

# Scenario Based Product Design

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## Climate proof city

Group 4



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# Abstract

In this document the researchers used knowledge gathered from the Scenario Based Product Design course to provide Pioneering and the municipality of Enschede solutions and suggestions to the spatial adaptation project in relation to increasing flooding problems. Their focus is on redevelopment of the urban areas. The aim of the responsible company is to get an answer to the following question: *“What are home owners willing to do on their plots to create temporary water storages?”*

Throughout the entire research period various SBPD methods are used to try and get better insight into (potential) customers' needs and feelings. With the use of participatory design methods, such as pivot sessions and mockups and artifacts, ideas are generated in order to answer the research question. Three pivot sessions have been organised with different type of users (roleplaying with personas, homeowners and designers), for which the researchers prepared with the necessary information. Personas were created for use during roleplaying sessions and as overall inspiration during other sessions.

Participants were informed with use of an interactive narrative mindmap. The pivot sessions made use of props and mockups for interactive purposes, allowing the researchers to achieve a high level of discussion and interaction with the participants. The results from the

The constraint in this case was mostly the reach to the real homeowners with different experience levels with the flooding issues (experiencing, indirectly experiencing, aware or not aware) from the desired target group in the affected areas. Despite multiple attempts, none of the homeowners from the desired target group have been involved in this study. Hence the choice on organising the pivot sessions with other people that have at least some relevance to the theme, such as homeowners from unaffected areas and designers, which also resulted in comparative data between different participant groups.

To conclude, no new ideas arose after performing the SBPD methods. However, a suggestion is to focus on the implementation in relation to the financial aspect. New ideas might arise, while thinking about how users can benefit from implementing a water collection system and how to make it appealing to the user to consider such product.

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# 1 Background & Analysis

## 1.1 Background

The Netherlands is experiencing more intensive rainfall than before. This can cause local flooding of (sub-)urban areas that are not able to discharge these rainfall peaks. One aspect of providing solutions to these issues is making cities climate-proof by making urban areas 'water robust'. Using temporary water storages allow regions to cope with the rainfall peaks, after which the goal is to control the discharge of the collected water during unsaturated moments of sewage processing.

The challenge is finding the space to implement such solutions in urban areas, especially in urban areas built years ago. Finding functional yet acceptable ways of integrating temporary water storages is the next step of solving the flooding issue. This study will focus on answering the main question of: *"What kind of products would homeowners be looking for to create temporary water storages?"* by means of a Scenario Based Product Design (SBPD) approach.

The following parties are involved in this project, but not all are actively involved in this study:

- Municipalities (especially Enschede and Deventer)
- Students (Saxion Hogeschool Enschede and University of Twente)
- Inhabitants of Overijssel and Drenthe provinces)
- Pioneering (innovation platform construction industry)
- Knowledge institutes

## 1.2 Analysis of current information

Several reports are consulted to get insight in what information is already present. This can give valuable insights or reveal information that can help with this study. Two reports are from Saxion students and one report is from a Bachelor graduation student from UTwente. The latter researched the adoption potential of a smart rainwater buffer in Enschede. The goal of the Saxion students were to frame taken measures to tackle flooding that is currently available on the private market and investigate user desires.

Four classifications of existing solutions are used in the current reports: reduction (1), prevention (2), disconnection (3) and prevention and redirection (4). During interactive sessions with participants in this study, preventive (1) and reactive (2) classification are used for simplification purposes. Certain reappearing aspects that play a role in consumer preference and acceptance are mainly investment costs, dimensions, maintenance, lifespan and effectiveness (Korbee, Oude Griep, Potman, Veenbergen, & Wolters, 2017), these aspects have also been reviewed on importance and acceptance thresholds by means of surveys (Korbee, Oude Griep, Potman, Veenbergen, & Wolters, 2017) (Boone, Braamhaar, Coppoolse, Hanning, & van Lith, 2017) (not verified with consumers, but can be cross-referenced), (Defize, 2018). A lot of responses indicate that investment and requirements plus consequences of the

system placement are very important to consumers. This has sparked an internal discussion on how to make solutions appealing, especially to people who are not experiencing the problem yet or can not/don't want to invest large sums of money (either in terms or as a single payment). It is also expected that the required appeal factor for consumers to purchase solutions will depend on the way the buffer systems will be introduced. If it becomes part of new regulations, making it a mandatory item for inhabitants, consumers might see the benefit aspect as less important than when they are free in determining if they would like to purchase such a system or not. On a related note, consumers indicate that their willingness to invest (more) would also depend on contribution from the municipality in form of subsidies.

The most suggested solutions (examples in figure 1) are characterised by low to non-invasive placement requirements and the advice for inhabitants to improve natural infiltration of water by means of adding more greenery with soil in gardens, flower and plantation in pots and adding (small) gravel/grit areas (Korbee, Oude Griep, Potman, Veenbergen, & Wolters, 2017) (Boone, Braamhaar, Coppoolse, Hanning, & van Lith, 2017). Conventional and somewhat more traditional use of water barrels is also advised, which is, together with the previously mentioned suggestions, considered one of the lower cost investment options.



Figure 1: replacing tiles with plants + soil (left), grit to improve infiltration (middle), water barrel (right) (Boone, Braamhaar, Coppoolse, Hanning, & van Lith, 2017) (Defize, 2018)

Consumers needs and desires often do not exceed expectations of being able to use the collected water for personal use, or as suggested by the municipality, monitoring via an app.

A remark on the previous studies is that, while most do weigh effectiveness in general, the solutions and products are not checked on applicability and effectiveness to this specific problem of flooding in the affected areas. It is, for example, not known if the addition of flower pots or a water barrel will suffice to storage requirements in terms of to be collected volumes of water in areas with high risk of flooding, or if these areas will require more intense products. Furthermore, as stated by (Defize, 2018), it is uncertain if water buffering will be sufficient enough to reduce risk of flooding, or if investment in improving the sewage systems is required.

## 2 Methodology

As most of the preliminary information about the climate proof city has already been performed by multiple research groups during the analysis phase, the most interesting for this study is to focus on the design phase. With use of a SBPD approach(es), this study aims to achieve additional or alternative ideas and concepts by means of a interactive collaborative effort between (affected) homeowners/consumers.

### 2.1 Defining suitable approaches

The participatory level of the users is exactly at the center intersection of the level of the user involvement and the project phase. This implies that in order to access the tacit knowledge and latent needs, it is necessary to design *with* the users.

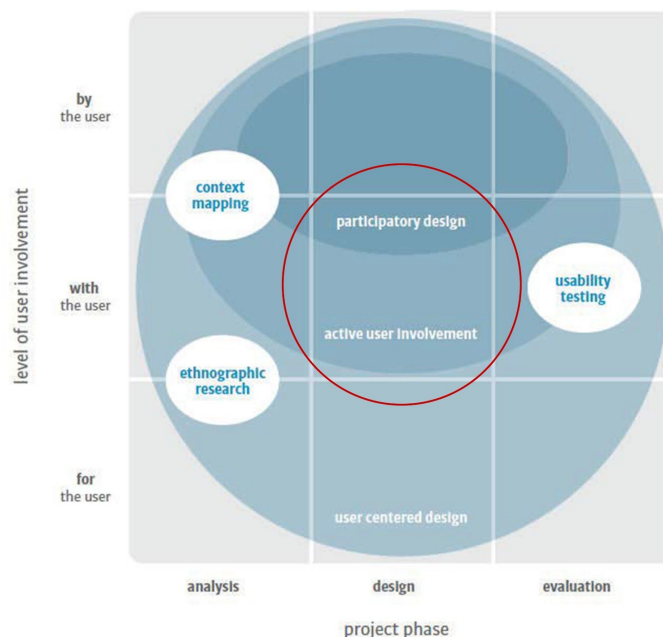


Figure 2: Graph depicting the relation between project phase and level of user involvement (Garde, 2013)

There are multiple conditions that contribute in choosing the most suitable SBPD approach(es) in this setting. As the experiences and desires in relation to flooding problems can be considered a niche, the goal is to involve individuals that are either experiencing, indirectly experiencing, aware or not aware of flooding issues. Involving external participants (inhabitants of Enschede) will mean that planning and coordination can become an issue, especially considering the available time given for this study. Furthermore, a collaborative group session is preferred over individual assessments, mainly to increase chance of discussion and better results. Using interactive elements could increase the desired interaction and results even more, as ideation and expression can be enriched with use of physical objects.

