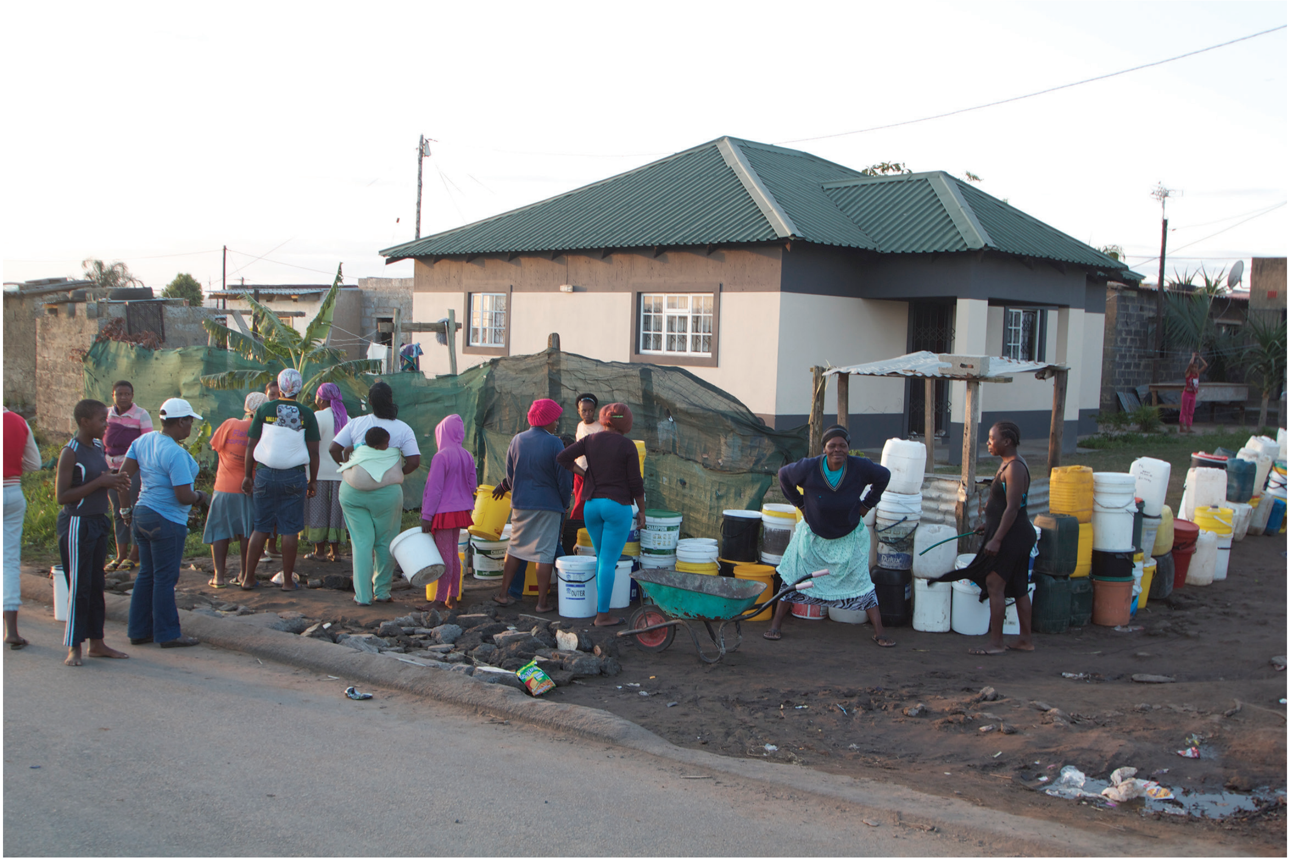


6 Water

Water is essential for life. Water is used in agriculture, industry, buildings and gardens to water plants and crops; to drink; for daily hygiene; to clean homes and wash cars; to prepare and cook food; and to flush the toilet. While water might appear to be an abundant resource, less than 1% of water on earth is freshwater available in rivers, lakes and wetlands for the benefit and enjoyment by people, plants and animals.

Fast Fact:

Water used in buildings

Approximately 25% of global water is consumed in the production of materials for buildings, construction and occupation of buildings.

