ADDIS ABABA

PROPOSAL FOR SETTLEMENT IMPROVEMENT

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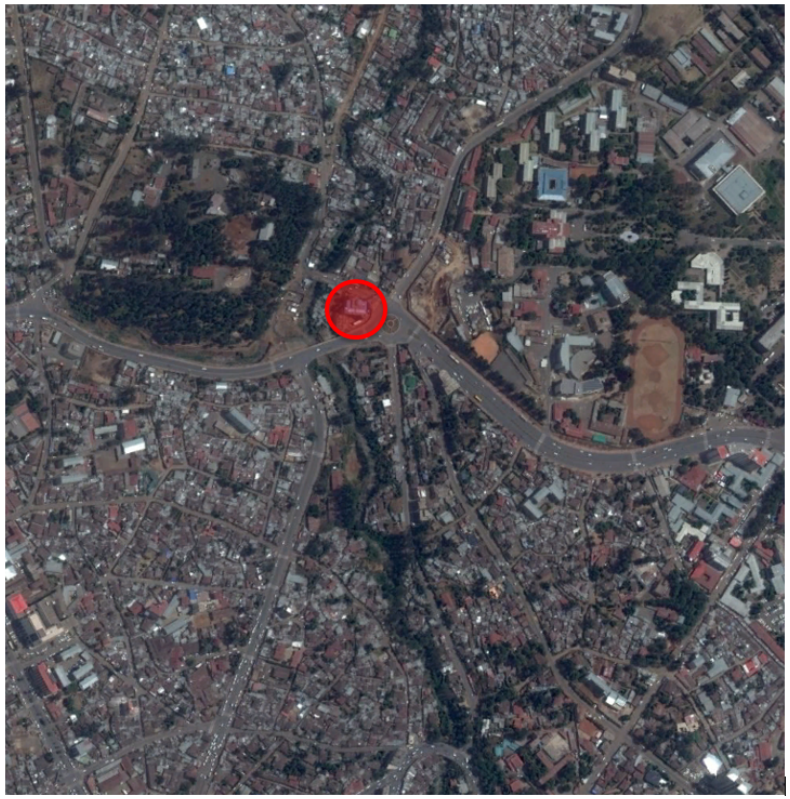
BACKGROUND

- Location: Addis Ababa, capital of Ethiopia
- Objective: To improve the quality of life along riverine settlements through integrated systems approach
- Major issues to be addressed:
  - Access to potable water and sanitation
  - Addressing settlement pollution
  - Planning park space
  - Accommodating livestock
  - Creating opportunities for local employment

Benefits we sought to achieve:

- Improving the quality of life
- Taking advantage of upstream river flow for clean water
- harvesting rainwater
- Improving the functionality of Addis Ababa through the usage of Systems integration.



Google earth image indicating location of Mosque at Weatherall St, Addis Ababa

MAP EXTENTS

- Map extent decied with the Mosque as the focal point.
- 0.5 miles on either side of the river.
- Further refinements were created in AutoCad.
- Contours 1m apart within an extent of roughly 1km x 1km.

- Software used:
- Google Earth and Maps
- Google Sketch Up
- Adobe Photoshop
- AutoCad

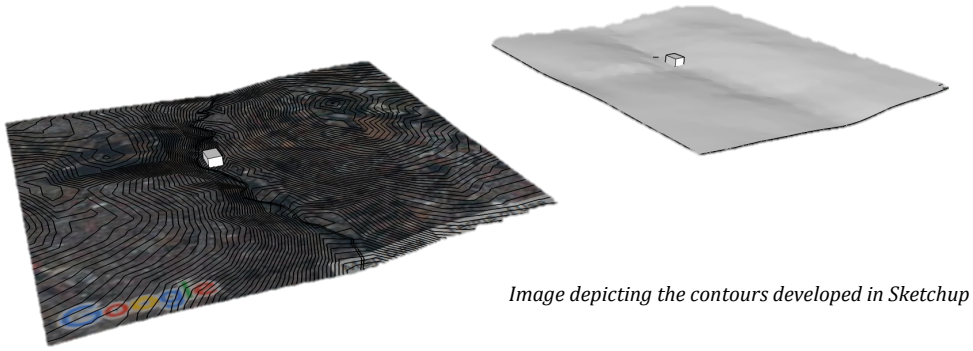
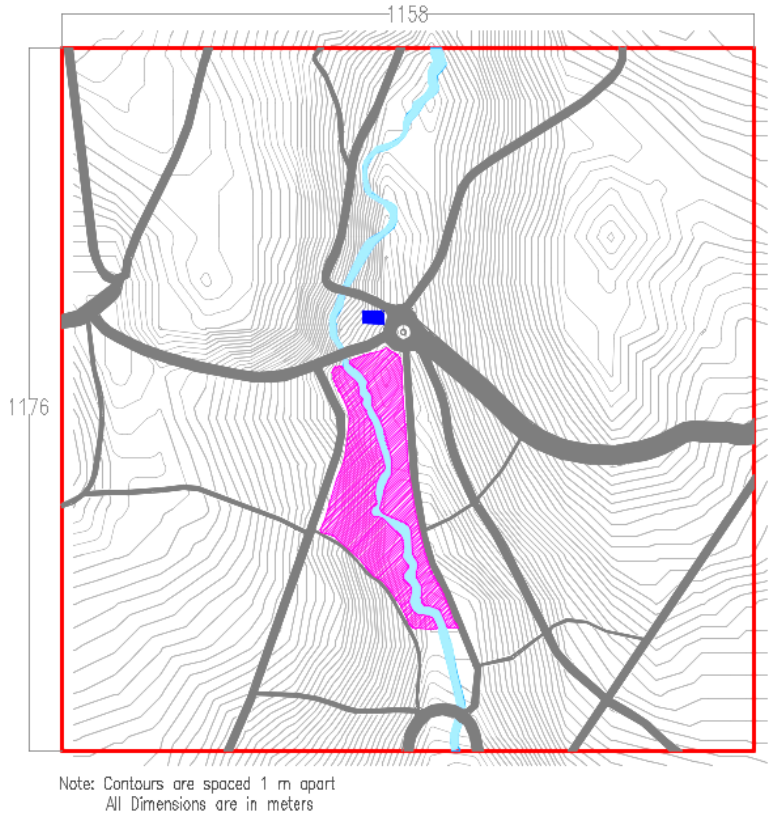
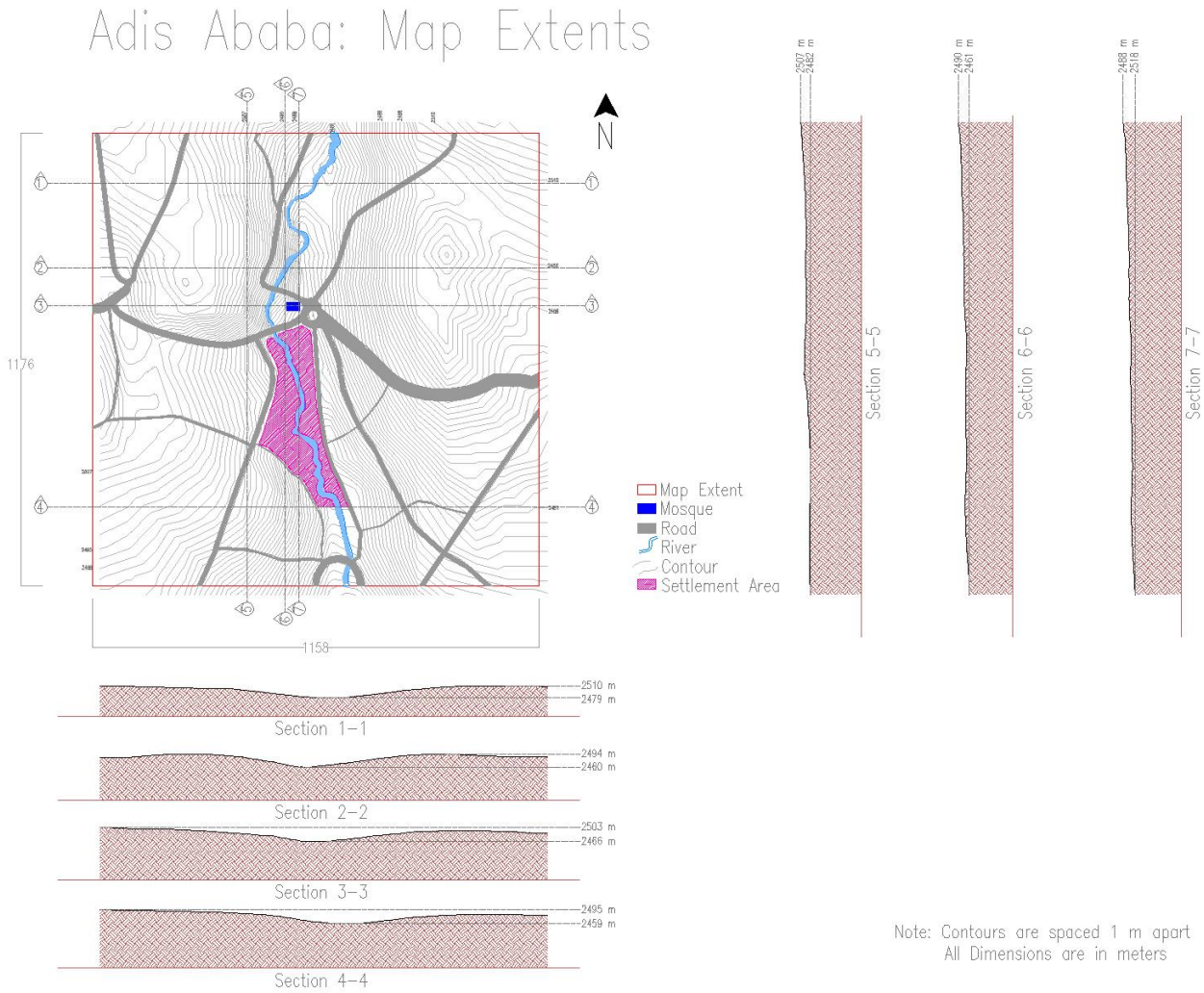


Image depicting the contours developed in Sketchup

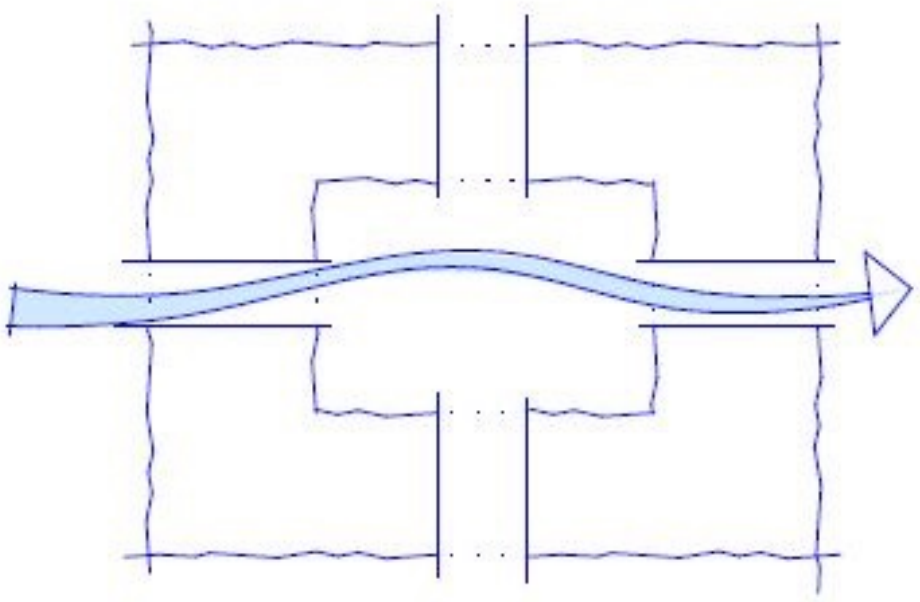


EXISTING TOPOGRAPHY Site Map with Sections



Housing

CLIMATE



1.TEMPERATURE:

