Negotiating Form:
Reconciling Two Philosophies of Making Through the Adaptive Reuse of the Petroleum Service Station

by

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CONTENTS

ABSTRACT

The community workshop is a space where a group of individuals can collaborate and share knowledge and expertise to create customized products for themselves and their peers. These communities have crystalized around productive technologies such as the computer numerical controlled (CNC) router and the 3D printer, which minimize the advantages of economies of scale and enable individuals to compete with the entrenched systems of production and consumption. While these technologies present a more localized economy of making, they are imbued with two centuries of technological thought that eschew the innate qualities of the process of making in favour of a streamlined role within a highly choreographed system.

This thesis oversees the development of a new community workplace on the site of a former service station which, through its dedication to the automobile and to a regimented approach to distribution, embodies a prescriptive model of technology. This intervention seeks to confront the prescriptive understanding of technology, based on interchangeability and the certainty of production, with an alternative growth model that is based on flexibility, fit, and uncertainty.

Keywords: technology, production, growth, community, negotiation, interchangeability.

DEFINITIONS

Making: The activity in which a person brings something into being that did not exist before, as defined by the Ancient Greek term *poiesis*.

Technology: A process through which an individual or community engages with a material or idea to create an outcome in accordance with an infrastructure of tools, settings, and social expectations.

Production: A model of technology whereby the process is broken down into highly regimented tasks in order to minimize risk and ensure that the outcome matches the intent of those who plan the process.

Growth: A model of technology where the process is influenced by local contexts that have not been determined in advance, and are instead left up to chance.

Reciprocity: An unscripted negotiation that takes place between two or more entities in order to establish a mutually acceptable outcome. While some forms of feedback improve the performance of a process, reciprocity affords the opportunity to alter an outcome.

Prescriptive: Describing a method, described in advance, which is closed to interpretation or improvisation, eliminating the opportunity for reciprocity.

Enframing: An intellectual framework, projected onto materials, individuals, and landscapes, that evaluates these entitites as "standing reserves," intermediate sources to be induced into producing a secondary outcome.

Opacity: The degree to which a technology mediates a practitioner's encounter with the world. Cutting plants with a scythe, for example, is less opaque than using a hand-driven lawnmower, which is itself less opaque than driving a lawn tractor.

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CHAPTER 1: INTRODUCTION

The Community Workshop

The community workshop is a place where people who wouldn't normally have access to tools and workspace can use these resources to make, alter, or repair material goods. This emerging community space enables a new system of local provision that offers an alternative to the standard model of production and consumption by providing users an opportunity to define and satisfy many of their material desires on their own terms. The *makerspace* is a contemporary interpretation of this community space; an informal network of spaces that cater to a community of individuals, known as "makers", who adapt and create material goods for their own personal use. Although these communities are not overtly political, an ethos of self-reliance is embedded within the movement, providing users with an opportunity to break the cycle of production and consumption that has become entrenched in modern society.

> The maker movement, as we know, is the umbrella term for independent inventors, designers and tinkerers. A convergence of computer hackers and traditional artisans, the niche is established enough to have its own magazine, Make, as well as hands-on Maker Faires that are catnip for DIYers who used to toil in solitude. Makers tap into an American admiration for self-reliance and combine that with open-source learning, contemporary design and powerful personal technology like 3-D printers. The creations, born in cluttered local workshops and bedroom offices, stir the imaginations of consumers numbed by generic, mass-produced, made-in-China merchandise (Voight 2014).

While the maker movement's central ideal of productive self-reliance has its roots in a practice that extends well before the development of mass production, the movement has only been able to reach a popular critical mass in the last decade, as additive manufacturing technologies have progressed from industrial scales to tools designed specifically for consumers. According to Zach Kaplan, CEO of Inventables, "The key driver is that the cost of the tools such as 3D printers, CNC Mills and things like Arduino and Raspberry PI mother boards and other core tech products have come down and are in reach of normal consumers" (Bajarin 2014).

Additive Manufacturing

Additive manufacturing technology is based on the direct translation of a digital model into a material good through the consecutive addition of thin layers of a base material (Gibson, Rosen, and Stucker 2010, 1-2). Where the prevailing mechanized system of production had been enabled by the economies of scale that were afforded through repetitive manufacturing processes that produced interchangeable parts, additive manufacturing technologies can produce a given quantity of unique components in the same amount of time it takes to produce the same quantity of standardized components. (Gibson, Rosen, and Stucker 2010, 8). The ability to rapidly create unique parts drastically reduces the scale required to create a product and allows entrepreneurs to design and produce goods without investing in massive production infrastructures. In addition, these additive manufacturing processes minimize waste by curing only the material that forms the final product (Figure 1), creating both environmental and economic incentives for their inclusion in a modern manufacturing process. While the tools themselves promote a reduced scale, they require a significant investment in terms of both money and space, which has led to the formation of collaborative communities that share this burden of investment as well as their time and expertise.

While additive manufacturing is itself a relatively young technology, having been first

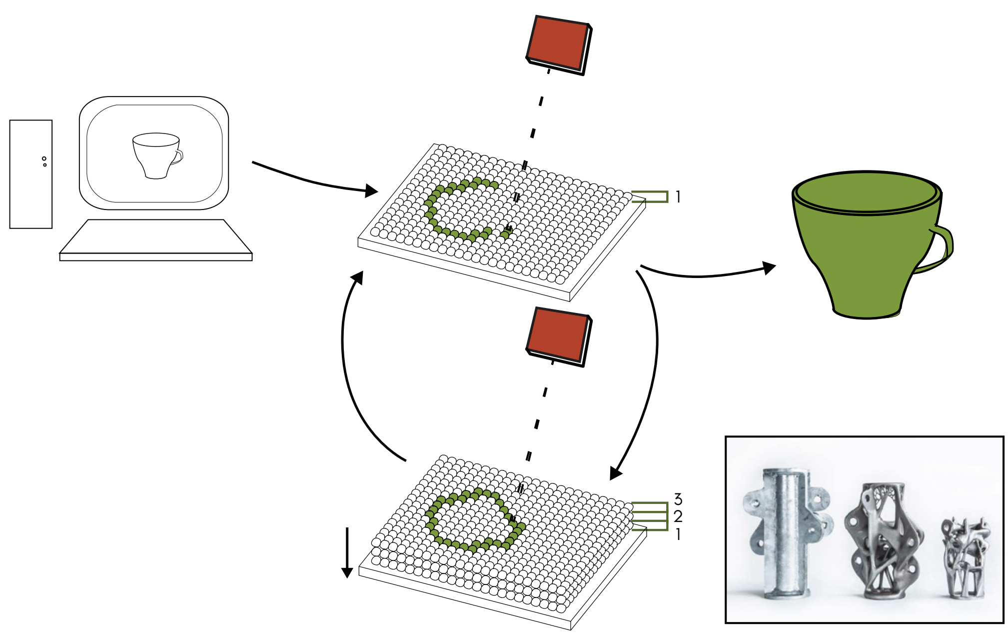


Figure 1. The selective laser sintering (SLS) process is a form of additive manufacturing where a material is laid out in successive layers of micropellets, which are selectively fused together to create a final form. Arup engineering have used this process to prototype structural steel components (inset). Image of 3D printed steel from New Steel Construction, 2015.

