ABSTRACT

Title of Thesis: THE GROWCERY STORE

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This thesis explores a socially, environmentally, and economically sustainable alternative to the current food production and consumption systems, a framework which currently leaves neighborhoods without food, farmers without incomes, and communities without a sense of the ecological or cultural significance of the food that they eat every day.

Utilizing the abandoned manufacturing infrastructure of Cleveland Ohio, this thesis explores how food production can be incorporated into the community as a new industry, focused on stewardship of the land, buildings, community, and history of the site. Integrating farming with sustainable heritage and building practices to create a multi-functional space to re-invent how we grow, buy, and understand food, both as a tool for preserving the past, as well as the future.

THE GROWCERY STORE

by

Hannah Lee Grady

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Chapter 1: The Current State of Food

1.1 Invisible Costs of Current Agricultural Practices

Economic Costs

Many of us today are unaware of how our food is grown, processed, and shipped to the local supermarket. Despite its direct impact to nearly every U.S. citizen, the agricultural industry is mostly invisible, and its true costs not fully understood by the average American. One of the most important facets of modern agricultural practices is the economic costs, largely impacting farmers, but being passed on to average consumers as well.

Over the last century, farming practices have changed drastically. Gone is the archetypal family farm, sustaining itself with cows and chickens and diverse crops and selling the surplus at market. This model began to disappear shortly after the railroad connected the country, allowing livestock and produce to be transported much further afield. Farming began to shift from being an individual enterprise to become an industrial complex. This trend continued more or less to today, the full history of which is an undertaking unto itself. What is important however, is where things stand now.

Despite producing more food that in any previous point in human history, American farming is a shrinking business. The number of farms are decreasing, while conversely, the size of remaining farms is increasing. This is because farmers require larger crop sizes to decrease their production costs, and maintain enough to profit to continue to operate. The precarious economic situation that most growers find themselves in is attributed largely to the monopolies that plague the industry at nearly every level.

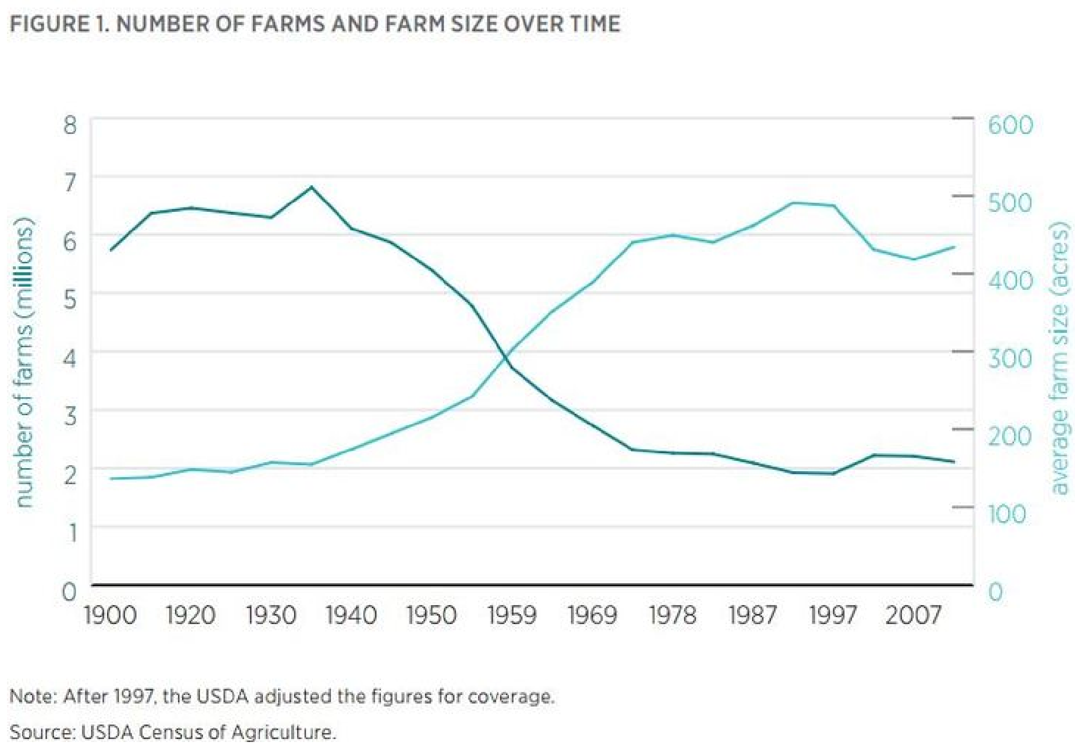

Figure 1: graph comparing number of farms and farm size in US

Wholesale distributors, processed food manufacturers, and national grocery chains have all merged into a handful of players. Additionally, some chains have begun to integrate vertically, consolidating growers, processors, and shippers under one company. This limits the number of buyers farmers are able to sell too, which forces them to settle for lower prices. Such savings by the grocery chains are rarely passed onto the consumers however, keeping control, and profits in the hands of a few corporations.

This monopolization of the agricultural industry continues on the other end, in which farmers are only able to procure necessary supplies such as equipment, fertilizers, and seeds, from an extremely limited number of corporations. This lack of competition means the cost of the supplies increases, putting further economic strain on the farmer.

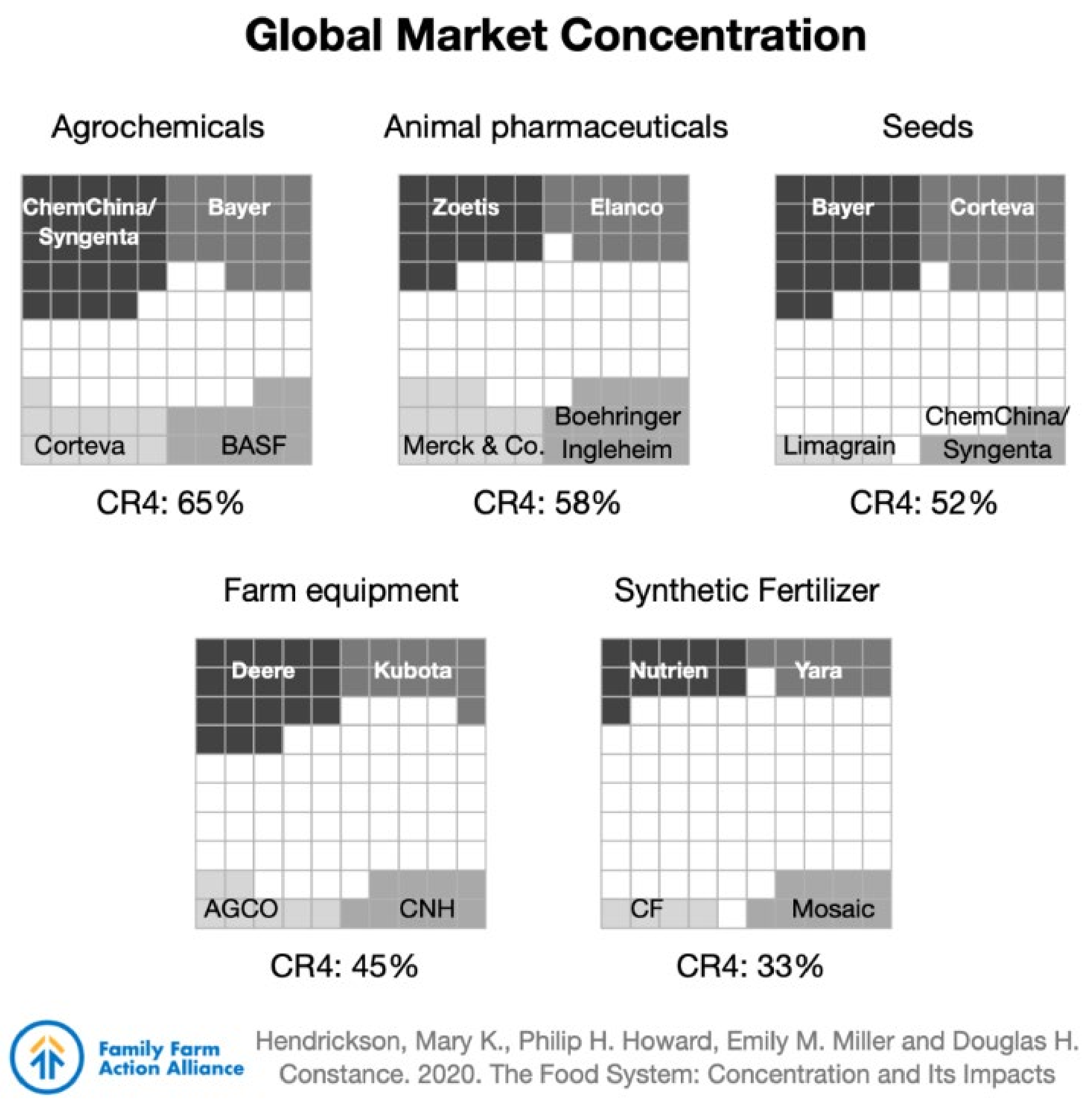

Figure 2: global market concentration of agricultural supplies and equipment

The most unsustainable aspect of this economic model however, is the practice of contract farming. This is a model in which either a buyer or supplier enters into an agreement with a grower to purchase a crop for a set price. Often the buyer/or supplier with provide credit or financing for the grower to produce the crop. This may include providing patent protected seeds or fertilizer, owned by the corporation entering into the contract. While such a process may seem to provide security in a field where hundreds of farmers must compete for the business of relatively few buyers, this model essentially puts all the risk on the farmer should the crop fail due to drought, early frost, high winds, or any of their other myriad elements that make farming such a perilous venture. The corporations enter into contracts with multiple farms, effectively hedging their bets so that should one fail, their losses are limited. The farmer, on the other hand, has dedicated the entirety of their land and resources to meeting the quantities required by the contract, and are left with no crop, no profit, ongoing expenses, and potentially owing loans to the corporations for the initial seeds and supplies.

Modern agriculture in the U.S. is essentially controlled by a few corporations that profit from the exploitation of the precarious financial situation most farmers find themselves in. The farmers and growers are expendable. As more farmers fail and sell their land, others are forced to expand their own acreage in order to stay afloat themselves. The ongoing consolidation process allows more power to the corporations to control food prices as they see fit, wholly unsustainable for creating a healthy and diverse economic landscape for the industry.

These economic conditions lead to a shrinking population of farmers. This in turn results in overall disinvestment of rural communities as populations shift to find work in more stable industries and regions. These communities are left with high unemployment, shrinking resources, and often become food deserts themselves, despite being surrounded by fertile farmland.

Social Costs

Another hidden cost of food production in the U.S. it the exploitation of immigrant workers. Despite ever improving technology, farming is still a very labor intensive job, one which fewer and fewer Americans are willing to do. The U.S. has a long history of using immigrant populations to fill these need, and like the industry does with farmers, is adept at treating them as expendable. In 1960, when Pilipino laborers at California grape farms went on strike, owners attempted to bring in workers from Mexico to replace them. Today, nearly half of farm workers are not legally authorized to work in the U.S., while many others are dependent H-2A visas, which allows them to work only for the grower they are contracted to. Both situations lead to a climate of abuse and fear in the industry.

Environmental Costs

Finally, there are the environmental costs. Despite great strides made during the 1930s to farm in a way that conserved the soil and water, technological innovations soon allowed farmers to tap deeper aquifers and abandon such practices. As it stands, agriculture accounts for almost 80% of consumptive water in the U.S.

The Ogallala Aquifer is one of the largest providers of freshwater for agriculture in the Midwest. Water is being pumped out faster than it is being replenished however, and with increasing droughts due to global warming, water shortages may become a very real issue in the coming decades. Additionally, sources of freshwater are being polluted by waste and fertilizer run off, further limiting our supply of clean, potable water. These pollutants, once in the water supply can also adversely impact the natural ecosystem and wildlife of the area. Nitrogen run-off from farms can lead to algae blooms which can make a body of water unfit for animal or human use.