High daytime temperatures 80F/28C

Low nightime temperatures 32F/0C

DESIGN RECOMMENDATION:

1. Natural ventilation - open courtyards
2. Shade and orientation away from solar radiation (W&E facades)
3. Thermal mass - use stone
4. Solar energy harvesting potential
5. Evaporative cooling

1.HIGH PRECIPITATION:

DESIGN RECOMMENDATION:

1. Slope roofs to drain
2. Harvest rain water
3. Percolation of storm water

CONNECTION TO THE RIVER

1.Visual Aesthetic:

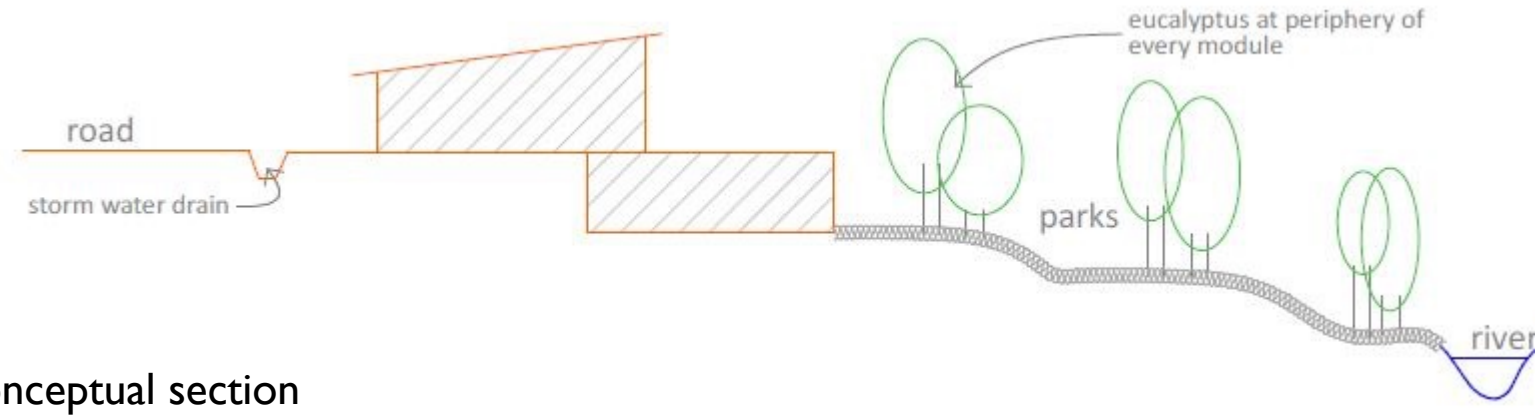
- Green belts between the settlements and river; as parks and to absorb surface runoff before it gets into the river.
- Terrace the green belt to slow down storm water; facilitate absorption.

2.Waste:

- Compost toilets within the modules for personal hygiene and to protect against river contamination.

3.Garbage Collection:

- Introduce garbage collection bins for each module; sensitize about dumping garbage in the river



Conceptual section

MATERIAL

1.Use locally available materials:

Cobblestone, timber, straw, eucalyptus*, mud and wattle*

Design Recommendation

1. Basement and Ground floor in Stone
2. Internal partitions -timber framing and strawboard cladding
3. Upper floors (G+1) - compressed earth blocks
4. Paving - semi-pervious surfaces

*mud and wattle is not durable and can be unhygienic except if well treated.

*timber may not be well cured and treated and may rot due to high moisture. Timber curing may be too expensive for low income groups.

CULTURE

1.Hierarchy of Open Spaces:

Design recommendation:

1. Domestic open spaces (private) - clothes' drying, family leisure; located at back of each unit
2. cluster open space (semi- public) – drying of food, cooking: courtyard and/or balcony in the middle of clusters
3. Communal open space (public)- parks on river front

2.Domestic Transportation:

Design recommendation:

1.Stables for donkeys - one layer away from the domestic open space to keep the smell away
2. Collect manure for fertilizer

3.Economy:

Design recommendation

1. unit fronting the road is a SHOP
2. COTTAGE INDUSTRY - preparation space for domestic baking, spices - for sale;

The project is about sustainable re-development of the riverine community. The aims of redevelopment are:

1. Optimal and orderly land use intensity
2. Protection of the River from waste pollution
3. Taking advantage of river views, water

MAIN CONCEPT:

Sustainable Community Development through:

1. Minimal Energy
2. Minimal Water
3. Minimal Waste

1. Minimal Energy

THERMAL COMFORT

Addis Ababa requires cooling during day and heating at night.

To minimize the energy required for Thermal comfort, passive design is recommended in following aspects:

a. Natural ventilation by facilitating cross ventilation through courtyard design and use of fans.

b. Thermal mass.

LIGHTING AND SOLAR ENERGY

Addis Ababa lies close to the equator and receives sufficient sunlight throughout the year to allow natural lighting throughout the year, with proper orientation. Solar energy will be harnessed.

2. Minimal Water

HARNESSING RAIN WATER

Addis Ababa receives 42.9 inches[i] of rainfall annually.
Rain water will be collected into an underground cistern in the courtyard.
Collected rain water can be used indoors.

[i]http://www.addisababa.climatemps.com/precipitation.php

USE GREY WATER FOR IRRIGATION OF VEGETABLE GARDENS

Grey water from the sinks and showers will be channeled to irrigate vegetable gardens at the back of the houses.

3. Minimal Waste

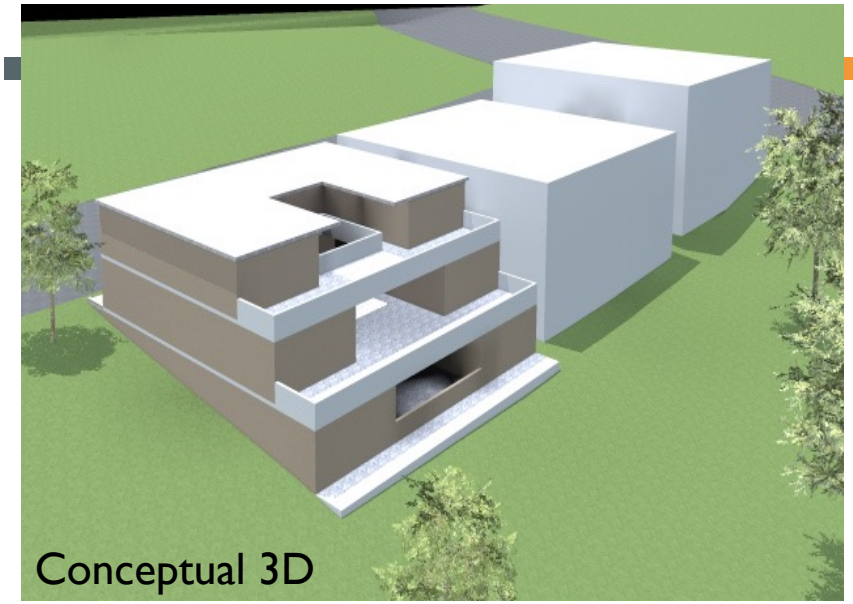
COLLECT, SEGREGATE AND RECYCLE WASTE

Solid waste to be collected, segregated and recycled where possible.
[i]waste handling to be elaborated under waste section

MINIMIZE SOIL WASTE WATER

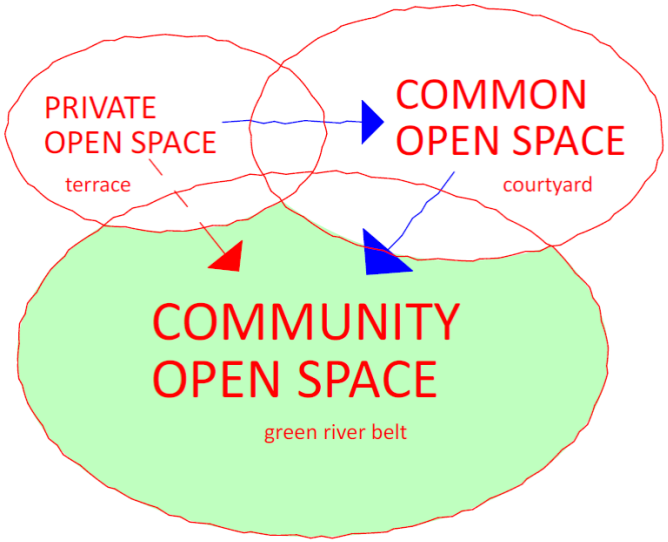
Separating black from grey water reducing the amount of black water handled.

