Beyond the drought; designing for water scarcity

Water wise species - and most gardeners interpret this label to mean plants that survive on little water - are currently the go-to plants as gardeners respond to a drought that ranges in degree of toughness from harsh to disastrous. But, beyond the drought – what then? Focusing on drought-hardy planting suggests to me a temporary fix, a way to ease a garden through a current crisis. We live, though, in a country of low rainfall and unreliable water supply, where future droughts are a certainty. Designing for water-scarcity then requires more from us than simply a change in plant material and installation of a water tank to collect roof runoff.

For the most part, we have gardened on through recent years, planting the same kind of landscapes as if the world was not changing around us", wrote horticultural journalist, Thomas Christopher, in a recent blog post on Garden Rant.

Decades of American and English-style garden design, plant choice and management has given South African gardeners a legacy of high-input landscapes, leaving us high and dry when this latest severe drought hit. Yet, as the rains arrived in Durban and Gauteng, volumes were heavy and concentrated, causing wide-spread damage as water flowed off hard surfaces rather than soaking into ground prepared to receive it.

So often droughts break with local flooding; how do we grow gardens to cope with these extremes? The same designs can mitigate both drought and high rain events.

It requires a 6-pronged approach:
Up until now, urban planning directs water off-site as a way to keep property and road surfaces clear of water. Now, designs must focus on keeping rain where it falls, slowing it down, spreading it out, giving it time to soak in. To do this, we need to:

1. Shape the ground – to direct water flow
2. Build living soil – to absorb and hold water and feed plants
3. Capture rainwater – to keep it where it provides the most benefit
4. Designate planting hydro-zones – matching a plant's water needs with soils moisture levels
5. Choose climate and soil appropriate plants – match plant to place (climate and soil type)
6. Establish resilient plants

1. SHAPE THE GROUND

Meet plant water needs through contouring and drainage. Imagine your property as a mini-watershed. A watershed (or basin) is the area of land that catches precipitation and directs it to drain into a larger body of water, like a wetland, natural lake, stream or river. Topography (physical features and shape of the ground) influences the entire watershed,

controlling the direction the water takes and the speed with which it moves across the ground. Plant roots and soil clean the water of contaminants as it filters through the profile to recharge underground water storage.

We can shape our properties to direct water away from areas where we don't need it to areas where we do need it, and finally to soak into the ground rather than exit through a stormwater drain. Giving the water a chance to soak in keeps it available to the local ecosystem.

Water directed away from one area becomes a resource for other areas.

We're not talking major earthworks here. Swales (bioswales), rain gardens (bioretention system), depressions, berms and sloping ground all help to direct, slow and hold surface water enabling percolation and preventing or significantly reducing damage from flash flood events. And, contoured ground captures water for long enough to be useful during dry periods. Make sure your re-shaping does not wash water from your property onto the neighbour's garden; you could be liable for any damage caused!

There is a relationship between topography, the volume of water, surface material, and capacity of the ground to absorb the water.

- Water moves fast on steep slopes, hard ground and impenetrable surfaces like paving and compacted soils, especially where it can gather speed over a distance.
- Water slows down as the gradient decreases allowing it to spread out, as it moves across lawn, through wild grasses and groundcovers, when rain is intercepted by foliage, and where the distance it travels is short. Slow moving water causes less damage and has more time to soak in.

Follow the water on your property after heavy rainfall; knowing the current watercourses will guide your new contouring designs.

Rain gardens, bioswales:

Two factors improve the effectiveness of rain gardens and bioswales:

- Increased contact time between water and soil
- Increased vegetative cover

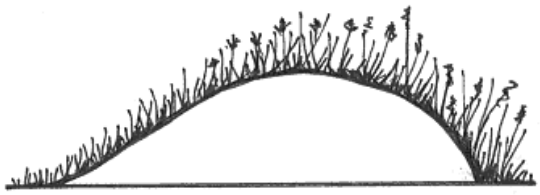
By now, we're all familiar with rain gardens, attractive features typically used in home gardens. These are shallow to mid-depth depressions that use plants and soil to manage water redirected from roof downpipes, and off driveways and other paved surfaces. They're designed to avoid ponding for longer than 24 hours, so mosquitos should not be a problem. Plants growing here can withstand periodic flooding, such as many wetland species, and the existing soil is amended with a top-dressing of organic matter to improve drainage if infiltration is insufficient.