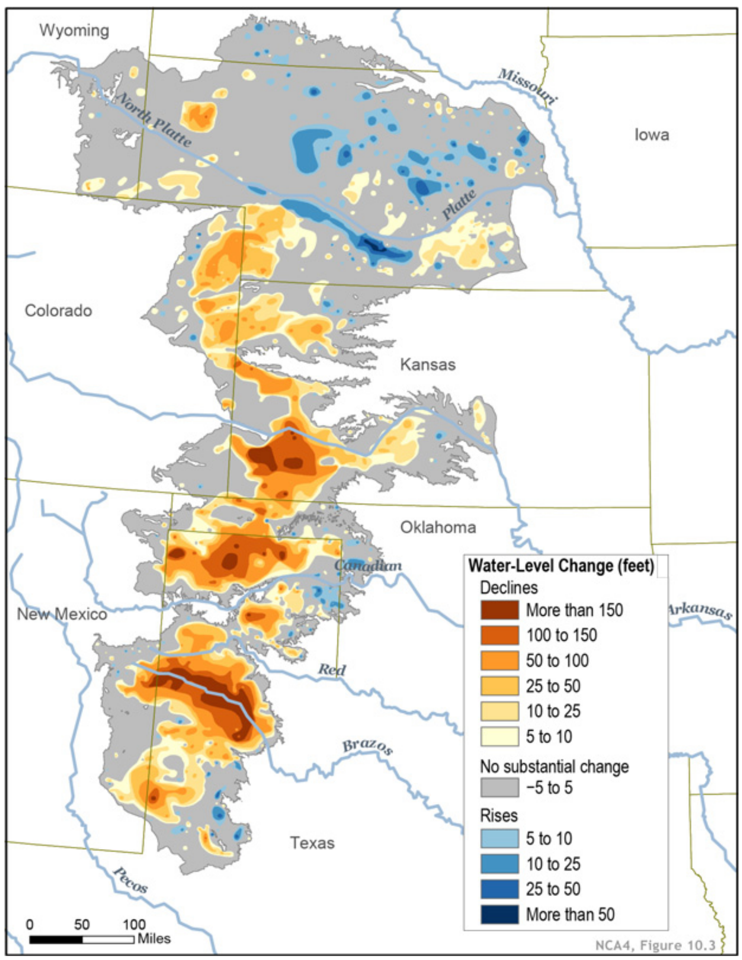

Figure 3: water level change of Ogallala aquifer since being tapped

Agriculture negatively affects wildlife in other ways. As farmland continues to increase, natural habitat is lost, limiting natural migration patterns of animals, and forcing dangerous confrontations with humans as herbivores and predators alike are forced to enter human territory in search of food. Additionally, pesticides can have adversely affect the wildlife, working its way through the entire food chain as predator consumes prey. One of the most well-known examples of this is the decimation of the bald eagle population through the use of DDT.

Though often not visible, the economic, social, and environmental costs of agricultural practices in the U.S. are unsustainable as populations and food needs continue to grow. These hidden costs necessitate a change in how our food is grown and distributed, as the current system becomes increasingly untenable.

1.2 Food Insecurity

Defining Food Insecurity

Considering the heavy costs of modern food production, it is shocking that so many Americans still struggle to access fresh produce. These areas which lack grocery or produce stores that are easily accessible to residents are known as food deserts. There are also food swamps, regions where food access is available, but only via fast food restaurants or convenience stores which do not stock adequate amounts of fresh produce, or sell them at affordable prices. Unfortunately, many of the urban food deserts across the country are poor, minority neighborhoods, though as stated earlier, many rural communities are also finding themselves in a similar situation.

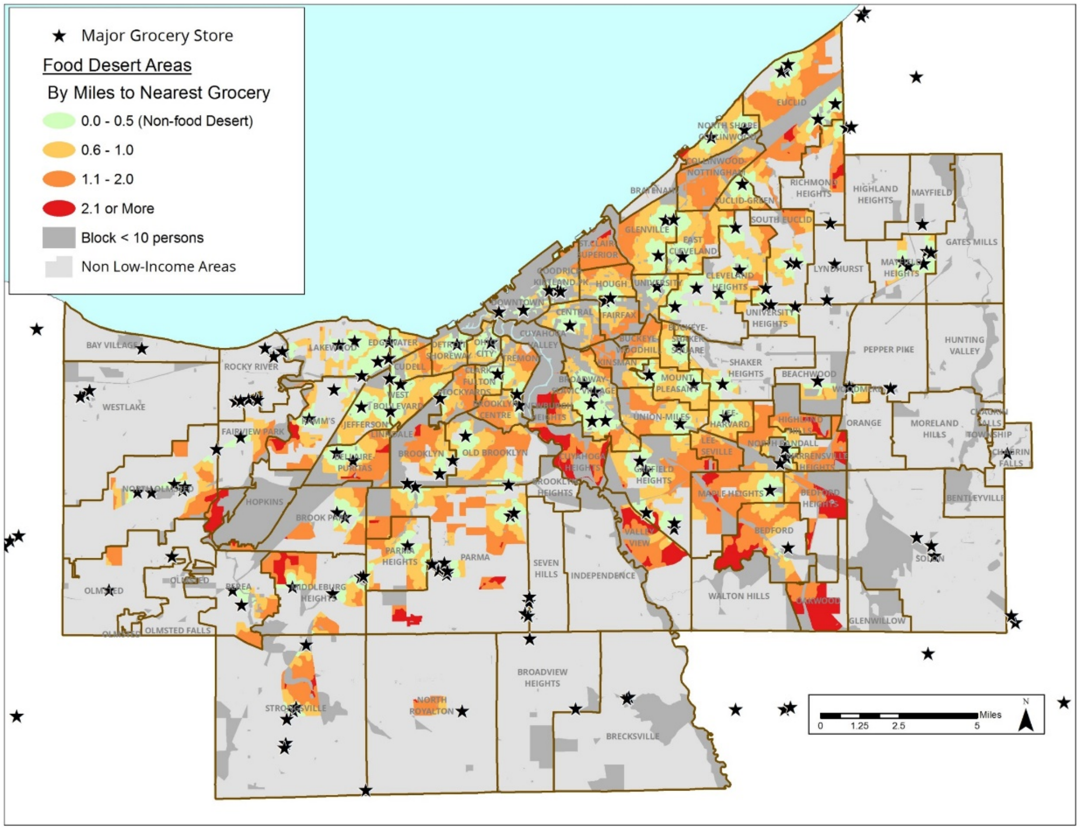

Figure 4: map of current food deserts in Cleveland Ohio

The rise of food deserts and food swamps is due in part to the increasing consolidation of grocers discussed in the previous section. As grocery stores became country wide brands, profits and costs became measured at a national scale, resulting in disinvestment in poor neighborhoods.

The Business of Food Access

Profit margins also affect the quality of food, in addition to its availability. Most processed foods have lower fiber and higher water content, which leaves consumers feeling less full, and thus requiring them to buy more product. Similarly the high sugar, high salt food available in food swamps create a chemical response in the consumer to crave more of the same stimulus, again resulting in increased purchases. Like any business, the food industry is interested in selling more product, the result being that neighborhoods which are already economically depressed have to spend more money for less nutrition and calories than wealthier areas that have access to fresh produce.

Health Impacts and Beyond

These conditions lead to an increase in obesity, and obesity related diseases, further draining the resources of disenfranchised residents.

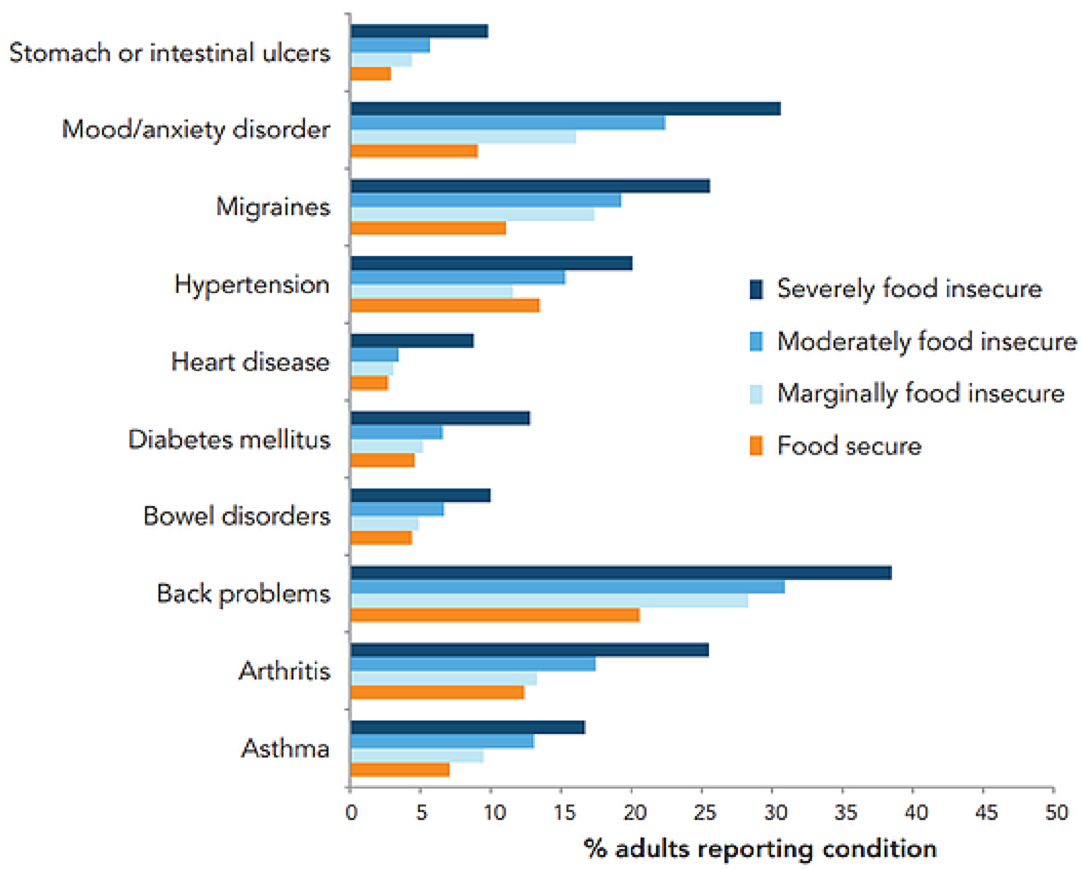

Figure 5: prevalence of chronic conditions in Canadian adults by household food security status

These increased health issues put a greater strain on the healthcare system. Additionally, children who grow up in food deserts develop poor eating habits which they are likely to continue throughout their lives, even if healthier foods are made accessible.

1.3 Industrial Cities as Opportunities

Rise and Fall of Manufacturing in Cleveland Ohio

Today, rustbelt cities are at a cross roads. The investments in manufacturing and industrial infrastructure over the last century have resulted in blighted landscapes that are extremely challenging to convert into more desirable uses. Additionally, despite the freedoms from geographic constraints given to us by technology, many manufacturing cities are experiencing a “brain drain” as highly educated workers are attracted to centralized hubs of tech, commerce, or finance. This results in the cancerous outgrowth of cities that already struggle to provide affordable living prices, while perfectly livable urban centers go to waste and decay. These cities are crying out for a new investment.

Filling the Void in Fairfax and Beyond

Those who remain in these industrial-centered areas are often trapped there through a lack of social or economic mobility. Suffering from unemployment and poverty, these communities are often victims of food deserts themselves. These out of work populations can benefit and be of benefit to a new industry in the area. The industry or urban food production. Providing jobs and products to a market desperately in need of both.

Agriculture is a business, and like many others, is moving towards a greater reliance on technology and eliminating the need for human labor. The assembly line worker profession is disappearing, while demand for skilled labor is rising. The challenge is meeting that demand within the communities most in need of job growth and economic investment.

One of the greatest hazards in food production is transportation. This is also a significant contributor to the industry's carbon footprint. Transporting fresh produce to urban areas is a tremendous challenge in terms of timing. Much produce and profit is lost in a delayed shipment. By having the means of production locating within the city itself, the food industry can cut down on transit costs and risk, as well as have greater outreach to urban markets which were once too costly to consider investing in.

Chapter 2: Heritage Management

2.1 History of Fairfax Cleveland

Migration from Agriculture to Industry

The Fairfax neighborhood is located on the East side of Cleveland, and is bounded by Euclid Avenue to the North, and Woodland Avenue to the South. Development of the neighborhood began in earnest around the mid-19th century, as manufacturing in the city expanded. The promise of manufacturing jobs attracted a large number of Eastern European immigrants, unable to find affordable land to work in their home countries, they came to start a new sort of life in the US. The Fairfax neighborhood was thus quite diverse in culture, language, and traditions through the beginning of the 20th century.

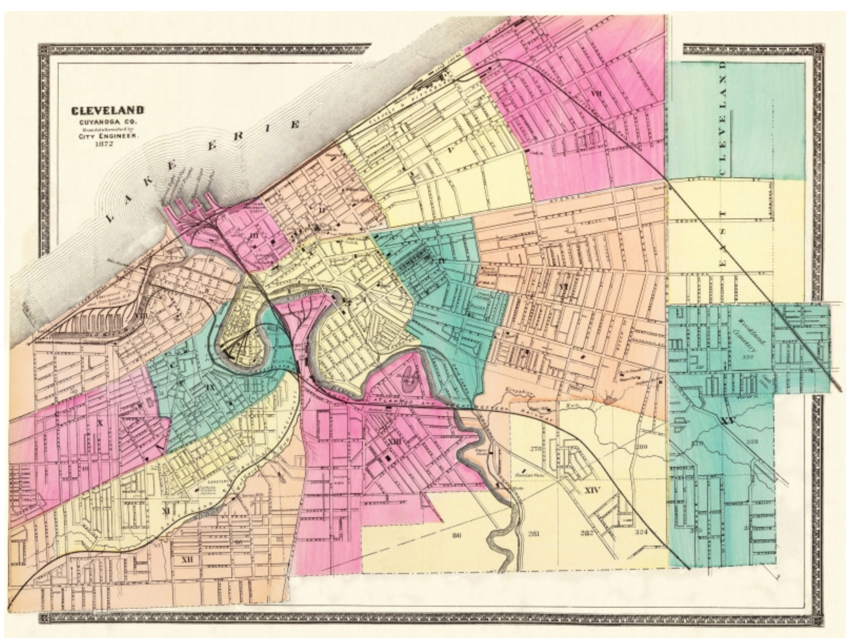

Figure 6: 1872 map of Cleveland Ohio

Following world war one, a labor shortage forced Cleveland factories to rescind their policies of banning African American factory workers. This policy change, common to many Northern industrial cities in need of workers, in combination with racial discrimination in the South, attracted large numbers of black tenant farmers, a demographic shift known as the great migration. This population growth continued through the 1930s in Cleveland, while at the same time the Jewish and Eastern European populations began to migrate to more prosperous neighborhoods further east. Such mobility was not possible for the African American population, as discriminatory practices were still common in Cleveland, even if not as severe as those practice in the South.

