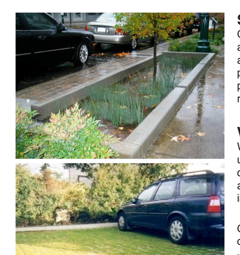
WATER



Sustainable storm water
Conventional water resource engineering practices directed at collection, conveyance, and temporary storage of stormwater runoff generally exacerbate downstream flooding, water quality degradation, habitat loss, and systems stability due to cumulative volume and velocity of discharge flows. In contrast, sustainable approaches to site and regional water resource management strive to treat water as a resource not a waste product. Practices that address both the quantity and quality of run-off include bioretention, greenroofs, porous pavement, rainwater harvesting and reuse, and native landscaping.

Waste water
Waste water treatment is a complex milieu of environment, politics, culture, and science. It is important to understand the impact that waste can have on human health as well as the benefits that waste can have if dealt with properly. Treating waste on site can provide fertilizer and nutrient rich effluent for urban agriculture as well as non-potable water for irrigation. In some cases it is possible to treat waste water for discharge back into the ground water source.

One example of positive waste water treatment is the Eco Machine. This system consists of the following components:

- Collection and Distribution
- Pretreatment and equalization
- Constructed wetlands
- Eco Machine Aquatic Cells

Waste water and agriculture
Wastewater is a resource of increasing global importance, particularly in urban and peri-urban agriculture. Wastewater is used for crop production, as well as for aquaculture and is often the only source of irrigation available. Wastewater use for irrigation generates livelihoods for farmers, agricultural labourers, produce transporters, market brokers and produce vendors. Consumers also benefit by obtaining access to fresh and cheap produce due to low transportation costs. **To prevent potential negative impacts on human health and the environment, the importance of wastewater reuse in urban and peri-urban agriculture has to be recognized** and clear policy guidelines for reuse need to be established.

The Right to Water
Water has not received the attention it deserves as a public good which is essential for life. There are increasing and conflicting demands on its use, which are compounded by the fact that water resources are being polluted or badly managed, causing a further depletion of safe water sources. Water has been established as a public or common good, but its role as an economic good often overrides this.

The usefulness of water in its various functions is evident. And **with the exponential demand of water for its various uses, freshwater has become a rare asset, which accentuates its role as an economic good.**

Treating water as a purely economic good implies that its various functions are considered as interchangeable values that can, therefore, be measured in monetary terms. However, the values linked to water are often complementary and, thus, cannot be replaced by money. For instance, the fundamental values of life, which are essential for dignified living conditions by people or communities are linked intrin trinsically to the values of preservation of the environment and aquatic ecosystems; the values of intra- and inter-generational equity or the values of social cohesion that water-distribution services bring. The value of these functions should not be administrated according to market rules, since they cannot be measured in monetary terms.

The different functions and values of water can be divided in three complementary levels:

- Water for life concerns providing water for the survival of both human beings (individual and collective) and other living beings. This must be recognized as the highest priority in order to guarantee the sustainability of ecosystems so that access for as regards public health or the promotion of values of equity or social cohesion, must be ranked at the second level of priority, in connection with all to a minimum quantity of good quality water is recognized as one of the human rights.
- Water for citizens concerns providing water for general interest purposes, as regards public health or the promotion of values of equity or social cohesion, must be ranked at the second level of priority, in connection with citizen's social rights and in the general interest of society as a whole. This is the role of public institutions.
- Water for development is an economic function relating to production activities which in general concerns private interests like irrigation for agriculture, hydroelectricity, or industry and should occupy the third level of priority. This function consumes the largest part of all water resources from rivers and aquifers and is, therefore, largely responsible for the problems of scarcity and pollution arising in the world. This production-based demand must be managed in accordance with economic efficiency, social equity and environmental sustainability.

source: World Water Council: The Right to Water

HEALTH

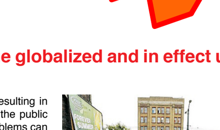
Social benefits of vertical urban agriculture
Eliminating a significant percentage of land dedicated to traditional farming has obvious health advantages regarding the restoration of ecosystem services, and for the immediate improvement of biodiversity by simultaneously restoring ecosystem functions, as well. The social benefits of urban agriculture promise an equally rewarding set of achievable goals. However, since the vertical farm is still a theoretical construct, it is difficult to predict all of the potential benefits that may arise from producing food in this manner. The first is the establishment of sustainability as an ethic for human behavior. At present, there are no examples of a totally sustained urban community anywhere in the world. The development of this keystone ecological concept has remained identified solely with the natural world, and specifically with reference to the functioning of ecosystems. Ecological observations and studies, beginning with those of Teal, show how life behaves with regards to the sharing of limited energy resources. Tight knit assemblages of plants and animals evolve into trophic relationships that allow for the seamless flow of ...

