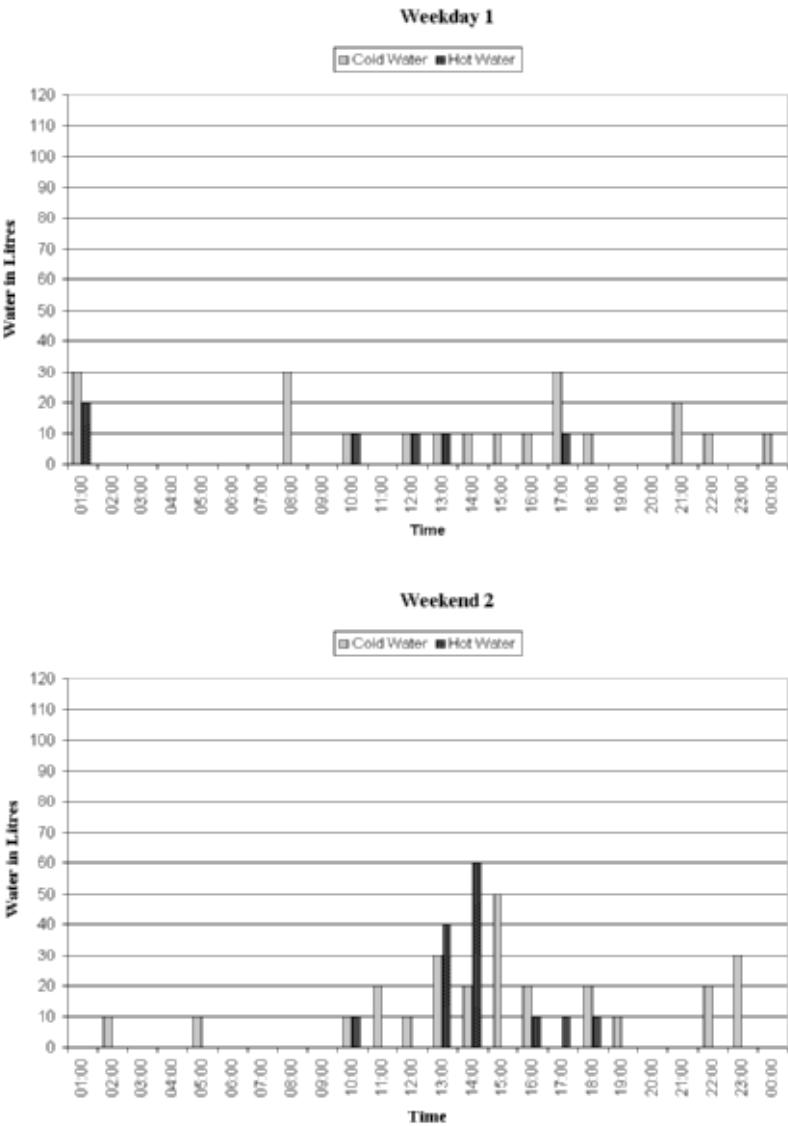
	Weekday 1	Weekday 2	Weekend day 1	Weekend day 2	January
Cold water	200 (77 %)	290 (85 %)	360 (40 %)	260 (65 %)	345 (58 %)
Hot water	60 (23 %)	50 (15 %)	550 (60 %)	140 (35 %)	252 (42 %)
Total	260	340	910	400	597
l/p/d	52	68	182	80	119

Usage varies considerably and would require a time-diary to be fully explained. The five members require a basic volume of water for activities such as toilet flushing and showers/baths. Most of the family members take a daily shower, and the children normally shower in the evening. On weekday mornings, they merely eat breakfast, go to the toilet and brush their teeth before leaving for school. On weekends, the children might shower in the morning, especially the older children if they come home late and are too tired to take a shower at night. Fabian takes a shower when he arrives home from work (likely causing the peak at 01.00 on weekday 1). Frida showers in lukewarm water for 5-10 minutes each morning, and says she does not have the time for longer showers. The bathtub is used on occasion; two of the children take baths either to relax or to play with toys, and Fabian sometimes takes a bath at the weekend. Frida, on the other hand, cannot take a bath due to her eczema – which also restricts her water use in other ways.

<sup>78</sup> There are no monthly values for December, and thus it is not possible to show the daily average use for the same month. Instead the January data is used.

Frida considers the three time-diary days as ‘normal’, and she thinks her weekdays and weekend days resemble each other, since she is unemployed and her husband works in shifts covering both on weekdays and at weekends.

Figure 4.16 Water usage by the hour in household F



Frida is the one who uses most of the water during weekdays, when she does most of the household work such as cooking meals, tidying up, washing and taking care of the dishes. On weekdays, cold water comprises a very high proportion of the water used, and she finds it difficult to stand water that is too hot. Total water usage, and proportion of hot water, is



higher at weekends since the household members spend more time at home.

The family use a dishwasher, but saucepans and larger bowls are washed manually in a sink in hot water. Frida waits until the water is lukewarm before doing the washing-up. The kitchen tap is running with cold water when she rinses the bowls she has washed. Dishes placed in the dishwasher are first rinsed, and the machine is normally used once a day, maybe twice if there are guests. The dishwasher reduces Frida's direct contact with water.

Frida usually cooks four meals a day, and she says that she uses a lot water when preparing food. She constantly rinses her hands, and the temperature of the water does not matter, mostly lukewarm but never hot. She should not be in contact with water as much as she is, but she believes she does not have a choice – water is used for everything.

About twice a week, Frida does the washing in the communal laundry room, where the large and fast machines reduce the time used. The washing machine in the flat is only used if she cannot get access to the laundry room at a suitable time. Then, she either spends an entire day washing at home, or she washes one or two machines per weekday to avoid spending an entire weekend day on this activity. The machine at home is also used for clothes that the children need urgently, or clothes that smell badly, such as the children's clothes worn in physical training at school. However, she also has alternative strategy for such clothes.

*[...] the children have had a gym lesson, they come home with wet towels and wet clothes, you can't put them away ... then they smell differently I usually leave them out on the balcony ... if I don't wash them same day or the next day ... then I put them there to avoid the smell [...]*

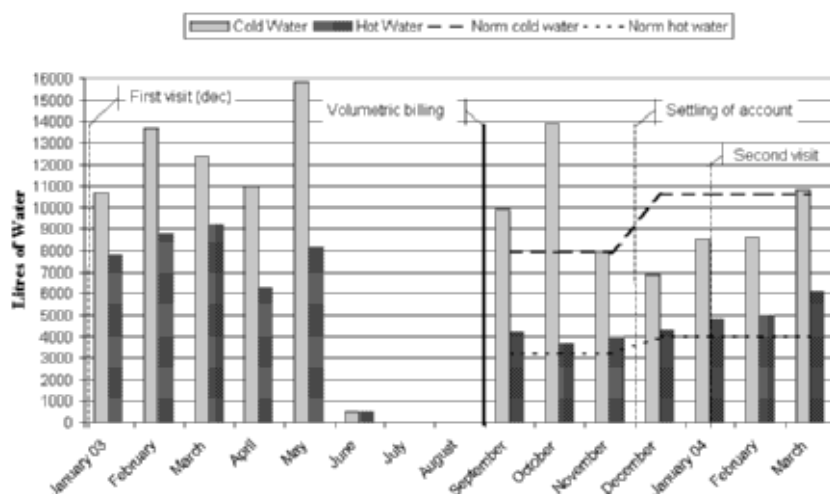
#### *Phase 2: Interview and metering*

Figure 4.17 shows two distinct periods, where January, 2003, to May, 2003, is the unbilled period in the evacuation flat. Water usage is considerable higher compared to the billed period in their regular flat from September, 2003, to March, 2004<sup>79</sup>. In January-March, 2003, hot water usage was between 7,800 and 9,200 litres a month, while in the corresponding period in 2004 it ranged between 4,800 and 6,100 litres. The relation between cold and hot water has changed a bit from 61/39 (January-May, 2003) to 67/33 (September, 2003 – March, 2004), and daily water usage has decreased from 138 litres per person and day to 116 litres.

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<sup>79</sup> No data available for June to August, 2003.

Figure 4.17 Monthly water usage in household F, January, 2003 – March, 2004



Between the two periods, there are some structural differences due to Fabian and Frida deciding to split up, and there is one household member less for the latter period. The children stay with Frida most of the time, but occasionally they live with their father, reducing the number of household members still further. Also, Frida now has a job and thus spends less time at home.

Frida maintains that she has not cut down on her water use, and that saving should not be exaggerated. She thinks it is necessary for her appearance to take a shower every day before work. What if people think she smells? Frida, however, monitors her children's water use more closely, which may contribute to the lower use. If she finds they stay too long in the shower or have the water running for no reason – which does not include having the shower on while soaping oneself – she informs them that she thinks they have crossed the line as regards the water use that she considers necessary. She has always been bothered when people just let the water run. If the bill is too high, she sometimes gathers the children and asks them to use the water more carefully, and tries to make them understand that water use is related to the consumption of other things they need and want.

She does not distinguish between hot and cold water but is aware that hot water is more expensive, and she uses cold water for most tasks. Hot water is used, for instance, for the shower and to scrub the floor. She never uses her washing machine for one piece of clothing, not even when the children insist that they need it right away.

Frida glances at the monetary figures on the bill, and occasionally also at the volume used. She has not used the Internet option. The settlement of the account in January, 2004, gave the household a total debt on SEK 502, where heating was a credit item (SEK 289) and cold water (SEK 117), hot water (SEK 144) and electricity (SEK 530) were on the debit side.

## Household G

The Gustavsson household consists of a middle-aged couple, George and Gunnel, and their two children, 20-year old Gustav and the teenager Gisela. They live in a four-room flat, and have resided in the area since the early 1980s.

George has a daytime job, which at times includes work at the weekends. Gunnel has retired early and spends a lot of time at home. Gustav also spends a lot of time at home, since he has left school and is unemployed at present. Gisela goes to compulsory school.

George and Gunnel frequently participate in residential meetings. They feel that it is important to have the opportunity to affect issues they are interested in. They do not take an active interest in environmental issues, but are far from ignorant about such issues.

George and Gunnel are in favour of individual metering and billing per household. They believe it is fairer that everyone pays for his or her use, especially since many households in Ringdansen most likely use water wastefully. The children agree, and Gustav says:

*[...] they can't mean that poor old Agda, an old-age pensioner, should live opposite in a one-room flat and pay for the water I use [...]* (GCM)

Nevertheless, they do not think the billing will affect their own water use, which they consider to be within reasonable limits. Gunnel believes it would be difficult for them to save more than the adjustments they made when moving back to their flat after being evacuated.

*[...] since we moved back here to the flat, we've become more aware, before, you didn't care that much ... because it was included in the rent, but now when you yourself have to pay [...] you want to know where your money is going ... that your consumption is fairly normal [...]* (GF)

George has more or less the same perspective:

*[...] knowing that you're going to start paying, that's what has influenced water use ... it's ... as soon as we moved in here and we knew that there was a water meter up there ... you have to start to think a bit [...]* (GM)

They no longer flush water without using it productively, and they turn off the water while soaping themselves, peeling potatoes and brushing their teeth. They are also more careful with water when washing the dishes, and let water run less. For instance, the coffee pot used to be cleaned by being left under running water but is now washed more efficiently. If they were to save more, the children suggest that they replace baths with short showers and turn off the water more quickly and turn it off while soaping themselves. Gunnel says:

*[...] as I said, the only thing I don't do today is to turn on the tap and leave the water running and do something else; instead, you ... you turn the tap on and turn it off again when you've taken the water you're going to [...]* (GF)

They believe their household economy will remain the same, since they think they use a similar amount of water or less than an average Ringdansen household. The children agree with their parents, although Gustav, who pays about SEK 1,500 a month (when he has an income) to his parents for food and accommodation, thinks they may use slightly more water than an average household. Gustav does not think that the volumetric billing would affect him much, perhaps if the bill is extremely high. Gisela maintains it is a more fair system, but that it might not benefit all households, such as families with children and where only one of the parents is employed.

The bathroom has a water closet with no low-flush knob (but the lavatory toilet has), a bathtub, and a washing machine. Most laundry is washed in the communal laundry room, but due to poor access in conjunction with the refurbishment, they wash the laundry more than normal at home at present. There is crowding in the laundry room, since there are fewer laundry rooms and households with new laundry rooms, where washes are billed, come to wash in the 'unbilled' laundry rooms to avoid the charge. Also, some households have two washing-board pointers and can thus book two washing periods. In the kitchen, there is a dishwasher (an older model), connected to hot water.

No metered values are accessible, but the time-diaries and interviews will provide the most important information about this household's water use pattern.

On weekdays, George goes to work early and Gisela goes to school, and neither of them uses much water in the morning. George boils water for coffee and/or tea, rinses the coffeepot and dishes, flushes the toilet and washes his hands and face with lukewarm water. He also brushes his teeth. Gisela merely gets out of bed, goes to the toilet, takes a quick shower, brushes

her teeth, gets dressed and heads off to school without eating breakfast. Gustav sleeps until lunchtime and takes a shower after getting out of bed. So, during the daytime on weekdays, it is mostly Gunnel who uses water for different household chores, such as for making coffee, cleaning, baking and preparing food.

Gunnel also does most of the laundry in the communal laundry room once a week (about 6-8 washes). But because of the access problems indicated above, the Gustavsson household uses the washing machine at home more or less every day. She says that the advantage of the communal laundry room is that it has tumble driers, which rapidly dry large items such as towels and bed sheets. Such laundry would take up too much space and be in the way in the flat because there is no place to hang it up to dry. Also, the laundry room machines are larger and can take more laundry. The benefits are not as obvious for clothes, Gunnel says:

*[...] I might just as well have clothes and so on at home if I'm going to hang them up, so to say ... you avoid having to carry them over there ... [...] ... everything's there then ... it's mostly pullovers, underwear and so on that are washed at home ... which are used a lot ... 'cos then they're waiting to be washed and I can't do it at once [...]* (GF)

George says about washing at home:

*[...] the advantage is that you can do the laundry when ... necessary ... when it's needed ... when you realise, hell, I've forgotten to wash that shirt and in with it and gym clothes and that sort of thing ... "yes, but I've got gym tomorrow" right, put it into the machine (laughter) [...]* (GM)

Washing at home may account for much of the cold-water use, together with toilet flushing, the large household size, and the fact that Gunnel and Gustav spend a lot of time at home. During the time-diary days, 18.3 flushes a day were recorded in the four household members' time-diaries, which is equivalent to about 105 litres a day<sup>80</sup>. All the household members are knowledgeable about the lavatory toilet's low-flush option and use it for minor visits, but since everybody except Gustav mostly use the bathroom toilet, it has little impact on total water use.

The dishwasher is used almost daily. George has connected it to the hot water pipe since it has happened that glasses have broken due to the water being too cold in the wintertime. Furthermore, he believes it may save some energy

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<sup>80</sup> The bathroom toilet, mostly used by all household members except Gustav, is not dual-flush but uses 6 litres/flush. On average George, Gunnel and Gisela had 15 flushes/day x 6 = 90 litres. Gustav uses the other toilet, which is dual flush (3 and 6 litres, a mean of 4.5 litres), and had on average 3.3 flushes/day x 4.5 = 15 litres.

since the machine does not have to heat the water. Before dishes are placed in the machine, they are rinsed with hot water to make sure that the dishes are clean after the machine wash. Gunnel and George believe that the dishwasher saves water, because otherwise a lot of the washing-up would be done under running water. Gunnel says:

*[...] it depends on how well you rinse it before putting it into the dishwasher ... in fact ... and then there's something all smeared with stuff and then you don't want to put it in the dishwasher and then you change and ... so I think that you'd use more water [...]* (GF)

Saucepans take up unnecessary space in the dishwasher and are washed separately with hot water (as hot as possible) and washing-up detergent. Rinsing is usually done with cold water, but dishes are primarily cleaned in hot water.

A large proportion of hot water is used for baths and showers. The daughter, Gisela, takes at the least one (hot) bath a day, sometimes two. She simply thinks it is better, more relaxing, to take a bath than to shower. She showers in the mornings and sometimes after the bath if she has washed her hair or if she has soap still on her body. George also likes taking a bath and finds it pleasant. The water has to be fairly hot, since it soon cools off – some heat energy is consumed to heat the actual bathtub, he says. He takes a bath about once a day and often before bedtime, since he likes to be clean when going to bed. He takes a shower after his bath to get rid of the dirt that most likely is stuck to his body. This dirt can be seen both on the water surface and in the bathtub when emptied. On winter mornings he normally just washes his hands and face with soap and lukewarm water in the washbasin, but in the summer he may also shower in the morning if he wakes up sweaty. The morning shower is sometimes done at work. Both Gustav and George think that they may take more showers in the summer:

*[...] usually, I shower once a day ... perhaps more often in the summer depending on the weather ... if it's 25 degrees outside, it's nice to take a cold shower for five minutes twice a day or something like that [...]* (GCM)

Gustav normally showers for about 15 minutes every afternoon or evening. Gunnel takes a bath about once a week, followed by a quick shower to wash off any soap and dirt remains on her body. Baths are soothing, nice if one's body aches, but takes more time. Most often, she takes a 5-minute shower before going to bed. Both she and George turn off the shower while soaping themselves, which has been made possible with the new mixer-tap. With separate taps for hot and cold water it was inconvenient to turn the shower off since many adjustments were needed to find the right temperature again.

About once a week, Gustav shaves in running lukewarm water:

*[...] I've tried filling the washbasin, but it gets all mucky almost at once so that ... I'd rather leave the tap on for a bit than fill it up [...]* (GMC)

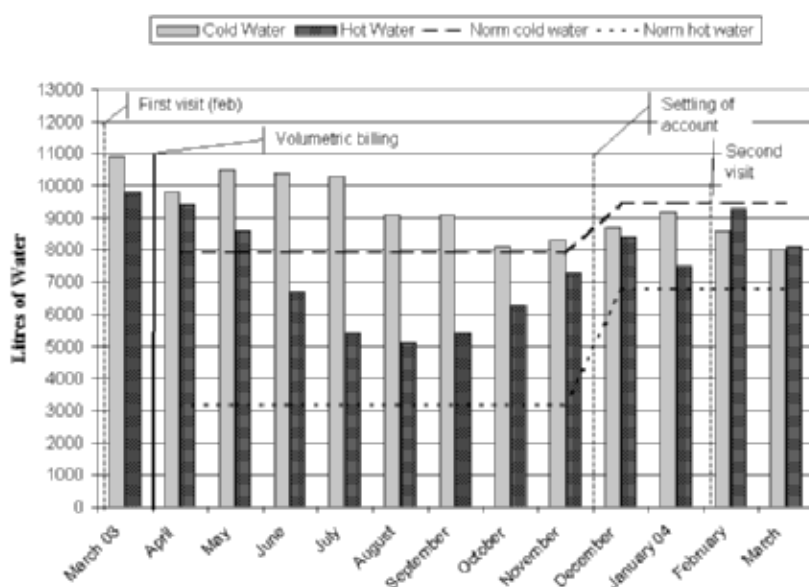
He also lets the water run a little while brushing his teeth, but cannot explain why – it is just a habit he has. George also shaves under running water, but says that the tap is only turned on a bit and that he turns it off now and again.

### *Phase 2: Interviews and metering*

The Gustavsson family use more than the preliminary norm for both cold and hot water according to Figure 4.18, which they state is in line with their expectations. Few changes are made in their water-using routines. Gunnel maintains that she uses less water than before volumetric billing, but that she has not altered her use since they moved back from the evacuation flat. She has not returned to her old habits, and uses hot and cold water without thinking about the differences between the temperature as regards price and energy consumption. What they have discussed is Gisela's frequent baths. However, Gisela estimated the cost to be SEK 6 /bath, which her parents think is reasonable. Consequently, Gisela still takes (at the minimum) daily baths with her parent's consent. George and Gunnel think it is alright for her to enjoy that luxury, and since they believe that it helps her to get through school (she does her homework while bathing) they believe it is worth the money. If the price doubled, then they would possibly restrict this practice.

Cold-water usage varied over the period with a downward trend, while hot water usage dipped drastically during the summer - beginning of autumn, and then returned to 'normal'. Since July, 2003, only three members are living permanently in the flat, since the son Gustav moved to another city to study. This is probably the most important reason for the lower volume of water used. The summer dip in hot water usage may be the result of shorter and colder showers talked about in the first interview, conceivably replacing some hot baths. The more frequent laundry washing in the flat may be of importance at the beginning of the period (March and April, 2003), but according to the family, the communal laundry room was about to be finished soon after my first visit. When finished, they returned to their normal laundry routine pattern; using the communal laundry room about once a week, but also regularly using the washing machine in the flat.

Figure 4.18 Monthly water usage in household G, March, 2003 - March, 2004



When comparing March, 2003, before volumetric billing, with March, 2004, with volumetric billing, we see that both cold water and hot water usage is lower, with the largest decrease in cold water use. Apart from the summer season, when much more cold water than hot water is used, cold water usage only marginally exceeds hot water usage. In February and March, 2004 hot water usage even exceeds cold water usage. Having the dishwasher connected to hot water, taking frequent baths, doing a large share of the laundry in the communal laundry room (limiting cold water use in the flat) and not distinguishing between hot and cold water, contribute to the comparatively large proportion of hot water. During the entire period, the household used 56% cold water and 44% hot water, and used 164 litres per person and day.

George does not scrutinize every bill, but when he does he relates monthly usage to the estimated annual usage. Gunnel takes an interest in the bill and checks the difference between paid and actual cost, but also the consumption figures in order to compare months. The Internet option has not been used. They think the new billing arrangement has been beneficial for the household economy. They have concentrated on saving on heating energy, which has been successful. They earned SEK 200 by saving SEK 2,719 on heating, despite a debt of SEK 1,131 for hot water, SEK 189 for cold water and SEK 1,189 for electricity.



## CHAPTER 5

### Gebers –the case of a nutrient-saving arrangement

*[...] I thought that the surrounding environment was very beautiful, with the lake and woods and everything ... I didn't think the house was beautiful then, because it looked pretty awful ... but I thought it would be possible to alter ... to make it ... nice [...]* (FF)

*[...] Gebers wasn't completely new ... I knew about Gebers because I had an allotment here and I spent a lot of time here as a kid [...] but that wasn't the reason, the reason, I guess, was that there was a large and cool-looking building at the edge of the forest as well as next to the water so that it's ... well, it's both permanent accommodation and vacation accommodation at the same time [...]* (BM)

These two comments are made by two residents in Gebers, explaining the importance of the site for their choice to move to Gebers. However, Gebers is more than a physical building in a physical place. The choice Gebers is also about ideas of a preferred way of living. These ideas and the place itself are interrelated and important for each other's development.

The ecological and collective tenant owners' association Gebers is situated in Orhem, about 15 km southeast of the centre of Stockholm. The two-storey apartment building was a small sanatorium built in the 1930s and converted into residential flats in 1996-1998, when dry urine-diverting toilets were installed in each flat. My focus is on the household responsibility for the operation and maintenance of this toilet arrangement. In this chapter, I describe how the dry toilet affects aspects of use, and how the household responsibility for operation and maintenance is carried out. The last section gives an account of water use. All information is based on my fieldwork and when not marked, the description is based on my interpretation of the interviews and visits there. The empirically based description of the residents as users and caretakers of the water and sanitation arrangements leads to some crucial themes, which are analysed in chapter 7.

## GEBERS

Collective living is about everyday life and household work, such as reducing living expenses, sharing household tasks and enhancing social contact. Utopian thinking - the idea of the good life - is also present in one way or another and facilitates the introduction of unconventional solutions (Caldenby 1992). The people starting up Gebers had two main objectives: a lifestyle enhancing close social contacts and entailing less negative impact on the natural environment.

### Idea – acquisition – realisation

In the autumn of 1994, a few friends and neighbours in a suburb of Stockholm started to discuss a vision of how to create affordable social and ecological living conditions. Early on, the unoccupied estate of Gebers was identified as a possible location. After the association EKBO (Ecological and Collective Living in Orhem) was formed in January, 1995, the members had a spatial and local base on which they could project their ideas (Thornblad 1998).

After some struggling with municipal planners and politicians concerning changes in the city plan in order to convert Gebers into an apartment building, the acquisition was agreed on. Different ways of carrying out the conversion and forms of occupancy were discussed and several housing companies were contacted. Finally, HSB<sup>81</sup> was selected as a collaborative partner, and the EKBO group decided to form a tenant owners' association associated with HSB (Thornblad 1998)<sup>82</sup>.

The possibility of self-administration and independent decision-making appealed to most EKBO members, and the benefit of being part of a housing association compensated the organisational and ideological differences – some

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<sup>81</sup> HSB (Hyresgästernas Sparkasse- och Byggnadsförening) was established in 1923 by the tenants' association in Stockholm. Hence, the housing association has its roots in the popular movement. HSB is a federation of independent local tenant associations (HSB 2005).

<sup>82</sup> A Swedish tenant owners' association is an economic association with the purpose of making flats available with right of occupancy. A member does not own the physical flat or a part of the house, but all members own the entire property together, e.g. flats and communal indoor and outdoor spaces. For a fee, the member uses one of the tenant owners' association's flats (the one which he/she has bought) for unlimited time. Each tenant owners' association has a board of elected members in charge of administration and maintenance of the building, and the members decide at annual meetings on the economy, maintenance plans and the use of communal spaces (HSB 2004; Bostadsrättslag 1991). Tenant owners' associations are regulated by a national law; SFS 1991:614 (<http://www.notisum.se/rnp/SLS/LAG/19910614.HTM>). The law of economic associations (SFS 1987:667) also applies to tenant owners' associations.

EKBO members wanted total independence and that the flats should be rental.

EKBO and HSB shared the responsibility for the management of the conversion and refurbishment. HSB was responsible for the financing and providing the necessary building skills, while EKBO was the initiator of ideas and practical solutions, and also organised the residents. The positions on the tenant owners' association board were initially shared between EKBO members and representatives from HSB, but eventually the tenant owners' association members made up the majority (HSB 1998; Thornblad 1998; Widén 1998).

Work on the refurbishment started in 1996. The members did most of the construction work themselves, but contractors were engaged for electrical wiring, plumbing and installing the heating and ventilation system. Some environmental consultants were engaged initially to provide knowledge about ecological construction among other things. The initial EKBO idea was that the members would do the work on their own flats while a construction firm would refurbish the communal facilities. However, as a response to the contractors' expensive tenders, the members opted to do much of the work on the communal facilities. After a long and arduous process, economically, socially and physically, most members moved in during the summer of 1998. From the 1 September, 1998, all the members paid the full fee. By October, all the flats had a dry toilet and three flush toilets remained in the communal basement (Thornblad 1998; Widén 1998).

### Collective living

The 32 households in Gebers mainly comprise families with children and/or teenagers. A study from 2002 reported that 28.5% of the residents were children under the age of 13 in Gebers, which is far higher than the Swedish average (16%) (Andersson and Jensen 2002). There are also some single-person households and couples without children. Most adults are in the age range 30-50 years, but the full range is from 20 to 80 years of age. According to one of the residents, some 36 children ( $\leq 19$  years) and 48 adults lived in Gebers in September, 2003. Over the years, the total number of residents has varied between 60 and 80.

Most adults commute to work or study, either to Skarpnäck, central Stockholm, or other areas in Greater Stockholm. Three are self-employed (October, 2004) and run their entire or part of their business from Gebers (Hort, pers com). It is about three kilometres to the nearest civic centre, Skarpnäck, where grocery shops, schools and other public services are located. Buses run between central Skarpnäck and Orhem's farm (about 200 metres

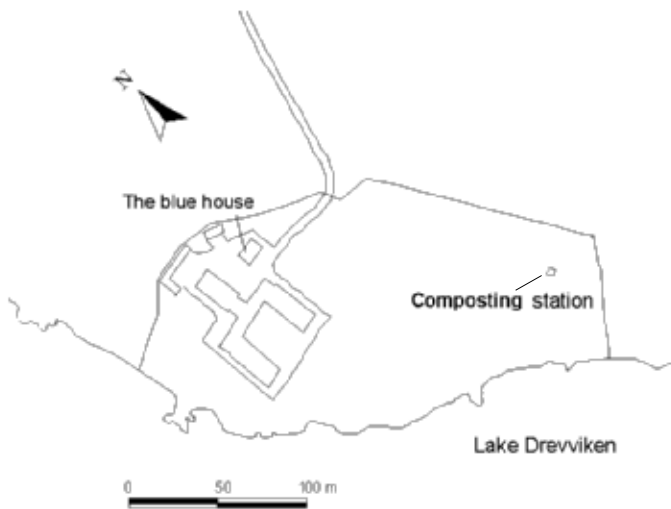
from Gebers) once every half hour during the rush hour and once an hour at other times and with the subway connection at Skarpnäck, one can reach central Stockholm in just over half an hour (Widén 1998).

The design of a collective building could either be seen as a tool for social change, or as a manifestation of a way of living already developed. Examples of important attributes, also present in Gebers, are a communal dining room and interior passageways from the flats to the communal facilities. Often, collective buildings are located “outside” their urban or rural context and have a complex social organisation. A collective way of living may separate and rationalise functions normally ascribed to the household (micro-level) or society (macro-level), or to an intermediate level (meso-level) (Caldenby 1992).

The two-storey building in Gebers, about 3500 m<sup>2</sup>, situated on Lake Drevviken, has a pitchfork layout with a central building and a northern, eastern and western wing (see Figure 5.1). There is an unbroken passage from the tip of the eastern wing through the central building to the end of the western wing. Where the central section intersects with the eastern and western wings, there are stairs leading down to the cellar and up to flats on the first and second floor. In addition to 30 permanent flats, there are also two rooms to let. The communal dining room and kitchen are located at the centre of the central section. The basement contains communal facilities such as a laundry room, a sauna with shower room, hobby rooms, storage facilities, the central heating unit and three water closets. The urine tanks and collection bins for faecal material are located under the eastern and western wings, in rooms excavated by the residents themselves.

There is also an additional building, “the blue house”, with two flats. These flats have different toilet systems (albeit not conventional) from the others, and are not included in this study. There are also some storage shelters and a carport.

Figure 5.1 Overview Gebers



*Source: Author's illustration*

The communal kitchen is a powerful symbol for the residents, and preparing food and eating together are deemed important for preserving the community. The residents eat dinner together four days a week, Tuesday through Friday, except during the summer vacation. Almost all residents belong to a “cooking team” of three persons. Each member prepares dinner six to nine days per term (follows the school terms). A few vegan households are not part of a cooking team despite heavy social pressure to participate. There is an ongoing debate about whether meat should be included in the menu or not, but the collective has agreed on a menu that includes all kinds of food. Recently (2003), the vegans started a cooking team of their own on Mondays, when the communal kitchen is available. Some households are part of both teams. Even though many respondents say that the communal cooking takes a lot of time, most of them also point out its importance. The cooking team is the basis of the collective, and the fact that not everyone takes part is seen as a problem.

In addition to belonging to a cooking team, collective rules stipulate that all adults must work eight hours a month for the benefit of the tenant owners’ association. The construction phase required 15 hours, and occasionally more, to manage the self-maintenance and operation of Gebers, and the number of

hours required for communal administration and maintenance has varied over time. For example, each adult was compelled to work 50 hours with window-frame painting. In 1996, two members were expelled after refusing to fulfil their work obligations, and in 1998, another member was on the brink of being expelled for the same reason (Thornblad 1998). Each adult member is engaged in one or more working groups or has a specific responsibility. For instance, there is a compost group, a solid waste group and a maintenance group. Other tasks have varied over time, since important tasks during the construction phase have become redundant and new tasks have been added. Most of the work duties are performed in these groups and often during a monthly working day, usually a Saturday. The tenant owners' association's board meetings are also included in the eight hours.

### Ecological living

Ecological living was one of the main objectives of the creation of Gebers. The collective translated ecological living into practical arrangements for transport, food preparation, waste handling, energy and water and sanitation.

*Transport:* Gebers members use public transport and bicycles, and nine families own a car. The collective administers one car-pool with petrol-driven cars (October, 2004). For a time, there were two car-pools. The car-pool initially had an electric car, but it was considered too expensive to replace it with another electric car when it wore out. Some members then started an alternative car-pool with an electric car, since they did not approve of having cars running on petrol. Now, the alternative car-pool has been closed down, and cars running on ethanol are about to be introduced in the existing car-pool.