With that being said, while segregated in practice if not in law, the black community grew into a middle class neighborhood, with a number of well-known theaters, shops, and privately owned homes built during this period. Like the population preceding however, those who could afford to newer suburbs did in the mid-20th century.

It was also at this time that manufacturing in Cleveland as a whole began to decline. The lure of factory work which attracted waves of rural immigrants to the city abated, the neighborhood and its inhabitants are left with an uncertain future.

Current Needs and Demographics

As of today, the neighborhood is facing a different set of circumstances, and in need of a new industry to bring jobs and investment to the neighborhood. Like many other neighborhoods throughout the country, Fairfax is categorized as a food desert, and the health demographics of the residents reflect this.

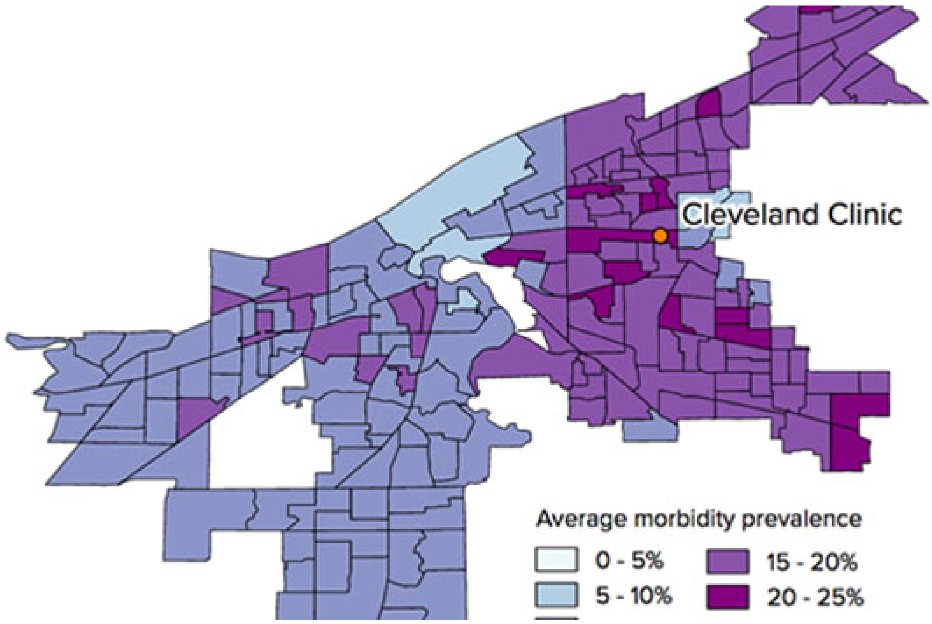

Figure 7: CDC map of comorbidity rates by census tract

Additionally, nearly half the population's income is below the poverty level, and unemployment is around 13%. The development of the Cleveland Clinic, rather than bringing respite to the area, has been a source of tension and concern for the citizens that have resided in the area steadfastly since the 1930s. The hospital provides few jobs to locals, but instead threatens gentrification, as the clinic grows and buys out property along Euclid Avenue.

The neighborhood that survived shifting populations for nearly a century is in desperate need of a new industry and new opportunities for the people that live there. Residents express fear that the needs and wants of the clinic (and the income it brings to the larger city) will overshadow the needs of the local community. With a steady loss in population and significant neighborhood structures and sites, there is real risk to losing the Fairfax neighborhood to the history books entirely.

2.2 The Importance of Food in Heritage and Culture

Gastronomic Anthropology

Food plays a role in all cultures, and the act of growing, preparing, and consuming food continues to carry cultural significance, and have impacts on the vitality and health (both emotional and physical) of communities. The idea of food sovereignty has been gaining popularity since its inception twenty years ago, particularly in application to indigenous populations; but the concept can have far broader applications. Not only in preserving food production and consumption practices, but restoring them. In Canada, studies of urban indigenous populations (many of whom suffer from the same food desert conditions ascribed to Fairfax) are finding that putting cultural significance and identity at the center of social improvement practices yields greater success. The relationships and sense of community is cited as one of the greatest benefits of practicing traditional food preparation. A benefit that would not be lost on Fairfax.

Gastronomic anthropology is a vast field, with sometimes conflicting approaches. The application of its intent in how food is produced and consumed by modern communities is already enough to revolutionize the entire ago-business system.

The Grocery Store

Part of Fairfax's history includes Doan's Corner, a stretch of shopping and entertainment, including a general store at one time. Throughout history, grocery stores have played a significant role in communities. The idea of the “third place” is often embodied in local grocery stores, even in modern chains. The challenge of Fairfax is that there are no grocery stores available whatsoever, but a response to this situation must consider how grocery stores, and grocery store shopping has evolved, and continues to evolve.

Figure 8: 1905 postcard of Doan's Corner

Some modern grocery store chains are responding to the historically social significance of the grocery store in a new way, focusing on experiential shopping with integrated wine bars and coffee shops. The focus is shifting from being purely fast and convenient to being enjoyable and meaningful. Part of this is due to the consumer’s increasing concern for local and organic foods, though again in the case of Fairfax, even accessing fresh produce at all is the primary concern. Like Gastronomic anthropology, the application of shopping design in tandem with other concerns is what will shape this new building typology.

2.3 Preserving and Interpreting History

Preserving Practice and Intangible Heritage

Preserving a structure is relatively straightforward compared to preserving a more intangible practice such as food practices. In one case study in Indonesia, intangible heritage of traditional theater production was maintained by re-structuring the practices into a new business structure, namely, tourism. Tourism is often a response to preserving historic or cultural practices, but this response can often lead to a slew of questionable outcomes. Gearing the experience towards outsiders can begin to alter the meaning and intent of the practice. Additionally, why many attempt to include an educational component, few outsiders can completely grasp the full significance, meaning, and history of a practice in the short time that they are there to experience it. While integrating the heritage of Fairfax into the new industry of farm/grocery store does parallel this response, the focus must remain on the neighborhood residents.

Additionally, when preserving a neighborhood identity as the neighborhood itself continues to change and evolve, the preservation efforts must be a distributed system rather than a singular intervention. For the purposes of this thesis, the site is studied as a starting point for such interventions, with the intention of becoming a catalyst and resource for future developments.

Interpretation Practice Outside the Museum

Too often history and cultural interpretations are contained solely within museums. When structures are adaptively re-used, the previous use and associated stories are not directly interpreted, but exist only in a government application document somewhere. Bringing historic and cultural interpretation and education outside the museum can be as simple as installing a plaque.

Additionally, virtual augmentation provides an efficient means of accessing a site's history and meaning without needing to unduly alter the physical structure or function. Scan-able QR codes can be used to overlay historic images, video, and even digital models that interact with the base structure, all through a user's phone screen. The digital platform also allows for faster changes and updates to the content, which keeps disruption of building function to a minimum. The ease of access also allows for greater user feedback and interaction, since any person with a smart phone can experience and contribute to the narrative.

Chapter 3: Urban Farming and Living Building Technologies

3.1 Crops and Production Methods

Choosing Crop Types

As described in the chapter above, food plays a significant role in heritage and culture. Therefore it is important to provide foods that respond to and reflect the cultural identity of the current community, as well as its past. Additionally, it is important to provide a nutritionally balanced and diverse crop selection that responds not only to the cultural, but the dietary needs of the community. Many urban farming businesses focus on a single crop. Microgreens are popular due to their scalability, small footprint, and fast turnover, which allows businesses to turn a profit much faster. The truth is, most urban farms simply cannot compete at the same scale of traditional farms regarding certain crops, whose sheer size and bulk production (however unsustainable it may be) help keep costs down. However, microgreens alone cannot feed mankind. A variety of nutritionally dense and diverse crops are necessary to fully meet the needs of the community, and avert the associated financial and health costs mentioned in chapter 1 that are a result of the type and quality of food options currently available in the area.

In response to this need for nutritionally diverse crops, it is important to understand that when it comes to indoor farming, one size does not fit all. Certain plant types are better suited for certain growing technologies and techniques. In most indoor farms, limiting the crop types and growing techniques obviously lowers costs, and is simpler to maintain and manage. The same is true for traditional farms, however as described in Chapter 1, there are economic, social, and environmental costs associated with this practice. Therefore several indoor growing techniques and technologies are explored, and the appropriate crops for each discussed in the following sections.

Aquaponics, Hydroponics, and Aeroponics

Hydroponics is a method of food production in which nutrients are delivered to the plants via water rather than soil. There are several variations of this growing technique, primarily differing by the means in which the nutrient water is introduced to the plants.

The wick system has the plants placed in an absorbent mineral or fibrous medium above the nutrient rich water reservoir. A wick draws the water to the plants as needed. This system can be done completely passively, but controlling the moisture absorption by the plants versus the growth medium can be difficult.

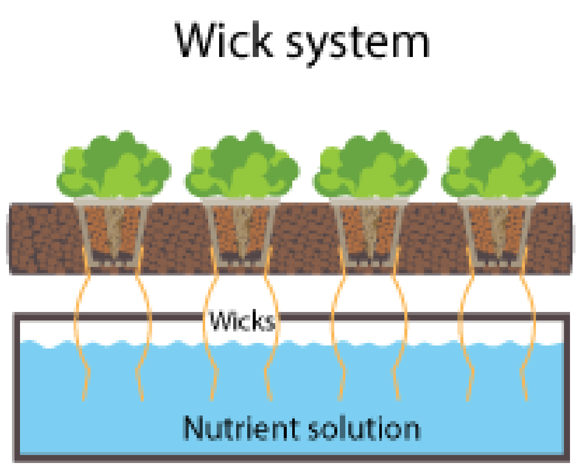

Figure 9: aquaponics wick system

The raft system (also called deep water culture) suspends the plants directly within the water, which is aerated by a pump, providing oxygen and nutrients to the plants. Because the roots are directly exposed to the water, their moisture and nutrient intake must be highly controlled. Leafy greens and herbs are well suited for this technique because they are small and lightweight, and will grow large and fast with lots of water.

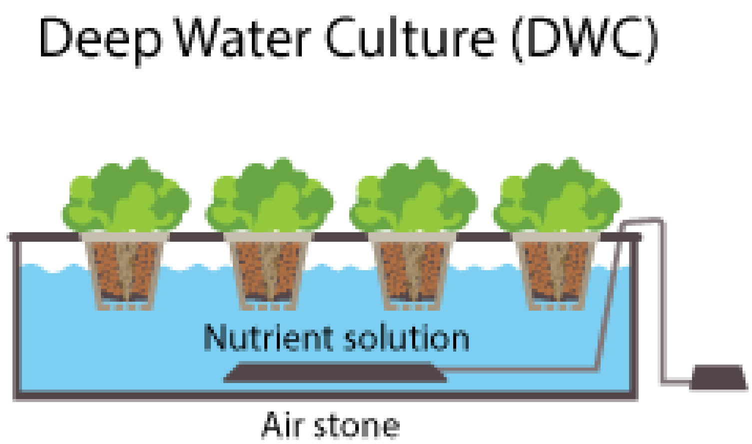

Figure 10: aquaponics raft system

The drip system also suspends the plants above the water in a growth medium. A pump connected to a piped distribution system delivers the water to the plants at a controlled rate. The excess moisture drips down through the growth medium back into the reservoir to be recirculated. Because the magnitude and frequency of saturation can be controlled and adjusted relatively easily, the infrastructure can be adapted to different crops as seasonal demands change. However, the more involved infrastructure does invite additional issues such as clogging or leaking pipes, which of course requires additional monitoring and maintenance. Because the plants are not suspended over the water, larger crops such as pumpkins, zucchini, tomatoes and melons are well suited for this technique.

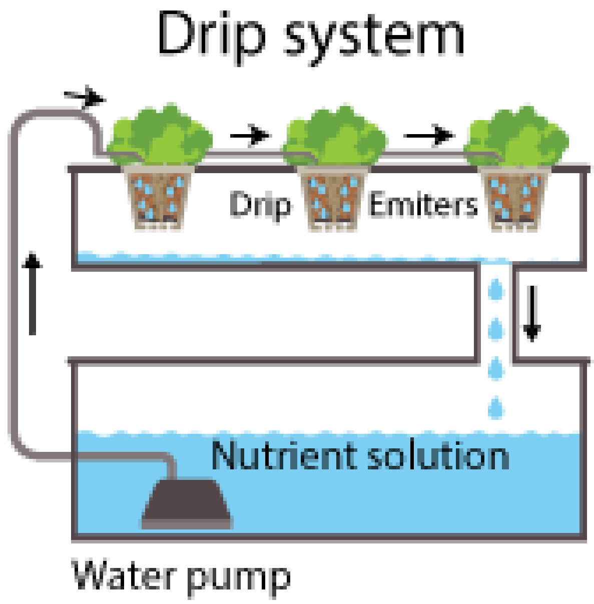

Figure 11: aquaponics drip system

The ebb and flow system has the plants in an absorbent growth medium as well, but are stored separately from the water which is pumped in according to a set schedule. The excess water drains back into the reservoir. Because the plants are exposed to the water intermittently rather than continuously as in other systems, adjustments and repairs can be made to the water conditions without risking total crop loss. Medium to large plants that need lots of water but also support do well with ebb and flow, including cauliflower, strawberries, and cucumbers.