Transforming asphalt fields into an industrial agriculture community

RESEED

FOOD

The traditional industrial agriculture model has become globalized and in effect unsustainible.



Fresh produce now travels up to 1,500 miles in order to be stocked in local grocery stores, resulting in reduced quality and an increase of pesticides and preservatives. Good quality food is vital to the public health, economic vitality and sustainability of urban and suburban communities. Many health problems can be linked to dietary patterns and the methods of food production. These problems include cancer, diabetes, hypertension and, the biggest of all, obesity.

The Solution: Urban Agriculture
The economic impacts of community-based food systems include the creation of jobs and self-sustaining markets. Environmental benefits include less energy use, cleaner air and water, remediated water, and the ability to greatly reduce stormwater run-off.

One of the biggest factors in the importance of urban agriculture is the impact that it has on the local community. Community benefits include food security, better health, neighborhood beautification, interaction on the public level, and greater connections and understanding between the people and the earth. Communities thrive when people are empowered to grow their own food.

Source: "Sustainable Urbanism"

What is urban agriculture?
Urban agriculture can be defined shortly as the growing of plants and the raising of animals within and around cities. The most striking feature of urban agriculture, which distinguishes it from rural agriculture, is that it is integrated into the urban economic and ecological system: **urban agriculture is embedded in -and interacting with- the urban ecosystem.** Such linkages include the use of urban residents as labourers, use of typical urban resources (like organic waste as compost and urban wastewater for irrigation), direct links with urban consumers, direct impacts on urban ecology (positive and negative), being part of the urban food system, competing for land with other urban functions, being influenced by urban policies and plans, etc. Urban agriculture is not a relict of the past that will fade away (urban agriculture increases when the city grows) nor brought to the city by rural immigrants that will loose their rural habits over time. It is an integral part of the urban system.

Urban Agriculture: Urban Ecology
Urban agriculture is part of the urban ecological system and can play an important role in the urban environmental management system.

Firstly, a growing city will produce more and more wastewater and organic wastes. **For most cities the disposal of wastes has become a serious problem. Urban agriculture can help to solve such problems by turning urban wastes into a productive resource.**

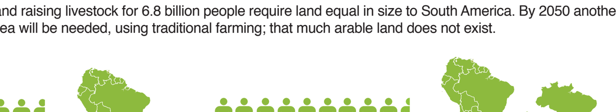
In many cities, local or municipal initiatives exist to collect household waste and organic refuse from vegetable markets and agro-industries in order to produce compost or animal feed, but one can also find urban farmers who use fresh organic waste (which may cause environmental and health problems). Quality compost is an important input that can fetch a good price, as the example from Tanzania shows. Compost allows an urban farmer to use less chemical fertilizers and by doing so preventing problems related to the contamination of groundwater. In addition, compost-making initiatives create employment and provide income for the urban poor.

Farmers may use wastewater for irrigating their farms when they lack access to other sources of water or because of its high price. The use of fresh (untreated) wastewater has the additional advantage for poor urban farmers that it contains a lot of nutrients (although often not in the proportions required by their soils and crops). However, without proper guidance, the use of wastewater may lead to health and environmental problems. Farmers need to be trained in self- protection during handling of the wastewater, proper crop selection and adequate irrigation methods, among other things. Technologies such as hydroponics or organoponics, drip irrigation, zero tillage etc. substantially reduce water needs and health risks and are very interesting for the urban environment and can indeed be found in many cities.

WHY VERTICAL INDUSTRIAL AGRICULTURE?

THE PROBLEMS WITH TRADITIONAL AGRICULTURE

Growing food and raising livestock for 6.8 billion people require land equal in size to South America. By 2050 another Brazil's worth of area will be needed, using traditional farming; that much arable land does not exist.



MY SOLUTION
Integrate industrial urban agriculture into third ring retail and business center retrofit or renovation projects. Not only does this form of agricultural production provide the food required to feed the community, it also has the ability to recycle the communities grey water, compost waste from adjacent buildings and provide renewable energy through photovaltaics or methane burning.

WHO WILL IT SERVE?
In order for this type of agriculture to be successful, it has to focus on the immediate needs of the community. **This project is based on the amount of food that is required to provide the community, within a one mile radius, with all of the food that they will consume in one year based on 2200 calories a day.** This includes all of the vegetables, protein, fiber and starch that is recommended by the US FDA.

