2019 8th REGIONAL african water LEAKAGE SUMMIT

DBSA Vulindlela Auditorium, Midrand, Gauteng, South Africa, 28 - 29 August 2019

Monitoring Amenity Landscape water Use

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Participating and supporting organisations :

wrp, gls consulting, RAND WATER, WATER RESEARCH COMMISSION, water & sanitation, DBSA Development Bank of Southern Africa, Johannesburg Water, CITY OF TSHWANE, DRAKENSTEIN, Zednet, TECHNOLOG, WISA Water Institute of SA, OVERSTRAND, CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD, City of Ekurhuleni, sebaKMT, PINPOINT Water Loss Management, TYDAN Control Valve (Pty) Ltd, SINGER VALVE, SALD, MACSTEEL FLUID CONTROL, re-solve Water Management Solutions, NOVAQUA aquicure, aquatrip, MOTHEO CONSTRUCTION GROUP, xylem Let's Solve Water, sensus a xylem brand, Ontec, AquaGuard, AQUAffection ... for the love of water, #SURPLUS WATER 2025

AGENDA

- Introduction
- Some current WC/WDM measures
- Benefits of amenity/ornamental landscapes
- Plant data bases
- Hydrozoning
- Landscape water use
- Amenity/ornamental landscape water use models
- ALWUMSA
- Study results
- Conclusion

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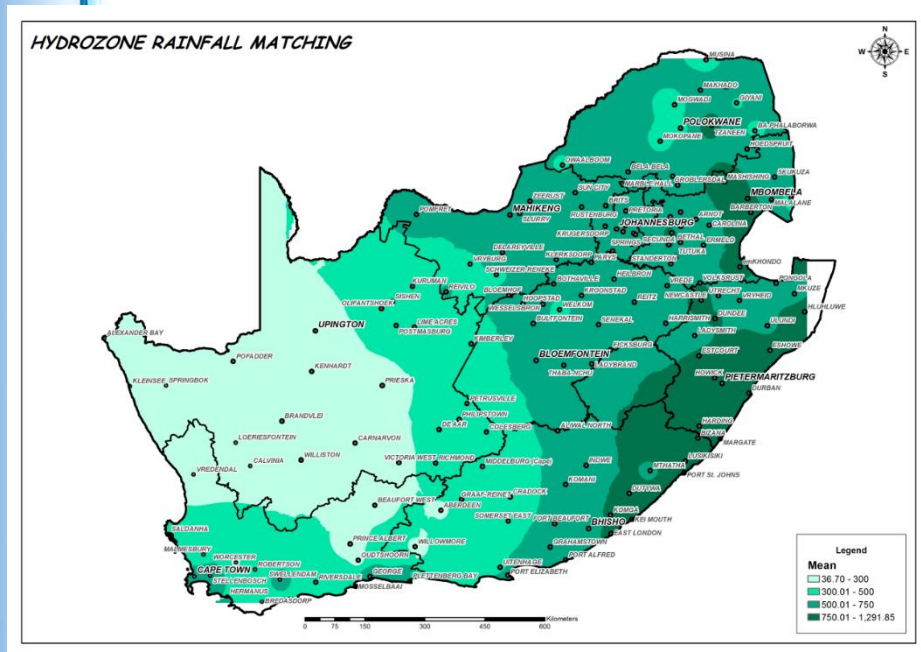
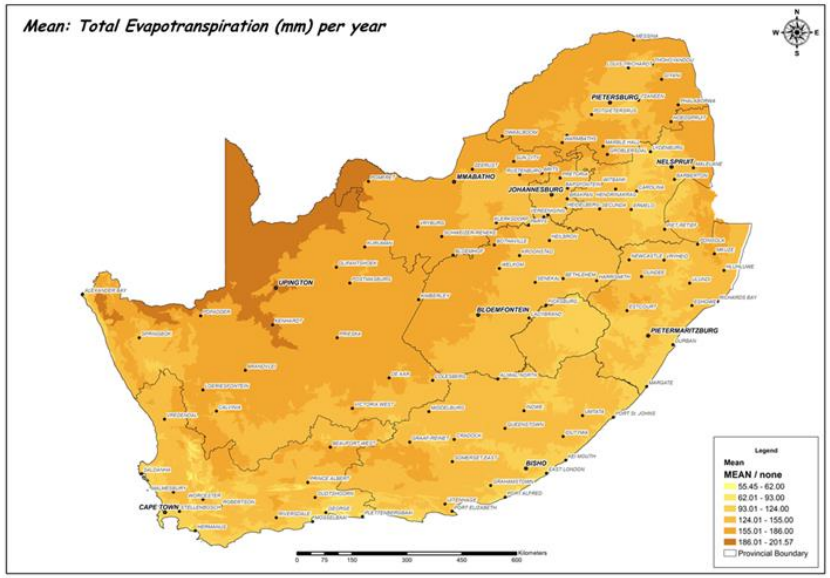
Introduction

- Average annual rainfall approximately 450 mm, compared to the global average of 860mm
- 65% of South Africa receives less than 500mm
- There is also a steady decline in average rainfall from east to west across SA
- In most parts of South Africa, potential evapotranspiration (ETo) rates exceed rainfall





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Introduction

Storage infrastructure on river systems is almost maximised and storing additional water is a major challenge.

SA resorted to balancing supply and demand by **transferring water across catchments** on a scale not common in the world.

Climate change will impose significant challenges on our fresh water sources.

South Africa –

- drier and hotter over time,
- decreases in rainfall of between 10% - 30%,
- higher rates of evapotranspiration will result in less ,
- rainfall available as surface runoff,
- traditional crop growing areas will shift,
- ranges of crop/plant pests and diseases will change.

This does & will add to the pressure on water systems, water storage facilities and ultimately, amenity/ornamental landscapes.

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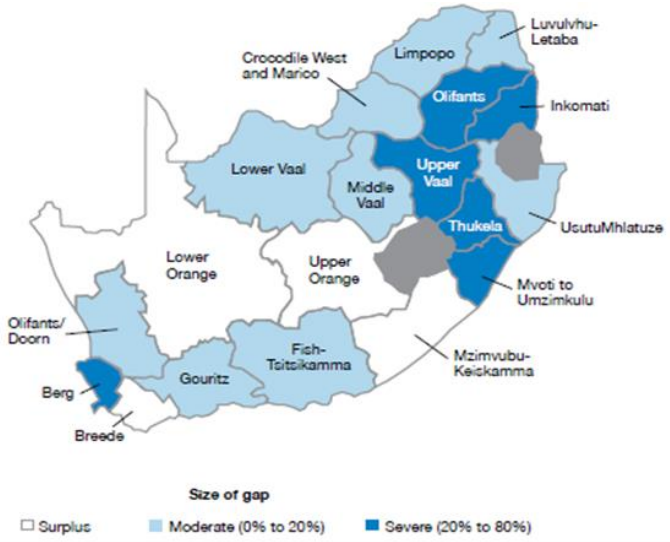
Introduction

- By 2005, 95% of SA freshwater resources were already allocated
- Municipal water services demand continues to increase.
- System pressure will be exacerbated by continued increases in industrialisation, urbanisation and population growth .
- By 2030 a shortfall of approximately 25% between available water supplied and demand
- An extreme water shortage of between -20% and -80% will be experienced by 6 of the 19 water management areas in SA.



