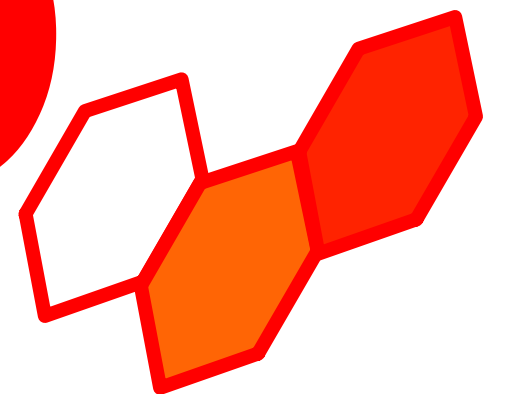


Transforming asphalt fields into an industrial agriculture community

RESEED



Transforming asphalt fields into an industrial agriculture community

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A DESIGN PROPOSAL BY **RYAN C. HORNE**

MASTER'S PROJECT REPORT

The role of an architect in today's modern world has not changed much since the early inception of the profession. We shape spaces, buildings and landscapes in response to certain needs whether it be an individual client or a community as a whole. We promote and provide for the health, safety and welfare of society. It is the value of these three platforms on which we position our profession, but it is the inability to fully recognize the impact of these platforms that has contributed to the current state of crisis in our social and ecological structures.

The fact that our ecological environment, in particular, is in a mode of rapid decline is not a new development nor is it front page news. Since the early 70's most of the world has understood that our patterns of development and industry are doing damage to our eco systems at remarkable rates. Architects, in particular, have been fighting the sustainability front for many years, promoting greener buildings, less consumption and use of local resources. In recent years the general public has even begun demanding organic foods and "greener" products and services. All of this is extremely relevant and progress in the right direction. However, I do not believe that it goes far enough. Architects must focus on the root of the problem in order to discover the correct solution.

I believe that suburbia and its associated development is the root from which many of our current ecological and social issues have grown. The major result being that the position and form of our current social and community structures are no longer viable or sustainable. Our development patterns have promoted an increase in the separation of uses resulting in great expansions of suburban neighborhoods disconnected from supporting programs. This separation has spawned a decrease in walkability, a loss of social capital, and resulted in countless ecological problems. Studies have proven each of these to be contributing factors in the decline of human health, both physical and mental, as well as the decline of communities as a whole.

So how do we as architects, the creators and form givers of public and private "spaces", provide solutions to these problems? We should start by focusing our attention on the elements of human necessity that have the largest impact on our societies. I believe that food is that element and, by placing food at the center of a community, we can alter the progression of our current development patterns.

In short, I feel that 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. In particular, I propose that this industrial agriculture take the form of a vertical farm.

How can vertical urban agriculture help the situation?

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 energy transfer from one level to the next, regardless of the type of ecosystem in question. In fact, this is the defining characteristic of all ecosystems. In contrast, humans, although participants in all terrestrial ecosystems, have failed to incorporate this same behavior into their own lives. If vertical farming succeeds, it will establish the validity of sustainability, irrespective of location (urban vrs rural). Vertical farms could become important learning centers for generations of city-dwellers, demonstrating our intimate connectedness to the rest of the world by mimicking the nutrient cycles that once again take place in the world that has re-emerged around them.

Furthermore, the elimination of large, currently unmanageable amounts of waste will improve the attractiveness of the local environment and help to correct the imbalance in energy utilization by recycling organic waste through methane digestion systems. Rene Dubos wrote in "So Human an Animal" that people tend to support the institutions that they grow up with, regardless of whether or not they foster a nurturing environment in which to live. Dubos advocated that all humans deserve to live in places that encourage healthy, useful lives, but to do so will require massive reconstruction of the urban landscape. By transforming cities into entities that nurture the best aspects of the human experience is the goal of every city planner, and with vertical farming serving as a center-piece, this may eventually become a reality.

Providing all urban populations with a varied and plentiful harvest, tailored to the local cuisine eliminates food and water as resources that need to be won by conflict between competing populations. Starvation becomes a thing of the past, and the health of millions improves dramatically, largely due to proper nutrition and the lack of parasitic infections formerly acquired at the agricultural interface. Given the strength of resolve and insight at the political and social level, this concept has the potential to accomplish what has been viewed in the past as nearly impossible and highly impractical.

It is further anticipated that large-scale urban agriculture will be more labor-intensive than is currently practiced on the traditional farm scene, since the deployment of large farm machinery will not be an option. Hence, employment opportunities abound at many levels. Finally, the vertical farm should be a thing of architectural beauty as well as be highly functional, bringing a sense of pride to the neighborhoods in which they are built. In fact, the goal of vertical farm construction is to make them so desirable in all aspects that every neighborhood will want one for their very own. (http://www.verticalfarm.com/essay_print.htm The Vertical Farm: Reducing the impact of agriculture on ecosystem functions and services, An essay by Dickson Despommier)

The Project:

The goal of this project in particular is to take an existing suburban shopping center, one that is completely overwhelmed by its asphalt parking lot, and retrofit it into the an industrial agriculture community.

The existing site contains multiple outparcel buildings and a few major retail buildings. I am proposing the retrofit of this condition to a multi-family community composed of approximately 3,000 residents. 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 at the center. 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.

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).

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.

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.

As mentioned previously, the center of the site contains all of the agriculture towers. These towers are located above an elevated ground plane, the roofs of retail below, which act as a large public park with the possibility to farm it in the future. The tower designs are rather straight forward providing for multiple types of food production as well as the option to swap or rotate food types as needed. Given the nutritional requirements of a well balanced diet, it was essential to provide space for multiple green vegetable species, chicken and tilapia for protein and starch and fiber sources. The vertical nature of the towers allowed for stacking the various food sources over a sub-surface entry and processing zone. By doing this, natural light is not wasted on non-productive areas of the building.

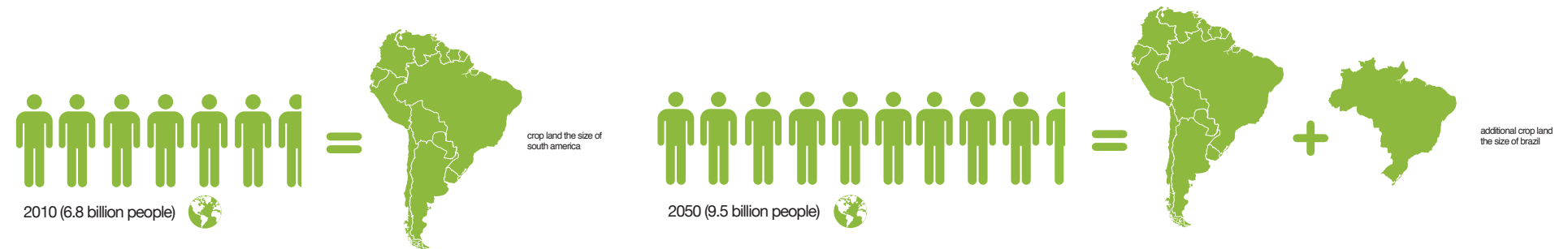
The intention of the buildings is to provide the food required for the community within a one mile radius. It is also intended to serve as an education and awareness device for the community. The thought is that people will be more thoughtful about the food that they put in their bodies as well as build community by providing a common bond.

I see this model as a prototype that can be replicated across multiple sites in the suburbs with the intention to completely retrofit the way that our societies think about food and community. If we are the change the world we have to start locally as well as grow locally.

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 photovoltaics 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 PROPOSED SITE DESIGN: 2,250 PEOPLE

TOTAL ESTIMATED POPULATION 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 yields, the following is the breakdown of the agriculture program requirements

WHAT TECHNOLOGIES WILL BE USED?