Taking these aspects into consideration together with Nielsen's Taxonomy theory (Nielsen, 1990), the appropriate scenarios for this setting are: 'presentation scenarios' (1), 'mockups' (2)

and 'experimental setting' (3). The selected corresponding baseline SBPD methods are: pivot session (1), endowed props (2), personas (3), stimulus set (4) and narrative (5). An elaboration on the execution of these methods can be found in chapter 3.

Besides the challenge of finding and involving the desired participants, the preferred interactive group pivot session could turn out to be an even bigger challenge on an organisational level. Secondary, tertiary and quaternary plans have been set up as backup alternatives. All plans are aimed at homeowners with different experience levels (experiencing, indirectly experiencing, aware or not aware), except if indicated otherwise. These are plans are, descending from most to least preferred, as following:

- A:** Group pivot session with homeowners
- B1:** (E-mail/paper) individual questionnaire + 3D toolkit (model of a home)
- B2:** E-mail/paper individual questionnaire + 2D toolkit (template of a home)
- C:** Group pivot session with use of role playing through personas
- D:** Group pivot session with (fellow) students

This ranking order is based on the involvement of real users experiencing the problem. This is why option C has the lowest rank, as it does not involve any external individuals.

Plan A is considered best because information can be gained from people who are facing the problem themselves as well as potential adopters. Direct feedback and discussions are highly valued in this session. Plan B1 and B2 use a slimmed down version of the pivot session, but is performed on a long-distance and individual level. This method lacks direct feedback and discussion, which are considered important aspects to stimulate creativity. Plan C involves no real users at all in the pivot session, but is performed while enacting personas, while plan D will involve students as participants. These last two plans are considered a last resort.

## 2.2 Used methodology

Due to the fact that presentation scenarios (Nielsen, 1990) is usually implemented as snapshots (often called storyboards), it is decided to use a part of this approach by presenting the participants with the necessary information through a series of pictures. Secondly, the mockup and experimental setting (Nielsen, 1990) will be combined to create a miniature roleplaying setting with props to help the users generate ideas. The pivot session with props can be considered the main method, whereas the personas, collage and mindmap are tools to enrich the pivot session.

## 2.3 Pivot session with props

The pivot session is considered most suitable and preferred method, as participants can actively interact with the model and discuss about a variance of solutions (which would be missed if people will perform something individually). People can incite each other with new ideas. It is a flexible method in the sense that you can easily present different scenarios or differentiate the scale (one house or a neighbourhood).

The (endowed) props are combined with the pivot session. Participants can state their ideas and use provided (generic and shape-altering) props to express their idea in the model. This is a strong way of presenting new ideas and a quick way to capture them. Participants are often

hesitant about methods where, for instance, sketching is involved, because they often lack drawing skills. However, everybody can craft something from simple objects.

The idea of this method is to provide users physical props (e.g. clay) which they can shape and place in a miniature household. This can determine where people would like to place their future water storage. These scaled models help people to generate new ideas about how a water storage can be integrated into a household.

### **Design of the figured world**

It is important to carefully design the miniature situation, it is important that there are symbolic representations of the stated theme aspects. The miniature situation could be certain different kind of households with (or without) a garden. The addition of certain event-cards (similar to dilemma cards) can spice up the session and give it alternate directions. During these session a 'magic' product (representation could be added to see how users would like to use this product.

### **Session characteristics**

To generate interesting interactions it is good to involve different kinds of users (big/small garden). Also one or two designers will participate in the interaction to keep the conversation going and to steer it in the right direction.

The session will need three to four potential users and will approximately take two hours. The sessions will be executed once, twice or thrice, depending on our access to representative and willing research participants. Preferably people that have experienced flooding themselves. The sessions will be filmed/photographed/recorded.

### **Pilot test**

On beforehand a test group will help with pilot testing the pivot session. With the insights generated from this pilot test improvements can be made to, for example, the model, the characters or the game rules.

## **2.3.1 Mindmap narrative**

Introducing the flooding and research subject to unknowing participants is important to get everyone up to speed for a session. Informing individuals beforehand with use of a narrative (email, brochure etc.) could achieve that goal, but this will always leave a chance of people not fully understanding it, or not reading it at all. An interactive narrative method during the pivot session has been chosen instead, which can also be considered a warm-up before the model interaction starts. With use of a mindmap participants are stimulated to think about the problem, while simultaneously being informed about multiple aspects of the flooding subject. When the mindmap creation and contribution starts to stall, the session can switch over to the interactive part. During idea generation the mindmap can function as either a catalyst or point of reference to fall back to if someone cannot think of anything yet.



## 2.3.2 Collage stimulus set

The stimulus set method is used in the form of a collage. Because the participants probably don't have any idea what is already on the market, it is good to provide a source of inspiration to them. For participants who did not experience flooding issues, the problem is also depicted in various situations so they can empathise. Several types of housing situations are depicted as well, so solutions can be addressed to these settings. Overall it can be stated that the collage functions as a point of reference or jumpstart ideation for the participants. In case of a session with affected homeowners, only the current existing solutions would be interesting to show.

## 2.3.3 Persona

In case the preferred SBPD approaches cannot be realised, a fictional representative of homeowners has to provide enough source material for roleplaying/enactment purposes. Four personas have been created (figure 3 and appendix IV), each with a certain level of experience with the issue and each with personal preferences and desires. These personas are partly a combination of respondent statements and opinions from Korbee, Oude Griep, Potman, Veenbergen, & Wolters (2017), Boone, Braamhaar, Coppoolse, Hanning, & van Lith (2017) and Defize (2018) as well as fictional additions. This way the personas are thought to represent real homeowners' interests as close as possible, given the conditions.



# Josef

<b>Age and family</b> <b>Occupation</b> <b>House situation</b> <b>Economics</b> <b>Type of garden</b> <b>Environmental awareness</b> <b>Degree of experience</b> <b>Level of interaction and control</b>	41, wife and 8y old child 9-5 job, truckdriver Terraced in middle city ring, connected to street Stable Small paved front, medium to large semi-paved back garden Separates trash, has one family car Experiences flooding of basement, waterdamage Solve issue, real-time distanced checkups on level and forecast
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*"I just want to stop my household from undergoing flooding issues"*



Josef is in one of the affected zones. If heavy rain occurs, the basement/crawlspace tends to flood. This has cost him money on restoration and on products that deal with the problem. He already has a waterpump installed, but this is a reactive solution. Josef would like to have preventive solution as well.

He is OK with having the product in the basement, or making small alterations to the garden(s). Personal use of the water would be great, but not necessary. He cares more about preventing flooding than watering the plants.

Being a truckdriver, Josef is away from home for a few days on a frequent basis. He would like to check up on and know the forecast and water situation in real-time, even when he is not at home. Having a preventive solution will be a reassurance for his family's wellbeing as well when he is away from home.

He is willing to invest, but it would be nice if he'd get some sort of subsidisation from the municipality considering the previous investments and damage.