*Food:* The communal meals served four times a week are prepared from organic products (according to the KRAV criteria).

*Waste system:* Food waste is brought to the composting station for organic waste, some ten metres from the main building. All other waste is sorted into 15 fractions in a storage shelter on the site, called the "recycling house"<sup>83</sup>. A contractor collects most of the fractions, but textiles, batteries, organic waste,

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<sup>83</sup> Rigid plastic, metal, coloured glass, transparent glass, waste paper for recycling, paper packagings, cardboard, textile, organic waste, batteries, combustible waste, non-combustible waste, bulky waste, electronic waste and wood (Hort, pers com). Compared to an 'ordinary' HSB association, such as the one I live in, this is more extensive. My association provides sorting facilities for household waste (combustion), paper, cardboard (paper packaging), electronic waste, batteries, light bulbs and fluorescent lamps. For rigid plastic, metal, glass and ecologically harmful waste, members are requested to use municipal facilities.

electronic waste, wood and bulky waste are part of the self-maintenance (Widén 1998; Hort, pers com). Ecologically harmful waste such as computers, fridges and freezers remain a household responsibility. However, small electrical appliances and paint residues are stored and their transportation is organised collectively<sup>84</sup>.

*Energy system:* A woodchip furnace provides central heating for the apartment building. The woodchips can be replaced or supplemented with oil, e.g. during peak periods and when there are operational problems related to woodchip combustion. Solar panels provide some energy in the summer and on sunny days during the rest of the year. The collective buys electrical energy, so-called “green electricity” produced by windmill generators, directly from the electric grid.

*Water and sanitation:* The Gebers collective formulated goals for saving potable water, not using water of better quality than necessary and installing urine-diverting toilets to enable nutrient recycling (Widén 1998). Being ultimately self-sufficient as regards water and sanitation has been discussed. Another aim is to use all equipment and materials until they have worn out, which in a way clashed with the ecological aims for water and sanitation. The conflict between aims was resolved by a compromise; the collective decided to install source-separating toilets in flats lacking an existing toilet connection and to keep the existing water closets in the others. However, this decision was overtaken by events, when the sewers collapsed after not being in use for some years. The fact that Gebers had to replace more or less the entire toilet and sewer system, and that the collective had decided that every new toilet must be source separating, meant that the alternative toilet system came to encompass all the flats.

A group of residents was given the task of coming up with proposals for different toilets, and among the suggestions were, for instance, a urine-diverting toilet from WM-ekologen<sup>85</sup>, a urine-diverting toilet with cyclone separation of faeces and water including UV light to kill micro-organisms, and the Rosen toilet where urine is sorted and the faeces are collected dry in the toilet itself. Vacuum toilets were also discussed. The weak and strong points of various toilets were evaluated. Due to the perceived poor status of the

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<sup>84</sup> From July 1<sup>st</sup>, 2001, the seller of electrical and electronic goods is obliged to receive a corresponding amount of worn-out goods from the buyer without compensation. For instance, if a new computer is bought the buyer can hand over the old computer to the producer (seller), irrespective of brand and without charge. One exception is freezers and fridges, which the municipality is responsible for (Naturvårdsverket 2003).

<sup>85</sup> WM-ekologen is a retailer of urine-separating toilets, previously called Wost Man Ecology.

sewer pipe through Lake Drevviken<sup>86</sup>, plans for recycling grey water, inspiration from a consultant and the possibility of complete nutrient recycling, the residents thought it would be wise to treat not only urine but also faeces. The dry toilet was considered to be more robust than a vacuum system that might require sophisticated maintenance and involvement of the tenant owners' association. The dry Rosen toilet, with the faecal matter collected in a bin in the bathroom, was rejected because faeces were more visible and emptying involved carrying the bin through the flat and building. Some residents, however, advocated the Rosen toilet because being closer to the faecal matter would create a stronger sense of responsibility for the system. Finally, a dry urine-diverting toilet was chosen, which allowed the faecal matter and urine to end up in a bin and tank in the cellar.

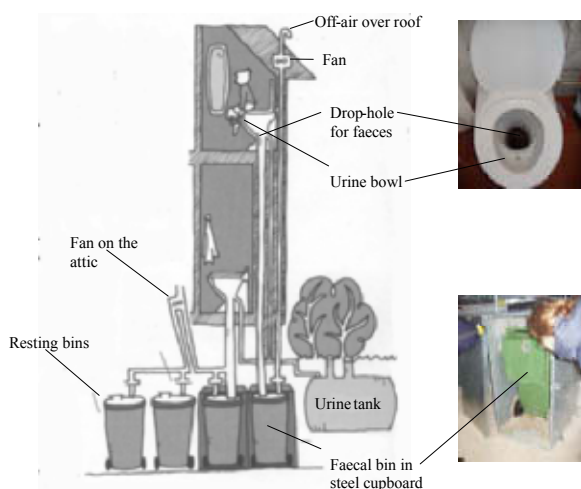
All flats have a dry toilet but there are still three flush toilets in the basement. These were the only toilets in the building that not needed replacement due to function failure (Widén 1998). The fact that dry toilets of the same kind were not installed there was partly due to difficult installation (no cellar space underneath), but primarily to difficult maintenance (Hort, pers com). The flush toilets are primarily used by persons residing in the two guest rooms (Andersson and Jensen 2002), by other visitors and by members using the washing room or sauna. Some respondents, however, say that some families residing in Gebers also use the flush toilets.

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<sup>86</sup> The owner of Gebers is responsible for this pipe. The quality of the pipe is contested; Widén (Widén 1998) claimed it would be functional for many years, whereas some respondents claimed its doubtful quality to be one of the reasons behind choosing and planning for a water and sanitation arrangement that relieves the pressure on the pipe. However, according to one of the residents, also involved in the 'toilet selection group', the quality of the pipe is good but in the early days there was a discussion about Gebers's vulnerability *if* it broke (Hort, pers com).



**Figure 5.2 The dry urine-diverting toilet**



*Source: Author's composition from (HSB 1998), illustration Jeanette Milde.*

The exterior of the dry toilet selected looks like a common porcelain water closet. However, inside there is a urine-bowl at the front and a drop-hole for faecal matter and paper at the rear (see figure 5.2). The urine bowl can be flushed with a small amount of water (ranging from 0.02 to 0.3 litres/flush, 0.08 litres/flush on average (Andersson and Jensen 2002)) and emptying into a pipe. The urine (and flush water) is led in copper pipes to one of the three plastic tanks, one in each wing of the building. In the eastern and western wings, the tanks are located in the excavated cellar and in the northern wing, in the room containing the central heating unit.

When the urine tank is almost full, the member who is responsible notifies the contractor to come and empty the urine with a suction truck. This occurs about 3-4 times a year. Ideally, the urine is taken to a farm at Lake Bornsjön<sup>87</sup> where it is stored in tanks for six months according to hygienic recommendations. In April, the urine is ploughed into the soil. In the winter, when no fertiliser is needed, the tank at Lake Bornsjön fills up and at times the contractor transports the urine to a wastewater treatment plant instead. But for the members, transporting the urine to a wastewater treatment plant is unthinkable. Not only does it undermine the entire idea of and reason for having a urine-diverting toilet, but it could also be done using less energy by using the ordinary sewers. At the time of the first study (February, 2002), one

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<sup>87</sup> According to one of the respondents it also receives urine from two other residential areas in Stockholm, Understenshöjden and Palsternackan.

of the residents had contacted the Rural Economy and Agricultural Society<sup>88</sup> to identify a farmer who wanted to use the urine. Finding a technical solution that enables urine to be released into sewers at Gebers was also considered. However, when the second study was carried out (September, 2003), none of these options had been selected and the arrangement for urine transport and utilisation was unaltered.

The rear part of the toilet has a drop-hole for faeces. A 200 mm wide vertical pipe leads down to a bin located in the cellar. The 140-litre bin is the same make as the ones used for solid waste. Some households have changed to a smaller receptacle in order to make the emptying easier. For fire protection reasons, the bins are placed in completely airtight sheet-metal cupboards with an airtight connection to the vertical pipe (Andersson and Jensen 2002). Underpressure is created in the bins by means of fan ventilation. A ventilation pipe is attached and a fan extracts air and smell and in order to dry the faecal matter (Widén 1998). The underpressure in the cupboard evacuates air from the toilet room and as long as the fan is on, there is no smell in the room.

Each household has to manage its dry toilet according to the instructions drawn up by the tenant owners' association (HSB 2000). Every household has to empty its own faecal bin. Some households have their bins in the excavated cellar and have to lift it up through a shaft with a tackle or manually. Others have the bin in a room in the basement and use the elevator in the building. The bin is emptied at the communal composting station on the compound, about 150 metres from the residential building (see figure 5.1)<sup>89</sup>.

Gebers receives its water from the city water company, Stockholm Vatten. Some of the water is heated to 58° C (to provide at least 50° C at the tap), and is horizontally circulated in the basement. The wastewater, mainly grey water, is discharged into the conventional sewer and conveyed to Henriksdals WWTP. The collective has plans for reusing grey water and storm water for non-drinking purposes, and has installed separate piping and taps for this purpose. These plans have yet to be implemented (Widén 1998).

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<sup>88</sup> In Swedish: Hushållningssällskapet. It is a regionally based and independent organisation. Its aim is to: "...enhance an enterprising spirit in rural areas and promote a healthy environment in the country as well as in the cities" (Hushållningssällskapet 2005). This is mainly done by developing and supplying knowledge to farmers and other company owners in the countryside as to their receivers (Hushållningssällskapet 2003).

<sup>89</sup> Faeces are merely stored and gradually decay rather than any 'real' composting process taking place. However, the place where faeces are emptied and kept is called *composting station* here since it is the word the respondents use.

## EVERYDAY LIFE IN GEBERS

The empirical material about everyday life in Gebers and water and sanitation routines is provided by a selection of the residents. Table 5.1 presents the participating households. Household members in greyish text do not take part.

**Table 5.1 Participating households**

Phase 1 & 2				
Household A	Male 40+ (AM)	Female 40+ (AF)	Child (AC)	Child/ren
Household B	Male 40+ (BM)	Female 40+ (BF)	Child	Child/ren
Household C	Male 40+ (CM)		Child	
Household D		Female 50+ (DF)		
Phase 2				
Household E	Male 40+ (EM)	Female 40+ (EF)	Child	Child/ren
Household F		Female 40+ (FF)		
Household G	Male 30+ (GM)			
Household H	Male 55+ (HM)	Female 55+		
Household I		Female 30+ (IF)		

These households make up 30%<sup>90</sup> of the total number of households in Gebers and about 15%<sup>91</sup> of the residents, and cover the main household types in Gebers. Since Gebers is a small community, approximations concerning ages and household composition are used to ensure anonymity. The letters in brackets are used to refer back to the respondents – e.g. AM stands for the male in household A and AF for the female in household A, etc. In some cases, if the quotes relate to delicate issues, I only indicate the sex of the respondent.

Most of the original residents (from 1998) still live in Gebers; tenants turnover has been low. Three of the nine households, household G, H and I, are “newcomers”, i.e. they moved in after 1998 when the flats were renovated and arrangements for e.g. water and sanitation and energy had already been completed. The respondents in household H and I were familiar with Gebers before moving in, since they had acquaintances there. Living with like-minded people, and in a place facilitating ecological living, appealed to the female in household I. She describes the lack of social and physical support for environmental activities in the area where she used to live:

<sup>90</sup> 9 out of 30 since the two households in the blue building are not included in this study.

<sup>91</sup> 13 out of 84.

*[...] I think I was one of few people who sorted the solid waste ... we had no containers in the vicinity so you had to transport it to the nearest petrol station [...] I had my sorting vessels and so on but composting was not possible there ... because no one, there was no one interested in taking care of it so to speak [...]* (IF)

The two male newcomers in household G and H had partly other reasons for moving to Gebers. The male in household G was familiar with the area, as he had practised outdoor activities in the vicinity. What appealed to him was the house itself; an institutional building that had become a dwelling but where the institutional character still prevailed. Also, nearness to the woods and the location by the lake made it attractive. The ecological profile appealed to him but was not his first priority, and the collective organisation was a new experience.

In contrast, the other male newcomer had considerable experience of collective living, and it was social factors that persuaded him to move there. He maintains that he has an active interest in environmental issues, particularly regarding transportation, but that was not what persuaded him to move to Gebers.

The other six households (A-F) have been involved since the very beginning or soon after, 1995-1996. Respondents from these households emphasise two aspects as being particularly important for their decision to live in Gebers: firstly, the area itself; beautifully situated next to the forest and the lake but still close to the city (see also quotations at the beginning of this chapter) and secondly, the opportunity to live closer to other (like-minded) people.

*[...] for me, it was being able to have a plot of land and to live ecologically and to live with other people ... being able to choose to have relations with people in everyday life ... and not having to have an allotment somewhere else or to ... that me and my kids are at the same place they play with their friends and I attend to my activities [...]* (EM)

Both the ecological profile and the social profile are of great importance, but few (3) mention the ecological profile when asked for their reasons for living in Gebers. When asking specifically about how important the ecological profile is, most think it is significant but no one mentions it as the most important aspect. Ecological living is described more as an additional benefit.

*[...] it was a bonus ... but it was not the main reason we moved there, I think [...]* (AF)

*[...] for me it was the environment ... I mean, not the environment meaning now we're going to save the environment but that it's so beautifully situated ... [...]* (CM)

*[...] for me it's like third priority or something [...] that's where we're I think we're very different ... some of us have great ambitions and then there are others who don't have such great ambitions (laugh) it must work out in everyday life ... and if it doesn't, there's sort of no point ... 'cos some people choose to put a lot of effort into it [...]* (BF)

The building and its solutions for solid waste, energy, transportation, etc. has been developed to enhance ecological living. Some solutions are 'built in' and automatic, but most depend on how households choose to act. For all collective activities, there is an ecological standard that should be met, but what standard each household chooses to apply is not a collective concern. It is clear to the respondents that the ecological ambitions vary between different households; there are, for instance, households that do not sort their solid waste and have petrol-guzzling cars (SUV). One respondent says:

*[...] it is assumed that everyone should feel an awareness for it and I don't think it's like that ... I'm living proof of that ... in a way you could view Gebers as a ... yes, as a miniature society ... there are those people who are really committed and those who are less committed [...]* (CM)

The existence of two communal cooking teams and two car-pools with partly different objectives also illustrates the differences in ambitions and principles among the residents in Gebers. While emphasising the household's right to set their own environmental standard, there are respondents who feel that there are social norms for how to act. The social context makes it easier to live ecologically because there is an ongoing debate, and knowledge transfer, about related issues, verbally but also e.g. through increased awareness of available organic products as a result of the communal cooking. In addition, the many bicycles placed outside are encouraging. There are no formal norms for how to act, but there are still some activities that the residents preferably should do, such as sorting solid waste. However, although residents in Gebers are referred to as a group, there are individual variations in both experiences of norms and of norm setting.

According to the respondents, what distinguishes their everyday life compared to a 'conventional' everyday life is less use of car transportation, taking into account the fact that the location of the building necessitates some form of transportation to reach workplaces, grocery shops, medical services, etc. Another commonly stressed issue is a general lower consumption of material things, including recycling and reuse of objects already possessed and buying second hand. A more careful selection of things that are bought and used is also related to this.

## SOURCE-SEPARATING TOILETS

In this section, I will describe the interrelationship between householder routines and the dry toilet arrangement from installation in 1998 up to 2003. Household members are users, and have routines as such, but operating and maintaining also requires certain routines. Operation and maintenance on the household level include cleaning the toilet bowl and urine pipe and emptying the faecal bin. This section will concern the respondents' experiences as users and facilitators of this toilet arrangement.

### The toilet in the flat

In 2000, when the toilet system had been in operation for two years (and about one year before I started up my studies in Gebers), one of the residents made a survey of the toilet system in each household (Moritz 2000). The survey covered the most common problems, issues such as occurrence of flies, urine leakage and blockages in urine pipes. The survey also included residents' general perceptions of the toilet system; whether the residents found managing the system reasonable in terms of work effort, and whether the system was considered to be socially sustainable. The households were asked to suggest how the system could be improved. 26 out of 32 households responded to the survey.

17 of the 26 households mention significant problems with flies<sup>92</sup>. Seven households have had some problems, and two have never had any problems. The most common fly-prevention method is to apply Radar<sup>93</sup> (a chemical insect repellent) and to empty the bin frequently. Some households have also placed a simple net over the ventilation hole in the bin to stop flies from escaping. Other measures were to use a smaller bin, add ashes to the faeces, to add ashes together with lime and peat or to apply sawdust. The survey also mentioned being more careful with the household waste compost and keeping the toilet lid closed as fly-prevention strategies (Moritz 2000). Most likely, individual households have used a combination of approaches. Many of the problems revealed in the resident survey are also addressed in this study and I will return to them.

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<sup>92</sup> The flies are called faeces flies in the results of the survey. The flies thrive in the toilet and there seem to be no doubt that they originate from there.

<sup>93</sup> Radar Dos O is a spray used for indoor vermin. It is exceptionally poisonous to fish and other organisms living in water and it could cause long-term effects in the water environment (Bayer 2005).

## *Usage*

The unique feature of a urine-diverting toilet is to keep urine and faeces separated, not to mix them with sewage water. The objectives are to protect the sterile urine from being contaminated by faeces or by pathogenic organisms. Also, if urine ends up with the faeces the content gets wet, which increases the weight of the sack, increases the smell, attracts flies and slows down the sanitation process. The need to keep the faecal matter dry and not allow pieces of faecal matter to enter the urine pipe places restrictions on toilet use.

Men should ideally sit while urinating in order to avoid splashing urine into the drop-hole and other spaces. No male respondent found it a big problem to sit down. Their previous routines differed; one claimed he always sat down, while the others usually did not sit down when urinating. The respondents who used to stand and urinate, sit down on flush toilets more regularly nowadays, although they still stand on occasion. Two respondents state that they still usually stand up at work, one believes it is out of habit, while the other refers to the stressful environment. The same respondents think it is nice to sit down, that it is much calmer. Another discloses that he sometimes stands up when urinating in the dry toilet, but not too often, since it is a point of conflict at home. A female respondent reports that there are men in the house who brag that they can hit the urine hole while standing, but she is not convinced.

Some residents, mostly women, are not satisfied with the design of the toilet. A female respondent proposes that the urine bowl be extended further towards the drop-hole for faecal matter.

*[...] the toilet isn't really designed for girls [...] you easily pee into the drop-hole and then urine ends up where it shouldn't be ... [...] perhaps the urine-bowl should be more ... arched or extended like a triangle maybe [...]*

However, she is not convinced that such a change in design is feasible. It would narrow the drop-hole at the rear and thus increase the risk of faeces clinging to the porcelain. Another female respondent made the comment that it was very difficult to use the toilet initially, before she found out how to sit:

*[...] I thought it was difficult in the beginning, I didn't think the toilet was made for women ... I felt that no matter how I positioned myself, I peed wrong (laughs)*

*HK: Have you learned how to sit now?*

*I: Yes, right on the edge*

Men are also concerned about the design of the urine bowl. Two of them would like to have a more suitably shaped urine bowl. One man maintains

that the female body has a shorter distance from the bladder to the outlet than men, and therefore women urinate at a higher speed. Consequently, the bowl cannot accommodate all the urine and it overflows into the drop-hole for faeces. He suggests that either the urine bowl outlet should be bigger or the bowl itself be bigger. However, this is not a problem for women only, since the other man living in a single-person household, also expressed worries about the bowl's receiving capacity.

Households with children experience other problems. The male in household B, who also empties his household's bin, sometimes quarrels with his children if the faecal sack is too heavy, indicating that they have urinated into the drop-hole for faeces. One female respondent said that it must be difficult for children as they usually urinate and defecate at the same time. A dry toilet requires the user to do one thing at a time. Children have problems in learning how to separate urination and defecation and to adjust their position on the toilet accordingly. Another indication of the problem is that some families with children use the communal WCs in the basement. The reason for this practice is, however, not totally clear. The possible reasons given by some of the respondents are that children refuse to use the dry toilet, problems with flies and poor ventilation, keeping the household bin from filling up quickly.

A potential problem is when the family has guests. New guests must be informed about how to use the dry toilet correctly. Respondents report on various reactions from guests. Some of them are curious and relate to their privy in the summerhouse, others are worried that they would not be able to manage and hold back. Men need to be informed that they should sit down to urinate. A female respondent maintains that men sometimes get embarrassed and/or decide to urinate outside in the bushes instead.

The fact that the toilet is not flushed has some implications. The WC receives all sorts of unwanted matter, such as outdated medicines, vomit, scrubbing water and tampons. Everything thrown into a dry toilet ends up in the bin in the basement and is not gone, but has to be emptied manually and eventually, the contents also should be used. A dry toilet both encourages and requires an increased awareness of what is acceptable to put in the toilet. The dry toilet made users think about what purposes it could be used for:

*[...] earlier, you could flush rubbish down the toilet which you can't do now ...[...] You have thought about it now and then, I guess, "well, where should I put this" when it's something disgusting, when you have something disgusting [...]* (EM)

The respondents say they are careful about what they throw into the dry toilet, and insist that the disposed matter must be biodegradable and not be a liquid. One female says:



*[...] it is a completely different behaviour it would never cross our minds, and nor do I think the children, would throw things into the toilet ... because it's really a completely different way of thinking about such matters [...] you are much more careful, I think, when you have a toilet like this ... because it affects us in a direct way if I flush something down a water closet it could end up affecting someone else far away [...]* (BF)

What is proper or not to put into the toilet is soon learned, and the direct feed-back is thought to support proper disposal, which is illustrated by these two comments:

*[...] it could almost work like you have to, it isn't as easy to put white spirit or something in it like ... there's probably no water ... you don't flush it away but it probably ends up down there [...]* (CM)

*[...] it's easy, if you don't have a toilet like this, to throw down plastic tops [...] you can't do that here, well, of course you can but you get it back if you cultivate using the shit then it pops up when you're raking ... it wouldn't happen if you throw it into a WC [...]* (AC)

One activity that has caused some reflection is vomiting. The WC has been used as a receptacle for vomit, either directly or indirectly. Residents were informed that vomit is biodegradable and throwing up in the dry toilet is permitted. The residents have developed a “vomiting practice”, but initially they were doubtful. One respondent told me:

*[...] I think that the first time someone in the family had gastric flu, oh can you throw up in the toilet ... you think about it before ... what you can do in the toilet [...]* (BF)

A couple of the respondents have thrown up directly in the toilet, whereas some are reluctant to throw up directly in the toilet and describe placing one's face over the faecal pile as an unpleasant or awkward experience. One respondent mentions the difficulty of cleaning the porcelain afterwards, since no water should go into the faecal bin. The solution has been to use the washbasin, a bucket or a plastic bag as receptacles for vomit. If a bucket has been used, the waste has been poured into the toilet or shower/bathtub. In the case of the plastic bag, it is usually placed with the combustible waste fraction.

A practice where the dry toilet is no option is the disposal of scrubbing water. The respondents say that they threw the wastewater from cleaning floors, etc. into the toilet where they lived before. Now, wastewater disposal poses the same sort of problem as vomit. One respondent says that when she cleans the communal stairs, she pours this water into the WC in the basement. This is also an option for wastewater from the individual flat, but here wastewater is poured either into the kitchen sink, the washbasin or the bathtub/shower.

The latter is the most common practice, and one respondent describes his practice in the following way:

*[...] the toilet is normally the sink ... and it is a blessing that you clean more often than you throw up ... when you've scrubbed the floor, where do you pour out the water ... if you pour it out into the washbasin, gravel and stuff end up in the bottom and that's not pleasant and you can't throw it down the toilet and if you pour it out in the shower you find yourself standing in your socks in it when this water comes up and you're standing in this water ... so I usually to kick up the grating for the shower and pour it in there [...]* (AM)

Besides faeces, toilet paper is the most common matter thrown into the toilet. Three households (B, G, H) throw all their toilet paper into the faecal bin, while the others more or less separate the urine paper. The sorted urine paper is placed in a wastepaper basket in the bathroom, which is emptied into the combustible waste fraction container. In households, which separate urine paper, practices may differ between household members, and in households with children the children usually put all the paper into the bin. The reason given for separating urine paper is to reduce frequency of emptying the bin. No respondent maintained it was because it is thought to be bad for the composting process, rather, the opposite. Research has confirmed a positive effect of adding paper, both for the composting process and for fly prevention because the bin content gets drier. One male (BM) also says that the paper is important when emptying since it facilitates emptying and makes the contents less repulsive than they would have been without the paper. Another reason for throwing all toilet paper into the faecal bin is to avoid the extra work of emptying the wastepaper basket.

Unwanted items are thrown, intentionally or not, into the dry toilet as well as the WC, but the difference is that the householders have to handle those items when emptying the dry toilet bin. A kitten once ended up in the bin, an incident with a happy ending. Cat owners are careful to keep the toilet lid closed because of this risk. In the beginning, people with small children were worried that the width of the drop-hole was enough for children to fall into. However, no such incident has occurred and today, no one worries about it.

### *The absent water*

The new technology requires the residents to change some of their routines; for instance, the “flushing-habit” was reflected on and then altered:

*[...] in the beginning it was really strange to ... it was really strange not to flush this toilet ... but now it isn't ... and then after a while it became strange to flush conventional toilets [...]* (BF)

This shift in routine behaviour seems to have been unproblematic for the residents in Gebers. Respondents have somewhat different flushing routines: one male claims he always flushes after he has urinated out of habit, whereas another claims he only flushes once every third day since he has been told that it reduces the risk of crystallisation in the toilet's urine-pipe. For the latter male, this meant that his time-diary lacked records of toilet visits for some of the days and only had brief notes other days, simply because he did not use any water!

The low water usage is perceived as positive, and is mentioned by most respondents as an important factor behind the toilet system selection<sup>94</sup>. They feel good not using several litres of water each time they use the toilet, especially not wasting water of drinking quality as in the case of conventional WCs.

*[...] my feeling is that every time I use a conventional toilet I'm wasting something we use as drinking water in this country ... it feels very unnecessary ... it didn't take long to get out of the habit of ... using water closets ... it feels completely idiotic to pee a few decilitres and then flush ten litres to get rid of it [...]* (CM)

Awareness of the water consumption of conventional toilets seems to have increased, and three respondents claim they actively look to see if low-flush options are available on public toilets and at work.

The fact that there is no flushing also means that the system is comparatively silent. Two respondents say they appreciate the silence; in apartment buildings you usually hear when neighbours flush the toilet.

*[...] I'm really happy that we don't flush. I've lived in apartment buildings and I've heard it, that is, in a flat where you can hear every sound, where I've not only heard the flushing but even the urinating [...]* (IF)

However, one of the newcomers questions the justification for installing a dry solution, considering that there is more water in Sweden than we will ever need. He thinks it would have been much easier to have a wet solution and then separate faeces from the water. This would also make it easier to clean the toilet.

### *Smell*

In most households, the toilet is not the cause of smell. The ventilation forces the air in the bathroom down through the toilet drop hole and prevents the

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<sup>94</sup> The question of system selection was only put to respondents in phase 1.

smell from the bin reaching the flat. As long as the ventilation works, there is no smell at all in the bathroom, not even right after defecation. In this way, it is superior to a water closet. The male in household E thinks the absence of smell is nice when having guests and also makes it possible for more than one person at a time to be in the bathroom. The female in household D thinks the absence of bad smell and no water splashing makes the dry toilet more hygienic to use than a conventional toilet.

Two single-person households, household G and I, suffer from bad smells from time to time, and the respondents believe that something may be wrong with the ventilation in their flats. Perhaps the air-pressure is too low. The male in household G has reported this to the resident responsible, and he is also careful to close the steel cupboard holding the bin properly so that the air-pressure is maintained.

It is evident that the ventilation system is crucial for keeping out the smell. The ventilation depends on electricity, and if and when there is a power cut, a bad smell soon starts to make itself felt. The smell is described as awful – it stinks. Respondents insist that it is impossible to remain in the building when this happens. To prevent the smell from spreading into the flat, some respondents tape plastic over the toilet, one respondent takes a towel in a plastic bag and cover the drop-hole for faeces, and another closes the bathroom door. One respondent says he take out the bin, and another respondent claims that this must be the right measure to take in the event of extended power cuts. Measures must be taken within hours, with a longer time frame in the winter.

Urine is not much of a problem when it comes to smell. Only one female, who separates her urine paper, reports a smell from the wastepaper basket and concludes that she will have to empty it more often. Another female says she keeps a paper bag in the wastepaper basket and keeps the lid slightly open to dry the urine paper to prevent it from smelling. An imbalance in the ventilation system also could cause the smell of urine, but otherwise smell from urine is related to the cleaning of urine-pipes and when the tanks are being emptied.

A recent concern (September, 2003) among the residents is that the drop-hole pipe to the bin has started to erode. The reason for this is that the pipe is made of galvanized sheet metal, and it is probably being corroded by moisture in urine and faeces and by the water used for cleaning. The residents are worried about the cost of the complicated job of replacing the pipes, and about getting someone to do it. Some respondents are also worried about how it will affect the smell. One respondent, affected by this problem, claims that it now smells in the cellar space where the bin is kept.

### *Cleaning the toilet*

All toilets need cleaning. Six respondents use the words more difficult and messier when comparing cleaning the dry toilet with cleaning a WC<sup>95</sup>. Most stains in the flush toilet are either beneath the water surface or on the porcelain, but the flush water removes most of them. The remaining stains are scrubbed off with a brush, which is then cleaned in the toilet water. If a dry toilet gets stains, on the other hand, they have to be removed manually and preferably without using water. The dry toilet obviously calls for other practices. A female respondent describes the problem:

*[...] with an ordinary toilet you can just put the brush down into the water that's there ... but here it's somewhat more complicated as ... we have the shower right next to it so you sort of have to shower on the brush and then put it into the toilet and try to clean and after that try to make it (the brush; author's remark) clean and shower it ... it's a bit trickier [...]* (AF)

All the respondents but one (who uses a cleaning agent in a spray bottle) use water to clean the porcelain, but they have different techniques to meet two requirements; not letting too much water enter the bin while still getting a clean toilet bowl.

All the respondents but one claim that they use only a little water, they only moisten their brush or rag in the washbasin or shower. One respondent, who recently moved in, worries about the amount of water being excessive and thinks it is difficult to adjust the amount of water used:

*[...] you have to think more here and maybe I haven't got it right yet but one is more particular here... [...]* (GM)

The male in household A, though, who also believes he has learned to deal with the cleaning issue and does not find the cleaning difficult, claims not to be too concerned about the amount of water, arguing that the compost is too dry anyway. He uses an ordinary toilet brush and water from the shower. Possibly, the bin gets somewhat heavier but he thinks it is such a small amount of excess water that it does not make it more difficult to empty the bin. Due to the possible moist conditions in his bin, flies could thrive and be a more frequent problem and the smell could be more intense when emptying, but he does not report any such problems. The same respondent does not believe there is any hygienic difference between WCs and dry toilets, but says he knows that there are residents with other opinions.

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<sup>95</sup> The teenager does not mention cleaning at all so it is assumed that the cleaning involved is done by the parents.

The amount of water depends partly on what brush or tissue is used for when cleaning. The tools used are toilet brushes designed for WCs, and washing-up brushes, while some respondents use a rag, ScotchBrite, or toilet paper. Some households use a combination of tools. Brushes, etc., which are used several times, are cleaned afterwards in the washbasin, bathtub or shower, and/or in the kitchen sink.