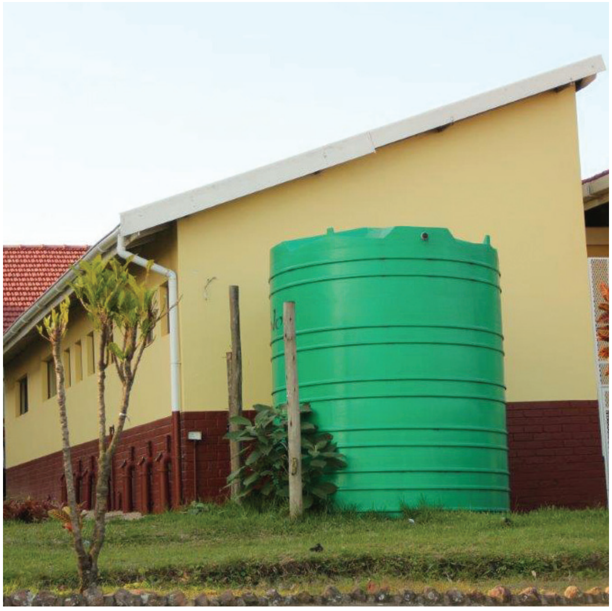
Source: UNEP, http://www.unep.org/sbci/About SBCI/ Background.asp

Fast Fact:

Potable and non-potable water

Potable water is water from rivers and dams that is treated and safe to drink. This water should be used at times when people ingest water, such as when drinking it, preparing food, and washing. Non-potable water is directly from boreholes, rainwater harvesting, rivers and dams or even from water reuse strategies such as greywater harvesting. This water is not treated and could be unsafe to drink. However, this water can be used safely to irrigate landscapes and crops, wash clothes, in the construction of buildings, for the flushing of toilets and in cooling towers.

In South Africa clean and accessible freshwater is considered a scarce resource. This means that more water is needed by agriculture, industry and the population than is available. This situation is made worse when drought reduces the amount of rainfall received and when floods inundate systems thereby polluting water and causing damage to infrastructure and housing.



6.1 What changes do we need?

To aid the transition to low emission development, measures need to be taken to protect rivers, dams and wetlands from pollution and harmful surrounding land uses and to reduce the amount of water used in everyday activities to allow sufficient and ongoing access to clean water. There are linkages between water and energy use – with municipal water infrastructure using significant amounts of energy. Efficient water systems result in efficient use of energy too. Everybody has a responsibility to use water with care, both through reducing the amount of water used and through ensuring that water is not contaminated. Simple measures to conserve water can be implemented at no cost, with well-informed site layout and landscaping, and with a small increase in capital costs, large amounts of potable water can be saved and reused through water-efficient fittings and on-site water harvesting systems.

Water as a resource

Besides potable water, we need to consider alternative types of water which can be used as a resource in buildings and in the municipality such as:

Rainwater includes water collected from roof runoff or other structures after rain. This water can be used as drinking water, if not left stagnant for too long.

Greywater includes water that has been used for showering, bathing, hand wash basins and laundry. Kitchen sink and toilet water is excluded. This water is, however, usually combined with blackwater unnecessarily as it can be a valuable resource for landscape irrigation or for flushing toilets.

Stormwater includes any rainwater that touches the ground and flows across the surface of the ground (roadways, parking surfaces, gullies, creeks, streams, etc.). This water is channeled into the municipal stormwater system which discharges the water into rivers, lakes or the sea unfiltered or treated.

Blackwater (also referred to as sewage) includes water that has been used to wash dishes and to flush the toilet, which contains harmful contaminants. This water is usually disposed of through the municipal sewer and treated at a wastewater treatment plant. This water can be recycled by treating it to the level of greywater or even to potable water to supplement drinking water sources.

Acid rain: South Africa is generally blessed with good drinking water, but in some regions this becomes compromised at certain times of the year or under prevailing climatic conditions when rain falling at times of heavy smog becomes acidic. When sulphur dioxide and nitrogen oxide gases come in contact with clouds in the atmosphere, these gases can make rain more acidic. This acid can be deposited in the form of snow, fog or rain, with serious effects on the environment. Acid rain contaminates drinking water, damages buildings by corroding cement, and causes metals to rust. It poisons soils, affects plant growth, and destroys plant leaves. It also harms animals, aquatic life, and other wildlife.

