Urban Drainage Strategies of Informal Settlement Residents in Cape Town, South Africa

This document is an adaptation of the guidebook created by a student group of Worcester Polytechnic Institute's Cape Town Project Centre while working with the informal settlement community of Monwabisi Park. The following contains a collection of urban drainage interventions that are currently used in some informal settlement communities.

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Introduction

This document was designed to describe the existing techniques residents of the informal settlement of Monwabisi Park have implemented as both individual and community-wide interventions to assist in controlling stormwater runoff and minimizing household flooding. The following section details the numerous existing interventions found along the road and provides a concise explanation of why residents use these techniques. Each intervention is briefly described, providing details of how it works to prevent the damages caused by stormwater. This description is followed by a "Key Features" segment that emphasizes the important aspects and attributes of each intervention.

As this is purely a report based on the observations of a single community not all techniques can be found in all informal settlement, and exact implementation and materials can vary between communities.

Figure 1: Landscape of Monwabisi Park, South Africa

Fences

Fences serve as a barrier against both rainwater and communal tap water runoff and are designed to prevent household flooding. They are commonly built around the perimeter of individual yards and they are often incorporated with other interventions to reinforce their stability and functionality. Due to them being built directly into the sandy ground, over time they sink into the sand and become lowered.

Figure 2: Improvised fence of wooden boards and metal sheeting

Dimensions:

Height: 1 meter – 1.5 meters

Width: Typically the same width as the house

Figure 3: Fence of chain link and vegetation

Key Features: Varied Materials

Thin boards of wood are used commonly as poles to hold the fences up, while the materials that hold these poles together vary from house to house. Some use strands of wire to hold the wood together, while others use scrap pieces of metal siding to keep the poles standing. With regards to stormwater management, the fences that are the most successful in preventing water from entering yards and houses are the ones that are metal. They create a barrier against the water, and help to redirect it around the yard. However, it usually directs it into another nearby, neighbouring yard.

Shadecloths, large pieces of material with a dark green tint that serve to help block the sun and provide privacy to residents, are another resource used in fences. Shadecloths are commonly not used as a method of stormwater management, but some people do consider this technique, and claim that it does help to create a small barrier against the water. In most cases it allows water to enter yards, but it helps to slow the overall flow of water.

Figure 4: Double-layer shadecloth fence against an informal settlement shack

Tyres

Old automobile tyres are used in various ways to help prevent household flooding. When incorporated with the sand found along the road, they can be very useful in producing a stable road surface that is able to withstand the pressures of water runoff. Tyres are used to stabilize the sand and prevent it from moving and shifting during a rain storm. They can also be used to form a barrier against water by being stacked on top of one another, ultimately forming a wall-like structure that is similar to a fence.

Figure 5: Stacked tyres filled with sand

Figure 6: Wall of half-buried tyres

Key Features: Incorporation with Sand

The two main designs observed involved either burying the tyres into the sand or stacking the tyres on top of one another and then filling them with sand. Burying the tires into the sand stabilizes the sand and help to reinforce the ground by providing enough extra support to keep the sand from moving around and creating unwanted natural paths and channels that redirects water into houses and shacks. The other design that involves stacked tyres allows the tyres to form a barrier against the water, and the sand inside of the tyres creates a sturdier base for the tyres to stand upon. Without the sand in the tyres, they would not be strong enough to redirect the water, as the flow would be too powerful and would begin to move the tyres and knock them over.

Dimensions:

Height: 1—3 Tires

Width: Usually the width of the house

Figure 7: Shallow hole in front of a residence doorway

Culverts/Holes

Culverts are placed in front of doorways to help capture the rainwater and prevent it from entering their houses. These culverts can also be found alongside roads to help redirect water away from houses and into a communal area where no one currently resides. Culverts built along a sloped area work well, as they work with gravity to aid the proper direction of water. However, culverts dug along the perimeters of various residents' yards redirect the water into the yards of neighbouring residents.

Similarly, different sized holes are dug in front of doorways in hopes of creating a trap for the water. The goal of these holes is for them to be deep enough so they can lower the height of water when it comes in contact with the house, but shallow enough to not create a dangerous environment (one that someone may trip on, or fall in). These holes are very common, and usually help to prevent a large portion of flooding.