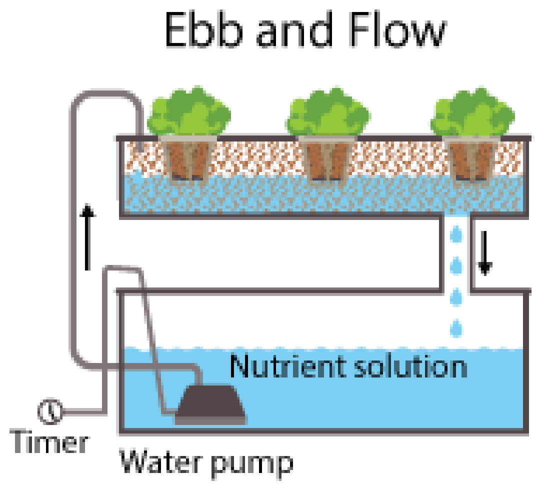

Figure 12: aquaponics ebb and flow system

The nutrient film system doesn't need a growth medium. Instead, the roots hang exposed from a support structure that is tilted. Water is pumped to the top and flows down the structure, hydrating the plants and being collected and recirculated at the bottom. Plants with deep roots do best using this technique.

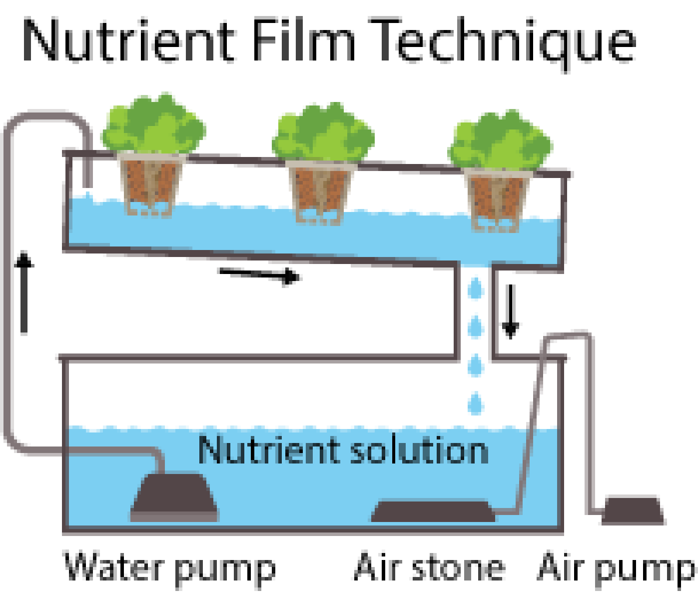

Figure 13: aquaponics nutrient film system

For the systems that utilize a growth media, there are several options. Peat moss, soft tree bark, clay pellets, and vermiculite are commonly used. Coconut coir is an increasingly popular media, in part because it can have very low environmental costs. The important factors when considering growth media are its ability to drain or retain water and nutrients, the inherent acidity level of the material and if that can affect the water solution, and the lifespan of the material. Like choosing the proper crop for each system, the appropriate growth media is really determined by the needs of the plant.

In all hydroponic systems the aeration, nutrient mix, water temperature, air temperature, light access, humidity, and plant spacing must be calibrated to the specific crop. Additionally, each of these factors must be tightly monitored and controlled to ensure successful growth and harvest. As with most indoor farming techniques, as variable elements such as weather and soil are eliminated from the process, so too is the flexibility they once provided.

The benefits of a hydroponic system is that there is no need to maintain healthy soil, which means one less resource that must be maintained and monitored. Pests, disease, and harmful bacteria can develop in soil, which must also be maintained to deliver the appropriate nutrient mixture to the plants, in addition to water necessary for growth. While bacteria and disease may develop in water as well, it is far easier to monitor, maintain, and correct in the controlled indoor distribution systems than soil. Interestingly, hydroponic gardens generally consume less water than traditional farms, in part because being grown indoors allows for more control of water run-off and reclamation.

In hydroponic farming, the nutrient mix is an artificial component that must be sourced externally. Aquaponics provides for the nutritional needs of the plant from the waste produced by another crop: fish. After the water has been processed by the plants, it is recirculated in the fish tanks, providing the fish with clean water which will again become nutrient rich and be fed back into the plant beds. Aquaponics can be integrated into most hydroponic systems. In addition to further reducing the water waste of indoor farming, the fish themselves become an additional crop to be grown and sold alongside the produce.

Aeroponics take the water conservation of aquatic agriculture one step further. The plants are suspended with exposed roots which allows for greater oxygen intake, and are misted with nutrient rich water. Aeroponics lends itself to vertical farming systems which can lead to a more efficient yield per square foot. While many aquaponics systems can be stacked like tray beds, this necessitates artificial lighting for each layer, which again increases energy consumption. Aeroponic crops can be grown not in stacked beds but in truly vertically oriented ones, which allows greater access to natural daylight. Root crops which may struggle in aquaponics systems (such as carrots, potatoes, turnips, etc.) thrive in aeroponic practices, assuming that the structure is appropriately scaled to the plant size.

Because of the control afforded to indoor farming systems, the rate of production, yield, and quality of the crops are greatly improved compared to traditional farming (acknowledging that the scale of operation differs significantly). It is important to keep in mind the limitations of these technologies. Most crops must be grown in traditional germination plots before being transplanted to a hydroponic or aquaponics system. While water waste, pesticides, and oil consumption are avoided, there are increased energy costs for lighting, monitoring, temperature control, and water circulation.

Soil and Composting

Traditional raised beds also have their place in urban farms, primarily in filling the gap of crops that may not thrive in an aquatic agriculture setting. The key to raising sustainable, soil based crops is in sourcing sustainable soil. Composting is an important element of this, as it allows for a certain extent of resource reclamation as organic waste from existing systems can be utilized in the compost, which will then go back into creating healthy soil to feed the crops.

Compost is essentially a mix of organic material that has decomposed back into a basic nutritional stew (or fertilizer) that can be mixed with topsoil or other growth medium to ensure that plants receive an appropriate balance of nutrients. Bacteria and other microorganisms are responsible for the decomposition process, but can also be aided by macro-organisms such as fungi earthworms, and even fly larvae. The four elements of a good fertilizer are Carbon, Nitrogen, Oxygen, and water.

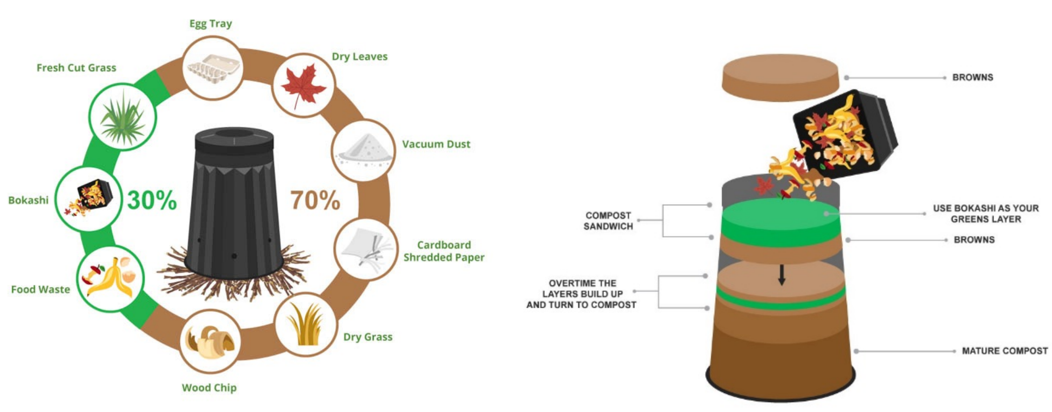

Figure 14: compost composition

To ensure the right mix of oxygen, composts are turned and aerated regularly. Water can simply be added manually or as part of organic matter. Most organic elements can be composted. Brown materials such as hay, straw, egg shells, coffee grinds, etc. are high in carbon while green materials such as fruit and vegetable scraps, grass clippings, and plants are high in Nitrogen.

Even as aquatic agriculture systems circumvent the need for soil and fertilizer, many of these systems require starter plants that have germinated in traditional growth pods. These germination pods can be fertilized with compost before the plants are large enough to transfer to the growth media. It is generally not recommended that compost be used as a growth media for aquatic agricultural systems because of the inherent inconsistency of the compost, which can upset the delicate pH of the water. While compost is high in nutrients, as stated in the previous section, successful aquatic agriculture hinges on the precise control of these elements.

3.2 Building Systems

Energy Production

The most suitable onsite energy production source for an operation of this scale would be solar collection technologies. Photovoltaic panels are an extremely popular option for energy collection. They are becoming increasingly affordable, have a long lifespan, and can installed most anywhere on site. There are however, several concerns with the technology. The panels are dependent on the weather to an extent, and having battery storage on site is a resource heavy investment, taking up space and infrastructure.

Additionally, photovoltaic panels become less efficient outside of a certain temperature range, which the seasons of the region fall far outside of regularly. For aquatic agriculture that must be properly maintained at all times, a lapse in energy can devastate a crop.

One alternative (or accompaniment) to photovoltaic panels is solar thermal collector systems. These systems use metal to reflect and concentrate sunlight which heat up a pipe of fluid. Often the heated fluid is used for water or space heating, but it can also be attached to a steam turbine to produce electricity for the building.

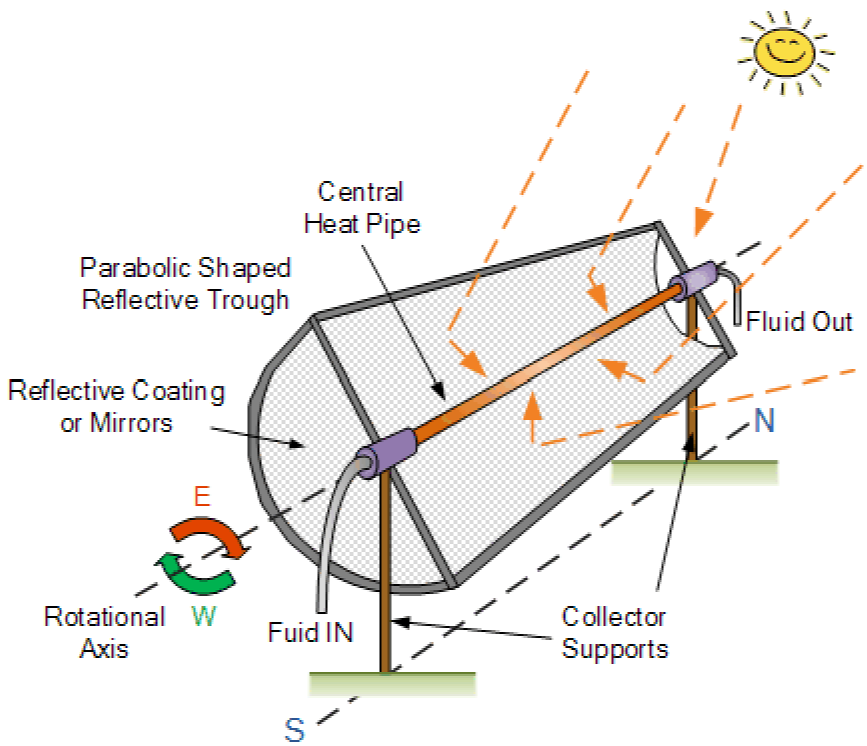

Figure 15: parabolic solar array system

Additionally, these systems tend to have an overall smaller carbon footprint compared to photovoltaic panels which rely on silicon and other highly processed materials.

It is important to mention that the most efficient form of solar energy use in regard to crop production is direct exposure to sunlight. Rather than use electricity to produce artificial lighting for the plants, many urban farms elect to use greenhouses or compound glazing systems, and using solar panels or other solar energy collection technologies to supplement the lighting, or provide electricity for other uses within the production process, such as water pumps and monitoring systems.

Climate Control and Insulation

As mentioned in the previous section, in addition to providing electricity, concentrated solar arrays can be used for space heating. Geothermal technology can also be used to heat and cool a space (but does require an energy input to function). In terms of regulating both passive, and mechanical climate control, insulation is key to efficient function. With that said, there are a number biomass insulation methods which utilize sustainable materials. These materials can be implemented in a number of innovative ways.

Integrating composts into brick is a developing field, decreasing thermal transmission while maintaining structural integrity. Bricks fired with coffee grind or mushroom compost provide an interesting outlet both for insulating the building and finding additional uses for organic matter produced through the building function.

Other methods of insulation include blown-in or filled insulation cavity between wall structures, again re-utilizing organic waste produced during food production. Such biomatter can be straw, sawdust, corn husks or coconut husks, again, materials that can be sourced from on site as waste from production or other functions.

Water and Waste Management

There are a number of options for procuring and filtering water on site. The first step in creating a sustainable water management cycle is of course procuring the water. One of the simplest means of accomplishing this is a rainwater harvesting system. By collecting the water run-off from the roofs and other surfaces, and storing it in a tank on site, one not only procures water for future treatment, but helps prevent flooding and run-off which are often challenges faced in urban areas plagued by impervious surfaces.

