Irrigation areas

Figure 143 sets out the irrigation areas and table 9 the corresponding need. The manicured lawn will be irrigated with 25mm per week during summer and 6.25mm during winter. The lawn mix will receive no water during summer and 10mm per week during winter (the lawn mix areas part of the groundwater infiltration scheme). The formalised planting and restio mix will be watered 10mm per week during summer and 5mm per week during winter.

All of the irrigation needs are met by the rain and runoff harvesting system.

Table 10 describe the anticipated building use, classification and water use per day. Tables 11 (next page) sets out the summary of the water budget along with an estimated water related cost saving of 30.71% per annum.
<table>
<thead>
<tr>
<th>Total harvested:</th>
<th>Irrigation need:</th>
<th>Buildings need:</th>
<th>with 10% water saving devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>5134.46</td>
<td>2068.77</td>
<td>16411.806</td>
<td></td>
</tr>
<tr>
<td>Total water need</td>
<td>18480.57</td>
<td>16632.52</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost of 1 m³ water</th>
<th>Yearly cost without harvesting</th>
<th>Yearly cost with harvesting</th>
<th>Yearly saving of harvesting</th>
<th>% saving per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 9.02</td>
<td>R 150 025.30</td>
<td>R 103 712.51</td>
<td>R 46 312.79</td>
<td>30.87</td>
</tr>
</tbody>
</table>

This leads to:
- using no potable water for irrigation
- using less water for sanitation
- reducing the impact on down stream systems by reducing site runoff
- saving money

(the author notes that the buildings on site needs more water than the landscape)

**THE RAIN METER MAZE SYSTEM**

The second on site water system addresses rainwater. Rainwater from one of the on site buildings is harvested and displayed in a rain-meter garden.

Water from roof B2 (see table 12) is used for the rain meter maze system. A first-flush device intercepts the first dirty water where after it drizzles down a rain-curtain into a rain meter system (see figure 144).

From the first rain meter tank, underground pipes with openings on the same level, controls the water level in all the tanks, thus all the tanks are equally full (figure 146).

Each tank has an overflow slot that lets water from rain events of more that 90mm drain into the temporary wetland.

After each rain event, the water is kept in the tanks until the next event. Solar powered pumps circulate the water and UV light reduces algae growth.

A rain sensor triggers the drainage system as a shower approaches so that the new event can be captured and celebrated. Figures 144 to 147 explains the phases of the rain meter maze system.

The rain-meters are large bullet resistant glass tank-like containers, calibrated to show how many millimetres of rain have fallen during the shower.

A rain sensor drains the water into the temporary wetland and lets it percolate into the underground storage tank.

Section 00 and PP (figure 149 and 151) illustrates the system further.

**Table 11 - Water balance and saving per annum**

**Table 12 - Water from B2 and rain meter tank capacity**
FIGURE 150. FLOATING BALL SEAL
FIRST-FLUSH SYSTEM
(Kinkade-Levario, H. 2007)

FIGURE 149. SECTION OO - RAIN DISPLAY SYSTEM
Scale 1:100

150mmx150mm gutter
150mm HDPE downpipe to first flush chamber
balcony hand rail
180mm diameter floating ball seal in first flush tank volume 1.324m³
150mm HDPE downpipe to rain curtain
100mm HDPE downpipe to temporary wetland
GMS Composite beam channel

3 x 100mm diameter HDPE pipes to distribute water equally to rain curtain
aluminium disc rain curtain
rainmeter maze (see detail below)
500mm x 500mm x 50mm brushed precast, 25MPa Afrimax All purpose high strength exposed aggregate grouted concrete (1:2:2) paver

275mmx75mmx500mm pre cast concrete coping
selected indigenous wetland species for seasonal inundation
220mm FBS Corobrick Terracotta Satin Imperial wall with 4 coats of ABE Super Laykold on 12mm plaster
200mm 15MPa Afrimax All purpose low strength concrete (1:3.5:3.5) foundation
100mm 25MPa Afrimax all purpose medium strength concrete (1:2.5:2.5) slab
**Figure 149 - Rain Meter Detail Section and Elevation**

**Scale 1:50**
Figure 149 - 2. Rain meter side elevation and rain meter with bench integration
Scale 1:50
THE GREY WATER SYSTEM

The third on site water system treats grey water from buildings through a stepped constructed wetland and displays the cleaned water in a jubilant motion activated display at one of the pedestrian entrances.