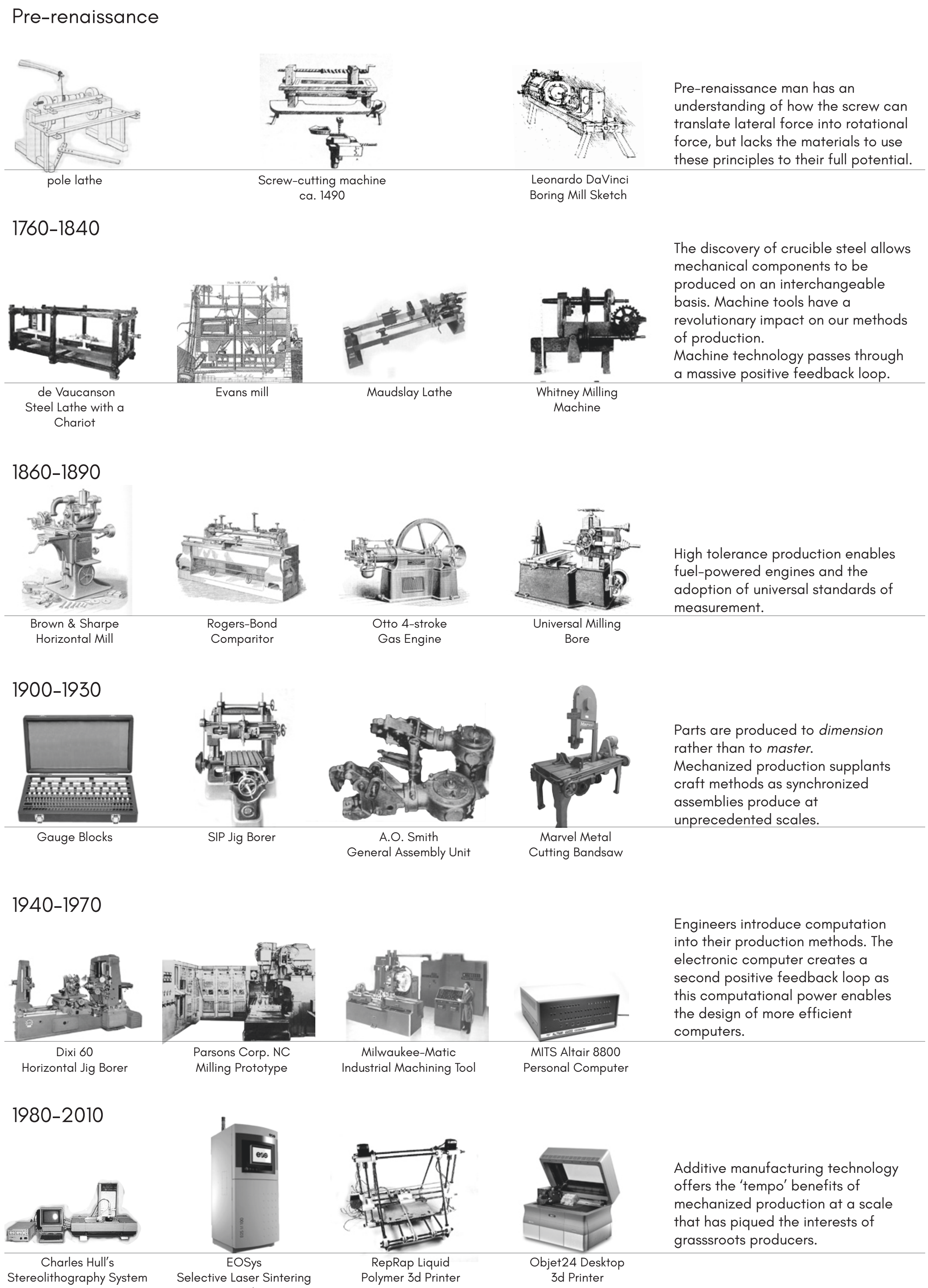


Figure 2. The evolution of machine tools follows a series of epistemological shifts. An understanding of the manufacturing potential of the screw gradually leads to the concepts of interchangeability, universal standards of accuracy, production to measure, computation, and additive manufacturing.

conceptualized in 1980, it is the most recent branch of a large family of *machine tools* (Figure 2). Although traditional definitions are based around the tool's ability to shape metal or other rigid materials, these devices are also united by the concept of reproduction and a shared reliance on the modern principles of interchangeability and measurement.

> Machine tools are man's most significant tools, since their purpose is to create other tools, instruments, and machinery. To make a distinction, machinery such as a weaving machine or a printing press may solve one problem, but have no heirs. A machine tool such as a lathe or jig borer, on the other hand, solves many problems in addition to generating a vast progeny (Moore 1970, 137).

A Technological Dichotomy

Although the word technology tends to be conceptualized as to the tools and ideas through which humanity interacts with the world, this thesis explicitly defines technologies as processes whereby individual practitioners interact with an infrastructure composed of tools, places, and social expectations (Figure 3). "There is a technology of prayer as well as ploughing; there are technologies to control fear as well as to control flood (Franklin 1992, 15)". The nature of the infrastructure that feeds into these processes govern the process and reflect back on the practitioner to shape not just the way they perform a task, but the lens through which they reveal the world.

The Philosophy of Mechanization

In 1816 John Hancock Hall, a boatbuilder-turned-gunsmith, designed a carbine for the United States' government. Although the outward design of this weapon differed little from its contemporaries, its production sparked a massive shift in the way that people relate to manufactured objects. Hall's rifle was the first man-made object to introduce interchangeable parts, where any individual component could be replaced by another piece made in the same factory (Moore 1970, 144). This revolutionary new method of thinking about production came in the midst of a period of rapid development in the world of machine tools, as the ability to produce high-tolerance metal parts allowed engineers to create devices capable of producing components to further augment themselves. Over the following 200 years, the concept of

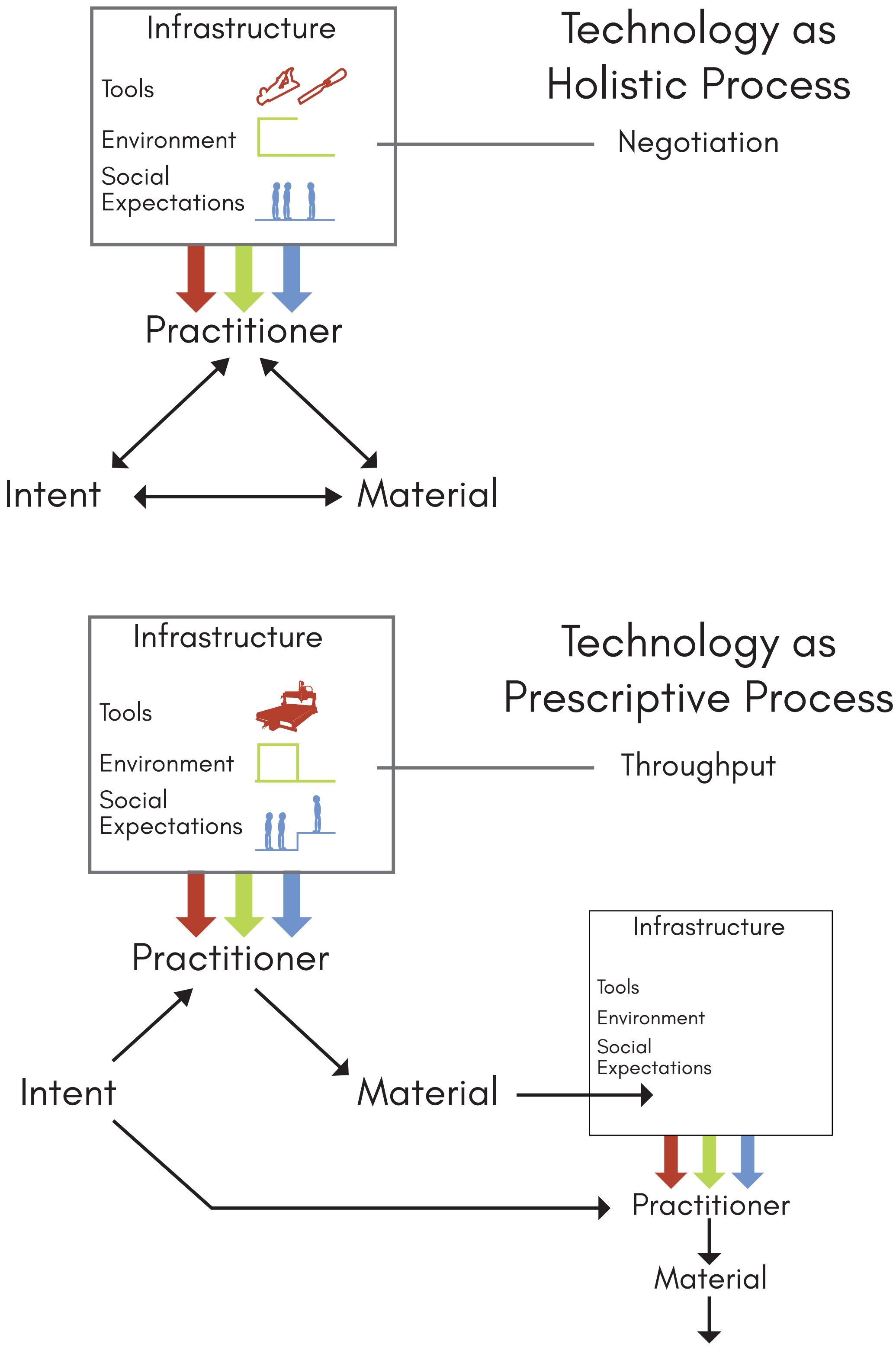


Figure 3. Technology is a process that can develop in either a reciprocal or prescribed manner, depending on the nature of the infrastructures that feed into it. The prescriptive approach adapts the idea of interchangeability to reduce the practitioner's agency in a pattern of dominance and subordination.

interchangeability has become ingrained into our methods of production to create an overarching philosophy based on measurement, computation, and tempo (Figure 3). By the middle of the nineteenth century the idea of interchangeability had moved from the product to the process, as the first assembly lines started to appear in bakeries and slaughterhouses (Giedion 1948, 169-256) (Figure 4). While the mechanized slaughtering process addressed a real need to process a vast quantity of meat within a short butchering season, the idea of high-throughput production was soon adapted to other industries, where the value of fast methods of production translated to higher profits.

Prescriptive Technologies

While interchangeability and the assembly line were new developments, production methods that relied on the division of labour by process had been around for millenia. One of the earliest recorded examples of this division of labour was the production of bronze vessels in the Shang Dynasty, described by Ursula Franklin:

> The casting steps that follow the assembly of the mold require different expertise.