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Some current WC/WD interventions

- Many government related interventions are in place and are addressing WC/WDM.

- Some Green Industry related interventions and mechanisms that address this pending water crisis in SA, e.g.
  - Business and building green star ratings,
  - Reuse of grey water,
  - Water harvesting,
  - Water technology innovations,
  - South African Green Industries Council
  - South African Nursery Association
  - South African Landscapers Institute
  - Turf Grass Managers Association

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Benefits of amenity/ornamental landscapes

- Employment both direct and indirect
- Improved aesthetics,
- Psychological well-being,
- Reduced sickness and improved health,
- Physical fitness, body health and stress relief,
- Carbon sinking/sequestration,
- Air conditioning and temperature control,
- Noise reduction barrier,
- Flood attenuation,
- Increased shading and associated cooling,
- Urban greening,
- Reducing and slowing down soil erosion,
- Reduction in loss of soil water content,
- Reduction of heat island effect, and
- Wastewater treatment.

Benefits either increase or decrease depending on the condition, management of and standard of these landscapes

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Landscape water use.

- Each amenity landscape is unique, in its
  - plant selection,
  - design and
  - location resulting in specific water requirements and should be treated as such.
- Ideally, only irrigate when rain is insufficient to support expected plant growth.
- In many situations watering systems are set to water at specific times – hence over watering.
- The average South African amenity landscape would almost always require supplementary water application.

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Landscape water use.

- Current water use places domestic water use (urban and rural) at 27%
- Traditionally outdoor water use = average winter consumption – (minus)total water consumption for summer (assumed no outdoor watering occurred in winter)
- North America – 7% to 75%
- Australia – 8% to 65%
- South Africa – 30% to 50% (perceived use surveys 14% to 73%)
- World wide landscapes most often over watered
  - Turf grass “green lawns”
  - Beds of seemingly lush well watered plants.
  - SABI - residents overwater amenity landscapes by as much as 60%.
  - Water in excess out of ignorance/desire

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Can we save water use in the Landscape

Some examples:

- Converting to a more drought tolerant landscape 50% (bank of America)
- Hotel industry – 30% to 50% by minimising water consumption
- 15% to 30% reduction in outdoor water achieved through implementation of a combination of
  - appropriate design,
  - suitable soil and plants and
  - appropriate irrigation and maintenance practices
- Improving irrigation controllers and aspects can save 30-50%

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How can we save water use in the Landscape

- Drought resistant plants & grasses (low water use landscapes),
- Mulching,
- Use of rain or grey water,
- Use of indigenous plants,
- Hydrozoning,
- Appropriate golf course and landscape designs,
- Improving the efficiency of irrigation devices (e.g. controllers & moisture sensors) and irrigation designs,
- Promoting practices that influence reduced water use by plants
- Improve our methodology of landscape design,
- Monitor water use more regularly;
  - Install water meters,
  - Read the meter,
- Set a water budget for each hydrozone and the whole site.

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Green industry water challenges

- We don't know;
  - how much water is needed for each hydrozone in the landscape?
  - how much water do we use/apply for each hydrozone in the landscape?

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Plant data bases

- Landscape crop coefficients/Landscape coefficient (Kc),
- Kc usually applied for mixed landscape plantings
- Plant databases
  - Species/crop factors - lengthy, time consuming, costly and involves the use of complex instruments/methods
  - Plant factor - acceptable function and appearance

    - Linked to hydrozones

    - for mixed landscape plantings
- Each amenity landscape site is unique and adjustments to reduce water use must, therefore be site-specific
- Plant databases linked to hydrozones
  - SA has no comprehensive and agreed database of readily available plants used & linked to hydrozone data.

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Medium

Agapanthus africanus

Begonia x hybrida

High

2529

18 different categories

63% Exotic &
37% indigenous

No

Aloe dawei

Low

Gazania rigens

	HIGH	MEDIUM	LOW	NO WATER
TOTAL -	527	1433	549	20

Proviso – All plants must be planted in correct location for that plant species

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SCIENTIFIC NAME	PLANT CATEGORY:	GENUS	SPECIES	COMMON NAME	INDIG/ EXOTIC	Hydrozone
Abelia chinensis	Shrub & Sub-shrub	*Abelia*	*chinensis*	Chinese Abelia	Exotic	Med
Aloe amudatensis	Succulent	*Aloe*	*amudatensis*		Indig	No
Aloe arborescens	Succulent	*Aloe*	*arborescens*	Krantz aloe	Indig	Low
Aloe chabaudii	Succulent	*Aloe*	*chaboudii*	Chabaud's Aloe	Indig	Medium
Aloe marlothii	Succulent	*Aloe*	*marlothii*	Mountain Aloe	Indig	Low
Begonia x hybrida	Annual	*Begonia*	x hybrida	Begonia	Exotic	High
Betula alba	Tree	*Betula*	*alba*	Silver birch	Exotic	High
Bulbine frutescens	Bulb like	*Bulbine*	*frutescens*	Stalked Bulb likeine	Indig	Low
Buxus sempervirens	Shrub & Sub-shrub	*Buxus*	*sempervirens*	Box	Exotic	Med
Celosia Spp	Annual	*Celosia*	Spp		Exotic	High

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SCIENTIFIC NAME	PLANT CATEGORY:	GENUS	SPECIES	COMMON NAME	INDIG/ EXOTIC	Hydrozone
Scabiosa incisa	Ground Cover	*Scabiosa*	*incisa*		Indig	Med
Senecio tamoides	Vine / Climber	*Senecio*	*tamoides*	Canary Creeper	Indig	Med
Solanum muricatum	Herb	*Solanum*	*muricatum*	Fruit Salad Plant	Exotic	Med
Spiraea japonica	Shrub & Sub-shrub	*Spiraea*	*japonica*	Japanese Spirea	Exotic	High
Tagetes 'Malanseuns' Spp	Annual	*Tagetes*	'Malanseuns' Spp	Marigold	Exotic	Low
Thymus vulgaris	Herb	*Thymus*	*vulgaris*	Common Thyme	Exotic	Med
Vachellia nilotica	Tree	*Vachellia*	*nilotica*	Scented Thorn	Indig	Med
Viola cornuta varieties	Annual	*Viola*	*cornuta*	Viola-Yellow face	Exotic	High
Watsonia galpinii	Bulb like	*Watsonia*	*galpinii*	Watsonias	Indig	Low
Zantedeschia pentlandii	Perennial	*Zantedeschia*	*pentlandii*	Yellow arum	Indig	Med
Ziziphus rivularis	Tree	*Ziziphus*	*rivularis*	False Buffalo Thorn	Indig	High