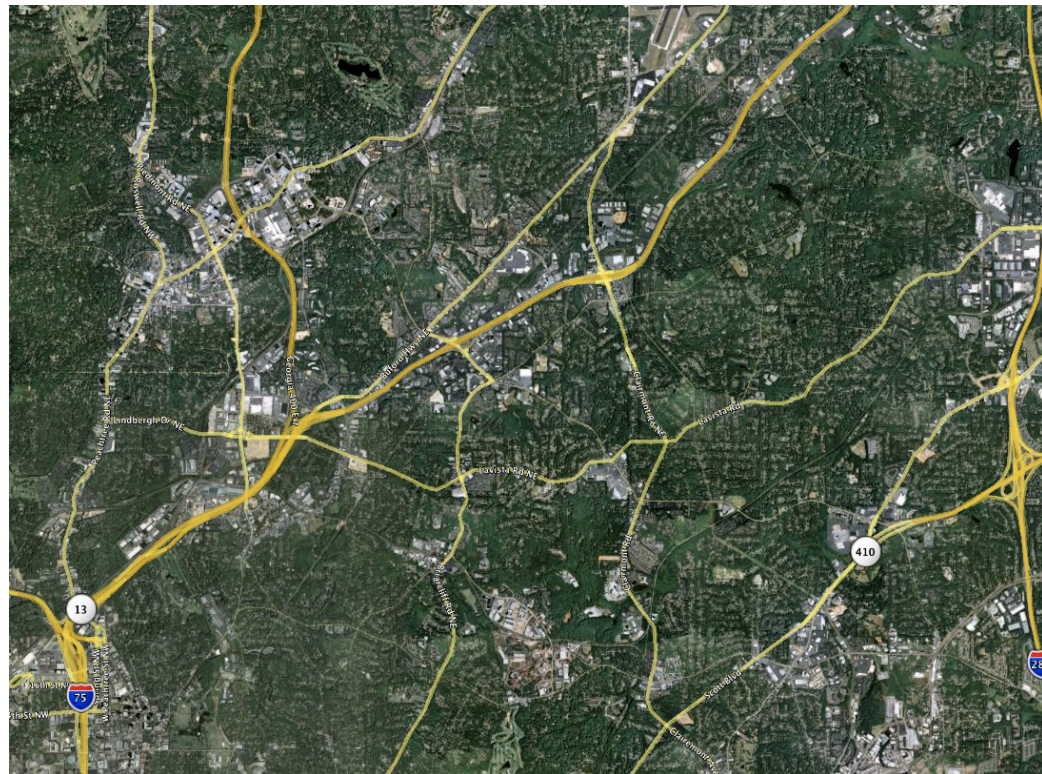
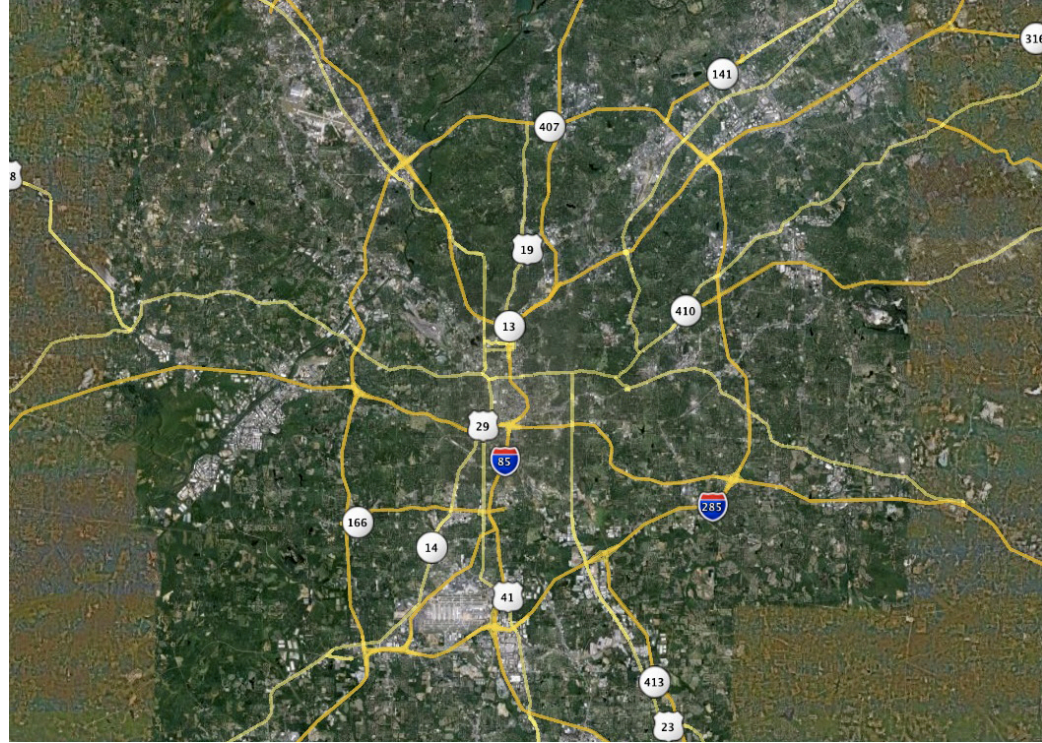
Drip Irrigation: Plants grow in troughs of lightweight, inert material, such as vermiculite, reused for years. Small tubing on the surface drips nutrient-laden water precisely at each stem's base. Good for grains (wheat, corn).

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.

Veg/Fruit	Tons/Yr (10,000 people)	Hydroponic s (tons/ hectare)/ year	HA/Yr	Square feet/ Yr	Small Back Bldg. Floors (12.5K ft ²)	Small Back Bldg. Floors (3 layers/fl)	Large front Bldg. Floors (35K ft ²)	Large front Bldg. Floors (3 layers/fl)	Small front Bldg. Floors (16.5K ft ²)	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				
			m³	ft³	Floors	Floors	Floors	Floors	Floors	Floors
Waste Management										
TOTAL					48.37	16.85	30.45	10.15	26.29	8.76

