CHAPTER SEVEN

7. Passive Systems
   7.1 Urban Framework
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      7.1.2 Biodigesters
   7.2 Passive Systems in the Facility

Figure i. Contextual photo in Plastic View (Author 2016)

7. PASSIVE SYSTEMS

7.1 URBAN FRAMEWORK

The approach to passive systems in the scheme may be seen as an extension of the arguments laid out in developing an appropriate structural and architectural language for the facility, whereby the processes and situations present in Plastic View were used as informants for the proposals put forward in this dissertation. The most notable of these informants being the collaborative collection and distribution of resources amongst the community.

Due to the anticipated size and population of the development on the larger site precinct, this concept proved to be a viable solution to the distribution of resources within the urban framework. As a result, a number of sustainable systems were considered as a part of the larger urban framework which each individual project on the precinct could then tap into. These systems include rainwater harvesting along the pedestrian and vehicular roads, and a number of biodigesters connected to public ablutions along the island separating the two access roads.

7.1.1 STORMWATER CATCHMENT

As there is a significant slope on the site and the vehicular and pedestrian access roads proposed span 1.4 km across the site, a significant opportunity for catchment of the stormwater runoff from these roads was realised for the urban framework. In order to accommodate this, 3 different underground catchment tanks are proposed across the site. These tanks are situated next to the project sites and in some cases, may also store runoff from the projects themselves. These tanks are seen as a part of the same water piping system and so any overflow from one may be used to fill the remaining tanks on site. Rainwater harvesting from the healthcare facility's roofs and courtyards is also seen to support the water consumption of the healthcare facility with smaller secondary water tanks situated within the facility's precinct. The grey water from the facility and public ablutions is proposed as being recycled in order to flush the toilets and water gardens within the facility's grounds.

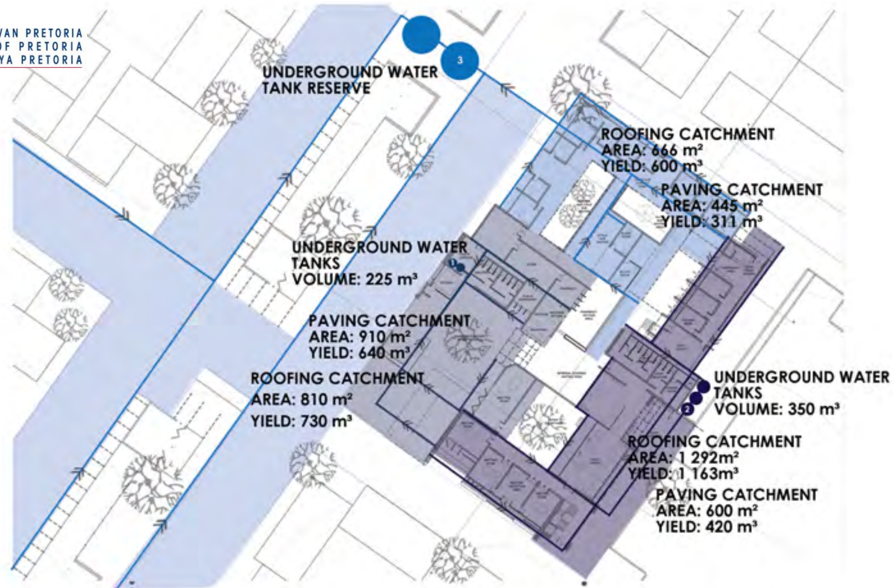
The total water demand for the facility was estimated to be 10 000L/day, while the total water demand for the public ablutions surrounding the site is estimated to be 5 000L/day. Refer to excel spreadsheet in annex for water budget and tank sizes.