Bioswales are usually larger and deeper than rain gardens – usually ditches and long, narrow channels - but with the same end-goal in mind, to slow, absorb, and filter stormwater.

They're engineered to manage known volumes of water off large impervious surfaces like parking lots, commercial properties and roads. Planted vegetation is adapted to seasonal regimes of flooding and drought.

Berms to direct flow

A berm is a small mound with sloping sides typically longer than it is wide. Often used to create a noise barrier or screen an undesirable view, in the home garden they are effective in changing the course of water flow or encouraging pooling after heavy rains. Mounds are best graded as in the image below rather than shaped like a sharp, uniform speed bump, with a gradual transition from the existing ground to sloping sides. Vegetation cover, whether lawn or plants, protects the raised soil from erosion and helps to slow down the water.



We'll focus on berm design and uses in another article.

Too much water? If you have water pooling where it is not feasible to contour, especially after heavy rains, strategically placed trenches filled with permeable materials - and perforated drainage pipes if needed - can intercept ground water and direct it to where it can slowly percolate over a wide, open area.

2. BUILD LIVING, ABSORBENT SOILS

Soils are our most valuable and effective ally as we design for water scarcity for the ground we plant into is the most important ecosystem on the planet. Loose, friable (easily crumbled) soils with good structure and texture act like a sponge to absorb, hold, then release large volumes of water that keep local ecosystems hydrated. And absorbent soils help us make the most of heavy rainfall events that otherwise cause damage as they wash ocean-wards uselessly.

Circular interconnectedness:

Water is critical to the formation of soil, and its structure and texture influence how soils hold or drain water and retain or leach nutrients. Microorganisms, bacteria, fungi, animals, plant roots, water, oxygen, and minerals, connect to influence these physical characteristics (structure and texture) all of which influence the health of the plants growing here. Without healthy living soil, our landscapes will NEVER be healthy watersheds.

Do you know how permeable your soils are? Test them. No specialist tools are needed; simply dig a hole in 1 or a few places, about 30 x 15 cm, fill with water and measure how long it takes to drain. Repeat the process twice; under 30 minutes both times is ideal.

For soils to absorb as much rainwater that falls on it or pools when directed there, they must have the following characteristics: *(also available in table format)*

GOOD TEXTURE AND STRUCTURE:

Why: For sufficient water absorption; To aid movement of water, oxygen, plant roots, animals micro-organisms.

What hinders this: Compacted soils; Low humus content; Dead soils with no or little biological life that help build soil structure; Soils bare of plant and/ or mulch cover makes soils vulnerable to erosion and temperature extremes

What you can do: Texture is difficult to change; work with what you have; Top-dress with a layer of organic mulch; Prevent compaction – soften impact with mulch & reduce machine use. Keep off soils in beds, and never walk on wet soils. If you need to weed or prune lay down a plank to spread your weight across the ground; Throw away pesticides and chemical fertilisers; Don't dig!

ORGANIC MATTER:

Why: improves soil structure and texture; absorbs holds and releases water; provides habitat and food for micro and macro organisms, bacteria and fungi; provide plant nutrients.

What hinders this: compacted soils; removal of plant material; No mulch layer to be worked into the soil profile; no biological life to break down plant and animal matter that build humus.

What you can do: Top-dress with a thick mulch layer to retain moisture and encourage microbes and animal activity; Prevent soil compaction

BIOLOGICAL LIFE:

Why: break down animal and plant detritus into organic matter; cycle nutrients by converting minerals into a form plants can absorb; connect with plants to aid water and nutrient absorption; hold nutrients so prevents their leaching from soils; help control pathogens, diseases and plant pests; build soil structure which aids movement of water and oxygen, animals and plant roots; remove carbon from the atmosphere holding it in the soil.

What hinders this: compacted soils; reduced oxygen reduces beneficial bacteria and increases harmful bacteria; over-use of pesticides and chemical fertilisers; frequent digging or tilling of the soil that kills beneficial bacteria and fungi; lack of organic matter that provides habitat and food; bare soils affected by temperature extremes and compaction.

What you can do: Stop using pesticides and chemical fertilisers; Don't dig as it destroys this frail, filament network; Fungi: add woody pruning's, sawdust, shredded paper, and brown, dormant or dead plant material in the mulch and compost as food for the fungi. Bacteria need nitrogen so add green grass clippings, fruits, vegetable skins.
Animals: provide them with habitat and food; leaves, twigs, old plant matter.