Water from all the taps and basins in the buildings are treated through the grey water wetland. For the biological processes in the wetland to be effective, the water needs to be in the system for a minimum of two days, thus 3283 litres over 2 days gives a flow rate of Q=0.019 (see table 13).
Water from the rain-meter system; the grey water system and harvested surface runoff all contributes towards meeting the water needs of irrigation and buildings.
**Figure 153. Section QQ - Grey Water Wetland**

**Scale 1:50**
Red powder coated mild steel asymmetrical tipping device decants grey water into wetland

grey water being aerated, pumped from gravel and sand filter

selected indigenous wetland species for purification (see planting strategy)

320mm x 75mm x 500mm precast 30MPa Afrisam All purpose high strength concrete (1:2:2) coping

220mm FIB Concorrick Terracotta Satin Imperial wall with 4 coats of ABC Super Laykold on 12mm plaster (on inside)

500mm x 500mm x 50mm brushed precast, 30MPa Afrisam All purpose high strength concrete (1:2:2) paver on 500 compacted on site rubble

200 in-situ 15MPa Afrisam All purpose low strength concrete (1:3:5:3.5) foundation

Gravel plating media in 1000mm x 750mm x 250mm precast fiber cement planters with holes on all sides

Screw to fall

100mm 25MPa Afrisam all purpose medium strength concrete (1:2.5:2.5) slab
Motion activated, solar powered aerating nozzle

50mm x 3mm GMS square tubing support frame with T-peices for support of 50mm x 3mm GMS grate with 100 gravel on top

270mm x 75mm x 500mm precast concrete coping

450mm FBS Corobrick Terracotta Satin Imperial seating wall with precast concrete coping

Reused, sandplastered and sealed concrete slab from river channel with compacted granite gravel in between on 50mm sand base

450mm FBS Corobrick Terracotta Satin Imperial seating - and water fountain wall with precast concrete coping and 4 coats of ABE super laycold on 12mm plaster (on inside)

in-situ soil compacted to 93% Mod AASTHO
230mm x 340mm in-situ concrete beam

500mm x 500mm x 50mm brushed precast, concrete paver on 500mm compacted on site rubble

150 HDPE standpipe drain to underground storage chamber

Solar powered submersible pump for spouts and circulation

2070mm x 200mm in-situ concrete foundation

100mm in-situ concrete slab with screed to fall and 4 coats of ABE Super Laykold on 12mm plaster
PLANTING APPROACH

Ecological intent
From the design goals and objectives (chapter 5), the following ecological objectives was identified
• Introduce constructed systems that supports components of ecology by focusing on water as a critical building block
• Incorporate the prominent themes from the ecosystem service analysis
  - Conserving water sources and the systems they support while optimising the use of on-site water and reducing the use of potable water
  - Introducing and preserving existing natural and on-site region appropriate biomass

Appropriate biomass
From the historical analysis of the Apies River (see chapter 5), the following appropriate tree and plant species have been identified
• Bushwillows (*Combretum sp*)
• Wild olives (*Olea europaea subsp. africana*)
• White stinkwood (*Celtis africana*)
• Wild currant (*Rhus pyroides*)
• Ferns (*Asplenium aethiopicum*, *Blechnum australe* and *Cyathea dregei*) are appropriate according to van Jaarsveld (2000 p. 126 - 131)
• *Zantedeschia sp.*

According to *Vegetation of South Africa, Lesotho and Swaziland* (Low & Rebelo, 1998 p. 39) the site is classified in the Rocky Highveld Grassland as part of the Grassland Biome.

Vegetation is dominated by grass species, forbs and trees. The use of veld grass in urban applications are limited due to the accumulation of biomass, the seasonal fire hazard and sensitivity towards trampling. A few species will be planted in manageable areas to serve as a reminder of what we have lost.

Selected forbs identified in *Vegetation of South Africa, Lesotho and Swaziland* will be used where appropriate.

All other plants selected are listed in ‘Waterbesparende Inheemse Tuinmaak - ‘n streeksgids tot inheemse tuinmaak in Suid-Afrika’ by Ernst van Jaarsveld. In his publication van Jaarsveld addresses gardening in South Africa by grouping indigenous plants together that are appropriate for each region of South Africa. The groupings are based on suitability regarding climate and water conserving for each region. The site is located in his classification of the highveld garden.