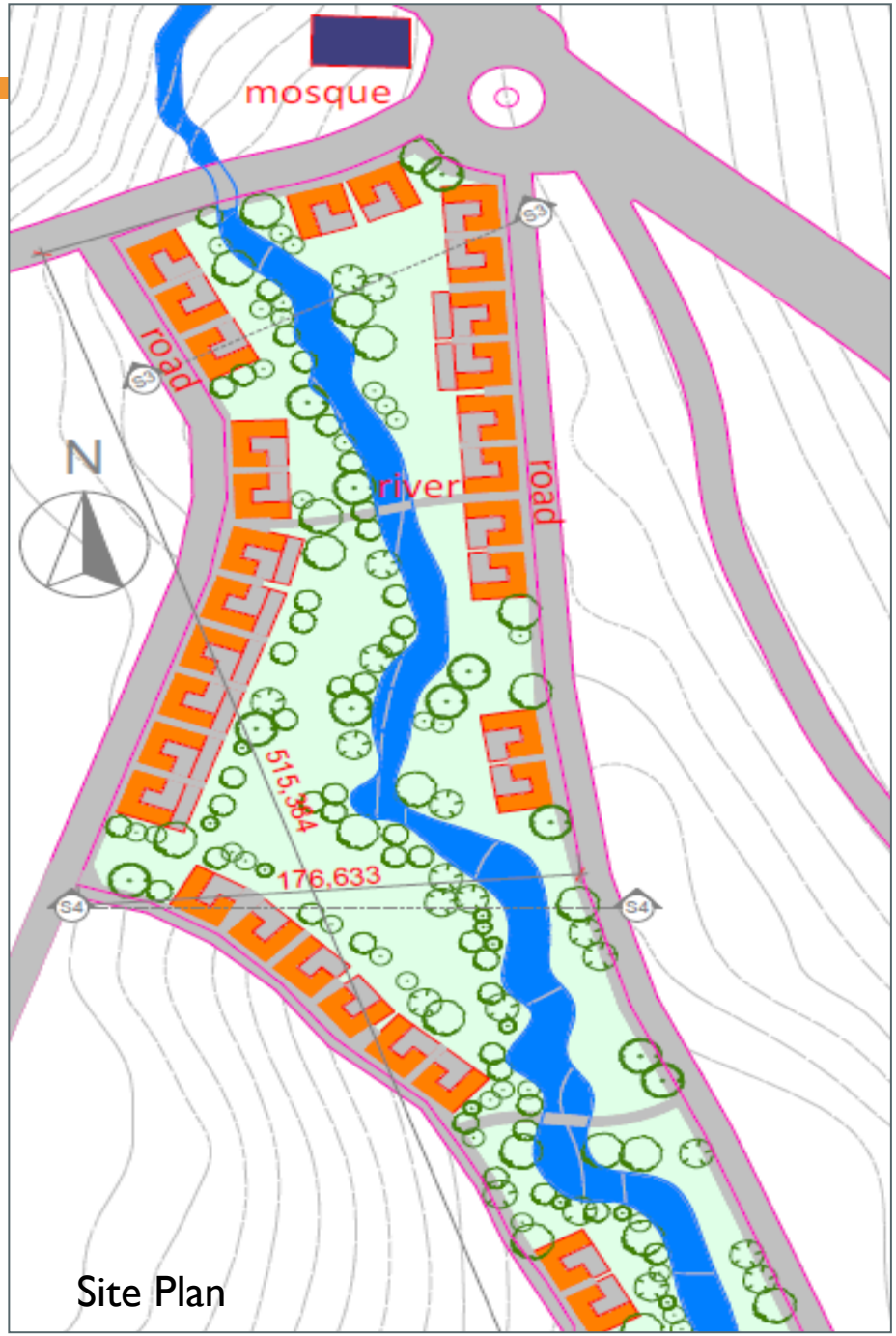
- Black water will be treated in the Municipal Waste water system.
- Grey water will be used for irrigation.



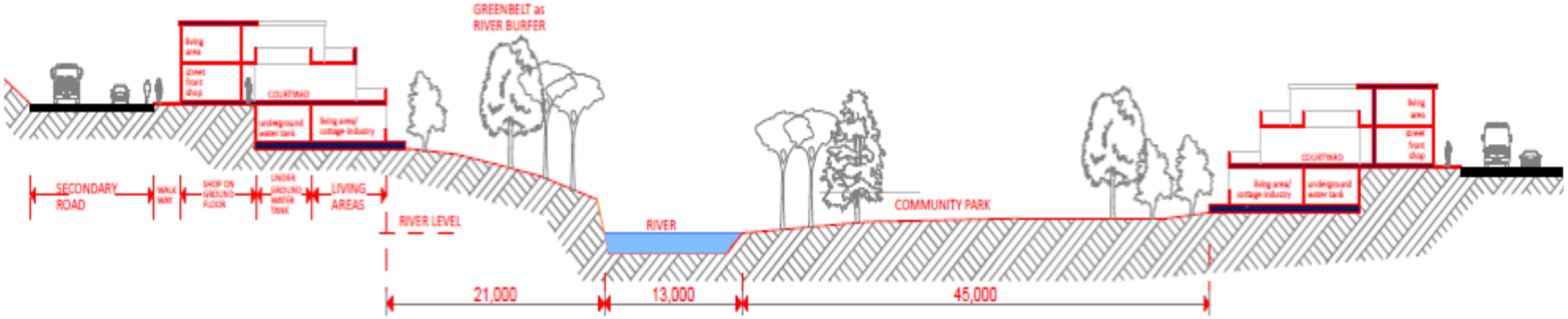
Conceptual 3D

HIERARCHY OF OPEN SPACES

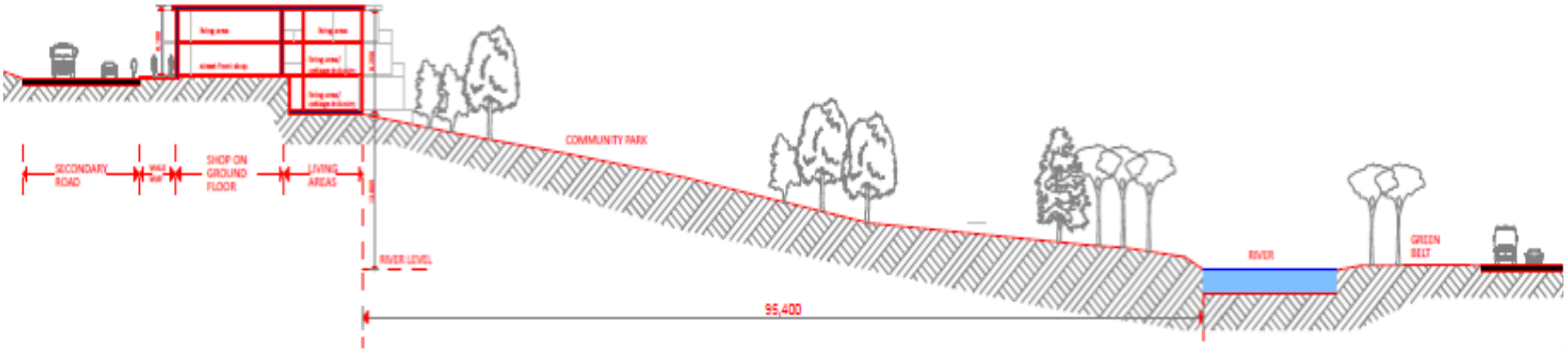




Site Plan

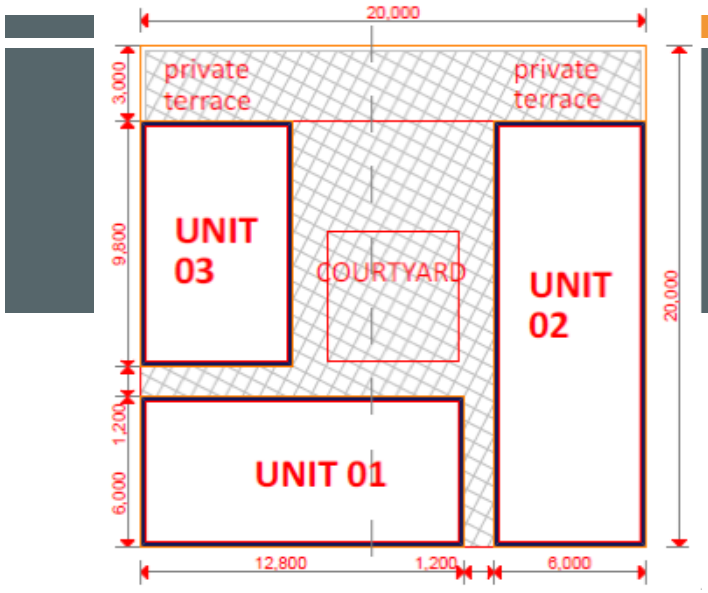


Section S3

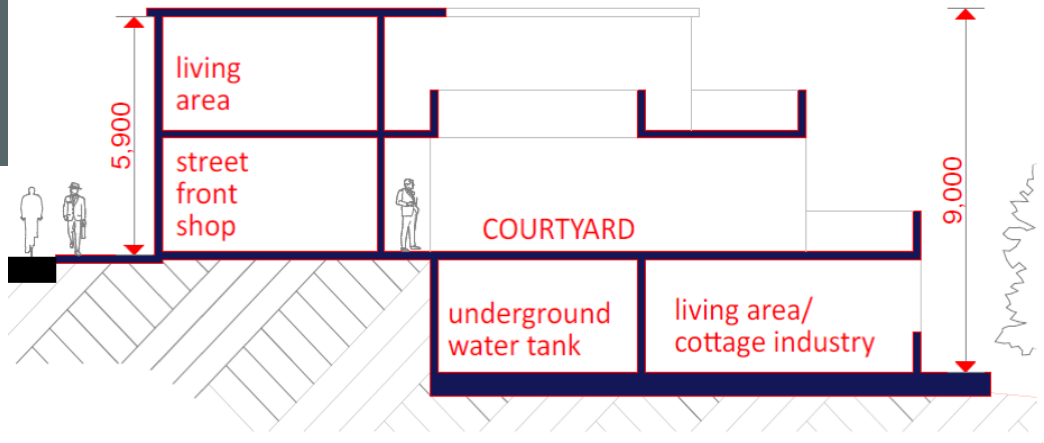


Section S4

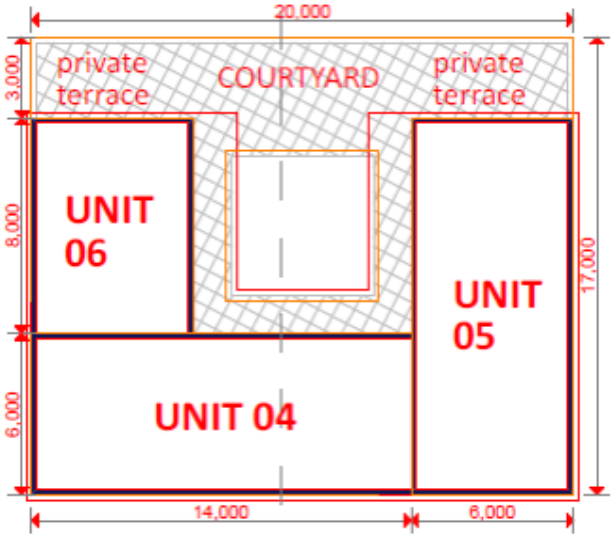
Site Sections



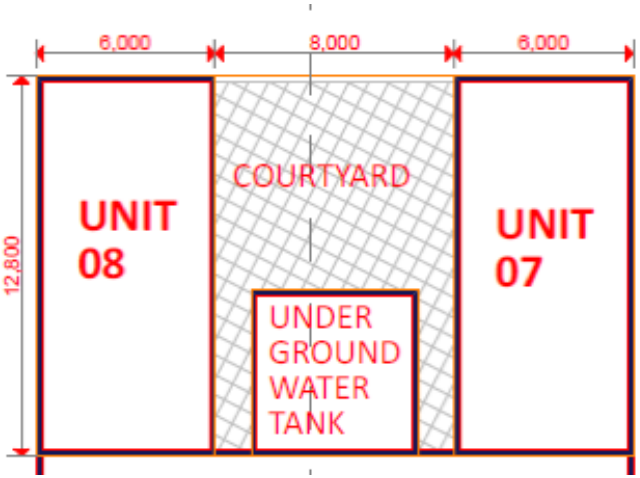
Ground floor



Typical Housing Section



First floor



Sub basement floor

Mobility

MODES OF TRANSPORT (EXISTING)

Transport Modes	Electric/Fuel
Metro Rail	Electric
Two Car Buses	Diesel
Haice	Diesel
Mini Buses	Gas & Diesel
Private Autos	Gas
Private Taxis	Gas
Bajaj Scooters	Gas
Bicycle	
Pedestrians and Animals	
Donkeys	
Horse-Carts	

To be Shifted to the Park system to reduce congestion on the existing roads

Public transport (share of total trips) [1]

Two Car bus	27%
Minibus	72%
Taxi	1%

[1] Source: http://regulationbodyofknowledge.org/wp-content/uploads/2013/03/WorldBank_Scoping_Study_Urban.pdf

SHORTCOMINGS OF THE SYSTEM

Road Congestion:

1. Lack of Lane Driving: no allotted lanes for buses, cars, pedestrians and bicyclists - Chaotic junctions
2. No defined animal paths: animal movement on the main roads slows down traffic.
3. Excessive need for mobility: People in settlements along the river need to travel large distances to reach their work places.