EFFECTIVE GROUND COVER:

Why: covered soil retains moisture, is effectively insulated against temperature extremes, reduces evaporation and wind and water erosion, intercepts raindrops that cause soil compaction; plants help to build soil structure and feed many organisms; enables water to percolate and recharge groundwater systems, slows water movement giving it time to soak in; Provide animal habitat

What hinders this: Large expanses of solid and impermeable surfaces; No mulch turns soil into brick; The following prevent healthy plant growth: Soils with little or no humus; Poor water absorption; Poor air & water movement & nutrient recycling; Lack of beneficial organisms; Compacted soils that prevent root movement and beneficial fungi associations to form.

What you can do: Prevent compaction; Top-dress with a thick mulch layer; Don't use pesticides; Reduce expanses of impervious surfaces; Don't dig; Improve conditions to encourage healthy populations of bacteria and fungi

3. CAPTURE RAINWATER *ALSO REFER TO POINT 1 - RAIN GARDENS AND SWALES*

Rainwater capture is best handled close to the source as large volumes are easier to control before given a chance to speed up and join other fast-moving sources.

Water tanks and containers:

Storing water in the ground is the first choice but double up with water tanks, barrels and other containers to catch overflow or surplus water that would otherwise flow off-site and slow down the water before directing it into the garden. These above-ground containers also provide irrigation during dry spells for struggling plants and those with high water-needs like vegetables. A 304 m2 roof gives you 2346.96 litres of water for every 2.54 cm of rain that falls! Without a soil storage facility, you'll need enough water tanks to collect it all. Make sure to direct the overflow away from the foundations into the garden. Redirecting the downspout into a series of rain gardens is another option. Again, plan for overflow.

Turn rooftops into green infrastructure:

Green roofs can absorb between 40 – 60 % of water falling on it. These designs direct water into storage systems at ground level but must be installed by a professional.

Pavement, driveway edging: Raised edging directs rainfall to a single exit area gathering speed as it washes along the hard, impervious material. Landscape architects are now designing edges with voids that allow stormwater to empty into adjacent rain gardens or swales at various intervals along its length. This spreads the solution along the line rather than having to deal with the problem at a single point. Watch how water flows over the paving or driveway - can you add a few exit places before it reaches the single exit point?

Permeable Paving:
According to a report from the Sustainable Business Network of Greater Philadelphia, 2,54 cm of rainwater falling on a 102 m2 of paving over an hour yields 27 000 gallons/ 102 200 litres of water; an irresponsible waste should it all wash down the storm drain.
Make paved or cement-based patios and pathways more permeable by replacing grout with a porous medium like sand or lime, or cutting grooves through to ground level in cement surfaces. All of these measures enable infiltration at intervals across the surface, reducing the volume and speed of water across a solid surface.
A point about gravel: while allowing water to soak in this stone material absorbs the suns' heat increasing evaporation and raising the ground temperature to levels dangerous to soil life. Keep this cover to small areas of compacted ground like pathways, firepits and driveways.

Nature: Did you know that trees use up a lot of water? Canopies can intercept up to 35% of the water that falls over them.

4. DESIGNATE PLANTING HYDRO ZONES

Every garden has its own microclimates, slopes and hills, soils and aspect. Having shaped the ground, built absorbent soils, and put systems in place to capture and direct rainfall and runoff, you now know where water will pool, spread out and soak in. Designate hydro zones – high, moderate, low, and a no water usage zone - to ensure you correctly match a plant's water needs to soil moisture levels. For example place plants with lower water needs in the areas that will have more extended sun exposure and no supplemental irrigation.

Driest areas: tops of slopes, steep banks, full sun, and hot west- and north-facing beds.
Moister areas: bottom of slopes, slight depressions, shady areas, south-side of buildings.
Seasonally wet soils: rain gardens, where water runs off paving and driveways. If you've built a berm or two, you'll find water collects where the existing ground and raised mound meet. This is often the right spot for wetland edge plants that grow in moving water, where land changes from dry to wet, or wet to dry. Use them in areas where directed stormwater temporarily pools.

5. CHOOSE CLIMATE APPROPRIATE PLANTS

Adding your garden's light conditions – sun, shade, partial – to the hydro zone plan, you're now ready to plant. Not all indigenous plants have low-water needs, but those that belong in your immediate area are climate and soil adapted with a timetable of water, nutrient and temperature needs that match your local weather patterns and geology. Locally indigenous species should be our starting point.