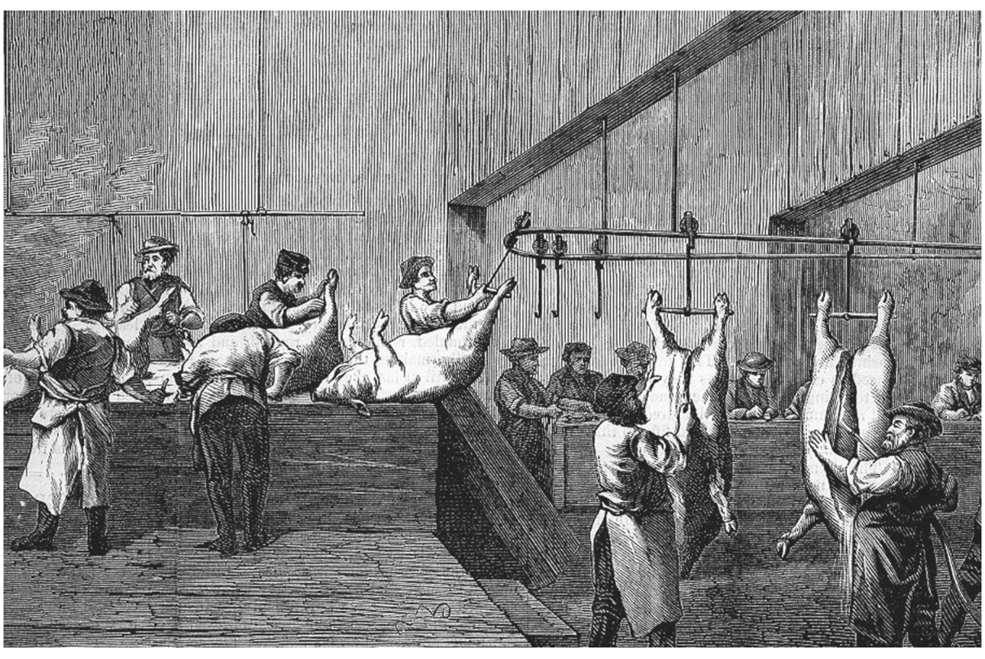


Figure 4. "Plump falls the hog upon the table, chop, chop, chop, chop; chop, chop, fall the cleavers. All is over. But before you can say so, plump, chop, chop; chop, chop; chop, chop, sound again. There is no pause for admiration." - Frederick L Olmsted (1857).
Image (Harper's Weekly, September 6, 1873) and quote adapted from Giedion, 1948, 217-218.

> Here the metal has to be prepared; the alloy has to be mixed in proper proportions and fused to a temperature high enough to allow a successful casting. Most, if not all, Chinese bronzes contain, in addition to tin, enough lead to make possible the casting of objects with very finely and elaborately designed surfaces. We are here talking about large castings. It is astonishing that toward the end of the Shang Dynasty, the Chinese cast cauldrons that weighed eight hundred kilgrams or more. From technical studies, such as X-rays of the vessels, we know that they were essentially cast in one pour. This means that groups of metal workers were handling about a thousand kilograms of liquid bronze to cast a large vessel. These alloys melt at about 1000ºC. They were poured from crucibles; a large number of them had to be ready for pouring at approximately the same time [...]
>
> Let's focus, for instance, on the need for precision, prescription, and control that such a production process develops. In contrast to what happens in holistic technologies, the potter who made molds in a Chines bronze foundry had little latitude for judgement. He had to perform to narrow prescriptions. The work had to be right - or else. And what is right is laid down beforehand, by others (Franklin 1992, 22-23).

Franklin defines this pattern of highly co-ordinated and divided production as *prescriptive technology*.

Holistic Technologies

Holistic technologies, based on the division of labour by product rather than process, stand in contrast to prescriptive forms of production. Prior to the rational development of interchangeable parts, these competing frameworks existed in a rough balance with one another, as the productive advantages of prescriptive technologies were far less universal. The holistic corollary to design for interchangeability is the more intuitive philosophy of design to fit, which found its place in the methods employed not only by skilled craftspeople in the production of artefacts, but in the common processes of living as well.

> Artisans, be they potters, weavers, metalsmiths, or cooks, control the process of their own work from beginning to finish. Their hands and minds make situational decisions as the work proceeds, be it on the thickness of the pot, or the shape of the knife edge, or the doneness of the roast. These are decisions that only they can make while they are working. And they draw on their own experience, each time applying it to a unique situation. The products of their work are one of a kind (Franklin 1992, 19).

Technological Infrastructures

The critical underlying difference between these two technological frameworks is the idea of *reciprocity:* a form of unscripted, unpredictable feedback and adjustment that takes place between an individual and the technological infrastructure, whether that infrastructure is a tool, a place, or other members of the community.

> In general, technical arrangements reduce or eliminate reciprocity. [...] Once technical devices are interposed, they allow a physical distance between the parties. The give and take - that is, the reciprocity - is distorted, reduced, or even eliminated (Franklin 1992, 48).

Peter McCleary provides a more elaborate understanding of reciprocity through the dual concepts of *transparency* and *opacity*, which describe the ways that technology interposes itself between practitioners and the world.

> Perfect transparency exists only where there is no mediation, as in the 'face-to-face' meeting or situation. We can experience either of two extremes; perfect transparency (that is, no mediation); or its opposite, the totally mediated situation in which one experiences not the world, but the machine-itself, which in turn encounters the world. In the latter case, the world is opaque to man, and it is not the technic that 'withdraws' but rather the world itself recedes from man (McCleary 1988, 328).

While both frameworks remain with us today, the introduction of interchangeability and the additional tempo that it provided to prescriptive forms of production has

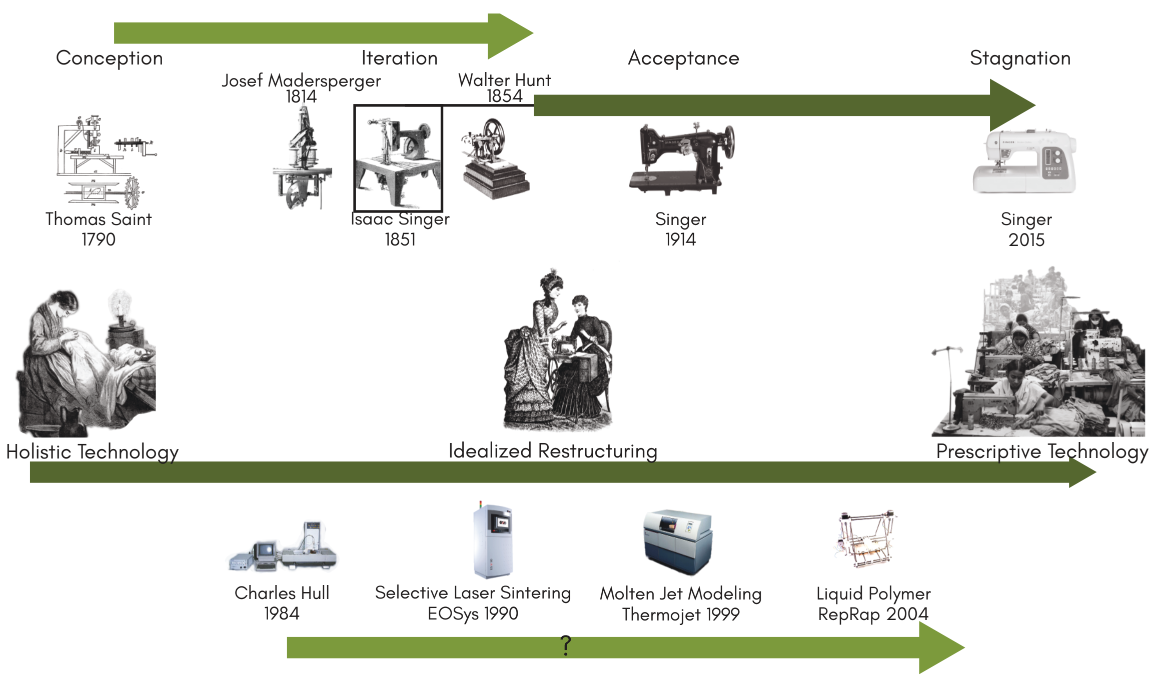


Figure 5. The evolution of the sewing machine, following the model of technological develoment described by Ursula Franklin. Additive manufacturing is currently undergoing the same developmental process, and it remains to be seen whether it will lead to a more democratic restructuring of the manufacturing process, or if it will continue along the same path toward opacity and prescribed use.

decisively swung the pendulum toward the prescriptive and the mechanical. Ursula Franklin describes this process of increasing prescription as something that is embedded in the modern technological progression, where a novel technology is first conceptualized before undergoing a period of explosive iteration and innovation. Within her model, this period of innovation is short lived and soon gives way to a terminal phase where the technology becomes accepted by society and a single form is chosen and streamlined. Any changes that occur during this terminal phase are purely cosmetic and the chosen form tends to remain both static and opaque, until a new technology arrives to displace it (Figure 5) (Franklin 1992, 93). This ubiquitous pattern demonstrates how a particular set of values has been projected onto nascent technologies, guiding them along a developmental path that favours efficiency and economy and suppresses the relationship between an individual and a device to a single prescribed interface.

Enframing and the Technological System

This philosophy of production has permeated throughout society, restructuring our social relationships in accordance with a *technological system*. Jacques Ellul defined technique as "the totality of methods rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity," a definition that includes all rational methods employed by society to govern its relationships, such as police, propaganda, and modern education (Grant 1998, 395). George Grant describes modern society's preoccupation with technology as global, autonomous, and self-augmenting. Although contemporary society has rejected most of modernism's underlying assumptions, our faith in technological progress, one of its fundamental tenets, has only become stronger over the last half-century.

> Technique is not limited by anything external to itself. It is not limited by any goals beyond itself. It is autonomous with respect to the areas of economics and politics – indeed, throughout society as a whole. It is the creator of its own morality (Grant 1998, 395).