Use of Non-Renewable sources:

The major public transport needs are met by Big buses and the mini buses, which utilize diesel and gas - becoming the cause of pollution in the city.

Mini Buses, Source: addisfortune.net

First & Last Mile Connectivity:

For metro users, the issue of the last mile connectivity persists for the users.

PROPOSALS

Minimize the need for mobility:

1. Generation of employment opportunities close to the river settlement by beautifying the river.
2. Opportunities may include: Handicraft stalls, pottery, handloom stalls etc.

Handicraft Stalls & Pottery: azrasyed.blogspot.com

Use of Eco-Friendly Vehicles:

1. Electric bikes can be utilized for daily commute to work.
2. Makes use of the slopes in the city.
3. Charges battery while going down-hill. Utilizes charge while going up-hill

Specifications: Battery comes in 24V, 36V, 48V and 72V.
Typical Electric bikes use motor (about 200 W) and battery (36 V), which can be recharged going downhill by the motor.

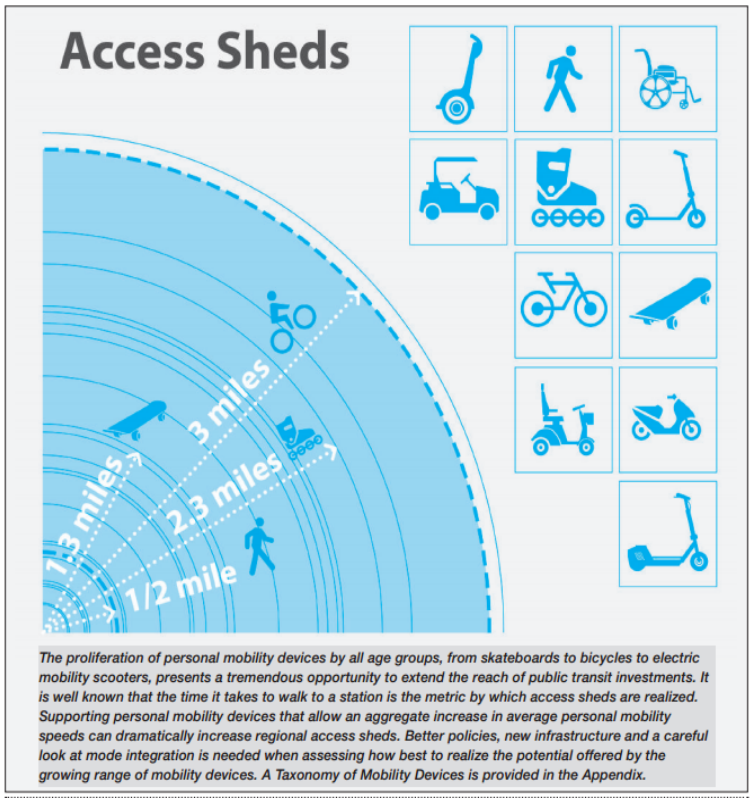
Source: http://electricbikereport.com/electric-bike-battery-basics-what-are-these-volts-amp-hours/

Electric Bikes, Source:
http://www.electric-bikes.com/bikes/specs.html

PROPOSALS: CITY

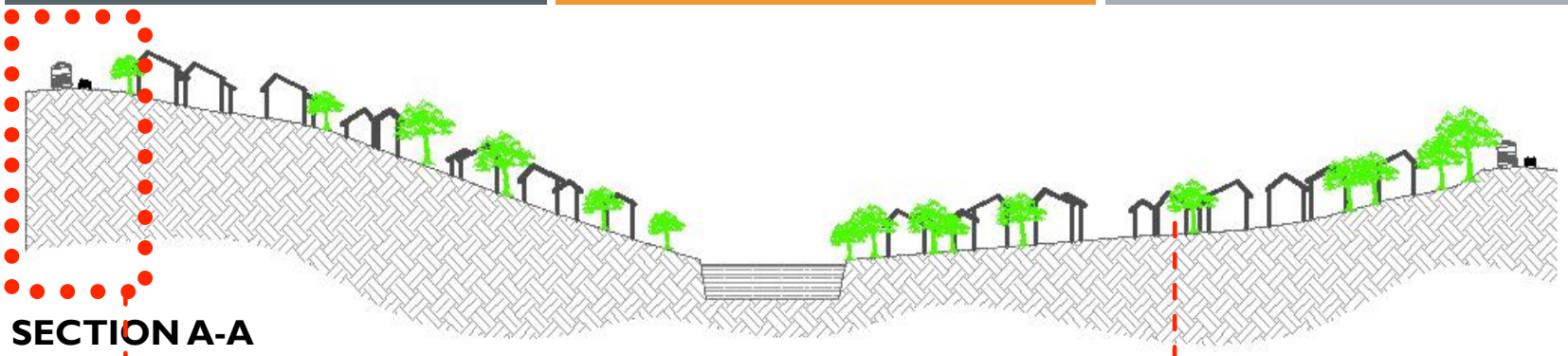
First and Last Mile Connectivity:

1. Connectivity options for trip portion between home or work to transit stations
2. This could be done by providing different transport options on rental basis at easily accessible locations close to the metro transit stations.
   - Bicycles
   - Electric Bikes
   - Bajaj Scooters
3. Easy access sheds will enable the use of these transit options.
4. Integration of existing Para-transit infrastructure



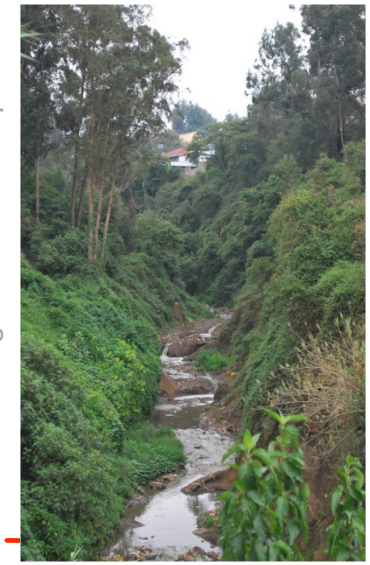
Sources: http://la.streetsblog.org/2014/05/09/metro-extends-reach-with-its-new-first-last-mile-strategic-plan/

EXISTING SITUATION ON SITE: CONCEPTUAL



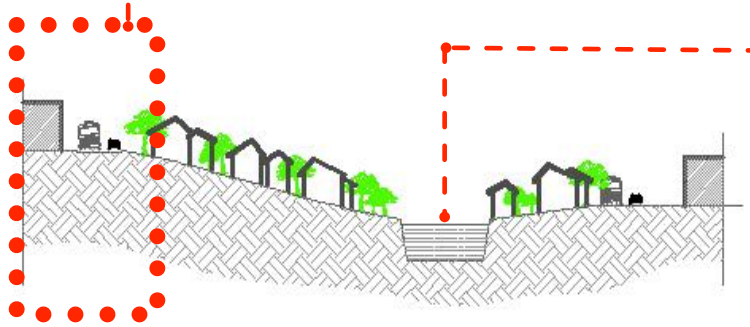
SECTION A-A

View of access roads showing existing residential development



River forming gauge like formation

Unorganized riverside housing development, mostly 2 storeys.

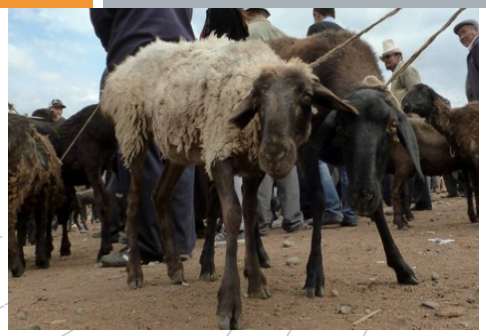


SECTION B-B

PROPOSAL: SITE

Community Gathering Space

Kindergarten



Market space

S1

S2

S1

S2

LEGEND:

Animal/ Cart Path

Vehicular Path

Pedestrian Path

Walkway around houses

N

PROPOSAL: SITE

Road Material

Animal Shelters

Community gathering area

S1

S2

S1

S2

LEGEND:

Animal/ Cart Path

Vehicular Path

Pedestrian Path

Walkway around houses

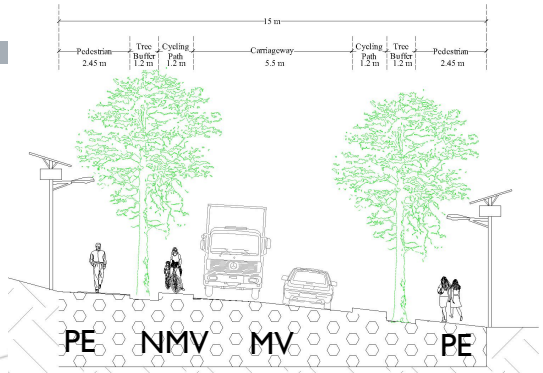
N

PROPOSAL: SITE

Pedestrian Access to the river

Pebelled Walkways around River

Pebbled Walkways around Houses



S1

S2

S1

S2

LEGEND:

Animal/ Cart Path

Vehicular Path

Pedestrian Path

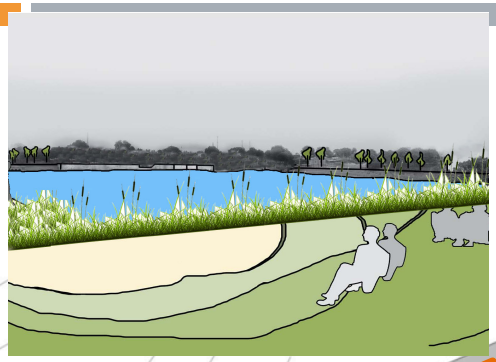
Walkway around houses

N

PROPOSAL: SITE

Greens to prevent soil erosion

Shops facing the river



Stepped seats leading to river

PROPOSAL: SITE

Conceptual Section through the river, depicting the reed beds and dotted with shops