TOTAL ESTIMATED ON SITE POPULATION BASED ON PROPSED SITE DESIGN: 2,250 PEOPLE
TOTAL ESTIMATED POLPULATION WITHIN A ONE MILE RADIUS OF THE SITE: 9,290 PEOPLE
TOTAL POPULATION THAT THIS FARM HAS TO SERVE: 11,540 PEOPLE/YEAR

Based on some very complicated calculations dealing with nutritional values of different vegetables and the amount meat that one tilapia yeilds, the following is the breakdown of the agriculture program requirements

VERTICAL FARM PROGRAM CALCULATIONS

Veg/Fruit	Tons/Yr (10,000 people)	Hydroponics (tons/ hectare)/ year	HA/Yr	Square feet/ Yr	Small Back Bldg. Floors (12.5K ft²)	Small Back Bldg. Floors (3 layers/fl)	Large front Bldg. Floors (35K ft²)	Large front Bldg. Floors (3 layers/fl)	Small front Bldg. Floors (16.5K ft²)	Small front Bldg. Floors (3 layers/fl)
Lettuce	200	827	0.24	25,833					1.57	0.52
Cucumber	182	912	0.20	21,528					1.30	0.43
Eggplant	299	272	1.10	118,403					7.18	2.39
Peppers	273	657	0.42	45,208					2.74	0.91
Carrots	468	1355	0.35	37,674					2.28	0.76
Spinach	657	119	5.52	594,168			16.98	5.66		
Soybean	657	150	4.38	471,459			13.47	4.49		
Green peas	529	537	0.99	106,563					6.46	2.15
Tomatoes	547	750	0.73	78,575					4.76	1.59
Subtotal veg-fruit	**3812**		**13.92**	**1,499,411**	**0.00**	**0.00**	**30.45**	**10.15**	**26.29**	**8.76**
Chicken broilers				339,000	27.12	9.04				
Chicken layers				19,240	1.54	0.51				
Wheat				146,000	11.68	3.89				
Potatoes				86,667	6.93	2.31				
Subtotal chick-starch				**590,907**	**47.27**	**15.76**				
Tilapia				**13,680**	**1.09**	**1.09**				
			m^3	ft^3	Floors	Floors	Floors	Floors	Floors	Floors
Waste Management										
TOTAL					**48.37**	**16.85**	**30.45**	**10.15**	**26.29**	**8.76**

WHAT TECHNOLOGIES WILL BE USED?
Drip Irrigation: Plants grow in troughs of lightweight, inert material, such as vermiculite, reused for years. Small tubing on the surface drips nutrient-laden water precisely at each stem's base. Good for grains (wheat, corn).

Hydroponics: Plants are held in place so their roots lie in open troughs; water with dissolved nutrients is continually circulated over them. Good for many vegetables (tomatoes, spinach) and berries.

PROJECT LOCATION

EXISTING SITE CONDITIONS

Transforming asphalt fields into an industrial agriculture community

RESEED

A DESIGN PROPOSAL BY RYAN C. HORNE

Traditional suburban development models are no longer viable for our growing population and declining natural environment. Action must be taken to retrofit existing suburban neighborhoods, retail and business centers into self sustainable community advancement centers. I propose a retrofit model that places industrial urban agriculture at the core of the community, providing for the improvement of public health, a focus on water/energy conservation and the empowerment of a community to build a strong foundation for future generations.

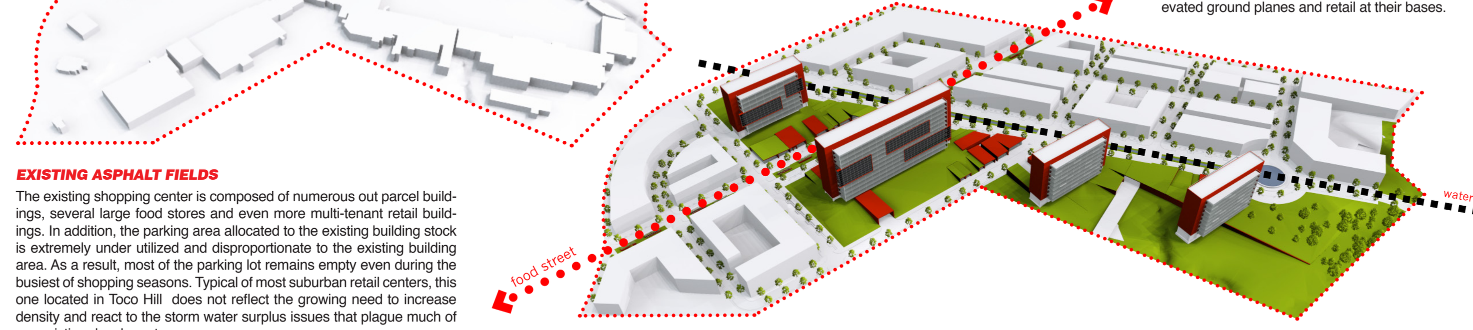
COMMUNITY DIAGRAM
The industrial agriculture towers bind the community together by providing vegetated ground plane at their base integrated with retail and open to the community.