Hydrozoning

- Placing plants of similar water needs in the same area (hydrozone) of the landscape
  - Categories of hydrozones (H/M/L/No)
  - Same valve & specific irrigation system
  - Applies to indigenous & exotic plants alike

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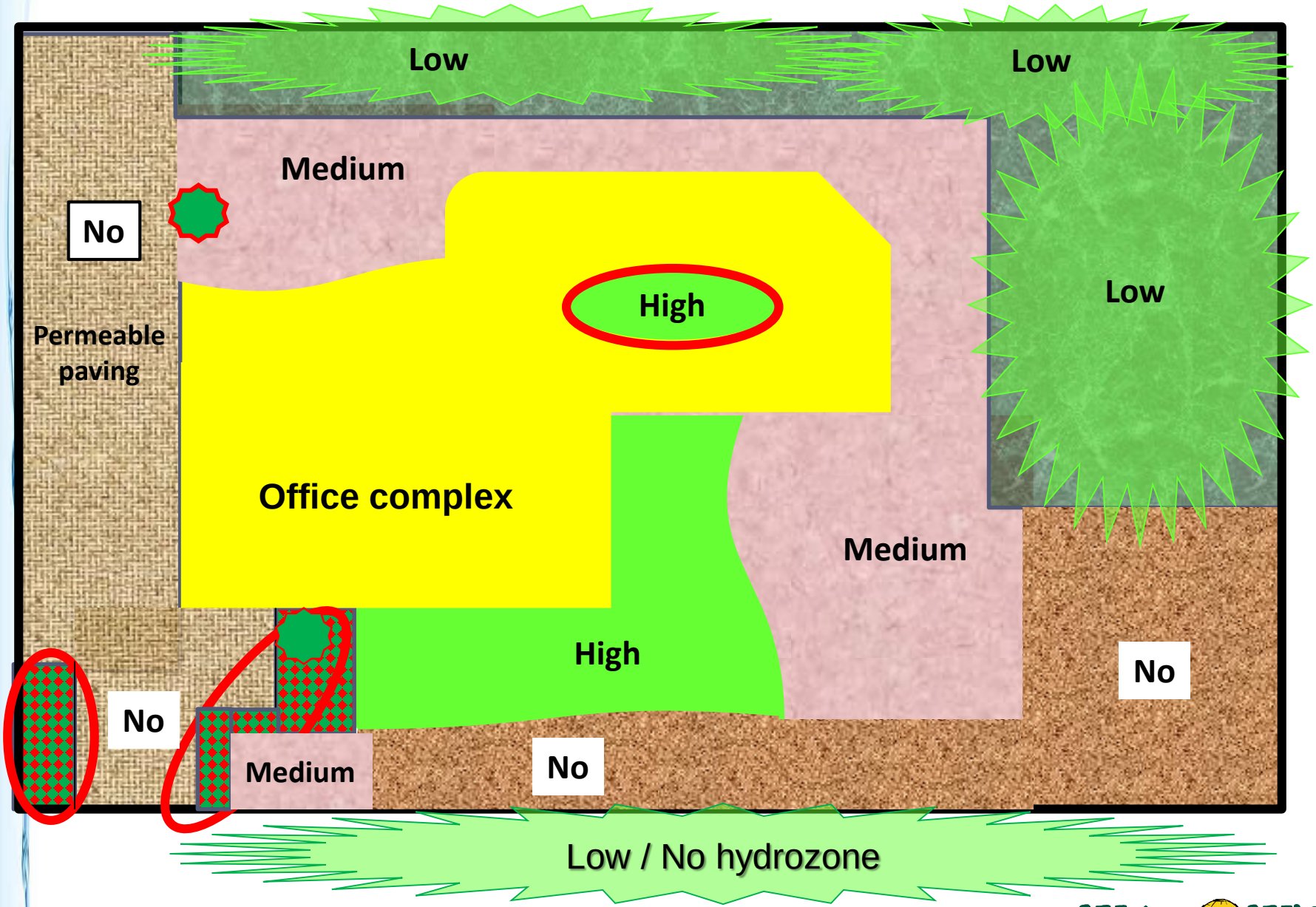
Hydrozone definition used

Hydrozone	Summer Rainfall region.		Winter rainfall region	
	Detailed definition	Annualised definition	Detailed definition	Annualised definition
No water	No watering required unless in extreme cases.	Receives **less than 300 mm** effective watering per annum.	No watering required unless in extreme cases.	Receives **less than 300** mm effective watering per annum.
Low	• Summer - 12 mm/week. • Spring/Autumn - 7 mm/ week • Winter - 12 mm every second week (including lawns but not if dormant).	Receives annual effective watering of between **300-500 mm.**	• Winter - 12 mm/ week. • Spring/Autumn - 7 mm/ week. • Summer - 12 mm every second week (including lawns but not if dormant).	Receives annual effective watering of between **300-500 mm.**
Medium	• Summer - 15mm/ week. • Spring/Autumn - 12mm/ week. • Winter - 7mm/ week.	Receives between **500-750 mm** effective watering a year.	• Winter - 15mm/ week. • Spring/Autumn - 12mm/ week. • Summer - 7mm /week.	Receives between **500-750 mm** effective watering a year.
High	• Summer - 25mm/ week. • Spring/Autumn - 15mm/ week. • Winter - 12mm /week.	Receives **over 750 mm** of annual effective watering.	• Winter - 25mm/week. • Spring/Autumn - 15mm/ week. • Winter - 12mm /week.	Receives **over 750 mm** of annual effective watering.

All hydrozones



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Amenity/ornamental landscape water use models

- Current research of international models points to two good examples
  1. **California** - Landscape Coefficient Method and WUCOLS (Water Use Classification of Landscape Species)
  2. **Australia** - Green Star Potable Water calculator Guide.

Many other similar models and water budget tools used internationally.

- **South African models example** being;
  1. **Green Building Council of South Africa's** Green Star rating system.
  2. **Stellenbosch University** Landscape water use model (Estates including pools etc.)