When it comes to hygiene and cleaning, there are several aspects that concern the respondents. The following quote illustrates the unease one respondent feels about cleaning the toilet brush:

*[...] I'm not saying that I waste a whole lot of water when I clean the toilet brush in the washbasin, not enormous amounts but one's not used to having the toilet brush and cleaning it then ... at first, I cleaned the toilet brush under the wastepipe from the bathtub ... I filled the bathtub so that water ran out and I cleaned around the floor drain down against the floor ... it was hard work (laughs) [...]* (BM)

Another respondent refers to hygiene issues in terms of the close contact he experiences when cleaning his toilet:

*[...] hygiene to me is that I don't need to deal with it ... in the same way more than a brush in the toilet and clean ... here I have to use a spray bottle and I can't flush with water as it comes down there and it's no good but I have to take a spray bottle with some sort of cleaning agent and then I have to wipe with paper and then, well, I'm in very close contact with it [...]* (CM)

No respondent expresses concern about hygiene in terms of health risks. The most frequently expressed concern is more in terms of the toilet not looking clean. The design of the toilet, with a rather narrow drop-hole means that it gets stained easily, thus requiring frequent cleaning. The households do not clean the faecal pipe leading down to the bin, even though they realise that it is not free from faecal matter. One respondent says:

*[...] the first two years, I thought that was disgusting ... knowing that that pipe all the way down there, that it was probably a bit disgusting down there ... but now, that pipe is just there ... as long as the bowl looks okay you think that the pipe seems hygienic and so it's okay [...]* (BM)

As everything placed in the bin ends up in the compost, there are restrictions on the choice of cleaning agents, as well as the amount used. Water is in some cases the only 'cleaning agent' while in other cases, it is combined with soap, soft soap or a mild cleaning agent.

Blockage by crystals in the urine pipe is a major problem according to the respondents. It can occur both in the large pipes leading to the urine tank in the

basement, and in the small pipe in the toilet bowl. We will focus on the ways in which the urine pipe in the bathroom is cleaned, since blockages and problems in the larger pipes are the tenant owners' association's responsibility.

The above-mentioned resident survey of the toilet system, found that almost all the 26 households have had blockages once or several times. According to the survey, the blockage is removed by adding sodium hydroxide<sup>96</sup> to the flush water, or by using a special brush or length of wire. In addition to blockages, the urine pipe may leak even though the pipe is intact (Moritz 2000)<sup>97</sup>.

The urine pipe has to be cleaned regularly, normally with a special brush and hot water. Respondents from seven out of the nine households report problems with urine-pipe clogging. The two who say they have not had any blockages are newcomers and their negative answer is perhaps due to this. The male respondent in household C says that the pipe gets blocked once every six months. The latest blockage was removed by blowing into a pipe inserted in the urine-hole. He says that he does not flush the urine bowl every time he urinates, but only once every three weeks. He argues that crystallisation take place when water reacts with urine. The male in household A says the blockages have been removed by flushing water into the urine pipe with a hose, but the last time this was not enough, since the blockage was further down the pipe in a bend. He then inserted a long hose in the urine pipe at the back of the toilet and the blockage was broken up by the strong jet of water. In this case, the respondent claims he flushes the urine bowl every time he urinates, but he has heard that you should either not flush at all or flush thoroughly. The female in the same household, who also flushes every time, says that their urine pipe has been blocked several times. She finds it tricky to solve since the pipe behind the toilet has to be loosened and flushed with water down the floor drain. She thinks the smell is awfully bad.

The woman in household D has faced problems with a clogged urine pipe, and she believes it is because too little water is used or that the pipe should be flushed more frequently. She lives on the top floor and flushes hot water for a couple of minutes once a week in order to remove the crystals that have settled in the horizontal urine pipes in the cellar. In addition, there are inspection points on the horizontal pipe where you can insert a hose to flush the crystals into the urine tanks. She says that the smell in the pipes is terrible.

Four of the respondents have general concerns about the urine-pipe clogging, if the entire system was to get clogged up. Between my first and second study

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<sup>96</sup> Sold as caustic soda in supermarkets. It is used for dissolving sewer blockages.

<sup>97</sup> Three households had had the urine pipe changed by the toilet manufacturer at the time of the survey (Moritz 2000).

the tenant owners' association had purchased a high-pressure washer to use at the inspection points to clear out the pipes. One of the concerned respondents, who also experienced a fountain of urine coming from his toilet, caused by the clogging problem, believes that the residents must understand that they need to flush their toilets with water to remove the crystals. The female in household D, who flushes extra water to avoid clogging in the main pipe, also reminds others of the importance of clearing the pipes.

Wider holes and wider pipes are suggested solutions, both for easier access for cleaning and for the reduced risk for clogging. Also, the urine-pipe in the toilet should go straight down, and not bend and be placed behind it.

### *Flies*

Flies in the flat is a crucial issue, although the households participating in this study do not seem to be the most badly affected. All the households in this study, both the original residents and the newcomers, have had problems with flies to varying degrees. The ones arriving at a later stage naturally have experienced the problem on fewer occasions, and they also benefit from the 'veterans' experiences. Households with longer experience believe that the situation has improved, probably because of measures and routines introduced to reduce the number of fly outbreaks, such as increased bin emptying frequency. The measures taken to get rid of the flies also show what they think stimulates or reduces the incidence of flies.

According to the respondents, flies breed all year round but seem to peak during the summer months. The flies are not 'ordinary' blowflies, but smaller flies known as 'flower flies' or 'fruit flies'. These are common in potted plants and fruit bowls. However, the respondents state that most flies multiply in the faeces collection bin, and they are sometimes referred to as 'faeces flies'. Flies are said to find their way from the faecal bin up to the flat, where they look for something to eat. They like more or less the same food as humans, such as fruit readily available in fruit bowls, ready-made sandwiches and glasses with beverages. Respondents have also noted that they are attracted to the food waste compost, found in nearly all the households in Gebers.

The respondents present various explanations about how flies multiply in the bins. Some believe that they come from outside, finding their way in through small openings to a conducive environment for breeding. Others think that maybe they are somehow in the faeces and start to grow after some time. A couple respondents say they have no idea. Some of them mention the probability that flies find their way from one bin to another. From this remark, it is just a small step to blame neighbours for the presence of flies, that bad maintenance by "others" makes it possible for flies to multiply and



spread. However, this is not the case. Only one of the respondents is worried about how neighbours maintain their toilets:

*[...] one of the neighbours had a problem only a month ago ... but in that case, I think that ... the family hadn't checked what it looked like down in the bin ... and the flies spread, then they came out here in the basement and, well ... they can spread to other ...*  
[...] (BM)

The fact that flies rarely affect some households while others still have severe problems is puzzling. Three respondents (DF, AM, CM), mention that residents living on the first floor, with a shorter distance between the faecal bin and the flat, may have more frequent problems, but cannot say that this is generally the case. None of the three respondents lives on the first floor themselves and they have a moderate “fly problem” in comparison with other residents.

Respondents point to one practice as being crucial, both in order to prevent flies from multiplying and for getting rid of the problem once it has occurred – emptying the bin. Initially, the residents emptied the 140 litre bins once every six months or even more seldom. However, when flies started to show up, and were found to come from the faecal bins, nearly all the respondents decided to empty the bin more often. This proved to be an effective method<sup>98</sup>.

*[...] so when you spot small, small, small, small flies ... then you know that there's a hotbed down there and then it is time to go down and remove the sack and you may have to take it often ...* [...] (CM)

As long as one household has problems with flies, there is always a risk that other households are also “contaminated”, either via the bins in the cellar or simply between flats. The female in household A says that nowadays, if they or a neighbour with whom they share cellar space spot flies, they notify each other and make sure that all the bins are emptied simultaneously.

Another measure to reduce fly problems is to prevent flies from getting access to food waste in the kitchen, to food and to the communal household compost heap outdoors. In some cases, when fly problems have become severe, households have stopped composting household waste temporarily and even permanently. Also, food such as fruit has been kept in plastic bags and not left in a fruit bowl on the table.

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<sup>98</sup> There were also other reasons for changing the emptying procedures; this is discussed at greater length below.

Emptying the faecal bin more often and being more careful with household compost waste and food are the most frequently used measures. It is also fairly common that chemical pesticides like Radar or Pyrex<sup>99</sup> are used and one respondent has used flypaper to catch the flies. Radar is sprayed in the flat, down in the toilet, and in the bin itself. One respondent, however, questions the effectiveness of using Radar:

*[...] some people use Radar and spray and so on but I don't do that [...] I suppose that it's mostly because I don't believe in it somehow ... should I go down and spray Radar ... when we have this ventilation system that has its main suction point in the toilet [...] I mean, it must disappear it feels like I'm letting the fire go up the chimney [...]* (CM)

Researchers have informed residents about the benefit of putting all toilet paper in the faecal bin to make the conditions drier, and in this way prevent the flies from appearing<sup>100</sup>. Many households put their urine paper in a separate basket. However, in my study, only representatives of household A explicitly say that they throw all of their toilet paper in the bin on the basis of researchers' recommendations. Household B has always done so and researchers merely confirmed their behaviour. Three households put all of their toilet paper in the bin, five separate urine paper, and in household A the female, but not the male and children, separates urine paper. However, the different practices do not seem to have as much to do with fly problems as with other concerns. This is discussed further when the emptying procedure is accounted for below.

Other precautions taken against flies are rare. The female in household D, who lives in a single-person household and spends a lot of time outside the home, is careful to close the lid on the toilet, as she believes that the flies are attracted by the light and move towards it. In between the two studies she also bought a dark toilet lid for the same reason. She has also spread ashes and lime in the faecal bin to try to stop the flies from breeding. She does not have increased emptying frequency as a strategy. She has only replaced her bin once in five years<sup>101</sup>. Still, she does not seem to be more affected by flies than others, which she believes have something to do with her living on the top floor, far from the bin.

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<sup>99</sup> Pyrex-N is used against insects on ornamental plants (Kemikalieinspektionen 2004).

<sup>100</sup> Research has been done in Gebers on the behalf of the Urban Water Program, which required the cooperation of the residents. In exchange, the residents wanted help with some of their problems, like the flies, instead of the fairly small amount of money (EUR 1,100 to the tenant owners' association) they were offered. Obviously, the researchers' activities have affected residents' behaviour to some extent, but I do not consider this a problem for the central findings.

<sup>101</sup> Her bin was also emptied during a research period in autumn, 2001, when researchers emptied it for study purposes.

Due to the relation between the faeces bin and flies, seven respondents explicitly say that the presence of flies is unhygienic, nauseating and a private nuisance, and another two respondents say it implicitly in the following quotes:

*[...] now the fly problem isn't that bad anymore ... but initially when you saw those flies in the kitchen, on the food, you knew where they came from that's where they'd been before that ... yes I threw away the food, I felt I couldn't eat it [...]* (FF)

*[...] those flies are nor ordinary flies that sit in the window and are happy and pleasant ... instead, they sit in the fruit juice and in beer glasses and wine glasses and on everything one drinks, you have to have a lid on everything [...]* (BM)

Some respondents maintain that flies indicate a system deficiency, and that the fact that some residents in Gebers dislike and are discontented with the toilet system may be a reaction caused by the flies.

*[...] the flies drive people crazy ... you have flies everywhere and you change (the bin; author's remark) and the flies come back and when you've changed three or four times in a period of five weeks and the flies keep coming back, then it feels meaningless ... but I think the situation has improved [...]* (CM)

*[...] Yes, I've heard some people say it's hell carrying on with these damn flies [...]* (CM)

*[...] I think they're tired of ... the people who've had problems with flies, I think they're really sick of it [...]* (FF)

One respondent says that the reason why families use the water closets in the basement might partly be because of the problem with flies. He confirms that it is no fun at all when the flies arrive. Apart from the repulsiveness of the flies themselves, respondents also find it annoying and arduous. The four who did not label flies as unhygienic are all men, and three of them merely refer to flies as annoying and arduous. One male just says he does not let the flies bother him.

Both men and women are disturbed by the presence of flies, but the women are more inclined to label them as unhygienic and disgusting. Perhaps because cleaning and food preparation have traditionally been, and still are, a woman's task in many households. I cannot say that the men do less cleaning than the women in Gebers, but they are more often involved when it comes to emptying the bin. The reason for them being more inclined to say that the flies are hard to accept and annoying could be that they are first and foremost responsible for emptying the faeces bin. The consequence of an infestation of flies is that the bin has to be emptied, sometimes not just once but several times during a short period in time. Perhaps this is harder to accept than the flies themselves.

## Handling the faeces

The story below is inspired by one of the resident's account of how the bin is emptied in his household:

*It was nearly a month now since he last emptied the bin, and therefore it is time to do it again. A suitable moment has come up since Sarah, his wife, is at home and can look after the children and see to it that none of them uses the toilet while the bin is removed from its normal spot. He informs Sarah about what he is going to do. He jokes with her, "or perhaps I can stay here and look after the children while you empty the bin?" Just one look at her tells him that she does not believe that it is a good idea, she is reluctant to do it and as far as he can remember he has always done it himself. He puts on a jacket for protection from the cold outside, gloves and a pair of boots and goes down to the cellar store where they and some other neighbours keep their bins. He opens up the steel cabinet and takes out the bin. He releases the plastic bag in which the faeces are collected, pulls it out of the bin and seals the bag with a knot. Since the bag seems to be whole this time, he puts it directly on the floor. It happens that urine leaks, but usually the bag is all right. He has put some newspapers on the bottom of the bin just in case. Before he places a new bag in the bin, he makes sure that the bin is clean. Before leaving the cellar he puts the bin back into the steel cabinet and makes sure that the airtight door is completely closed, so that the underpressure is maintained. Today, the bag was not as heavy as it could be at times. When it is, he quarrels with his children, as he assumes that they have urinated in the faecal drop-hole. Well outside, he puts the sack on the children's sledge and pulls it over the snow down to the communal composting station. In summertime, he often uses some sort of cart, such as a wheelbarrow, for the same purpose. A sign at the composting station, put up by the compost team, advises residents to empty new faecal material in the right compartment. He removes the upper layer of leaves and reeds, with which the previous resident had covered his or her refuse, with a rake or spade available for the purpose. He unties the sack or merely tear it open and pours the contents out in the assigned place. He knows that some of his neighbours find this part of the process repulsive, but he doesn't. It does not take more than a few seconds and he really does not think about the smell or that he could get sick or anything. Next to the composting station there is a small plastic bag in which the greasy sack is put and thereafter sealed to prevent any smell and dirt leaking out. He takes some leaves and reeds to cover the faeces. Heading back to the house, he goes past the garbage recycling area and puts the plastic bag into the container for the fraction that is destined for incineration. Back home, he announces that the toilet is now okay to use.*

Other households may have a slightly different procedure, depending on, for example, household composition, problems with flies and whether the bin is placed in the basement or in the excavated cellar. The story should be seen as an introduction to a description and analysis of the emptying procedure - who is doing what, where, when, how and why?

### *Emptying frequency*

The households' management of faecal matter has changed over time. When the system first was installed in 1998, all the households had two bins of 140 litres each at their disposal. When the first bin was full, it was swapped and stored in the excavated cellar/basement or under a tarpaulin at the edge of the wood next to the composting station. Here, the faecal matter was left to dry for six months in order to be harmless, dry and odourless. The original idea was that the decay of faeces would start already in the bin and subsequently reduce the volume and make it more soil-like. After a period of six months the bin was emptied at the communal composting station. However, the system did not function for several reasons:

- No decomposition process in the bin, but more or less an anaerobic process,
- Problems with flies,
- The full bin was very heavy and hard to handle.

The solution to these problems involved changed routines. There is no reason to store the faeces in the bin, since no decomposition takes place. Residents jointly decided to abandon this practice, and the message to the households in Gebers was that it is all right to leave the faeces at the composting station without prior storage. One bin was sufficient; it was emptied, cleaned and put back in place.

Since the need for pre-composting was unnecessary, it was possible to empty the bin more frequently. As described earlier, emptying bins more often could eliminate the pressing problem of flies, thought to originate in the bin. Most households also began to empty their bins more often, generally varying between once a month and once every four months. In the summer months and in the case of fly outbreaks, bins are emptied even more often. This was seen as a fairly effective method to reduce the risk of flies, since it gave them less time to breed. However, none of the respondents seem to know that flies develop in about two weeks.

However, when the number of emptying occasions increased, the shortcomings of other arrangements were accentuated. Hitherto, the faeces had been collected directly in the bin. After being emptied and before being put back in place, it was cleaned. This was done in different ways. Some cleaned it in the shower room in the basement, but the most common way was to use a hose, or seawater, together with some sort of brush outdoors. Cleaning the bin was considered both tacky and time-consuming and in order to avoid this task, plastic bags were introduced. They reduce the need for cleaning as long as

they stay intact and are kept folded over the brim of the bin. One respondent, a newcomer, says that once, the plastic bag slid down from the brim:

*[...] these new black bags are too small, you have to force them over the brim of the bin [...] now the unfortunate thing was that one corner had let go so that the shit came ... missed and sort of ended up outside the bag and ran down the side [...]* (GM)

After this incident he cleaned it up with paper, filled the bin with water from the lake, scrubbed it and emptied the water in the forest. He did not appreciate this activity and says he hopes it was the last time. He got hold of adhesive tape with which he secured the four corners of the bag, a strategy also practised in another household.

Without doubt, the plastic bags have been important for the emptying routine, but none of the respondents mention it as conflicting with the ecological aims. The plastic bags also facilitated altered emptying routines; the bin can be left behind and only the bag is taken to the composting station. However, this requires a small household and/or increased emptying frequency. Many households in the east and west wings, with bins in the excavated cellar, empty their bins simply by lifting out the sack. Single-person households may empty the bin after 3-4 months, while larger households have to remove the bag once a month. This means that they do not need to take the bin out by the shaft, which is a heavy task. One male in a single-person household uses a smaller bin that can be hauled over thresholds and through small openings through the house if the contents are too heavy to carry.

Households in the north wing and the central body keep their bins in the basement and can use the lift to take the bin to the ground floor. This means that they can manage a heavier bin and therefore empty it more seldom. A comparison of the three larger households in the study, A and B with bins in the basement and E with the bin in the excavated cellar, shows that households A and E fit the presumed pattern. Household A empties its bin once every third month, and it has access to the lift, and household E empties once a month and does not have access to this resource. Household B, however, empties once a month despite having access to the lift. In this household, the male single-handedly empties the bin, while in household A both the man and the woman take part and in this way manage a heavier bin. When they empty the bin, it is filled to 70-80%. About 100 litres of faeces weigh about 100 kilograms and cannot be managed by a single person<sup>102</sup>. Thus, the localisation of the bin in combination with household size and available manpower seems to affect the emptying schedule. The paper routine,

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<sup>102</sup> The resident who emptied the bin at the time of the observation, estimated that his household's sack (approx. 4 persons) weighed about 20 kilos after about one month of use.

whether the paper is thrown in the bin or in a wastepaper basket, seems to be of less importance for the emptying frequency. Household A empties once every third month and throws most of the toilet paper in the bin, and household E separates urine-paper and empties once a month.

Apart from the benefit of lower weight and fewer opportunities for flies to breed, increased emptying frequency means that there is less faeces to handle. The male in household E says:

*[...] instead of lugging this large bin, pulling it down, emptying it all out it sort of ... you build up such a resistance when you work with heavy loads [...]* (EM)

In one household, another reason for using a smaller bin was that emptying the smaller amount was considered less messy and disgusting. The female in household F uses two bags in her bin in order to reduce the risk of leakage when carrying the faeces to the composting station.

The two small households D and H, consisting of persons in their upper-middle age, claim to empty the faecal bin only once a year or even more seldom. The reason for their bins not filling up as fast could be that they spend a considerable amount of time away from home. The woman in D also puts her urine paper in a basket next to the toilet and uses as little paper as possible, thus contributing to the slow filling of the bin. In contrast, the male in H claims to put a lot of toilet paper in the bin, which is thus not a valid explanation in his case. Despite sporadic emptying, neither of them claims to have much of a problem with flies. The woman says that she has been spared compared to other households in Gebers, but mentions a variety of methods that she has used to get rid of flies and to prevent them from occurring. The man does not really indicate if he has had a fly problem or not, but says that flies do not bother him. He may be very tolerant, or he simply has no flies. He claims that the content is very dry, and since flies are thought to thrive in moist environments, it is very likely that this has saved him from flies.

### *Household responsibility*

Emptying the faeces is a private task, although collective members help each other on occasion to lift the bin out of the shaft and tip it at the composting station. The arrangement of having one bin per household is a clear indication of the household responsibility for management, and thus only the household itself suffers from poor maintenance except for when flies spread between flats.

The respondents do not question this order. In the first interview round, they responded that there was no need to have a special collective taskforce for emptying all bins. Rather, most of them express a general reluctance towards

other peoples' faeces. Faecal matter is considered private, and emptying a neighbour's bin would be too intimate.

*"[...] then you would get in contact with other peoples' like neighbours' ... faeces and it would feel, no it wouldn't feel right ... then I think it would be easier to have a contractor that regards it as garbage and just comes and gets it [...]" (BF)*

The community has never discussed having a contractor, or forming a collective taskforce for bin emptying. The respondents believe it would be very difficult to recruit EKBO members to such a taskforce, but working with the faecal matter as a task during community workdays, as they have done a couple of times, seems to be in order:

*"[...] then it's so general, then it is like any work ... but this individual part everyone has to deal with separately ... it'd be too intimate [...]" (BM)*

Nevertheless, two out of the seven respondents from the first round of interviews, the male in household A and the female in household D, said they would be prepared to empty other residents' bins. The woman later on confirmed her statement by translating words into deeds; together with two other residents (among others, the male in household H) and one handicapped resident's helper, she took care of thirty abandoned bins, left with contents, at the composting station.

One way of finding out how a responsibility is distributed is to investigate what happens if a rule or norm is violated. At the time of the second round of interviews, I observed bins and plastic bags next to the composting station. Respondents confirmed that the bins and bags were filled with faeces. They also labelled it as a hot topic at that time. The compost taskforce had sent several e-mails, calling for immediate emptying of the bins and bags, and an announcement on the notice board requested households to put their signature next to having or not having emptied their bin/bag. The female who later on participated in the emptying of the bins and bags told me:

*"[...] at the edge of the forest there are a lot of bins, a lot of plastic bags with excrement are lying there and no one will admit to being the owner ... [...] we've asked people to empty everything as it really looks bad and it's bad when people on their Sunday walk see our bins ... you wonder what people say ... [...]" (DF)*

Since not all residents responded to the request to empty the bins, the four people mentioned earlier volunteered to deal with it. The male from household H says:



*[...] sure you get a bit irritated that there is this ... anonymity even here, as I said. Thirty bins and the group (compost taskforce; author's remark) has asked the residents a couple of times, that everybody must take care of his own bin, but most didn't and then some of us went down there and sorted things out [...]* (HM)

He suspected that some bins had probably been there for about five years. He also acknowledged a variation in the consistency of the faecal contents, some were dry but many were very wet. A reason for not emptying a bin might be the fluid content. Small children may have caused this, before they learned how to sit in order to get urine and faeces in the right place. Another factor that could potentially result in a wet content is if cleaning involves a lot of water. The fly problem was also worse in the early days of Gebers, and flies thrive in moist conditions. The combination of flies and a liquid semi-rotten content could explain why some of the households choose to turn a blind eye towards their unemptied bin.

Bins and bags were not marked, so the risk of emptying the wrong bin/bag, and thus handling other peoples' faeces, in addition to the possibility of remaining anonymous, might have persuaded some resident to take no action. It is also possible that residents, who moved out forgot about their 'resting' bin, but since the turnover of residents has been low, this would only explain the origin of a small number of the thirty bins and bags.

Some bins were probably left over from the time when the contents should be left in the bin for six months, before being emptied on the compost. The plastic bag, however, was introduced after this recommendation had been abandoned. Perhaps all households did not know about the new regime. The woman who finally emptied the bins provides another explanation:

*[...] perhaps it was because of many flies and minus 20 degrees outside and you can't stand it and just take it down to the woods or just put your bag there ... and then you forget, perhaps you don't remember that you left it there, I don't know how people think ... it's a bit strange*

*HK: what if they don't empty their bin or bag*

*R: well, then other people will have to do it [...]* (DF)

A private task becomes a communal task if it is necessary for the benefit of the community as a whole. The male who also participated in the emptying suggests that this solidarity sometimes, as in this case, can be abused:

*[...] you think that someone else'll do it or it ... well it's there all the time [...]* (HM)

In the future, it might be necessary to supplement household responsibility for emptying with support for aged residents who are physically incapable of

emptying the bins themselves. Several respondents propose solutions within the framework of the tenant owners' association; four suggest trading services between neighbours, and two buying services from neighbours – suggestions, which, however, contradict the earlier statements of crossing boundaries of privacy if one deals with neighbours' faeces. Other suggestions are related to the family/household: emptying the bin more often (3) and asking the children (probably not living at home anymore) to help out (2). Many believe one solution could be a single household purchasing the service from a company, or that the tenant owners' association making a collective deal with such a company (8) or hiring a janitor (2). The janitor would then not only deal with emptying the bins, but also attend to other parts of the (self-) administration that may be difficult when physical strength has diminished. One male respondent thinks it may be possible to find a home-help service to assist in emptying faeces, whereas one female does not believe they would be willing to do that.

### Male responsibility

The emptying of faecal bins appears to be a job for men in households where this is an option. The most obvious argument is that the bin could be quite heavy if it is filled, which certainly was a valid argument when the bin was emptied more seldom. Possibly, the fact that the men started to empty the bins due to their heavy weight may have made this task theirs. A female respondent told me:

*[...] I've not had to empty that much because my husband has taken care of it ... so it ... it hasn't been that onerous [...] it's just got that way because it was so heavy [...]* (EF)

The female in household B thinks that it just happened to become her husband's task, maybe a result of her latest pregnancy when she was unwilling to deal with faecal matter. Another less evident cause is that women seem to be more reluctant than men to deal with this task. The females in household A and B say that their husbands do not seem to mind, which their husbands also confirm:

*[...] I don't think it smells, or at least I don't think about it ... it just takes a couple of seconds just emptying it there and then the spade there and rake and out with it [...] it doesn't touch me ... cause I'm not worried about getting ill or anything ... no, it is just fun [...]* (BM)

*[...] I'm not that nauseated cause my wife she almost starts to puke when we empty the toilet and it doesn't bother me so it has become my task to do these things [...] I think it's quite ok ... I don't regard it as tiresome ... not tiresome at all [...] you take the consequences of your actions in a rather nice way ... we use the toilet and take care of it ... it actually feels very good [...]* (AM)

But if there is no male in the household, females take on the duty. All three women in single-person households empty their own bins and do not mind. As mentioned earlier, one of them did not even hesitate to take care of her neighbours' bins. So emptying is something that is tied to necessity. Also, it is something that is possible to get used to, as implied by one single female:

*[...] the first time I emptied I thought I was going to faint ... but you get used to that too [...] it's these feelings of disgust ... we aren't used to do it nor to seeing it [...] now I've got used to it and I do it quickly [...]* (FF)

The division of responsibility is shown in Table 5.2.

**Table 5.2 Household practices connected to emptying of faeces**

Household	Bin location	Paper in bin	Emptying frequency	Who empties?	Bin/bag
<i>Household A</i>	Basement	Most	Every 3 <sup>rd</sup> month	Male + female	Bin
<i>Household B</i>	Basement	All	Every month	Male	Bag
<i>Household C</i>	Excavated cellar	Faeces paper	Every 3 <sup>rd</sup> month	Himself	Bin/bag
<i>Household D</i>	Basement	Faeces paper	> once a year	Herself	Bin
<i>Household E</i>	Excavated cellar	Faeces paper	Every month	Male	Bag
<i>Household F</i>	Excavated cellar	Faeces paper	Every month	Herself	Bag
<i>Household G</i>	Excavated cellar	Faeces paper	Every 3 <sup>rd</sup> month	Himself	Bag
<i>Household H</i>	Basement	All	> once a year	Male	Bin
<i>Household I</i>	Basement	Faeces paper	Every 3 <sup>rd</sup> month	Herself	Bin

#### *At the composting station*

During the first five years, the composting station was a temporary structure made of loading pallets. This was considered to be insufficient, both as regards the risk of nutrient leakage into Lake Drevviken and the height the bin had to be lifted in order to empty the contents. One respondent involved in the construction of the new composting station said, before the new station

was completed, how difficult the old station was and what he expects from the new one:

*[...] it's sticky and it smells [...] and it's pretty heavy if you don't empty often ... in the future we'll invent a system where it won't get heavy so that one person can manage, at least one or two persons could empty the bin in the new compost with ease [...] now when we build this, we've got to make sure that it doesn't get like what it used to be that it's heavy ... and that you need to concern yourself with the shit ... you can pour it out and then it is pretty much over and done with [...]*

The male in the large household A, empties the heavy bin only every third month, and he says:

*[...] we're still building this new composting station down there so it's temporary [...] on New Year's Eve we dragged the bin down in the snow ... and then lifted it over the edge, God, it was heavy ... it worked out alright because my son and I helped each other [...]* (AM)

The construction of a new composting station has constantly been delayed by lack of time, and also by uncertainty about how to build it. However, in summer, 2003, almost five years after the introduction of the dry toilet, the new composting station was in place. It has two compartments consisting of wooden boxes on a waterproof concrete foundation, and the roof is made of corrugated iron sheet. It is thus protected from the rain and there is no risk of nutrient leakage. The front is removable and the contents can be emptied with a tractor shovel. The composting station is large enough to store several years' of faecal matter without being emptied. The low walls of the boxes make it easy to empty a bin or to throw in a bag (see Figure 5.3). Two respondents say:

*[...] I've been out there and emptied for the first time in the new composting station, which they have built but it works splendidly, much easier to pull the bin and it was easier to empty because having to lift it high up is only for the young and healthy [...]* (AM)

*[...] the ergonomics are much better [...] and probably a lower level of disgust [...]* (EM)

The contents of the old composting station have been left to decay longer before being reused.

**Figure 5.3 Emptying of faecal material in the new composting station**



A closer look at the picture on the right in Figure 5.3, showing a resident emptying faecal material into the new composting station, shows that he is wearing gloves, rubber boots and work-trousers. Although different clothes are worn, most of the residents wear special clothes for this activity, (see Table 5.3). Some of them also routinely take a shower and/or wash the clothes used when they have finished.

**Table 5.3 Use of special clothing when emptying**

	Male	Female
<i>Household A</i>	Work clothes, special gloves, boots.	Overalls (work clothes), handkerchief over nose and mouth, gloves
<i>Household B</i>	Gloves, boots and a jacket (for the cold)	Does not participate
<i>Household C</i>	Gloves, special clothes or the ones he is wearing at the time	-
<i>Household D</i>	-	No special clothes, but washes herself and changes her clothes afterwards. Uses no gloves
<i>Household E</i>	Work clothes, special gloves, boots. Pour boiling water over gloves afterwards.	Does not participate
<i>Household F</i>	-	'Gardening clothes', showers and washes clothes afterwards
<i>Household G</i>	Work-clothes or normal clothes that would have been washed anyway, old shoes. No gloves, washing hands sufficient. Nice to take a shower afterwards.	-
<i>Household H</i>	Ordinary shoes, worn-out trousers, gloves	No data
<i>Household I</i>	-	Boots, gloves

## Hypothetical alternatives to the present system

### *Using the composted faecal material*

Gebers has an agreement with Ersta Manor to take care of the faecal material. Ersta Manor will use it as fertilizer when growing animal fodder. The volume of the compost after five years is fairly small, only a few cubic metres, and no compost has been transported to Ersta Manor so far. The available space for compost is far from filled so there is plenty of time to decide how to use the compost, says one of the respondents. Up to now, no residents have used the compost in their small gardens. However, some compost has been used to build an embankment covered with grass.

There are discussions about using the faecal compost on Gebers' own property. Some residents are in favour, but according to one respondent who is also responsible for the composting station, they are not allowed to. The reason is that they want to be cautious due to uncertainty about the effects on human health.

A female respondent pictures the contesting views:

*[...] we've discussed if we might use it on our garden plots where we grow flowers or ... lawns or something and some people in this building are totally against it while others think it's okay [...]* (FF)

All the respondents in this study but two consider it to be all right to use compost material on flowerbeds, lawns and bushes. Eight of them are also in favour of using it on currant bushes, etc. and fruit trees. However, ten respondents would be against using it on garden plots for vegetable production, and four are also reluctant to use it for fruit trees. Three respondents would consider using it even for vegetable cultivation; a female qualifies her approval by requesting that the compost to be turned into soil, and a male says that it is alright if researchers say it is acceptable.