Figure 3: persona example

### 3 Pivot sessions with props

Due to the fact that, despite multiple efforts of several parties, no participants from the related and/or affected target group have been able to participate in these pivot sessions, a number of three sessions were held. The first session can be considered a practise session, in which roleplaying of multiple personas was used but with internal 'actors'. Prior to performing this workshop with homeowners or any other external participants, the setting was simulated with members of this design group. The second sessions used a select group of external homeowners, not involved in this project. The third group consisted of student designers, not involved in this project. All results of these sessions are displayed in chapter 4.

#### 3.1 Preparation and alterations

The following items were created for the first session:

- game-master instruction (see appendix I)
- miniature of a single home including objects that are often used
- miniature neighbourhood of a street and a park
- personas

The following additional items/changes were made for the second session:

- removal of predefined living areas
- predefined generic objects
- use of existing building systems (e.g. LEGO)
- predefined subjects and possible mindmap flows
- addition of second story and slanted roof
- addition of more templates (grass, flora, car)

The following additional items/changes were made for the third session:

- predefined generic objects
- summarised personas



Figure 4: model of a home and objects (left) and neighbourhood (right), both fictional

## 3.2 Pivot session #1: persona-driven (pilot)

*How will a session, composed of designers familiar with the topic but roleplaying with use of personas, play out?*

**Execution** This session was executed with four designers that were already involved in the project. The duration of this session was seventy minutes. Each participant was assigned to one of four personas and interacted during the session by means of roleplaying according to their character's needs and wishes. Firstly, the warm-up mindmap was performed, but its implementation was purely for evaluative reason as all participants were already sufficiently informed. After this exercise the participants would place the objects in model to represent their fictional household (as far as the objects, model and description of the persona allowed for). Idea generation started with the use of rapid modelling using clay, paper and readily available objects. Some of these ideas were also applied to the neighbourhood model.



Figure 5: Interaction with the model and objects during the first pivot session with personas

**Evaluation - positive** The willingness and involvement of the participants throughout the entire pivot session resulted in a good atmosphere. A relaxed attitude together with building on one another's ideas (from a persona perspective) helped creating differentiating and new ideas. However, due to the fact the designers were simply roleplaying and were in fact already involved in the process, some proposed ideas mostly originated from earlier ideation sessions.



### Evaluation - improvements

Shortly after the interactive session began it became clear that there weren't enough prepared generic objects. Creation of objects on the spot takes a lot of time, while doing so the conversation could have already moved on. Additionally, it is expected that external participants are less likely to immediately start on object creation to materialise their ideas due to the fact that they could be either unaccustomed to do so, or feel oppressed in an unfamiliar environment with strangers, or both.

The mindmap should have pre-defined subjects to somewhat guide the conversation in the right directions. Without any subjects it is expected that external participants, with most likely no prior knowledge of the workings of a mindmap,

Some sample images and examples would help in giving an idea of possible solutions, both in terms of dimensions and alternative products that wouldn't immediately come to mind.

More templates should be made to comply to the variation of possible layouts of gardens etc., and the predefined living areas should be made blank and left up to the participant to fill in.

### 3.2.1 Pivot session #2: homeowner-driven

*How will a session, composed of homeowners that are unfamiliar with the topic, play out?*

#### Execution

The session was performed with six homeowners (four young and two middle aged adults) who do not have any direct experience with flooding. The duration of this session was fifty minutes. This subject was somewhat familiar for two of the participants, as one is a water specialist and someone else works at a company that is engaged with managing sustainability projects. It must also be said that all participants were family of the session host, the host being one of the design group members on this assignment. Two of the participants live in a house, four live in an apartment.

The session started with an introduction and explanation of the design situation and some facts were explained. The participants were given a collection of images with possible flooding problems, types of houses and existing solutions were presented (appendix II). This was used during the mindmap warm-up. The participants were asked to make associations of the problems that occur after or during a flooding and some solutions for them.

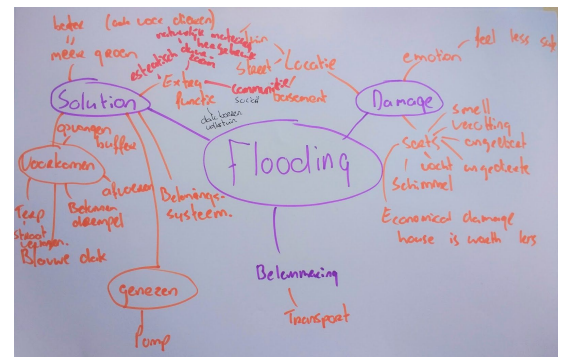


Figure 6: mindmap of second pivot session with homeowners

Multiple maps were created (appendix III), of which the following are associations based on the predefined subject of 'damage':

1. Location (street, basement, garden)
2. Emotionally feeling less safe
3. Sorts of damage in house (smell, rotting, pests, moisture, mold)
4. Economic damage (house decreases in value)
5. Transport is obstructed



Figure 7: Interaction with the model and objects during the second pivot session with homeowners

After the mindmap warm-up the participants were asked to put the common household objects, such as furniture or a shower, in to the model. The neighbourhood was introduced later on.

**Evaluation** The structure overall of the session was logical. The transition between the warm-up and the core part of the session was logical and the participants felt well prepared for the ideation with the model. The participants had fun during the session, one participant said: “Oh, this is just like Sims!”.

The participants appreciated the model together with props, it was a good medium in order to express their ideas. One of the participants stated that he had some trouble expressing ideas, he thought his ideas were not “good”. It could be concluded that it would be better to emphasise that all ideas are welcome despite their execution, especially during sessions with non-designers.

**Evaluation of the game master** The vibe of the session was very cozy, this partly because all the participants knew each other very well. This also resulted in a lot of interaction.

Putting the common household objects in to the miniature household is a good way for the participants to get familiar with the model, but it did not (directly) add something to the ideation.

### 3.2.2 Pivot session #3: designer-driven

*How will a session, composed of designers that are unfamiliar with the topic, play out?*

**Execution** All five participants were students from the University of Twente, all of which were either colleagues or friends of the design team members. The duration of this session was forty minutes. The session started with an introduction and explanation of the

design situation and some facts were explained. The participants were given a collection of images with possible flooding problems, types of houses and existing solutions were presented (appendix II). This was used during the mindmap warm-up. The participants were asked to make associations of the problems that occur after or during a flooding and some solutions for them.

Multiple maps were created (appendix III), of which the following are associations based on the predefined subject of 'damage':

1. Basement: frequently the basements flood
2. Parks: get filled with water
3. Infrastructure: cars and trains are obstructed
4. Roofs: people may climb on them if the situation is too bad
5. Animals: flooding presents danger for animals (and humans)
6. Power grid: may fail due to the situation
7. Sub-street garbage bins may flood
8. Primary needs, food supplies: shops do not work and it may be hard for people to get food
9. Financial and emotional damage
10. Property value decrease

After the warm up, the participants were obliged to engage in the model of the house. With use of the mock up and various tools such as LEGOs, stick paper, scissors, pencils, paper, clay, predefined objects and shapes etc. During most of the interactive parts the group tended to split up into sub-groups with smaller participants (size of 2-3), most likely because it speeds up back-and-forth discussion and ideation between individuals.



Figure 8: Interaction with the model and objects during the third pivot session with designers

**Evaluation** The time was too short (limited based on participants schedules).

The personas that were presented for the pivot session did not really help the participants. Because of the limited available time they did not have the chance to really get into the role and act according to the (despite summarised) persona needs and wishes.

It is suggested to start with the neighbourhood exercise. "It might be better and easier when you first see the whole situation of multiple houses in a neighbourhood and then focus on one house."