Once the water has been procured, the next step is to clean and filter it, which can be done to differing degree through various means. Carbon filters, sediment, and UV light sanitation can all be used to help purify and clean rainwater. Additionally, plants can be used as a filtration system, similar to their function in an aquaponics system. These methods can also be used to clean and prepare gray water from the building function for re-use in the crop production systems.

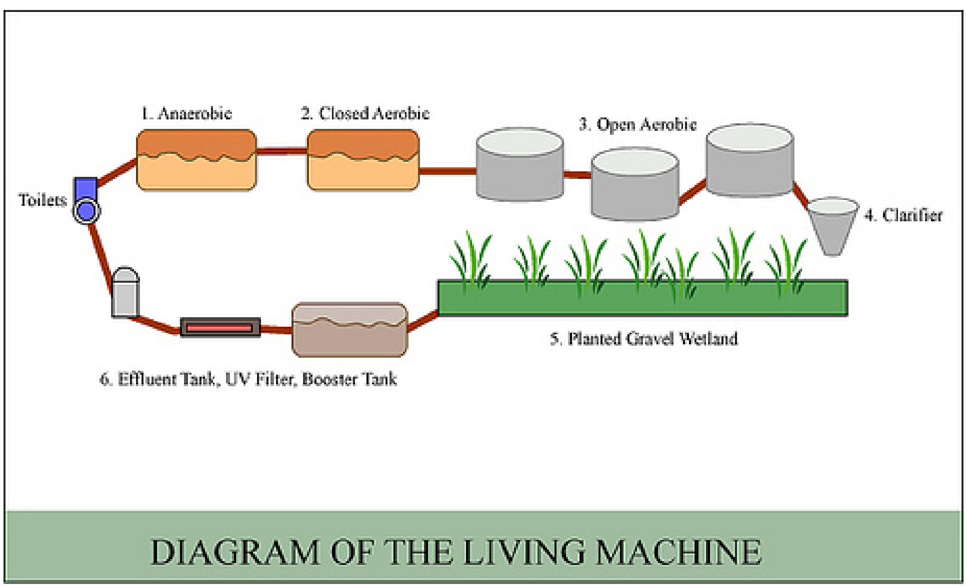

Figure 16: living machine system

Chapter 4: Site Analysis

4.1 The Region

The Rustbelt

The thesis site sits within the larger rustbelt region. As stated previously, this is an area of the country that is facing economic, and subsequent social downtown. Communities that once based their economies and identities on manufacturing and production industries are finding themselves lost and left behind.

Figure 17: map of rustbelt region

These communities are in need of an evolutionary intervention that can allow them to invest internally, and once again become thriving places. So while the thesis is sited in Fairfax, the resources, challenges, and potential application exist in similar locations across the rustbelt region.

4.2 The City

Cleveland

Zooming in on Cleveland alone, there are multiple locations across the city that have abandoned industrial structures, and can service nearby food insecure populations.

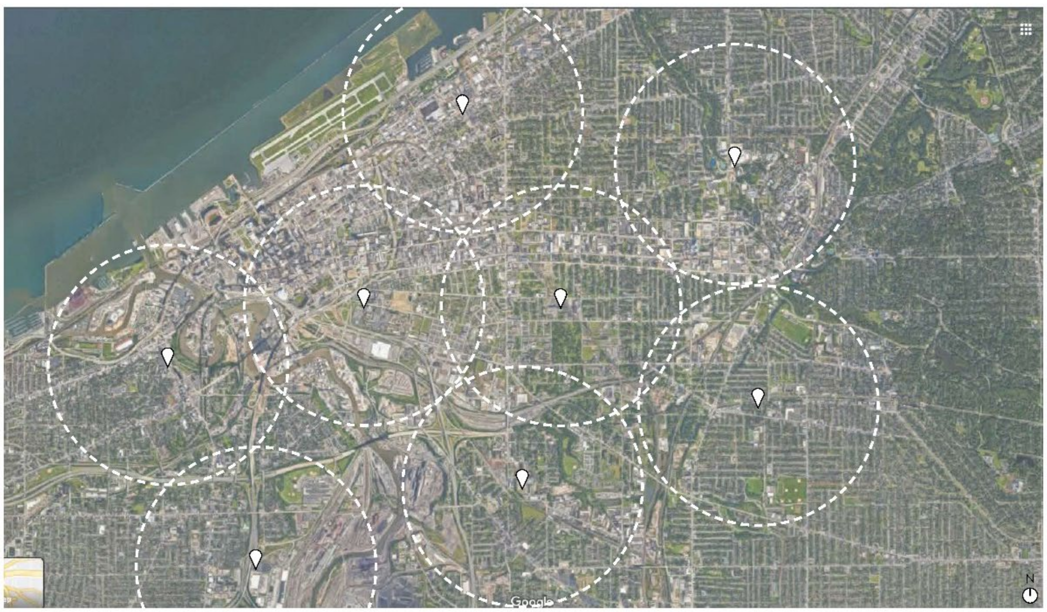

Figure 18: map of similar sites in Cleveland

Though this thesis is an exploration of the architectural interventions at a single site, it is possible to consider the design as part of a larger, citywide network of food production hubs which, in addition to meeting local needs, can also contribute to the existing global market, albeit along more sustainably scaled supply chains.

Fairfax

The neighborhood itself is dominated by the Cleveland Clinic which continues to expand to surrounding properties. The thesis site sits along Central Avenue, one of the main thoroughfares through the residential area, and so is very walkable for the community. Sitting at the tail end of a light residential district, site context is an ideal mix of existing infrastructure and opportunity for potential future reinvestment. Raised railroad tracks define the eastern edge of the site, also creating an overpass which connects the neighborhood to the site properties.

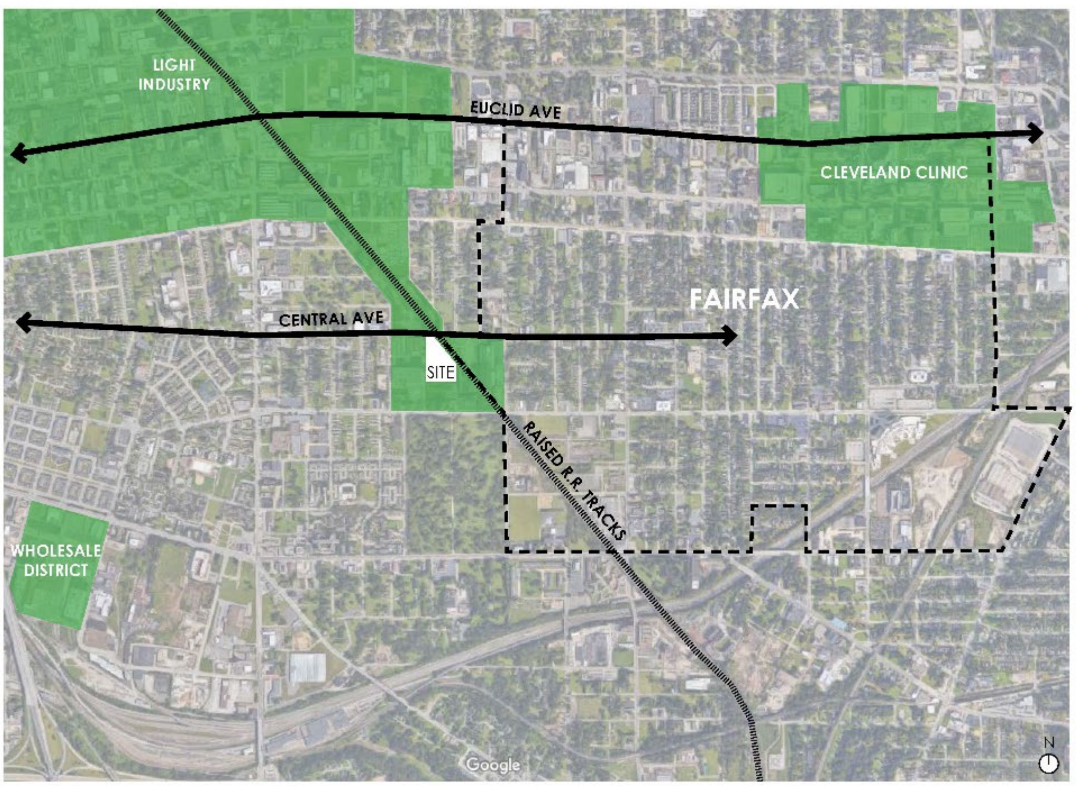

Figure 19: site context

4.3 The Buildings

The 1860 Buildings

The thesis site is composed of three adjacent properties, at the intersection of Central Avenue and East 67th Street. The northernmost of these properties is a stove manufacturing building constructed in 1860. The building was heavily fire damaged and has sat vacant for over a decade, but remains more or less structurally intact. The building sits right up against the intersection, and its historic facades are a defining characteristic of the streetscape.

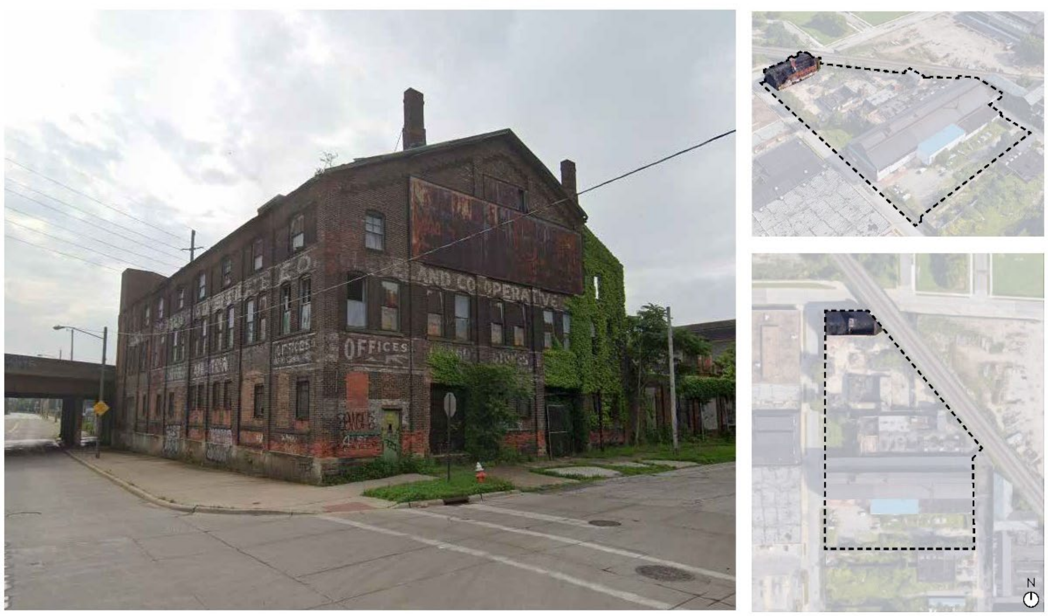

Figure 20: existing 1860 building

The Ruins

Adjacent to the 1860 building are the ruins of a structure decimated by the same fire that damaged the 1860 building. The fire left only a few walls remaining, providing the outline of the building's footprint and some interior rooms, but leaving mostly an empty concrete pad that is being overtaken by weeds.

Despite the damage, the periphery walls provide an edge to East 67th Street, and help define the property as an enclosed space.

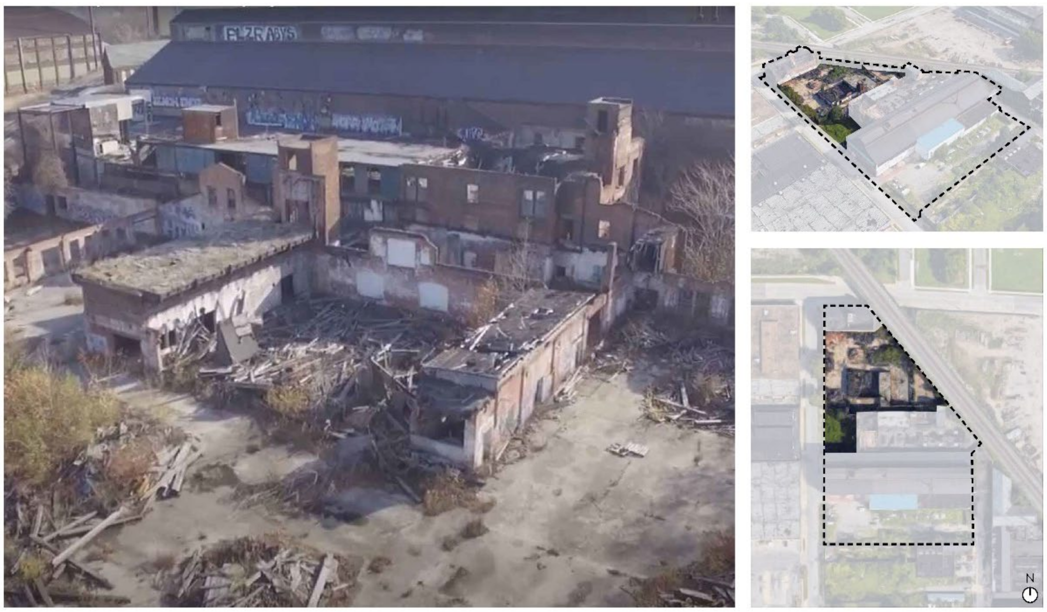

Figure 21: existing ruins

The 1910 Building

Bookending the southern edge of the site is a 1910 key manufacturing building. It has been in continuous use since construction, and reflects this, with many additions and changes visible from the outside. The northern additions are also fire damaged, but remain standing.