6.2 How do we design our buildings?

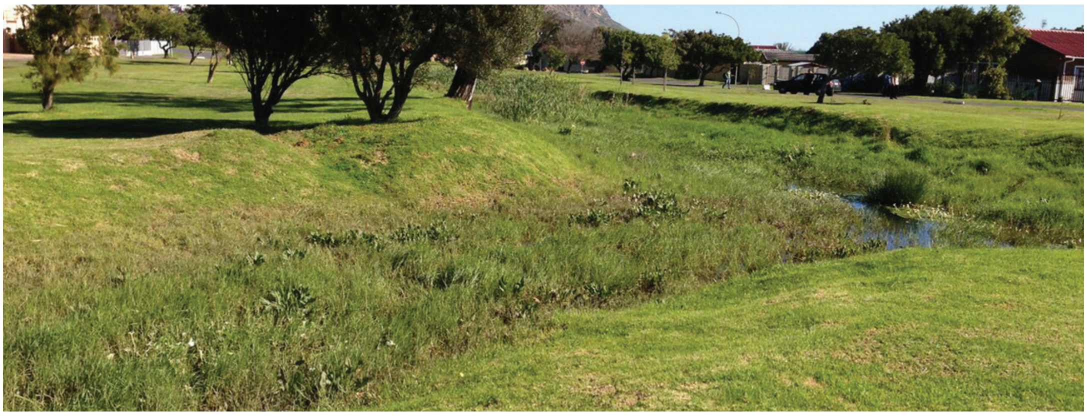
The way in which a building is designed can have lasting effects on the resource efficiency of building systems and can limit the extent to which occupants can implement improved systems later on in the building's lifecycle. The design of buildings refers to both the initial design process prior to construction and when a refurbishment or retrofit occurs.

6.2.1 Design for on-site water management strategies

Water metering: Good design strategy dictates a well-designed and laid out water supply system with a network of water meters (including good sub-metering and leak detection). Water meters monitor the amount of water that is supplied to the building and then each floor, bathroom or major water-using system depending on the level of detail desired. These meters must be connected to a system whereby water consumption can be monitored and evaluated by the building's facility manger or occupants. Water meters can bring points of excessive consumption to the attention of building managers and occupants who can then fix the problem or change their behaviour to reduce water use in the building.

On-site stormwater management: How a building is designed can have a negative effect on its surrounding environment. With regard to water this can occur through building in flood plains or riparian buffers which degrades local water courses, increasing the flow rate and volume of water from a building site, and an increased pollution flow into water bodies.

In the site's natural state, most stormwater would infiltrate and be absorbed by the vegetation and soft, open ground. However, as water flows along hard, paved surfaces the water can no longer infiltrate which increases the flow rate and quantity of stormwater being released from a site. This can cause or exacerbate flooding and the associated damage, especially in properties near to rivers. Methods of capturing, retaining and filtering stormwater on-site and releasing it slowing to municipal or ecological systems should be incorporated into the design of the building site and landscaping. This is known as Sustainable Urban Drainage Systems (SUDS). This is especially needed in the KwaDukuza Municipality, where there is a large proportion of rainfall in short and hard bursts from thundershowers which can quickly inundate stormwater systems and cause flooding.



On-site strategies for stormwater management, which can be designed by a civil engineer or landscape architect include (these are designed in accordance with the calculated amount of stormwater for average rainfall and storm events):

- Increased permeable paving and surfaces which allows for stormwater to infiltrate the ground.
- Soak-aways are usually excavated pits that are packed with course aggregate where water is directed to a specific permeable portion of the site where it is detained and slowly infiltrates the ground.
- Designing a green roof where the roof of a building is planted with low maintenance vegetation. Green roofs retain and filter rainwater thereby releasing cleaner water more slowly, which reduces the damage caused by flooding during large storm events.
- Filters and traps: When placed on-site at a point in the stormwater system before water is released from the building site, these help to reduce the amount of solid particle pollution, grease and oil released into the stormwater system which can clog pipes and harm rivers and wetlands and their wildlife. This can be especially important in vehicle parking lots, vehicle mechanic workshops and petrol stations where there is often a high concentration of toxic oils present on the paving surfaces.

Building location and orientation on site: If a land parcel chosen for development has either a wetland or river (seasonal or perennial) flowing through or present on the site, then great care must be taken not to disturb the water body and its surrounding ecology by locating the building too close to these systems. Along with the recommendations provided through the environmental impact assessment process, a building should not be located within 100m of a water body or within a floodplain (1:100 year flood line). This is to reduce the likelihood of damage to the ecosystem or building.