The warm up with the mindmap really helped, it was useful and played a contributing role to generating ideas. This also applies to the example images of solutions, it helps give you a jumpstart into possibilities and dimensions and consequences.

## 4 Results and ideas

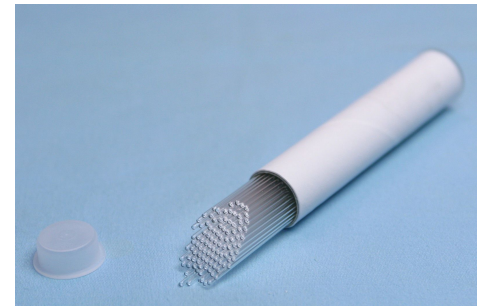
### 4.1 Internal idea generation

During the analysis phase of this subject several ideas emerged while discussing current solutions in how the end user could benefit from a water collection system, other than just collecting and maybe reusing water. As investment costs are This brainstorm helped to explore the different aspects of the project at the beginning. These generated ideas are explained briefly in this paragraph.

**Sponges** This idea uses the principle of superabsorbent materials that takes up water. This principle could be integrated in a product for the garden to prevent water entering the house or turning your garden into a swimming pool. It could also function as a standalone flexible buffer system, as the dimensions in its dry state are much less. One of the issues is the way the water would be released from the superabsorbent materials, as it could be prone to mould in its wet/moist state.



**Hydroelectricity + capillary motion** The distribution of water could be used to generate energy (when extreme rainfall takes place) by means of hydroelectric principles. As height and pressure is an important factor, an idea arose while brainstorming about how water could be distributed in height. If water could be transported upwards without help of any electric device, it could later be used as a source for hydroelectric energy. Introducing a system that makes use of capillary motion to transport water from ground level to a higher place could solve that issue. The capillary pipes allow water to 'climb' by itself into (e.g.) a secondary storage tank, after which it can be released into the electricity generating system. This (understandably low amount of) energy could be used for (energy saving) garden lights or inside the house. It could also be implemented on neighbourhood scale, at which the capillary pipes could for example be illuminated to also function as a piece of artwork.



**Floating house** The house is basically a boat in a big tub. When flooding occurs the house will rise and prevent the house from water entering inside. This principle could also be applied to objects in the garden, for example a green area that is enclosed with a certain material and lies inside a slightly bigger watertight area. When water enters the lower part, the inside part (being the green area) will rise up. If designed well, the plants could also benefit from this water.



### Collective useable car wash

The water that is stored during rainfall peaks is collected with use of a neighbourhood-scaled collection system and can be used in a car wash (free of charge). This car wash will only be accessible to the people living in the neighbourhood.

The



## 4.2 Persona (pilot) session

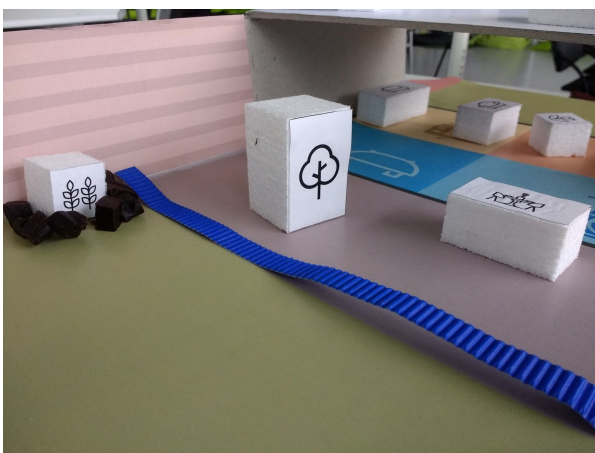
The following list of pictures are conceived ideas during the session with persona roleplaying. The first suggestions are based on a single setting of one household, after which ideas related to a neighbourhood (collective) scale are listed. Each idea includes a small description, which will emphasise on assumed aspects such as benefits, placement, investment, consequences and application scale, where deemed important and applicable.



### Buffer underneath plants under the ground

The rainwater can filtrate through the plants into the buffer that is beneath the ground.

This idea requires small spatial investment of the user, as a buffer beneath the ground is needed. This idea can be implemented on a short term basis.

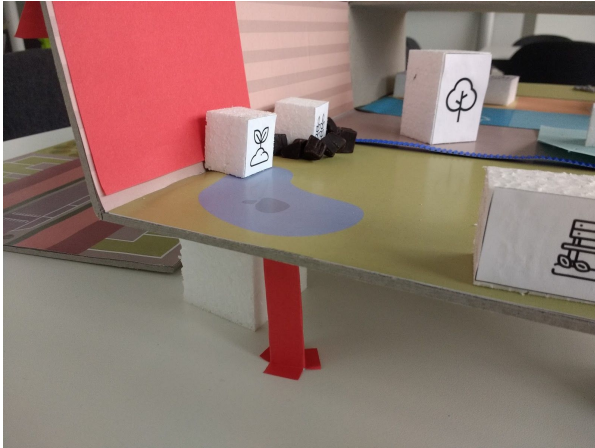


### Sloped garden

The surface of the garden is slightly descending toward a ditch that further distributes the rainwater. A downside of the idea that it is perhaps unpractical for leveling reasons (such as furniture in the garden).

This idea is very demanding for the user, because the garden needs to get lowered and a ditch has to be made. This idea presumably only works if all the neighbours implement a ditch. It will require medium to major changes, making it more suitable for future housing projects.



**Buffer underneath puddle**

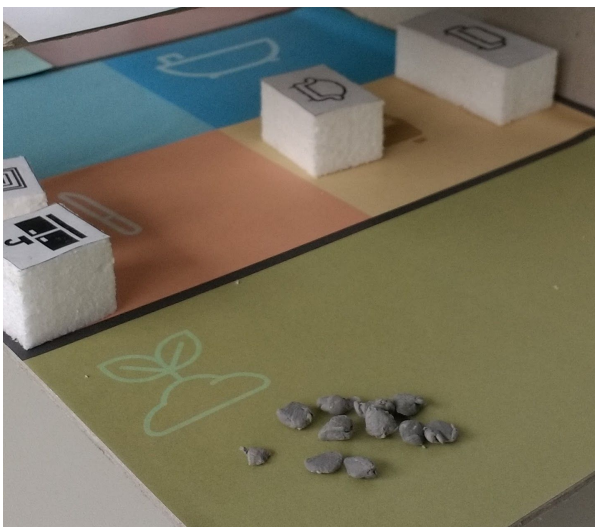
Pipes beneath water puddle that regulates the water flow. At extreme rainfall this opens so that water can flow through it. At dry periods it is closed.

This idea requires a system that regulates the water flow and a buffer that temporarily stores the rain water. It requires medium spatial investment of the user, as a buffer beneath the ground is needed plus the puddle itself. This idea can be implemented on a short term basis.

**Permeable paving #1**

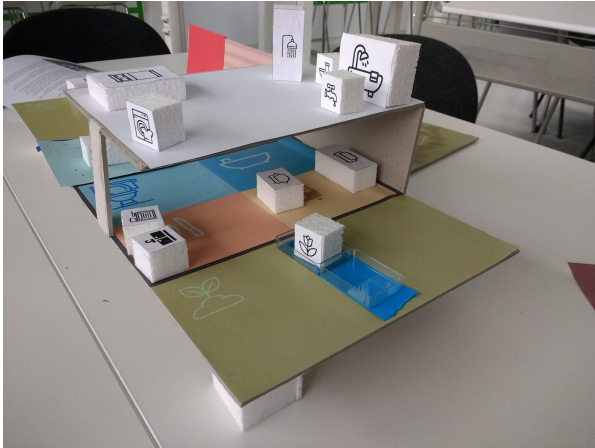
Garden tiles that filtrate water into the ground.