PROGRAM CALCULATIONS

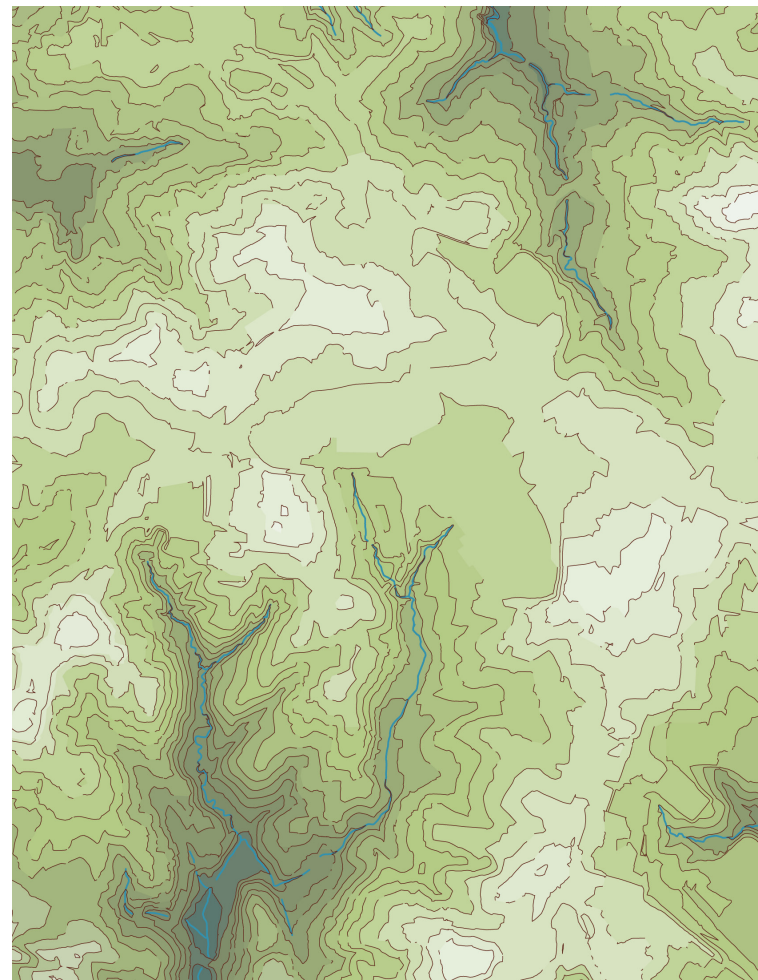
PROJECT LOCATION



EXISTING CONDITIONS



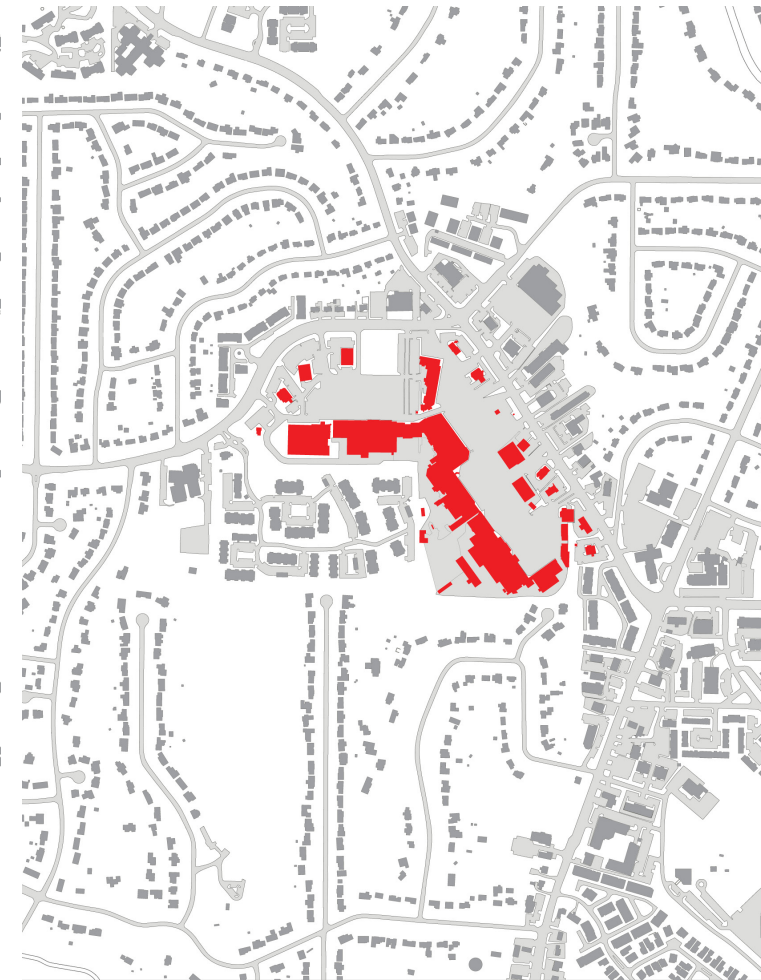
EXISTING TOPOGRAPHY



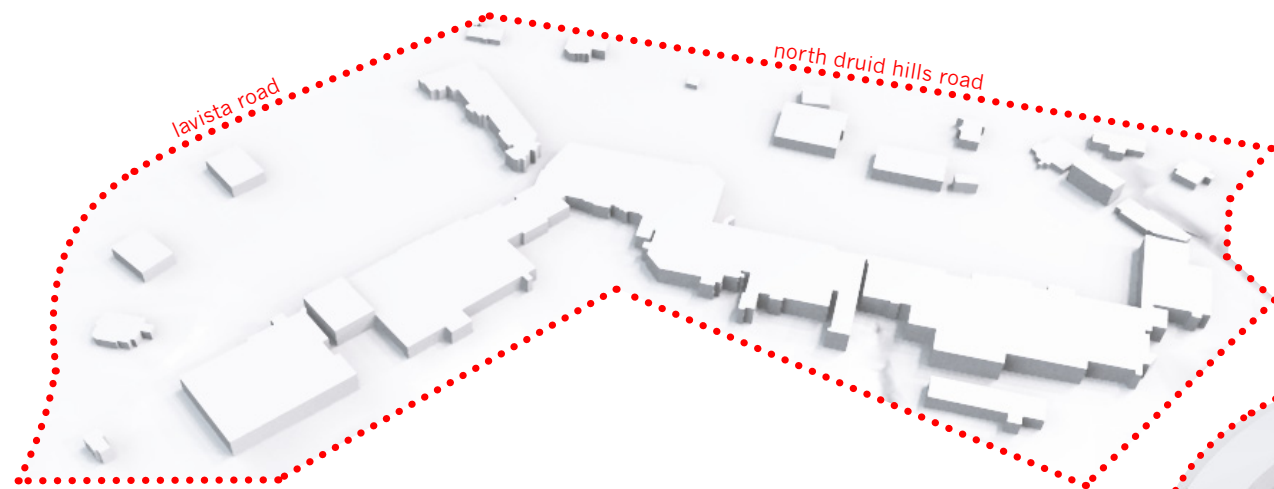
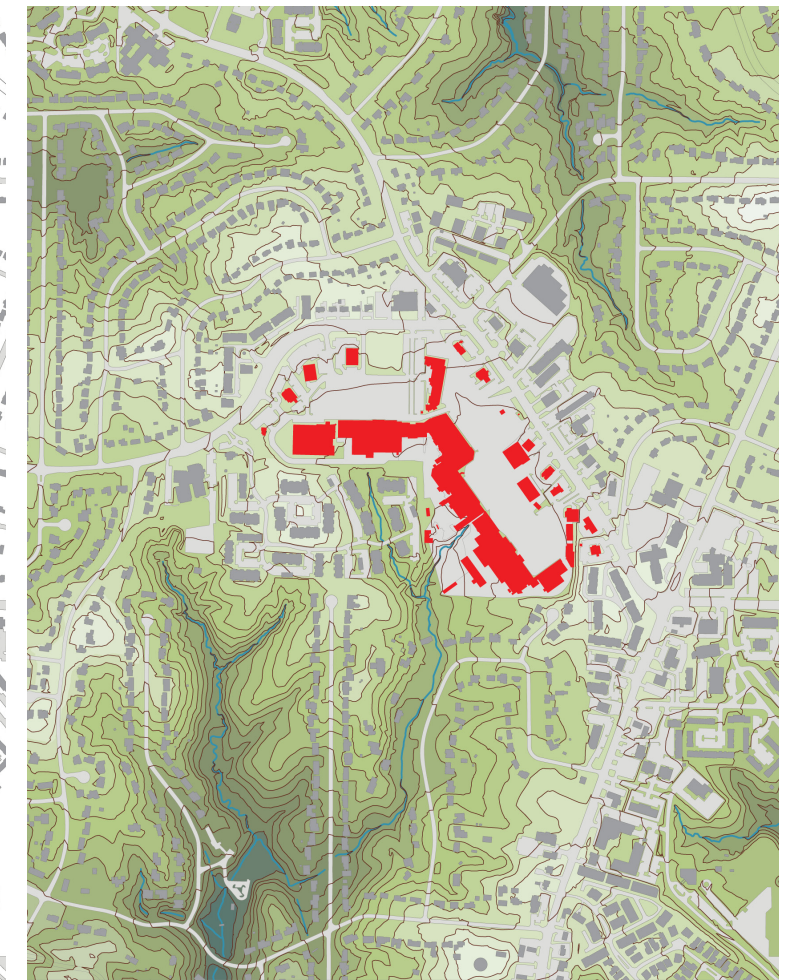
EXISTING FIGURE GROUND



EXISTING BUILT ENVIRONMENT

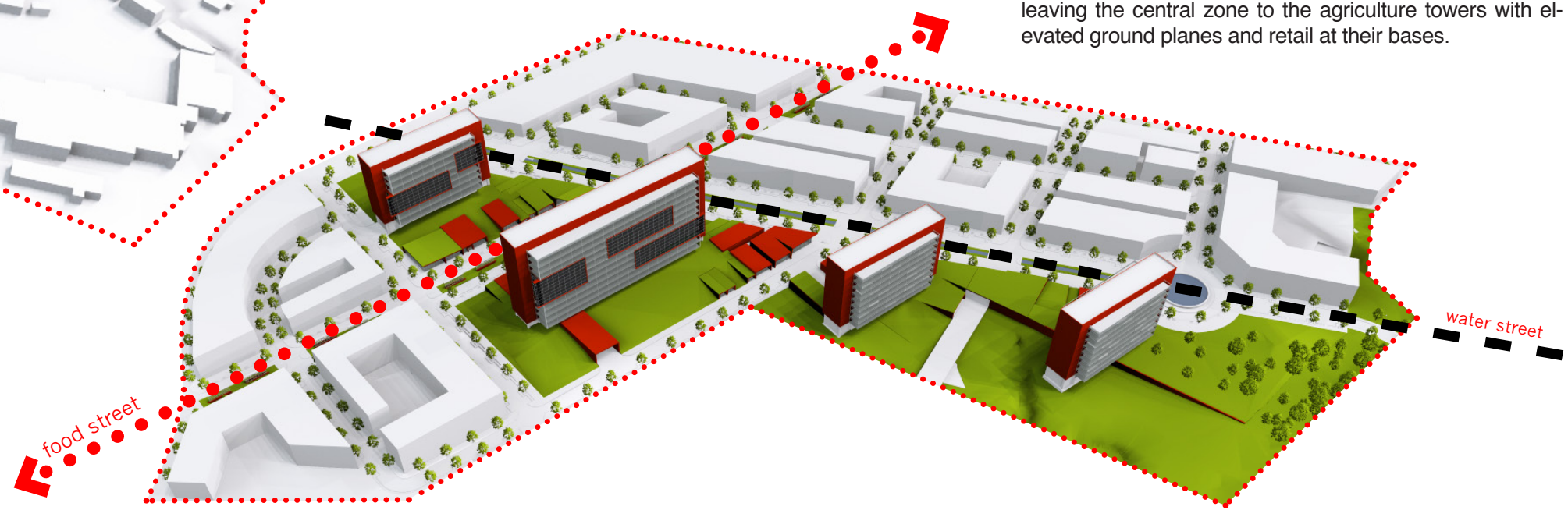


COMPLETE EXISTING CONDITIONS



EXISTING ASPHALT FIELDS

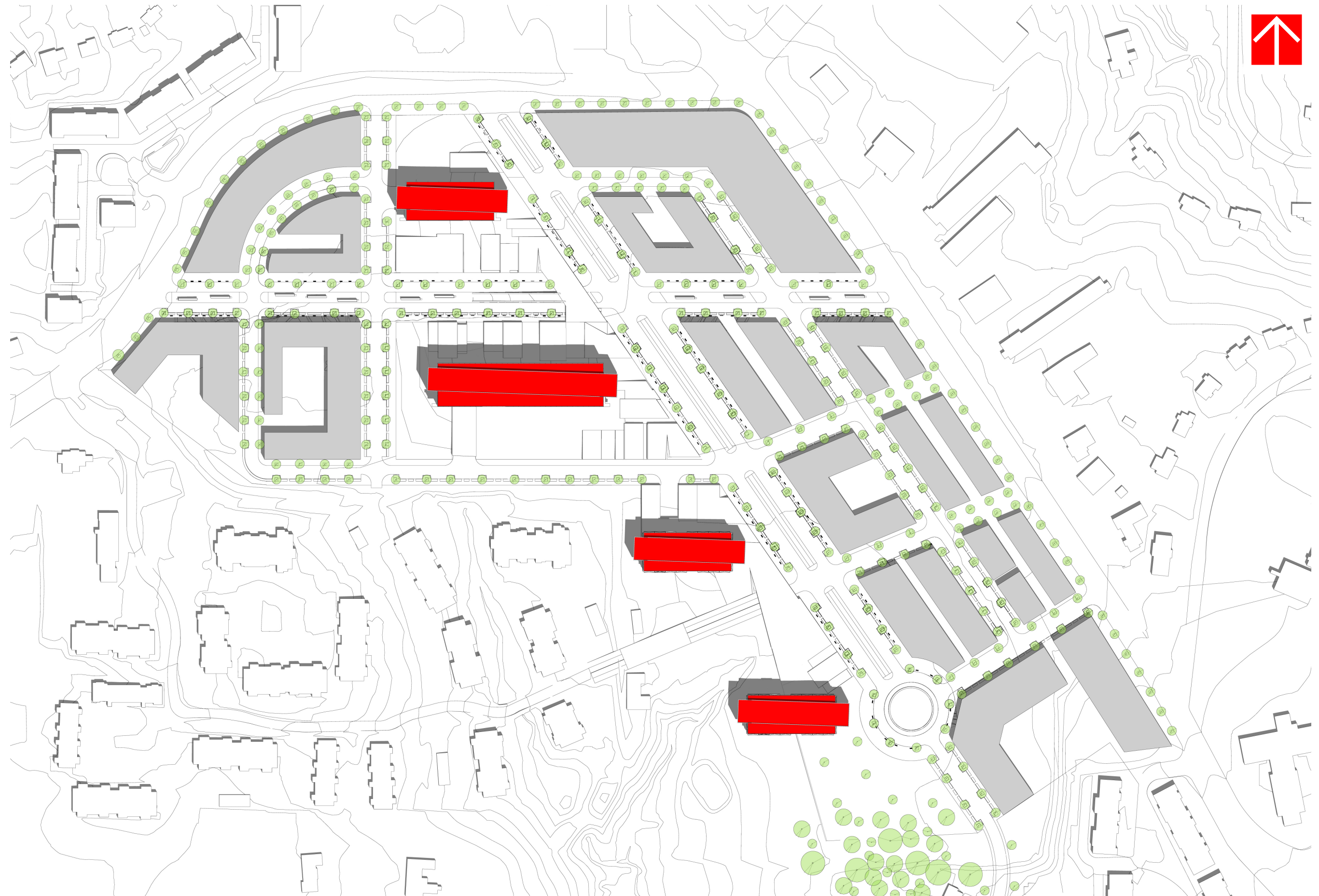
The existing shopping center is composed of numerous out parcel buildings, several large food stores and even more multi-tenant retail buildings. In addition, the parking area allocated to the existing building stock is extremely under utilized and disproportionate to the existing building area. As a 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 developments.