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WUCOLS (Water Use Classification of Landscape Species) (USA)

Step 1: Calculate the Landscape Coefficient (KL)- explained

KL formula: KL = ks x kd x kmc

Species factor (Ks) (water use of diff species)(Diff value is based on individual experience and knowledge or not.)
Density factor (K_d)
Microclimate factor (K_{mc})

Step 2: Calculate Landscape Evapotranspiration (ETL)

ETL formula: ETL = KL x ETo

Step 3. Calculate the Total Water to Apply (TWA)

TWA formula: TWA = $\frac{ETL}{IE}$ ....(ETL = landscape evapotranspiration - calculated in Step 2)
IE .... (IE = irrigation efficiency - measured, estimated, or set)
= _____ inches/month/plant bed

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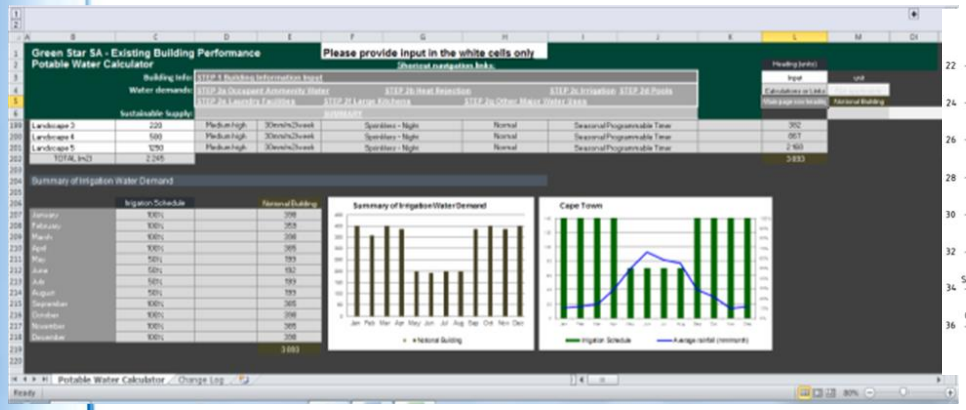
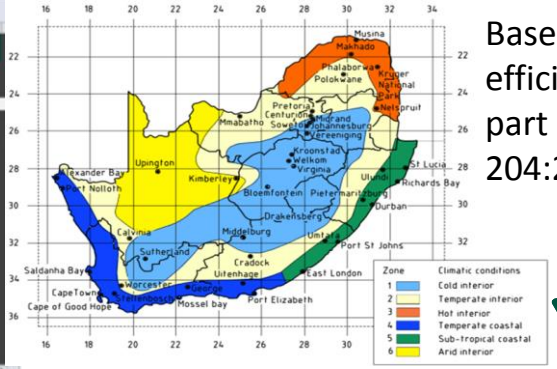
Green Star South Africa – Green Buildings Council SA (GBCSA)

- Potable Water Calculator Guide, produced by the GBCSA.
- **Water calc** = Place in SA, area m^2, zone, irrigation type, microclimate, irrigation controls.
- Six possible **zones**: xeriscape, low, medium low, medium, medium high and high.
- The **irrigation schedules:** pre-set within the system and assumes that watering is reduced during the rainy season.
- 10 **sprinkler watering options**:
- **Microclimate** -three options: exposed no shade, normal, protected full shade no direct sun.
- **Irrigation system controls:** e.g. seasonal programmable controls and rainwater sensing





Based on energy efficiency measures as part of the SANS 204:2011(SANS 2011).

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Amenity landscape water use model South Africa (ALWUMSA)

[Amenity = Ornamental]

Workshops

- Attended by a people from a range of SAGIC and non- SAGIC bodies.
- Delfi process used to obtain feedback
- Aim: Determine from industry members what they believe were the most important site, management, environmental climate and other factors (aspects) that impact water use on site.
- Factors (elements) 235 → 78 → 31

Evapotranspiration and Rainfall data

- Pietermaritzburg University – 40 years of data averaged
- SAWS – 30 years of data averaged

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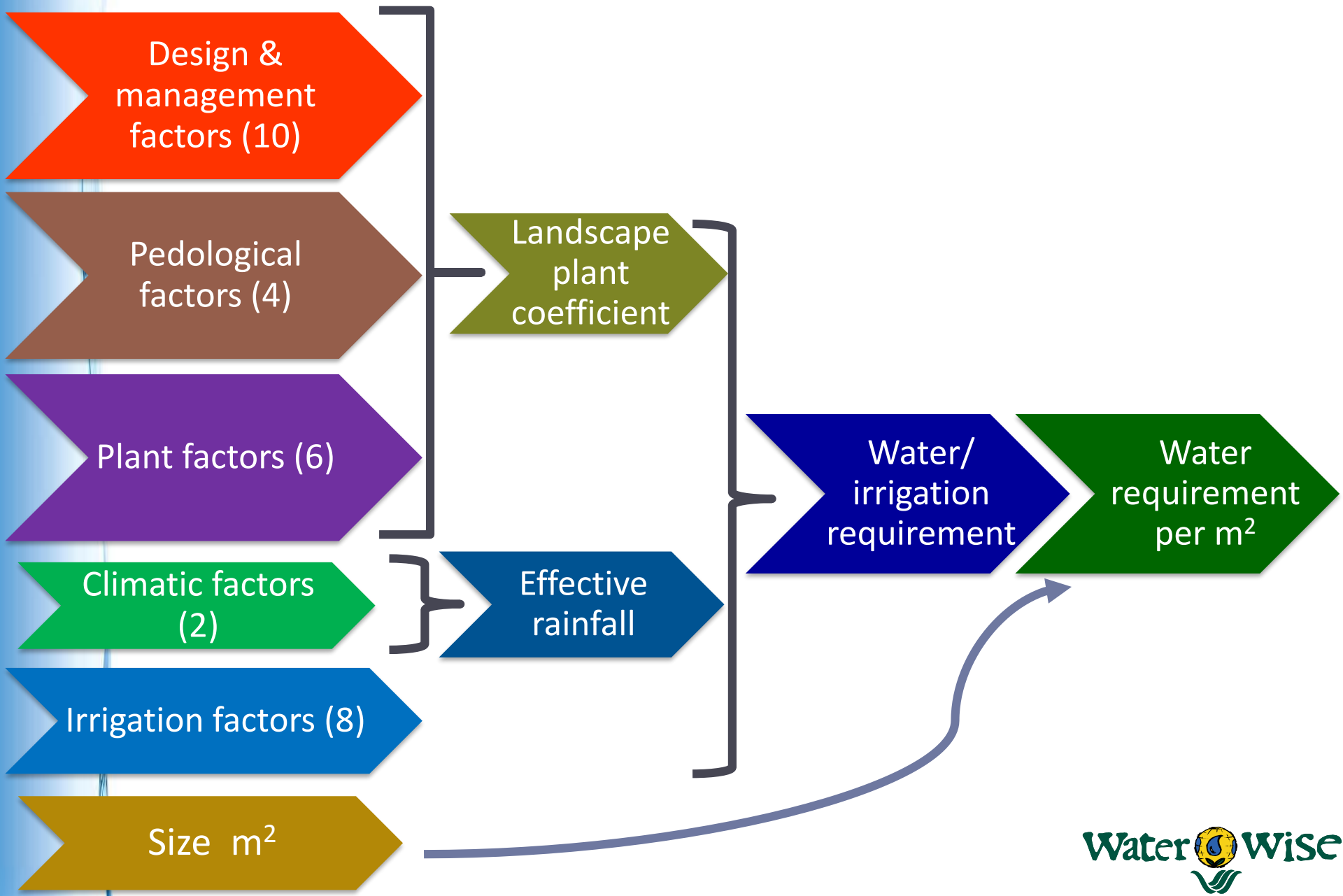
ALWUMSA



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Model Testing phase

- Visited numerous sites to determine if water use figures were available or if water meters are installed (Gauteng, Western Cape, KZN)
- Obtain data from site in Centurion – 3 years of data.