7.1.2 BIODIGESTERS

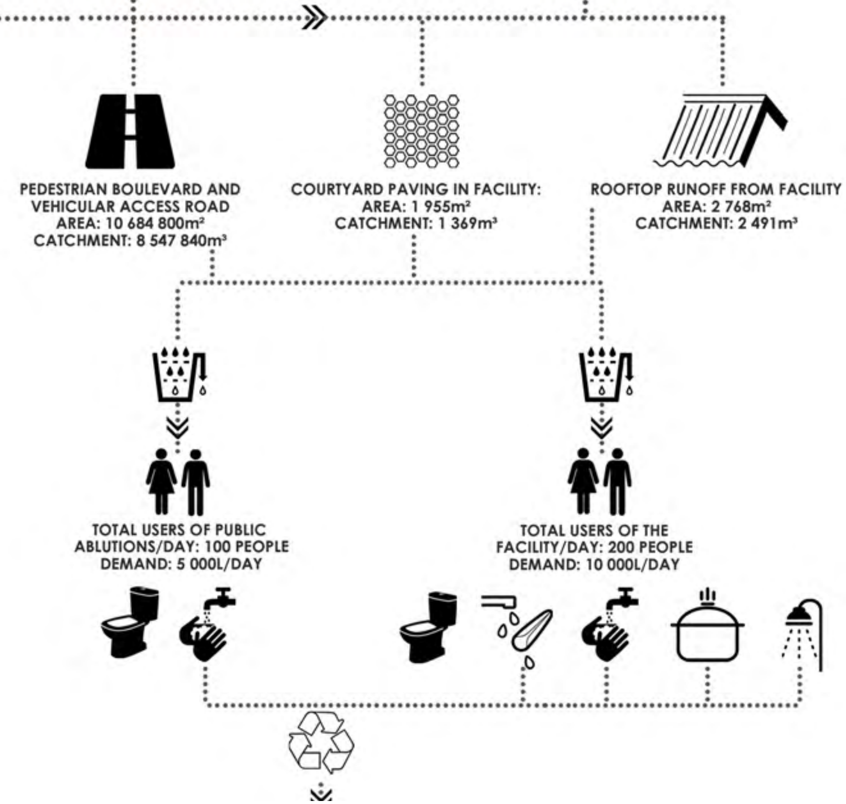
As the island intended to act as a buffer between the pedestrian and vehicular roads is anticipated to host a lot of commercial and pedestrian activity, a number of public ablutions are proposed at intermittent intervals on this island throughout the framework. These public ablutions are then connected to underground biodigester plants which would use of the waste produced in these ablutions in order to produce electrical energy to run lights and appliances, and heat to warm water for individual research projects on the site. The excess energy may then be used to support surrounding residential units if possible. The ablutions found in the healthcare facility supply the nearest biodigester to the facility with waste matter for energy production.

The average amount of waste going into the biodigester daily and the subsequent amount of gas this would produce was first calculated. The assumption was then made that $1m^3$ of gas would produce 9kWh and as a result, it was calculated that the biodigesters will produce 329KWh/day, of which 40% may be used for electricity, and the other 60% for heating water etc (Mudzuli 2015: 19).

The total electrical demand for the clinical facility is 73.5 kWh/day. Therefore the biodigester facility will be able to support the proposed design as well as supply a number of surrounding residences with electricity.



Rainwater harvesting from the facility



Rainwater harvesting system for site area near the facility

Figure 75. Rainwater harvesting system on site (Author 2016).