In <u>The Question Concerning Technology</u> Martin Heidegger explores humanity's relationship with modern technology, enquiring into the essence of modern technology and how it has structured our perceptions. This enquiry starts with the ancient Greek concept of *poiesis*, an act of occasioning where three principal causes (*materialis*, *formalis*, and *finalis* – material, form and purpose) are gathered together through a fourth cause, *causa efficiens*, to create a product. This product is not necessarily a physical object, but could also be an artistic or poetic form of understanding. In essence, Heidegger argues, this is more than an act of creation: it is a revealing wherein the concealed becomes unconcealed.

> Whoever builds a house or a ship or forges a sacrificial chalice reveals what is to be brought forth, according to the perspectives of the four modes of occasioning. This revealing gathers together in advance the aspect and the matter of ship or house, with a view to the finished thing envisioned as completed, and from this gathering, determines the manner of its construction. Thus what is decisive in techné does not lie at all in making and manipulating nor in the using of means, but rather in the aforementioned revealing. It is as revealing, and not as manufacturing, that techné is a bringing-forth (Heidegger 1977, 8).

This is an important distinction, as it acknowledges the importance of uncertainty and discovery in creative endeavour and broadens the framework so it could easily be adapted to other acts such as science and education. As society embraced mass production, our value system has restructured itself around emerging technologies. Although the framework of revealing is still relevant to modern ideas of production, those aspects which we seek to reveal have fundamentally changed. The industrial revolution brought with it an acute understanding of energy and the methods of harnessing it. As a result, our understanding of an object's essence has been reorganized with a greater emphasis on potential; the object is redefined as a standing reserve. Heidegger refers to this new form of revealing as a challenging revealing, an *enframing*.

> The coal that has been hauled out in some mining district has not been supplied in order that it may simply be present somehwere or other. It is stockpiled; that is, it is on call, ready to deliver the sun's warth that is stored in it. The sun's warmth is challenged forth for heat, which in turn is ordered to deliver steam whose pressure turns the wheels to keep the factory running (Heidegger 1977, 9).

Enframing is not just a technological process, but a framework that we have chosen to mediate our relationship between ourselves, our tools, and our environment. It is a way of looking at the world and its constituent parts in terms of intermediates rather than entities, which pervades modern society and orders our ways of doing and being in the world. It persists beyond the built environment and restructures our social relations: just as the stream becomes a means of producing energy, a forester becomes a means of producing wood.

> In this way the impression comes to prevail that everything man encounters exists only insofar as it is his construct. This illusion gives rise in turn to one final delusion: It seems as though man everywhere and always encounters only himself (Heidegger 1977, 16).

The fundamental characteristic of Franklin's prescriptive technology is the division of labour by process rather than products (Franklin 1992, 20). This process is analagous to Heidegger's concept of enframing in that the relationships between actors are dominated by the transitory; in both of these frameworks, the means have become the ends. As a result, these frameworks take on a life of their own and manifest in all of our actions, creating a world ruled by the logic of dominance and subordination.

> But the revealing never simply comes to an end. Neither does it run off into the indeterminate. The revealing reveals to itself its own manifoldly interlocking paths, through regulating their course. This regulating itself is, for its part, everywhere secured. Regulating and securing even become the chief characteristics of the challenging revealing (Heidegger 1977, 16).

> All social interactions proceed according to a certain characteristic internal logic ... Where prescriptive technologies are structured to perform social transactions, these transactions will be organized according to the logic of technology, the logic of production. Thus, as more and more of daily life in the real world of technology is conducted via prescriptive technologies, the logic of technology begins to overpower and displace other types of social logic, such as the logic of compassion or the logic of obligation, the logic of ecological survival or the logic of linkages into nature (Franklin 1992, 94-95).

A Network in Service of the Technological System

The ascendance of the technological framework is best exemplified in the automobile, a tool that has emerged as both a means of transportation for millions of North Americans, and also as a modern icon that acts as a status symbol, a source of employment, a lifestyle catalyst, and a subject for our emotional attachments. In the first half of the twentieth century, the car became a battleground where manufacturers strove to demonstrate the superiority of a new, scientific method of production. From its humble beginning as a pair of bicycle frames welded together and driven by a small engine, the automobile has rapidly adapted to a shifting productive landscape, its changing form recording not only technical innovations, but a changing relationship between individuals and the material objects that inform their daily activities (Figure 6). The ultimate triumph of mass-production over the high quality craft-built alternative came in response to the automobile's increasing symbolic role during the mid-1920s.

> By this time, however, mass production had brought the auto within the economic reach of many Americans, diluting the social distinction of mere ownership. From this point on, writes one automotive historian,"the use of the automobile as a status symbol would be restricted to the type of car one owned rather than to automobile ownership per se." Because standardized, mass-produced vehicles connoted a lower-class position, buyers began to demand that their ugliness be eliminated, or at least obscured. They sought cars that borrowed the organic aesthetic of the craft-produced luxury vehicles, thus obscuring undesirable social connotations (Gartman 1994, 62).

This challenge was addressed by General Motors' Alfred Sloan, who developed a policy where the outward appearance of GM's cars were refreshed on a yearly basis, creating an illusion of technical innovation that compensated for the stagnating development of the mass-produced automobile's mechanisms and structure.

> With automotive improvements thus defined in terms of appearance, Sloan's policy of offering continuous improvements came to mean regular changes in automotive appearance, that is, annual model changes. Automakers traditionally incorporated product changes on an annual basis due to the highly seasonal nature of production. But in the early industry, most of the yearly changes were mechanical improvements that enhanced the car's utility. The use of autos became less seasonal, innovations were often introduced at midyear, and many new models remained unchanged for several years. But Sloan's policy of offering cars continuously improved in appearance quickly led to annual style changes that spread throughout the industry (Gartman 1994, 75).

An early form of planned obsolescence, this systematized pattern of continuous design turnover - whether technically warranted or not - proved to be a death knell for craft production in the automotive industry. As expensive as it might be to modify tools and dies, the training of a manual workforce was even more disruptive and craft methods were pushed further into the luxury market. As a widespread sense of austerity arose from the great depression, the holistic process that informed the craft-made automobile was marginalized to near irrelevance.

> Sales of luxury autos fell from 150, 000 in 1929 to 10, 000 by 1937, and their manufacturers struggled to survive. At first they fought among themselves for the diminished market with the horespower weapon, offering bigger and more powerful V-12 and V-16 engines. But as sales continued to decline, many of the grand makes like Packard, Cadillac, and Lincoln stopped to compete in the middle- and low-priced autos. Those who did not so condescend - Pierce Arrow, Marmon, Stutz, Auburn-Duesenberg - bit the Depressionary dust. The decline of these craftbuilt cars also

First automobiles are designed without attention to aesthetics. Design is adapted from horse-drawn carriage and two parallel bicycles.

Skills and traditions developed in coachbuilding are adapted by craftspeople to automotive bodies.
Mechanical aesthetic dominates as manufacturers reveal underlying systems.
Components originate from disparate manufacturers; assembled products lack visual unity.

Assembly line introduced to automotive production. By 1915, the proportion of skilled labourers is reduced from 60% to 13%
Automotive design becomes bifurcated: crafted autos develop aesthetic coherence while assembly-line vehicles are visually disjointed.
Aesthetics become linked to price.

Markets become saturated and companies recognize the commercial power of beauty.
Craft aesthetics such as rounded corners, sweeping hood line, and full fenders are integrated into mass-production models.
Firms introduce 3 year design cycles into products to maintain competition. The costs of aesthetic turnover begin to price craft automobiles out of the market.

New designs adapt streamlining from the aeronautic and rail industries. This style symbolizes technological progress and obscures signs of industrial production.
Interchangeability moves from the workspace to the product: models begin sharing common engines, chassis, and bodies while targeting different demographics.

Following the war, designers adapt aesthetics of the warplane to the automobile. This is most prominent in the rear of the vehicle, where tail lights are enclosed in a tail fin.

Designers have been given complete autonomy over design of the automobile.
Style moves away from size and ornamentation.
Round, bulging edges give way to tapered corners and lighter appearances.

As ownership expands and practical demands become less important, the automobile is seen as an outward manifestation of an individual's personality and self-identification.
Interchangeability is subordinated to design: designers create different models and convergent parts are developed afterward.

Automotive producers develop a wide array of makes within single car model.
The first wave of mass customization makes the link between income and the automobile more precise.
The 1973 oil crisis forces a massive shift in consumer priority. Producers shift toward a boxy aesthetic to symoblize austerity.

Following the 1973 and 1979 oil crises, Detroit's design philosophy was revealed as out of touch. Economy and size have displaced styling.
Japan, having no oil resources of their own, had been developing fuel efficient cars for decades. In 1982, Honda beomes the first international producer to run a plant on American soil.

International automobile designs converge toward a single aesthetic that acknowleges consumers' preoccupation with aerodynamics and economy.
Although sports cars decline in popularity, sporty designs are incorporated into most car models.

Escalating fuel prices allow international manufacturers to gain further inroads into North American markets. Our understanding of the finite nature of oil pulls manufacturers toward fuel efficiency once again.
Smaller "K-car" models, developed in Europe and Asia over the last half-decade, begin to take hold in North America. There is a trend toward compressed lengths.