- Testing of the model against
  - A range of selected scenarios
  - 3 test sites in Centurion
  - 2 existing South African models
  - 1 Australian and 1 USA model

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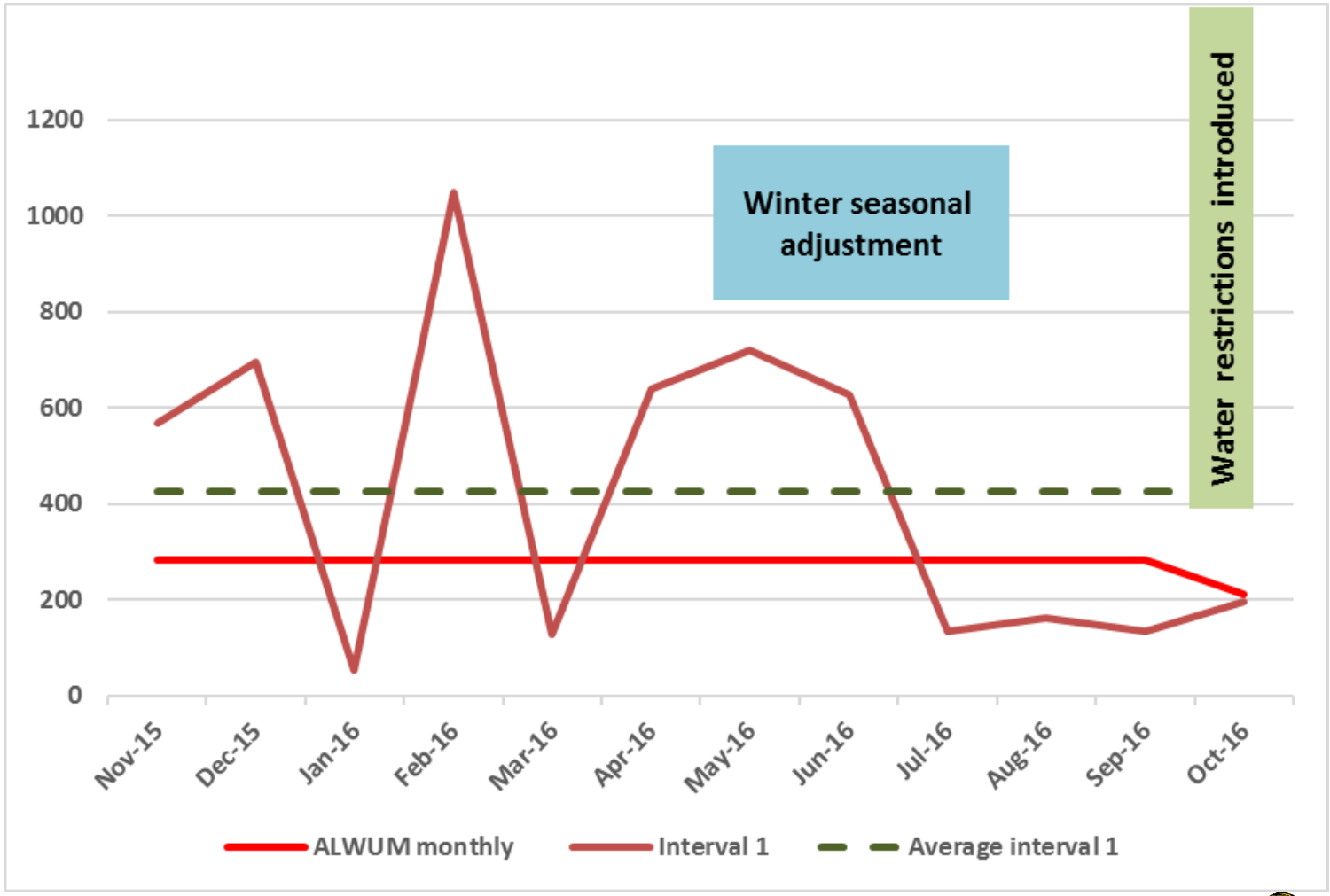
Model Testing phase – Block A before restrictions