DESIGN INTERVENTION

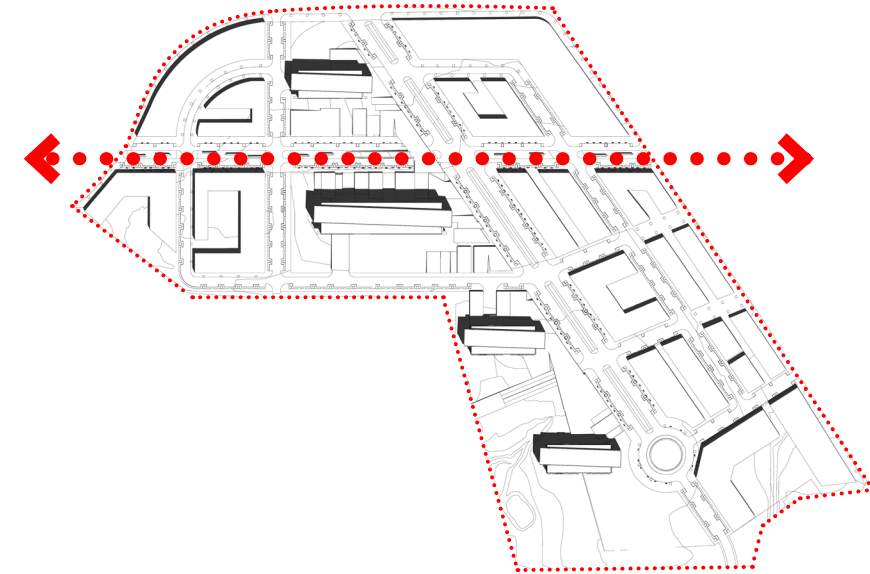
The obvious solution to the problems at this shopping center was the insertion of a lot and block system in order to define the boundaries for the proposed change in density. Mixed use buildings will occupy the perimeter of the site leaving the central zone to the agriculture towers with elevated ground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

SITE PLAN



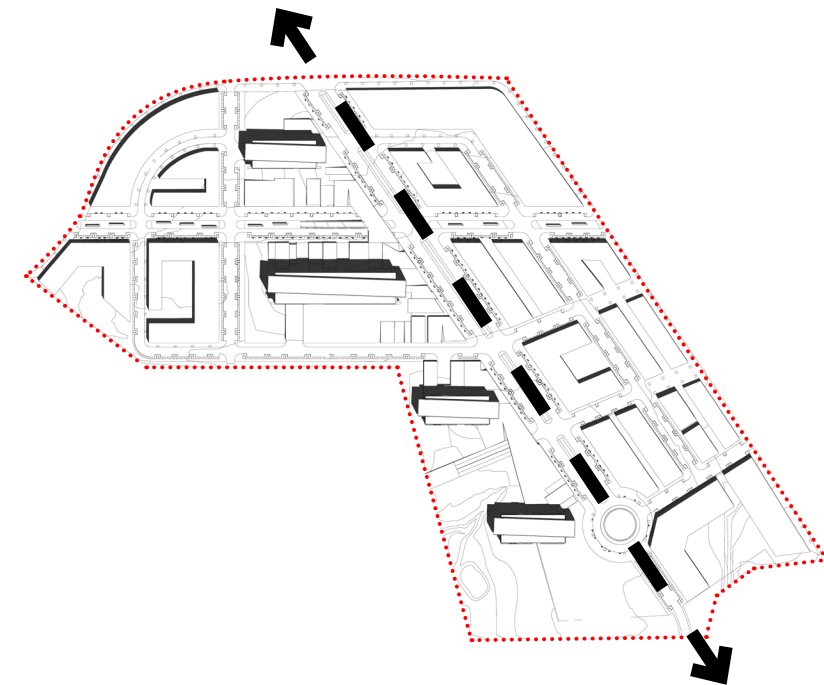
Food Street.

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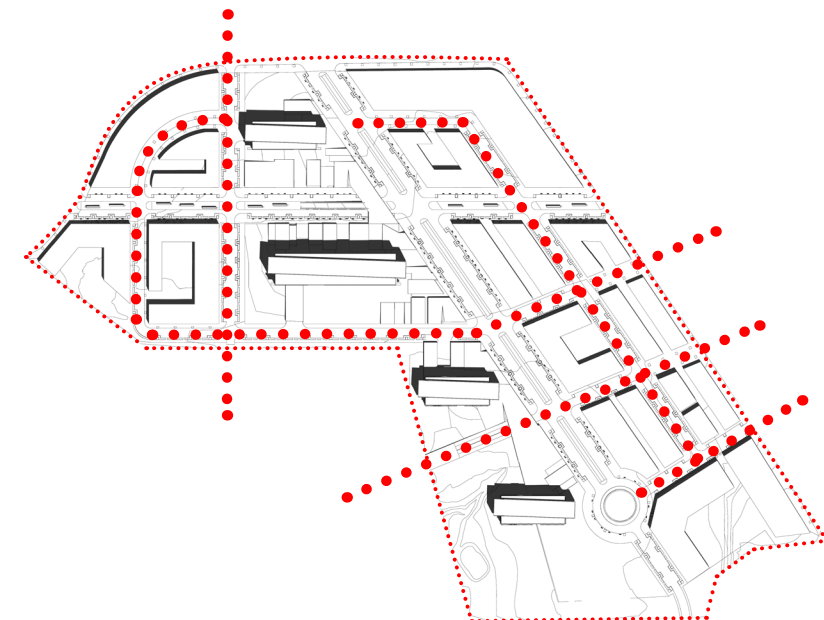
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Tertiary Street.

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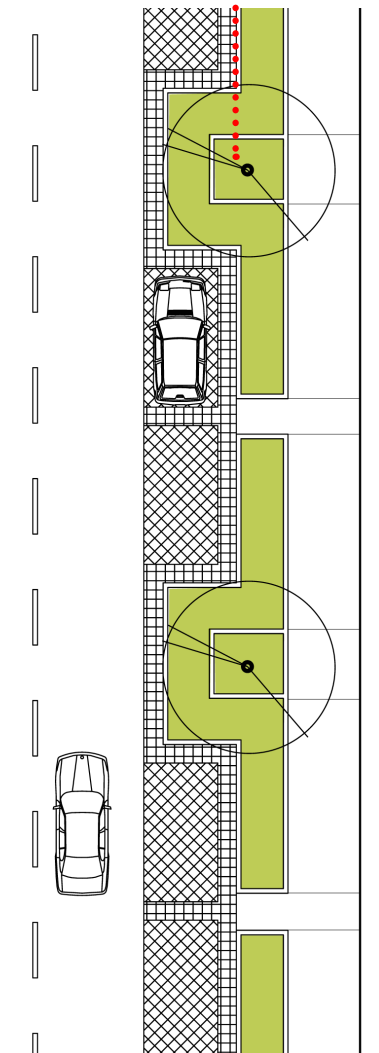
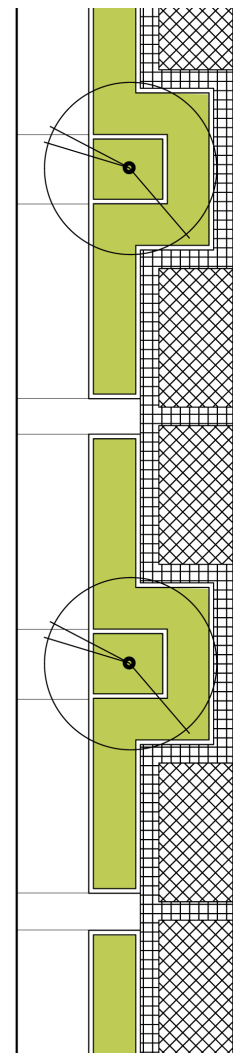
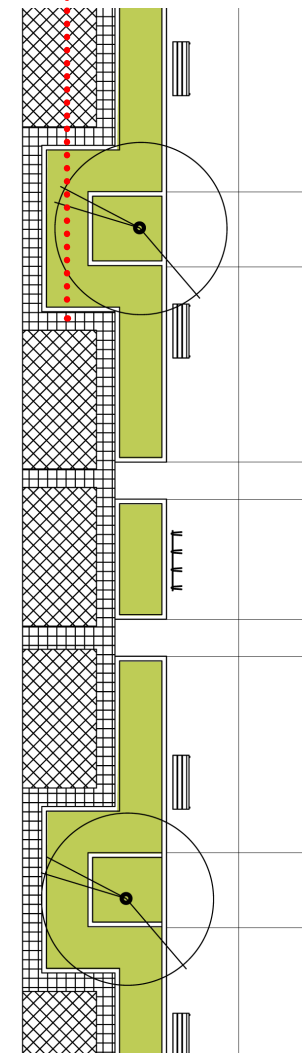
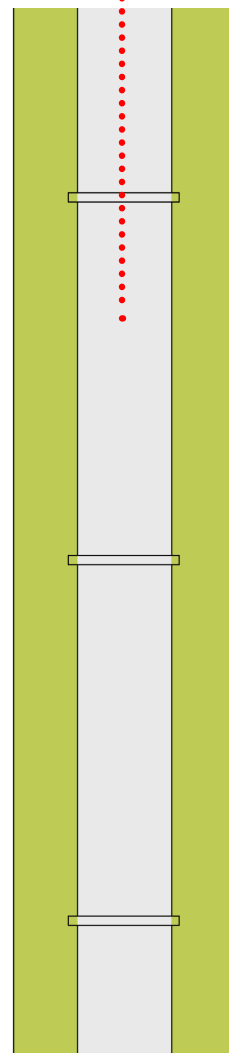
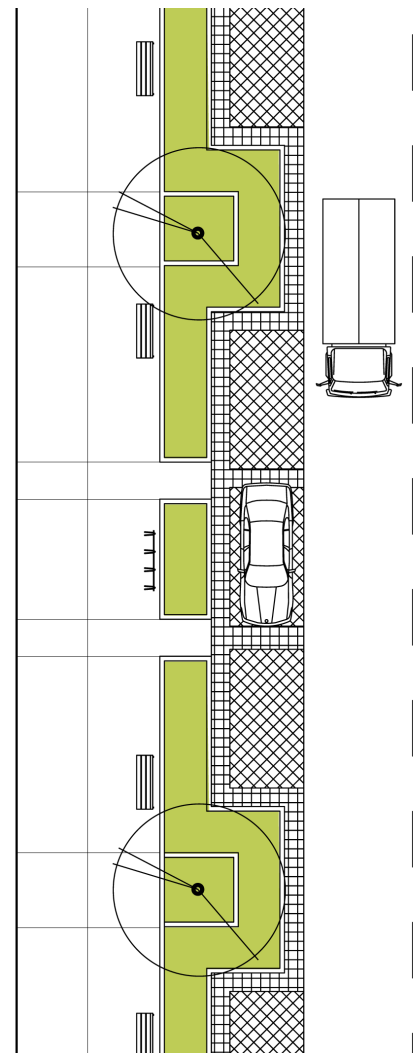
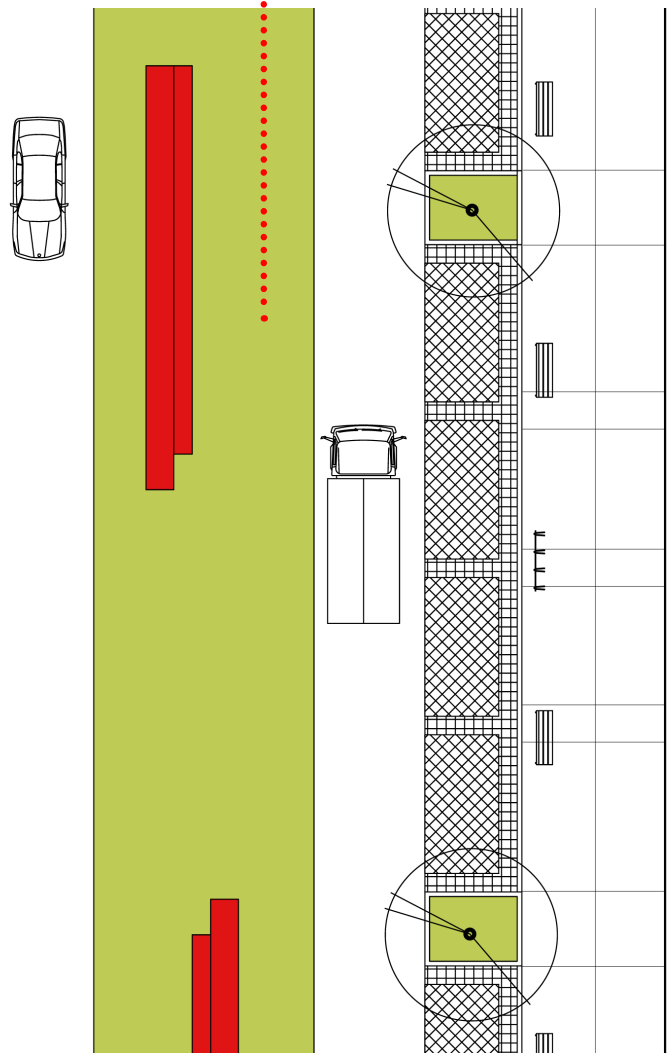
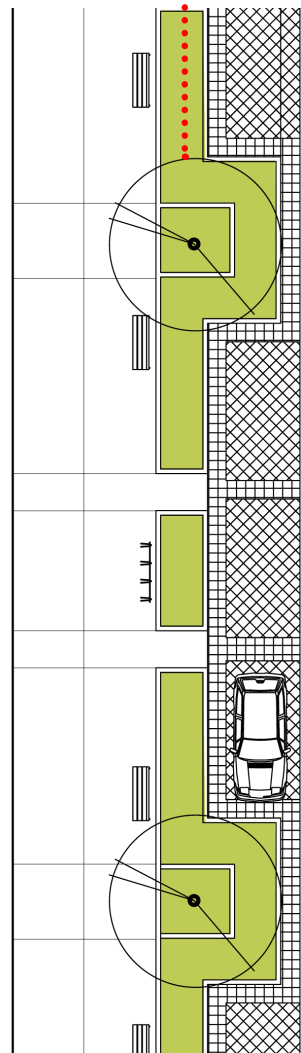
Rain Garden