Although automobiles undergo massive changes under the hood as consumers look for more fuel efficient vehicles.
As engines shift away from oil consumption, autos continue to decrease in size.

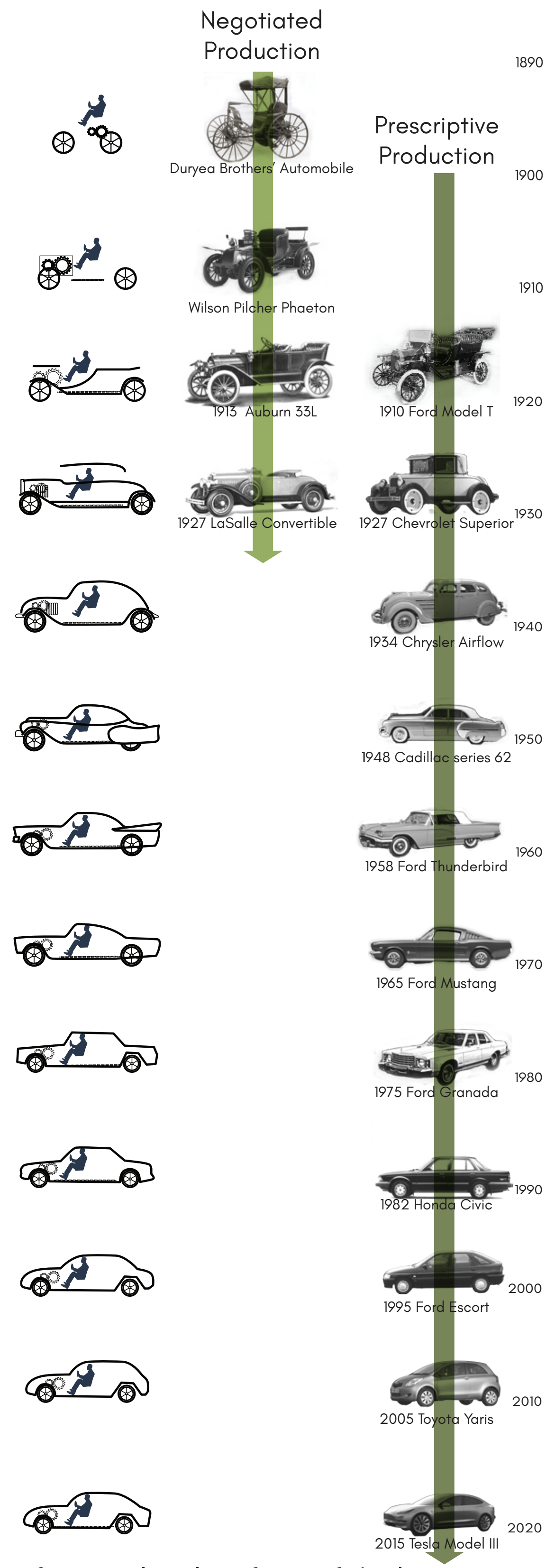
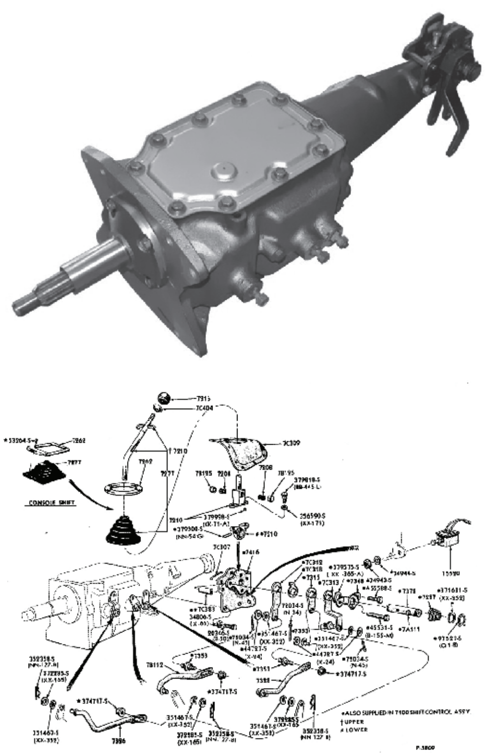


Figure 6. The automobile is one of the most significant cultural artifacts of the last century. Its developent documents a changing philosophy of design, production, and the way that individuals engage with technology.

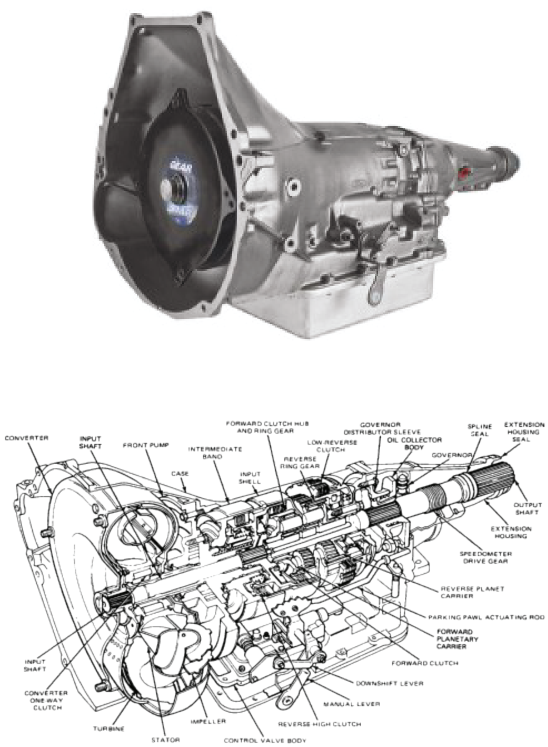
> spelled doom for the coachbuilding shops which supplied them with custom-built bodies – only a handful survived by 1945. As the grand luxury makes either died or downgraded, the aesthetic gap betwen them and the mass-produced cars closed, helping to obscure the widening class gap (Gartman 1994, 105).

Just as the development of the automobile reflects the rise of the technological mode of thought in the field of production, this framework made comparable inroads on the consumer side. In The Mechanical Bride, McLuhan likened the relationship between a typical car owner and his automobile to the emotional bonds they might form with another individual. This relationship is characterized by a great deal of care and pride, involving countless hours polishing, repairing, and maintaining the vehicle and the development of peer groups dedicated to these pursuits As the cars' owners engaged in this anthropomization, McLuhan argued, they subordinated themselves to avatars of progress.

> As early as 1872, Samuel Butler's *Erewhon* explored the curious ways in which machines were coming to resemble organisms not only in the way they obtained power by



Ford Toploader Manual Transmission
1965/67 Ford Mustang



C6 Automatic Transmission
2008 Volkswagen Passat

Figure 7. The technological system is accompanied by a gradual loss of opacity, and an increased reliance on a mechanical object's original producers to replace or repair a defective component.

> digestion of fuel but in their capacity to evolve ever new types of themselves with the help of the machine tenders. This organic character of the machines, he saw, was more than matched by the speed with which people who minded them were taking on the rigidity and thoughtless behaviorism of the machine. In a pre-industrial world a great swordsman, horseman, or animal-breeder was expected to take on some of the character of his interests. But how much more is this the case with great crowds of people who spend their waking energies on using and improving machines with powers so very much greater than theirs (McLuhan 1951, 99).

While this idea of the mechanical bride already suggests a voluntary submission to the mechanical, the continual development of the automobile has pushed the prescriptive framework even further; while a driver's enthusiasm and devotion to their car might still persist today, the rules of engagement have beome more controlled. Progress within the automotive industry has produced integrated solid-state components that have become progressively difficult to understand and repair. Although defective components can be replaced on an interchangeable basis, many of these new parts can no longer be replicated with an engine lathe, but must instead be ordered from a factory (Figure 7). The manual control afforded by a "stick" transmission is being phased out in favour of a more universal automatic transmission component, an interface decision that is based "not only by a direct influence of the user but also by an autonomous process of 'engineering principles dictated by production constraints' (Mom 2008, 178)". This pattern matches the model of technological progression described by Frankin, and is paralleled in the process of driving itself, which forms around a prescribed driving interface (and even now, driver input is becoming phased out of car design in favour of self-driving processes), on a prescribed network of paved roadways, obeying an elaborate and prescriptive set of rules that control how,

Figure 8. The combustion engine is heavily integrated into the technological system. Together with the network of petroleum service stations. it forms a distribution system for the cycle of production and consumption, while also feeding into the system in the form of products that are themselves consumed. Photo taken by Todd Dills (Hard Working Trucks, 2015).