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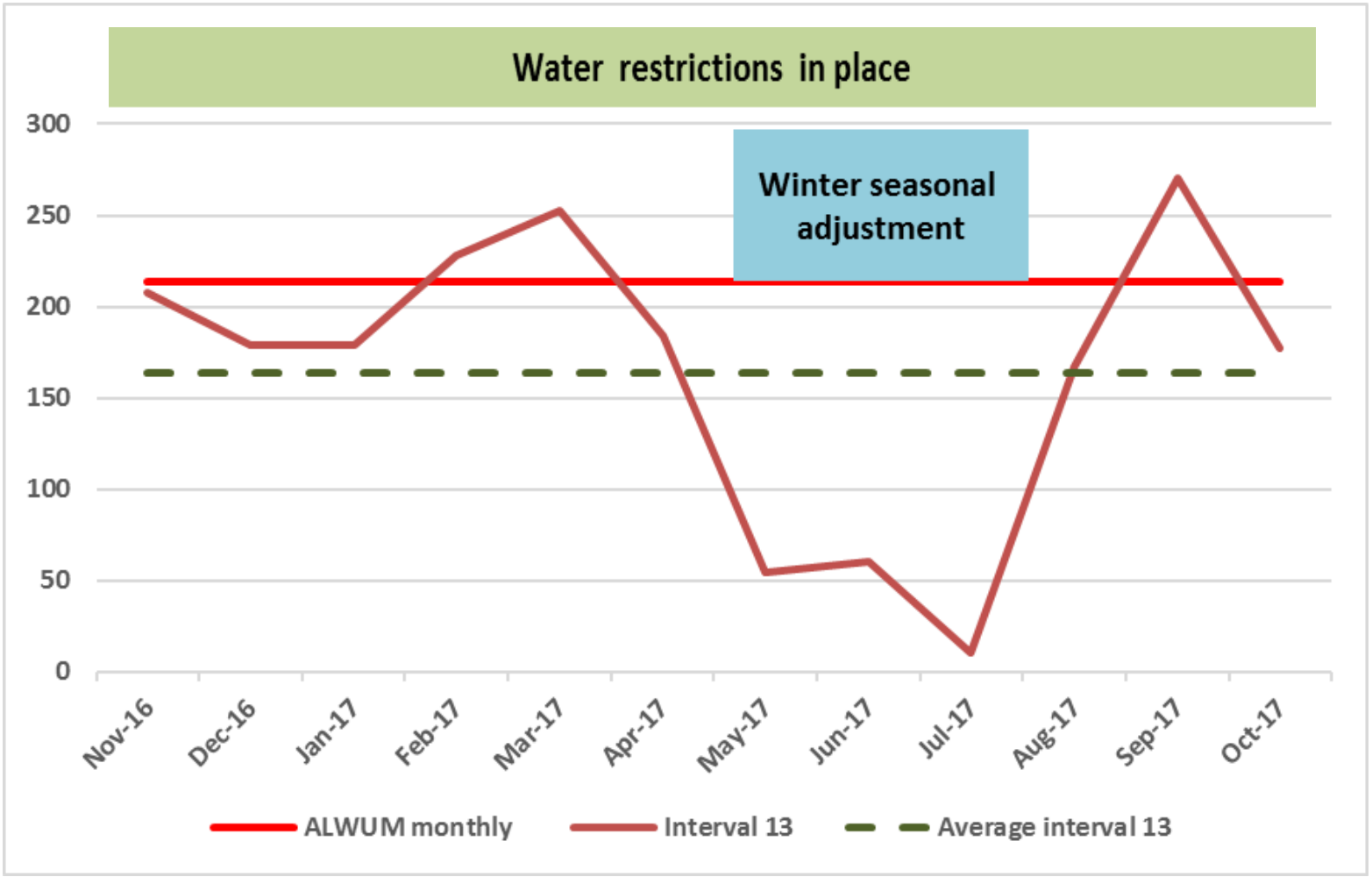
Model Testing phase – Block A during restrictions



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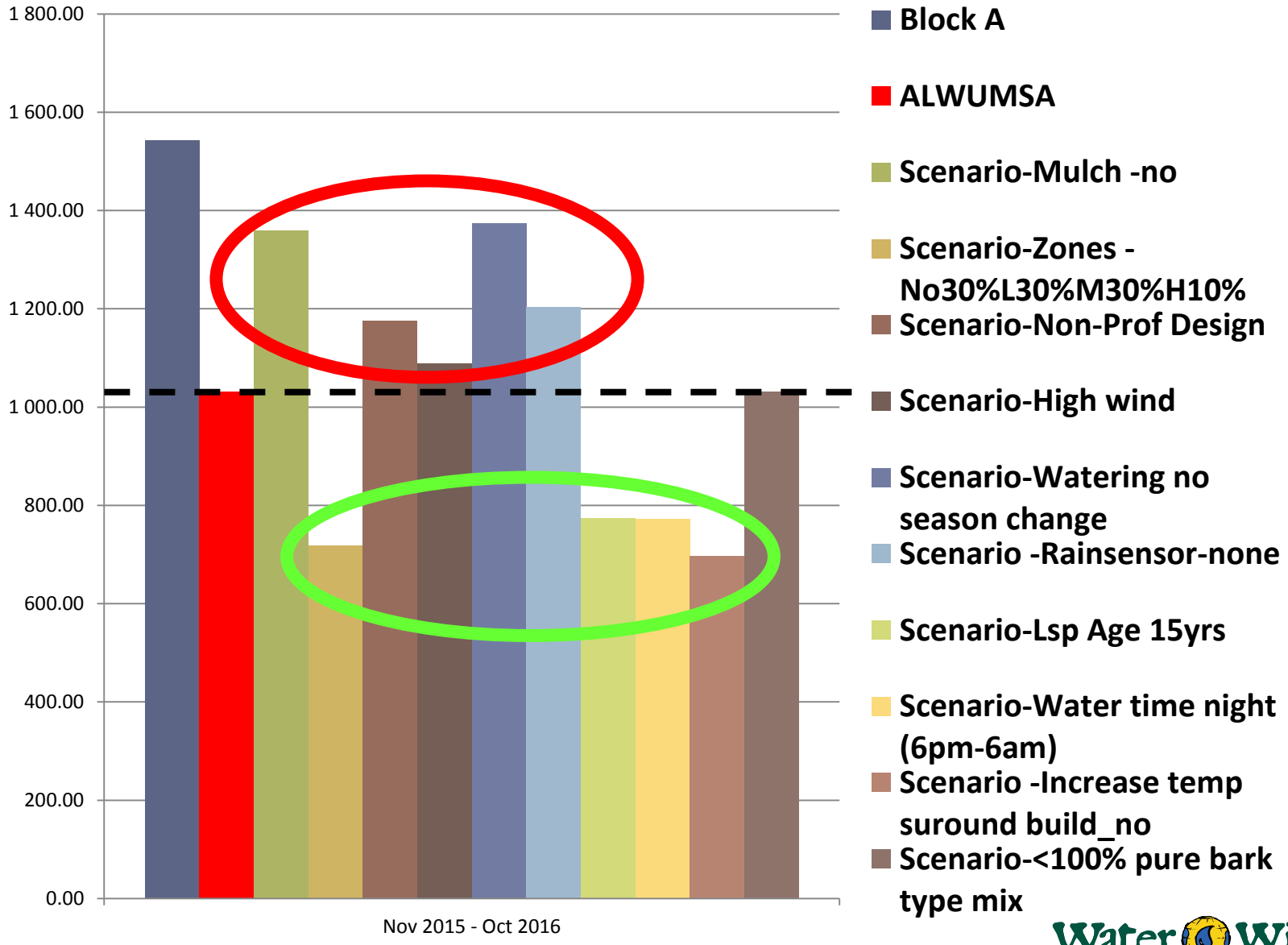
Comparison of ALWUMSA to scenarios