Figure 22: existing 1910 building

The inclusion of both the 1860 and 1910 buildings as part of the site provides an opportunity to explore how both vernacular and "high architecture" industrial buildings can be successfully adapted to new function and use. Additionally, the drastically different scales of the buildings allows for a similar diversity of explorations in terms of programming and use.

Chapter 5: Design Approach and Evolution

5.1 Economic Sustainability

Food

As has been stated earlier, the current food production system it not economically sustainable long term. Agribusiness fails to respond to the needs of places like Fairfax, as well as the farmers that sustain the industry. As such, an alternative framework must be explored, in which there is less financial risk associated with food production, and formerly neglected markets like Fairfax are addressed. The business of food cannot be ignored as an aspect of the thesis topic, so instead much be incorporated as part of the response.

Buildings

Now when it comes to economic arguments for preserving and adapting buildings, tax incentives and other regulatory elements often dominate the conversation. In regards to this thesis however, it is important to take the much broader view. These buildings have functioned for over a century. While adapting and redeveloping the site certainly poses upfront costs, these must be balanced against the investment in the existing and future site function. Looking at the true market cost of procuring new materials, land and labor and what detriments these may have in fostering a *sustainable* global economic system, as opposed to minimizing these complex costs of consumption and utilizing the existing resource of the buildings and land, and how this utilization can contribute to fostering a more stable and healthy future market.

Community

Currently, Fairfax is food desert and does not have access to fresh food. Economic factors contribute to this situation, namely that grocery stores are unwilling to invest in a depressed area where residents may not be able to afford to buy the fresh produce, even if it were available. With that in mind, food can be viewed as a resource, an opportunity to bring in a new industry that will not recede as manufacturing did, but evolve as needed.

Bringing urban farming and food production into the community creates economic sustainability by creating jobs for the residents, which can help stabilize the local market and allow the neighborhood to advance and grow. It is important to note that this architectural exploration is not a solution to what is a deeply complex and multi-faceted set of issues that contribute to Fairfax's economic woes, but it is important to consider the subject and integrate elements that can begin to respond to the issues, not as a singular solution but as a contributing element.

5.2 Social Sustainability

Food

One of the greatest drawbacks of the current food system is the disconnect between the things and how to actually relates to the land. To that end, education is an important element to guide the proposed design. Connecting people to the role food plays in our society, both historically and today. The cultural significance of food can also play a role in connecting the many populations that have inhabited the Fairfax area.

Buildings

Preserving the buildings is also of social significance, as they are important historic resources that represent the evolving history of the area. Education regarding the site's historical significance must also be represented, alongside its new role of food industry.

Community

Lastly, addressing the needs of the current residents must be considered in the design. As the Cleveland Clinic continues to expand along the main commercial corridor, spaces for the community to gather and represent itself disappear. The site must serve as a community resource, beyond industry and commerce, it must provide an area for the community to define and express its identity, even as it continues to change and evolve.

5.3 Environmental Sustainability

Food

Utilizing the agricultural technologies described earlier, it is the goal that food be produced on-site in a way that sustains the community, industry, and planet. Addressing the environmental issues of modern agriculture not by returning to a bygone era of small family farms, but by imagining a future that utilizes new technologies to foster a healthy ecology, in which agriculture and humanity can positively contribute to a healthy ecosystem, rather than consume its resources.

Buildings

Utilizing the existing buildings can also contribute to a more sustainable future. Not only by utilizing the embodied energy within the existing building, but saving on resources that would have been needed for new construction. Additionally, this project can be a case study for how to utilize similar building structures that are currently sitting vacant across the rustbelt region, avoiding additional future resource consumption for new construction.

Community

Residents will also benefit from the project, with access to public greenspaces improving mental and physical well-being. This is in particular contrast to the site's previous function as manufacturing plants which polluted the soil and air, likely causing health detriments to the surrounding community. In developing the project design, it is important to consider humans as part of a healthy ecology, and not somehow separate from nature.

With these considerations and principles in mind, the thesis design can begin to respond to multiple issues holistically.

Chapter 6: Design Proposal

6.1 Building Adaptations

Now this is a preservation and adaptive re-use project, so it is important to define the preservation principles guiding the design, the first of which is to utilize the historic features and character of the buildings in service of the new program, treating it more as a continuing evolution of industry rather than a complete shift in building function. Secondly, to include the history of neglect and deterioration of the site and region as part of the narrative, and not necessarily restoring the buildings to a previous period of significance. And lastly, to celebrate the industrial aesthetic that is so distinctive to the rustbelt region.

Beginning with the 1860 Building, we can begin to break down the physical interventions, starting with a new roof, then adding exterior storm windows to preserve the existing openings. Infilling the fire damaged portion with a glass and steel atrium, and adding more openings at the first floor to visually connect to space to the street. Finally, a glass and steel awning is added to denote the entrance without disturbing the historic façade.

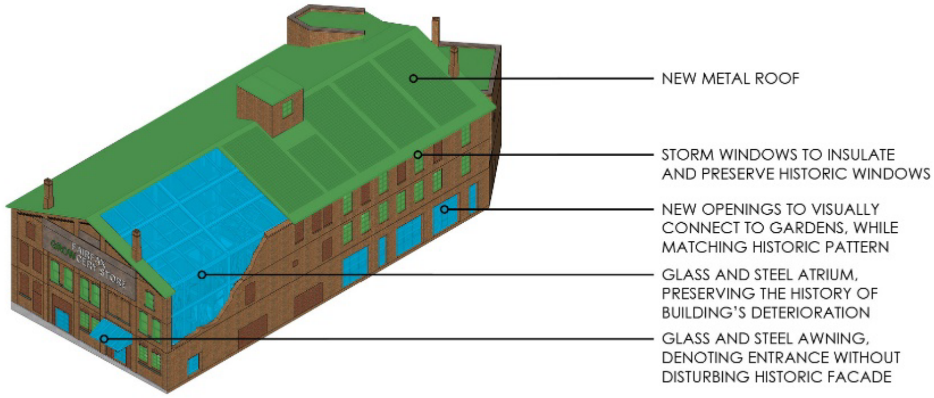

Figure 23: 1860 building adaptations

The ruins are more or less left alone, with the West structure being enclosed as a garden learning center, a glass and steel roof added to the east structure to create sheltered seating, and permeable pavement being added so water can be collected from processing and use in the food production.

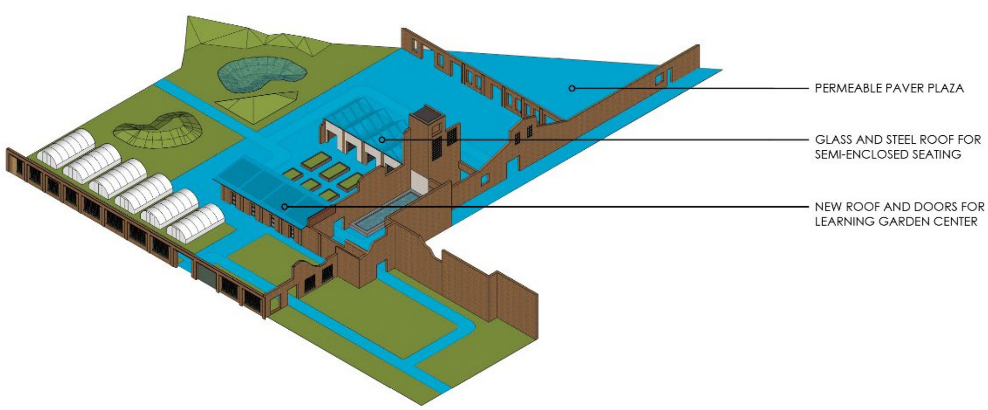

Figure 24: ruin adaptations

The 1910 Building too receives storm windows to protect the existing openings, a smart glazing roof to control the amount of light entering each growbed zone, new openings at the ground level, and a glass and steel awning. A parking garage entered from 68^{th} street replaces the fire damaged additions, while a chicken pen is installed just outside the café area.

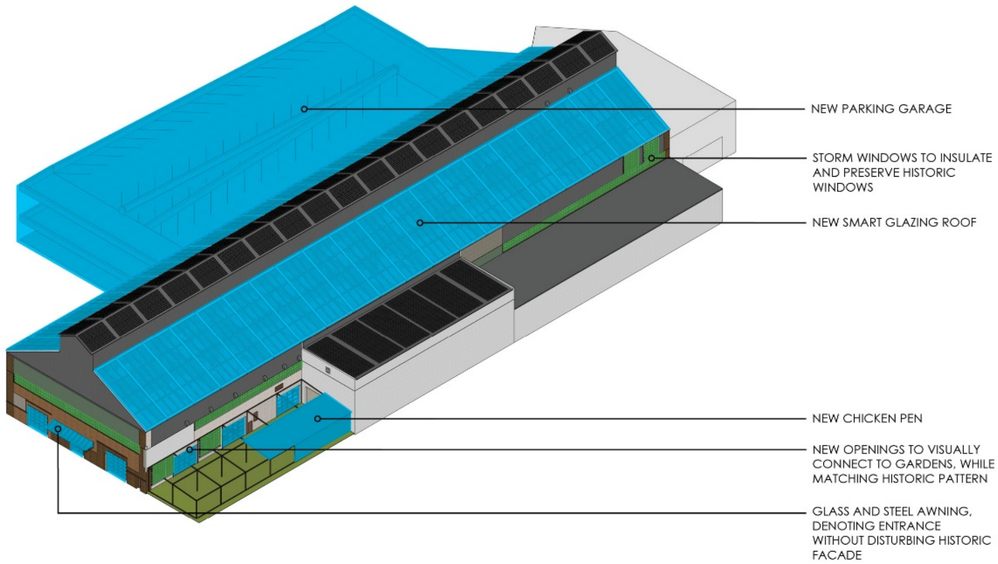

Figure 25: 1910 building adaptations

6.2 Programming

Looking into the actual program, it divides itself into three categories, in which the resources of food, industry, and community are integrated and reflected in each. So the first is food production, essentially the back of house factory/farm spaces that are being made visible as part of the education aspect of the thesis. The second is food consumption, the more traditional aspects of a grocery store that one visits to fulfill a primary need of obtaining food but formatted in way that educates people on how their food is actually grown and processed. Third are the public amenity spaces, treating the site not as a traditional private business that is closed off, but as a public resource where people can connect, learn, and celebrate their shared heritage of the food, site, and ecology that sustains the collective community.

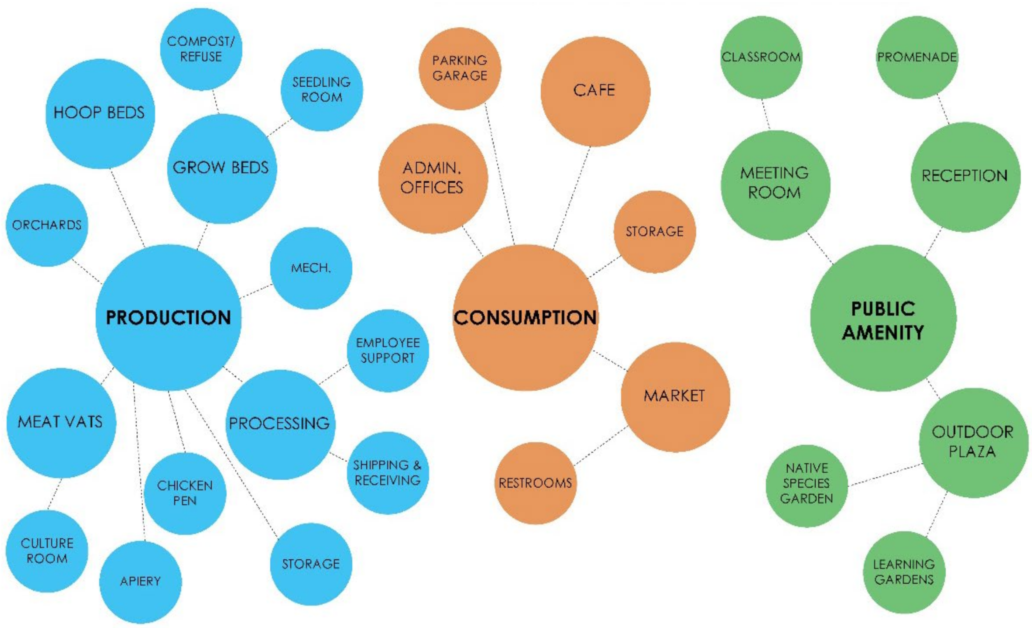

Figure 26: programming diagram

These program elements are distributed throughout the buildings on site, though for the sake of clarity a primary function is given to each adapted space.