With regard to how a building is orientated, often urban water systems can be neglected, misused and polluted as a negative environment is created between a building and the water body. This should be prevented by orientating an active part of the building towards the river and by allowing for a good interactive facade between the building and the river or wetland, where people can overlook and/or interact with the water system.

Rainwater harvesting: Rainwater harvesting is a system which collects rainwater runoff from the roof(s) of buildings and stores it on-site. This untreated water can then be used for irrigation of plants or crops, the refilling of swimming pools, washing cars or other non-potable water uses. This reduces the demand of potable water for many activities in urban areas and too often is a neglected source of this precious resource. Rainwater harvesting is a survival strategy that has been around for thousands of years. This strategy is especially appropriate in KwaDukuza as most rainfall is received in summer when increased temperatures drive a higher demand for water. These systems can be installed by home owners or experienced contractors.

Greywater reuse: The average suburban house can use between 200 – 300 litres of reusable water on a daily basis. Greywater is water that has been used for showering, bathing, hand wash basins and laundry, excluding water from the kitchen sink and toilet. This water can be captured and reused on site rather than releasing it into the sewerage system as it does not contain harmful pathogens. It can therefore be reused, without being treated, for non-potable water uses (as is done with rainwater). Again, this reduces the demand for potable water in buildings and is a source of water that is available all year as it is not dependent on the weather and cliamte. Note that phosphate free washing powder needs to be used.

Landscaping practices and drip irrigation: The average suburban household can use up to 37% of their total water consumption in watering their garden. This is a large proportion of potable water which could easily be saved through implementing the following:

- Use rainwater or greywater to irrigate plants.
- Plant vegetation that is indigenous and endemic to the region – these plants are best suited to the natural rainfall and climatic conditions and therefore will require less water.
- Plant landscapes that are made up of plants that only require watering for the first year, whereafter they rely solely on local rainfall (also known as xeriscapes).
- Specify drip irrigation for landscaped areas. This system allows water to be released where it is needed, with benefits including less weeds hence reduced maintenance costs. Whilst it is more costly initially, the benefits see a rapid payback. Note that drip irrigation can often not be used with greywater systems.

Swimming pools: Swimming pools are regarded as significant users of water. Traditional backwashing wastes vast amounts of water, which is often also inappropriately disposed of into the stormwater system. Furthermore, water is lost through evaporation. It is thus essential that swimming pool design (be it commercial or residential) includes a settling and recycling tank for backwashed water (this has the added benefit of reusing chemicals) and pools should be required to have a pool cover over the pool when not in use.

Case Study

My Green Home

Swimming Pool backwash tank

A family in Pinelands worked with the Green Building Council of South Africa to 'green' their home. In order to save water they installed a settling tank into which the pool backwash water now flows. Within 24 hours the majority of the water can be pumped back into the pool, thus saving on water and chemicals!

Source: www.mygreenhome.co.za

6.2.2 Specify water-efficient fixtures and fittings

Specify fixtures and fittings in accordance with National Regulations: National Building Regulations provides limits on the expected water demand and flow rates for fixtures, fittings and appliances in buildings. Adhering to these is mandatory but building design should strive to exceed these through specifying water-efficient and low flow fixtures and fittings.

Mandatory Requirements for Water Demand in Buildings

SANS 10252-1: 2004: Stipulates the hot and cold water daily demand provision permitted in buildings according to typology (for detail refer to SANS 10252-1: Table 1).

SANS 10252-1: 2004: Stipulates the average water consumption of hot and cold water per appliance (for detail refer to SANS 10252-1: Table 2)

SANS 10252-1: 2004: Stipulates the design flow rates for water fittings in buildings (for detail refer to SANS 10252-1: Table 3)

Water-efficient fixtures and fittings: The easiest way to reduce potable water consumption, requiring no change in building delivery and design nor in occupant behavior, is the installation of water-efficient toilets, urinals, taps and appliances. In the design specifications, the water services engineer/architect should only specify fittings that have flow inhibitors or low flow rates, which are for example:

- Washroom Taps: 6 litres per minute aerator or a 1.7 litre per minute spray
- Kitchen Taps: 6 litres per minute aerator
- Showerheads: 6 - 10 litres per minute
- Toilets: 3.6 litres per flush (when low and high flush flows are combined) dual flush system
- Urinals: either waterless or a maximum of 1.9 litres per flush
- For residential and commercial kitchens and laundry rooms, water-efficient dishwashers and washing machines should be included as part of the base building.