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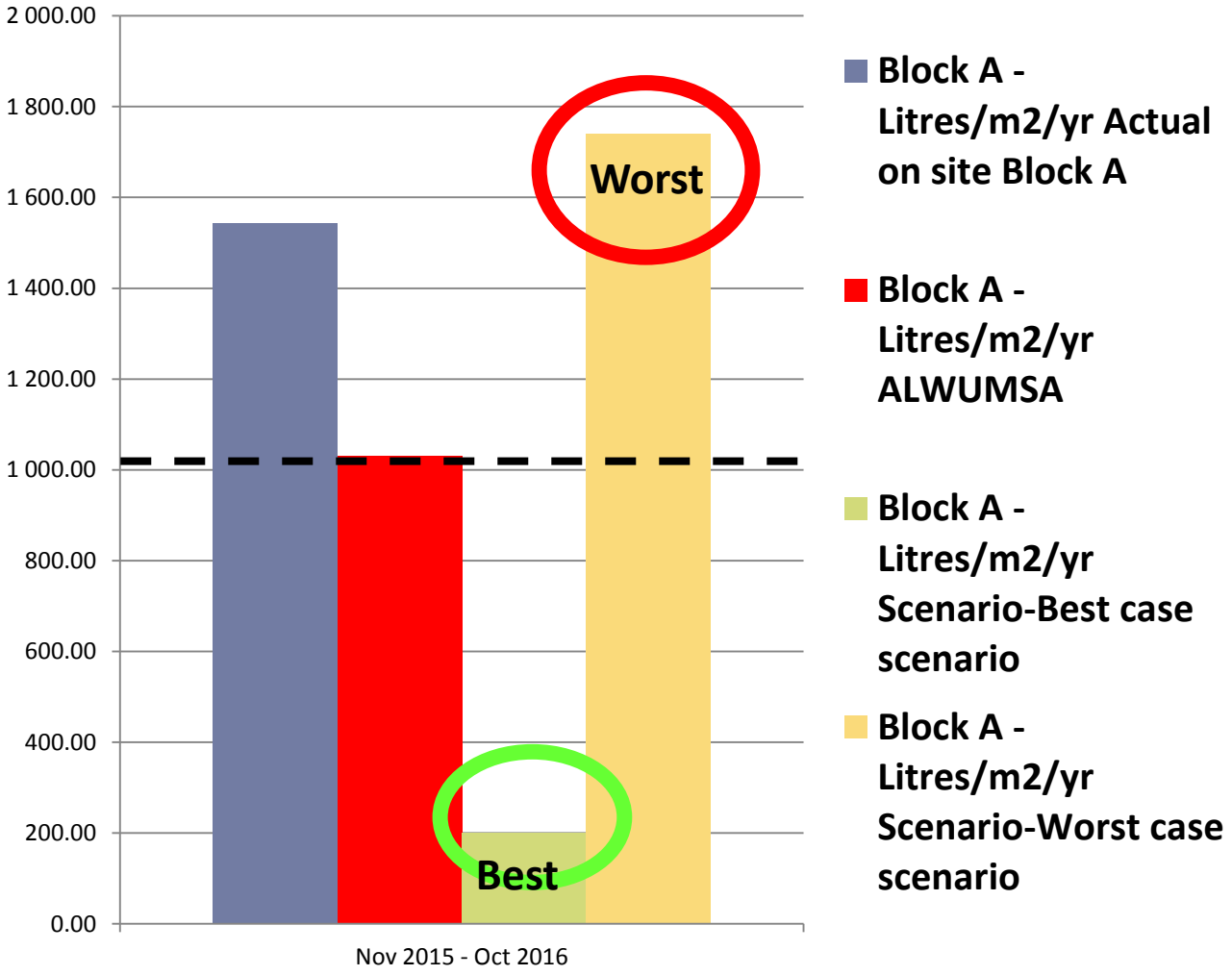
Comparison of ALWUMSA to <u>best</u> and <u>worst</u> case scenarios



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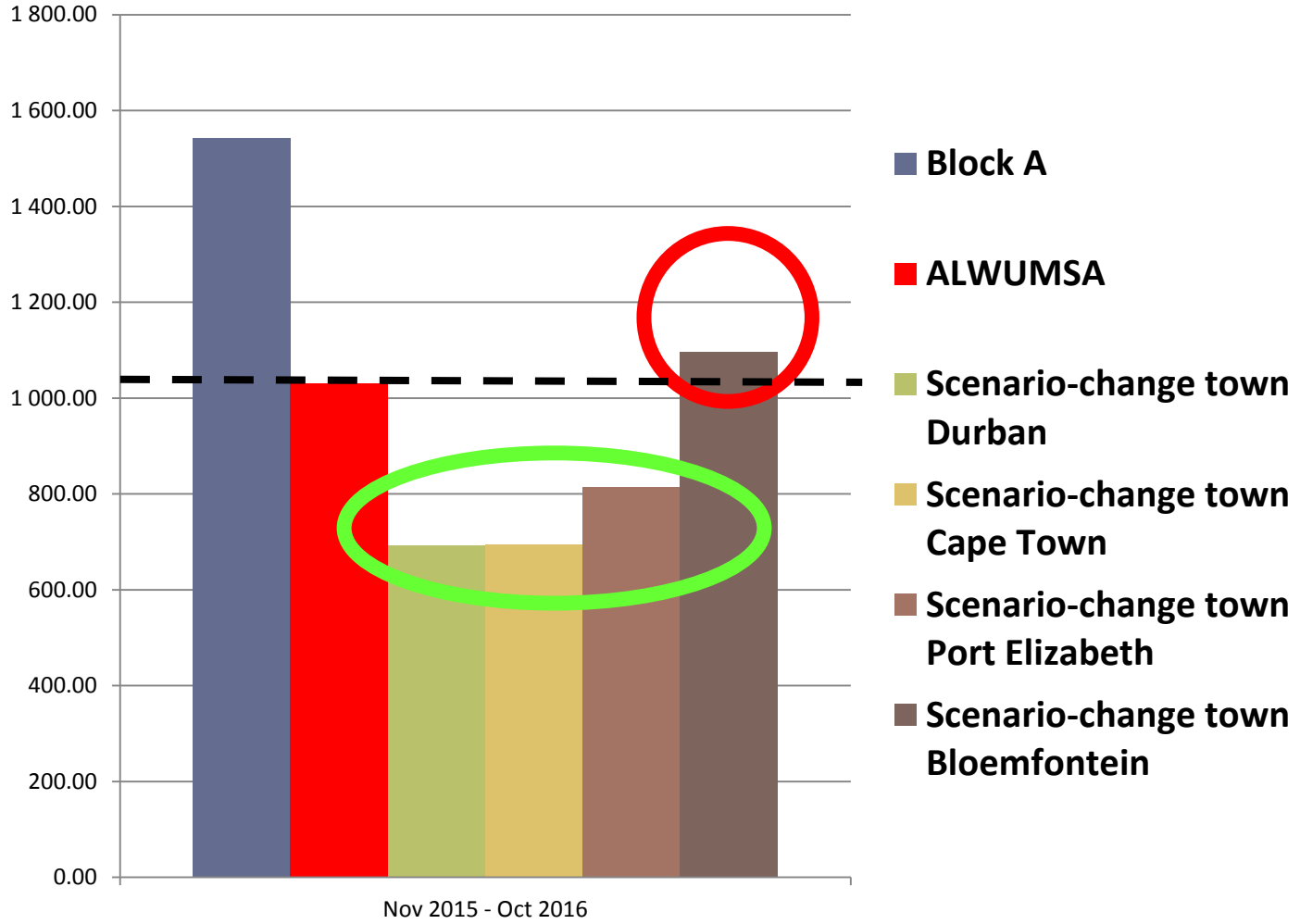
Comparison of ALWUMSA to town scenarios



Average annual rainfall between Cape Town and Bloemfontein is merely 29 mm (more in Bloemfontein), however evapotranspiration difference is 603.36 mm higher in Bloemfontein.