This idea is cheap and easy to implement and maintain and is not demanding to the user. This idea can be implemented on a short term basis.

**Permeable paving #2**

Use gravel instead of tiles, this way rainwater can filtrate into the ground.

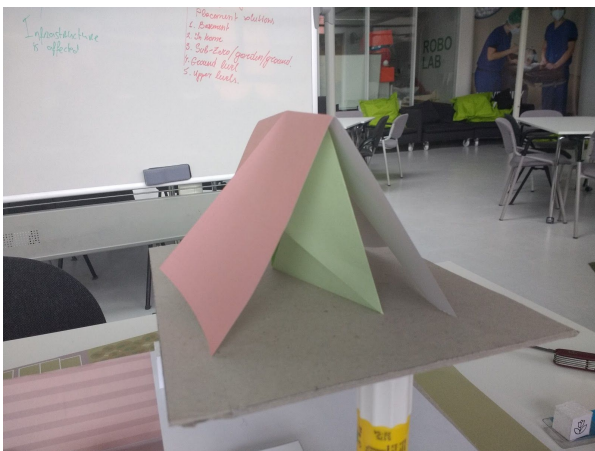
This idea is cheap and easy to implement and maintain and is not demanding to the user. This idea can be implemented on a short term basis.



### Camouflaged buffers

Flower pots in a basin that float when precipitation reaches flooding levels. Instead of only using the pot volume as a buffer, the entire basin in which the pots reside and float in on can store rain water.

This idea could also be a system that is shared between neighbours. It requires small spatial investment of the user, which can either be realised above ground level or at ground level. The latter will require digging. It can be implemented on a short term basis.

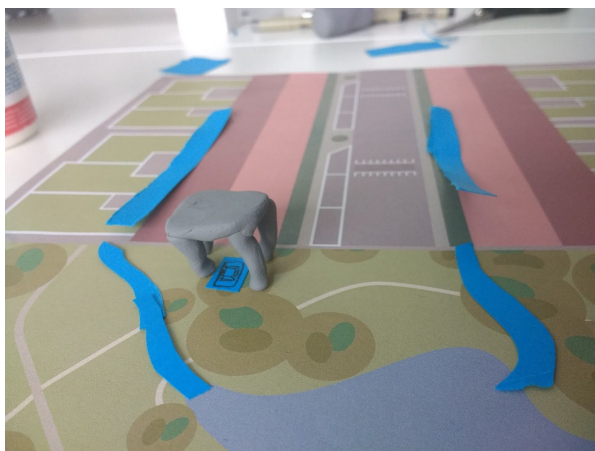


### Buffering roof

A buffer can be added in or on top of the rooftop, in between the roof tiles and the roof framework or on the roof tiles, respectively. An advantage of this way of buffering is that the water can be used for the household without the use of a pump because of gravity assistance.

This will require major constructional changes to the roof, making it more suitable for future housing projects.

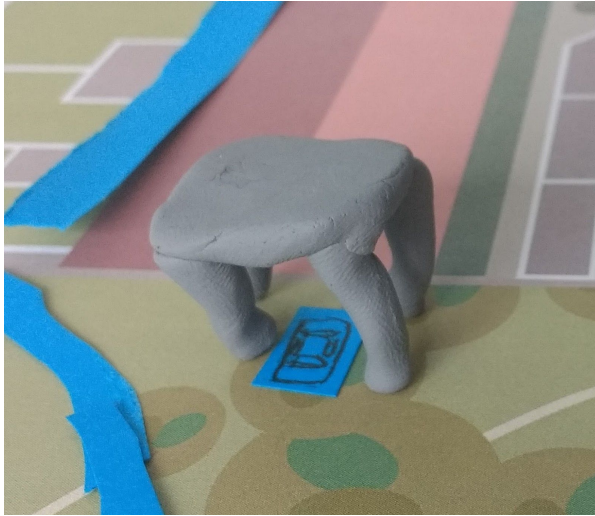
## Neighbourhood ideas



### Water distribution to the park

This idea is about distributing the water from places that can divert extreme rainfall to a place that is able to store a large amount of rainwater.

This idea requires major changes to the infrastructure of the neighbourhood, making it more suitable for future housing projects.



### **Collective carwash**

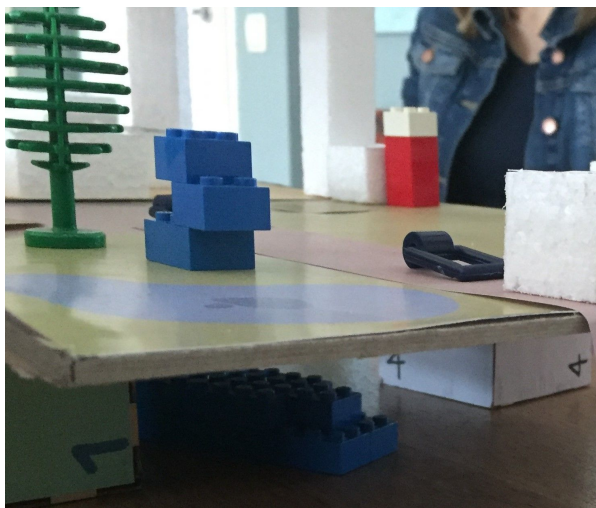
The water that is stored during rainfall peaks is collected with use of a neighbourhood-scaled collection system and can be used in a car wash (free of charge). This car wash will only be accessible to the people living in the neighbourhood.

This carwash requires a large space which can be a quite radical change to a neighborhood. This idea requires major changes to the infrastructure of the neighbourhood, making it more suitable for future housing projects.

## **4.3 Homeowner session**

The mindmap segment (appendix III) of this session resulted in a number of suggested solutions and ideas: adding more vegetation (also better for wildlife) (1), placement of a mound (2), placement 'blue roofs' (roofs with water buffers) (3), use of water pumps (4) and redirect water to another place (5). Extra functions of solutions could be: aesthetically attractive, reuse of water, creating a better community with the neighbourhood, allotment (on the roof) etc. It has also been theorised that a rewarding system might be necessary to realise a solution.

The following list of first suggestions are based on a single setting of one household, after which ideas related to a neighbourhood (collective) scale are listed. Each idea includes a small description, which will emphasise on assumed aspects such as benefits, placement, investment, consequences and application scale, where deemed important and applicable.

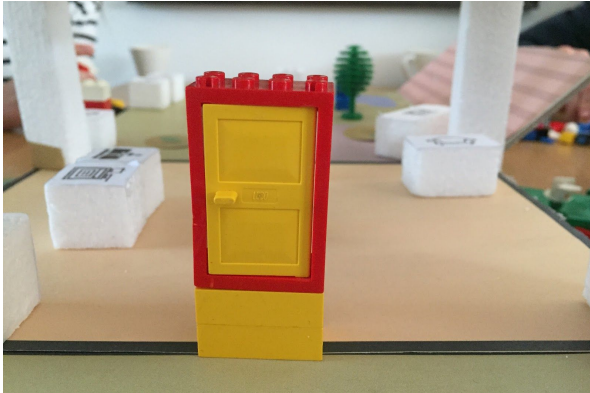


### **Water fountain buffer**

Water fountain with a water buffer beneath it under the ground. This is a way of using a buffer in a way that has an additional benefit, namely the aesthetics of a beautiful fountain.

This idea requires a system that regulates the water flow and a buffer that temporarily stores the rain water. It requires medium spatial investment of the user, as a buffer beneath the ground is needed plus the puddle itself. This idea can be implemented on a short term basis.