Respondents generally insist that either that the faeces must have been processed for a number of years and/or that it must have turned into soil:

*[...] there should be as much soil as possible partly because it feels like there's more soil and less shit visually ... and partly because it gets easier to handle [...] we laid lawns there and then they fetched when you saw bits of toilet paper then you've been too eager [...]* (AM)

*[...] some people used this soil and put it on garden plots and stuff outside here before it was ready ... it still smelled of shit and it was nauseating ... I didn't like it, it really should be soil [...]* (CM)

The sceptics as regards reuse are mostly hesitant because of their uncertainty of the content in faeces, such as heavy metals and pathogens. One respondent emphasises the importance of using it exclusively for growing animal fodder until such time it can be proved that it can be used without endangering human health. Another respondent thinks that perhaps it should not be used for any agricultural purposes because of its toxic content:

*[...] it can hardly be used in ... agriculture ... not because shit, our own faeces, is disgusting, it has to do with the chemical medicine accumulation that you accumulate toxic substances in the body [...] I imagine stuff like poisons and chemicals [...]* (GM)

Repulsiveness is not the reason for his hesitant attitude, but it is a reason given by others:

*[...] I wouldn't like it [...] I never use gloves when I work in the soil when I weed and so on ... I sort of like to push my hands down into the soil and I wouldn't like to do that in that soil [...]* (FF)

*[...] you have to really know ... what it contains ... before you use it if you had complete knowledge and knew that there wasn't anything disgusting then maybe ... but it doesn't feel that way ... well, there would probably be some resistance [...]* (AF)

*[...] in that case I think it has to be very mixed ... it would probably feel quite awkward ... it's the problem of heavy metals and stuff in the faeces, I think ... that makes it difficult to use [...]* (BF)

Thus, the reluctance to use the decomposed faecal matter in Gebers has more than one cause; from insufficient knowledge about its effects on the environment and health to an indefinable feeling that it is not all right to come in contact with composted material.

#### *What about views on the WC?*

All the residents in Gebers have prior experience of the conventional water closet, and often viewed it as robust and user-friendly:

*[...] sometimes when I use the toilet at work I think oh what an amazing innovation, just flush and everything is gone ... then maybe it damages the environment [...]* (FF)

*[...] sometimes it's almost pleasant to use an ordinary toilet ... it's civilisation in a way and this is something else, it's difficult to explain ... it's like when you are in the country and come into town and it's nice and comfortable [...]* (BF)

I inquired about the possibility of installing water closets in flats in Gebers, and if they or some other resident would like to have one. The respondents express almost unanimous views. First of all, there are practical and technical

difficulties involved in installing new pipes without having to enter and work from other residents' flats. Residents still hesitant about the condition of the pipe under Lake Drevviken see it as an obstacle. Installed water closets would also make it impossible to have grey water recirculation, since the wastewater would then also include urine and faeces.

Secondly, a change to WCs would not be socially supported:

*[...] there would probably be an intense discussion and opposition and questioning about whether that person is suitable to reside in Gebers [...]* (DF)

*[...] I think it's part of the building's profile so it's nothing one considers [...]* (HM)

Even the woman, quoted as saying that a normal toilet is more civilised, questions such a request:

*[...] it probably would be incomprehensible why one would like that ... yet it feels somehow like this is the toilet system of the future in a way even though it's not perfect it still is I mean it's better than an ordinary toilet ... it's a rather strong feeling and I believe everybody thinks so even if one curses it at times [...]* (BF)

Some respondents express a more open-minded approach, that it depends on why a person wants to abandon the dry system, but they all agree that it would be emotionally disturbing. They believe that a request would provoke unsympathetic reactions and most likely the person's suitability as a member of the collective would be questioned. Choosing to live in Gebers also includes leading an ecological lifestyle. A change away from the dry toilet would go against the original idea and this indicates that the physical installation is the representation of the ideal.

## WATERLESS TOILETS – BUT WHAT ABOUT WATER USE?

As noted, one main reason for choosing a dry toilet was to retain a low water usage. The water transportation of excreta is regarded as unnecessary and wasteful, and some draw analogies with situations abroad:

*[...] it's a bit sick visiting Africa and knowing that we flush toilets with water of better quality than the water you can buy in the shops there ... [...]* (AM)

There is a rumour of excessive water usage in Gebers; that Gebers used water at a level equal to houses with water toilets. All but four respondents, including all the newcomers, were aware of this rumour. Three express doubts about the accuracy of the consumption figures and/or calculations made, and they have made some rough estimates themselves, showing that the water consumption is not extreme in any way. One of them says:



*[...] I don't believe it's correct because we had 115 or 105 litres per person and day and that's not much, is it [...] 140 or 160 is what is normally discussed [...]* (EM)

The male in household C doubts the accuracy of the water meter, since he thinks that there is nothing that could consume that much water in Gebers. The male in household B thinks that the calculations may have been based on summer usage, thus showing excessive use due to watering the garden and children playing with the water hose. The male in household A reflects on the reasons for the high water usage, if any. He maintains that households with large bathtubs and old-fashioned taps and showerheads may cause the high consumption. Watering lawns and gardens during the recent dry summers could also have added to the consumption. He says:

*[...] the cost of having dry toilets is enormous ... and then we pour potable water on the lawn, it is completely outrageous [...]* (AM)

On the other hand, he says that the increase in summer could be neutralized since residents change from showers to bathing in the lake.

Respondents express surprise about water use being excessive, and they have difficulties in explaining the causes. It is perceived as odd because of the use of dry toilets, communal cooking and a belief that residents in Gebers are more aware and think more about saving water. Possible causes mentioned are lack of individual measurement and billing (economical incentives), residents spending more time at home due to being a student, unemployed and working less, and the comparatively many families with children. One respondent says about taking showers:

*[...] in that respect we're probably not so special [...] showering is a tough thing to do something about since it's extremely commonplace [...] you don't think about how long you stay in the shower, time doesn't exist in the shower [...]* (AC)

Another respondent is surprised by the information on excessive use, but realises that the frequent baths in his household consume a lot of water:

*[...] my children love to take a bath and it uses a lot of water ... while others have chosen not to have a bathtub to save water but sometimes we have neighbours' kids coming over to have a bath with them [...] it's fun that they can have baths so I don't think ... it's not wasting but it's not like an extreme saving [...]* (BM)

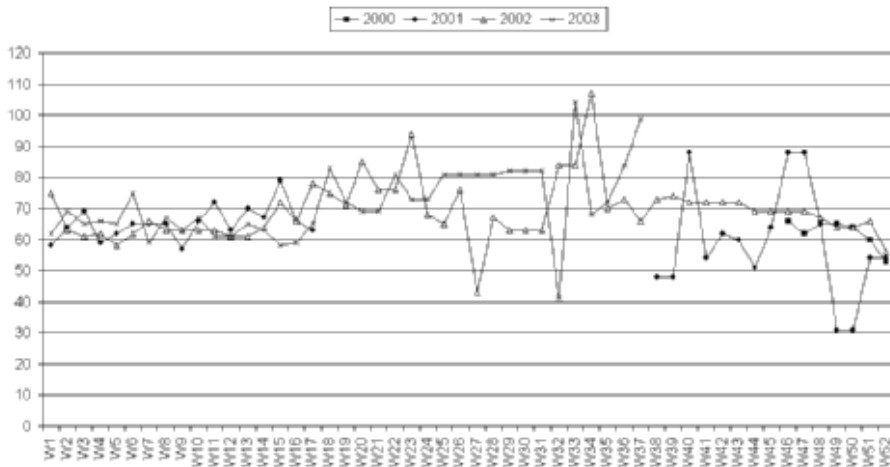
## Water use

Water usage is not metered individually, but aggregated values for the whole tenant owners' association are obtainable<sup>103</sup>. According to the water supplier, Stockholm Vatten, Gebers used 6,774 m<sup>3</sup> between 2<sup>nd</sup> of April, 2001, and 1<sup>st</sup> of April, 2003, which corresponds to a daily average of 9.3 m<sup>3</sup> (Elfving, pers com). Assuming that there are about 80 residents in Gebers, the average resident uses 116 l per day. The average for residents in apartment buildings in Sweden is about 230 l per day, whereas residents in private houses on average use some 170 l per day (Boverket 2002).

The resident in charge of the heating system has read off and recorded the total water usage and the volume of heated water since November, 2000. Ideally, he should have made a note of the volumes every week, but not all weeks are recorded, especially during the summer the notes are more sporadic.

The weekly average has been calculated for each week, and when readings are not available for 1-4 weeks there is an estimated average value. In 2001, there are no records from 30<sup>th</sup> April to 16<sup>th</sup> September, so this period is excluded<sup>104</sup>. Figure 5.4 shows the total water usage per week in Gebers for the period studied.

**Figure 5.4 Total water usage per week (m<sup>3</sup>)**



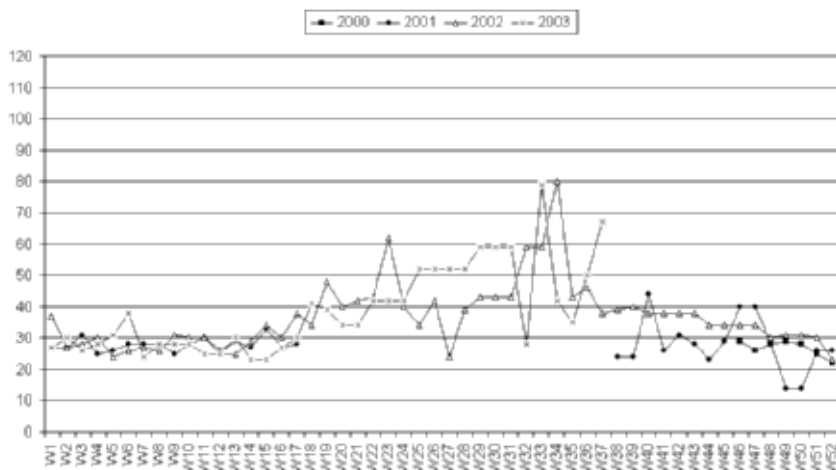
<sup>103</sup> The "blue house" is included in the aggregate values.

<sup>104</sup> The weekly average for this period is 62 m<sup>3</sup> of which 27 m<sup>3</sup> is hot water.

Total weekly consumption varies between 31 m<sup>3</sup> and 107 m<sup>3</sup>. The first 15 weeks of the year show similar annual values, but from about May (week 17) and onwards water usage tends both to increase and to fluctuate during the summer months, and then decrease but still fluctuate during the autumn and winter. The water used in the summer months' for gardening varies with the rainfall, and occasional special cultivation activities such as laying new lawns. During the autumn, the need for water in the garden decreases.

Studying cold water and hot water usage separately may give additional information. Figure 5.5 shows cold water usage during the period studied.

**Figure 5.5 Cold water usage per week (m<sup>3</sup>)**



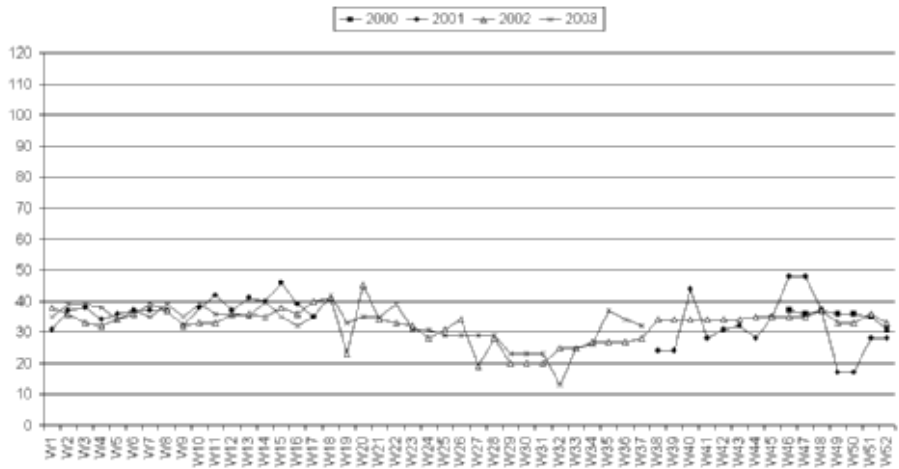
The cold water use pattern is similar to the total use pattern; in the first part of the year around 30 m<sup>3</sup>/ week, then increasing and fluctuating during summer, and decreasing but fluctuating in the autumn and winter. For 2002 and 2003, there are summer data. According to the Swedish Hydrological and Metrological Institute (SMHI), the summer weather was in general hot and sunny in 2002 and 2003 in the Stockholm area. In 2002, the beginning of June was sunny and hot but the rest of the month varied with some rainfall most days. In middle of July, it was warm and sunny again, and after a period of daily rainfall between 18 and 26 July, a period of dry and hot weather lasted more or less all of August, which was very dry. The hot and sunny weather lasted until the middle of September when cold weather took over and lasted for the rest of the year (SMHI 2002). The cold water peaks more or less coincide with the hot and sunny weather (i.e. the beginning of June, week 23, and August, weeks 32-34). In the summer of 2003 the first and last days in June were sunny and hot but the rest of the month was rather cold. It rained 14 days out of 30. The summer heat came in the middle of July (week 29) and after a few days of rain, there was a dry period again from 30 July to 11

August (weeks 31-32). The summer warmth ended earlier than the previous year, in about the middle of August (SMHI 2003). There was an increase in water use during the warm period in the middle of July, which decreased again in week 32 during a period with hot and sunny weather, and increased sharply in week 33. This was perhaps due to residents being behind in their watering due to the warm weather the previous week. The material cannot be used for detailed comparison between water usage and climate, partly because information on the local weather is unavailable, and partly because some values of water usage are based on averages for several weeks. However, the fact that both 2002 and 2003 had comparably hot and sunny summers affects the figures. We also know that new lawns were laid in the summer of 2003, which would have increased cold water use that summer.

A hot summer may also result in increased showering and/or more mixing of cold water than in wintertime. However, it is also said that some residents switch from showers to bathing in the lake. It is not possible to estimate the relative amounts of any of these activities, perhaps they balance each other, but they both may have some relevance.

Hot water is also climate-dependent to some extent. Figure 5.6 below shows hot water usage in Gebers.

**Figure 5.6 Hot water usage per week (m<sup>3</sup>)**



The use of hot water fluctuates considerably less than cold water. From a stable 30-40 m<sup>3</sup>/week at the beginning of the year, water usage declines and in the summer months (about week 23-35) low hot water usage is recorded, mostly between 20-30 m<sup>3</sup>/week. At the end of the year, water usage increases to about the same level as at the beginning of the year. Low hot water usage

during the summer may be due to replacing some hot water with cold water when showering, fewer hot baths and people spending less time at home.

Due to the self-maintenance of premises and gardens, Gebers' water use resembles water use in private houses. On the other hand, the collective metering and billing resembles the condition in apartment buildings. The special form of housing makes it difficult to compare the water use in Gebers with other types of housing, but 116 l per day is low by any comparison. The question is how important the existence of a dry toilet system is.

Statistical figures for Swedish household water usage indicate that about one-third of the water is hot water and two thirds is cold water. In Gebers, the proportion is about 50/50<sup>105</sup>, thus the share of hot water is comparatively high. In private houses, the proportion of cold water is probably higher due to gardens being watered. However, total water usage is at the level of 'conventional' private houses (170 l per day), if the volume for flushing is added – 40 l per day according to national statistics – to the metered 116 l per day, 156 l per day is used. Thus, if Gebers had had water toilets, the hot water consumption's proportion of total usage would be lower since it would have been 'diluted' by an elevated cold water use, about 63/37 – thus close to the national average.

The figure of 40 litres is based on all kinds of water closets, but low-flush toilets are becoming increasingly common. In the case of the dry toilets in Gebers, water use for flushing is almost zero<sup>106</sup>. During the time-diary days, the respondents on average used the dry toilet 3.6 times/day<sup>107</sup>. If they had used a water closet using 6 litres a flush, their water usage would rise from 116 l per day to 137 l per day. The fact that a water closet may also be flushed for other purposes, e.g. when cleaning, for garbage disposal and for scrubbing water, should also be considered.

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<sup>105</sup> The relation between cold water and hot water in Gebers is 49% cold water/51% hot water for 2001 and 53%/47% for 2002 (years with complete data for the entire year).

<sup>106</sup> Andersson and Jensen (Andersson and Jensen 2002) calculated the average water use for urine-bowl flushing to be 0.34 l per day. They also showed that 92% of the water in the urine fraction comes from flushing the urine bowl and only 8% from cleaning activities.

<sup>107</sup> Based on five respondents' time-diaries. Two time-diaries were discarded, one because all toilet visits (no water use) were not reported, and one for having suspiciously few toilet visits combined with little information content in general. One day for one of the time-diaries was also excluded since the respondent said she did not report in full that day. Thus the figure is based on 24 days in all.

## Save and spend

The dry toilets save a considerable amount of water in Gebers and their use is below average, but still not extremely low. The water saved on toilet flushing is due to the construction of the toilet, but what about other water-consuming activities in Gebers?

### *Water use in households according to time-diaries and interviews*

In this section, the information from the respondents' time-diaries is discussed. The time-diaries covered seven respondents' water use for five days. For respondents only taking part in phase two, there are no time-diaries to compare with, so I have had to rely on the interviews in these cases. These households are discussed first in this section.

The female in household I, says she does not use much water – even less than the Gebers average. She has to leave for work early and has breakfast at work. Her water use is somewhat elevated in the winter since she likes to take a bath about once a week. But during the summer, she replaces showers and baths with bathing in the lake – which she also think is a good way to save water. The single male in household G, in about the same age, does a lot of sports so he has to shower every day, which he does not consider necessary under normal circumstances. He describes the pleasure of taking long showers to be his environmental Achilles' heel. He claims that the long showers indicate that he is not extremely concerned about water; nevertheless, he is aware that his showers take longer than necessary. He owns a dishwasher, which he purchased for convenience, but does not think it affects his water use negatively. He describes his water use in general as normal – if he needs water he uses it but does not let the water run. The female in household F, older than the other two, states that she does not use much water.

The issue of water use and age is discussed by other respondents. One of the older respondents thinks that water use is a generation issue – he is content with 1-2 showers a week and takes a bath about three times a year. The female in household E states that she often takes a bath and argues that a lot of water is saved by not having a water closet and that the hot water is heated by solar panels. Still, she believes her household uses a moderate amount of water, a statement confirmed by her husband.

Five of those writing a time-diary are members of two large households. The male in one of these households maintains that no one uses the shower for a long time since they only have one bathroom and other household members must be given access. The time-diaries for this household show that no shower exceeds 10 minutes, but one of the household members has a

physically demanding job, which may entail two showers a day. The teenager in the same household says that his water consumption is low, he more or less only showers, and he also emphasises that they have installed water-saving taps and shower heads. If his time-diary is broadly accurate, which he says it is; only washing his hands and brushing his teeth on some occasions were not noted when compared to the interview information, I am inclined to agree.

The male in the other large household rates his household's water usage as being rather high because of the many baths. His children and even friends of the children (since they do not have a bath of their own) take a bath several times a week. The oldest child takes a bath nearly once a day. The members also point to dishwashing because many of the dishes are washed under running water and because various containers are washed before being sorted. The female says that it is difficult to tell the children not to bathe, but that savings may be achieved by altering washing-up practices:

*[...] perhaps one could wash up dishes in some other way than we do and ... what we don't have room for in our dishwasher we wash by hand and ... then perhaps one could make an effort not to wash up under running water [...]* (BF)

The female in household D claims not to use much water in Gebers. This is confirmed by her time-diary. She does not spend much time at home, once she showered at work, and most meals are prepared in the communal kitchen or eaten at the homes of relatives and friends during the time-diary days. However, she does take one bath and she says she likes long showers of 15-20 minutes because it is pleasant. She suggests shorter showers and subsidies for the installation of water-efficient showerheads in Gebers as ways of saving water.

Also the male in household C maintains that he uses little water. He does not have a bathtub and only takes a shower for five minutes in the morning. However, he reports in his time-diary two showers of 20 minutes each, one after working with association tasks, and one after being out running. He explains this discrepancy as follows:

*[...] if I remember, when I wrote that it was a long shower because I felt cold after I'd been outside and it was cold [...]* (CM)

Respondents link water use mostly to showers, baths and dishwashing, and their time-diaries confirm this. Laundry is rarely mentioned in this context, despite being a potential water consuming activity, but is reported in the time-diary. Consequently, the suggested water-saving measures, in response to the hypothetical question of which water-saving measures one would take if requested, are focused on the same activities; e.g. not taking baths every day, replacing baths with showers, showering less, reducing the time in the shower,

turning the tap off while soaping oneself, not washing up dishes under running water and being careful when rinsing dishes.

### *Collective water use*

Water use for communal activities in Gebers includes the communal preparation of food and doing the dishes, watering lawns and gardens and cleaning communal areas. Respondents find it difficult to say how much water is saved, if any, thanks to the communal preparation of food. Some believe that the dishwasher saves water, as indicated by the following statements:

*[...] the communal kitchen ought to save water, for example, that dishwasher would be far more effective than twenty five than the sum of everybody's washing up [...]* (AM)

*[...] communal cooking means that our water usage is minimal ... that is, every individual should wash his own dishes ... at home and fill up ten litres in a sink with hot water and then add some washing-up liquid and then rinsing, I think, must result in much higher water usage than rinsing the dishes and then rinsing them again a bit more thoroughly in the large dishwasher [...]* (AC)

All utensils are not washed in the dishwasher; bowls, knives, casseroles, etc. are washed up manually. One time-diary reports on two such washing activities that took 30 minutes and 45 minutes, respectively. If we assume that the water was running at a speed of 5 litres/minute<sup>108</sup> and that the tap was on for one hour and fifteen minutes, 375 litres of water were used. In addition, many of the respondents also rinse the dishes before putting them in the dishwasher.

The time-diary period coincides with the monthly workday, and several respondents noted water use related to maintenance of communal premises, such as water for mixing mortar and cleaning the entrance and stairways. As has already been mentioned, watering lawns could also be an activity requiring large collective water use. One respondent says:

*[...] we have watered ... that we've actually had very dry summers ... several ... which mean that we have done quite a lot of watering ... since we have had recently laid lawns and flower beds and so on [...]* (AM)

The tenant owners' association has discussed purchasing a pump to be able to use lake water for this purpose.

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<sup>108</sup> A 'speed test' was conducted in Ringdansen, which showed that the volume of water running at medium speed is about 5 litres/minute.



In this chapter, we compared Gebers' water use with national averages and found that the Gebers households use small amounts of water. The dry toilet be the reason for a substantial part of the difference. In chapter 8, we will take the analysis further by comparing water use in Gebers and in Ringdansen in order to assess the impact of environmental concern and volumetric billing, respectively. The impact of a dry toilet and a water closet in terms of waste disposal is also discussed in the same chapter. The primary focus in this chapter has been on giving an account of user/facilitators interrelationship with the dry toilet arrangement, and in the analysis in chapter 7, we hope to gain new insights by applying the theoretical approach developed in chapter 2.



# Analysing the effects of volumetric billing on household water routines

Chapter 4 shows that water is commonly used for drink and cook with, as a transporting agent, for cleaning and for comfort. The period studied covers the changes in water use just before and after the introduction of individual metering and billing per household. This chapter aims to analyse this process of change in terms of how and why household routines alter or not. The theoretical model from chapter 2 will be used to identify the relevant household pockets of local order for water routines, to analyse the intentions behind their development and discuss what they entail for water use.

What possible changes in water-usage routines and water use emerge from this change? The households' pockets of local order change, but this does not automatically result in a parallel routine change. Routines change much more slowly and result from awareness of the pocket of local order, and a redistribution of resources within the pocket may thwart the anticipated effect on routines. A household pocket of local order is not arranged in isolation from values and norms present in society as a whole. Cultural definitions of cleanliness, comfort and convenience are important motives behind its development. Still, water consumption does differ between households, and here we will investigate why this is so.

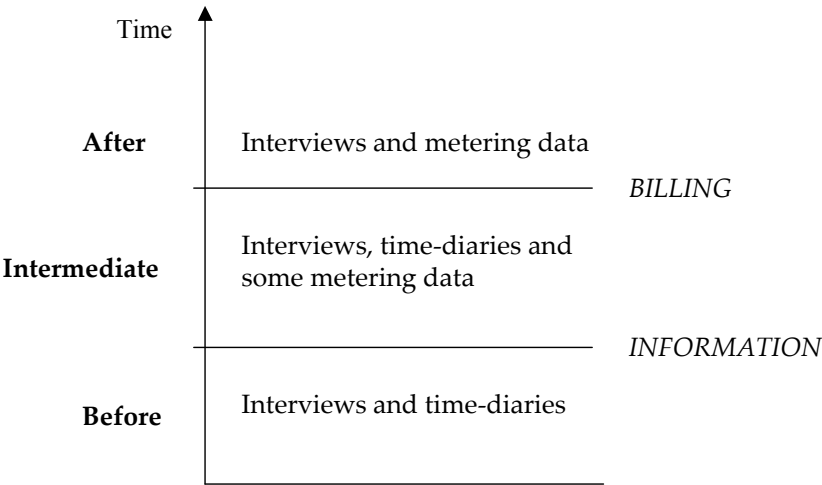
Pockets of local order of varying size will be studied and analysed since households' water routines are influenced by pockets of local order on different levels. The households develop and maintain their pockets of local order in their flats located in the residential area Ringdansen, a larger pocket of local order mainly developed by the housing company. Households in Ringdansen are tenants, and as such they do not own the space (flat) in which they develop their order. The flat is used for a fee – monetary resources are traded for physical space, material resources and services. In this rented space, the physical arrangements are given resources and constraints providing small opportunities for individual and flexible solutions. The use of the physical space is also conditional on households respecting the authority constraints set up by the housing company, for instance, silent activities after certain time

in the evening and prohibition of renovation activities. Thus, pockets of local order formed in tenant households are weaker and more subject to external influence than pockets of local order formed by households in tenant-owners' associations and private houses.

During the refurbishment process, residents have been invited to influence the arrangements in the housing area in general, but the decision on individual metering and billing per household was not negotiable. It was regarded as an important resource/constraint to develop a less resource-intensive way of living. If a resident feels that it is too great a constraint on activities regarded as important in his/her household, and thus not compatible with the household pocket of local order, the remaining option is to move – to develop a new pocket of local order elsewhere. The households in this study have decided to stay, and most of them are content with their living arrangements. Some of them also believe that volumetric billing will sooner or later be introduced everywhere.

I have identified two events that are critical for household routine change: when households are informed about the metering and billing arrangement, and when the metering and billing arrangement comes into force. Figure 6.1 illustrates the two events, the three phases these events give rise to, and the empirical material underlying each phase.

Figure 6.1 Analysis overview



The three phases structure this analysis, and the chapter ends by answering the research question of how and why the individual metering and billing per household affected the households' water use.

## BEFORE: WATER USE ‘UNAFFECTED’

It has been possible to reconstruct a time of ‘unaffected’ use – that is, before any information about the introduction of volumetric billing was provided – since the respondents in the interviews discussed current routines partly in the light of old habits.

Automation, as described in chapter 1, is regarded as one important factor behind the non-reflective use of water. The arrangement of concealing the cost of water in the rent and not relating it to actual use reinforces the unreflective use. Households did not need to consider either water or money as capability constraints for water-usage activities. According to the respondents, this cause excessive use:

*[...] I see how other people who don't pay for their water and so on, how they're a bit more wasteful ... the fact is that they are [...]* (GF)

*[...] if I move to Porten over there in Hageby, which is also Hyresbostäder, then water and hot water is included ... so then I could use as much as I wanted ... you just don't care, it's that simple ... I've got that sort of mentality [...]* (AM)

Nevertheless, from the data given in chapter 4 we know that water use differed between the households even before the introduction of volumetric billing. One set of reasons is accounted for here.

Water is used in the kitchen and the bathroom(s). These places have been arranged as a combination of two factors: the socio-cultural interest in having water indoors and the physical composition of water (a thing with many units). The physical arrangements in kitchens and bathrooms only differ slightly between the households, but the existing variation is important when it comes to which activities using water are possible, and hence when it comes to total water usage. Baths and flushing toilets need facilities for water storage, where the volume of the container also determines the amount of water possible for each activity. Having a bath without a bathtub is impossible, and without a double command on the toilet it is not possible to vary flushing according to use. Having and using a washing machine in the flat is important for the amount of cold water used, but washing is never a zero item since the laundry would otherwise be done in the communal laundry room. However, individual preferences, knowledge, environmental awareness and health status are examples of other vital ingredients when explaining household water use. A bathtub is a required resource for a bath, but it does not consume any water if it is not used. Not being knowledgeable about the toilet's double command is a capability constraint on using the toilet “properly”, and may result in higher water use than necessary.

In the following, we deal with three important activities in terms of water usage – dish washing, laundry washing, and taking showers/baths – in their physical and socio-cultural context. In so doing, we will go beyond the question of how and discuss the question of why the households' water use diverged before the information on and introduction of volumetric billing.

## Washing dishes

Dirty dishes are a consequence of food preparation and eating. In the kitchen, the households develop a certain pocket of local order for activities having to do with the household members' nourishment and related activities such as dish washing. Food residue that remains on plates, casseroles, cutlery and glasses is matter out of place, which all households have to handle. The cleaning activity is not flexible in space; under normal circumstances, it should take place in the kitchen. However it is flexible in time; it does not have to follow directly after preparing the meal and eating, but it is in order to accumulate dishes used during the day and wash them all at once. This order is possible since the households have a sink that they do not need for other activities during the day, because the necessary resources in the pocket do not alter in time, and because it is socially acceptable. The acceptance of a certain (time-limited) disorder is possibly related to another cherished benefit provided by this order of things: i.e. making the cleaning activity flexible in time, convenient. In household D, disorder is accepted for even longer time, sometimes the dishes are not taken care of until dirty dishes become a capability constraint on other activities:

*[...] we don't do the washing-up all the time because none of us gets that ... irritated about dirty dishes from several meals in the sink, we don't do the washing-up in the morning and never if we come home for lunch ... I've never seen that happen ... and we might do the washing-up some evening when there's hardly anything left to eat off (laughs) all the plates and so on [...]* (DF)

To satisfy demands on cleanliness, however, it is necessary to rinse the dishes before putting them on the draining board. Some households have an order where they put the used dishes into the water-filled sink. Both practices eliminate the risk of food residue drying and sticking to the dishes and causing smell. Since this risk increases over time, this practice must be carried out in connection with food preparation and eating activities. Since hot water is normally a better resource for dissolving food residue than cold water (except for milk products), mostly hot water is used. The pocket of local order maintains an acceptable standard of cleanliness and makes the washing-up activity temporally flexible.

A mix of hot and cold water, a balance between hot water improving cleaning capacity and cold water overcoming biological capability constraints, is used for washing dishes. The female in household E also mentions the need for hot water to make it hygienic; that is, to achieve sufficient cleanliness. The routine of rinsing the dishes before washing them also keeps the dishwater cleaner. The temperature of the dishwater also relates to matter out of place. Hot dishwater with (visible) food residue seems to be considered 'cleaner' than cold dishwater with the same content. If the temperature drops while doing the dishes, hot water is added. The female in household C has an order where she likes to wash glasses first and dry them with a kitchen towel before proceeding with the rest of the dishes, and when she has finished with the glasses, additional hot water has to be added. The female in household G, with a dishwasher, says she would use more water if she did the dishes manually, because she would not want to put her hands into greasy water and thus she would replace water considered too dirty. Neither of the spouses in household D likes greasy water, but their routines differ – they use the pocket's resources differently. The female says:

*[...] I think that in one way I probably use quite a lot of water even though I try to keep it in mind [...] ... well, lack of time and bad planning so you leave the washing-up and when come back to it, it's ice-cold ... and the fat is floating and all the food scraps [...]* (DF)

She starts all over with new water when this happens. Her husband does not like the idea of filling the sink with water, and to avoid greasy water, he washes up under a running tap - despite having developed a pocket of local order where environmental concern makes water use a capability constraint. This routine ensures that dishes are sufficiently clean.

Running water in contrast to containing water in compartments is also a valid consideration in the development of bathroom pockets of local order, which will be discussed later in this chapter.