Waste layout for the facility

Electrical layout suggested for the facility

Waste system for site area near the facility

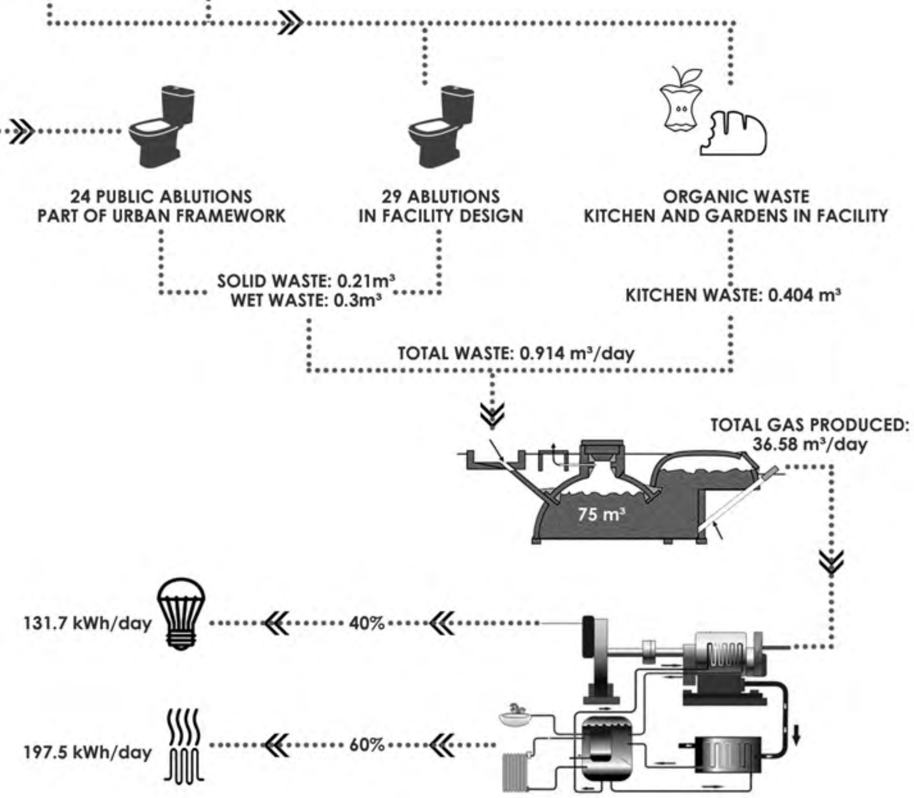


Figure 76. Biodigester system and electrical layout on site (Author 2016).

7.2 PASSIVE SYSTEMS IN THE FACILITY

As argued throughout this dissertation, incorporating as much of the natural context into the facility as possible is important in assisting the mental and emotional well being of the users of the facility. This argument is intended to be represented through bringing in as much natural ventilation and daylighting into the facility as possible. Due to the minimal sizes of rooms throughout the facility, simple passive systems are suggested for these aspects. These are illustrated on the following pages.