On site biomass
All of the Jacaranda trees on site will be utilised and some will be moved to form a continuous edge along the streets. Restricting the use of Jacaranda trees to the street edge not only defines the edge but also maintains and enhances the historical value of Jacaranda trees as part of the heritage of the city.

Indigenous groundcovers will be replanted on site while exotic groundcovers will be used in the on site composting system.

Planting design as a system
Vegetation depends on soil, water and light. The soil on site mostly lies bare, compacted and polluted by rubble. An extensive soil rehabilitation plan needs to be drawn up (it is not within the scope of this thesis to do so). Part of the problem can be addressed by the proposed on site composting facility in that forms part of the service yard behind the shops.

Appropriate water strategies have been devised and covered earlier in chapter 9. Further water saving can be achieved by mulching. Using rocks or gravel as a mulch not only retains moisture in the soil but also reduces the presence of weeds and invasive species and stabilises the soil as well.
**Planting groups**

**Manicured lawn**
*Cynodon transvaalensis ‘florida’*

**Formalised planting**
A selection of the following groundcovers
- *Sphenostylis angustifolia* (Low & Rebelo, 1998 p. 39)
- *Geranium incanum*

Some of the following perennials
- *Asparagus virgatus*
- *Barleria obtusa*
- *Diascia integerrima*
- *Europs tysonii*
- *Haplocarpa scaposa*
- *Plectranthus grallatus*
- *Senecio seminivius*
(van Jaarsveld, 2000 p. 126 - 131)

**Lawn mix**
LM or *Dactyloctenium australe* (average height of LM lawn is around 200mm high) used as a continuous surface that will not be regularly mowed. Some of the following bulbs and forbs will be scattered throughout.

When needed, a brush cutter can be used in between emerging plants. These scattered bulbs and forbs will include some of the following
- *Senecio venosus*
- *Xerophyta retinervis* (monkey tail)
- *Crassula lanceolata*
- *Scilla nervosa*
  Above mentioned are specific to Rocky Highveld Grassland vegetation (Low & Rebelo, 1998 p. 39)
- *Boophane disticha*
- *Chlorophytum krookianum*
- *Crocosmia aurea*
- *Dierama adelphicum*
- *Eucomis autumnalis*
- *Eucomis bicolor*

- *Gladiolus dalenii*
- *Haemanthus sp.*
- *Hypoxis hemerocallidea*
- *Moraea huttonii*
- *Nerine bowdenii*
- *Scadoxus puniceus*
- *Watsonia pillansii*
(van Jaarsveld, 2000 p. 126 - 131)

**Wetland species**
Herbaceous species with roots in water
- *Crinum bulbispernum*
- *Cyperus latifolus*
- *Cyperus papyrus*
- *Echinochloa cabana*
- *Phragmites australis*
- *Scilla natalensis*
- *Typha capensis*
- *Zantedesica sp.*
Herbaceous species on edge of wetland
- *Juncus kraussli*
- *Juncus effuses*
- *Hermarthisa altissima*
- *Cynodon dactylon*
- *Kniphofia uvaria*
*(Wyatt, 1997 p. 3 - 11)*

**Veld grass mix**
Rock or gravel mulching will contribute to control and space the following grass species
- *Cymbopogon validis*
- *Hyparrhenia hirta*
- *Melinis nerviglumis*
- *Themeda trianrda*
(van Jaarsveld, 2000 p. 126 - 131)
Combretum erythrophyllum
Eucomis autumnalis
Crocosmia aurea
Cyathea dregei
Melinis sp
MATERIALS

Red face brick relates to the history of the Kirkness brickworks in Groenkloof, Pretoria.

Wooden decking (Eucalyptus diversicolor ‘karri’) is widely associated with waterside activities and will strengthen emotive link with the river.

The extensive use of concrete connects with the river channel and the finishes hints at the erosive quality of water. The concrete will be brushed, sandblasted or off shutter while the aggregate will be exposed in some applications. Square concrete flagstones used throughout links with the rigid grid of the city.

Bullet proof glass will be used for the rain meter tanks along with stainless steel and powder coated black and red mild steel.

Handrails will be stainless steel.