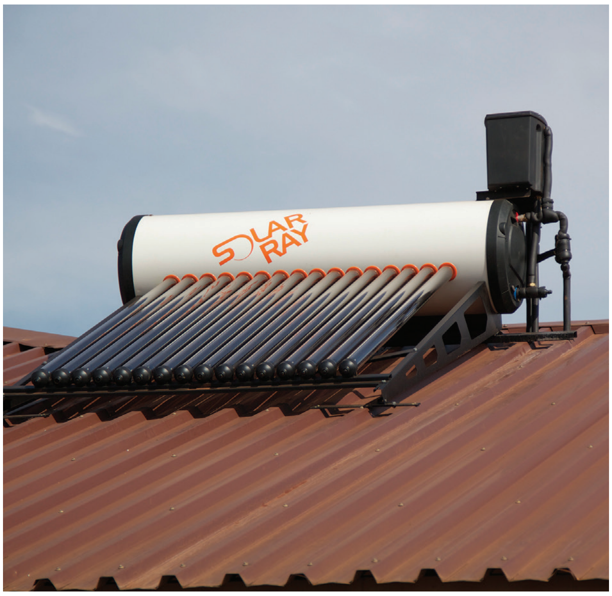
Fast Fact:

Water use in the home

Water fittings are the conduits of consumption for approximately 40% of water used in high income homes and approximately 92% of water used in low income homes.

Source: *Jacobs, H; Geusteyn, L and Loubser, B. 2005. Water - How is it used at home. http://www.ewisa.co.za/literature/files/220%20Jacobs.pdf*

Provision of hot water: Hot water can be provided for by electrical resistance heaters and solar hot water geysers. While it is good practice to turn down the temperature of the geyser in a building to save energy, take note that the risk of legionella, a potentially fatal type of pneumonia, occurs at water temperatures between 20°C - 45°C and can no longer live above 55°C. Make sure your geyser is set to reach 55/60°C to avoid concerns regarding legionella.



Mandatory Requirements for Hot Water in Buildings

SANS 10400-XA refers to SANS 10252: At least half of the annual average hot water heating requirements shall be provided by means other than electrical resistance heating. The alternative means could be via but not limited to heat pumps, solar water heating, heat recovery from other processes or heating via gas.

Hot water installations need to comply with further SANS requirements as provided in section 4.1 of SANS 10400-XA:

- All hot water pipes must be clad with insulation, in accordance with Table 1 in SANS 10400-XA section 4.1.
- Solar hot water systems must comply with the following standards which govern the quality and functioning of these systems: SANS 1307, SANS 10106, SANS 10254 and SANS 10252-1.

Fire management systems: The use of water-based systems for fire suppression in buildings such as sprinklers can be replaced with other non-water-based systems, which include carbon-dioxide and foam systems, either automatic or manual.

6.2.3 Consider alternatives to waterborne sewerage systems

The largest use of water in residential buildings is for the flushing of the toilet. This water use is also predominant in other building types, such as retail, commercial and educational. Alternatives, such as greywater captured on-site, need to be considered for the use of non-potable water for waterborne sewerage systems or to do away with waterborne sewerage within the design. Non-waterborne sewerage systems include:

- Waterless urinals, which are increasingly becoming more common in retail and commercial buildings.
- Composting toilet systems using a ventilated pit, which have been used in schools and residences. These systems breakdown the collected waste into harmless matter which can be used as fertiliser and compost.
- Vacuum toilets use a suction technology to remove waste within a closed system which can then also be treated on-site with the little water that is used being recycled for use as greywater. This vacuum system uses 80% less water than conventional waterborne sewerage systems (typically used on airplanes, but also implemented at the Table Mountain Cable Car Station to reduce water consumption and wastewater production).

6.3 How do we construct our buildings?

6.3.1 Implement water efficiency and demand management initiatives

As water is used on-site in the construction process and for operational functions of the site, it is also necessary to reduce water demand through the use of waterwise practices and water-efficient features. These strategies can include installing water-efficient and low flow rate taps and showers (this is discussed in greater detail in the section on how we the design our buildings) and ensuring the water is used only when needed – hoses and taps are not left to run unnecessarily.