STARTELING DATA
1 indoor acre is equivalent to 4-6 outdoor acres or more, depending upon the crop (e.g., strawberries: 1 indoor acre = 30 outdoor acres).

4.4 billion acres were used for cropland production in 2000, 70% of which were used solely for domestic production (23,15). While the population of the U.S. increases by an average by 5,000 each day, the amount of agricultural viable land decreases by 15,000 acres.

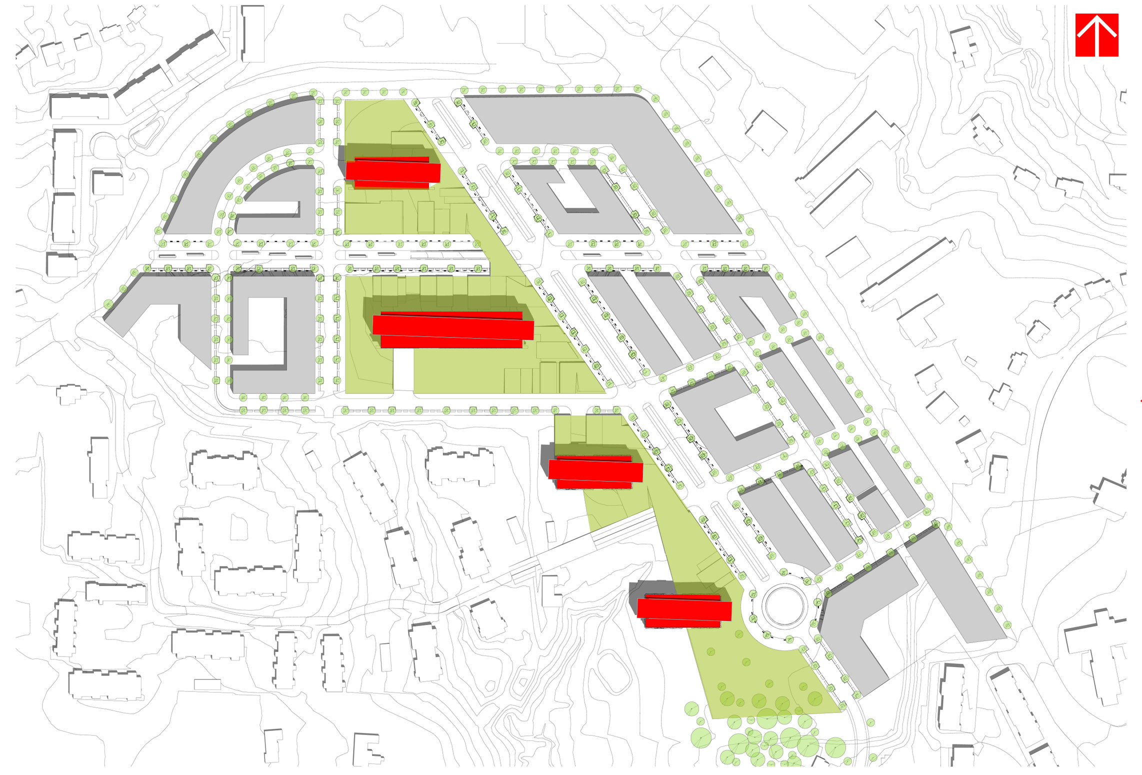
30 stories (approximately 3 million square feet) could provide enough calories (2,000 cal/day/person) to comfortably accommodate the needs of 50,000 people

DESIGN INTERVENTION
The obvious solution to the problems at this shopping center was the insertion of a lot and block system in order to define the boundaries for the proposed change in density. Mixed use buildings will occupy the peremeter of the site leaving the central zone to the agriculture towers with elevated ground planes and retail at their bases.



EXISTING ASPHALT FIELDS
The existing shopping center is composed of numerous out parcel buildings, several large food stores and even more multi-tenant retail buildings. In addition, the parking area allocated to the existing building stock is extremely under utilized and disproportionate to the existing building area. As a result, most of the parking lot remains empty even during the busiest of shopping seasons. Typical of most suburban retail centers, this one located in Toco Hill does not reflect the growing need to increase density and react to the storm water surplus issues that plague much of our existing developents.