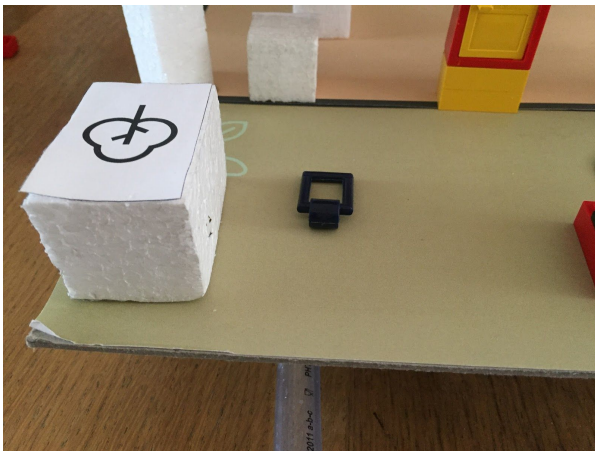




### **Heightening entries**

This is a way of preventing rainwater flowing into homes and buildings.

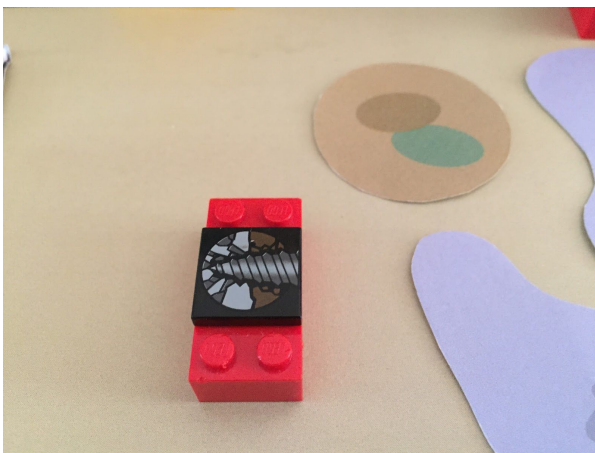
The heightened door requires major constructional changes, making it more suitable for future housing projects. A downside is that this will require some sort of additional entrance (e.g. small staircase).



### **Water pits in the garden**

Adding water pits could be connected to the sewage system or divert the water to the park.

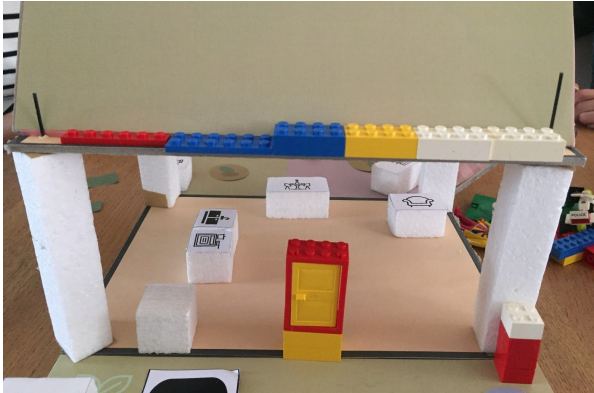
This idea requires a pipeline that goes underneath the garden. It requires medium spatial investment of the user. This pipeline is easier to implement when the house or building is constructed. It can be implemented on a short term basis.



### **Underground hole**

A deep small hole is drilled into the ground where rainwater can flow through.

For this idea special equipment is needed in order to drill the hole in the ground which requires a cost investment, as well medium spatial investment. It can be implemented on a short term basis.



### **Adjustable gutter**

A water gutter that adjusts to the amount of rainfall, more rain means a bigger gutter that can temporarily store and/or distribute the water.

Implementing this idea requires medium constructional changes to the roof, wall and gutter itself. It can be implemented on a short term basis, but it is expected that future implementation on a neighbourhood scale makes more sense.

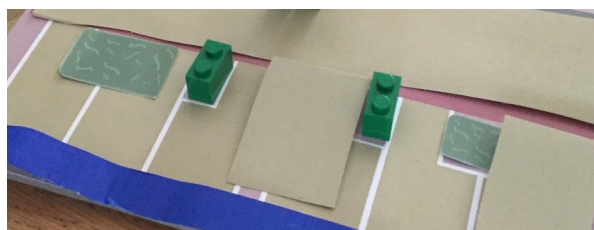


### **Green dormer roofs**

It is more feasible to have plants on flats roofs since it is very difficult to have plants on a slanted roofs.

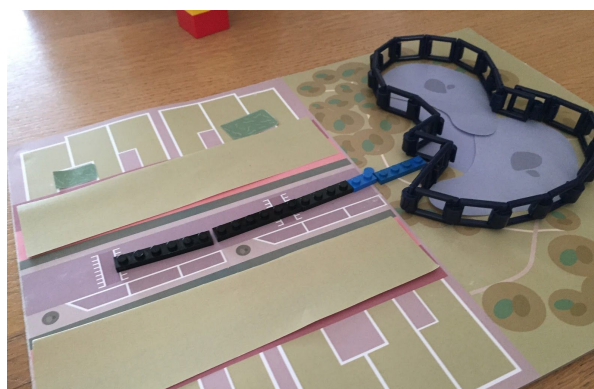
The dormer probably needs to be adjusted in order to carry the weight of the vegetation and the water. Realising this idea requires minor constructional changes to the roof. It can be implemented on a short term basis, but placement during construction of the dormer makes more sense.

## Neighbourhood ideas



### **Green shed roofs**

The same argumentation of the dormer roofs applies here. Implementation of this idea is expected to be less intensive.



### **Distribution to a nearby lake or river**

This idea is about distributing the water from places that can divert extreme rainfall to a place that is able to store a large amount of rainwater. It should be said this has a limit to the amount of water that is healthy for the park.

This idea requires radical changes to the infrastructure of the neighbourhood, making it more suitable for future housing projects.



### **Sloped gardens and streets**

The surface of the garden or street is slightly descending toward a ditch that further distributes the rainwater. A downside of the idea is that it is perhaps unpractical for leveling reasons.

It will require medium to major changes as it presumably only works if implemented on a neighbourhood scale, making it more suitable for future housing projects.



### **Lowered street/park or heightened buildings**

In this idea the neighbourhood area is higher than the surrounding area, in this example the park or streets.

This idea requires major changes to the infrastructure of the neighbourhood, making it more suitable for future housing projects.

## **4.4 Designer session**

During the mindmap segment (appendix III) of this session the participants concluded that there are two types of solutions: preventive (1) and reactive (2). Based on this, the following solutions and ideas were suggested: a small channel on the streets to guide the water to a collection place (1), green roofs with grass on the rooftops of houses that will help at preventing the flooding (might be too heavy for the rooftops) (2), inflatable swimming pools for all people: they inflate when the rain starts, could help at gathering the water (3), inflatable bags with water pumps (flexible volume uptake) (4), placing large heating plates that heat up and evaporate the water (5), electric water pumps (6), sensor communication system in the sewers: sends a signal to the responsible people that the sewers are near maximum capacity (7), alter the shape of the roof: endow it with an inflatable bag that inflates and stores water when needed (either on top of or in between the roof tiles and construction) (8), alter the construction of the streets (9) and the placement of a big concrete buffer (10).

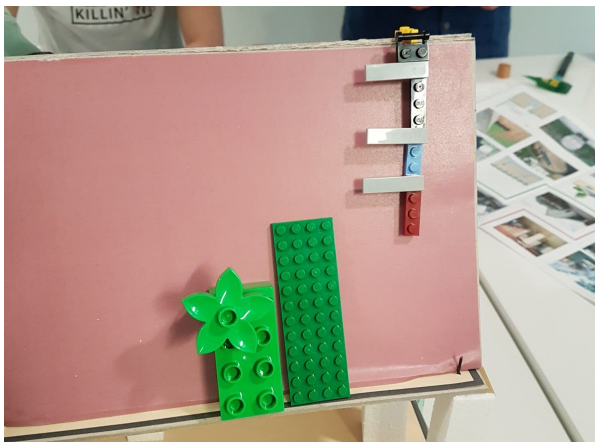
The following list of first suggestions are based on a single setting of one household, after which ideas related to a neighbourhood (collective) scale are listed. Each idea includes a small description, which will emphasise on assumed aspects such as benefits, placement, investment, consequences and application scale, where deemed important and applicable.