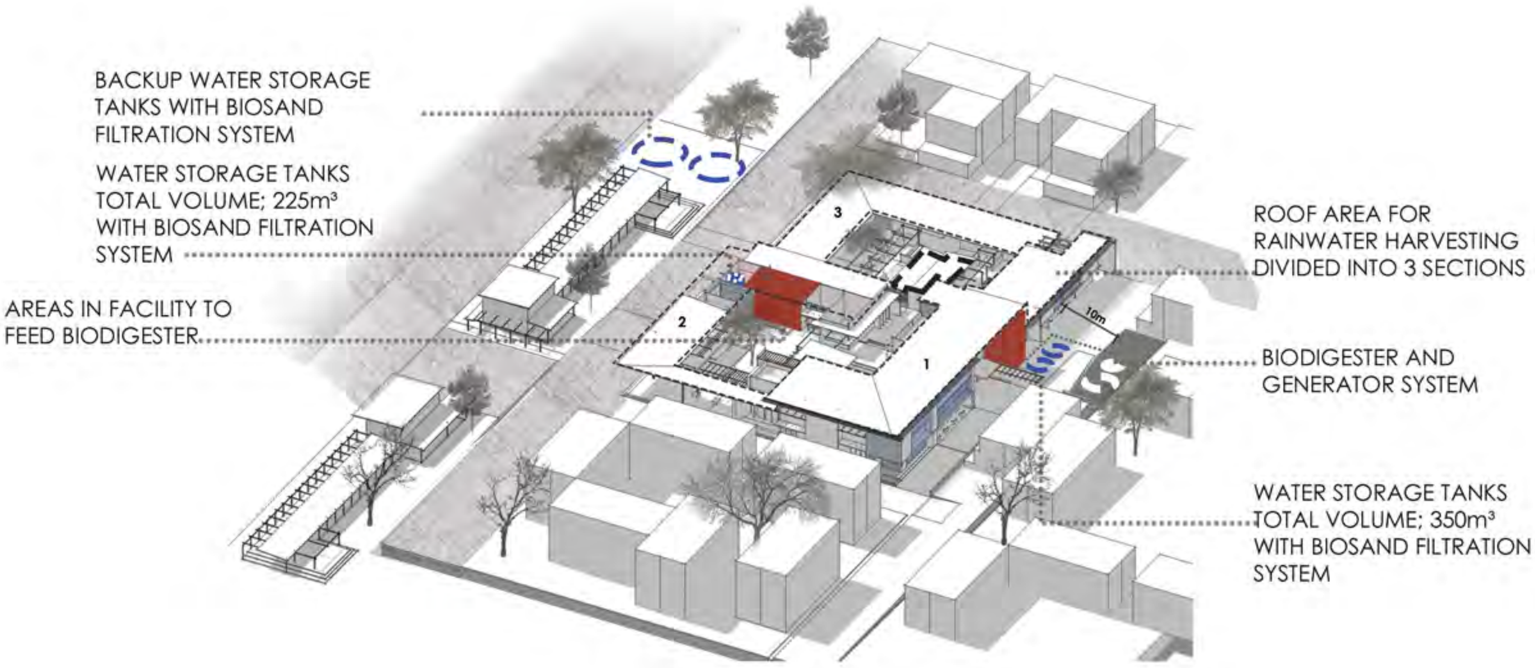
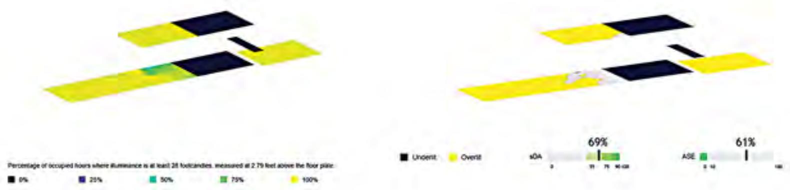
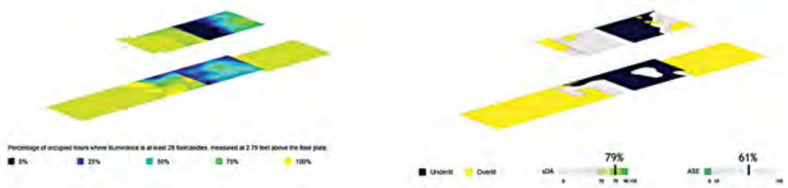


Figure 77. Diagram illustrating passive systems in facility (Author 2016).