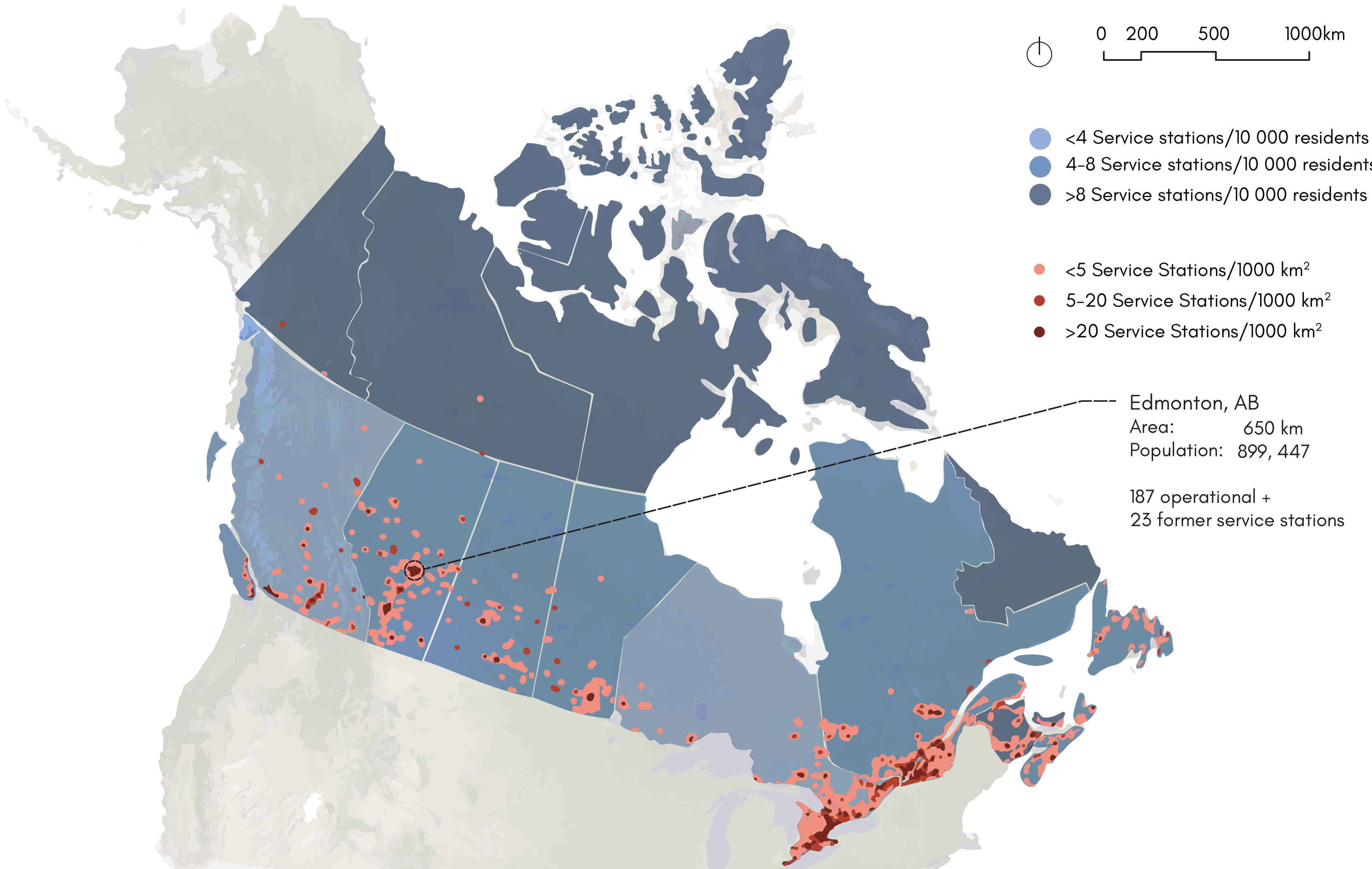


Figure 9. Distribution of Petroleum Service Stations in canada.
Distribution per 10 000 residents adapted from Gardner Pinfold and MJ Ervin, 2005, 11.
Distribution per 1000km^2 adapted from Statistics Canada, Environment Accounts and Statistics Division, 2009.

when, where, and at what speeds these processes take place.

The Petroleum Service Station

As a site and building typology that developed in parallel with the automobile, the petroleum service station similarly represents, and adheres to, the modern system of production and consumption. These locales, with their dense signage and distinctive canopies, go hand in hand with the spectacle of the automobile: a machine that provides as much value as a symbol as it does as a form of transportation.

> For one's family and oneself the automobile spoke immediately of social status both through the mobility engendered and through the thing possessed. Part of the mystique of automobility was the use and care of the motorcar as machine and central to car maintenance was the gasoline station. For males, especially, the neighbourhood gasoline station – with its ringing bell announcing customers, its smell of gasoline and grease signifying technology, and its brisk socializing indicating community – constituted a very important social setting indeed. Here could be found the exhilarating tension of mechanical and other problems faced and solved. In gasoline stations, both close to or far from home, young boys eagerly entered the exhilarating adult world (Jakle and Sculle 1994, 3).

A Dispersed Network

While the car distinguishes itself as a universal symbol of the modern identity, the service station provides the infrastructure that sustains this economic model. This distribution system maintains the logistic needs of both the mobile consumer and the producer, providing fuel for individual consumers as well as the fleet networks necessary for the mass transportation of products across the continent (Figure 8).

Like the car itself, the design of the service station has slowly evolved over the last hundred years to fall in line with the technological mode of thought. These sites form a vast, distributed network that roughly mirrors a nation's population density (Figure 9). This network's primary role is the distribution of petroleum, a commodity that is valued not for its innate qualities but for its latent energy and the ability to move people from one destination to the next. As such, the petroleum service station system reveals itself as the quintessential enframed site: a standing reserve dedicated to the transitory. The most explicit manifestation of this enframing lies in the asphalt paving that surrounds the building. Like the road itself, the service station's lot is a flat expanse designed to accomodate a fast, uninterrupted flow of automobiles to and from the station's pumps. Those stations that also feature carwashes are home to the most expressive technological inversion yet designed. Where the garage once housed the reciprocal process of manual servicing, the modern driver now joins their automobile as it travels through a mechanically choreographed cleaning sequence, experiencing an assembly line through the eyes of the product (Figure 10).

Penny Oil Company; Garage Interior — Lafayette Studio, 1934

Still Image from Relax, Let's Go Through A Carwash — Burger Fiction, 2015

Figure 10. The "service" aspect of the modern petroleum service station is vestigial at best, as the face-to-face interaction that once gave the service station a social character has been replaced by an automated cleaning sequence.
Penny Oil Company; Garage Interior from University of Kentucky Special Collections, 2013.
Relax, Let's Go Through a Carwash from Burger Fiction, 2015.

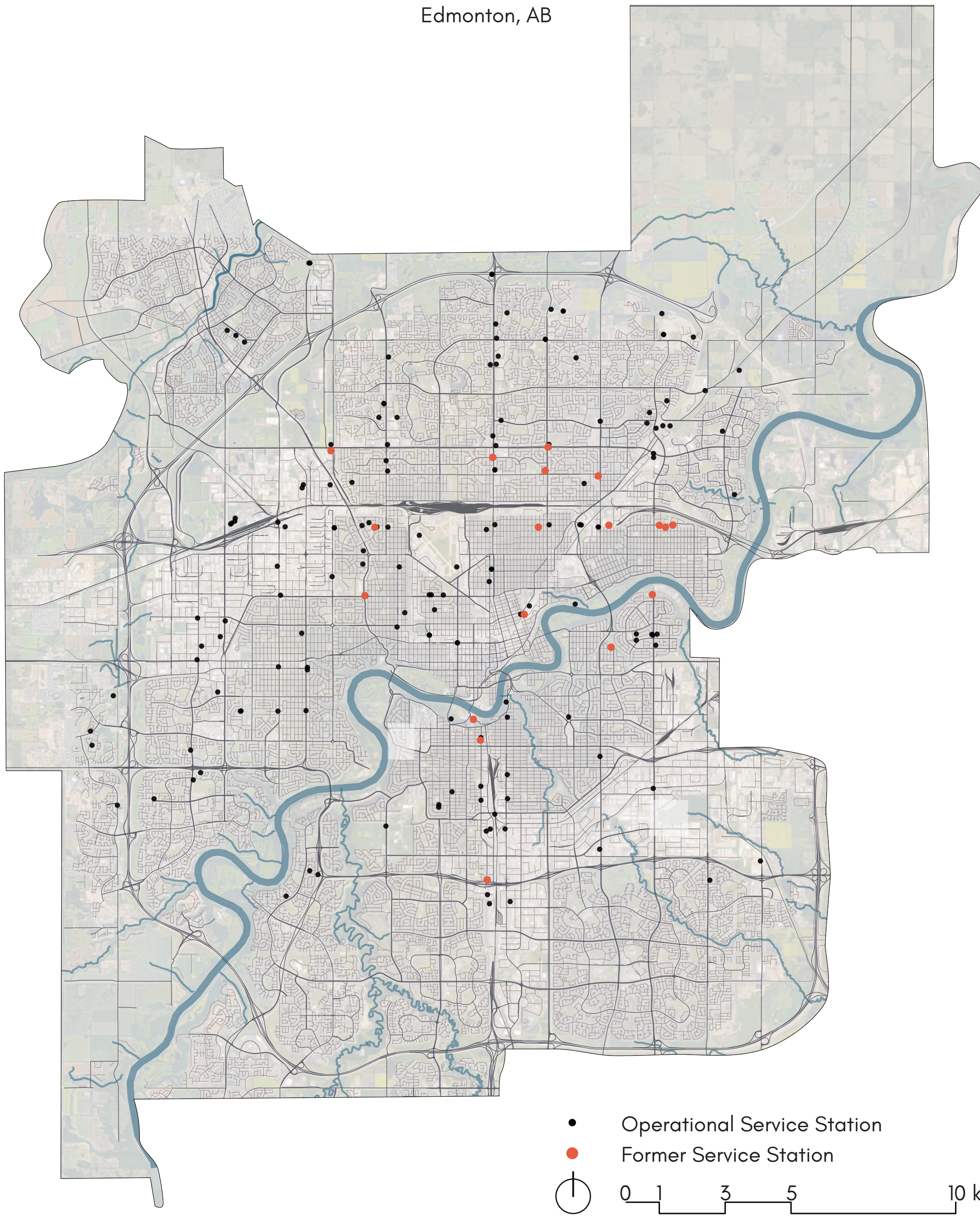


Figure 11. Distribution of 187 current & 23 former service station sites throughout the city of Edmonton. All data from OpenStreetMap, 2017.