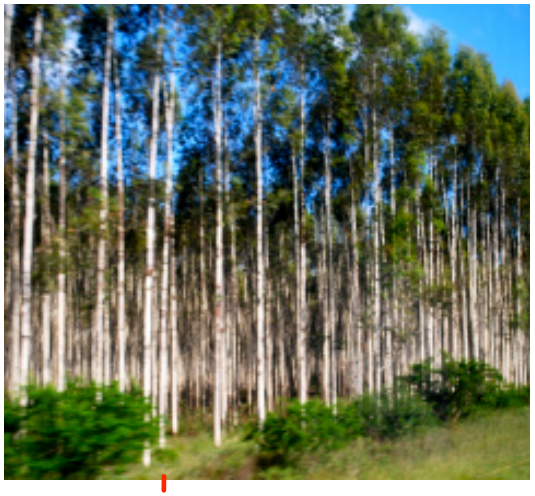
Section by Aakash Goliyan

PROPOSAL: SITE

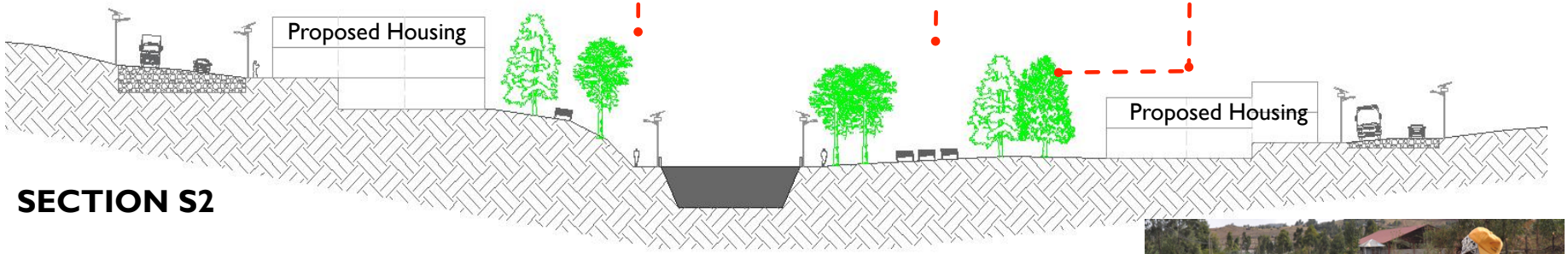
Solar powered street lights on main roads as well as bicycle and pedestrian pathways [1]

Park along the river with Bicycle and donkey pathways to ease congestion on main road [2]

Street Furniture [3]



Eucalyptus trees growing alongside the river settlement [4]



SECTION S2

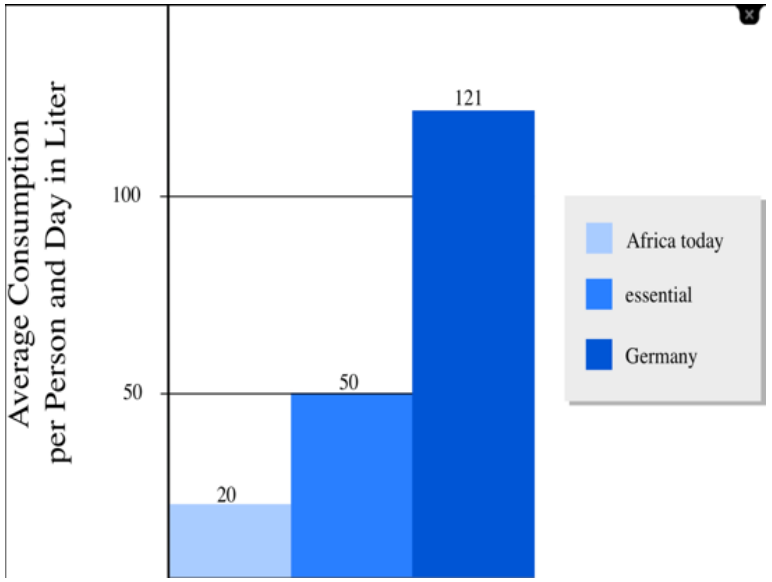
[1] http://nikkouenergy.com/portfolio/solar-led-street-lights/
[2] http://www.visitstcharles.com/visitors-sports-rec.cfm
[3] https://commons.wikimedia.org/wiki/File:Memphis_Parks_benches_Memphis_TN_004.jpg
[4] Credits: Jean Janssen
[5] Source: http://www.advancedeplc.com/portfolio/addis-ababa-city-cobblestone/

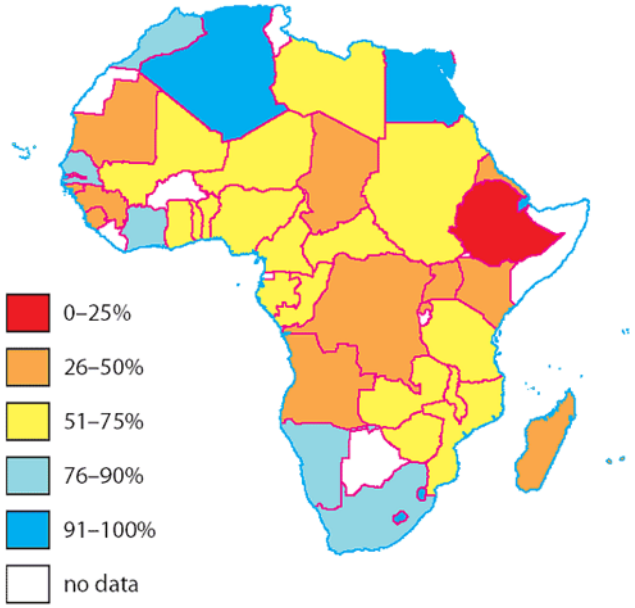
Use of local material and labour forces t, to help generate employment opportunities
Use of COBBLE STONE [5]

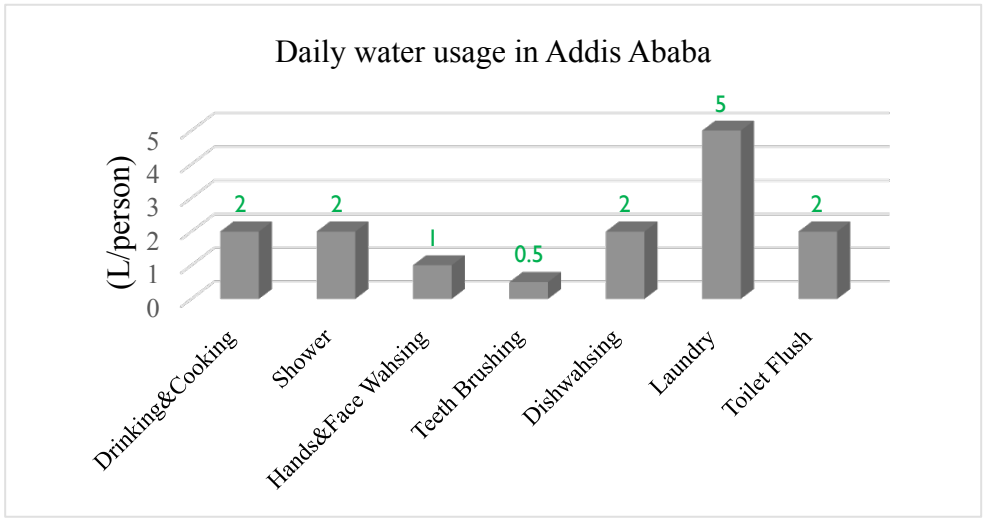
Water

WATER MANAGEMENT

WATER USE







Human being needs 50 liters of water per day to prepare meals and for personal hygiene, but many humans in Africa have to get along with 20 liters per day according to UN studies. Unfortunately, Ethiopia is the country with lowest water supply coverage rate across the continent. Studies show that the average daily water consumption in Ethiopia is 15 L/person. The situation is bad in Addis Ababa, Ethiopia's capital city. Due to river pollution and bad water treatment. Water utility is now a serious issue in Addis Ababa.

Reference: http://www.water-for-africa.org/en/water-consumption.html
http://www.unep.org/dewa/Africa/publications/AEO-1/149.htm

WATER USE

Fresh (piped)Water Supply

Reed bed along river

Pedestrian bridge

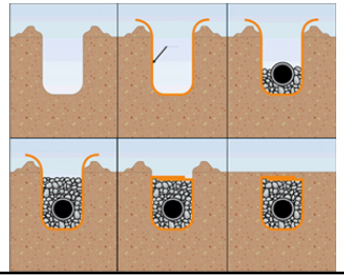
Boulevard

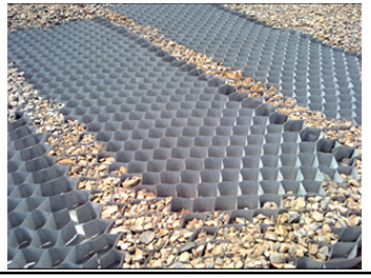
River Edge Water Management

The proposal is to filter the storm run-off water before it enters the river stream. This can be done by providing a reed bed along the river edge. A reed bed is an alternate method for sludge treatment. Reed beds have been applied for the treatment of domestic effluents in rural communities. Reed bed sewage treatment systems uses the horizontal flow type of reed bed, where the liquid flows horizontally through the bed. The wastewater moves very slowly and carefully through the mass of reed roots and can be successfully treated, in a manner somewhat similar to the conventional biological filter bed systems of sewage treatment plants.

Developed as large water harvesting zone through the use of a ground grid membrane filled with gravel that allows water percolation.

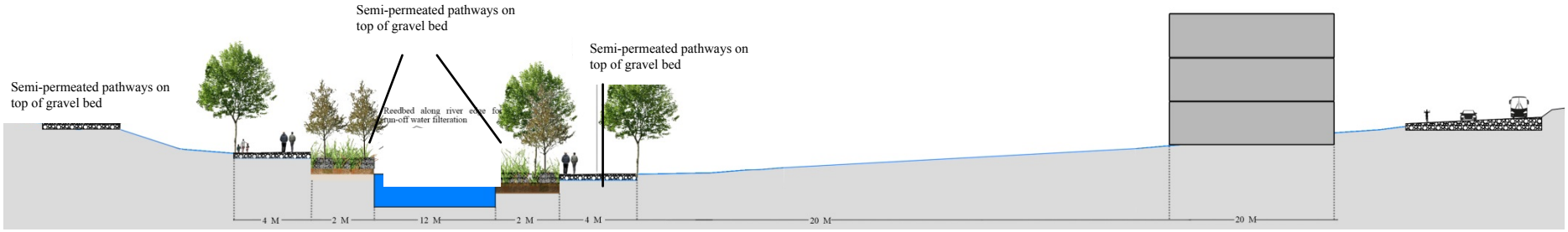
1) Excavate trench
2) Place geotextile layer
3) Place drainage material and perforated pipe
4) Cover with drainage material
5) Wrap geotextile over top
6) Compact backfill





Reference: 1)SAKA Architects (2012), Gurgaon, India.
2) http://www.lowimpactdevelopment.org/projects_recent.htm

RIVER EDGE TREATMENT



Schematic Site section – development of reed bed and boulevard along the river edge

The proposal is to develop walkways along reed beds to provide a vibrant public realm in support of new buildings that abut and face the river. These also interconnect a series of new parks along the river bed with safe and attractive bicycle and pedestrian facilities. Interconnecting bridges and breakaway decks in between have been provided for connections and public activities.