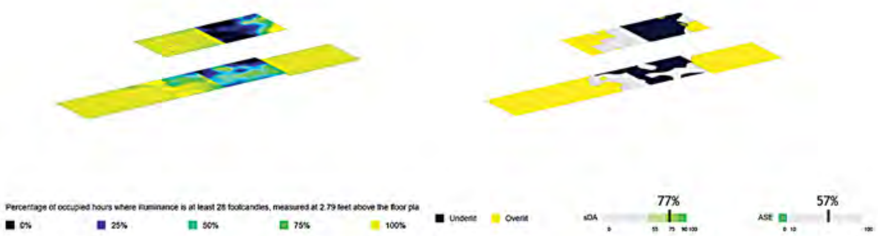
Iteration 1



Iteration 2



Iteration 3



Iteration 4

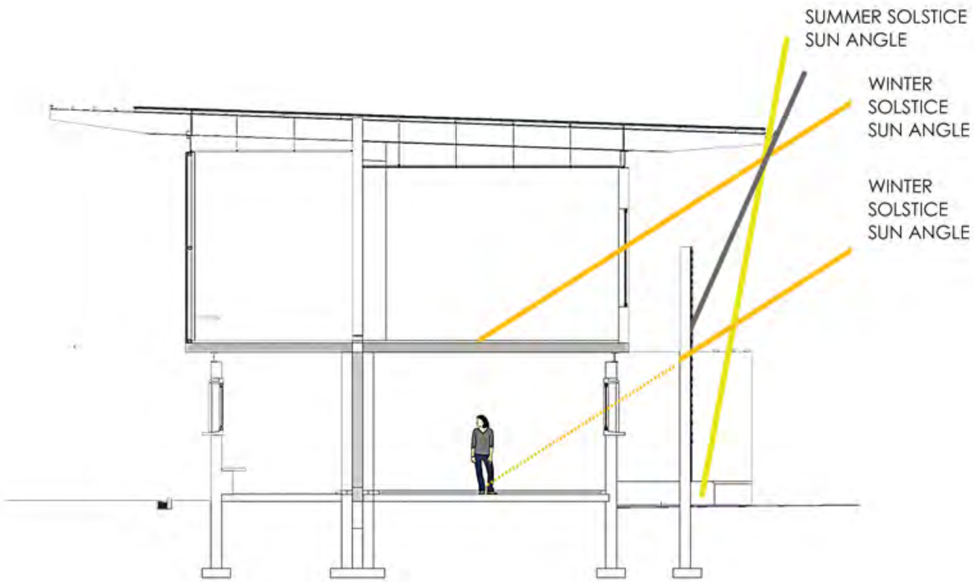
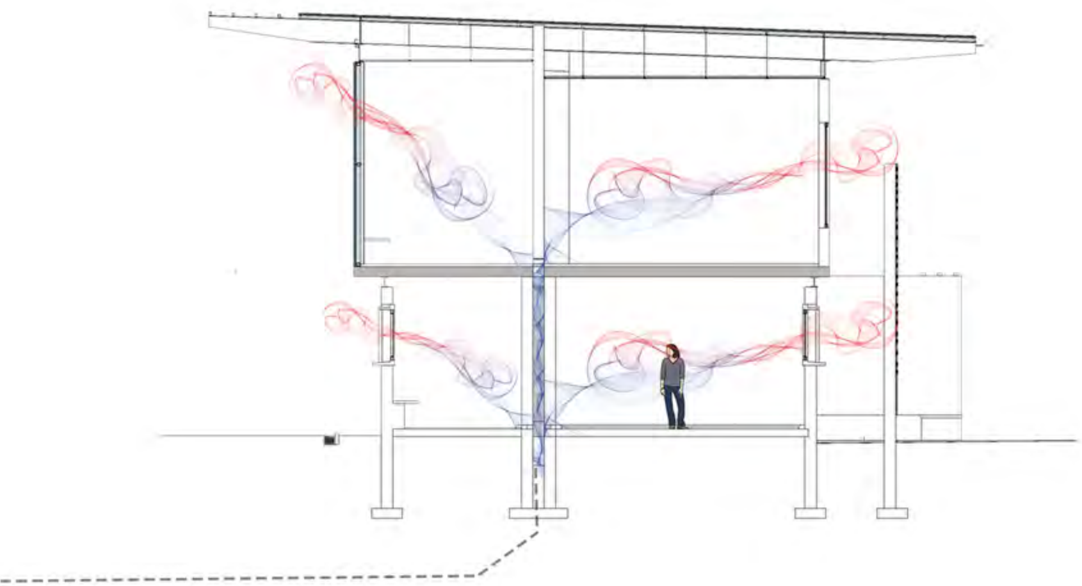
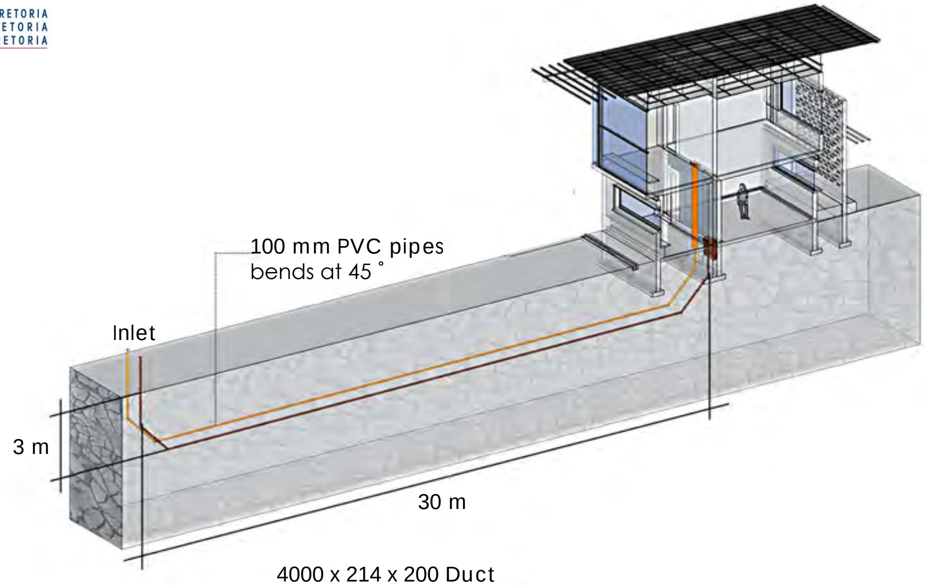
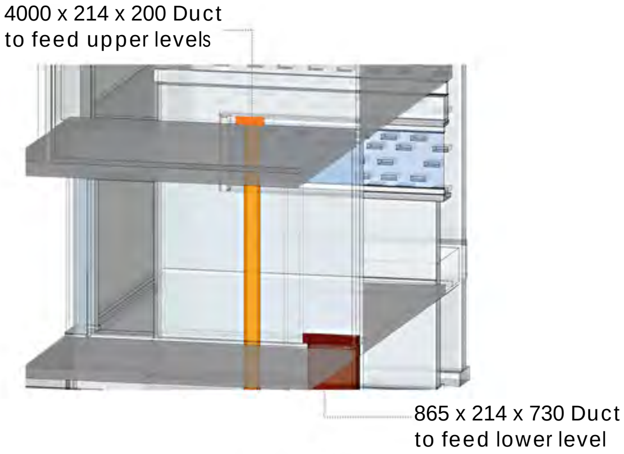
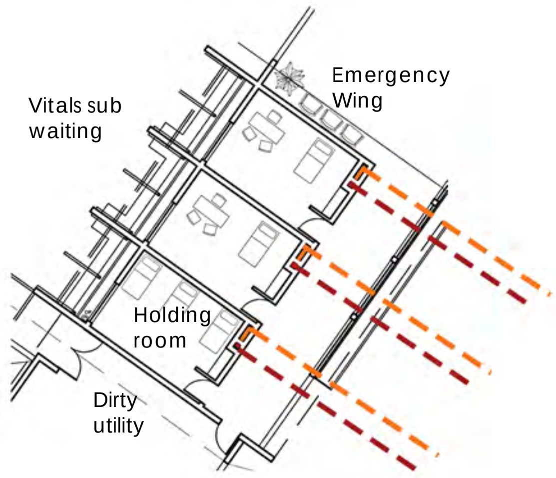