Network Characteristics

The petroleum service station has been a part of the urban fabric since the mass acceptance of the automobile in the early 20th century. Although the service station's symbolism and function have changed during this timespan, this building typology persists in the urban landscape, ordered by an economic approach that seeks to maximize the volume of fuel that is purchased at a given site on a given day.

> Gasoline service stations of the major oil companies are nearly perfectly competitive at the retail level. The sites' stock in trade is convenience to the automobile driver: the shorter the distance to a service station, or the higher its linkages, the larger the probability a customer will patronize that facility. Location and layout are factors that distinguish or influence the volume of retail sales for all companies not categorized as price cutters (Claus 1969, 19).

Each station balances proximity to a local consumer population against the visibility required to entice those coming from abroad, while maintaining a territorial equilibrium with nearby competitors that draw on the same consumers (Claus 1969,

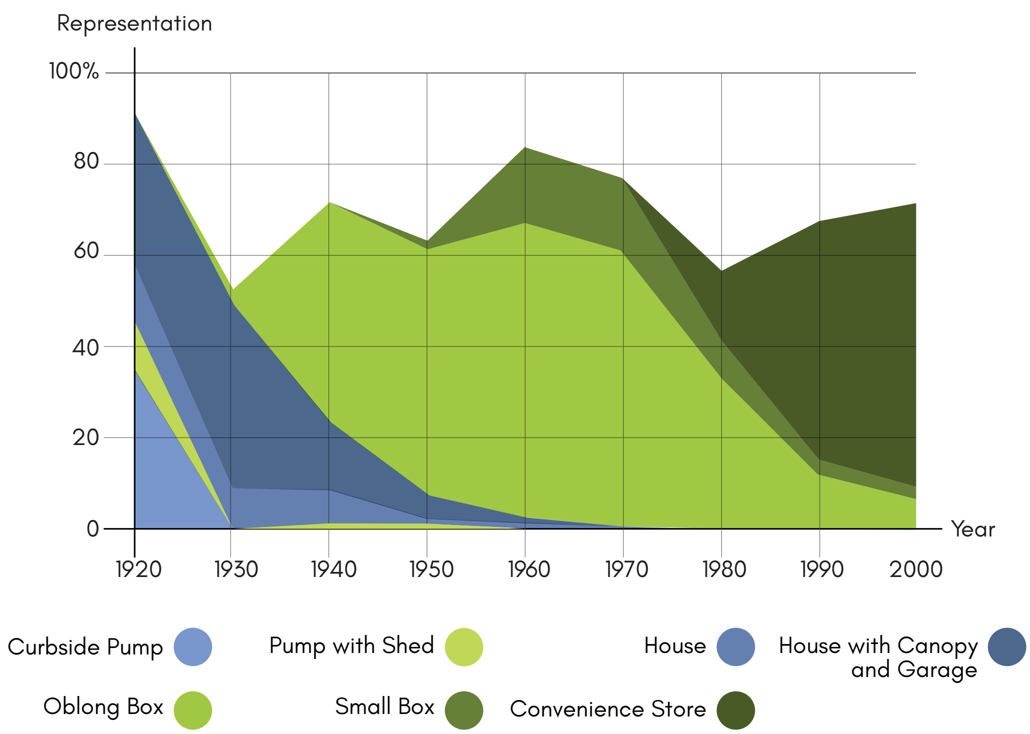


Figure 12. Following a short iterative period in the early twentieth century, the form of the service station converged toward the oblong box typology. This convergence accompanied the widespread adoption of *place-product-packaging*, an advertising system where an individual retail location differentiates itself through clip-on advertising rather than any intrinsic character. Adapted from Jakle and Sculle, 1994.

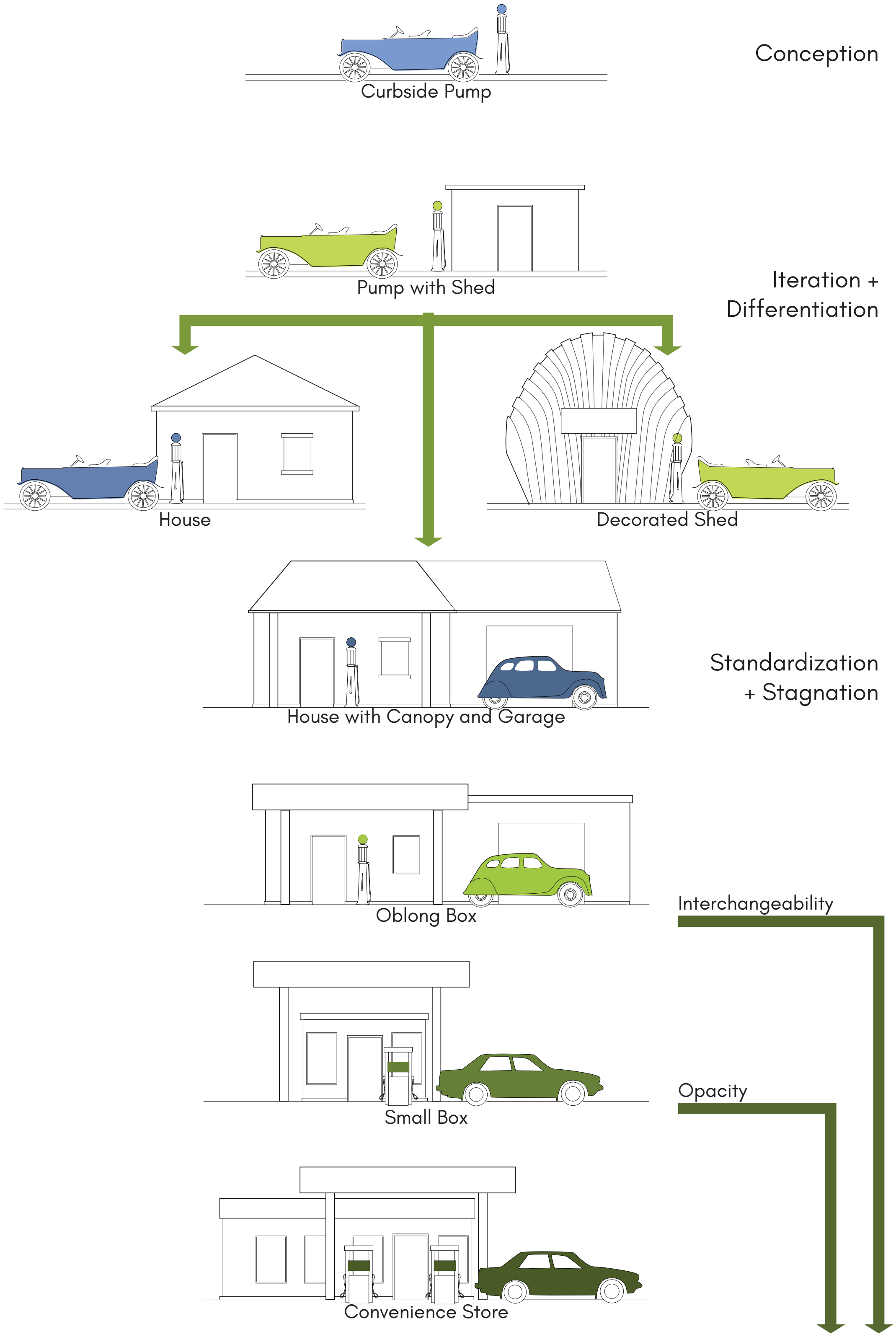


Figure 13. The petroleum service station evolved through seven major typologies This development adheres to Franklin's model of technological progress, where the dominant modern archetypes reflect a philosophy that favours high-volume, standardized transactions over the stations' individual identities. Adapted from Jakle and Sculle, 1994.

13-15). As a result, urban service stations are distributed along the city's major roads, with a higher density near residential areas and high volume interchanges such as highway on-ramps. Edmonton adheres to this typical pattern, with a network of just under two hundred operational service stations that services an area of 650 km^2 and 830 000 residents (Figure 11).

The Evolution of the Petroleum Service Station

Ursula Franklin's model of technological progression, as previously described, matches the evolution of the petroleum service station from the early 1920s to the present day. The automobile's transformation from a crafted vehicle for the wealthy to an ubiquitous part of urban life was mirrored in the development of the sites that serviced these vehicles The early twenthieth century oversaw the development of a diverse set of service station typologies, followed by the consolidation of form into the oblong box in the following years (Jakle and Sculle 1994, 156) (Figure 12)(Figure 13).