Dimensions:

Height: Height: 15 centimeters -30 centimeters

Width: 0.5 meters – 1 meter

Key Features: Varied Size

The sizes of the ditches and holes can vary depending on their location. These interventions are very adaptable to different conditions, and can be created in numerous, varying areas. Some ditches are approximately a half meter in width, while other ditches are only a quarter of a meter wide and are found in smaller, narrower areas (between houses, along yards). The ability of these interventions to vary in size allows them to be used very commonly by residents who live in different areas and in different conditions. The sizes of holes, most generally the ones found in front of doorways, range from a quarter of a meter in diameter, all the way to a meter in diameter. These larger holes are less commonly found within individual yards, and can be located at the ends of side roads to help prevent flooding for numerous residents.

Vegetation

Small patches of vegetation, such as grass and small shrubs can be utilized for urban drainage management. Grassy areas are commonly located alongside the road, bordering the fronts of residents' yards, and serving to help catch excess water to direct it to various places both on and off the road. Vegetation in yards and around the base of houses serve as small, commonly useless, barriers between the house and excess water. Small shrubs can act as fences, and their greater size encourages more water absorption by the soil.

Key Features: Cost and Privacy

Grass

The most common grass is referred to as Buffalo Grass (S. secundatum), which is indigenous to Cape Town. This grass is found sporadically alongside the road and throughout residents' yards. Unfortunately, the grass is not well maintained, so there are only a few prominent strips while the rest is found in small patches. This grass helps to soak up and catch the rainwater as well as excess water that runs the length of the road.

Dimensions of grasses:

Height: 15 centimeters – 30 centimeters

Width: Along the side of the house

Dimensions of shrubs:

Height: 1 meter – 1.5 meters

Shrubs

The shrubs found along the C-section road are most commonly used as fences and barriers against the water. They are placed along the bordering section of yards with the road, and they also serve to provide privcy and isolation to many residents.

Figure 8: Grass and shrubs outside of a residence

Figure 9: Shrubs lining a road

Accumulation of Sand

Residents have strategically piled up sand both along the perimeter of their yard and at the base of their house, which helps create a barrier against stormwater flowing into the houses. The residents who build up the sand along the perimeter of their yard commonly do so by incorporating it into an existing fence to cover up any holes in the fence. This also stabilizes the fence. The other method of using sand around the base of a house serves to reinforce the foundation, and provides a shield between the water and the walls of the house. This helps to keep water from coming in contact with the house, eliminating the amount of damage seen by floors and furniture, that is caused by water.

Figure 10: Sand piled along the base of a shack

Dimensions:

Height: 15 centimeters – 30 centimeters

Width: Length of the side of the house

Key Features: Temporary Nature of Sand Piling, Incorporation with Other Interventions

Temporary Nature of Sand Piling

The use of sand as a preventative method against stormwater is often seen as counter productive. The build up of sand is much stronger than loose sand found within the road, but it is still not strong enough to form a barrier against powerful stormwater flows. Over time, the sand begins to shift, and the barrier that the residents had formed with it eventually breaks down and begins to allow water to push through it.

Incorporation with Other Interventions

Due to the unreliability of sand, incorporating it into other interventions, it can be more useful and beneficial. The main intervention that sand is incorporated with is tyres as discussed on page 5. Sand is also commonly incorporated with fences, used mostly as a stabilizer to ensure that the fence will stay intact during rain storms and wind storms.

Wooden Ledges/Boards

Wooden ledges are made from long, thin scraps of wood (mostly frequently found along Mew Way) and are positioned either along the perimeter of yards, or directly in front of doorways. They serve not only to block the water from entering the unwanted areas (yards and houses), but they also assist in redirecting the water into either neighbouring yards or central areas where water accumulates and pools.

Figure 11: Boards used to create a ramp leading to the doorway of a shack

Dimensions:

Height: 10 centimeters – 20 centimeters from the ground

Width: Length of the door

*It is buried 10 centimeters – 15 centimeters into the ground

Key Features: Permanency

Wooden ledges and boards are built securely into the ground, so that they are able to stand upright and endure the forces of water witnessed during the heavy rain seasons. Due to these slabs of wood being positioned deeply into the ground, they are often hard to remove. This is often seen as an added benefit, because they do not need to be replaced after each rainstorm, except for when the wood rots and decays over-time. The elimination of constant management with these interventions is very beneficial to the residents. Unfortunately, some see this permanency as an obstacle and problem. If the ledge is not working properly, or it was placed in the wrong area, the time and labour that must go into removing and relocating it is sometimes excessive.