In most households, the manually cleaned dishes are rinsed in running water. Household C and D, the ones most environmentally aware, have added a washing-up bowl to their pocket of local order, but it is only used by the female in household D. The bowl is perceived as a means of managing the water resource in a way more in line with ideas of environmental sustainability. However, despite having similar environmental concerns about water use, the male and female in household D also have different routines for rinsing. The pocket of local order is the same, resources and constraints are similar, but the female chooses the bowl out of environmental concern, whereas perceptions of sufficient cleanliness, and perhaps ease of use, result in the male temporarily abandoning his environmental concerns and selecting

running water. Since they cherish different values, their routines also become different.

The three larger households (A, F, G) have dishwashers. Having a dishwasher makes possible a new pocket of local order in the kitchen. Less time has to be spent on the dishes, but the dishwasher itself requires space and can be noisy when in use so that an organized timing procedure has to be set up in such a pocket of local order. In household F the dishwasher is a resource for overcoming the capability constraint of the female's eczema. Without the dishwasher, manual washing would be required to keep matter in place, but this coupling<sup>109</sup> with water would worsen her health status. The dishwasher thus increases her comfort.

The dishwasher could be a water saver if it replaced washing-up routines conducted in running water (depending on whether the water flow is constant, the speed the water flows and whether it is turned on and off). However, like households washing up dishes by hand, households with dishwashers also routinely rinse the dishes in hot water before putting them in the dishwasher. The idea behind this routine is to avoid the risk of having any dirt, matter out of place, left on the dishes after washing. The general view seems to be that no coarse residue should be left on the plates when they are placed the dishwasher but, again, the standard varies from household to household. An extreme case is the male in household A, who rinses the dishes as thoroughly as other people do when washing them manually. Large dishes and utensils, such as saucepans and frying pans, do not fit into the dishwasher or should not even be washed in it, and are washed manually in running water. These routines show that even if a dishwasher is part of a pocket of local order, different time-space constraints such as lack of space in dishwashers and on kitchen benches, a shorter interval between using a certain utensil and cleaning it in the dishwasher, result in washing up manually still being part of the order. It also seems as if a dishwasher encourages to wash in running water compared to households with no dishwasher.

However, the dishwasher is not totally automatic, it has to be filled and emptied. No household without a dishwasher would want one. Partly, because they cannot see a need for it due to the small number of persons in the household, and partly because the dishwasher is seen as a constraint rather than a resource:

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<sup>109</sup> The word coupling and related forms of this word will be used throughout the analytical chapters, even though other interpretations and associations exist, since it is the accepted term in time-geography for a certain group of constraints.



*[...] I think the dishwasher is hard work ...emptying it and so on ... I think it's easier to do the washing-up by hand, although I don't like that either (laughs) [...]* (EF)

The dishwasher is a splendid example of the fact that a thing considered as a resource in one household may be considered as a constraint in another, and how such perceptions impact on the development of pockets of local order.

## Washing laundry

Laundry washing is a vital part of cleanliness. Clothes, towels and sheets are in need of washing since they are linked with the human body and other objects makes them look, smell and be perceived as dirty. Households also develop certain pockets of local order to accomplish this cleanliness project.

The importance of laundry washing is illustrated by the physical arrangements in the households and in the residential area. Unlike most other household chores, this one is not necessarily performed in the household. The communal laundry room, arranged by the housing company to make it easier for the residents to do their laundry, is equipped with several washing machines, usually larger and faster than ones for household usage. There also are tumble dryers, drying the laundry quickly with hot air, and a drying room, a space normally not available in flats. Some households have the option to choose where to wash, but for household B and D the communal laundry room is the only option - unless they choose to do their laundry by hand. Contrary to washing dishes, however, manual laundering is not an alternative to using a washing machine. The washing machine has become the normal and natural way to wash, while washing by hand is restricted to garments with special characteristics. It would be a heavy and time-consuming task to wash large amounts of laundry by hand every week.

The households E, F, and G have a washing machine in the flat, but still use the communal laundry room since they believe the pocket of local order that can be developed in the laundry room makes it simpler to do the laundry. They are large households with a lot of laundry. The capability constraints present in the flat (lack of space for hanging clothes to dry, slow and small washing machines) are not present in the communal laundry room. The order developed in the communal laundry room is perceived as saving time and hindering jamming problems in the flat. The female in household G says:

*[...] the biggest advantage of the laundry-room is that there are tumble-driers so you can dry large things like sheets and towels and so on quite quickly ...which take up space at home and are in the way because there's nowhere really to hang them [...] and you can fill, you can put more into the machines down there than at home [...]* (GF)

However, since several households share this space, it must be booked in advance, the convenience it offers is somewhat restricted. This authority constraint means that the households can only develop their order at a certain time, which makes spontaneous washing difficult and doing the laundry inflexible as regards time. Doing the laundry at home is a way of increasing convenience; here households set their own authority constraints and wash when it suits them. Furthermore, it is easier to protect the order developed at home – violations of the laundry room pockets of local order in the form of stealing of clothes, double booking, insufficient cleaning, and “time-hijacking”, are common according to the respondents. During the period of refurbishment it was also difficult to gain access to the communal laundry room as often as desirable, since there were fewer laundry rooms used by more people than intended. The competition for access to the laundry room increased, and the washing machine at home became an even more used and valuable resource.

Doing the laundry at home is also a way of overcoming biological capability constraints on the physical strength needed to carry the laundry to a place outside the flat. Household A and C do all their laundry in the flat. Both are single-person households (one of them contains more household members at times). Convenience is the main reason for doing the laundry at home, according to the respondents, but being a small household is also an important factor in the choice of where to do the laundry. For a single-person household in a two or three-room flat, the bathroom is perceived as spacious enough to function as a drying space, and the space conflict between washed laundry and people is less pronounced. Furthermore, with a small amount of laundry there is no time to be gained by taking the laundry to the communal laundry room, and larger machines are not considered necessary.

A washing machine at home makes it possible to “do away” with dirty laundry, matters out of place, and could increase the frequency of doing the laundry. Laundry with an unacceptable smell and gym clothes are matters out of place. They are either placed where the smell cannot be felt, e.g. on the balcony, or washed instantly. Such events do not necessarily mean that the machine is filled. It depends on the availability of other laundry of a similar colour and with the same temperature requirements. The cramped spaces in the flat and the avoidance of dirt and odour, mean that the (perceived) available space for dirty laundry is limited. Consequently, a washing machine in the flat is an asset, since order can be restored instantly. Cleanliness requires a thorough washing with water (and enough detergent to create sufficient soap-suds and to perfume our clothes). None of the respondents said that he or she aired clothes so as to be able to wear them for longer time.

## Showers and baths

The bathroom is an increasingly important space for order-restoring routines for the human body. Certain values and norms, not present in other areas in the dwelling are connected to this space and impact the pocket of local order developed in the bathroom. The physical space and technical arrangements are given, and while water and human paths are (by human choice) linked up, matter out of place are transmitted to the water flow (now out of place) and transported out from the pocket. Order is restored since sufficient cleanliness is achieved<sup>110</sup>.

With respect to our biological capability constraints, the cleaning of body parts is mostly conducted with a comfortable mix of hot and cold water. The temperature is individual; some respondents like it hot while other prefer lukewarm or cool water. Individual preferences lead to variations in routines:

*[...] I don't like it being as warm as Doris does (laughter) if she's taken a shower first, I have to turn the thermostat down a bit [...]* (DM)

The demand for hot water is thus guided by biological and cultural needs. Health aspects may both cause and hamper water use; frequent hot baths ease stiff joints and the temperature is maintained by adding hot water while taking a bath, although people suffering from conditions such as cystitis and eczema should avoid taking baths. Some biological capability constraints have a seasonal variation and alter the pocket of local order accordingly. Hot water use decreases in the summer, while cold water use decreases during the winter, and interview responses point to a shift from baths to showers in the summer. Thus, different experiences of comfort also result in different routines.

Sweating is natural for the human body, but the smell of sweat is not acceptable; it is matter out of place in nearly all contexts except in spaces where sports are practised. Taking a shower is thus a necessary act to restore order, to satisfy cultural standards of cleanliness. In the attempt to maintain order, one or even two showers a day are considered normal.

Cleaning the entire body daily is the norm followed by most respondents. Generally, taking a bath is seen as a comfort activity, while a shower is for cleaning. Most respondents consider themselves dirty after a bath, which means that soap, skin residue and hair in the water are matter out of place. This dirt is visible, both on the water surface and on the sides of the bathtub, after emptying the water. Thus, a bath for comfort entails a subsequent

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<sup>110</sup> Sufficient cleanliness mostly also entails the use of different chemical products such as shampoo, soap and shower gels. Although they are of vital importance both for (perceived) cleanliness and for wastewater quality, this study focuses solely on water usage.

shower to attain cleanliness. Such standards of cleanliness do not exclude opposing opinions, for instance, the male in household A considers himself to be clean after a bath, despite knowing that others may believe differently. If one remains in the shower for just a little bit longer than “necessary” to be clean, taking a shower also becomes a matter of comfort. Much longer than necessary is considered a luxury.

A bath needs more time both for filling the bathtub and time to enjoy the bath. The frequent bathers include a male on the sick list and a student doing her homework simultaneously (thus combining activities in one period of time).

The norm of daily showers and baths is not followed by the two older females in household B and C. A biological capability constraint in the form of a dry skin is an important reason in household B. Another explanation relates to their experiences from earlier times when hygienic standards were lower and there was not always running water. They then economised in the use of water, and such routines may still be deeply rooted and impact on water use and the development of pockets of local order. On the other hand, the female in household G (although somewhat younger) also has experienced times when water needed to be fetched, but says that this does not influence her routines today. This shows the difficulty of making general statements about the logic behind water use.

## INTERMEDIATE: WATER USE REFLECTED

Residents were moved to other flats in the area during refurbishment and the installations of meters. When the households moved back, new pockets of local order were developed with partly new and different resources and constraints.

New physical installations, e.g. low-flush toilets and water-saving taps were added, and the bidets and bathroom sinks were removed. However, water-saving devices only constrain water use marginally. The fact that it takes some 20 minutes to fill a bathtub with a water-saving tap did not discourage household members from taking a bath, or make them do so less often. If you plan your bath, you can turn on the water 20 minutes in advance. Water-saving devices may even encourage, for instance, extended shower-time and flushing the toilet twice after use.

The new technical arrangements, in combination with lack of knowledge of their function, can even be seen as capability constraints on economical water routines. For instance, the new mixer tap in the bathroom requires two separate actions, one to turn it on and one to alter the temperature. If used as

intended, the mixer tap can reduce consumption compared with the previous taps, particularly of hot water. However, the mixer tap also makes it easy to use more hot water than with the conventional tap. The female in household C maintains that the temperature mode for showers (37-38 degrees) is also used for all washbasin activities, even teeth-brushing, since the water that first comes out of the tap is cold. Furthermore, two respondents did not understand that their toilet had a low-flush option. Sometimes, it is solely the technology that constitutes the capability constraint on water savings; the combined mixer tap requires a minimum water flow for the shower mode, otherwise it automatically switches back to bathtub/washbasin mode.

Consequently, the new physical arrangements altered the bathroom pocket of local order, but without leading to large adjustments in water use. More important for routine change is the idea of a meter and volumetric billing. Even before the new billing arrangement had come into force, some respondents said that the idea of being measured and billed according to use would make water a capability constraint. This constraint was based on a new awareness and reflections on the respondents' own use. The respondents evaluated the pockets of local order they had developed by categorising water use as necessary or unnecessary. Three households, A, B and G, concluded there was scope for lower water use and they altered their pockets of local order accordingly. Adults in household G told their children to be considerate when using water, to turn the tap off sooner and not let it run unnecessarily, which also applied to themselves. Thus, routines such as cleaning the coffee pot and teeth-brushing under running water, were abandoned in favour of actively washing the coffee pot and brushing teeth with the tap turned off between rinses. By reducing the acceptable time for a tap to be turned on without using the water pouring out of it, the adults – who have the economic and social responsibility and power over the household – introduced an authority constraint that transformed certain water uses previously acceptable into unacceptable use. As the pocket of local order changed, as a result of water becoming a capability restriction through economy and new perceptions, conceptions of order and disorder also changed. However, the authority constraint was a “gentle” one and not combined with other constraints. It was individually enforced and maintained by what household members expected of each other, and with no threat of sanction if infringed.

A similar definition of unnecessary use resulted in a similar routine change and order in household A. Being a single-person household, the individual himself enforces the new order, such as reducing the frequency of taking a bath. Household B, also a single-person household, altered her routine for washing dishes by adding a new resource, a dish-bowl. She “collected” the water (thing with many units) and used it over and over again instead of constantly having new units pouring in an uncontrolled way from the tap. She

also altered her shower routines; considerably shortening the shower time for one of her pets and for herself. She also turned the shower off while soaping herself. Economy is an important capability constraint for this household, and she is highly motivated to exchange water resources for more monetary resources, which can be used for cherished activities.

In households C and D, where environmental concerns already constrain water use, the pockets of local order remained unchanged. Household E and F came to the conclusion that they did not use water for anything but normal activities, and therefore they saw no need to change their routines. The female in household F also mentioned lack of knowledge as a capability constraint on establishing more water-economising routines:

*[...] water is used for everything, where should I save: that's the problem [...] shouldn't I shower ... not possible ... I'm supposed to save water and not rinse vegetables, not possible ... [...] I don't know how [...]* (FF)

No respondent identified his or her own household as an extreme or unusual water consumer, which is no surprise. The pockets of local order are developed from the view of the order of things and this cannot be deviated from. However, awareness of the meter and about the future changes in billing arrangements made the households reflect on their own use, and three out of seven households found reasons to revise their pockets of local order. A previously “unlimited” resource was about to become a capability constraint on household activities due to its new link to available monetary resources. However, no respondent distinguished between hot and cold water resources, which, in turn, means that his/her pockets of local order did not discriminate between cold and hot water routines. Whether they rearranged their pockets of local order or not, what all households had in common at this stage of the process was that they all perceived their water use as normal – regardless of the amount used. When water is used, it is used for activities regarded as essential for survival, wellbeing and to meet negotiated standards of cleanliness.

## AFTER: WATER USE METERED AND BILLED

The analysis shows that there are three groups of households at the time volumetric billing was introduced: *the environmentally aware*, who had been considerate water users for a long time (household C and D), *the early converters*, who adjusted their water use before metering and billing came into force (household A, B and G), and *the indifferent*, who still could not find a reason to change their use of water, and/or did not know how to (household E and F). When water eventually was billed according to use, however, household economy became a capability constraint with the power to affect water use.

Since I lack metering data from the time before water-saving devices and volumetric billing were introduced, the changes I can see are the ones motivated by information and implementation of volumetric billing. With this as my starting-point, I argue that the small changes in use patterns, displayed in the graphs in chapter 4, are the result of small adjustments in pockets of local order. Apart from the seasonal variability, the fluctuations are minor, which indicates that water use is embedded in deeply rooted routines. The change in water use is in most cases marginal and structural changes (household member moving in or out, less or more time spent at home) have been more important changes in pockets of local order than have alterations of routines.

Of the early converters, only household B has made additional changes in routines after the introduction of volumetric billing. She reports having reduced the number of times she flushes the toilet and making use of water remaining in the pipes for purposes that do not need absolutely clean water, such as rinsing dishes before wash. Economy is an important capability constraint on which activities she can pursue and she is highly motivated to save money; nevertheless, she considers the water fee to be low. She has learned that it is more effective to save on heating, and therefore she keeps the heating knob turned down as low as possible and adjusts her comfort by wearing more clothes. In household A and G, only structural changes are behind use changes; in household A, increased cold water use is most likely due to a new person spending time in the flat, and in household G decreased use coincides with a child moving out.

Of the environmentally aware, household C has made some small adjustments after the introduction of volumetric billing, reducing her use of both hot and cold water somewhat. She has begun to use the largest saucepan instead of the larger sink when washing up, and in this way she physically restricts the volume of water used. Furthermore, instead of having the thermostat always set at body temperature, she has turned it to cold as the basic setting to prevent routine-like use of hot water. Although sacrificing some comfort for herself and her guests, her standard of cleanliness is preserved and she is thus content with this change. Compared with Betty, who is about the same age and lives in similar circumstances, Caroline uses slightly less hot water but more cold water. The difference in cold water use could be ascribed to the fact that Caroline washes her laundry at home, and because her routine of letting the tap run every morning (using about 30 l/day) goes on for much longer than in Betty's case. The members of household D claim not have altered their routines at all, and their use has instead increased somewhat. Again, structural changes, such as Doris spending more time at home during the autumn and one child being home for the Christmas vacation, have a greater impact on use than do changes in routines.

Household E has (still) done nothing to alter water use, but the female says that being considerate when using water is stressful. Being considerate could be viewed as a capability constraint impacting on water use, but it seems to act as a constraint on water use being levelled out rather than reducing it. The household's water use is stable over the period studied. Household F, however, has not remained indifferent. Some changes in water use are structural; parents have separated, the children live with their father at times and the female is now employed. However, the structural changes have also been combined with the development of a new pocket of local order when moving from the temporary flat. As the only adult with social and economic responsibility, Frida has used her power over the children and has set up authority constraints on their water use. She tells them to turn the tap off when she notices that the water is running without being used, and tells them when she thinks they have spent enough time in the shower. When she gets high bills, she gathers the children and tries to make them understand the relation between their water use and the overall household economy, that excessive water use is indirectly a capability constraint on other activities and purchases. It is not possible to separate the importance of the new authority constraint from structural changes in the pocket of local order, but the more pronounced decrease in hot water use indicates that the authority constraint (based on economic concerns) is important.

This is a disheartening result for believers in volumetric billing and its impact on households' water use. I mentioned earlier that the selection of households may have been "extraordinary", i.e. that the way the households were recruited may have resulted in a bias towards more involved and interested households. The small changes in use would then be possible to explain by pointing out that their water use is already fairly low and 'adjusted'. The Figure 6.1 displays the participating households' average monthly water use (total) for April, 2003 - March, 2004<sup>111</sup> (marked with letters and larger dots) in the context of other Ringdansen households' usage during the same period<sup>112</sup>.

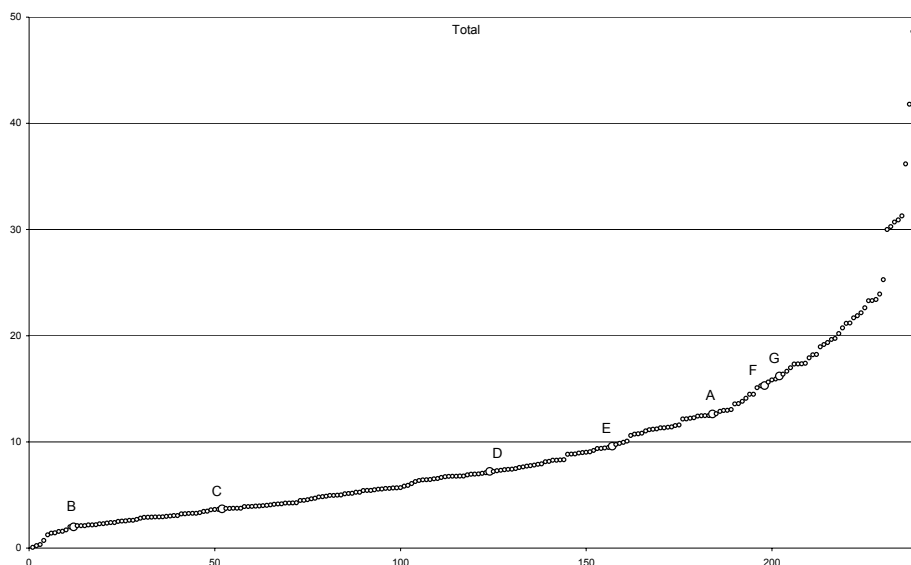
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<sup>111</sup> Technical circumstances determined the start-up month – at that time, all participating households could be metered properly.

<sup>112</sup> The selection is from two blocks in Guldringen, including households that have signed up for individual metering per household and consume > 0. The graph is published courtesy of Mattias Hjerpe.



**Figure 6.1 Average monthly total water usage ( $\text{m}^3$ ) for 232 + 7 households, April, 2003 - March, 2004**



This illustration makes it clear to us that the participating households can be found over the total spectrum of users in Ringdansen as they are displayed in statistics. The only category missing is the most excessive users, using over  $20 \text{ m}^3$  per month. Furthermore, we see that the households I label as the most environmentally aware (C and D) are found in the lower range – although this is also a consequence of being small households. Household B is among the lowest consuming households in the area. The importance of the number of household members is evident; with each additional household member, use increases and, as a consequence, we find the largest households (A, F, G) at the upper end of the spectrum. From a national perspective, all the participating households are low or moderate users, using between 77 (B) and 164 (G) l/p/d over the total metered period (national average 200 l/p/d)<sup>113</sup>. Here, washing in the communal laundry room is not taken into account. However, the difference is small. From months where data are available, adding water use in the communal laundry room makes a difference of 2-13 l/p/d.

As Hjerpe (Hjerpe 2005) shows, the largest decreases in use are to be found among the large users in Ringdansen, who use more than 10 cubic metres a

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<sup>113</sup> Household A uses 401 l/p/d if calculated as a single-person household. However, as we know by now, this household often consists of up to four or even five persons.

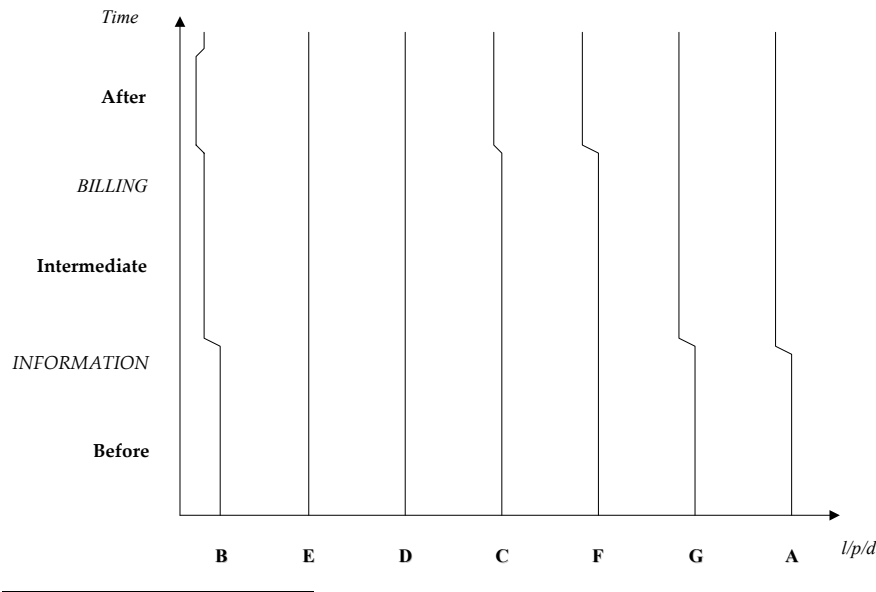
month.<sup>114</sup> In this study, household A, F and G are large users, and they all have made some adjustments to their use. Still, when taking household size into account, the daily average usage per capita is low or moderate in these households compared with the national average<sup>115</sup>. Thus, their scope for further savings has been regarded as limited.

Even if it is not possible to draw statistical conclusions from the material in this study, the analytical conclusions are most likely valid for Ringdansen in general, and for similar areas throughout Sweden. The diagram above also illustrates the importance of studying water use in its context if the aim is to reveal the logic and conditions behind household use patterns – i.e. the story behind the ‘dots’ in the diagram.

### SUMMARY AND DISCUSSION

My conclusion is that volumetric billing per household in flats has not resulted in far-reaching changes in households’ water routines – which also means that the effects on water usage related to routine change are small. Figure 6.2 summarises the changes in household water routines and their evaluated and metered impact on water usage.

**Figure 6.2** Changes in household water routines and usage



<sup>114</sup> Hjerpe (Hjerpe 2005) maintains that water consumption fell 15-25% in Ringdansen as a result of volumetric billing. The decrease was most pronounced in households using over 10 m<sup>3</sup>/month.

It has been possible to reconstruct “before” routine patterns from the time-diaries and the interviews with the respondents. The household routines for washing dishes, laundering and taking showers and baths at this stage are thoroughly accounted for. However, we cannot know the impact of the routines on water use since no metered data is available from this period. A qualitative evaluation of the use is possible, since how much water is used has not been as important as how and why water is used the way it is. In the diagram the use for each household is indicative, and provides a starting-point for discussing changes in routines and volumes used.

The second “intermediate” stage covers a period during which the households are knowledgeable about volumetric billing. Interviews, time-diaries, observations and some metering data constitute the material. Changes in routines took place in three (A, B and G) of the seven households, labelled as early converters. A and G are large users, and thus may have expected high bills in the future. B is a low user, but highly motivated to save water for economic reasons. Before water became a capability constraint for economical reasons, it became a capability constraint due to mental perceptions of future expenses and the respondents’ reflections on their own use. Contrary to the other households, these three identified a low-value use possible to abandon without forgoing cleanliness, comfort and convenience. The other four households did not see themselves as using an unnecessary amount of water; the environmentally aware (C and D) claimed to have long been thrifty for environmental reasons, and the indifferent (E and F) could not see what could be categorised as wasteful in their water use. Thus, before volumetric billing was coming into effect, the households had changed (or not changed) their pockets of local order in accordance with their perceptions of wasteful/thrifty, discomfort/comfort, dirtiness/cleanliness.

In the third “after” stage volumetric billing is effective. At this time, households consider themselves to be normal users of water with limited opportunities for initiating further constraints on water use since this would risk creating disorder; one cannot stop washing dishes, flushing the toilet or doing the laundry. Water is an irreplaceable resource for such activities involving maintaining order. Nor is the comfort of taking a bath negotiable. Consequently, adding household economy as a capability constraint in households’ pockets of local order only resulted in minor (B, C and F) or no change in routines. B and C are households with older women, who already had capability constraints of a mental nature affecting water use (economical and environmental concerns, respectively). Volumetric billing merely reinforced their initial concerns, B still saves on water for economic reasons

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<sup>115</sup> With reservation for household A, depending on how often the children live with him.

(albeit seeing more favourable opportunities for saving on heating energy), while environmental concern still is the main reason for saving in household C. They have the lowest per capita use of hot water among the seven households, which, in the case of B, is also a result of being away during the summer. The most pronounced reduction in use (especially hot water) in this study took place in household F, where the economic incentive is an important factor.

Several interrelated causes can be presented to explain the rather meagre outcome of volumetric billing as a motive for changes in routines. The households studied, have the necessary monetary resources to pay the housing company for the water. The households are willing to pay for their use of both hot and cold water, which has more or less the same characteristics as before volumetric billing was introduced, rather than making an effort to try to save more. Trading additional water resources for more money is not regarded as possible, since the households have already adjusted their routines as much as they believe possible without risking discomfort, dirtiness and inconvenience. Questioning such standards obviously does not result from arrangements of this kind; or, in other words, economy as a capability constraint on water use in household pockets of local order was not sufficiently restrictive to affect socio-cultural classifications of order and disorder. The households believe their present water use is normal and worth paying for, and are not prepared to reduce their use further – at least not at today's prices. Their insensitiveness to cost is further accentuated by their lack of interest in distinguishing between hot and cold water. Hot water is twice as expensive, but households still insist on the importance of using water according to need – irrespective of temperature and cost.

Two other factors of potential relevance are the similarity in physical arrangements and the billing administration. The physical arrangements in bathrooms and kitchens were more or less analogous before and after the refurbishment. There were no built-in coupling constraints, and access to hot and cold water in time and space was unaltered. Thus, the households could stick to old routines, and take the coupling to water for granted (as before) when developing their pockets of local order. The removal of bidets and sinks in the bathroom did not bring an end to related activities, since the new physical arrangements enabled any previous activities to be carried out in just as convenient ways. Their removal were not motivated by decreased water use, instead, the reason given was that the bathroom would be modified for use by disabled persons and to make room for other physical resources. Although the physical structure was the same, water-saving devices were installed. A double-command toilet, however, does not result in a shift in routines since it has the same function as its forerunner (pull or push to flush). Other examples of equipment that do not require a change in routine are

water-saving taps and water-efficient washing machines. The principle for using them is the same and the water savings are automatic. In some cases, water-saving devices became less effective since they were not used as intended, also proving that technical arrangements are not always as self-instructive as implementers might think. Changing routines is difficult in any setting, and even harder if the physical environment remains unchanged.

Billing according to a fictitious norm based on apartment size and payment of the same amount each month, has an administrative advantage. However, instead of residents comparing their own past and present use, which they would do if they did not have a norm (monthly bills) or if they had a norm based on their factual previous consumption, the households relate their use to a norm that really does not indicate anything since water use and apartment size are not related. A single-person household in a large flat and with large water use is compensated, while a large family with a low use (per capita) is heavily charged. Thus, the incentive for saving may not provide the anticipated result. The main strategy when reading the utility invoice is to check on the monetary items (difference between paid and debited amounts). This means that as long as the debit and credit figures do not differ too much from what has already been paid for, the resident settles for this and takes no measures to adjust. Of course, there are households, which are aware that the norm is preliminary and fictitious, and realise that their use may deviate from it, but for those who do not, it may send out the wrong signals and become normative.

The 'problem' is further accentuated by the fact that the bills present use figures for hot and cold water, heating energy and electricity together. The total of the four services' credits and debts are given at the bottom end of the bill. The integration of the different consumption figures makes the bill complicated and some respondents find it difficult to understand and read. In such a case, just looking at the combined sum at the bottom end is a fast and easy option, but this also makes the bill a blunt tool for saving water. A total credit may be due to savings on heating energy rather than on water. Heating energy in particular is easier to 'save', since this norm has been generously set compared to the more narrow hot water norm (Hjerpe 2005). It may be part of the explanation of why the debit on hot water, which all but one household in this study has, has not become an issue. Two households in this study (B and G) expressly emphasise saving on heating energy rather than water. In household G, a debit of SEK 1,000 for water is 'eaten up' by a SEK 3,000 credit for heating energy. The fact that all households but D have heating energy as a plus item and all households but C have hot water as a minus item in the first settlement of their account underlines the difficulty of establishing preliminary norms. The second year's norm is settled according to the household's actual use during the first year. Even though it is a more relevant

indicator of use, depending on how the households followed the first year's norm, it is more or less influenced by the initial norm based on flat size.

## CHAPTER 7

# Ecological toilets in ecological households –a theoretical perspective on use and management

The empirical chapter about Gebers (chapter 5) describes how the residents perceive, use and manage their water and sanitation arrangements. In this chapter, the empirical data will be analysed in accordance with the theoretical approach developed in chapter two in order to explore and explain the interplay between the dry-toilet arrangement and household routines.

The residents in Gebers opted to install dry toilets. These are important resources in the common pocket of local order, facilitating an everyday life in line with the socially negotiated aspiration of ecological living. Dry toilets also require the active maintenance by residents and thus need household resources to work as intended. User routines are somewhat different from the WC routines, such as the sitting technique and disposal of waste (vomiting, scrubbing water, other solid and liquid wastes), but it is principally user management that distinguishes this arrangement from a conventional one.

My analysis will focus on identifying and explaining the (conscious and unconscious) development of pockets of local order to make the dry toilet functional and acceptable to live with and manage. Order means that it is possible to define disorder and therefore intentions and meanings behind the development of pockets of local order are included in the analysis. Ideas of order and disorder are seen as deriving from socio-cultural classifications, where disorder is what separates the order from its surrounding – it is matter out of place. Categorisation of cleanliness/dirtiness is a ‘classic’ order/disorder issue in socio-cultural studies, and also is the categorisation emphasised here. Attention is also paid to standards of comfort/discomfort and convenience/inconvenience since they have also been shown to be relevant categorisations in studies of environmentally relevant behaviour.

## COLLECTIVE AND PRIVATE POCKETS OF LOCAL ORDER IN GEBERS

Households in Gebers develop private pockets of local order. Together, they also develop a common pocket of local order in the form of a tenant-owners' association and collective. Collective living may be interpreted as a way of reinventing the dissolved collective peasant society, and of creating a level between the family and society at large. The collective house is a cultural form both physically and socially. Dwelling in such a house supports a way of living, and is a manifestation of cultural change (Caldenby 1992).