SITE PLAN



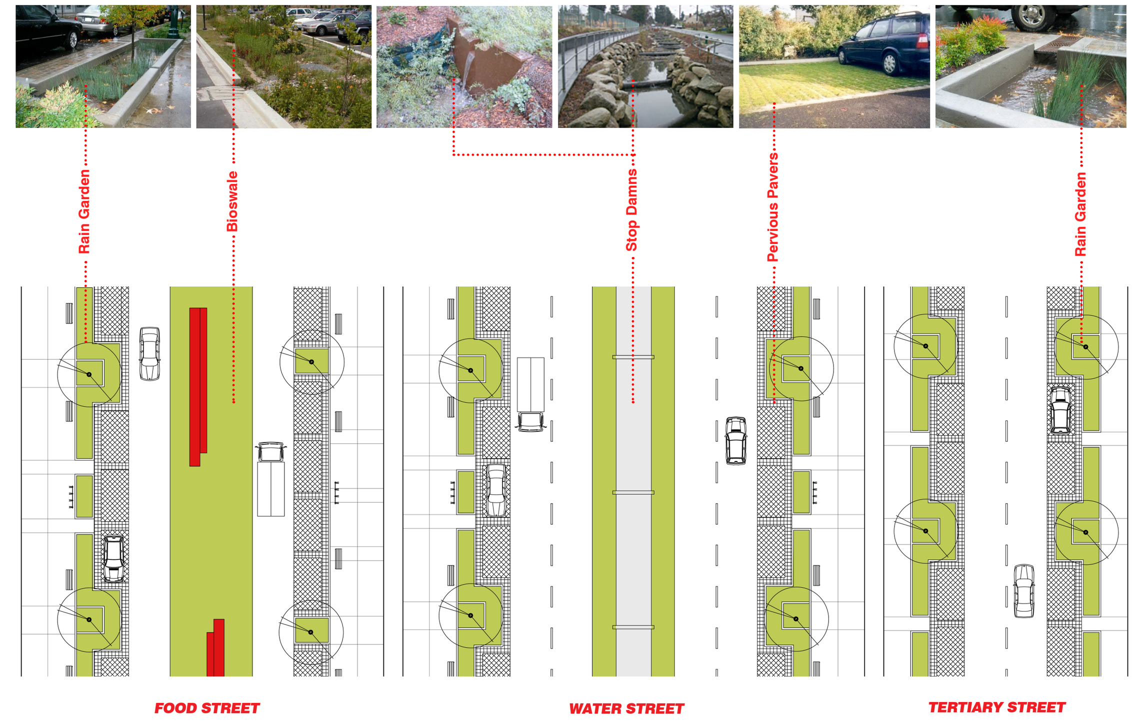
MASTER STREET PLAN
In order to provide for a development structure with the potential for large variation in building size and use as well as unique conditions for interaction, a Master Street Plan was conceptualized. Organized primarily to reduce storm water run-off, the Plan utilizes many of the existing site access points while inserting two major boulevards, The Food Street and the Water Street, each with its own unique function. All of the streets are organized to focus attention on the four industrial agriculture towers situated within a large swath of public open space.