Image Reference: http://www.lowimpactdevelopment.org/projects_recent.htm

RAIN WATER HARVESTING

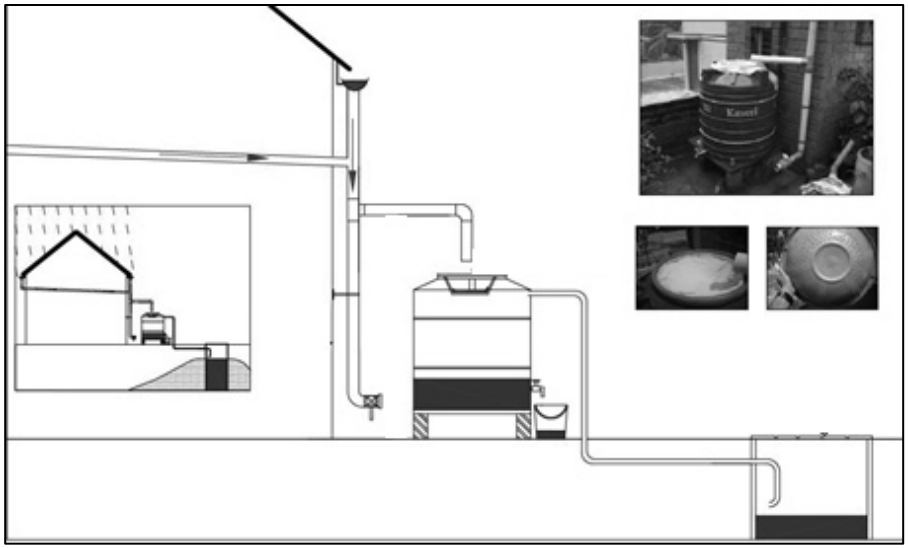
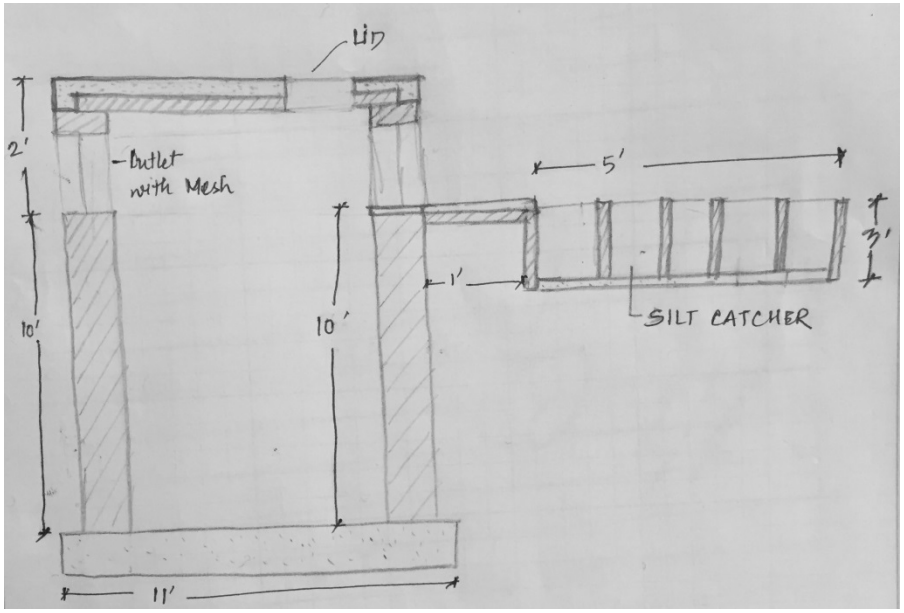


Image Reference: http://sustainabilityworkshop.autodesk.com/buildings/rainwater-harvesting
http://greywater.com
http://hardgrapevine.blogspot.com/2015/04/rain-water-harvesting.html.
http://www.sswm.info/category/implementation-tools/water-sources/hardware/precipitation-harvesting/rainwater-harvesting-u

RAIN WATER HARVESTING

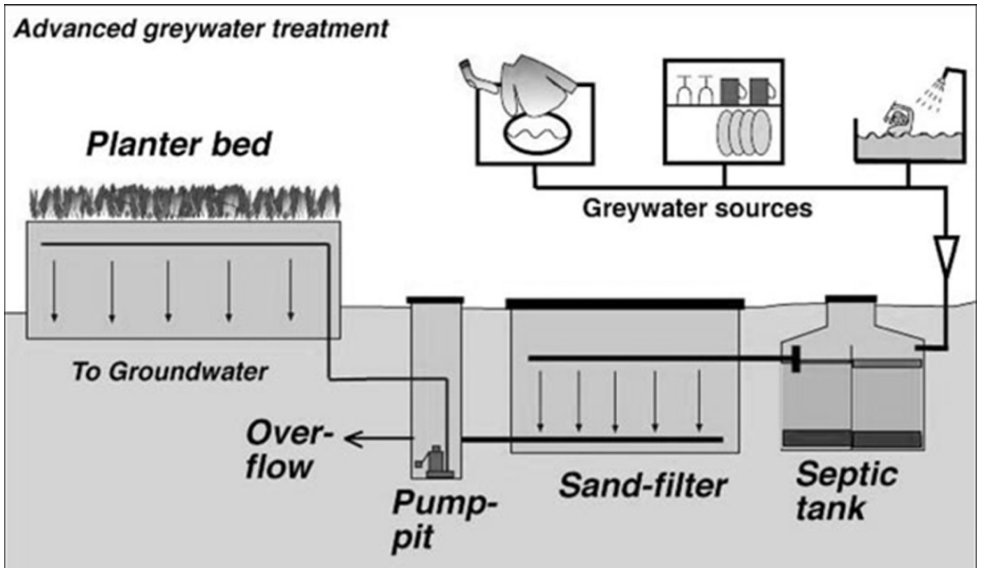


Another alternative to use rain water can be traditional storage water tanks from Rajasthan, India. It is meant to provide drinking water for a single or a small group of families and is an important element of water security in these arid regions. A cylindrical underground rainwater storage cistern usually 10' x 10' in size, wherein rainwater from rooftops, a courtyard or natural or artificially prepared catchment flows into the paved underground pit, through filtered inlets made on the external wall of the structure, where it is stored and can be used by one family during the dry season. Once fully filled, the water is sufficient for a family of 5-6 members for a period of 5–6 months, and saves it from everyday-water-fetching-drudgery.

Reference: https://suzzaneyrk.wordpress.com/2011/08/26/a-taanka-to-improve-lives.
Image Reference: https://en.wikipedia.org/wiki/Taanka.

WASTE WATER TREATMENT

Greywater utility is also a way to save fresh water. For each or several houses, there is a greywater system. Typical greywater sources includes laundry water, dish washing water and shower water. Greywater can be treated by sedimentation and filtration. And treated greywater can be used for agriculture, cleaning and toilet flushing.



House hold grey water treatment

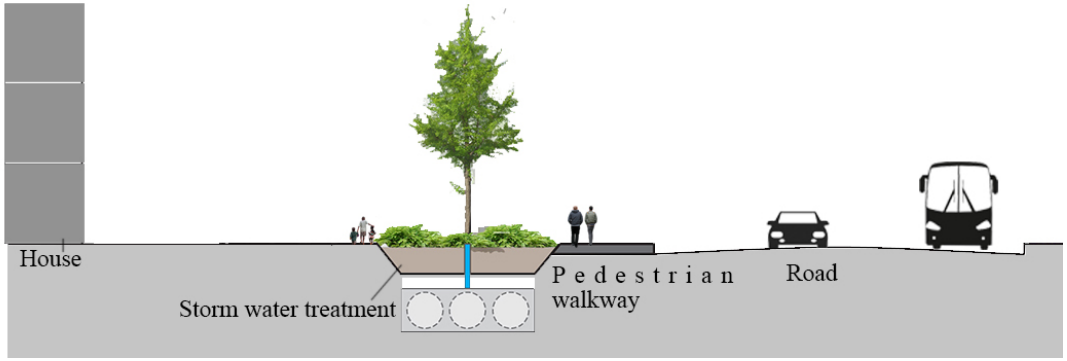
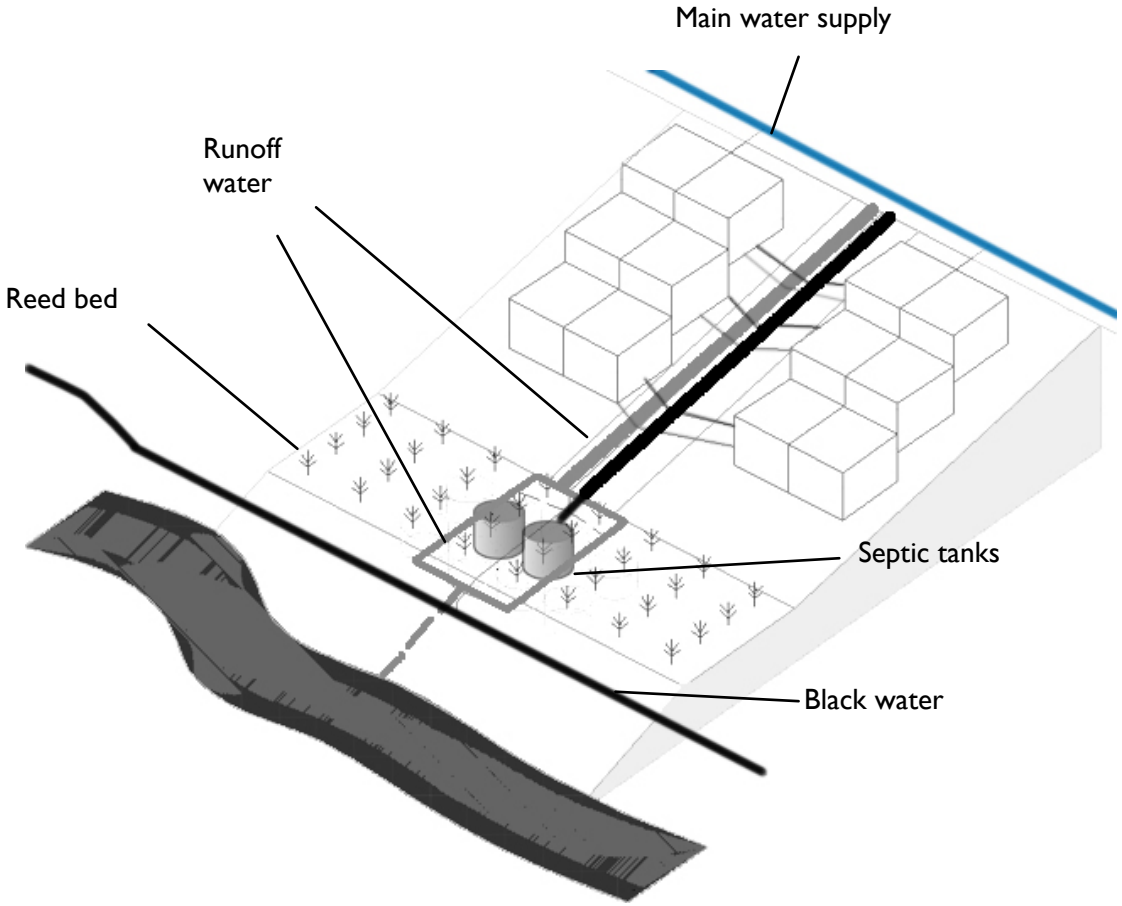


Image Reference: http://www.lowimpactdevelopment.org/projects_recent.htm

WASTE WATER TREATMENT



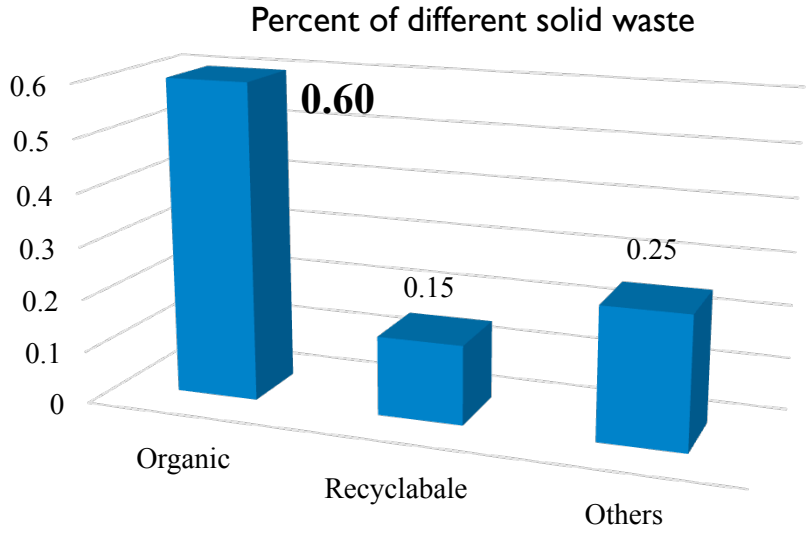
The figure shows three different systems in the community. The first one is fresh water supply system, which supply fresh water to each house. The second one is runoff water system, in which runoff water be guided and filtered by riverside reed bed and then runs into river. The third system is waste water system. Pipes collecting waste water from each house lead to septic tanks at a lower level of the slope. And primarily treated waste water runs into a main black water pipe and then runs to city centralized water treatment facilities.