Bioswale

Stop Damns

Pervious Pavers

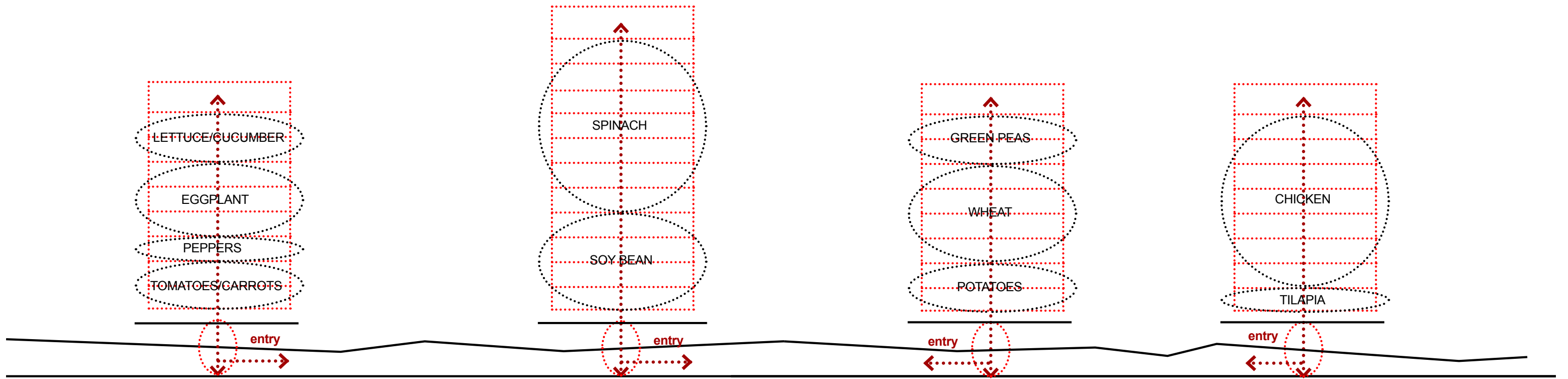
Rain Garden



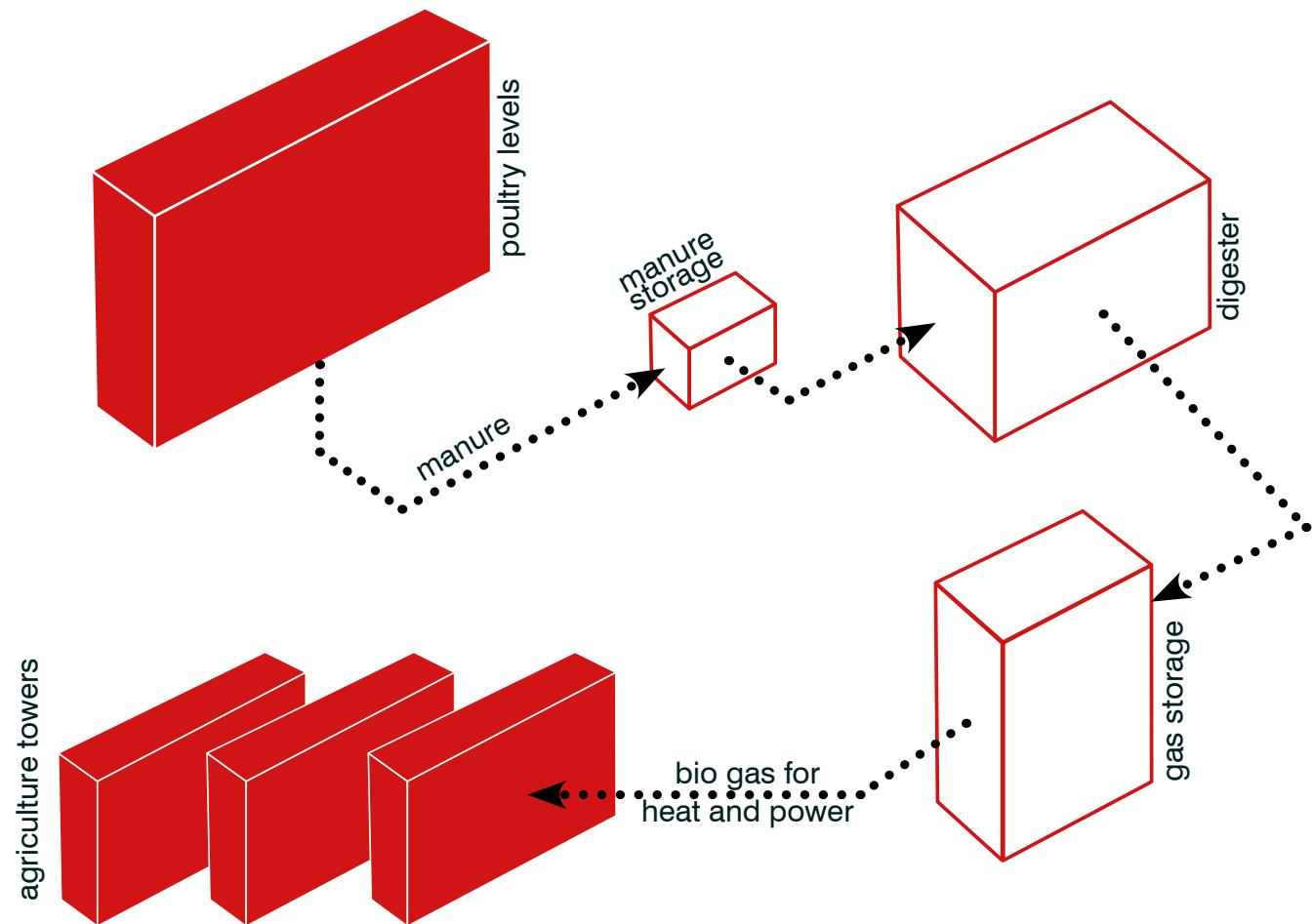
FOOD STREET

WATER STREET

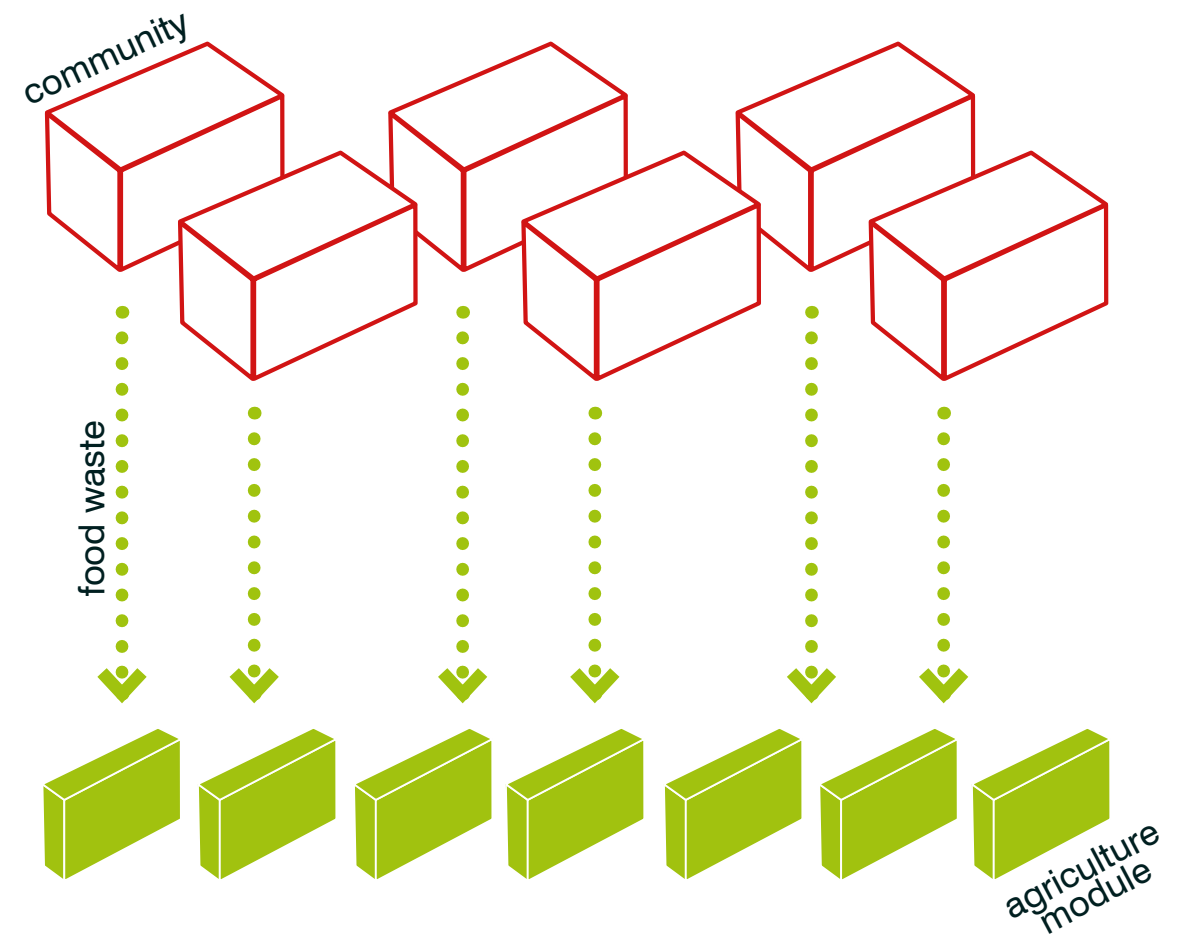