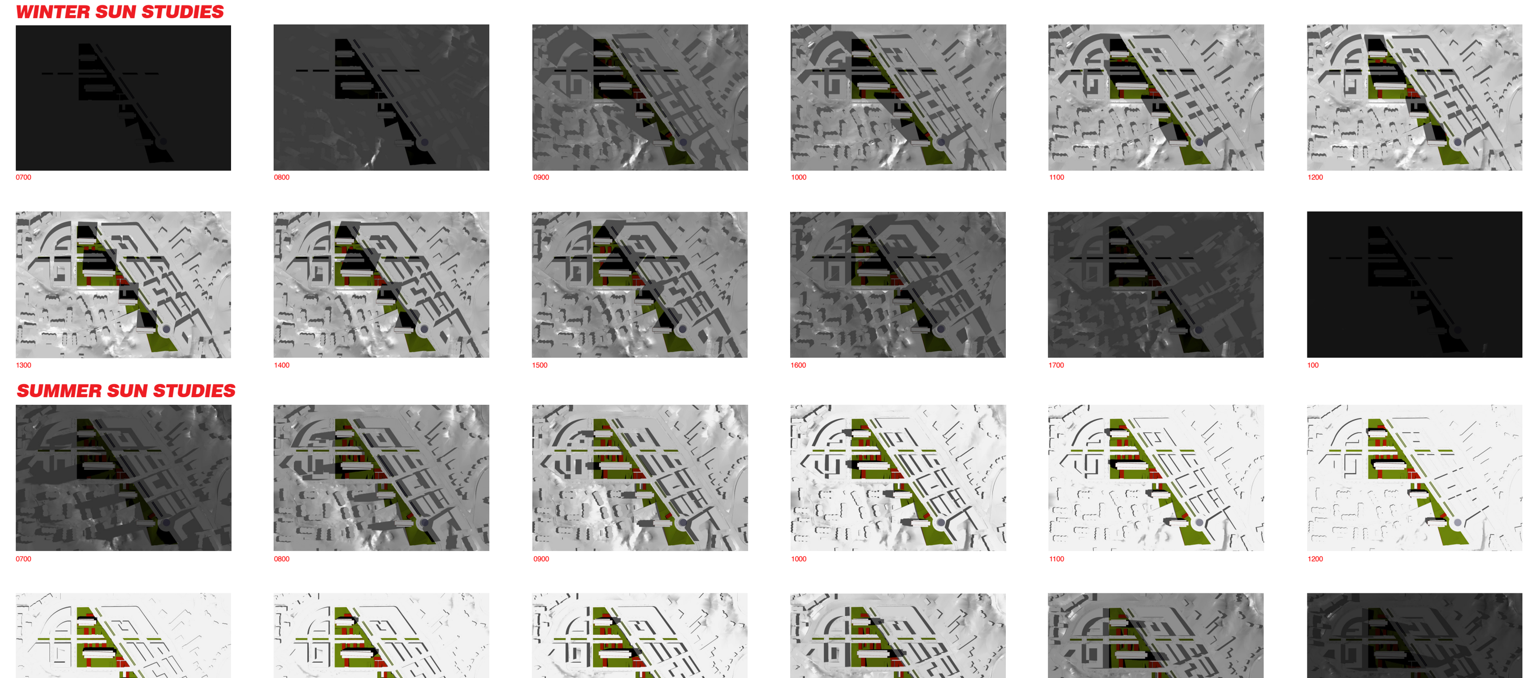
All streets are lined with tree species that produce fruit in an attempt to bridge the gap between the sites industrial use and the surrounding community.

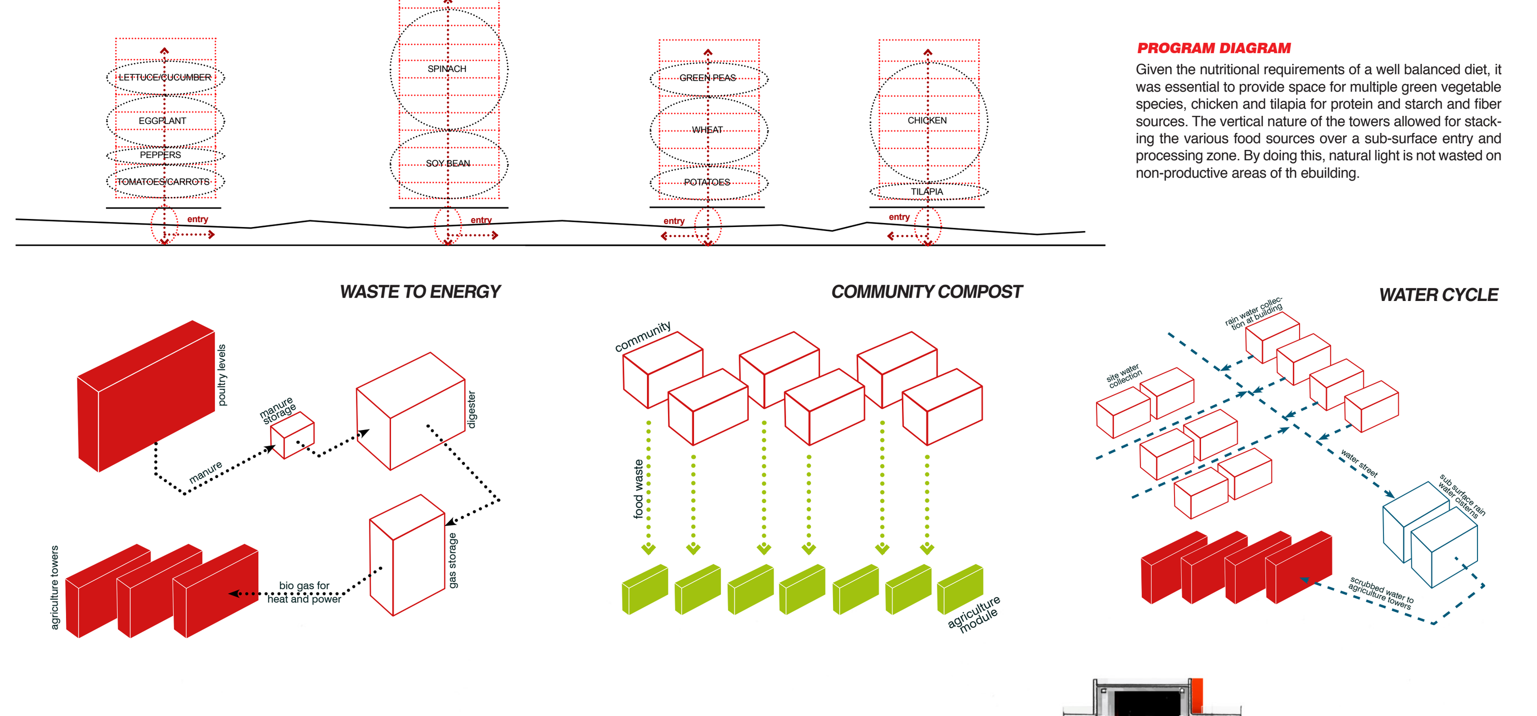
Food Street.
The Food Street utilizes the traditionally unoccupiable median zone for a series of modular vertical agriculture systems for use by the local community members. These modules provide the conceptual framework of the community agricultural model (Grow locally, healthy and sustainably)