The interviews clearly show that the leading cultural values of Gebers' common pocket of local order are a social and ecological way of life. The time-space pocket is developed to facilitate meetings between residents, and to assist households in applying resource-saving routines. Certain physical spaces are arranged to assist members of the collective to link up; e.g. the communal dining hall, communal hobby rooms, a communal sauna, a garden, etc. There are explicit norms and rules for how to manage and use communal resources and spaces. Members of the Gebers collective are to varying extent involved in each others' private pockets of local order, e.g. when exchanging household resources: baby-sitting (time) for shopping assistance (car and time), or sharing tools and muscle power. Collective living requires residents to engage in activities and projects both in the household and in the common pocket of local order. The tenant-owners' association's statutes and collective rules and norms regulate most communal and some private tasks. Members' collective activities are considered crucial for the upkeep of both the collective social order and for the physical space.

The interviews provide strong evidence that the residents have a common understanding of the social order, e.g. the division of private and communal tasks and the expectations of complying with the social and ecological way of life, and they are able to identify and agree on what is matter in or out of place. This is expected since they joined and participated in its formulation. There is also evidence that the collective organisation makes this common pocket of local order more influential than an ordinary tenant-owners' association. For example, all members are supposed to participate in the communal meals and prepare the food according to a rolling schedule. However, we have also seen that there are deviations.

### Collective pockets of local order

The members of the collective have agreed to develop a pocket of local order including self-maintenance. Instead of buying maintenance services externally, resources within the pocket such as residents' time and skills are used. This



promotes social as well as economic aims. To ensure that such activities are attended to, the collective pocket of local order contains an authority constraint – each adult must perform eight hours of compulsory community work per month and absences are not sanctioned. Some tasks require more than one resident to be carried out, and the establishment of task forces with members expecting each other to play a role, facilitates the necessary couplings. Individual capability constraints are taken into account; children and the handicapped are not required to work and old residents get tasks they are physically able to manage. A special collective pocket of local order – a working day - is developed every month on a weekend (when the coupling constraints related to regular employment are of less significance). On such occasions, the necessary resources for the work are mobilised and common coffee-breaks and lunch are arranged to attract residents to a social event and to further manifest the importance of the work done.

The joint cooking and eating of meals is an important social event in Gebers where constantly recurring couplings between members of different households take place. The activity is of such importance that a certain collective pocket of local order has been developed to support it. Residents are divided into groups that do the cooking and washing up. A specific time is reserved for meals, special spaces are kept and physically arranged to facilitate food preparation, eating, and washing up, and the necessary food resources are purchased. The communal meals have symbolic importance in Gebers's social way of life, as something more than just any shared dwelling, but a community based on a larger context than the individual household.

Any pocket of local order depends on the loyalty of its members. The local order may allow certain exceptions in order to survive, and there has to be a forum for negotiating deviations. For example, members who do not participate in the communal cooking of meals might threaten the social way of life since if many did so, the social order would break down and be replaced by a non-collective social order. However, the collective was able to diffuse the potential risk by adapting the previous rule to the new situation. The collective allowed the vegans to create a pocket of local order of their own, i.e. another team cooking vegetarian meals in the communal kitchen on another time. As a result of this 'compromise', the established pocket of local order was not threatened since the new team had the same collective aspiration. The establishment of a second car-pool is another example of a threat to the collective self-image. When worn out electric cars were replaced by petrol cars, some of the members felt that it deviated from the ecological ambition of the collective and started another car-pool with one electric car.

Although the collective allows several joint pockets of local order to be developed in parallel, it conflicts with the idea of having an all-embracing

social order that everyone agrees with. Obviously, there are conflicting values within the collective, or at least different degrees of commitment to certain values, which are displayed by the development of these enclaves of pockets of local order. The collective social order in Gebers is being challenged and contested, and so far the collective has managed to resolve this by means of innovative adjustments.

### **Private pockets of local order**

The social order in Gebers has somewhat permeable borders in a social sense between the private pockets of local order and the community-based pockets of local order. Private household pockets of local order are influenced by some of the collective orders, but each household is also an autonomous unit. The everyday life of residents in the private domain is mostly not a collective concern.

Households and individuals in a household may develop private pockets of local order that may be more or less in line with existing collective pockets of local order. In the following, we will focus on the interplay between collective and private pockets of order that prescribe and physically facilitates ecological routines, e.g. nutrient recycling, sorting of solid waste and composting of organic household waste.

A part of the common order no household at Gebers can choose to ignore, however, is the dry toilet. The dry toilet can be regarded as a symbol for the ecological way of life, and there is one in each flat. This gives Gebers a 'standard of ecological excellence' compared to other housing areas, although other ecological solutions could easily be found elsewhere. The residents in Gebers may have different ecological ambitions, but the dry toilet is their basic common denominator, and a symbol of the ambition to turn away from a normality they consider to be unsustainable. The dry toilet is more than a technical arrangement; it is part of a complex social and symbolic context (Gullestad 1988).

Nevertheless, some households with children evade the collective pocket of local order by developing household pockets of local order including the communal water closets. Cultural values of comfort, cleanliness and convenience, established when they lived in flats with water closet arrangements, seem to play a vital role in these arrangements. The inconvenience of distance to the water closet is compensated by less argument with children refusing to use the dry toilet, children's bad sorting resulting in flies and wet and heavy bags, and delaying the emptying procedure. Arranging for a private pocket of local order like this is a way of handling resources and constraints in a specific household, rather than the collective resources and

constraints. This is possible because the collective pocket of local order is based on authority constraints without any checks being made of observance, and because water closets are part of its physical order.

Such private pockets of local order are, however, not accepted in Gebers, since they violate the social order of ecological living, negotiated private/collective responsibilities and solidarity. The regular use of the communal water closets in private pockets of local order clashes the cultural classification. It has made collective members question the communal responsibility for these areas and suggest that cleaning and provision of toilet paper becomes a private matter instead. Such a responsibility shift would not just be for practical reasons, but would also establish a new more clear-cut boundary between what is regarded as being part of the social order and what is not.

The borderline between private and collective pockets of local order is clearly defined and negotiated by the members. The dry toilet arrangement is part of a preferred order in Gebers, and the collective pocket of local order is only developed to handle the end products – urine collection tanks, a communal composting station, agreements with receivers of the nutrient products and transport services. As soon as the urine reaches the larger urine pipes and tanks in the basement, and as soon as the faeces are emptied in the community composting station, the responsibility passes from the household to the tenant-owners' association. Until this point, however, households are requested to see to the necessary maintenance.

## MANAGING DRY ECOLOGICAL TOILETS

Proper household management activities are crucial for sustaining the ecological idea of reclaiming nutrients, but they are also crucial for creating socio-cultural acceptance of the arrangement as such. In this regard, three issues stand out in the empirical data as particularly critical: emptying of the faecal bin, occurrence of flies and smell.

These issues have one common denominator; they all involve human-faecal contact in the form of solids, gases (smell) and as a microscopic residue on flies. Since they are defined as issues, i.e. matters of concern, I regard such human-faeces couplings as constituting 'matter out of place'. The risk of such couplings occurring is elevated if the faecal matter is not properly managed. Urine management, on the other hand, is as automatic as in the case of a conventional water closet and piped transportation. Installing a conventional toilet has so far not been a solution considered, and therefore the only solution (apart from moving away from Gebers) is to develop an altered private pocket of local order.

As I understand it, each of the three critical issues is so important that any one of them could cause the dry toilet arrangement to be abandoned. Given the dry toilet's symbolic importance, signifying and maintaining the aspiration to live ecologically, its abandonment would lead to a new common pocket of local order. Other topics are not likely to cause havoc, such as cleaning the toilet itself, in terms of matter out of place. Faecal matter easily clings to the porcelain and is difficult to remove because a lack of water in the toilet and a limit on the amount of water in order not to create a new constraint on emptying. Also, the vertical pipe is considered dirty but can only be cleaned with difficulty. The residents do not perceive this as threat to the dry toilet arrangement, partly because the households' view of cleanliness has altered somewhat – they now tolerate the porcelain not being spotless all the time and the faecal pipe having faecal matter on its sides (only a part of which is visible). Also, after some trial and error, the households have developed a certain cleaning pocket of local order that provides a satisfactory standard of cleanliness. Some informants wish for cleaning tools suitable for this particular task.

Avoidance of faeces is not merely a question of disgust; the bad smell sends warning signals. Faeces contain pathogens, which could be spread to humans via direct contact and via flies. Nevertheless, no one is afraid of getting ill from managing their own or others' faeces, or via flies and smell. Only a few respondents bring up the health aspect. Therefore I conclude that socio-cultural threats such as the disruption of a socially defined order (matter out of place) is more important when explaining the development of pockets of local order and routines than the risk of falling ill. The three critical issues are analysed one by one to test this hypothesis.

### **Emptying of the faecal bin**

Each household is responsible for the management of its faecal bin. If a household neglects this task, the bin will fill up and the toilet would not only be inoperative but would cause disorder in terms of unhygienic conditions (matter out of place). Consequently, each household is forced to develop a pocket of local order for this crucial task. As indicated in the empirical chapter, the available resources such as manpower and access to the bin vary between households and hence shape different pockets of local order.

An alternative dry toilet solution with the faecal compartment inside the bowl would have been in line with the preferred social order of household responsibility. The necessary space was available, but the vast majority did not like the solution and decided in favour of a physical order where faeces were kept away the flat, out of sight. Furthermore, the solution selected was believed to satisfy the convenience of long intervals between emptying, and

clean management of completely decomposed matter – dry, sanitised, soil-like, without smell. Hence, the cultural classifications of order set the time-space constraints for the emptying pockets of local order first developed. As we will see throughout this analysis, however, these pockets of local order have been altered over time as a result of not complying with socio-cultural perceptions of order. What is also demonstrated is that pockets of local order may be path-dependent and inert in some respects, for instance, the space initially selected for faeces collection is a constraint/resource of permanent nature.

In practice, the decision was between a large and heavy bin emptied seldom and a light bag emptied frequently. Selecting the former entailed certain constraints and made specific resources desirable. Storing faeces directly in the bin – a thing with many units directly coupled to it – required bringing the whole bin up from the basement. The heavy weight in combination with keeping the bin below ground level made physical power a required resource. For some households, it was possible to develop emptying pockets of local order including the elevator as a resource; it was both physically and socially possible to establish this coupling. Considering that using the elevator means transporting the faecal matter through the building – an issue of disorder raised in connection with the solution of collecting faeces in the flat – it is worth noting that bin transport in the elevator is not constrained by norms and rules in the common pocket of local order. By temporarily compromising on this matter out of place, however, the collective ensures the continuation of the arrangement and hence preservation of the ecological aspiration. It prevents members from losing interest and makes possible (wished for) long intervals between emptying occasions. ‘Elevator households’ were able to manage the bin single-handedly, but the larger households with heavier bins still needed to develop a pocket of local order where two adults are linked up in time-space to overcome the capability constraint of physical power. Rolling the bin to the elevator and composting station and emptying its contents, were too heavy for one adult to physically manage. Households with no access to the elevator were forced to take their bin through a deep outside shaft. Since the existing simple tackle was considered difficult to use, and similar resources were lacking, these emptying pockets of local order required at least two individuals to lift the bin.

The two individuals were usually men from different households, temporarily linked up in each other’s emptying pockets of local order to exchange physical power resources. However, it was not only due to physical strength that these couplings mainly consisted of men. Generally, women seem to be more reluctant to handle the faeces, also because of the smell. One woman believed that her pregnancy, when the toilet system was introduced, was a valid reason for not participating in the practical emptying at the time, since pregnant women should not deal with faeces. This norm for faeces, if there is one,

underlines the preferred responsibility pattern in the household rather than any real risk to the woman – she still does not participate in the practical emptying even though she is no longer pregnant. Possibly, the amount of faeces and the context in which it is presented makes it a matter out of place, since we know that women do deal with faeces when it comes to their traditional tasks such as taking care of children and the elderly. We also see that females who do not have any male to share tasks with (single-person households or single mothers) deal with the practical emptying, alone or by developing similar arrangements with members from other households as do men.

In combination with capability constraints related to physical strength, the woman has a small role in the larger household's emptying pockets of local order. This does not mean that they are excluded from it; they simply take on another role in the pocket of local order. Keeping faecal matter out of sight also means an inability, a capability constraint, to see whether the bin is in place or not. A mishap would result in matter out of place, i.e. faeces ending up on the cupboard floor and requiring manual cleaning. This risk of disorder motivates households with more than two members to develop a pocket of local order with toilet - human coupling constraints. Either, the woman stays in the flat and sees to it that household members are informed about the emptying in progress or, if both adults/parents participate in the emptying the toilet, they lock the bathroom door, thus creating the necessary coupling constraint. If all coupling constraints fail, or if faecal matter escapes from the vertical pipe while emptying, a newspaper on the cupboard floor is the final coupling constraint. The newspaper is also a resource for convenient and clean removal of the matter out of place, making direct faecal contact unnecessary.

The couplings between neighbours in order to help each other with the lifting are probably easier to achieve in Gebers than in a normal tenant-owners' association, because of the sharing of a common pocket of local order based on collective values. However, neighbours do not assist in emptying and cleaning the bin. Dealing physically with neighbours' faeces is considered to be too private, a cultural categorisation mirrored in the physical arrangements in private and collective pockets; each flat owns a separate bin, and the composting station for faeces is placed away from the living quarters partly to ensure privacy when emptying. Faeces emptied in the composting station lack identity and are considered more acceptable to deal with collectively.

When the bin is emptied, the faeces are transferred from the private to the collective pocket of local order, from a household to a collective responsibility. The filled bins and bags next to the composting station violated this social order. Having faeces in bins next to the composting station was

part of the collective pocket of local order when long intervals between emptying and bin storage was a “soft” authority constraint. Then, space for storage during the recommended period was needed and, together with certain spaces arranged in the basement, storing the bins and bags next to the composting station was in order. Removing the authority constraint in order to enable more frequent emptying (due to problems with flies) also meant the exclusion of filled private bins on communal ground as matter in place, which was communicated to the residents. The fact that some residents did not obey the collective request to take care of their old faecal matter and that plastic bags with faeces were left next to the composting station also shows that the new order has been violated. Plastic bags were not introduced until the abandonment of the 6-month storage recommendation.

The culprits could not be identified since the bins, with no indication of who owned them, were removed from the household pockets of local order. Nevertheless, bins and bags conflicted with ideas of order, and eventually the collective found a solution to cleaning up and reproducing order, not only to dealing with internal disorder, but also to maintaining an accurate picture of the local social order externally, e.g. for passers-by on their Sunday walk. By means of the social order emphasising values of solidarity, it was possible to develop a certain pocket of local order to solve the issue. Some residents volunteered and decided to link up with each other and the necessary resources at a certain time in order to empty their neighbours’ bins and bags in their rightful place. Solidarity was a necessary resource for these couplings to succeed, but in this case an overexploited one since it really should not be used for issues considered to be the responsibility of the individual. This incident shows that a pocket of local order does not always mean that all the actors act in accordance with the pocket of local order, but that order can still prevail due a shift in the use of resources – in this case, collective resources being used for private tasks.

Plastic bags were introduced as resources for emptying pockets of local order to meet demands to reduce or even abolish bin cleaning. The occurrence of flies<sup>116</sup> required more frequent emptying, but cleaning the bins every time they had been emptied was considered impracticable. Emptying and cleaning activities took a lot of time and were inconvenient since they often had to be carried out in sequence. The introduction of plastic bags in combination with the abandonment of the authority restriction of six months of faecal storage in the bin – not creating order (decomposed ‘natural’ material) but, rather,

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<sup>116</sup> Flies as a critical issue are dealt with in a separate section below, but since the occurrence of flies was an important reason for changes made to emptying pockets of local order, this particular aspect is treated here.

disorder (flies and rotten material) – created an altered order. Firstly, the plastic bag more or less eliminated the untidy and time-consuming cleaning activity since the matter out of place adhered to the disposable plastic bag instead of the bin. After use, the plastic bag is thrown away and replaced with a fresh one.

Secondly, the shorter time of use before emptying (lighter content), and the plastic bag used as a container, meant that it was no longer necessary to bring the entire bin up to ground level. The developed emptying pocket of local order did not require two persons anymore, one person could now empty the bin him/herself as long as the bags were emptied frequently enough not to trigger capability constraints in the form of biologically determined physical powers and bag material durability. Large households must, for example, empty on a monthly basis if they choose this order. This increases the time-flexibility for when the emptying takes place since coupling constraints in the form of neighbours' differing time-schedules do not exist.

Even though the introduction of the plastic bag has reduced the importance of female strength as a capability constraint (if emptying frequently), the males still perform the practical emptying in households where both sexes are represented among the adults. The women who do not participate in the emptying still “guard” the toilet, even though the plastic bag also shortens the time the toilet cannot be used. This fact lends further support to the more pronounced faeco-phobia among women in this context, but also points to the power of habit. For instance, females who empty bins experience a gradually diminishing mental capability constraint related to getting used to smell and management. In households where women do not participate, working and socially acceptable routines surrounding this activity have developed and therefore there is no reason for change. Pockets of local order are maintained by actors acting in accordance with the pocket and, as a result, routines develop that further reinforce the pocket. Sticking to established work routines and roles saves time, and although pockets of local order change in some respects, routines may remain. Thus the pockets of local order for emptying are not only physically inert due to the path dependence of the technical arrangement, but also socially inert in that cultural change and ideas of social order rarely take place. There is an element of time-economy in knowing the order of things. Consequently, the routines developed when the pocket of local order was new also are difficult to change.

In a way, the introduction of the plastic bag was a return to the solution discarded earlier; a lighter bag and frequent emptying (thus, still with faeces out of sight). However, although every household uses plastic bags, the ‘old paradigm’ of heavy bin and intermittent emptying remains unchanged in some of the households. Elevator access in combination with a flat location on the



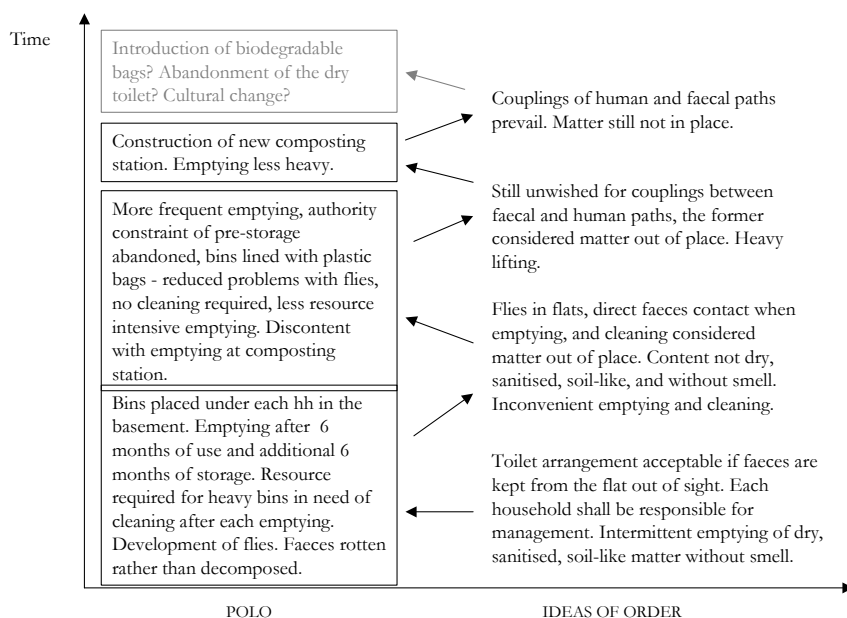
upper floors, seems to be the common denominator for the ‘old paradigm’ households. The elevator provides the necessary resource to manage the lifting of the heavy bin, and flies seems to be a less frequently occurring disorder (unwanted path coupling between humans and flies) in these households. Accordingly, I draw the conclusion that as long as increased emptying frequency is not required as a measure to overcome unwanted path couplings (disorder) and capability constraints, infrequent emptying is considered preferable to frequent emptying. This preferred order might also partly explain why it took so long for the residents to abandon the initial emptying pocket of local order, based on long time-intervals. Issues of cleanliness and convenience can help us explain why this is a preferred order. Less frequent emptying means handling a heavier bin, which supposedly takes somewhat more time to empty than a light bag (bearing in mind the rolling and lifting at the composing station). However, time does not have to be found as often as with a monthly emptying routine, and therefore it could be conceived as more convenient. Although the residents with smaller volumes to empty report on ‘cleaner’ and less ‘splashy’ management, faecal contact is more or less the same.

Observation showed that the emptying is practically impossible to do without getting into contact with the faeces. The significance of this path contact is manifested by the common use of certain gloves, clothes and shoes, working as coupling constraints between the incompatible paths. Since the dirt instead ends up on the garments, cleanliness is restored by washing and airing – further manifesting the ‘dirtiness’. Households influenced by a more ‘scientific’ view of pathogens use boiling water, but it is nevertheless an act of reproducing order. Also body cleaning, both of parts and the whole body, occurs to separate oneself from the matter out of place.

If a biodegradable bag was used instead, direct contact could be entirely avoided since the bag can be left as it is. However, this type of bag is not being used. Instead, a new composting station has been constructed to facilitate the emptying, and this is a telling example of how the collective and private pockets of local order interplay.

The figure below illustrates how the pockets of local order for emptying, including changes in both private and collective pockets of local order, have developed over time in interplay with conceptions of matter out of place.

**Figure 7.1 The development of emptying pockets of local order in time**



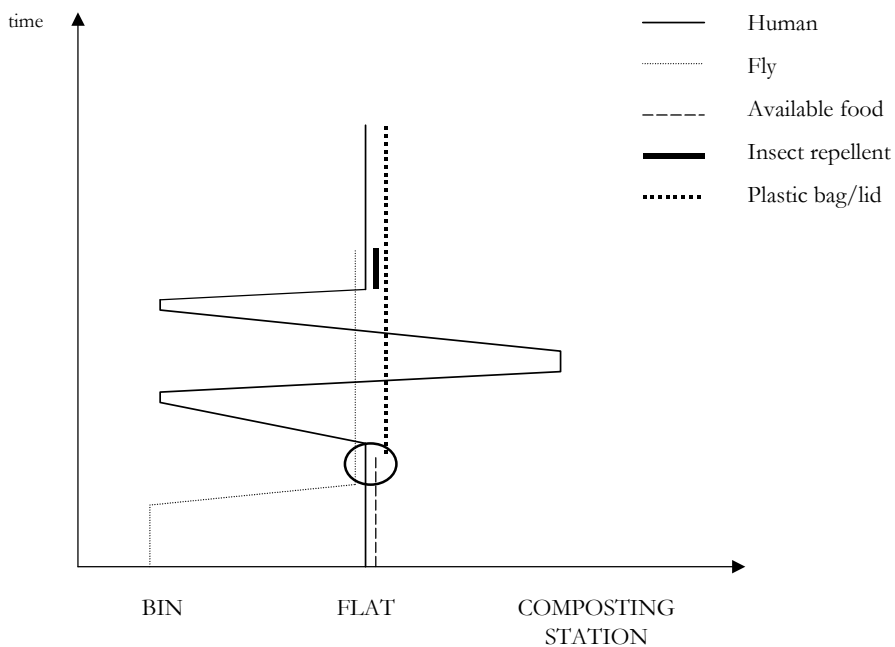
*As usual, time runs upwards. Time is from toilet system start-up (autumn, 1998) until my last data collection (March, 2004). The arrows from cultural analysis (ideas of order) to pocket of local order as an analytical perspective (polo), indicates meanings of order and disorder in terms of matter out of place forming the development of a pocket of local order. Arrows in the other direction indicate what constitutes matter out of place in the developed pockets of local order. The greyish parts indicate possible directions of future pockets of local order.*

A constraint likely to be more pronounced in the future, but not included in the figure above, is the need of physical fitness to carry out the emptying. Hitherto, the use of other resources, such as the use of time (to empty more often), the elevator, other residents, friends and relatives, means that this constraint has been circumvented. Nevertheless, physical strength and fitness are a capability constraint most households will experience in the future. Today, the household members in Gebers are fairly young, but if the present trend continues, with few residents moving out, in time, the pockets of local order developed for bin emptying will have to adapt to this constraint or the arrangement itself will have to be altered. As long as the toilet arrangement remains the same, it is an activity not amenable to compromise. Since all the neighbours are growing old at the same time, the available physical resources in the collective pocket of local order will gradually diminish. One option being discussed is to bring in resources from outside the collective, such as hiring a janitor and/or employing service companies. A home-help service willing to take on such tasks is also a relevant issue.

## Flies

The dry toilet facilitates the satisfaction of essential collective values, and is an important part of the order in Gebers. However, it requires paths of faeces to be controlled. There are clear borderlines between where faeces are in place and where they are out of place. For instance, they are in place in the plastic bags in the bins, but out of place between the bag and the bin. It is not only faeces as matter that is critical in this regard; also individuals/existents who in fact and supposedly have been in contact with faeces are perceived as matter out of place if found outside the legitimate spaces. Flies are such existents, they disrupt the orderly pattern (labelled as unhygienic and annoying) when they fly around the flat and land on food after thriving in the faecal bin. The figure below illustrates where flies and human meet (couplings of disorder), and the most common measures applied to maintain and restore order.

**Figure 7.2 Fly-human couplings and measures applied for avoidance**



*Flies thrive in the bin and reach the flat through the faecal pipe. In the flat, flies are matter out of place, disrupting patterns of order through the coupling with food and humans – the circle illustrates the critical coupling. Access to available food is hindered by lids and plastic bags and/or by abolishing food composting. The human path illustrates the emptying of bins, the most common and effective measure, and the thick path the employment of an insect repellent, also a common measure.*

Fly elimination and fly prevention are a project in its own right, and households have developed their household pocket of local order to manage

this matter out of place. Since they have dealt with varying constraints and resources over time, the pockets of local order have also altered accordingly.

Initially, limited knowledge of how flies breed was a capability constraint. It resulted in households not adopting the most effective tools and arrangements for elimination and prevention, and hence more or less all the households had flies in their flats. The generality of the problem, in combination with flies moving between different households (due to their small size and inability to recognise different domains), meant that providing all the households with the required resources to deal with the problem was in the common interest. Hence, arrangements found effective in one household were communicated to other households, e.g. when residents were linked up with one another in corridors and during the communal meals. The sharing of a common pocket of local order enhanced couplings of resident paths, which, in turn, made possible altered capability constraints and more effective household pockets of local order in terms of fly elimination and prevention.

Some knowledge of flies' breeding capability constraints have been provided by Urban Water researchers, who visited Gebers due to study the dry toilet arrangement. For instance, they recommended placing all toilet paper in the faecal compartment to create a dry environment disliked by flies. Despite the authority researchers have in our culture, many households kept to the routine of storing the urine-paper in a wastepaper basket. This means that the bin does not fill up as fast and need emptying so frequently. However, this routine is not as important as the separation of faeces-paper. The fact that it is urine-paper that is separated and not faeces-paper, shows their different cultural classification, their difference in character – urine is relatively pure liquid, and does not smell when the paper has dried, whereas faeces are impure, sticky (neither a liquid or a solid), and smelly. In the flats, faeces are matter out of place, which is a conception that guides many of the common and private pockets of local order in Gebers.

The exchange of information resulted in households' pockets of local order being more alike; for instance, the instant emptying of bins in the event of an outbreak of flies and covering the kitchen-waste container became more or less general measures. However, this does not mean that households developed a new common pocket of local order; rather, each household developed a pocket of local order in accordance with local (household-related) resources and constraints. For instance, insect repellents became a resource in households believing in their efficacy, whereas they were not used as a resource in households that did not believe in their efficacy. Moreover, sorting and decomposition of food waste are a part of the common pocket of local order and of most private pockets of local order, but they also attract flies. Creating a coupling constraint preventing the flies from getting at the

compost by putting a lid on the kitchen waste container and stored it away from the flies was a common development of the private pocket. Households with more severe problems even gave up sorting this fraction, which, however, conflicts with the common values and order of an ecological way of life. Either way, disorder is created, but since flies are regarded as matter out of place, and food waste composting is not compulsory in the collective pocket of local order, and not doing so does put the ecological profile at risk in the same manner as abandonment of the toilet arrangement (also a possible fly prevention measure), household disorder is prioritised.

As mentioned earlier, the borderline between private and common pockets of local order is clearly defined. The basement areas where bins are kept are, however, partly shared by 'bin neighbours' and thus the order in these spaces is negotiated between a limited number of households. The flies' association to the faecal bins has also resulted in some of the 'bin neighbours' creating a certain order in the event of local fly outbreaks, based on the time-space coordination of the households' emptying pocket of local order. The couplings between the 'bin neighbours' are achieved through mutual expectations of adhering to negotiated agreements, and out of a common interest in preserving order – that is, keeping the flat free from matter out of place. In a way, 'bin neighbours' have created a certain pocket of local order, which comes into play only at certain times (when flies invade) and in a certain place (the shared cellar space). In this way, a culturally deviant issue could be handled more effectively than by only taking action within the household pocket of local order.

The problem with flies has diminished but occasionally crops up. Since flies are to some extent climate dependent, household pocket of local order must be able to mobilise more resources (e.g. for emptying) in the summer to keep the preferred order intact. Households living on the first floor also seem to need a more resource-intensive pocket of local order in this respect. Another type of resource, although not discussed by any of the respondents, is the ventilation system, which creates underpressure in the toilets to prevent the smell of faeces from reaching the flats. Whether it could be used to also prevent flies from gaining access to the flats is an open issue.

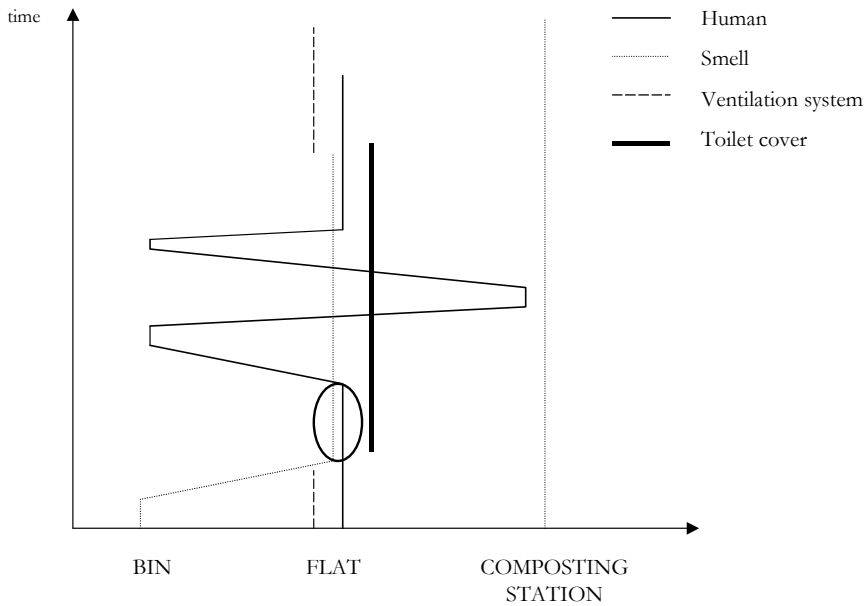
## Smell

The nose and olfactory sense are the only resources we have to detect smell, but the experience of and associations related to smell are individual - what one individual believes is bearable another finds unbearable. This is also true when it comes to the smell of faeces, a smell most of us find repulsive.

The smell of faeces is a matter out of place in our culture, and here, it has even proved to be a constraint on carrying out the required emptying. In household A, both adults are included in the emptying pocket of local order as ‘muscle power resources’, but the female’s problem with enduring the smell is a capability constraint. Placing a handkerchief over one’s mouth and nose to keep out the smell is a resource that somewhat reduces the power of this capability constraint and is thus a resource for emptying. Nevertheless, she seldom takes part in all the activities in the emptying project; her husband carries out all the emptying activities possible to do single-handedly. As a result, this household’s pocket of local order is developed taking into account the female’s capability constraint when it comes enduring the smell of faeces; i.e. her strong reaction towards a matter out of place.