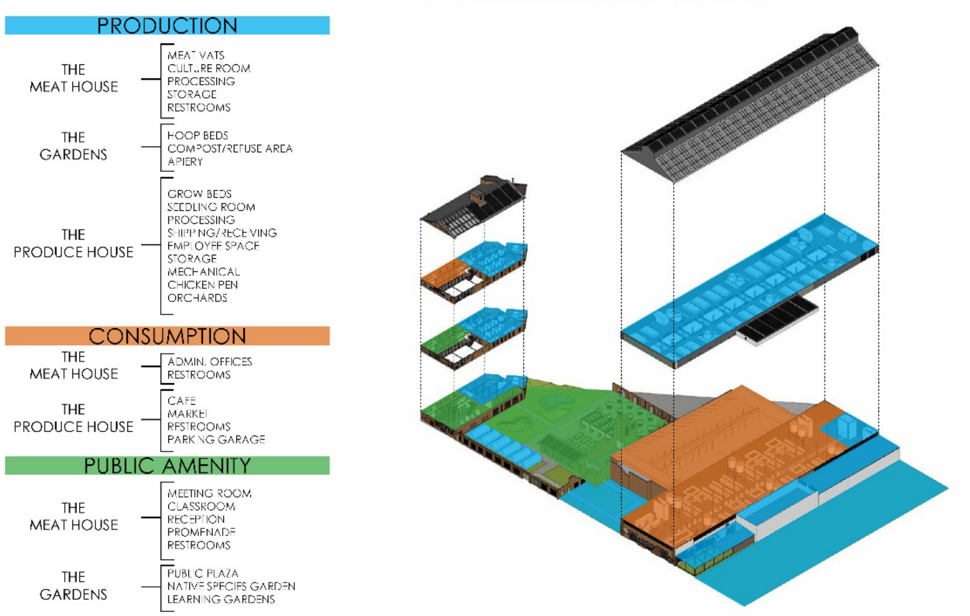

Figure 27: programming application

So now looking at the site holistically, we can break it down into The Meat house, The Gardens, and The Produce house.

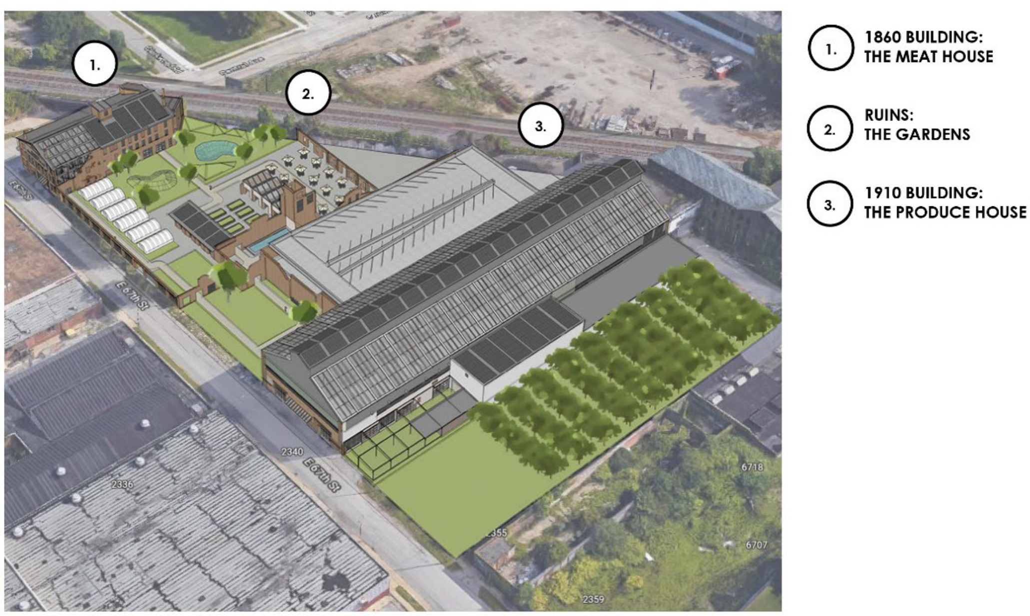

Figure 28: site map

The Meathouse, being the first structure encountered when walking along the main street, houses the reception atrium, community center spaces, as well as the artificial meat production facilities. People coming to the site for the first time can learn about the building functions in the atrium, where they have views in to the production spaces, community rooms, and public gardens. People can also tour the artificial meat production spaces, where proteins are cultured and grown in water vats in a process that looks very similar to touring a micro-brewery. The promenade leads people from the reception atrium to the gardens and the rest of the site. The space acts like a public porch, where people can gather sit, and enjoy the views.

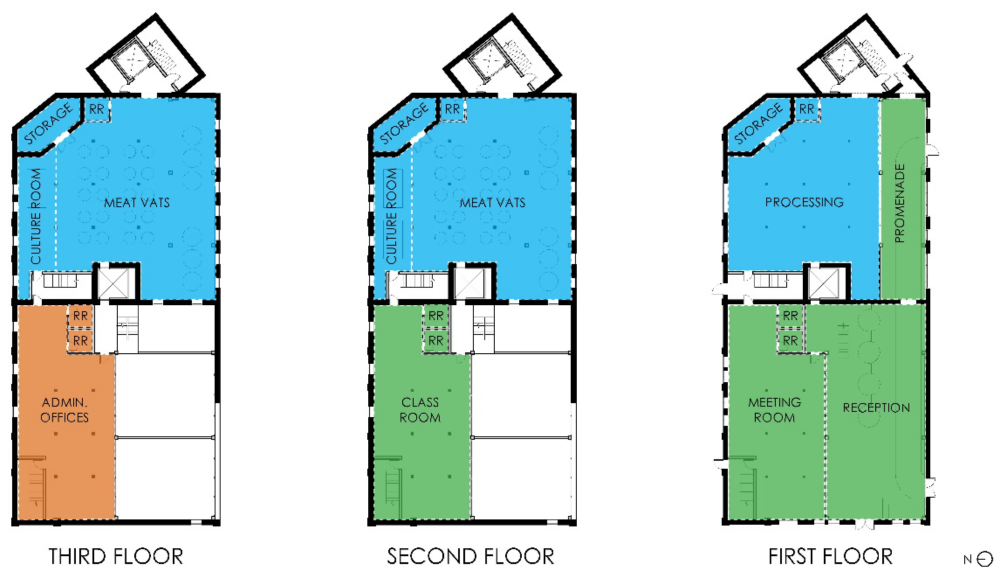

Figure 29: meathouse programming

Next, the gardens connect people entering through the meat house to the rest of the site, or can be entered directly from the side street. The gardens serve both a functional programmatic need of collecting water and housing crops, while also providing a beautiful space for the community to learn and connect to nature. Directly beyond the meathouse promenade is the native species garden, with community beds and an outdoor garden classroom beyond. Traditional hoopbed greenhouses are also housed in the gardens, for crops that are not well suited for indoor hydroponic growth. Sheltered seating also allows people to enjoy the public plaza space, even during cold or rainy weather.

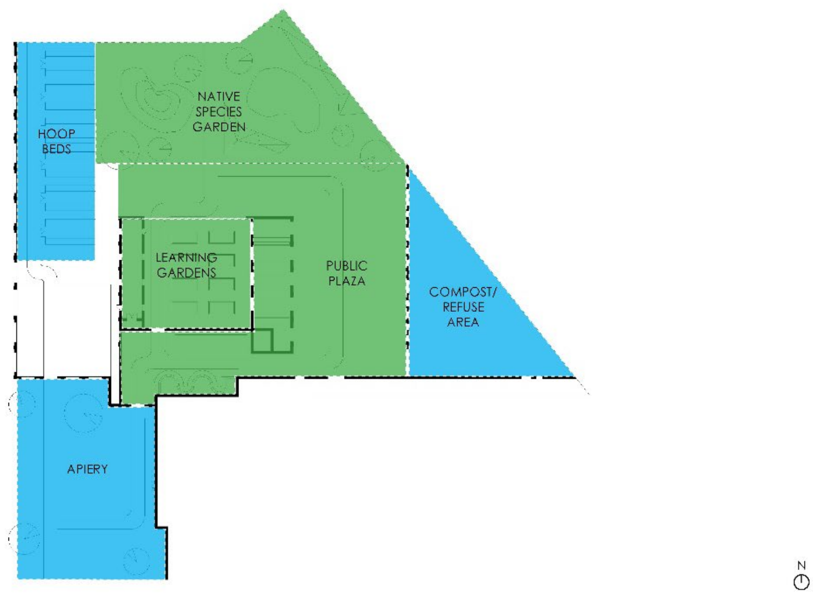

Figure 30: garden programming

At the other end of the gardens is the produce house, which has the hydroponic beds, market space, and café. The hydroponic growbeds are above the market, so that shoppers can see exactly how their food is grown and where it is coming from. The different growbeds are connected by a series of bridges across a central open corridor that allows views up from the market below. There is also a café that produces healthy dishes developed from ingredients grown on site. Shoppers can buy their produce, grab a snack, and watch the chicken pen while chatting with their neighbor.

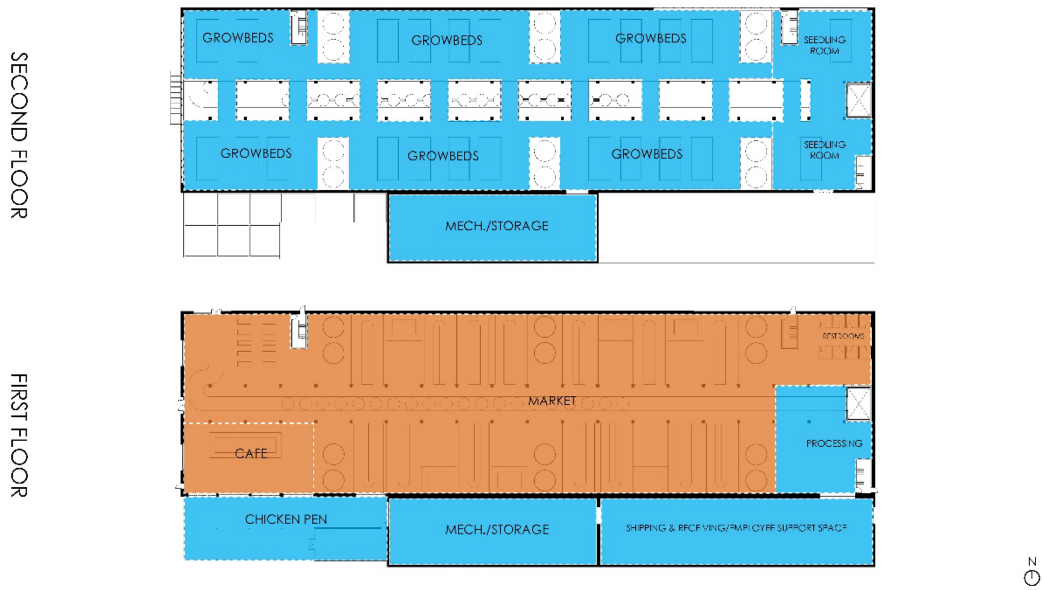

Figure 31: producehouse programming

The aisles themselves are low for accessibility. Infographics along each bin describe the lifecycle of the product, from seed, to plant to harvest, as well as nutritional information. On either side of the central produce aisle are processed items derived from the raw produce, so that even buying things like corn chips or poptarts, one has an understanding how that product is connected to the food that is being grown above.

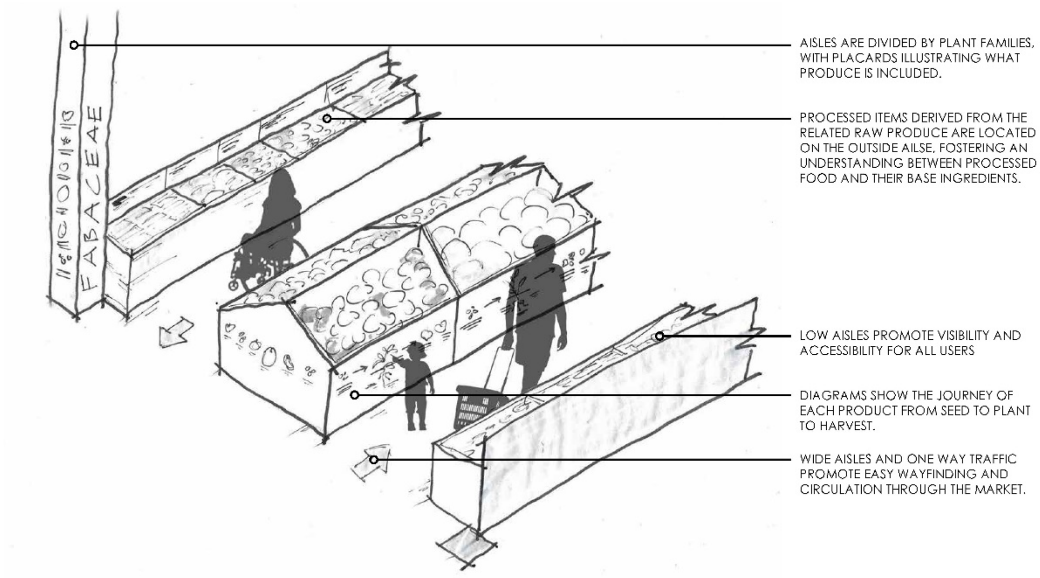

Figure 32: market aisle diagram

The market aisles are separated by plant family type, with local vendor stalls in between. The large water tanks needed for the hydroponic beds are also interspersed between aisles.