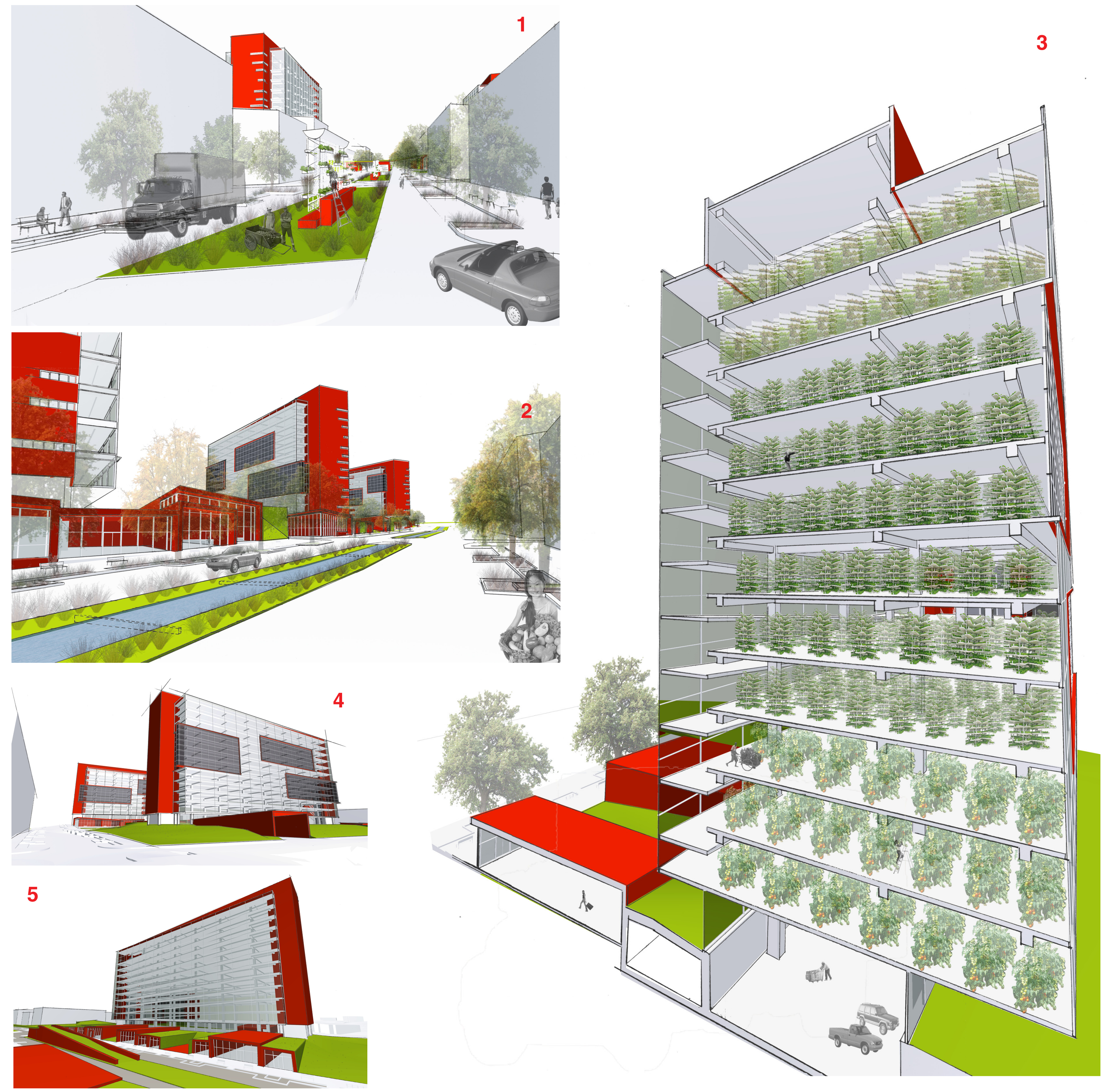
Water Street.
The Water Street is the heart of the sites storm water collection and run-off reduction system. Yes, storm water run-off is reduced through the use of bio-swales and rain gardens on all of the streets, but it is the Water Street that collects excess run-off and distributes it to be used in the industrial agriculture facility. Additionally, through a series of stop damns and a concluding water feature, this street provides a visual connection between the land and the agricultural towers.