TERTIARY STREET



WASTE TO ENERGY



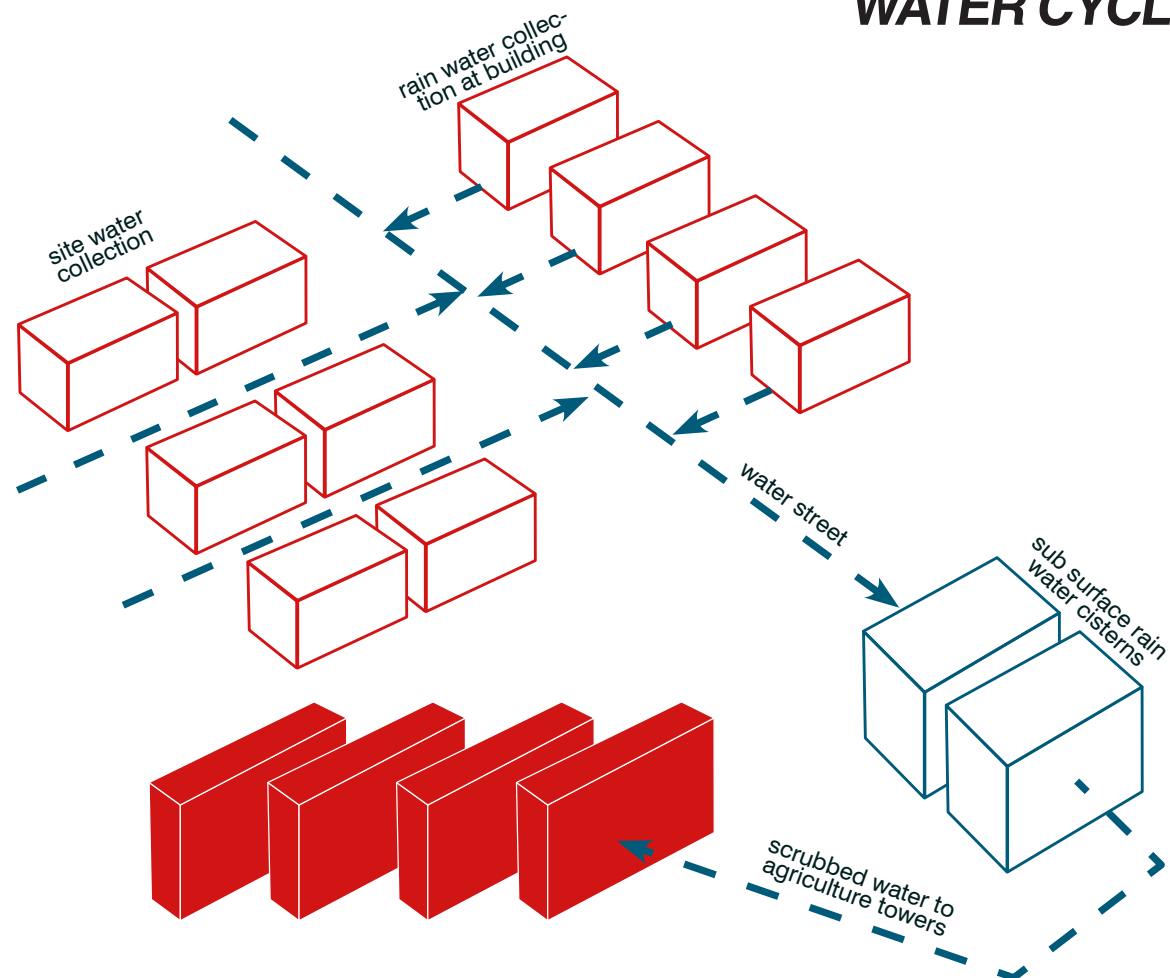
COMMUNITY COMPOST



PROGRAM DIAGRAM

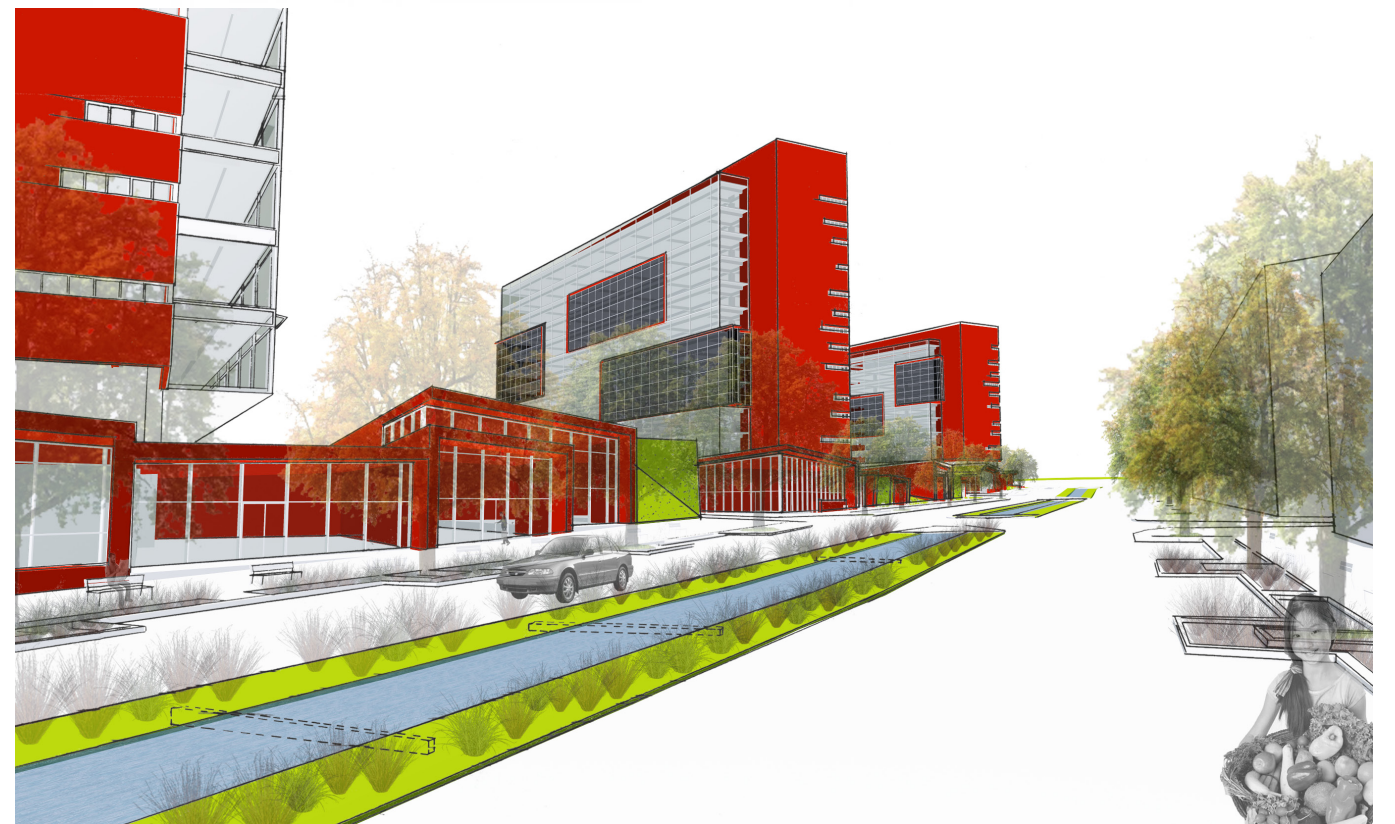
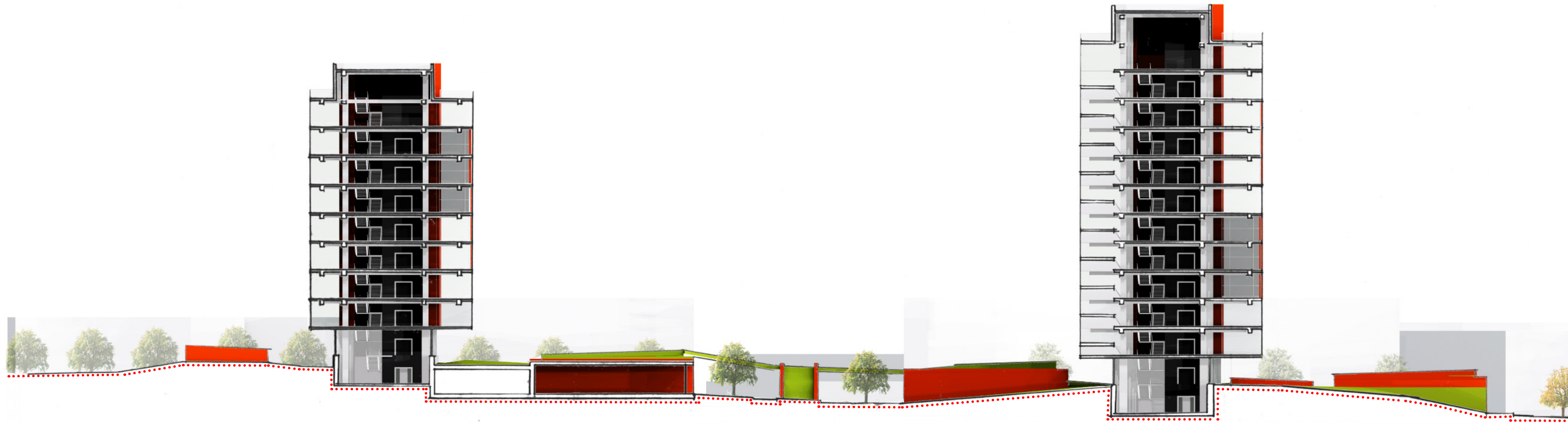