Figure 78. Daylighting iterations and investigations through detailed section (Author 2016).









Principle used for calculating the duct size required to adequately ventilate the required spaces.
(ASHRAE 2011)

Equation: $$\text{Quantity of air (l/s)} = \frac{\text{Vol. of habitable space} \times \text{Air change rate/person}}{\text{Floor area/person}}$$

Air change rate for consultation rooms: 11.5 l/s (ASHRAE 2011: 3)

(Note: As no consultation room was listed, the space with a similar health environmental quality was chosen for this calculation, namely a pharmacy prep room)

1. Consultation room on Ground Floor level:
   Quantity of air (l/s) $= \frac{62\ m^3 \times 11.5\ l/s}{10.6\ m^2}$
   Quantity of air (l/s) = 67.3 l/s
   =0.0673 m^3/s
   Therefore Duct Size =
   865 deep x 214 wide x 365 long

2. Consultation room on First Floor level:
   Quantity of air (l/s) $= \frac{89\ m^3 \times 11.5\ l/s}{12.5\ m^2}$
   Quantity of air (l/s) = 81.9 l/s
   =0.0819 m^3/s
   Therefore Duct Size =
   4000 deep x 214 wide x 100 long

3. As the duct needs to serve the circulation space as well, which is half the width of the consultation rooms calculated above; the duct size for these spaces together may be seen to be 1.5 times the amount calculated in the equations above.

Therefore: Duct size for the first floor level = 4000 deep x 214 wide x 200 long
Duct size for the ground floor level = 865 deep x 214 wide x 730 long

Figure 79. Earth pipe ventilation system in clinic section of the facility (Author 2016).