### **Foldable emergency rooftop stairs**

This idea is mainly applicable at a very extreme scenarios. The benefit of this is that the user can stay safe on the rooftop while waiting for help. Unfortunately, it does not contribute to either preventing or reacting (in a sense of solving the problem) to flooding issues.



### **Grass on the rooftop**

The grass together with the soil can absorb rainwater.

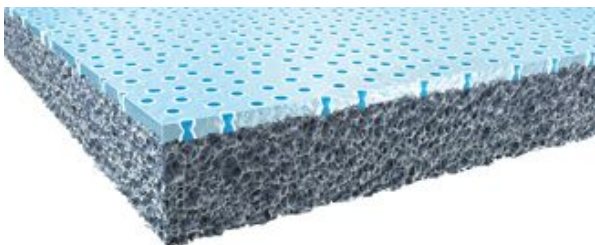
The roof probably needs to be adjusted in order to carry the weight of the vegetation and the water. Realising this idea requires minor constructional changes to the roof. It can be implemented on a short term basis, but placement during construction of the house makes more sense.



### **Underground pipe network #1**

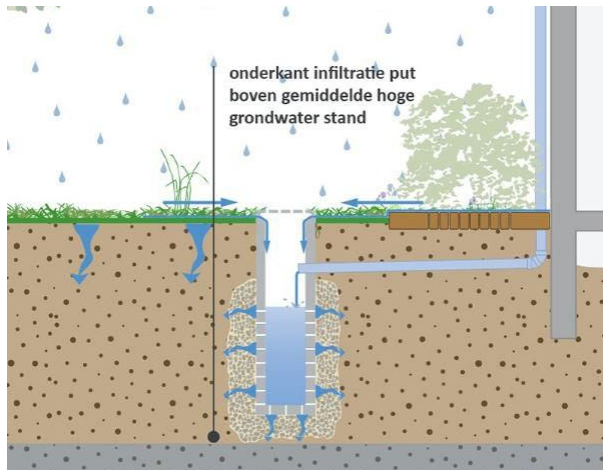
Underground pipe grid system for guidance to the buffer (combined with the roof) (could also pump back the water when the garden is dry and when the buffer is full the water goes into the sewerage system).

It requires medium spatial investment of the user. This pipeline is easier to implement when the house or building is constructed. It can be implemented on a short term basis.



### **Water membrane buffer**

This idea uses an underground water storage tank, but with a water membrane as walls. When surrounding soil becomes less saturated (after rainfall) over time, water from the tank can permeate through the walls to the less saturated soil. It can be implemented on a short term basis, but does require medium spatial investments due to digging.



### Underground hole with plants

A hole in the ground with plants where the water is guided to during flooding. The main idea is to dig a hole and fill it with plants that will absorb the water on rainy days.

This solution could be both individual and neighbourhood scale. It requires medium spatial investment of the user as digging is required. This idea can be implemented on a short term basis.

*Image for indicative purposes, source Rainproof (s.d.)*



### Storage fencing

Use the fence around the house or the house walls to store the water, which can be reused.

This idea is easy to implement and maintain and is not demanding to the user. This idea can be implemented on a short term basis.

*Image source Rainwinner (2018)*

## Neighbourhood ideas

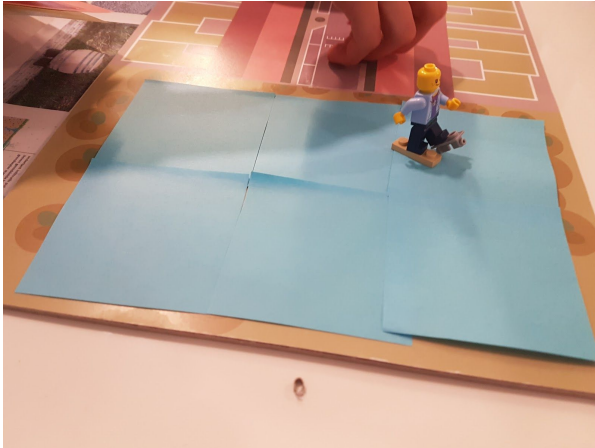


### Hot water supply

The water could be pumped to a heating system under the ground to use hot water for various purposes (heating can come from roof-mounted solar hot water products)

This is a planned solution for the neighbourhood which can be combined with the upper underground pumping system. It requires major changes to the infrastructure of the neighbourhood, making it more suitable for future housing projects.





### **Storage and use for festivities**

Regulate the flooding and save the water for a year. This water can be used for seasonal activities and events, such as ice skating.

This idea not only stores water but also creates an additional benefit for the users. It can be combined with a number of suggested ideas in this study, such as collective distribution to nearby lakes or buffers.



### **Storage and use for recreational purposes**

Regulate the flooding and store the water in a pool.

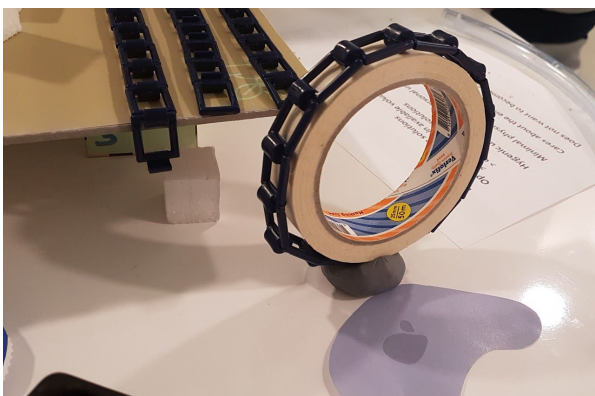
The placement should be somewhere suitable for these kind of activities, the participants of the pivot session decided to put it in the nearby park. It requires major changes to the infrastructure of the neighbourhood, making it more suitable for future housing projects.



### **Floating neighbourhood**

Houses are put on a floating pontoon that makes it float on the water when flooding takes place.

It requires major changes to the infrastructure of the neighbourhood, making it more suitable for future housing projects.



### **Watermill hydroelectric power**

The rainwater can be collected on a roof and then be used to generate energy with the use of a watermill.

The additional benefit is the generation of the energy. This is a large scale idea, but a smaller size could be used for individual use. It probably requires medium changes, making it more suitable for future housing projects.



### **Underground pipe network #2**

An underground pipe grid system will guide water to a central gathering point. This system can be combined with other suggested ideas.

It requires major changes to the infrastructure of the neighbourhood, making it more suitable for future housing projects.

## 5 Evaluation

### 5.1 Pivot session with props

The method used for participants to interact with was a combination of two methods, the pivot session and endowed props. A scaled model was made, for participants to interact with. However, they did not make use of a person acting out a scenario like normally. A diversity on props were presented. The participants could use those to place them in the scaled model and talk everyone through their idea while making the prop into their idea. It took a fair amount of time to make the model for the session, but that was acceptable whereas it was the base of all the sessions. The model evolved over the sessions, where flaws presented themselves in the beginning, the second and third sessions gave no new insight in possible improvements. It was nice to have a model where participants could interact with. This made it more 'alive' as well. A restriction of the model in this case would be that only one type of house was considered, while it is imaginable that more types of houses are of interest in this project. Other house models could also lead to different solutions. The down point being that the outcome is dependent on the model that is made. This means that great attention should be spent to the choice of what model(s) to make and/or not to make, in order to come up with a model that functions as efficient as possible for the desired outcome.