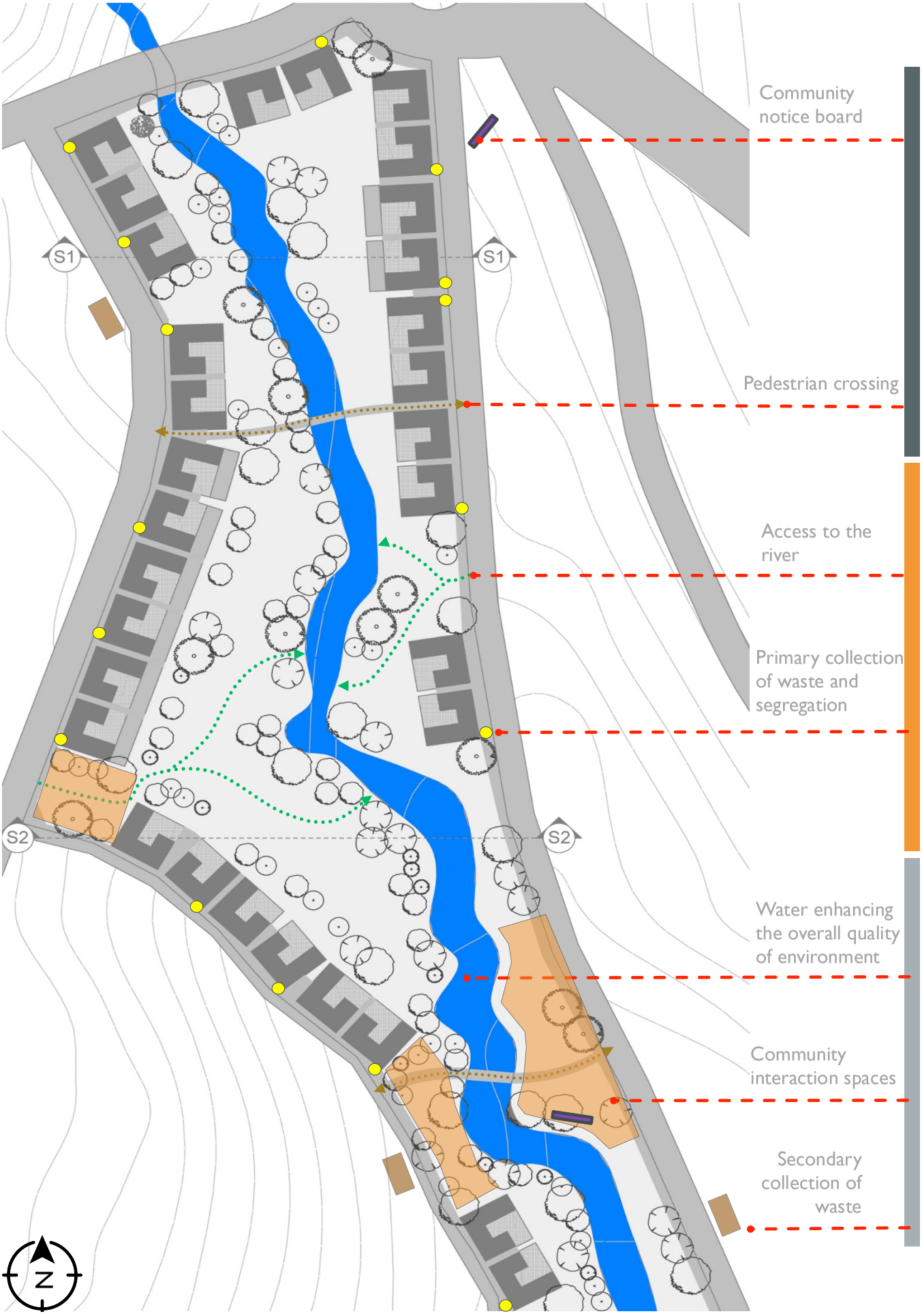
Energy

Table 1 - Estimate of solid waste generation

Gulele	Metric	Values
Location	North of Addis Ababa	
Population		300000
Generation rate per capita	kg/c/day	0.4
Total waste	t/day	**120**
Percent of different waste sources	households	76%
	institutions, commercial, factories, hotels	18%
	street sweeping	6%

Based on cradle to cradle perspective, waste is not just waste. We can make the most of it with **solid waste management (SWM)** as well as "**waste into energy**" strategy.




S1
S1
S2
S2
Community notice board
Pedestrian crossing
Access to the river
Primary collection of waste and segregation
Water enhancing the overall quality of environment
Community interaction spaces
Secondary collection of waste
N

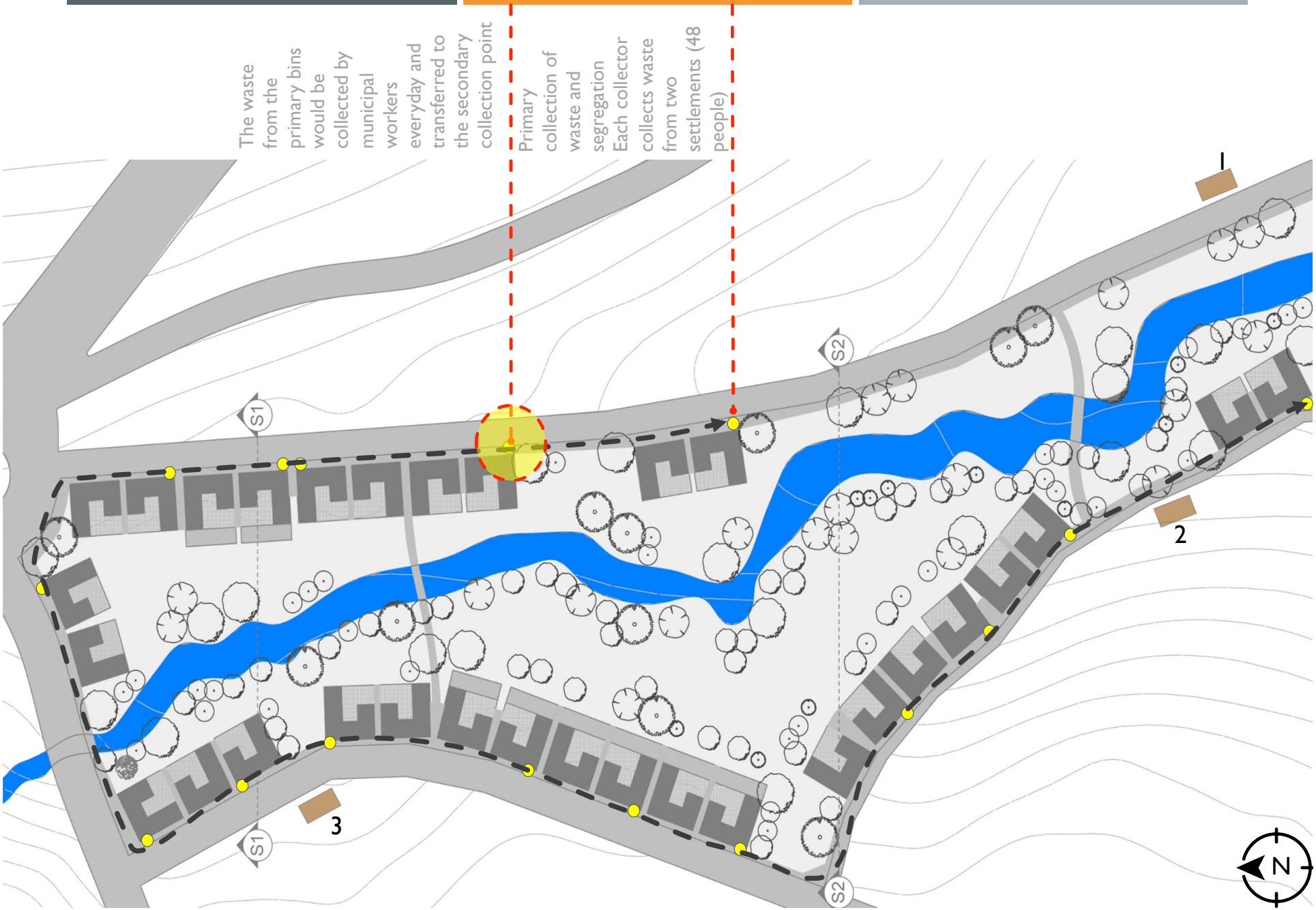
SOLID WASTE MANAGEMENT (SWM)