6.3.2 Implement on-site water management strategies

The construction of buildings can cause damage to local water systems through dumping waste in or next to rivers and wetlands, bulldozing or using hydrologically sensitive areas for construction purposes, and from runoff from the site containing excess pollutants.

It is therefore necessary to adopt an environmental management plan which stipulates the following practices for water:

- No leaking taps or hoses on site.
- Sufficient, well-marked and enclosed waste holding areas (bins/skips) and toilet facilities to prevent the spread or leakage of waste from the site which could pollute local water bodies.
- Washing of cement mix and paint brushes to take place into designated settling tanks where the particulate can be separated and disposed of suitably. No cement water to be allowed to seep into the ground.
- Any groundwater pumped from site to be pumped into suitable settling tanks and the particulate removed before being allowed to enter the stormwater system.
- Ensure all hazardous wastes and materials (such as motor oil) are in sealed containers to prevent the spread or leakage of waste from the site which could pollute local water bodies.

6.4 How do we manage our buildings?

Good building design is one thing, but in order for water efficiency to be maximised and proper savings enjoyed, a building needs to be well maintained and managed, and the building users educated so that their actions are in line with best practice.

6.4.1 Encourage water efficiency through behavioural changes

An ongoing educational program should be run to teach building users how to maximise the benefits of the green building features installed, and to reinforce good behaviour over time. This may include a dashboard (electronic screen or intranet based) showcasing savings due to good behavioural practices, and indicating ways to better improve or extend this to another environment (office to home or residential complex to commercial).

6.4.2 Improved water management and efficiency through good operational practices

Water use audit: As part of a full eco-audit or separately, building managers should undertake a water audit to understand where water is being used in the building. Building services or features which are found to be using a disproportionate amount of water should be investigated as there might be a leak to be fixed or certain changes needed in occupant behaviour.

Water management plan: Once the water audit it completed and the building manager understands where water is being used, a water management plan can be adopted and implemented. This water management plan can span a few years and include measures to reduce the building's total water consumption with measurable targets indicated to track consumption trends. This plan can also identify actions for improved education and awareness of water use in the building for occupants.

Water meters: Water consumption should be monitored regularly (monthly or quarterly) and be compared with the first water audit and management plan to see if the measures put in place to improve water efficiency and reduce demand are working. If there are spikes in water use, as registered by the water meters which have been installed, it is necessary to investigate what it was caused by. This could be from behavioural change in occupants, from water leaks or from burst pipes. These must then be attended to appropriately, through engaging with occupants or fixing the leaks.

Fire systems: Water-based fire suppression systems require that the pressure and water supply be checked regularly. When undertaking the Main Drain Test, ensure that the water is left running for no longer than needed (approximately 1 minute) so that water is not unnecessarily wasted.

Irrigation practices and water conservation systems: In summer, water in the early morning or late afternoon as this reduces water lost to evaporation. (Avoid watering between 10am and 2pm from October to February.) Water less during winter as evaporation rates are lower and many plants are dormant therefore requiring less water. In winter, when the evaporation rate is lower, change the hours of watering to the warmer hours – 9am to 3pm. Furthermore, consider installing a drip irrigation system to apply water only where it is directly needed. Automatic watering systems should also be connected to a moisture reader, to ensure that landscaped areas are not watered when there is sufficient moisture already in the soil.

[More information at: http://www.waterwise.co.za/export/sites/water-wise/gardening/water-your-garden/downloads/Water_Wise_Watering.pdf]

On-site stormwater management: Ensure that regular cleaning and clearing of the stormwater system is undertaken to prevent blockages that can cause on-site flooding. This flooding could then carry pollutants that otherwise would have been trapped by the site's filters to rivers and wetlands, thereby causing damage to surrounding ecosystems.

6.4.3 Encourage water efficiency and demand management within the maintenance cycle

Leak detection: Ensure that all pipes in the building's water systems are maintained and replaced when necessary to prevent water leaks.

Install water flow inhibitors in all taps: Many taps can be fitted with flow inhibitors which reduce the flow rate of water and therefore reduce the amount of water used. This is a simple measure which can be done at low cost with large benefits to reduce water consumption.

Install cutoff switches to houses and gardens, or at least to bathrooms and public restrooms to ensure that water supply is automatically stopped should it be seen to be running constantly for a period of time.