### 5.2 Mindmap narrative

While using the mindmap, the gamemaster tries to get people started thinking about what happens when a flooding is occurring. Two main subjects are discussed in the mindmap. One about the damage a flooding gives and who/what this affects, and the other about possible solutions. While it seemed that the mindmap was helping to boost their creativity, it was mostly not used in the pivot session once the participants started generating ideas. However, it can help the design team to think about new ways of approaching the main problem.

### 5.3 Personas

The personas are used in the first pivot session with endowed props, in order to try to look to the problem with a different mindset and through different eyes. The personas were handed one day before the session, so people had some time to get into their role of the person they would represent for the pivot session. The personas are based on outcomes of the interviews from previous research, performed by Saxion students. In this way, the persona gets a realistic touch. Different households, interests and budgets were defined in order to get ideas throughout different demands and/or wishes. In the first pivot session with endowed props, the participants tried to address solutions based on the persona. This was effective for the first 10 minutes, after which they tended to switch back to their own perspective. It is also hard to empathise with the personas, especially given the fact that this topic can be considered quite niche. In the third pivot session the personas were introduced again, this time without time to prepare beforehand. It was noticeable that the personas were not used at all (even with the summarised parts), and

the participants would still react throughout their own imagination and experience instead of the personas' experience. Derived from this experience, it can be stated that personas were not effective in the session. It can be speculated that if personas are addressed earlier, allowing for investment time, the effect is of a bigger influence as well.

## 5.4 Collage stimulus set

A method that was considered a significant help to participants was the stimulus set, in this case in the form of a collage. The collage is enclosed in the appendix II, and consists out of three 'parts'. One part shows flooding in different areas (e.g. garden, basement, infrastructure). In the second part a variant of households is presented, to think in different ways about how an implementation can have effect on your own (or maybe collective) property. The third part gave insight into existing solutions that should trigger the participants' imagination/creativity. As participants mentioned, it was a helpful tool to get them started or derive from existing solutions. When looking at the time/efficiency ratio of this tool, it can be stated that it does not have to take much time in order to get some effective outcome from it. The collage can hang on the wall, but preferably be among the participants so they can have a quick look now and then.

## 5.5 Participants

The participants also play a very important role in the sessions. All the three sessions had different kinds of participants, namely: designers related to the project enacting personas (session 1), homeowners from unaffected areas (session 2), and designers not related to the project (session 3).

At the session with the designers who are related to the project, the participants were able to apply their knowledge about flooding problem into their ideas. Although some ideas are highly influenced by existing solutions, other ideas are new applications of these solutions. The participants were active and eager to share their ideas, although they were just acting out the personas.

The second session with the homeowners has gained different insights than the people of other sessions. In the warming up with the mindmap the participants came up with a lot more problem associations. This is presumably because they have more experience with households. They think outside the box and are able generate new ideas. Although some ideas are not feasible, the experienced homeowners can deliver new insights on the solution.

The third session with the designers that are not familiar with the project had also interesting results. The participants came up with a lot of ideas. These ideas are also inspired by their knowledge of the design & engineering field.

Overall can be said that experience and (technical) knowledge are important aspects when considering participants. With the participants that have experience with households are able to deliver new insights, but often these ideas need to adjusted in order to make them feasible. The danger of doing sessions with designers that are already involved with the project is that they

are biased and tend to think in existing patterns. But their knowledge can also be an inspiration for making ideas feasible.

The overall response to the pivot session was very positive. Participants mentioned afterwards that they had fun, and that it was a new experience for them. Overall an relaxed atmosphere developed during the session progression, which also contributes to idea generation and group discussion and participation.

# Conclusion

## Problem and solutions

The main encountered problem was finding the participants who are experiencing the earlier stated problem. Therefore these persons are substituted by creating personas with the methods gathered from the lectures on how you analyse and design personas and eventually enact.

The designers had some problems at the beginning with getting into the role of the people that experience flooding, but eventually it worked out good resulting in various ideas and solutions.

Some of these solutions gathered during the pivot session were not of much use just because they were already existing ones and some of them are already implemented and used.

Also, the solutions found by the Saxion reports as well as Defize (2018) overlapped with the solutions that emerged during the pivot sessions. Nearly all of the information and suggestions from these research reports answer the two main research questions. So by analyzing the many solutions that were gathered, it was decided that one of the most suitable ones would be the idea of: Offering a subsidy for the users of the products.

If the company wants the users to buy their product or they somehow force the users to install it by adopting a general law with the municipality, it is better to (1) offer them a subsidy, (2) give them their money back or at least a part of it, or (3) offer them the possibility to gain money from the state by reusing or selling the water they collect.

## SBPD approach and usability/applicability

In this paragraph the different methods used for this scenario-based project are evaluated on its usability and applicability. In choosing the necessary techniques and artefacts some difficulties were encountered with selecting the exact tools in order to offer the participants a big range of possibilities to generate and express their ideas. A deep process of analysis of the methods presented in the lectures and the Nielson's taxonomy document has been executed. This resulted in the generation of personas and exercises and artefacts that were used in the three pivot sessions are presented and analysed earlier in the document. The stimulus set, persona, props, and mindmap are the additional tools that are used in a pivot session. The pivot session is suitable for being the main method in which the additional methods were integrated.

When preparing for the sessions it is important to take the kind of participants into account and to test the session. The pilot session (session #1) gained valuable insight in the practicality of the session. The mindmap is a quick and simple tool that helps people getting excited and interested about what problems they try to solve. A bottleneck is that participants who are not trained in being creative, will not address very innovative and new solutions, other than an engineer might think of. This is why an extra stimulus set (in this case a collage) can help participants think differently or in another direction. Persona are useful if you want to generate ideas through a certain person from your target group and it is hard to get the people for a session yourself. The time available for implementing the persona should be about a week to

really become this person and think through his/her mind. When considering to apply the props method, it is important to offer a wide range of options in order to empower the participants to generate.

All in all it can be stated that, besides the difficulties with finding the appropriate users, no major problems were encountered (besides getting the right participants).

## Suggestions

One of the suggestions derived from the study results is to think about how people can be pushed in considering and willing to buy a water collection system. A rewarding system and/or funding system is one way to achieve this. A different, more forceful way, is to change the law and making it mandatory to have a water collection system. Both could be combined, so it is made mandatory to install a water collection system, while it will be (partly) funded by the municipality.

A second suggestion is to think about the scenario when people once have a water collection system. How can the user benefit from this, other than preventing flooding from happening? One suggestion is to use the waterflow in order to create a little amount of energy that can be used by the user in or around their domestic property. Another suggestion in case of a collective system, is to apply the generated energy to a collective use; like powering several street lanterns.

Overall it is important to notify people who are not yet experiencing flooding, why it is so important to consider a solution and state all the benefits that it can provide.

## Contribution to overall project

Taking into consideration the Saxion and Defize (2018) reports and the amount of information gathered from all the resources it can be concluded that the pivot sessions and exercises that were done, did not give any new insights and will not have a really high impact on the current situation of the company.

Many of the ideas are already available and others are general ideas that would cost loads of time and money. Therefore it could be said that the created scenarios only accentuated the conclusions made by the Saxion research. Although this also could be considered some kind of contribution to the project because through all the sessions the main points were reinforced in such way, that the next steps became a bit more clear. All in all, the sessions and methods that were used proved to be successful because they generated same results as the results of the Saxion and Defize (2018) research. Therefore, four or five similar or different SPBD sessions organised by the company with the real users could bring deeper insights for them.



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