According to soil specialists, plants play a role in developing the soil profile and so are closely adapted to growing in these soil types. Unfortunately, gardeners world-wide grow

similar plant palettes, so we're advised to amend our soils to a default rich, moist loam! Rather work with what you have and plant local species already adapted to local soils.

Opinion: We must be careful not to plant up most of the garden with a limited palette of succulents and dry-region plants as it reduces your regions diversity and, should most of the plants be out-of-area, reduces available wildlife food impacting local plant/ animal relationships. Plus, most dry region plants won't handle prolonged damp, humid conditions of summer rainfall gardens, and may not thrive where the rainfall and temperature timetables are out of sync with their needs. Restrict these beauties to the toughest spots if you're unable to find local plants that work there. They are also well suited to growing in containers.

6. ESTABLISH RESILIENT PLANTS

Establish new plants during the rainy season as they need frequent and generous watering for the first few weeks. Often though, days can pass between rainfalls, so, to be safe, plant to plant up the size of the area to match the amount of irrigation water you have available. This means it will take longer to establish the garden you envisage, but plants, if given enough water during the establishment, phase grow stronger, deeper roots to withstand dry periods or seasonally wet soils. Even drought-tolerant plants need watering when newly planted.

How to water: Water plants as soon as you get them in the ground. Allow the water to soak in, then water again until the soil is thoroughly moistened. For the first week or so after planting: Plants need watering daily or every other day as the roots cannot access soil moisture from a wide area until they begin to grow. Supplement with stored water when rainfall is insufficient. After the first week, two or three times per week is sufficient unless you're battling scorching heat. Hand water during intermittent rain and test soil moisture around roots with a moisture meter (available at hardware stores for around R100). After a month, plants should cope with seasonal rainfall.

Know your soils absorption rate: Soil type affects watering frequency and duration. Don't apply the water faster than the soil can absorb it. Add a thick mulch layer to absorb the water.

Get water to the roots: Direct water onto the soil around the plant, not over the foliage from above.

Don't over-water: Deeper, less frequent watering will grow plants with healthier and more extensive roots that stand up better to drought stress. If you are planting a few plants in an existing planting bed, hand water the new plants while not overwatering the rest of the bed.

Buy young plants in 2 and 3-litre bags: The smaller root systems need less water to establish and adapt quickly to your garden's soils, resulting in more resilient plants.

Space plants according to final size, so they don't compete with each other for scarce water and nutrient resources.
Plant in suitable conditions: Don't plant in high heat, windy days as both evaporation and transpiration will be high. Early morning is best, or late afternoon once the day has cooled down.

Don't amend the planting hole with rich compost and fertiliser; plants are already nursery pampered, and the different textures between garden and nursery soils cause water to wick away from the roots into the existing soil.

Keep weeds down with a dense mulch layer as these opportunists rob the soils of nutrients and moisture. Cut those that are growing off at root level; pulling them out disturbs the soil bringing new seeds up to the light where they'll germinate and grow as fast as Jack's beanstalk.

Reduce evaporation: build living screens to block drying winds that strip soils and plant leaves of moisture increasing transpiration. If necessary, create temporary screen until the shelterbelt has grown in. Try to shade new plants – cut small, leafy twigs off large shrubs and pop into the soil around them.

Lawn: Reduce the size to just what you need for children and pets, and replace with easy-care local species. Don't be tempted to cover the area with gravel or permeable paving; while they do allow infiltration, they increase the ambient air and ground temperature, increase evaporation, and reduce animal habitat. Aerate the lawn with a hollow tined fork to improve compaction and air and water movement. There are a few intriguing aerator shoes available too! Mow long to shade grass roots and keep soil temperatures cool, reduce surface evaporation, and provide longer blades to capture the early morning dew. Finally, do not fertilise during dry periods.

We have such an opportunity to design beautiful, creatively self-sustaining landscapes. It may take a bit of back-breaking work but it's essential that we take time to prepare our gardens to absorb and hold the precious rain, for they play a vital role in supporting the fragmented patches of nature by offering wildlife food and shelter. They, in turn, provide valuable goods and services without which we'll battle to survive – clean air and water, regulation of air and ground temperature, rainwater management, carbon sequestration, and the pollination services that help grow our food. And they bring us joy.