Landscaping: As vegetation needs to be replaced on-site, consider planting vegetation native to the local area which will contribute towards a xeriscape (where no irrigation is needed after the first year of growth).

6.4.4 Opportunities for improved water efficiency when retrofitting or refurbishing

Water-efficient fixtures and fittings: During a retrofit or refurbishment it can be necessary to replace sanitary fittings in the bathrooms and taps in the kitchens. This offers the opportunity to replace high-water-demand fixtures with low-water-demand fixtures. This is discussed in greater detail in the section on how we design our buildings.

6.5 How do we enhance our precincts?

6.5.1 Identify areas prone to flooding

Rivers and wetlands that flow through or next to the towns in the KwaDukuza Municipality benefit the municipality as areas of recreation and beauty. However, due to harmful planning practices, many properties are built either on or too close to these water bodies. In times of excess rainfall, flooding often occurs in these areas leading to damage to property and people's livelihoods. Flooding is expected to get worse as climate change causes increased rainfall in shorter time periods. It is therefore necessary to identify these areas and adopt measures to prevent flooding. These strategies could include rehabilitating riparian buffers, which help to slow and absorb flood waters, and moving harmful structures from these sensitive areas.

6.5.2 Incorporate Incorporate Water Sensitive Urban Design (WSUD) strategies

Stormwater management at the scale of a community or grouping of buildings can protect rivers and wetlands from being degraded and polluted in times of rainfall, drought and flood. This is due to larger scale interventions which reduce the volume and velocity of runoff from building sites by filtering and cleaning water and allowing water to infiltrate permeable areas (and potentially recharge aquifers). This is especially important if not all the buildings in an area have incorporated on-site stormwater management measures and with regard to runoff from public areas and roads.

The following stormwater management tools are appropriate for intervention at the preciinct scale and can also be used to add green areas to a neighbourhood:

Filter strips: are vegetated areas or strips of land that are used to manage shallow overland stormwater runoff through filtration. These are most often located along pavements or cycle paths.

Bioswales: are landscaped depressions used to manage stormwater runoff through several natural processes such as filtration, adsorption, biological uptake and sedimentation (Debo & Reese, 2003). These are larger than filter strips and can be planted with larger vegetation such as trees and are often placed along roads or in parking lots.

Figure 12: Bio-swale to enable stormwater filtration and infiltration (KZN)

Detention ponds: are relatively large depressions that temporarily store stormwater runoff in order to reduce the downstream flood peak (Woods-Ballard et al., 2007). These could be multi-functional areas that in the dry season act as a sports field.

6.5.3 Cluster activities for water reuse

When designing a new city piece or neighbourhood, consider activities which use water and how they can be clustered and located near one another for easy reuse of water. For example, a sports field that has shower facilities can reuse water from the showers for the field or for a local community garden once filtered.

6.5.4 Consider a precinct-scale blackwater treatment system

Blackwater refers to water flushed down toilets and urinals, which may or may not also include greywater from other sources. Blackwater recycling refers to the treatment of this water to potable or non-potable water standards. This works best at a precinct scale, as the system requires a continual waste stream to work effectively, and have numerous benefits (economic and ecological) for a community. Although it is standard practice in some countries, blackwater treatment and reuse is not yet common practice in South Africa, in part due to our historically cheap potable water and the large numbers of the population who were not supplied with waterborne sewerage. As a greater proportion of the population is provided with waterborne sewerage, and the costs of potable water increase and water scarcity worsens, municipalities will increasingly need to actively encourage alternatives such as blackwater recycling.

Case Study

Wastewater Reuse for Municipal Drinking Water – George, Western Cape

The town of George in the Western Cape has re-engineered one of their largest wastewater treatment works (WWTW) to allow for the abstraction and reuse of water from the plant. The project was fast-tracked last year due to the worst recorded drought experienced on the Garden Route in 133 years. George was severely affected, with the dam dropping to an historic low of 16.9% in February 2010. The reuse plant will supply 10Ml/day of high quality treated water into the Garden Route Dam, which is the only source of raw water supplying George with its water requirements. Not only is it a reliable water resource in times of water shortage, but is an excellent example of water demand management and environmental responsibility. The project also created job opportunities for residents living along the pipeline route, who worked 7000 labour days at a cost of R630 000.

Source: http://www.southafricaonline.co.za/george-mun-first-in-sa-to-implement-indirect-reuse-of-treated-effluent_article_op_view_id_5680