Tertiary Street.
The Tertiary Street design utilizes bio-swales and rain gardens as its largest identifying characteristics. These streets, along with the two boulevards, contain on street parking constructed of pervious pavers to add one more layer to the storm water run-off reduction.



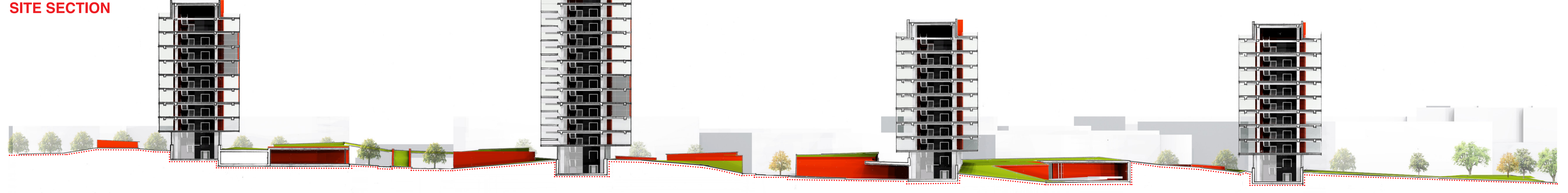
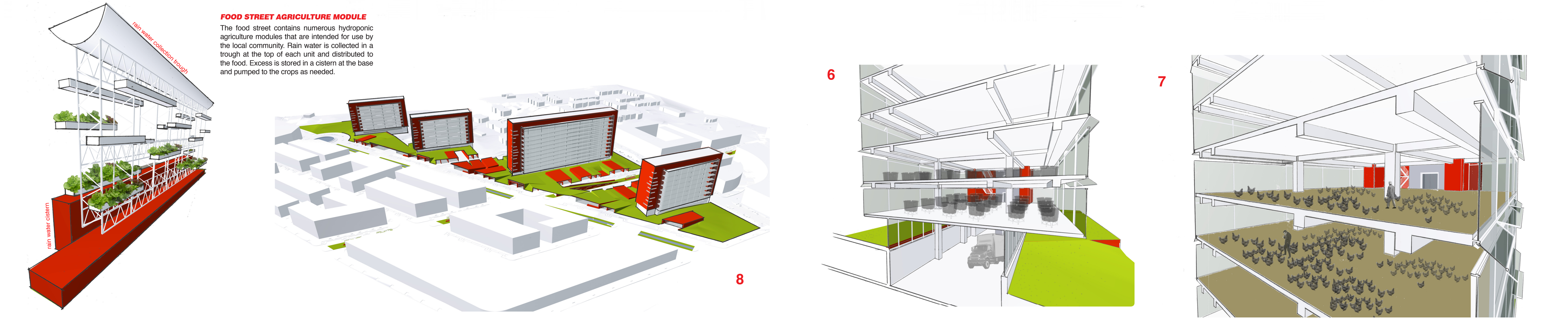






PROGRAM DIAGRAM

SITE SECTION



FOOD STREET AGRICULTURE MODULE
The food street contains numerous hydroponic agriculture modules that are intended for use by the local community. Rain water is collected in a trough at the top of each unit and distributed to the food. Excess is stored in a cistern at the base and pumped to the crops as needed.