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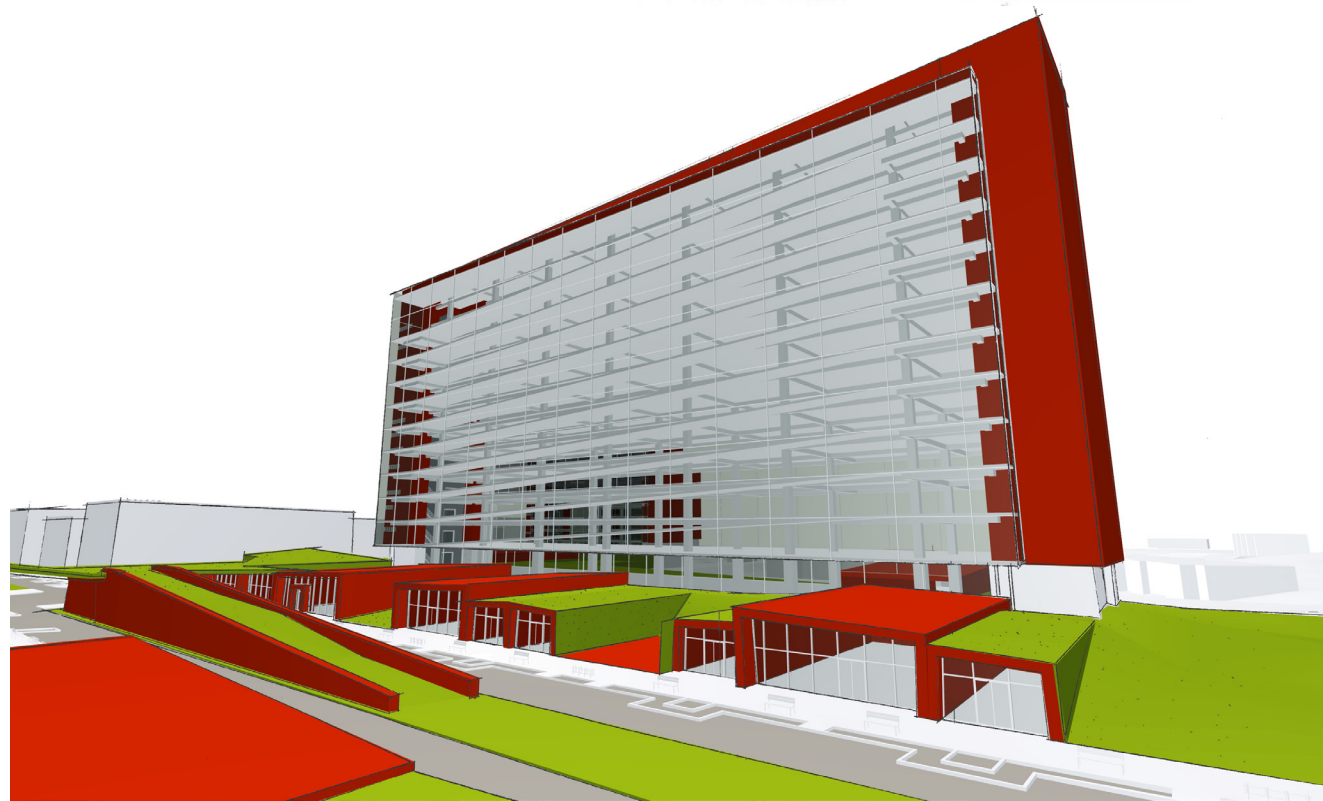
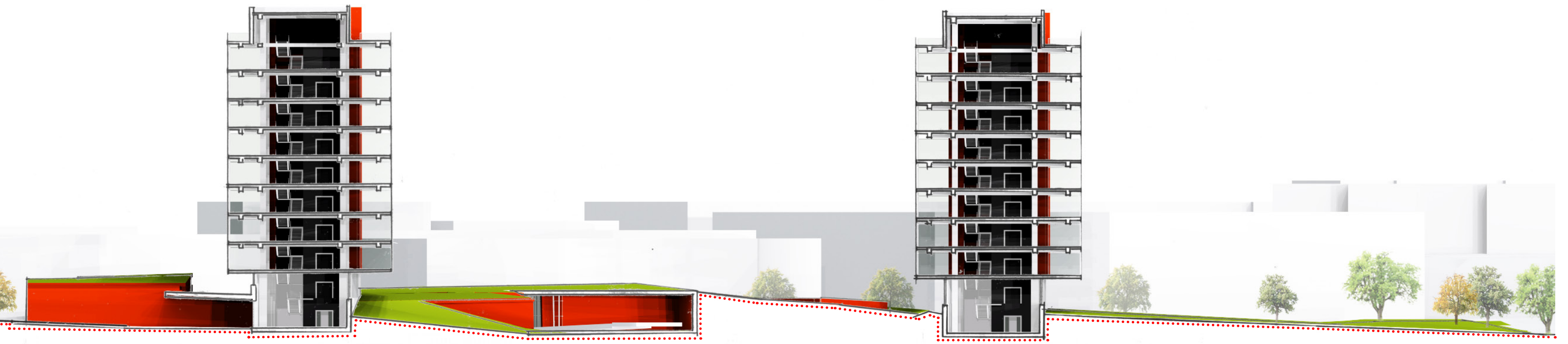
WATER CYCLE

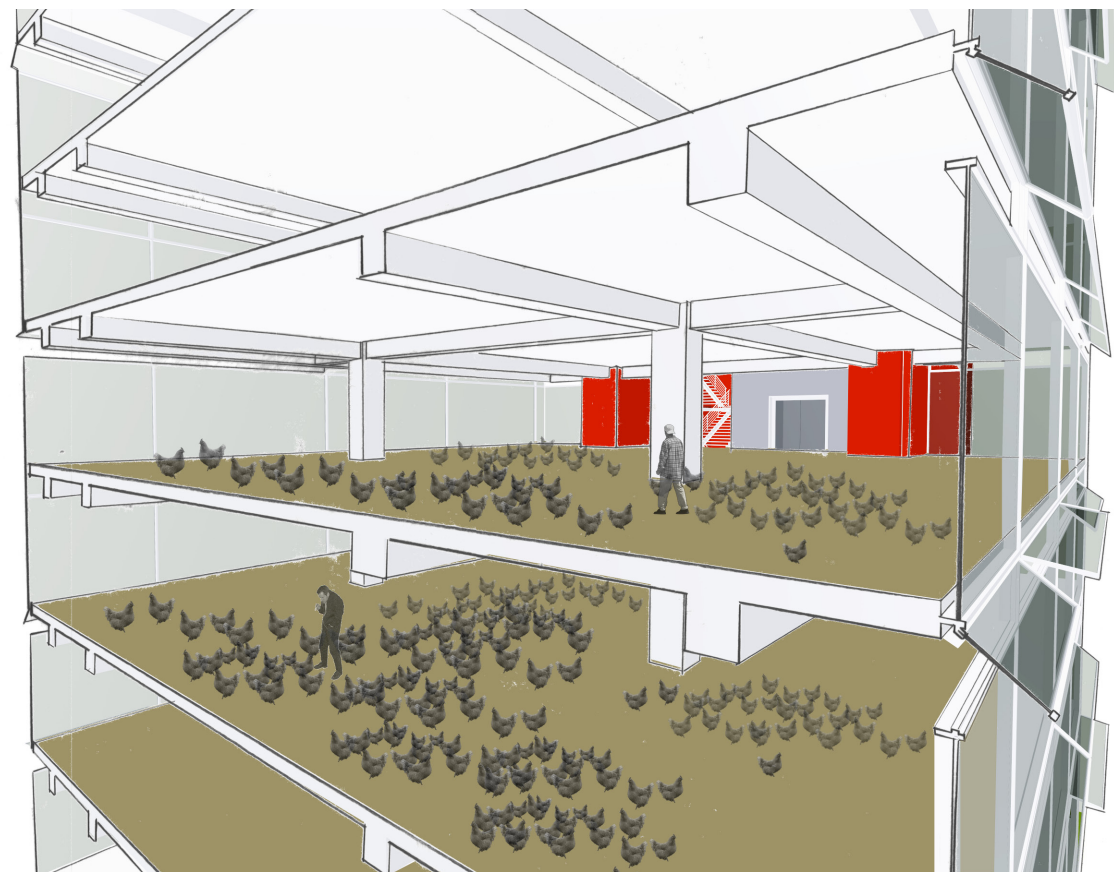
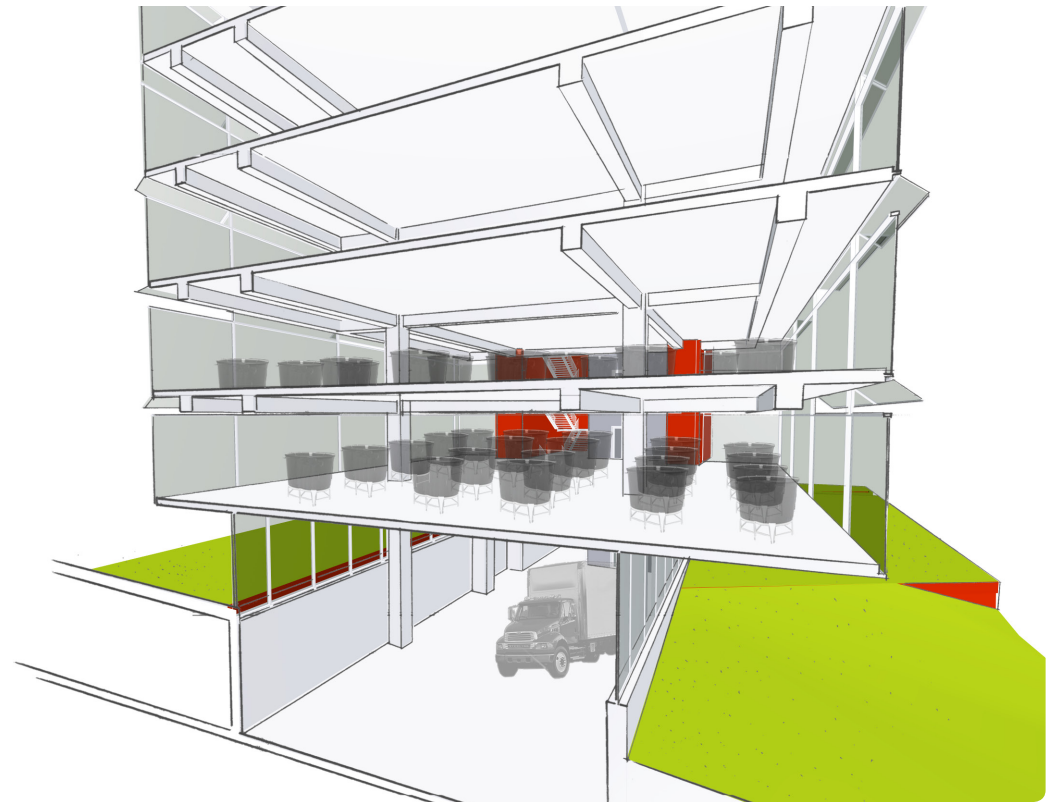