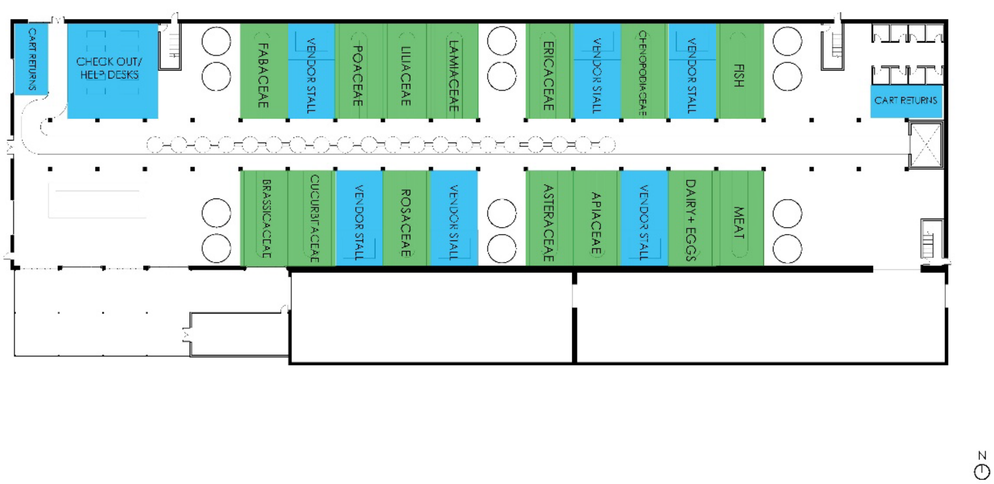

Figure 33: market aisle map

6.3 Circulation

Within each site element are circulation paths for each program function.

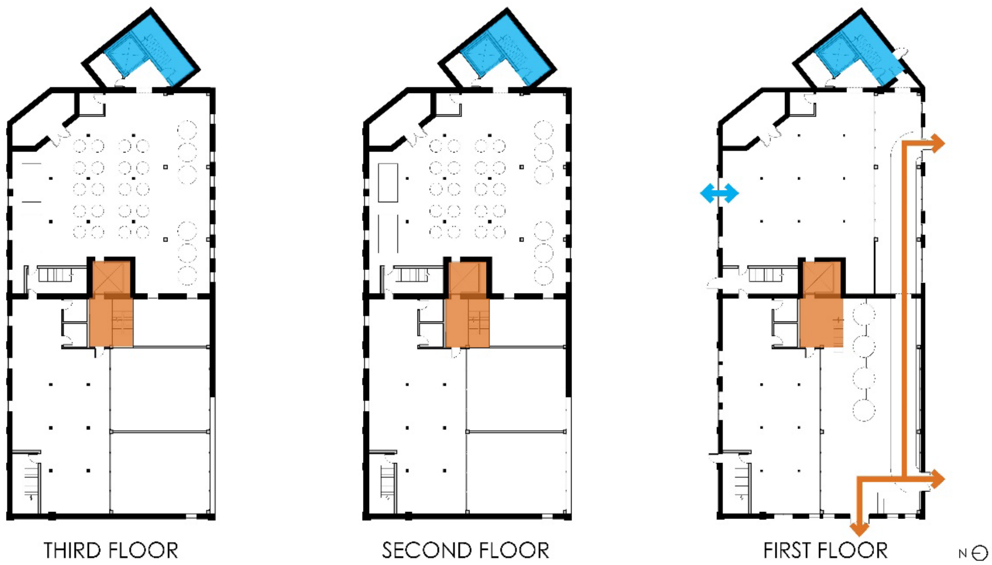

Figure 34: meathouse circulation

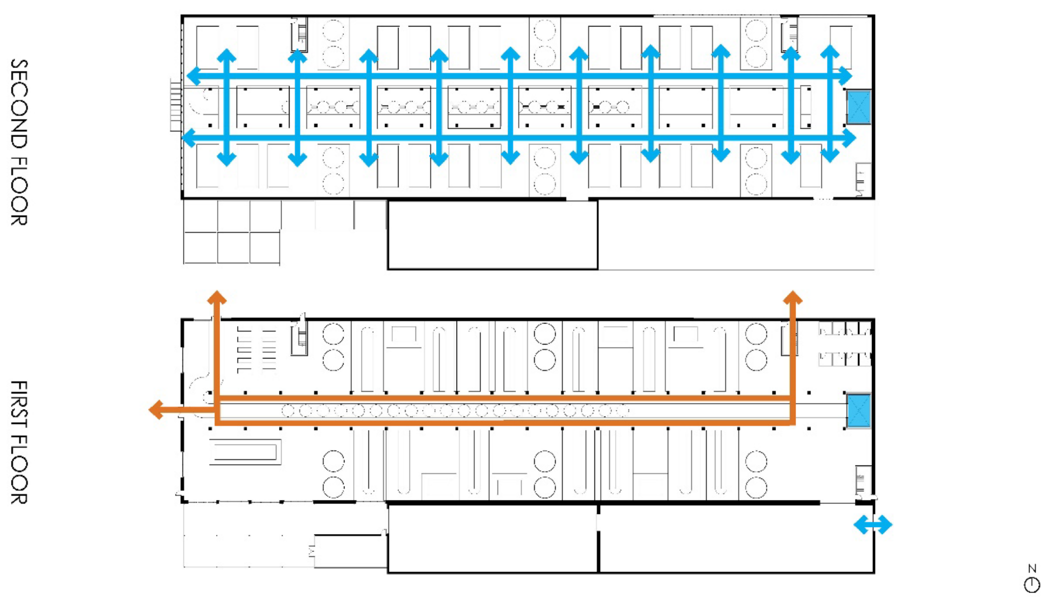

Figure 35: producehouse circulation

The main path started in The Meathouse continues into the garden spaces, helping people navigate the large site.

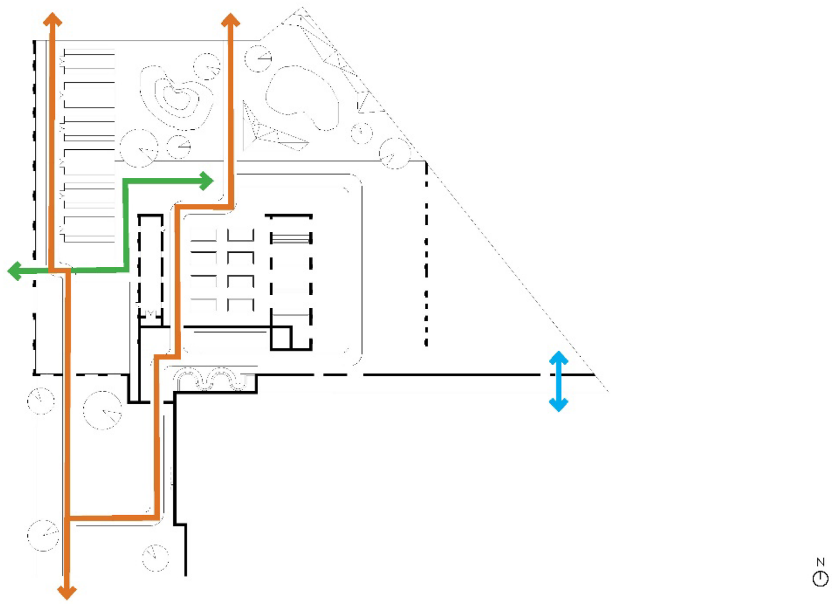

Figure 36: garden circulation

The scale of the site allows for multiple entrances, but is connected by the continuous path that winds throughout the site, visually connecting spaces and functions.

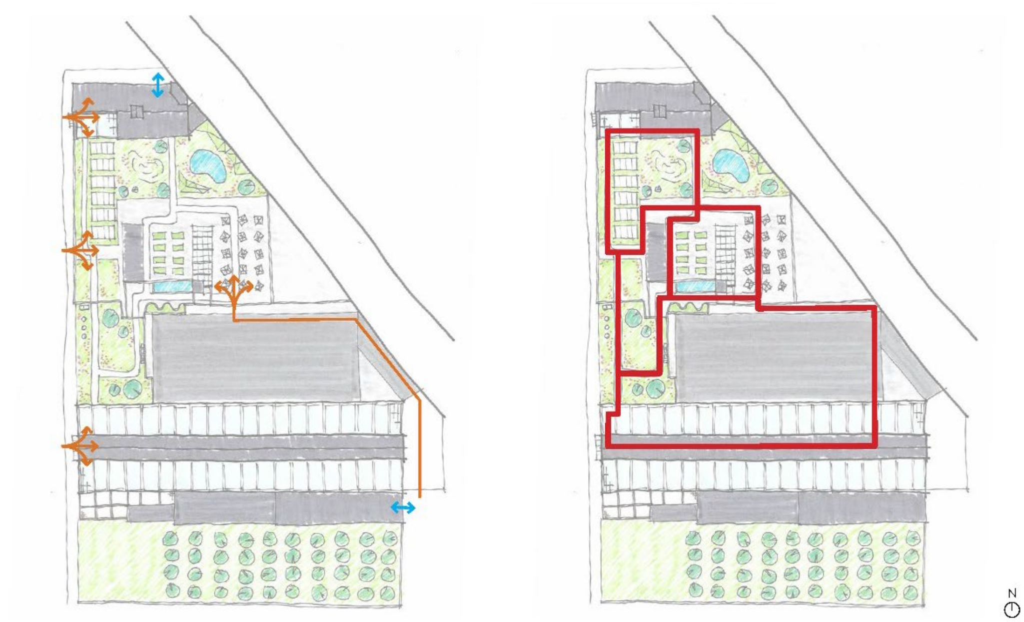

Figure 37: site circulation

6.4 Conclusion

In response to the unsustainable practices of today's food industry in which most people only see the end product, The Growcery Store offers a sustainably scaled alternative that imagines solutions to communities like Fairfax in terms of food, jobs, and an understanding of the environmental and cultural significance of food, all of which is made visible on site.

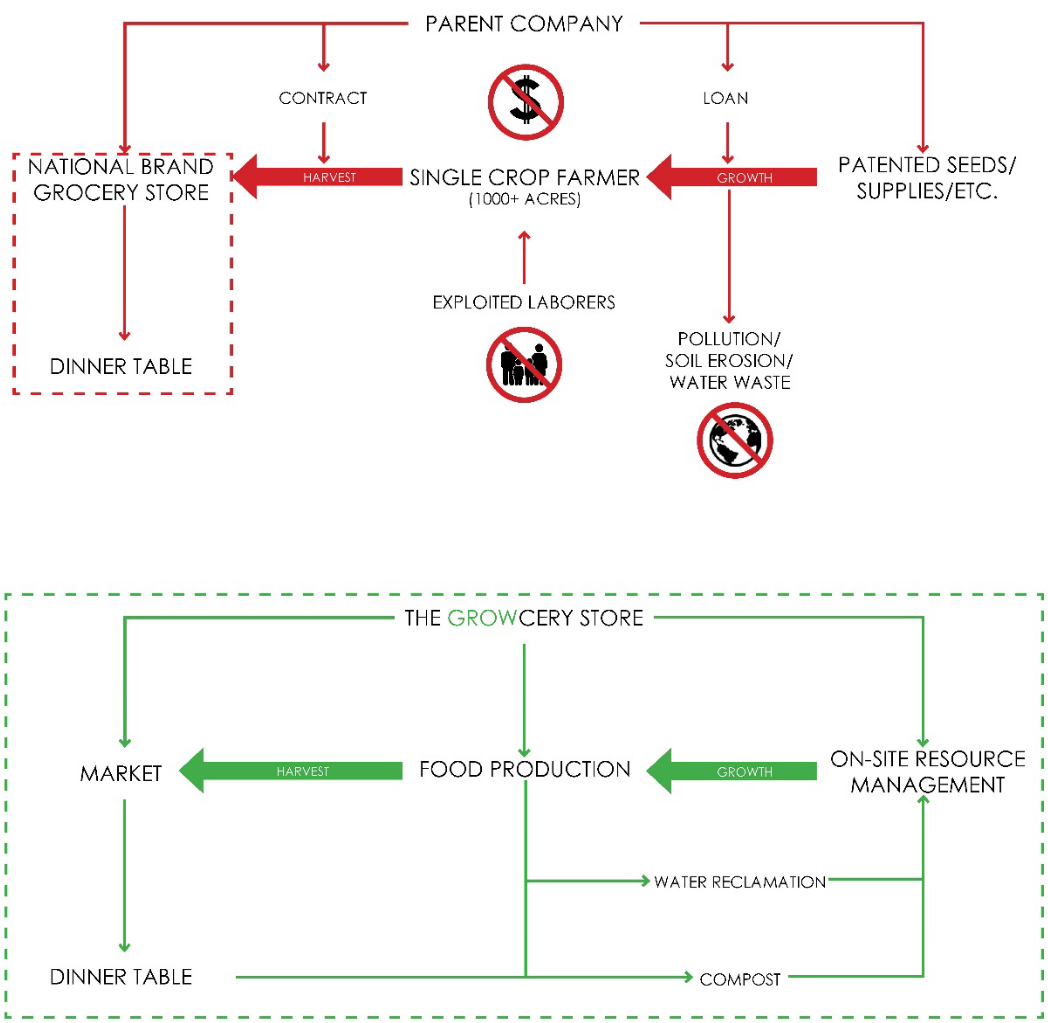

Figure 38: food system diagrams

The Growcery Store envisions the next evolution of food production and consumption, and how rustbelt communities like Fairfax can also evolve to play an instrumental role in that future.

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