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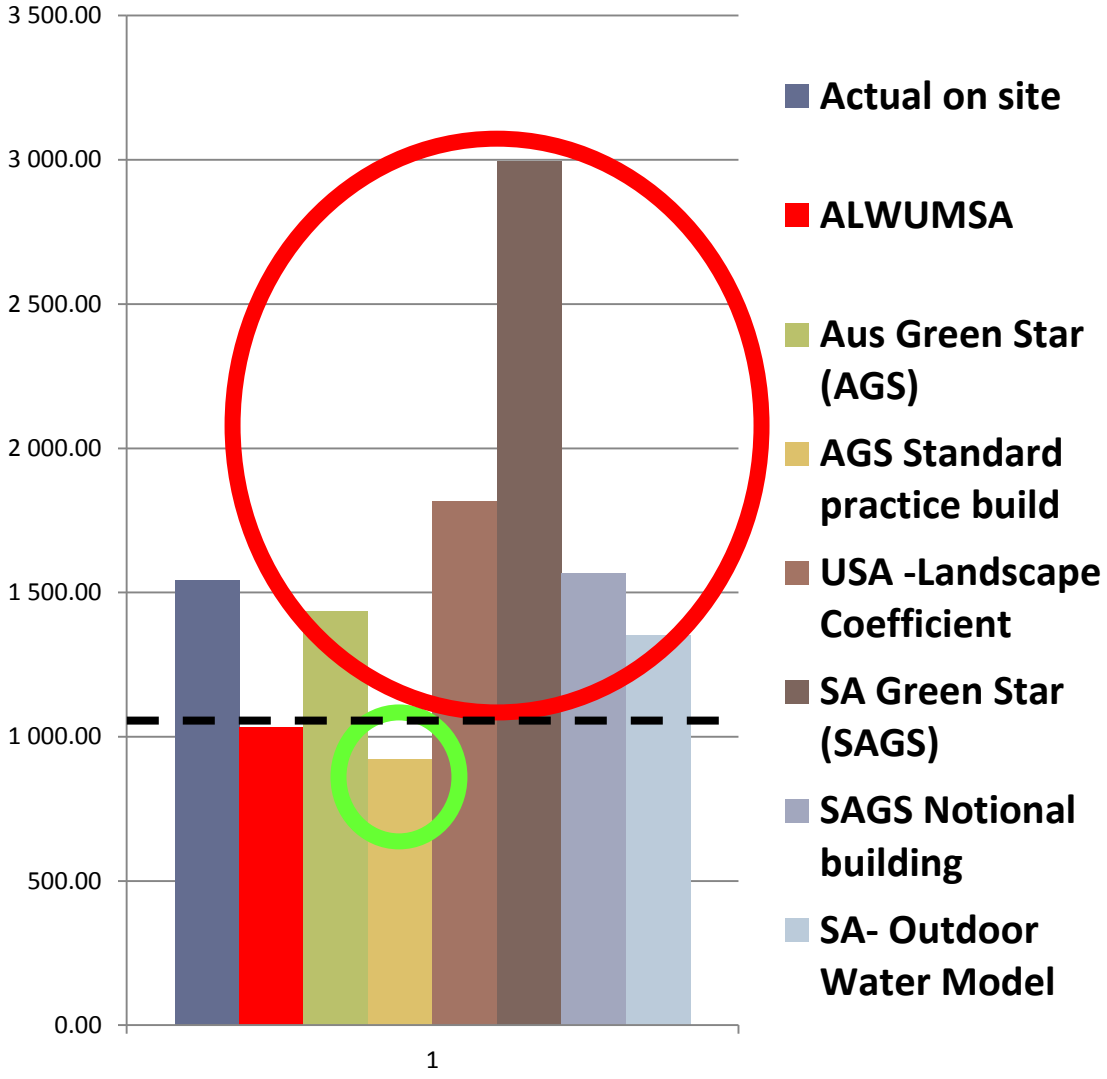
Comparison of ALWUMSA to other models



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Some notes for clarity:

- For ALWUMSA to be effective
  - One of 160 towns must be chosen (rainfall and potential evapotranspiration is automatically included)
  - Each one of the questions (factors/elements) must be answered to allow the model to calculate water use
  - Currently the model makes use of drop down menu‘s
  - Hydrozones must be used
  - Plants must be planted in correct location

- It applies equally to indigenous and exotic plants
- Watering for establishment (2 year period)

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Conclusion

- Adopt and implement the improved plant data base and ALWUMSA
- Who –
  - South African Green Industries Council and its member bodies,
  - education learning institutions and
  - other relevant organisations and property-owners.

- Regardless of the water source amenity landscapes must reduce and optimise any water used.

- **We cannot manage and improve water use if we don't or cannot measure it.**

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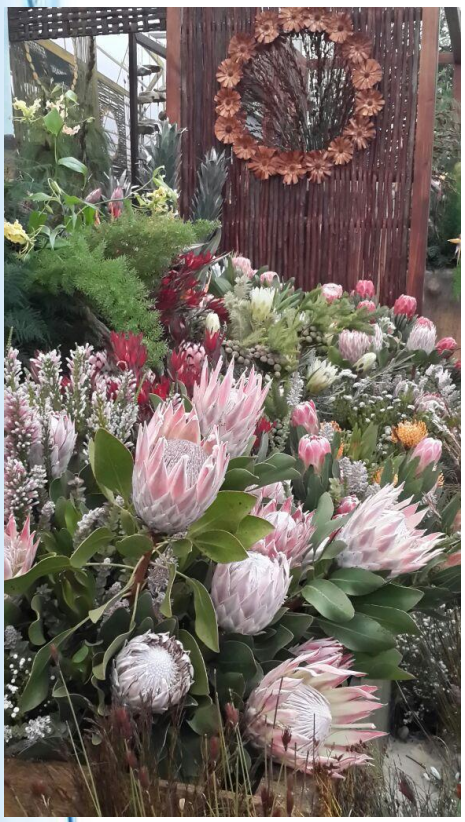
Thank you

Questions



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The original study has been undertaken through Unisa as part of my PhD.
Supervisors: Dr A Barrett, Prof L Brown & Prof J Hendrick

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