- Household separation-
  - Categories
  - organic waste
  - recyclable waste
  - Batteries, Electronic waste
- Settlement level
- Community level

https://www.coorong.sa.gov.au/binuse

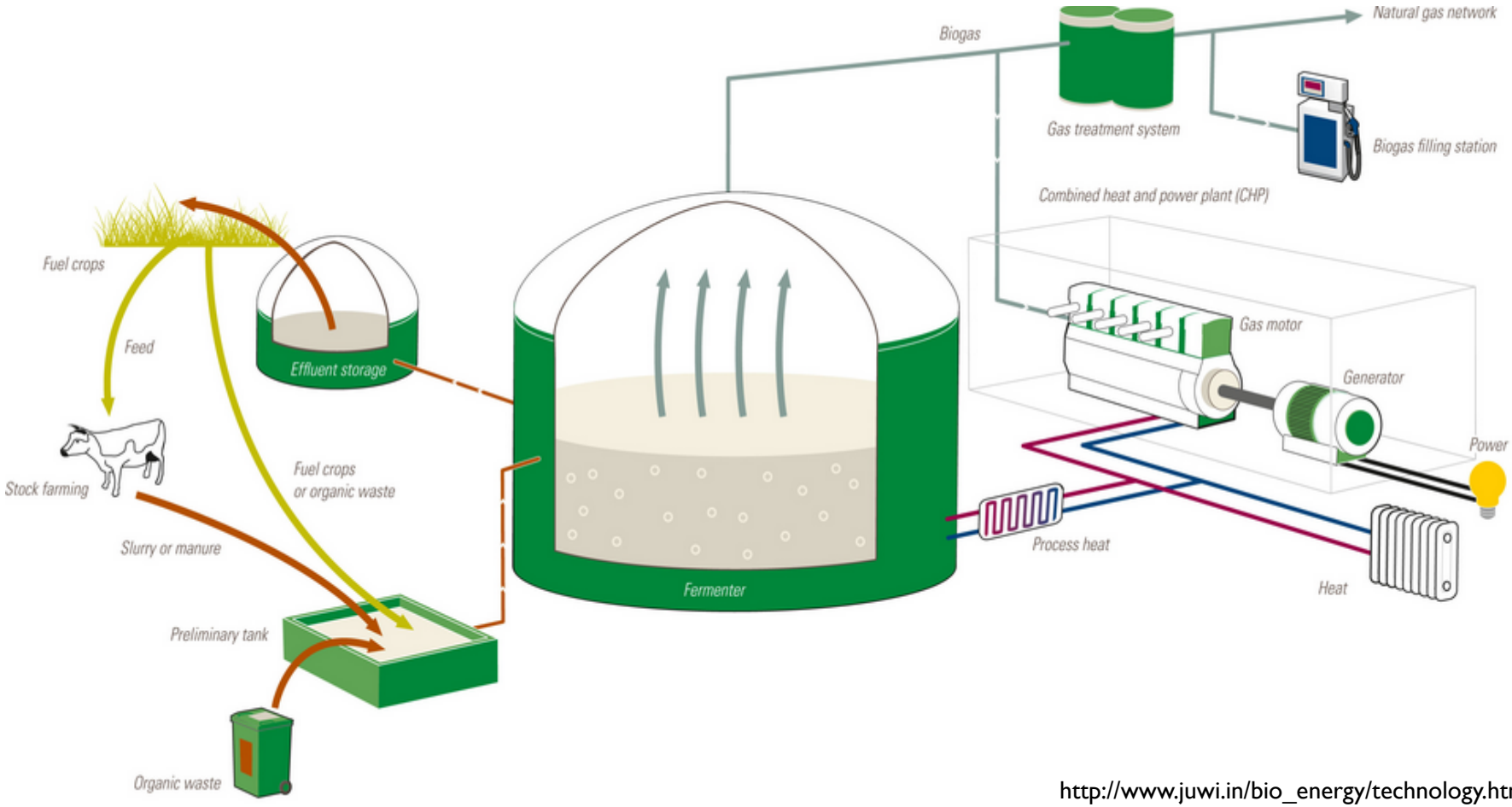
http://green-mom.com/recycling-101-sweden/#.Vi1kXH6rS00

SETTLEMENT LEVEL



COMMUNITY LEVEL

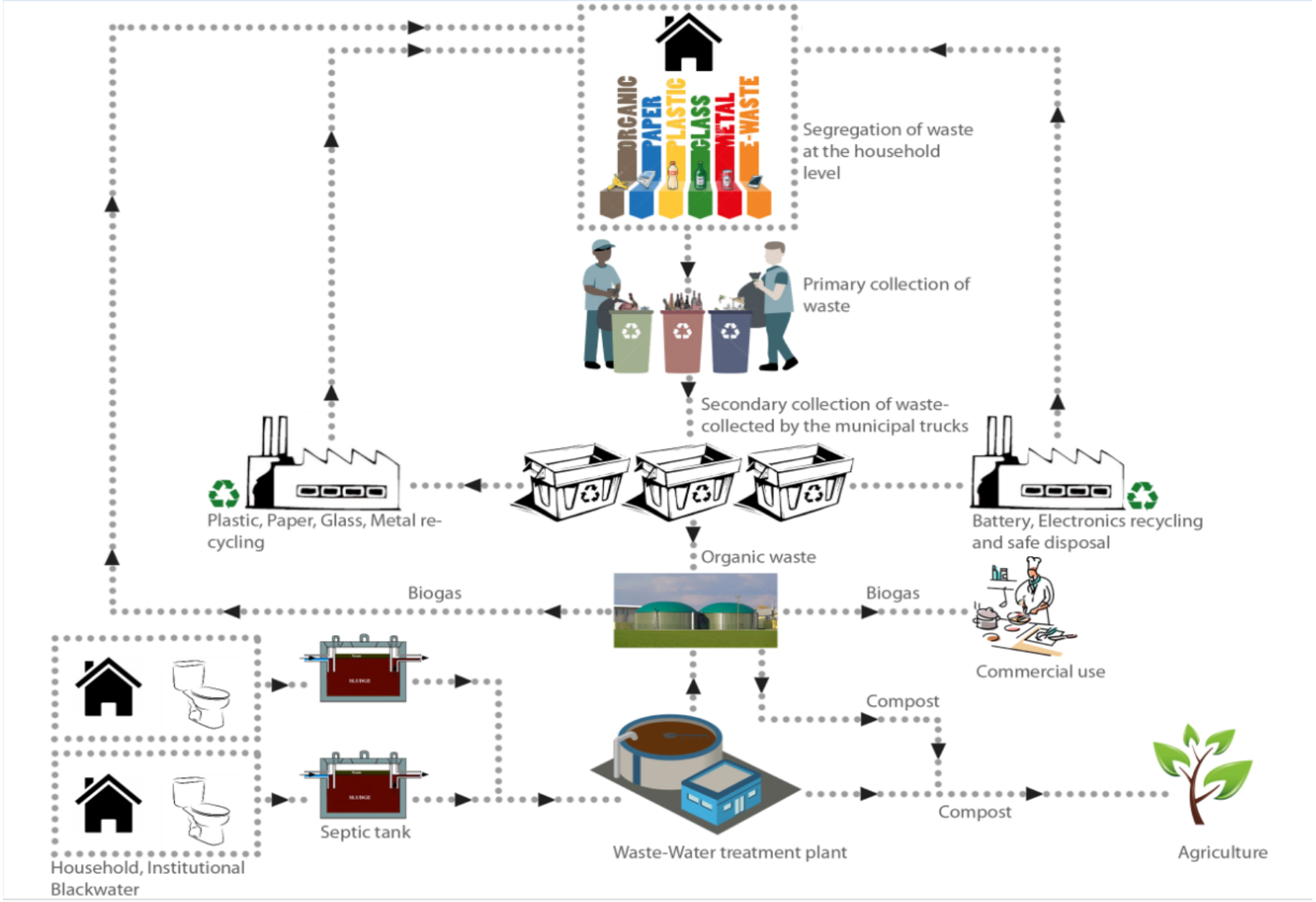
BIOGAS PLANT



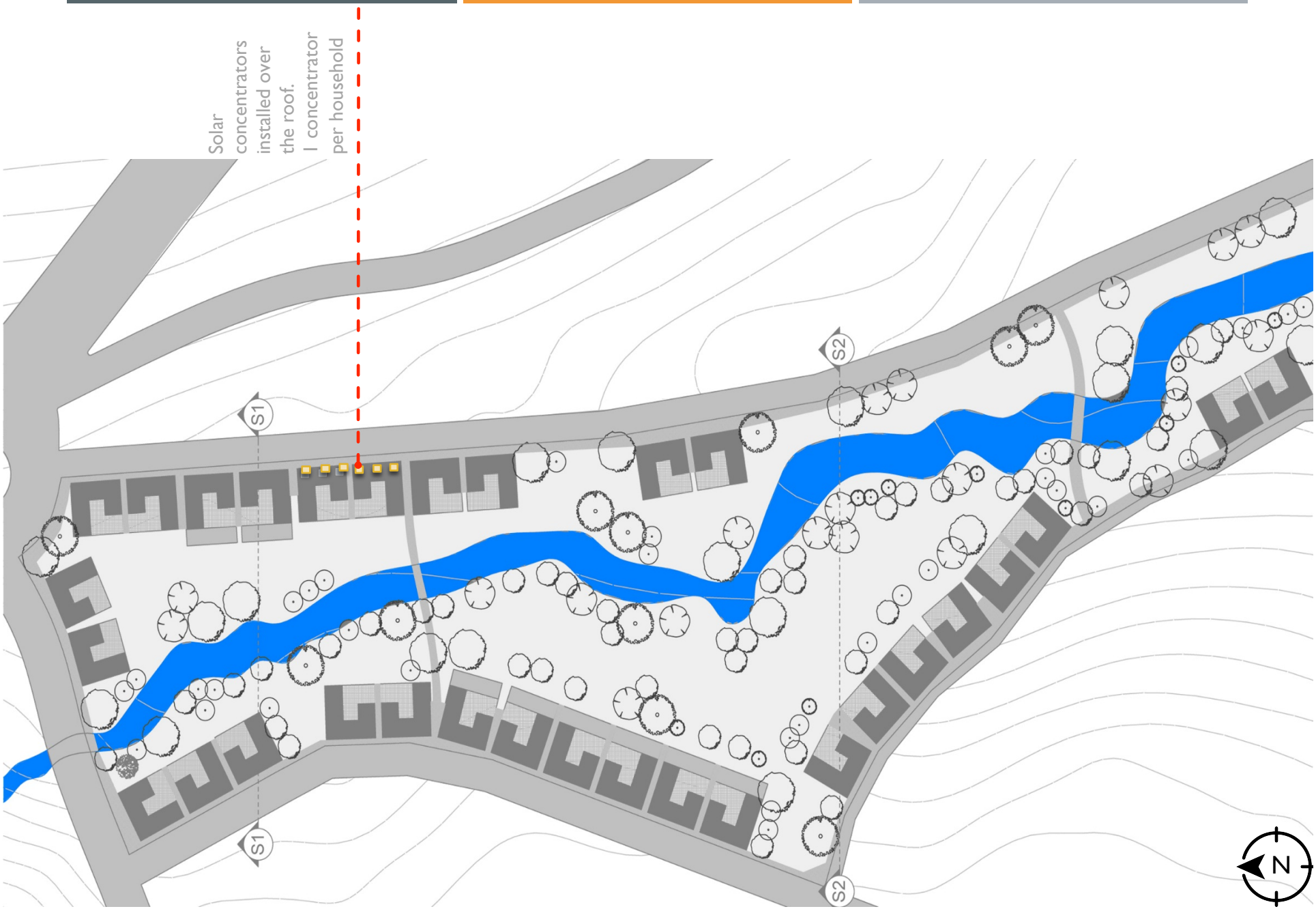
http://www.juwi.in/bio_energy/technology.html

- In order to avoid pollution from the waste, the biogas plant shall not be built close to the river.
- The plant shall be located at the lower level than the river.
- If the available biomass is mostly agricultural slurry, the maximum radius of supply should be less than 5km.
- The demand of biogas in the community is 1.55 m^3/day.

WASTE MANAGEMENT



SOLAR CONCENTRATOR



Solar concentrator – Barefoot college, Tilonia, Rajasthan, India

Clock attached to the Solar Concentrator

Solar Concentrator made by the people themselves

Advantages

- Inexpensive
- Developed and assembled by the people
- Mobile
- Changes direction with the sun

Disadvantages

- Requires some training
- Efficiency is less
- Not as precise as the concentrators developed at the industrial level

INTEGRATED PLAN OF SITE