The smell of faeces is obviously tolerable for short periods of time, such as when emptying, but is not acceptable if it lasts. The importance of keeping the smell out of the flats is shown by the presence of a ventilation system powered by electricity. The smell of faeces indicates impurity (lack of cleanliness) and in the case of power cuts, the smell is so strong that it results in physical discomfort, making it impossible to remain the flat. The ventilation system is part of every household pocket of local order, and when in effect it provides a bathroom environment considered superior in terms of smell compared to bathrooms with water closets – experienced as more comfortable and hygienic. This condition, however, is guaranteed by an electricity resource provided from outside the pocket of local order, over which actors in both the common and private pockets have no control. What they can do is to develop a specific pocket of local order to prevent the smell from reaching the flat when the power is cut. Preventing the smell from escaping is the primary concern; i.e. closing the lid and the bathroom door, covering the toilet with plastic bags, or stuffing a towel inside a plastic bag into the drop-hole for faeces. In the event of lengthy power cuts, it may be necessary to empty the bin. Figure 7.3 illustrates the pocket of local order in the event of a ventilation failure.

**Figure 7.3 Smell-human couplings and measures applied for avoidance**



*The ventilation system is a coupling constraint on smell reaching the flat, but it is dependent on electrical power. The circle illustrates a critical event when the ventilation system is out of order. The drop-hole for faeces is instantly covered, and in the event of a lengthy stoppage, the bin is emptied.*

The smell coming from toilets in the event of a power cut is more intense because it rises into a closed space. Hence, the intensity of the smell is partly caused by the socially preferred physical order of having toilets indoors. An indoor location is considered to be more comfortable since the human body is not exposed to climatic variations such as the winter cold. It is also more convenient, since it is more time-flexible to have the toilet readily available. By having a dry toilet solution indoors, residents are partly compromising with ideas of matter out of place. It is not in order to have faeces inside a dwelling, but the potential disorder has been solved by using airtight plastic bags and bins and airtight cupboards. This guarantees control over the matter. However, this solution creates matter out of place since it intensifies the smell; the airtight containers create a more or less anaerobic process in the bins. The smell from this process requires the ventilation system to be kept out of the flats. Thus, the goal of having an ecologically acceptable toilet solution similar to the water closet in terms of comfort, convenience and cleanliness contributed to intensifying the smell.

In contrast to the arrangement for preventing smell in the flats, the arrangement in the common pocket of local order for preventing smell at the composting station is less resource intensive. Long ago, the collective decided in favour of a temporary composting station directly on the ground, naturally

ventilated and fully exposed to precipitation. The dilution of smell molecules in larger air masses and the aerobic conditions, result in only a vague smell, which can be recognised when standing next to it. Nevertheless, the composting station is located in the corner of the area, a considerable distance from the residential buildings. Probably, the anticipated risk of smell (partly) determined the location; our biological capability of sensing smell diminishes with distance. Keeping the matter out of sight may have been a related reason. Furthermore, going to the toilet and emptying the bin are private matters. Apart from keeping matter and smell far away and keeping private matters out of sight, there is no advantage in the location of the composting station. On the contrary, resources such as time and physical strength would be saved if the composting station were located closer to the main building, a more convenient solution. In this case, issues of cleanliness (keeping matter in place) and smell comfort were given priority over convenience.

## CONCLUSIONS

The three crucial issues focused on here can be found in other studies of similar toilet arrangements. However, unlike other studies, I have tried to provide a deeper understanding of the context in which they appear as critical, and by means of that understanding explain households' impact on the arrangement as such.

Pockets of local order develop and change over time to deal with matter out of place. Without such changes, the dry sanitation arrangement would be threatened or even abandoned. The fact that the dry toilet arrangement is still part of the collective and private pockets of local order in Gebers after six years is an indication that the development and revisions of pockets of local order have been in line with socio-cultural standards of cleanliness, convenience and comfort. Hence, the three issues focused on here, initially described as 'critical', are not as important today.

The effort to alter other resources/constraints in the pocket of local order rather than the toilet *per se* is related to the arrangement's symbolic importance. Apart from being a crucial resource for the nutrient recycling project, it represents Gebers's ecological profile. With the exception of the dry toilet arrangement, most other features of the collective pocket of local order could apply to any private house in the suburb, e.g. the location, transport opportunities, water provision and arrangements for heating, electricity and solid waste.

The changes in pockets of local order are directed towards the critical sustainability issue of social acceptance. However, the two sustainability dimensions (the ecologically best solution and the best solution with regard to



social acceptance) could result in different solutions. Ecology and social acceptance must be balanced, and the account given above indicates that the most ecological solution has been somewhat watered down in order to be socially accepted. This issue is further elaborated on in the final chapter.



## CHAPTER 8

# Ringdansen vs Gebers –how different are they?

Ringdansen and Gebers were provided with new arrangements to improve ecological sustainability. The technical change in Ringdansen is geared to provide economic incentives to lower water consumption, while the aim of the change in Gebers is to re-circulate human-derived nutrients and lower water consumption. Thus, the two changes in technical arrangements have a common objective but entail different incentives for routine change, as illustrated in table 8.1.

**Table 8.1 Households' incentives for routine change for ecological sustainability**

	Technology	Economy
<i>Ringdansen</i>	No	Yes
<i>Gebers</i>	Yes	No

The difference in character allows for comparisons of changes in household routines. In this chapter, similarities and differences in water and sanitation routines in the two cases will be used to address the first research question: *In what way do the changes in arrangements impact on householder routines?* In so doing, we turn back once more to the empirical material.

## WATER USE

The housing company in Ringdansen introduced volumetric billing per household as a measure to make households reduce the amount of water and energy used. Hot water is more than twice the price of cold water, and this was expected to be a strong incentive to save. The company also installed water-saving equipment in bathrooms and kitchens, but this was not aimed at motivating residents to alter their routines, neither was the removal of bidets and bathroom sinks.

The single water meter in Gebers and shared cost is the arrangement Ringdansen had before. The vital difference in Gebers is the dry toilets, using negligible amounts of water. Taps and showerheads are not exclusively water-saving, but mixed with more old-fashioned equipment. The aggregated water

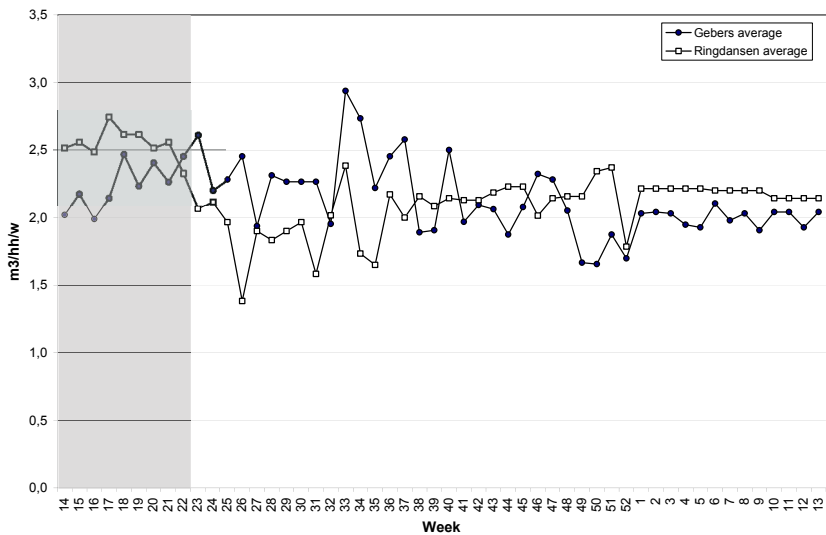
use in Gebers includes watering lawns, gardening and property management such as the cleaning of entrances, stairways and other communal areas.

Seven households in Ringdansen and all 32 in Gebers are included in the comparison on the aggregated level, and the number of members per household is 2.5 in Gebers (80 individuals/32 households) and ranges between 2.14 (15/7) and 2.86 (20/7) in Ringdansen.

### Aggregated metered water usage in the two areas

The diagram in Figure 8.1 gives the total water usage per household and week in Ringdansen and Gebers.

Figure 8.1 Total water usage ( $\text{m}^3/\text{hh}/\text{w}$ ) in Ringdansen and Gebers



The data for Gebers are averages of available data for 2000-2003<sup>117</sup>, and data for Ringdansen are based on average values for the period April, 2003-March, 2004, which is why week 14 be the start-up month for the comparison<sup>118</sup>. For weeks 1-13, only monthly values were obtained in Ringdansen, and therefore

<sup>117</sup> Weekly readings are obtainable for 2000: weeks 46-52; 2001: weeks 1-17, weeks 38-52; 2002: weeks 1-52; 2003: weeks 1-37. When weekly data are missing for one to four weeks, weekly averages are calculated for the period, which mean that some weeks get the same value.

<sup>118</sup> Not until April, 2003, did all participating households have a functional meter. However, weeks 23-35 are based on figures from only 6 households. One household returned to its normal flat in week 23, which had no working meter until week 35 when the volumetric billing took effect.

the weekly averages (based on monthly values) overstate regular use. The grey period marks a transition in Ringdansen households, when two have metered and billed water consumption, in four it has just been introduced, and one was not covered by the arrangement until the autumn of 2003 (week 35)<sup>119</sup>. Water use is at its peak during the transition period while chapters 4 and 6 show that many changes in use took place before the metering and billing per household took effect. A decline in use after the transition period is explained by some further adjustments in use as well as structural changes (e.g. changed household composition and time spent at home).

Figure 8.1 indicates no major difference in total water usage between Gebers and Ringdansen. From January to the end of May (weeks 1- 21), Ringdansen households use about 5-30% more water than the Gebers households. During the summer, Gebers households' usage increases due to watering gardens and exceeds Ringdansen's usage, at the most by 1.1 m<sup>3</sup>/w. In week 38 (September), Ringdansen's usage exceeds Gebers' usage again, and thereafter Ringdansen households use more water for the rest of the year with some exceptions (week 40 and weeks 46-47).

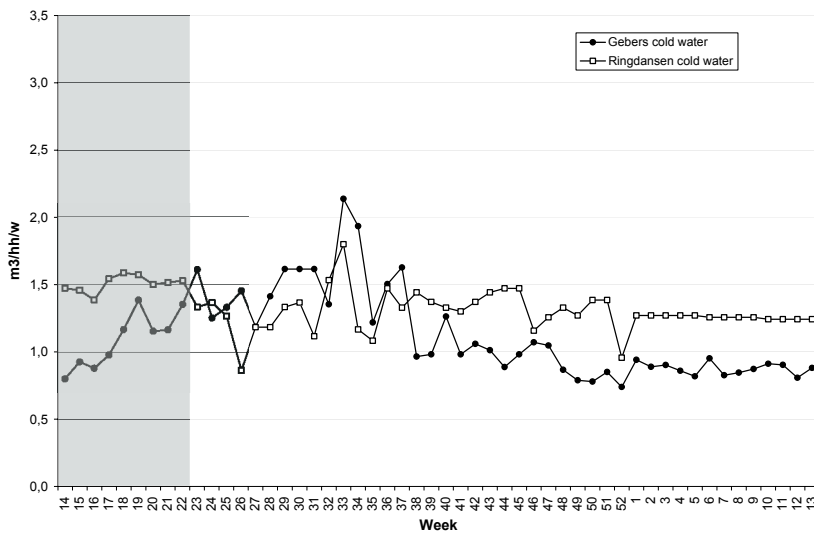
The metered values support the previous qualitative suggestions; the dry toilet explains the lower usage of water in Gebers during the winter months, and the gardens and lawns explain the increased usage in summer in Gebers<sup>120</sup>. However, distinguishing between hot and cold water would increase the validity of this tentative conclusion, since watering lawns and toilet-flushing is done with cold water. Figure 8.2 displays the cold water use.

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<sup>119</sup> From about week 20, the first six households were informed about their own use on the invoice, and from about week 42, the seventh and last household also received this information.

<sup>120</sup> Some correlations have been made with climatic factors, see chapter 5. Generally, the summers in question (2002-2003) were dry and fairly warm in the Stockholm area.

**Figure 8.2 Cold water usage ( $\text{m}^3/\text{hh}/\text{w}$ ) in Ringdansen and Gebers**

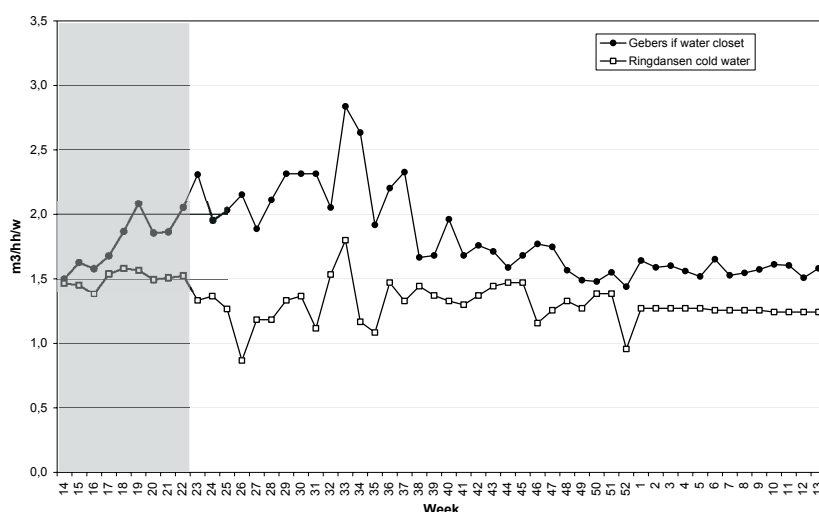


Ringdansen households use 30-50% more cold water than the Gebers households for most of the year. In the summer, however, the Gebers households use more than the Ringdansen households most of the time. This supports the hypothesis of increased summer usage in Gebers due to watering gardens, and lower cold water usage during the rest of the year as a result of the dry toilets.

In order to visualise the explanation, we add  $0.7 \text{ m}^3$  (2.5 household members x 40 litres of flush water x 7 days) to the average Gebers household's cold water use. 40 litres per capita and day is the assumed amount for toilet flushing in the standard household (SWWA 2000)<sup>121</sup>.

<sup>121</sup> It was possible to estimate the proportion of water used for flushing toilets for household B and C in Ringdansen. During the time-diary days, they used 28% (B) and 16% (C) of the total water use for toilet flushing. The large share for B may be explained by her being a low consumer, making toilet flushing one of the more important items. The smaller share for C may be explained by the use of more cold water than B, e.g. for laundering, "diluting" the importance of toilet flushing.

**Figure 8.3 Cold water usage ( $\text{m}^3/\text{hh}/\text{w}$ ) in Ringdansen and Gebers ( $+0.7 \text{ m}^3/\text{w}$ )**



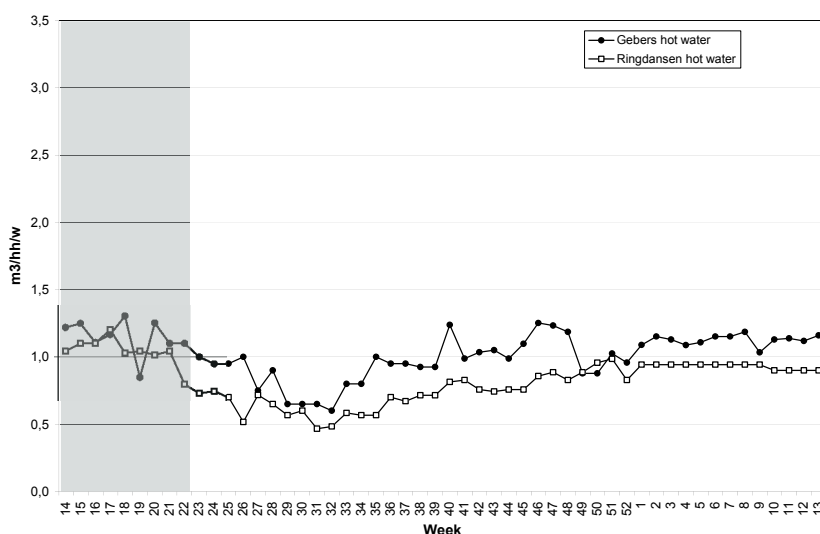
This would mean that Gebers used more cold water all the time. However, 100 litres per household and day for toilet flushing may be a bit exaggerated, considering that residents in Gebers spend more time away from home than do residents in Ringdansen<sup>122</sup>, and considering that the average figure of 40 litres is based on all kinds of toilets, which is not comparable with Ringdansen, which only has low-flush toilets. The important point is made, however – that the existence of the dry toilets is an important factor behind the lower cold water usage in Gebers.

Other likely reasons are savings from joint food preparation, or more consistent use of the communal laundry room in Gebers. The lower cold water use in Gebers could also be interpreted as Gebers ecological alignment having a greater impact on cold water consumption than volumetric billing in a conventional household.

Hot water use affects both water and energy resources, and is visible in the household economy and may also be the subject of environmental concern. Figure 8.4 displays the hot water usage.

<sup>122</sup> Based on the eight time-diaries from which it is possible to estimate time spent at home, Ringdansen residents were at home (including the immediate surroundings such as the communal laundry room) on average about 79% of the total time. The corresponding figure for Gebers is 67%. Another study in Gebers, which takes into account the time spent at home by all residents (79) for three weeks, reports a figure of 63% (Andersson and Jensen 2002).

Figure 8.4 Hot water usage ( $\text{m}^3/\text{hh}/\text{w}$ ) in Ringdansen and Gebers



The relationship is opposite to that of cold water. The Ringdansen households use 10-25% less hot water than the Gebers households for most of the year. Two contributing causes behind the dip in use in the summer are the more frequent showers, usually requiring a more cold water than winter baths, and in Gebers, the switch from indoor baths/showers to bathing in the lake. The summer also results in both increased and reduced presence in the home due to vacations and school holidays.

Both Ringdansen and Gebers have a system where hot water is circulated, which reduces the time and volumes needed before hot water runs from the tap. Hot water circulation in Ringdansen, however, includes vertical circulation, which is not the case in Gebers, and this means that it may take some time to transport hot water to flats at a distance from the boiler in Gebers. The Ringdansen flats are generally equipped with water-saving taps, which is not the case in Gebers. This may account for part of the lower usage of hot water, and the water-saving taps may, of course, also have an impact on cold water usage. The staying-home factor would imply that Ringdansen hot-water use is higher than that of Gebers.

One factor likely to be of relevance is the difference in hot water temperature provided at the tap, 50 degrees in Gebers and 55 in Ringdansen<sup>123</sup>. It is

<sup>123</sup> According to Värmemätningutredningen (Värmemätningutredningen 1983) the used volumes of hot water decrease when temperature increases (from 50 to 55 degrees with about 6%), but not enough to compensate the increase in energy consumption.



calculated that the difference in temperature (10%) is also the approximate difference in use between the Ringdansen and the Gebers households in order to attain the same comfort temperature. For instance, taking a bath in 40° C water in Gebers requires a mixture of hot and cold water with 10% more hot water than the same bath in Ringdansen, provided that the cold water temperature is the same. This may also be a factor in the lower cold water use in Gebers, since the higher proportion of hot water also means a lower proportion of cold water.

Lower hot water usage in Ringdansen may also be taken as indication that the economic incentive works. The initial norm for hot water was related to the size of flats and set at a low level of 29% of the total use (the national average is 35%). Consequently, residents were likely to face a debt at the end of the month, and the low norm may have contributed to a lower use than would have been the case with a more generous norm. On the other hand, the more generous norm for heating flats often resulted in a surplus at the end of the month, which may have hindered an even lower use of hot water (an issue discussed in chapter 6).

The data support the hypothesis for hot water use, that routines in Ringdansen and Gebers are fairly similar and that the differences in use are due more to differences in technical arrangements and local circumstances. Most respondents in both Gebers and Ringdansen realise the importance of saving hot water, but they indicate no special efforts to deliberately save hot water. Another possible reason for higher hot water use in Gebers, is that residents are proud that they use environmentally-friendly heating with solar heating and pellets, which in turn may make it more acceptable to use hot water. Furthermore, the minimal use of water for toilet flushing may also legitimise a higher water use for other activities, and water savings have not been as intensely debated in the collective.

The difference in age-distribution may also play a role, since the older generation is almost non-existent in Gebers, where there are more families with children, which are considered to consume the most resources. The two representatives for the older generation in Ringdansen use low volumes of hot water. A comparison of routines on a household level might provide us with new insights into whether the difference in hot water use is related to the volumetric billing or to other aspects.

## Water use and routines at household level

Households' water-use routines as mediated by time-diaries and interviews will be related to measured values for a discussion about differences in the amount of water used.

Table 8.2 lists household data on routines for showers, baths, toilet visits and laundering. Spaces are marked with (-) if data is lacking, primarily for respondents in Gebers households E-I who did not participate in the full time-diary study, but only in the second round of interviews, when laundry washing and showers/baths were not systematically recorded, since the focus of interest was on the dry urine-diverting toilet. The number of toilet flushes is an average based on the time-diary information. Laundry habits include both laundry done in the bathroom and in the communal laundry room.

**Table 8.2 Water-use routines: frequency and duration**

Individual	Househ. members (approx.)	Shower routine	Bathing routine	Toilet flushes/day	Laundering per week
<i>Ringdansen A</i>	1-4	Rarely	Every 2 <sup>nd</sup> day	8.7	3 machines
<i>Ringdansen B</i>	1	Every 3 <sup>rd</sup> day	No tub	5	2 machines
<i>Ringdansen C</i>	1	Rarely	Twice a week	5.7	1.5 machines
<i>Ringdansen DF</i>	2	Once a day 5-15 min	Never	5	2-3 machines
<i>Ringdansen DM</i>		Once a day 4-5 min	4 times/year	6.3	
<i>Ringdansen E</i>	3	Once a day 5-15 min	Never	2.3	4-5 machines
<i>Ringdansen F</i>	5	Once a day 5-10 min	Children and male on occasion	1.7	10 machines
<i>Ringdansen GF</i>	4	Once a day 5 min	Once a week	6.7	10 machines
<i>Ringdansen GM</i>		Once a day	Circ. 1 time/day	6	
<i>Ringdansen GFC</i>		Once a day 5 min	1-2 times/day	2.3	
<i>Ringdansen GMC</i>		Once a day 15 min	Seldom	3.3	
<i>Gebers AF</i>	4	Twice a day 5 min	No tub	3.6	8 machines
<i>Gebers AM</i>		Once a day 5 min	No tub	3.8	
<i>Gebers AC</i>		Once a day	No tub	-	
<i>Gebers BF</i>	4	Once every 2 <sup>nd</sup> day	On occasion, child once a day	4.5	9 machines
<i>Gebers BM</i>		No regular habit	Rarely	3.4	
<i>Gebers C</i>	1	Once a day 5-20 min	No tub	0.4	-
<i>Gebers D</i>	1	5-20 min	Once a week	2.2	1 machine
<i>Gebers EF</i>	4	-	Often	-	-
<i>Gebers EM</i>		-	-	-	
<i>Gebers F</i>	1	-	Yes	-	-
<i>Gebers G</i>	1	Not every day but long time	-	-	-
<i>Gebers H</i>	2	Twice a week	3 times/year	-	-
<i>Gebers I</i>	1	Winter, summer baths in the lake	Once a week in winter	-	-

As can be seen in the table, long showers, frequent showers and baths are about as common in both areas – while variations appear between households. For instance, a bathtub is most frequently used in households with children/youths (*Ringdansen A* and *G*, *Gebers B*), but without a bathtub,

short showers dominate in Gebers household A, also with children. Elderly households in the two areas (Ringdansen B and C, Gebers H) show similar routine patterns in that they do not have a daily shower/bath habit. The fact that there are few households of this type in Gebers may have an impact on the higher hot water use compared to Ringdansen.

The similarities in use may indicate that volumetric billing per household in Ringdansen and ecological concern in Gebers have a similar outcome in terms of saving water. The interviews in chapters 4 and 5 show that respondents highly value taking a bath or a shower, and they seem less concerned about saving costs and resources. Showers and baths are important hot water uses in a household. According to the Ringdansen data, filling a bathtub some 70-100 litres of hot water is needed. A 10-minute shower with a normal non water-saving showerhead requires some 80 litres of hot water<sup>124</sup> - thus about the same amount as a bath. Lower use may be expected with water-saving shower equipment and/or lower water pressure, which indicates a generally lower volume of water used for showers in Ringdansen than in Gebers. On an aggregate level, routines can balance each other in terms of water use despite being different in character. For instance, one woman in Gebers replaces showers with bathing in the lake during the summer, and one woman in Ringdansen barely uses any water for showering during the summer due to not being at home.

The fact that Ringdansen respondents spend relatively more time at home compared to the respondents in Gebers most likely explains the higher number of toilet flushes, on average 4.8 flushes per day in Ringdansen compared with 3 flushes per day in Gebers. An additional factor is that a water closet is sometimes flushed twice (with either a small or a large flush) to make the bowl sufficiently clean, whereas the urinal in the dry toilet in some households is only flushed once in a while. The latter flush-saving routine is also found in Ringdansen. Also, for 'small visits' householders often select the low-flush option - if they have a dual-flush toilet and are aware of this function. The water closet may also be used (and flushed) for other objects and substances than human excreta, while the dry toilet can only function to a limited extent as a garbage can. The amount of water used for cleaning a dry toilet and a WC is probably the same, since little water has to be used in the dry toilet since the cleaning tools are washed separately. Water closets and the toilet brush are cleaned with the water standing in the toilet, but may also require a flush.

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<sup>124</sup> The figure is based on a test of my shower at home. A 10-minute shower with moderate-high water pressure uses about 130 litres of water. At body temperature (37-38 degrees), which most respondents in Ringdansen have their thermostat adjusted to, I have estimated the mix to be approximately 40% cold water and 60% hot water.

The last column in table 8.2 depicts laundry routines – commonly between 1-2 machine washes per person and week. Households in both areas mostly use a communal laundry room for laundering, but it is more common to have a washing machine in the flat in Ringdansen. According to the interviews, the reason is first and foremost that it increases convenience, but it also removes the risk of clothes being stolen and problems with double-booking – a frequent problem in Ringdansen before the locks for the laundry rooms were computerised. Gebers is a small community where the neighbours know each other, and in such a context, the risk of stolen clothes and conflicts with other neighbours about reservations is minimal.

The lack of individual billing and more or less exclusive use of the communal laundry room in Gebers make where the laundering is done insignificant. In Ringdansen, however, the metering data indicated elevated cold water use in households doing some or all of their laundering in the flat. Most residents in Ringdansen view doing laundry in the communal laundry room and at home as economically similar alternatives. However, the price of SEK 4/wash in the communal laundry room (2003) is compared with SEK 9.06 if done in the flat, based on the following calculation: 100 litres of **cold water** (SEK 18 x 0.1 = SEK 1.8), 1.1 kWh in **energy use** (1.1 x SEK 0.92 = SEK 1), **detergents** (about SEK 2.50 for a 5-6 kg wash), **write-off cost** (SEK 2.80 per wash) and **cost for repairs** (SEK 0.96 /wash)<sup>125</sup>. The price of washing at home is even higher if a tumble dryer is used. Since the new washing machines in the communal laundry rooms are extremely water efficient (about 40 litres/wash, adding water according to weight), and can take more laundry per wash, it would be preferable from a water economy perspective to use the communal laundry room. Weighing the laundry may also be beneficial in terms of water savings in the event of the machine not being filled. Most likely the relationship is about the same in Gebers (that the washing machine at home uses more water than the communal ones), and since only a few households have a washing machine in the flat, Gebers may save some (cold) water with this arrangement. During the refurbishment in Ringdansen, more laundry was done at home due to overcrowding in the communal laundry rooms, but

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<sup>125</sup> The calculation is based on a calculation example from Råd & Rön (Holm 2005), a magazine published by The Swedish Consumer Agency. In this calculation, I have used participating households' water consumption figures for laundry and actual prices of electricity and water in Ringdansen. Estimations of energy consumption, cost of detergents, write-off cost and cost of repairs are taken directly from the example in the magazine. Write-off cost and cost of repairs are included in the rent if choosing a washing machine from the housing company option program. In this case, water use should also be lower than 100 litres/wash, considering the policy of only offering energy and water-efficient washing machines (Råd & Rön's example is based on an average machine using 70 litres/wash).

otherwise no change in routine has been noted – either concerning the location or the frequency and number of washes.

In Table 8.3, households for which data is available concerning routines for washing dishes, more differences appear, which makes a comparison difficult. The communal kitchen for preparation of shared meals in Gebers is used four days a week and residents use less water for food preparation and washing the dishes at home. One question is whether it is possible to save water by means of large-scale cooking. The normal dishwasher is of a kind normally used in restaurant kitchens, which reuses part of the rinsing water for the next wash. Large-scale cooking may also save some water, for instance, one large saucepan for boiling potatoes may use less water (and energy) than the sum of every household's saucepan for boiling potatoes, including the washing up. Furthermore, possibly social controls may dampen water use during communal cooking; the increased importance of collective values (reduced use of resources) when carrying out activities for common purposes, compared to the more independent choice in the household. A study of households' energy consumption showed large-scale benefits in terms of dishwashing (Nutek 1994) (Carlsson-Kanyama and Lindén 2002). The relative effect of large-scale cooking in Gebers is difficult to estimate, however, since joint cooking activities do not exclude cooking and dishwashing in the flats.

When it comes to household-related dishwashing in Gebers and Ringdansen, some households have access to a dishwasher while others do it by hand. Table 8.3 shows the routines in the households.

**Table 8.3 Dish washing routines**

	Pre-treatment before washing	Dishwasher	Manual washing	Rinsing routines after washing
<i>Ringdansen A</i>	Rinses carefully under running hot water	1/ day – 1/week	Under running water	Under running water
<i>Ringdansen B</i>	Rinses	No dishwasher	Filling the sink (1/d)	Washing-up bowl
<i>Ringdansen C</i>	Rinses	No dishwasher	Filling the sink while washing up (1/d)	Washing-up bowl
<i>Ringdansen D</i>	Leaves dishes to soak	No dishwasher	Filling the sink (f), under running water (m)	Washing-up bowl (f), under running water (m)
<i>Ringdansen E</i>	Leaves dishes to soak a while in the water before washing	No dishwasher	Filling the sink	Under running water
<i>Ringdansen F</i>	Rinses	1/day	Filling the sink	Under running water
<i>Ringdansen G</i>	Rinses	2 times in 3 days	Filling saucepans with water, wash off and rinse.	Under running water
<i>Gebers A</i>	-	No dishwasher	Filling the sink while washing up (f), filling the sink (m)	Under running water or in the sink
<i>Gebers B</i>	Rinses (f), often no rinsing (m)	3 times in 5 days	Under running water (saucepans, bowls etc)	Under running water
<i>Gebers C</i>	-	No dishwasher	Filling the sink	Under running water or in the sink
<i>Gebers D</i>	Rinses	No dishwasher	Filling the sink	-

Whether a dishwasher saves water or not depends on the routines for rinsing and washing by hand and the type of dishwasher. Interviews and time-diaries often indicated that dishes not suitable for the dishwasher are washed using running water, a routine also followed in the communal kitchen in Gebers. Generally, rinsing dishes under running water is the most common practice in both areas. Running water does not necessarily mean that more water is used than if using a washing-up bowl or sink. The female in Gebers A claims that washing up (rinsing done simultaneously) under a thin jet of water uses about the volume of one sink. The high water pressure used by the male in Ringdansen A to rinse dishes before putting them in the dishwasher clearly

requires more water than do the male and female in Ringdansen G, who were more careful to turn off the tap more quickly after the introduction of volumetric billing. The use of a washing-bowl bowl or filled sink for rinsing the dishes after cleaning them is about as common in Ringdansen as in Gebers, and one household in Ringdansen (B) has adopted this routine as a result of the volumetric billing. The same household has also started to use the first tap water in the morning (previously wasted since it was not considered fresh) for the pre-treatment of dishes.

### Summing up

Built-in technical devices, such as the dry toilet, and local circumstances such as the existence of a garden in Gebers, more elderly people in Ringdansen and differences in hot water temperature have a profound impact on water use. However, built-in installations do not require altered routines and it is the technical device itself that saves water. Routines for doing the laundry, washing dishes, and personal hygiene/comfort are alike in the two study areas – as regards both frequency and how they are performed.

Thus, we have found no support for relating lower cold water use in Gebers to environmental orientation, although it was environmental orientation that made Gebers select a toilet with little or no cold water consumption. Nor is the lower hot water use in Ringdansen solely related to volumetric billing, although it made most households in Ringdansen reduce their low-value use of both hot and cold water. This is important, however, since environmental awareness in Gebers is said to reduce low-value use. Thus it seems as if volumetric billing and environmental awareness provides the same outcome in terms of reducing low-value use.