FOOD STREET AGRICULTURE MODULE

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.



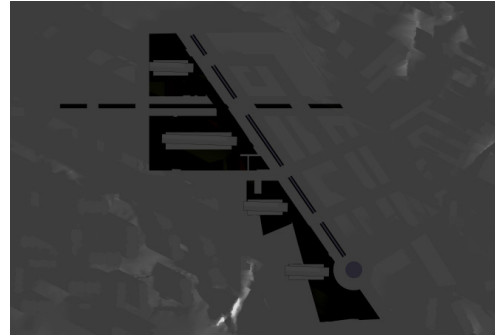




WINTER SUN STUDIES



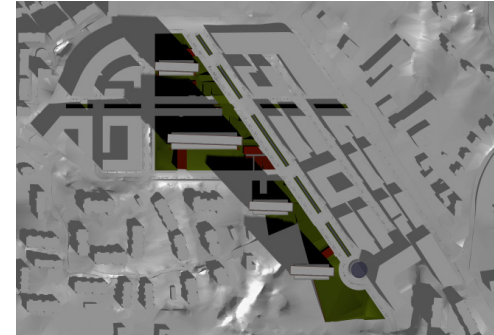
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0800



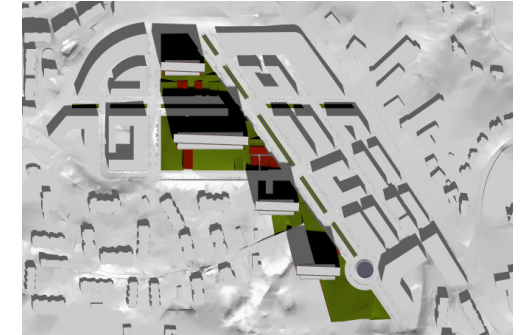
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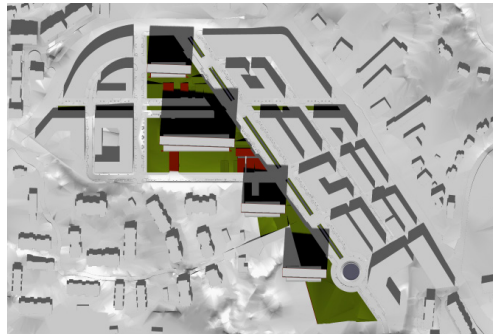
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1100



1200



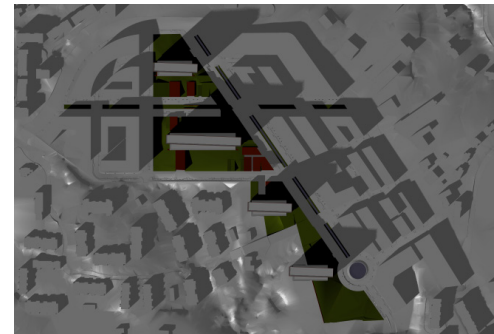
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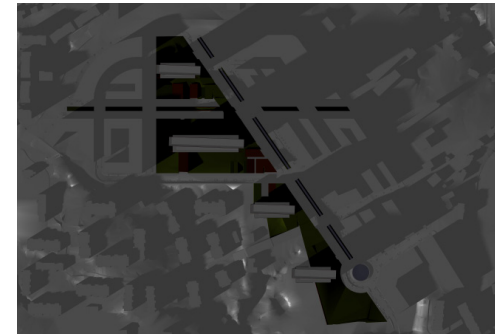
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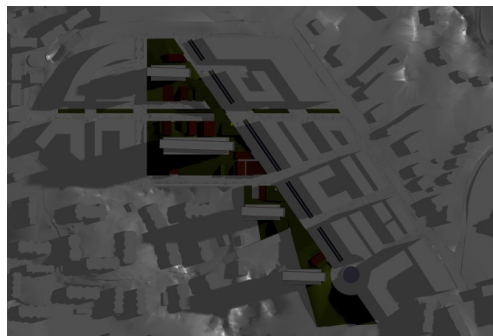


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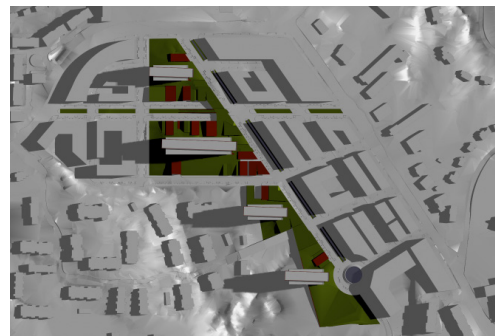


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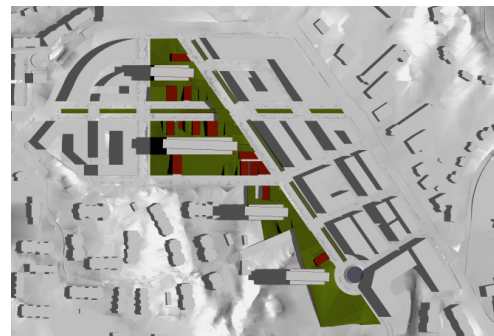
SUMMER SUN STUDIES



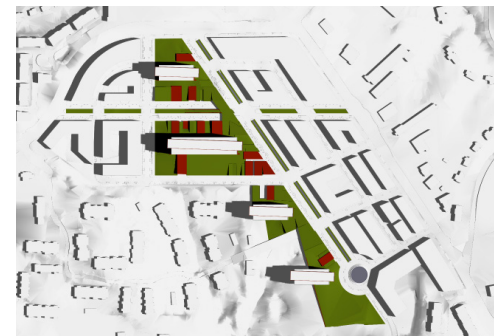
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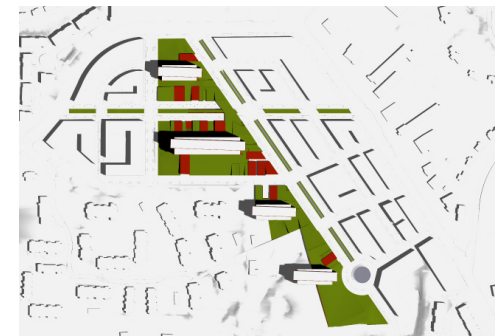
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0900



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1100



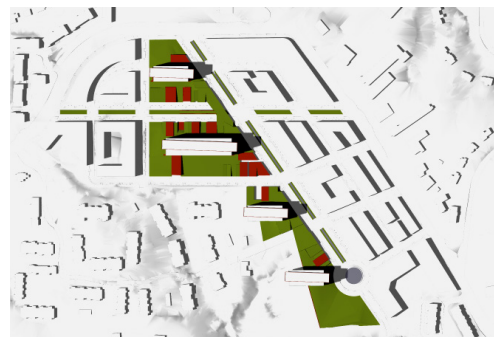
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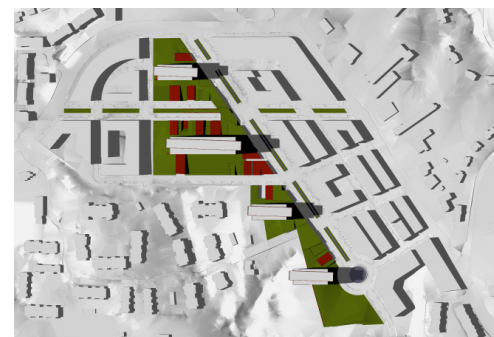
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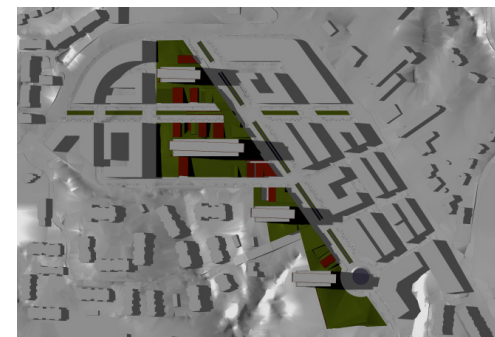
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