Figure 12: Wooden ledge preventing water flow into a home

Raised Platforms

Raised platforms that enable their yards and houses to sit above the road level. These houses are often found at the bottom of hills and in low-lying areas, where flooding is the most prominent. The raised platforms incorporate scrap pieces of wood found throughout the settlement to create a border along the entirety of the yards, primarily composed of excess sand. The boards provide an outline for the sand and a barrier against the water. The risk of flooding is highly decreased since the whole house is raised above the ground.

Figure 13: Small raised platform underneath a dwelling

Key Features: Permanency and Aesthetic Appeal

Permanency

Similar to wooden ledges and boards, raised platforms are very permanent. They are often time consuming to initially implement, but once they are in place, they are very hard to remove. The wood pieces need to be dug into the ground, and need to be strategically placed so that they form a complete enclosure. The inner layer of sand also contributes to the permanent nature of this intervention because it becomes packed down over time and forms a raised layer within itself. The boards primarily act as a support to keep the sand in one area, but after the first rainfall, the sand becomes saturated and compacted, creating a firm and sturdy layer.

Aesthetic Appeal

Due to the large amount of time and labour that goes into designing and building such an intervention, many residents choose to implement a smaller plan to manage stormwater. Despite their scarcity, raised platforms that have been built are often well maintained and cared for. Many residents who put the time and effort into implementing and maintaining a raised platform often incorporate other aspects of design into their overall intervention, such as vegetation and shrubs.

Dimensions:

Height: 5-30 centimeters

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Plastic

Incorporated with sand and other select materials (metal siding, scrap wood), plastic is used to help stabilize the sand and protect houses from coming in direct contact with water. The plastic is intended to create a barrier between the sand and the walls of the houses, to eliminate the amount of damage caused by stormwater. The plastic can be located either between a layer of built up sand and the outside walls of houses, or it can be placed between the outside walls and inside walls, including the floors of houses. When placed between the sand and walls, the primary purpose of the plastic is to stabilize the sand and assist in preventing it from shifting around and breaking down around the houses. When located on the inner portion of the houses, the plastic serves to block the water from entering. When the water comes in contact with the walls, it often seeps through small cracks and holes, but with the extra layer of plastic in place, the water is unable to proceed any further, severely decreasing the amount of household flooding.

Figure 14: Thick plastic placed between the walls of a shack

Dimensions:

Vary greatly

Key Features: Thickness

Plastics range from thin, garbage bag-type consistency, to thick, unbendable forms of plastic that are commonly used in high-strength industrial products. The thick plastics perform better overtime when it comes to forming a steady, reliable barrier against water, but they are often more expensive and harder to find. The thin plastics are much more assessable, and they are consistently less expensive. Unfortunately, these plastics tend to disintegrate with time, and they begin to break down, preventing them from creating a sturdy, reliable barrier.

Figure 15: Thin plastic along the base of a house

Rocks

Rocks and stones are often very easily acquired within an informal settlement. Buried both completely and partially in the sand., they serve to help stabilize the sand and help to prevent it from shifting and moving around. Unfortunately, the rocks that are only buried partially create an uneven surface and disrupt the natural flow path of water, resulting in spreading and flooding in unwanted areas (off of side roads, and into yards and houses). Residents take some of these rocks and incorporated them into their yards to prevent flooding. In some cases, large rocks have been used and lined up across the perimeter of the yard to create a barrier against the water. These rocks serve a similar purpose as fences, but they are often hard to acquire, so the barriers have open spaces and large gaps enabling the water to flow through into the yards.

Dimensions:

Small: 2-3 centimeters in diameter

Medium: 15-20 centimeters in diameter

Large: 0.5 meters in diameter

Key Features: Varied Size

Depending on the size of the rock, its purpose can vary greatly. Within roads both small stones as well as medium sized rocks can be found. The small stones, approximately two to three centimeters in diameter, help to keep the road level and provide the sand with a slight amount of stability. The medium sized rocks, roughly fifteen to twenty centimeters in diameter, serve to keep the sand in certain areas of the road from moving around and shifting. These medium rocks are successful in doing this when completely buried, but when they protrude from the surface of the road they begin to redirect the water and enable it to spread to areas such as yards and houses. Alongside roads rocks much larger in size, about half a meter in diameter, are placed above the ground and are located directly next to one another to form a barrier against the water.

Figure 16: Small and medium-sized rocks embedded in a road

Figure 17: Large rocks lining a road