### WASTE DISPOSAL IN TOILETS

Water meters do not imply routine change by necessity. The urine-diverting toilet, however, requires partly diverging practices compared to the water closet in terms of sitting technique, cleaning procedures, disposal habits and waste management. All these routines are of importance for nutrient recycling, and they have all been thoroughly described in the empirical chapter (chapter 5). In this chapter, dry toilet routines related to waste disposal in the toilet are discussed and compared with general knowledge of what waste is disposed of in water closets<sup>126</sup>.

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<sup>126</sup> The Ringdansen households are assumed not to diverge from the general disposal pattern.



There is a necessary disposal of other substances in the toilet when cleaning takes place. The dry toilet requires sparing use of cleaning agents and the frequent use of more gentle cleaning agents than for the water closets, for instance, normal hand soap, lather or just water is used instead of chlorine and water-closet detergents with a chemical composition that enhances the cleaning process by dissolving the dirt. The urine-pipe is cleaned mechanically with water and/or a specific brush, but the resident survey revealed that biodegradable sodium hydroxide (caustic soda) has also been used to dissolve urine blockages.

All the households in Gebers follow the rule of disposing of only biodegradable matter and no liquids in the dry toilet. This limits the use of the dry toilet as a garbage can, and the faecal bin is used as a receptacle for faeces, toilet paper, water, vomits, urine, lime and possibly some insect repellents. In contrast, both liquids and solid waste of different origins are disposed of in the water closet. Only the size of the object limits water closet disposal. The water closet is perceived as suitable for the disposal of liquids and objects and especially those that smell, for instance, shrimp-shells, snuff, nail-polish remover, tops, condoms, cotton balls, tampons, sanitary towels and perceived self-ignitable substances (e.g. acetone). Some liquids, which should be taken to a special collection point, are more convenient to get rid of in the water closet. It is physically possible to put all these things in the dry toilet, but since nothing 'disappears' but remains in the bin and must be taken care of, it is not an acceptable solution. Furthermore, the contents are used on farmland, which further restricts the disposal of anything that is not biodegradable. Residents with ordinary water closets in general do not apply this perspective. One routine, which may cause concern, is spraying insect repellents in the toilet, but it remains unclear if and how much of this that actually reaches the bin content.

As the toilet is not intended for waste disposal, pouring liquid substances down the drain may continue due to the conventional sewer solution still being present for grey water. It does not affect the recovering of nutrients at Gebers, but hinders the recycling of nutrients from sludge and constitutes both a treatment and an ecological problem.

From this principal empirical account of the two arrangements' impact on householder routines compared to a standard solution, we turn to the concluding chapter for a more in-depth analysis.



# Conclusions: Changing routines by changing water and sanitation arrangements -issues of concern for improved social and ecological sustainability

The focus of interest in this thesis has been to describe and analyse the interaction between householder routines and changes in water and sanitation arrangements. This issue has been dealt with theoretically as well as empirically using two cases; one on individual metering and billing per household in Ringdansen, and another on dry urine-diverting toilets in Gebers. This chapter aims to discuss and analyse the results, and to evaluate the surveyed routine patterns in terms of ecological and social sustainability. The two research questions formulated in the objective will guide the presentation. The possible planning implications for future sustainable urban water and sanitation derived from the results conclude this chapter and the thesis as a whole.

## IN WHAT WAY DO THE CHANGES IN ARRANGEMENTS IMPACT ON HOUSEHOLDER ROUTINES?

The interpretation of empirical data on routines takes into account issues of economy, culture, environmental concern, physical arrangements and social organisation. Such a comprehensive analysis has been made possible by introducing the concepts *pocket of local order* and *matter out of place*. A change in water and sanitation arrangements changes households' pockets of local order and can change householders' routines. It may also result in a new understanding of what is considered matter out of place.

Culture analysis provides an understanding of routines in addition to a time-geographical description. An analysis of what respondents considered necessary use and wasteful use should include both a description and interpretation of the context. For instance, the use of water per person and day ranges between 80-170 litres in Ringdansen, while the similarity in use between the two areas at the aggregate level indicates a common perception in our society about what is necessary use. Boverket's (Boverket 2002) definition of wasteful use related to routines matches the respondents' ideas of what

wasteful use is. The necessary use, the lowest perceived volume that few would like or even think of going below, seems to be culturally defined; *a socio-culturally defined water volume regarded as necessary for maintaining order, keeping matter in place, and preserving desired levels of comfort.*

The empirical evidence of impact differs depending on what change is studied. We have established that households respond differently to the volumetric billing in Ringdansen; some residents are particularly inclined to react to economic incentives, while others are resistant to pecuniary incentives. Other residents are particularly sensitive to ecological arguments, but may also be resistant to pecuniary incentives. As a consequence, some adjusted their use on being informed about the coming payment according to use, others adjusted their use when the volumetric billing took effect, and some made no adjustments. The billing of water used primarily induces routine change among large users, while those who already use little water (including the more environmentally oriented households) find it hard to lower their use still further. One household using little water but having a strong economic incentive to save, initially made important adjustments to routines, but seems to have returned to old routines to some extent after the first settlement of account. There is a metered difference in per capita hot water use between households with older residents and those with young persons in Ringdansen. This may be attributed to the fact that youngsters are not directly hit by higher cost, unless their parents inform them, and their habits when it comes to showers and baths require more water. In general, however, no sweeping routine changes took place in the households. Behind many reductions in use are other factors, such as altered household composition (members moving in or out) and females changing the time they spend at home. The latter result confirms earlier studies pointing to somewhat more excessive water use in households where the woman works part-time or is a housewife (Gaunt 1985).

A comparison of average total water usage per household (at an aggregated level) between Ringdansen and Gebers shows no significant difference. There is an outspoken view among all residents about not wasting water, but also no compelling reason to save. In theory, many define it as more important to save hot water, but in practice no distinction is made. This confirms the hypothesis of a culturally determined lower limit. This limit does not change much over time, despite a gradual reduction in water use at a national level. This reduction is mainly a result of built-in arrangements, which reduce the volume and still provide the same service or level of comfort.

Apart from changes in water and sanitation arrangements, cultural changes in various spheres may have direct effects on water use. The recent cultural idea that clothes must be washed after only one day's use will result in significant

increase in cold water and energy use, unless offset by more efficient washing machines. With decreased water use, however, modern washing machines are also criticised for not rinsing properly. Properly rinsed clothes are said to be a Nordic demand, and therefore there is little interest on the supplier side to develop water-saving machines that also rinse effectively (Holm 2005). If clothes are perceived to be poorly rinsed, an extra rinse or yet another wash would counteract the water saved.

Gebers uses less cold water in the winter and more cold water in the summer, when watering the garden explains the increase in use. The dry toilet saves all cold water that would otherwise be used to flush the water closets. For hot water, however, the use pattern in Gebers was reverse. Ringdansen households use less hot water than do Gebers households. Economic incentives in Ringdansen may play a role and also the general installation of water-saving taps, a higher hot water temperature and more efficient hot water circulation. Ringdansen households spend more time at home, which implies higher use, but this seems to be offset by a larger proportion of elderly people. Gebers has a larger proportion of households with children and teenagers, leading to higher use of hot water in Gebers than in Ringdansen.

Had we only had access to metered data and technical information, the obvious conclusion would be that volumetric billing reduces hot water use. However, the qualitative data from time-diaries and interviews clearly establish that water-use routines are similar in the two areas. The fact that households with an environmental orientation do not shape their everyday living much differently than other households is also supported by other studies (Mårtensson and Pettersson 2002). Therefore, the conclusion is that, *routines for hot water usage are similar and so are used volumes irrespective of the influence of ecological or economic incentives*. Differences in household composition, technical water-saving equipment, type of hot water circulation and water temperature explain the differences in hot water use between the two areas.

The dry toilet has a decisive impact on disposal routines; only biodegradable waste products are thrown into it and the cleaning agents are environmentally friendly. The fact that all items thrown into it must be taken care of by the owner of the toilet, constrains the use of the dry toilet as a waste bin. Furthermore, knowing that urine and faeces are returned to nature restricts disposal to objects regarded as natural, or biodegradable. The households in Gebers selected the dry toilet solution for environmental reasons, and they are therefore expected to be knowledgeable about what to dispose of also in the WC. Still, they claim to have gained a different view of what to dispose of in the toilet after experiencing the dry toilet. *The change in technical arrangements secured environmentally friendly toilet disposal routines that reach beyond the 'good' routines evolving from environmental concern.*

The empirical data suggest that only an extensive physical change in water and sanitation arrangements will lead to a major change in routine. In Ringdansen, a small physical change in water arrangements was accompanied by a likewise small routine change. Also, the money to be saved from cold and hot water was too little to become a vital capability constraint for households' use of water. A drastic physical change in the toilet arrangement in Gebers resulted in a household routine that no information campaign ever has been close to accomplishing. The physical change in Gebers was accompanied by increased responsibility for the household. Misuse also affects the household negatively. The relationship between changes in water and sanitation arrangements and householder routines may be expressed as follows: *an extensive change in arrangements, either technical/physical, organisational and/or economical results in more radical routine changes, and more so if combined.*

In more general terms, there is a need to continue technical developments linked to installing water-saving equipment, and thereby reducing water use while maintaining comfort levels and satisfy cultural aspirations. Volumetric billing is, however, not a single measure. The chosen design to bill according to a standard norm, by regulating the debt/credit at the end of the year, and by presenting water and energy costs as a lump sum, is likely to have reduced the impact of volumetric billing. The norm is not related to the resident's previous use, nor to a certain goal, but only to flat size and not even to the number of household members. Residents in small apartments may use water very sparingly and still get a 'debt', while households with few members in large apartments may use water in a wasteful way and be 'refunded'. The low hot water norm may also discourage a reduction in use merely by being impossible to reach. The norm for heating energy also relates to flat size, which is reasonable and more informative since they are correlated. Consequently, it is just as important to consider how the information is presented to the residents as adjusting meters and computer programs for administering the information on use.

### Assessing the usefulness of the methods used

The applied method has been effective in bridging the gap of missing metering data for individual households, adding to the robustness of conclusions reached. Time-diary information as complement to metered individual data has provided a sound way of assessing water use and existing routines. When individual data are missing, the time-diary has been analysed in relation to monthly use or for a longer period, and this allows us to draw conclusions. The time-diaries also allow us to compare seemingly divergent user groups in Gebers and Ringdansen.

The recording of water-related activities in the time-diary has to a varying extent stimulated reflections among respondents on routines, which in turn has helped respondents to talk about their routines. Furthermore, the time-diary offers a common starting-point for the respondent and the researcher about pre-understanding of everyday routines. The metered data, on the other hand, indicate when and how much water is used. The combination of methods made inconsistencies between empirical data visible and thereby possible to interpret further. In the three Ringdansen households where the methodological combination worked in full, we have a near ideal approach for learning about household water-use routines. An example is a case where metered data indicated that a large volume of water was used, while no water-use activity was recorded in the time-diary for the period of time, but the following interview revealed that children had had baths. The respondent explained that the baths were ignored in the time-diary because he had understood that only his own use should be recorded. This example also highlights the importance of being thorough when giving instructions on how to fill in the time-diary.

The metered water volumes corresponded surprisingly well with the routines recorded in time-diaries and interviews. This fact makes it possible to interpret and validate the empirical data. Also, metered data for longer periods of months and years show to what extent the routinised water-use pattern remain or change. The triangulation method has made it possible to analyse the important issue of whether the documented routine changes are permanent or not.

It is preferable if all members participate in the study in order to gain a full picture of household water use and routines. However, if this is not possible, this study shows that the main contributor of household services may provide enough information also about other members' water use. Much of the water use relates to these persons' activities. The male in household A and the female in household F are two good examples of such spokespersons, since they spend their time at home and have the main responsibility for the household chores, and an overview of all activities taking place.

## HOW CAN THE NEW ROUTINES BE EVALUATED IN TERMS OF SOCIAL AND ECOLOGICAL SUSTAINABILITY?

Sustainability is an overexploited word, defined in a number of ways, and thus it needs to be characterised when used. My use of the word is related to human routines. Improved ecological sustainability is related to routines using fewer resources, primarily water and energy, and/or routines that recycle resources (e.g. nutrients) in a better way than before the change in arrangements. Social sustainability, on the other hand, is about routines that

are socio-culturally accepted, affordable, and which users are comfortable with. A sustainable arrangement must satisfy both kinds of sustainability.

The volumetric billing per household in Ringdansen did improve ecological sustainability by stimulating residents to reflect on their use and it led to some routine adjustments and reduced 'unnecessary' water use. The dry toilet in Gebers also improved ecological sustainability by encouraging residents to only dispose of biodegradable waste and to use more gentle detergents for cleaning.

The empirical data made it possible to define what routines the respondents consider acceptable or not. They tell us how far we can reach with changes in water and sanitation arrangements without trespassing on what is perceived to be normal, hygienic, affordable, etc., that is, what is socially sustainable. It is one reason why we do not witness a larger decrease in water use, and why the dry toilet arrangement requires resources, which somewhat compromise ecological sustainability.

Compared to the national average of 200 litres per person and day, both Ringdansen and Gebers households are low or moderate users of water. Nevertheless, they use volumes far above what is required for survival, and still they claim that they cannot cut back on the volume. Meeting cultural standards of cleanliness and comfort requires a certain amount of water, and a reduction could cause disorder. The price for water is considered to be low for preserving the order, and the households can maintain their present water use without jeopardising the household economy or the environment.

Economic incentives to save resources have some potential, but as Shove (Shove 2003a) points out, cultural changes have not indicated a reduced need for comfort, cleanliness and convenience; rather, these needs tend to escalate – and with them the need of resources, such as water.

The dry toilet arrangement keeps faecal matter in a place away from the flat, out of sight and with little risk of noticing the smell of it. Furthermore, faecal matter is considered private, and thus every household was provided with their own compartment for faeces. Long emptying intervals was a preferred routine, both for convenience and to allow time for transforming faeces into soil. All these social requirements indicate the categorisation of faeces as matter out of place, and how it should be managed to maintain order. A consequence of these perceptions is a physical order with watertight large plastic bins in airtight steel cabinets (also for fire-safety reasons) beneath each flat, fitted with ventilation powered by electricity.

Thus, the acceptance of managing a dry toilet arrangement for faeces was conditional on spatial arrangements and a certain resource use. Some of the



initial assumptions among the residents proved wrong. They thought that decomposition would take place in the bin and that there were no flies. However, no decomposition took place and there were flies, and therefore changes in arrangements became necessary. An increase in emptying frequency solved much of the fly problem. The six-month period of storage and emptying was an authority constraint easily altered, especially since it did not serve its purpose of maintaining order. To avoid cleaning the bin, a plastic bag was placed inside to collect the faecal material and paper. The plastic bags improved social sustainability, because the emptying process was made more hygienic; no need to clean the bin, more convenient; no need to lift the whole bin from the cellar when emptying which saved time and physical resources. In short, the plastic bag made many aspects of the dry toilet arrangement more acceptable. The bags slightly compromised ecological sustainability. Some households use insect repellents to kill the flies, which is not considered ecological. In an effort to prevent flies from reaching the apartment, some households abandoned the routine of sorting kitchen waste for composting. All these measures were taken in order to make the household conditions more socially sustainable.

The new composting station satisfies the demands for both social and ecological sustainability. The risk of nutrient leakage into Lake Drevviken is avoided, and the emptying activity is made easier and somewhat more hygienic. However, the fact that it took nearly five years to construct a permanent composting station indicates that this was not the most critical issue for creating social acceptance of the management routines.

Perceptions of what matter out of place is have been stable over time, although some respondents report having become somewhat accustomed to the smell and management of faecal material. Issues of order and definitions of matter out of place have proved to be important factors behind the evolution of household pockets of local order. The hands-on management of faeces is essential for the dry toilet function, but the close link between the matter (out of place) and residents has not been fully accepted, indicated by the many adjustments in pockets of local order. Urine management has remained the same. Blockages of urine pipes and smell have been perceived as problems occasionally.

Management routines differ among households, not due to cultural differences but to differences in local resources and constraints in terms of flat location (type of cellar space beneath), household size, individual sensitivity towards smell and management, ideas of convenience (emptying a small amount often or a large amount more seldom), etc.

Some inconvenience such as emptying the bin and not having a spotless porcelain bowl is acceptable since the toilet solution is thought to benefit the environment. But the way the emptying and cleaning are executed must not compromise the standards of cleanliness, comfort and convenience. A century of experience with the conventional flush toilet, which transports excreta away, has changed our view of excreta as a resource into excreta as waste. Residents at Gebers have revived the old resource paradigm, and arranged their living environment accordingly. They have gradually rearranged the pockets of local order to create routines and an arrangement that better fits the socio-cultural norms. The chosen toilet arrangement has moved towards qualities associated with the conventional water closet arrangements; robust, hygienic, and simple to use and manage. The dry toilet facilitates nutrient recycling, which makes it more ecologically sustainable, but social sustainability has been achieved through continuous adjustments of pockets of local order and, to some extent, of the concept of matter out of place.

As earlier studies have shown (e.g. Fittschen and Niemczynowicz 1997; Haglund et al. 1999), issues raised in opposition to source-separating toilets are not unique for Gebers. However, the struggle to gain acceptance is perhaps a bit more pronounced in Gebers because the dry toilet is not only a requirement for nutrient recycling, it also symbolises an ecological way of living. The joint meals symbolise the principle for social living in Gebers. These two features are especially important, since they enable the Gebers pocket of local order to be distinguished from the ones developed in other housing areas. However, the resources and efforts allocated to make the toilet system socially sustainable have left little time and energy to develop other ecological solutions; especially large projects such as a system for recirculating treated grey water. The fact that the permanent composting station took five years to complete also indicates a lack of time resources and possibly even physical and mental strength.

### **WHAT RECOMMENDATIONS CAN BE MADE FOR FUTURE PLANNING OF SUSTAINABLE URBAN WATER AND SANITATION SYSTEMS?**

Water and sanitation utilities are highly interested in how to communicate 'better behaviour' among their customers, and they often point to the difficulty of reaching out to a large audience. My empirical data show the diversity among households. They live in different social and physical contexts and have different reasons for taking action, and different measures appeal to different residents. Some residents already save water out of environmental concern and are only slightly affected by volumetric billing – if at all. Others are sensitive to economic incentives and altered their use before volumetric billing came into effect. Yet other residents are not affected at all since they

perceive that they use what they need, nothing more, nothing less. Some residents appreciate new technology, while others have trouble understanding how it works. The residents of Gebers were willing to try out new water and sanitation arrangements for the sake of the environment and to try out something beyond the ordinary.

The measures aiming at improving household routines need to be as varied as the households are as a group. Some households will respond favourably to repeated information in the form of brochures or instructions about a 'correct' use of the water and sanitation arrangements, while others will be encouraged by changes in technical arrangements and economic incentives.

Just as the diversity in social and physical arrangements affect routines, so does similarity. Technical arrangements communicate and might physically impact on routines through design. What we have learned by comparing Ringdansen and Gebers is, among other things, that as long as the technical arrangements for water and sanitation services are in principle the same, built-in arrangements rather than routine change will be the decisive factor for improved ecological performance of the system. *Changes in physical arrangements, however, may improve ecological sustainability also through changes in routine, more so for major changes than for minor ones.*

Changes in water and sanitation arrangements do have an impact on routines, but there is no template for how and why such change is achieved. Bringing routines more in line with ecological sustainability requirements is more likely to succeed if the existing uniform urban water and sanitation system is abandoned in favour of more diversified technical and management arrangements. In addition, a diversified way of managing water and sanitation has the potential of breaking up standards of normality and order since it becomes clear that several types of arrangements can be perceived as normal.

This thesis should be seen as a first step towards more studies of this kind in other housing areas to increase the knowledge about prerequisites of and logic behind routines. We will then know more about what routine change to expect under certain circumstances. In this endeavour, the methodological and theoretical approaches developed and implemented in this study will be useful. Their applicability goes beyond the water and sanitation sector, they certainly would be useful also in research on, for instance, household energy use and waste management.

The methodological and theoretical approach developed here can be applied in studies of household pollution of water. The emerging chemical society is the most critical threat to sustainable urban water and sanitation management. The use of 'ordinary' everyday household chemicals and medicines is a major challenge for the water and wastewater utilities, as well as for society. This

issue is partly dealt with here, in terms of what is disposed of in the toilet, but it should be extended to embrace all flows through the household; washbasins, kitchen sinks and floor drains. The fact that several respondents in Ringdansen started to reflect on what products they use and release into sewers when writing the time-diary, verifies the usefulness of such an approach.

“Nothing is forever but change”. These five words are as valid for everyday living as any water and sanitation arrangement. Studying water and sanitation routines is thus an endless topic, and this study is probably only one of many future contributions in this area.

# Appendixes

## APPENDIX 1: TIME-DIARY SHEET

Time	What I do?	Water consumption?	Where?	With whom?	Comments
		<input type="checkbox"/> No, <input type="checkbox"/> Yes, Why?: Product: <input type="checkbox"/> Hot water Amount or time: <input type="checkbox"/> Cold water			
		<input type="checkbox"/> No, <input type="checkbox"/> Yes, Why?: Product: <input type="checkbox"/> Hot water Amount or time: <input type="checkbox"/> Cold water			
		<input type="checkbox"/> No, <input type="checkbox"/> Yes, Why?: Product: <input type="checkbox"/> Hot water Amount or time: <input type="checkbox"/> Cold water			
		<input type="checkbox"/> No, <input type="checkbox"/> Yes, Why?: Product: <input type="checkbox"/> Hot water Amount or time: <input type="checkbox"/> Cold water			
		<input type="checkbox"/> No, <input type="checkbox"/> Yes, Why?: Product: <input type="checkbox"/> Hot water Amount or time: <input type="checkbox"/> Cold water			



## **APPENDIX 2: GEBERS FIRST INTERVIEW – THEMES AND EXAMPLES OF QUESTIONS**

### **About the time-diary**

- Describe how you felt about keeping a time-diary
- How did you set about it?
- Do you think that keeping the time-diary influenced the way you think about water/sewage use? If so, how?
- Did the time-diary influence your routines?

### **About the toilet arrangement**

- At Gebers, you actively chose a toilet arrangement involving handling dry faeces and sorting urine. Why did you choose such an arrangement?
- Each household empties its own faecal bin. Can you describe how you go about emptying the bin?
- What does your faecal bin contain, apart from faeces?
- Do you think that you could use faecal compost in your own garden?
- The urine is collected jointly while each household is responsible for its faeces. Have you discussed a joint solution for faeces, e.g. paying somebody or appointing a working group in the collective to manage faeces collection for all the households?
- If you could modify your toilet arrangement, what changes would you make?
- If one of the residents wanted to install a WC in his/her flat, how would it be handled by the collective?

### **About water**

- I have heard that some of the residents believe that Gebers has a relatively high water usage. If this is true, what could the reason be?
- Do you think that it is important to save water? Is there a difference between saving hot water and cold water?
- What method of reducing water usage in Gebers would you recommend?

### **About products/substances/organic material in the toilet/sewer**

- Where does water from the sink, washbasin and floor drains go?
- Could this water be treated on site so that it can be reused? What possibilities/difficulties do you anticipate?
- (Inventory of household chemicals for different forms of cleaning and personal hygiene; also questions about medicines and food residue).

### **Individual questions relating mainly to the time-diary**

- You write that you "flush the water-pipe" on Thursday morning. What are your reasons for doing this? When do you do this?
- From an environmental point of view, how do you compare taking a sauna with taking a shower in your flat?
- On Friday evening, the last entry in your time-diary was at 19.20. Why did you stop writing?



## APPENDIX 3: GEBERS SECOND INTERVIEW – THEMES AND EXAMPLES OF QUESTIONS

### Questions for all the respondents:

#### **About ecological everyday life**

- What made you decide to live in Gebers?
- How does one live ecologically? What are the main differences in everyday life compared with "conventional" urban everyday life?
- A common objective of the residents in Gebers is to live ecologically as regards the environment. Is there a common environmental policy for Gebers or does each individual decide on his/her level of environmental commitment?

#### **About information**

- Living ecologically involves making a number of choices. For example, what cleaning agent to buy, whether or not to buy a cucumber with an environmental stamp of approval, what should be done with the white spirit left over or what supplier of electricity one should choose. When you make choices like these, how do you decide which alternative is the most environmentally friendly?
- Information on environmental friendliness is often contradictory, how do you deal with this (e.g. the ongoing debate about whether incineration or sorting waste is most environmentally friendly)?

### Questions for new respondents (the same questions were asked at the first interview):

#### **About the toilet arrangement**

- At Gebers, you have a toilet arrangement involving handling dry faeces and sorting urine. Can you describe what it is like living with such a toilet arrangement, both practically and emotionally, compared with an ordinary WC?
- Can you describe (in detail) how your faecal bin is emptied?
- What does your faecal bin contain, apart from faeces?
- I know that some households have had problems to varying degrees with flies. What causes the flies to appear?

- If you were to modify your toilet arrangement, what changes would you want to make?
- If one of the residents wanted to install a WC in his/her flat, how would that be handled?

Questions for previous respondents:

- Has anything happened as regards the toilet system since I was last here 18 months ago?

Questions for all the respondents:

- The toilet system has been in operation for about 5 years. A completely new arrangement is seldom optimally adjusted or perfect from the very beginning. What changes or modifications have been made to the toilet system since you moved in here?
- Do you think your behaviour has changed in any way?

**About risks**

- What is your opinion of the health risks associated with handling faeces, from using the toilet, cleaning, emptying, storing the faeces at the composting station to possibly using the resulting compost?
- What, in your opinion, are the main uses of faecal compost?
- Is there a difference in risk handling your own faeces compared to handling other people's faeces?

New respondents:

**About saving water**

- In my studies and others like it, people often say that we don't need to save water here in Sweden because there is so much of it, but they also say that that doesn't mean one should be wasteful either. How do you feel about that, what is wasteful and economical behaviour, respectively, when it comes to water?

All respondents:

- The last time I was here, there was talk about Gebers' relatively high water usage. Do you know anything about that?

New respondents:

- What ways of reducing water usage in Gebers would you recommend?

**About the wastewater's quality (grey water)**

- BDT water, which is intended to be reused, comes from washbasins, floor drains and kitchen sinks in the households in Gebers. Do you think it is possible to clean this water so that it is of acceptable quality?

All respondents:

- Is the toilet arrangement as it is today also sustainable in the future?



## APPENDIX 4: RINGDANSEN FIRST INTERVIEW – THEMES AND EXAMPLES OF QUESTIONS

### About the time-diary

- See the first Gebers interview (appendix 2)

### Individual questions about water use, mainly related to the time-diary.

#### Themes concerning:

- Morning routines?
- Preparing food?
- What activities involving water can be carried out where? (Scenario: there is no water in the kitchen – broken tap)
- Toilet and sewer?
- Showers and personal hygiene?
- Other household members' habits (where appropriate)
- Washing up and doing the laundry?
- Cleaning?
- (Included in each theme: inventory of household chemicals).

### About volumetric billing

- Do you think it is important to save water? Is there a difference between saving on cold water and saving on hot water?
- Following the refurbishment of Ringdansen, the way you pay your rent has been changed: a part of the rent is variable due to metering and billing hot and cold water and heating and electricity on an individual basis. How do you feel about that?
- How did you find out that these services were going to be individually metered and billed?
- Do you think that this individual metering will affect how you use water, electricity and heating? Will it affect the other family members' usage?

- In the case of water, some households in Ringdansen use quite a lot and could be regarded as heavy users, which could they be? What do you think about your own usage?
- If you wanted to actively save on water, what would you do? What ways of saving would you recommend?

## APPENDIX 5: RINGDANSEN SECOND INTERVIEW – THEMES AND EXAMPLES OF QUESTIONS

### About metering and billing in Ringdansen

- Heating, electricity and hot and cold water have now been metered individually for each household in Ringdansen for some time now and you now pay according to what the meter shows you have used? What do you think about this way of paying for what you actually use?
- On your rent bill, you can see your usage and the cost of heating, electricity and hot and cold water. What do you do with the bill when you get it? (This is followed by looking at a rent bill together with the respondent)
- How has payment according to usage affected your living cost compared with before?
- Do you think you use more, as much or less water at home now compared with before?
- Have you talked with each other about how you use water?
- Have you tried to change your water usage? Is there any other reason why your water usage could have changed?

### About reusing water (rainwater, grey water)

- Would you consider using water of a lower quality than drinking water for some other purpose in the home?
- Could the bathwater, washing-up water and water used for washing the laundry produced by the households in Ringdansen and flushed down the drain from washbasins, bathtubs, washing machines and kitchen sinks be used again here after being cleaned somewhat?

### About recycling nutrients in human faeces

- Another housing area I am studying has a toilet arrangement where the faeces is collected separately and passes down a pipe and into a bin in the basement. Each household has to regularly empty its faecal bin onto a communal compost. Do you have any experience of toilets where you yourself have take care of what is usually flushed down the drain (a summer cottage or boat, for example)?

## **Environment and health**

- Questions involving the environment and the impact we humans have on it are constantly being debated, even if some environmental questions attract greater attention than others in the media and among people in general. What environmental problem or problems do you consider to be the most serious today?



## APPENDIX 6: RINGDANSEN UTILITY INVOICE

### Billing information

#### 1. Billing object

Contract no.                      Address: Guldringen xx                      Floor space: 82 m<sup>2</sup>  
    First month: 2002-04                      Billing month: 2002-08

#### 2. Preliminary monthly billing for August, 2002, according to the rent invoice

Preliminary billing is based on the estimated normal annual consumption

	Estimated annual consumption		Rate	Annual billing in krona	Prel. per month
ELECTRICITY	2460 kWh	x	0.75 kr/kWh	1845	154
HOT WATER	32.76 m <sup>3</sup>	x	39.50 kr/m <sup>3</sup>	1294	108
COLD WATER	81.96 m <sup>3</sup>	x	17.00 kr/m <sup>3</sup>	1393	116
HEATING	7464 kWh	x	0.50 kr/kWh	3732	311
consumption					
minus HEATING	-1116 kWh	x	0.50 kr/kWh	-558	-47
adjusted for location					

**Total preliminary annual billing: 7706 or per month: 642**

This billing information shows the preliminary billing for August (should correspond with what is billed on the rent invoice). The actual figure for June as well as the accumulated figure (point 4) are shown for up until the end of June.

#### 3. Actual cost for June, 2002 – deducted from the prel. billing on the rent invoice

Actual consumption is based on the figure on your meter electronically recorded at the end of the previous month.

	Amount		Rate	Actual cost		Preliminary	
ELECTRICITY	188 kWh	x	0.75 kr/kWh	141	-154	Your credit	13
HOT WATER	4.20 m <sup>3</sup>	x	39.50 kr/m <sup>3</sup>	166	-108	Your debt	58
COLD WATER	7.00 m <sup>3</sup>	x	17.00 kr/m <sup>3</sup>	119	116	Your debt	3
HEATING	0 kWh	x	0.50 kr/kWh	0			
consumption							
minus HEATING	0 kWh	x	0.50kr/kWh	0	-264	Your credit	264
adjusted for location							

Note that in the case of billing for heating (debt/credit), see point 5 below.

**Total for June                      Your credit: 216**

#### 4. Actual cost to date (from start-up month)

Here, You can see what has happened since the billing started and up until the end of the previous month.

	Amount	Cost		prel No of billings		
ELECTRICITY	645 kWh	484	-462	3	Your debt	22
HOT WATER	17.90 m <sup>3</sup>	707	-324	3	Your debt	383
COLD WATER	23.10 m <sup>3</sup>	393	-348	3	Your debt	45
HEATING	330 kWh	166				
consumption						
minus HEATING	-50 kWh	-26	-793	3	Your credit	653
adjusted for location						

Note that in the case of billing for heating (debt/credit), see point 5 below.

**Total since initial period                      Your credit 203**

#### 5. Important information on billing for heating

Heat consumption varies according to the time of the year while the same amount is charged per month, unless the rate is changed. This means that credit/debt (the difference between "actual consumption and "preliminary consumption") may vary. A final settlement of your account is always made at the end of the calendar year or when you leave the flat. At the end of the billing year, or when you move out, you will have paid for what you have actually used in the flat.



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