Pared down to a simple prism, this typology became a platform for place-product-packaging, a highly refined marketing strategy that recast the site and building as two components within a total work of advertising. Coordinated logos and colour schemes promoted brand recognition while accentuating the visibility of the fuel pumps and product displays. While this system demonstrated a sophisticated attitude toward self-promotion, the underlying architecture was compromised in favour of a base form of ephemerality. This system of advertising developed alongside a continuous desire to modify the brand that mirrored auto manufacturers' rationale for yearly model updates: induced change represents energy and progress, and in a competitive and saturated market, falling out of fashion can have catastrophic results. This philosophy drove a "clip-on" form of architecture, where appearance takes precedence over substance.

> In recent decades place-product-packaging has been a mechanism of standardization generally undertaken as a form of modernism. True, the eccentricities of postmodernism have come to the fore. Nonetheless, place-product-packaging remains essentially a modernist idea, a means of organizing markets for mass consumption tied to assembly lines and other methods of labor specialization (Jakle and Sculle 1994, 35).

The Decline of the Service Station

The economic crises of the late 1980s forced many petroleum distributors to close their stations, and by 1994, 4000 sites had closed down across Canada. While the rest of the country managed to rebound from the recession, the service station never did. Since then, the number of service stations in Canada has steadily decreased (Figure 14). This decline has occurred as factors on both the demand and supply side of petroleum retail. While gasoline consumption peaked in 2008, the economic downturn that followed has had a major impact on car use. In response to rising fuel prices, households are much less reliant on cars than they had been, and those new autos that are purchased are more fuel-efficient than yesterday's cars. Meanwhile, the continuing densification of the modern city and a blurring of the boundary between the spaces we live and work is pushing more people toward alternative forms of transportation as well. On the supply side, environmental regulations have increased the cost of operating a station, and many service stations are consolidating to create single, high-volume operations in areas that were once served by two or three outlets (Gross 2013)(Lee 2014). These recent trends are compounded by the long-term

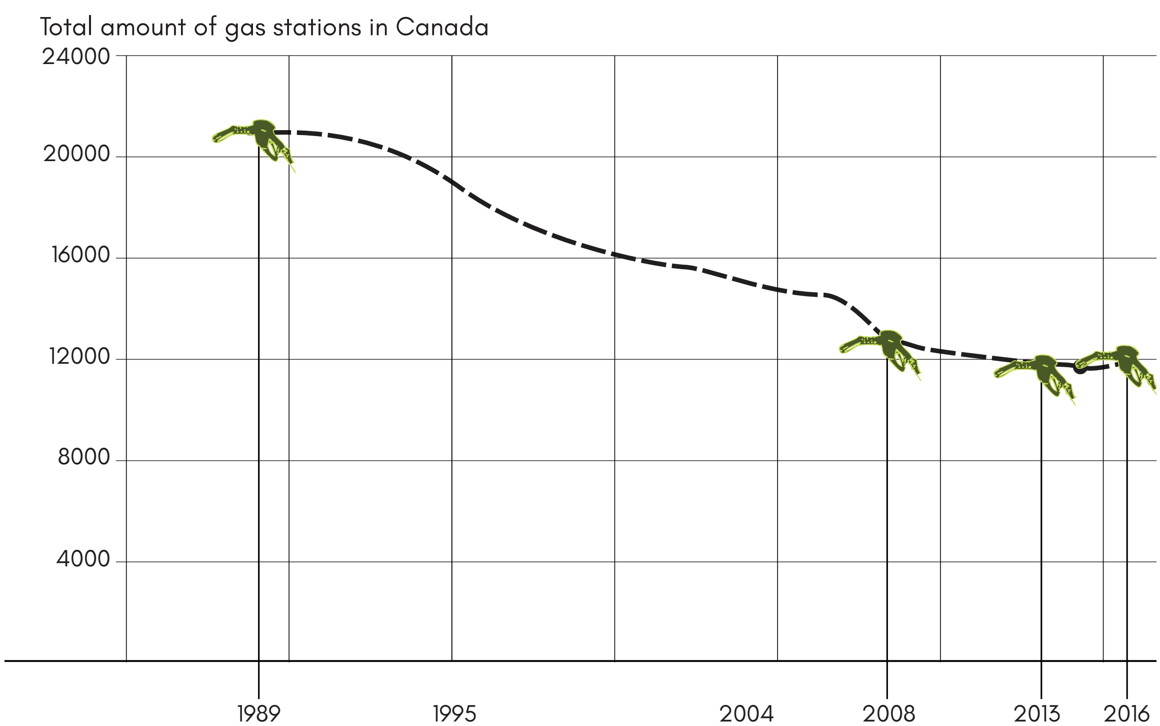


Figure 14. Since the first formal census in 1989, the number of petroleum service stations has seen a steady decline. Retail site data from1989 to 2008 adapted from MJ Ervin & Associates 2009, 6. Data from 2013 to 2016 adapted from Kent Group Ltd 2013, 2014, 2015 ,2016.

outlook of fossil-fuels, with limited reserves that may or may not be exhausted this century, but will most-assuredly become cost-prohibitive as a commodity for mass-consumption (Leach 2014)(Hussain 2011).

Urban Legacy

Once a petroleum service station closes, its second life tends to fall within a narrow range of options; many are bought by another distribution company and are simply re-branded, while those that have their pumps and tanks removed fall into three major categories: auto-related adaptation, other adaptation, and vacancy. Although there have not been any national or global studies regarding these patterns of re-use, a survey of 69 former service station sites along highway 20 in Western New York found that most sites had been repurposed for automobile-related activities such as used-car storage and sales, and that an equal proportion of sites were left vacant as were redeveloped (Coffey and Norris 2000, 47). These trends are even more pronounced

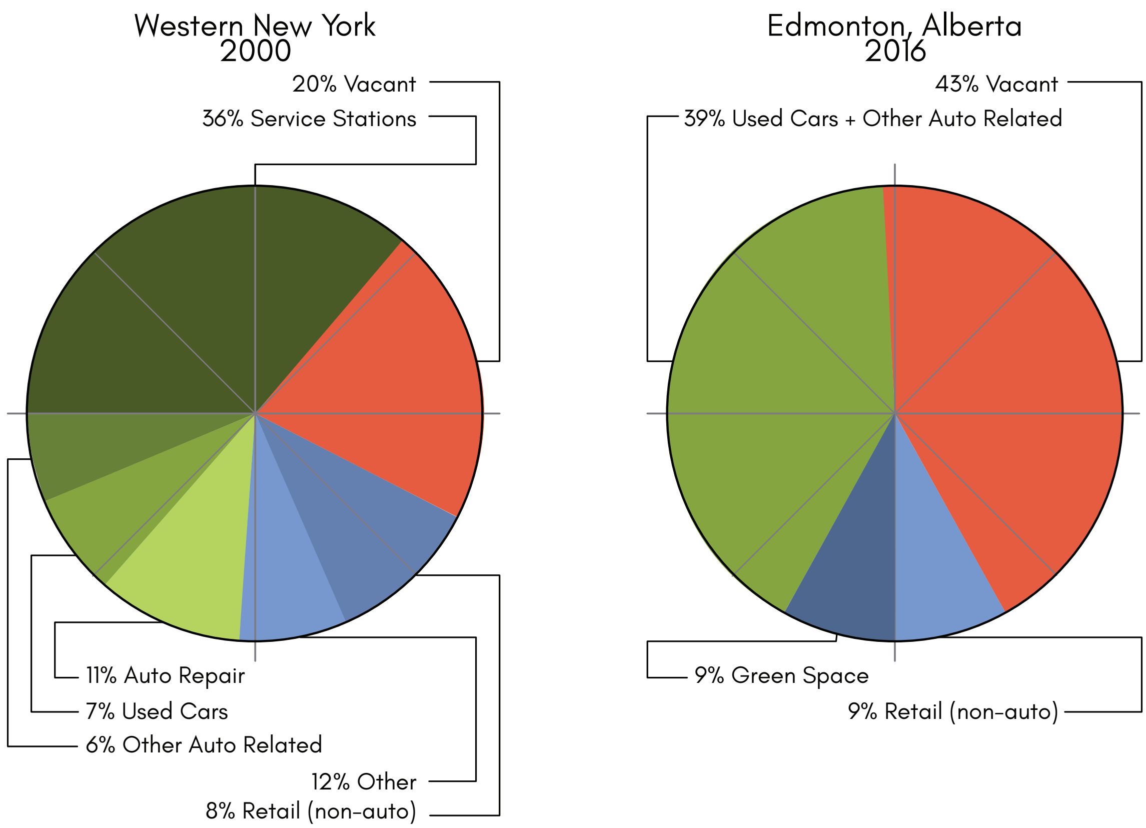


Figure 15. The patterns of adaptation of former service stations in urban Edmonton show a much more exaggerated disposition toward vacancy and automobile-related reuse than highway-adjacent sites. Western New York data adapted from Coffey and Norris, 2000. Edmonton data from Alberta Environment and Parks, 2016.

in Edmonton. Using data from the Government of Alberta's Environmental Site Assessment Repository, a pool of 23 former service stations within the bounds of the city were located using data from the Government of Alberta's Environmental Site Assessment Repository and manually surveyed via satellite imagery. This survey showed that these sites were much less likely to be redeveloped than to be left vacant or repurposed for cars (Figure 15).

This characteristic pattern of use is a result of soil contamination caused by underground storage tanks. Expensive to install and replace, older tanks slowly leak petroleum hydrocarbons such as benzene and toluene into nearby soil. These petroleum hydrocarbons are a class of persistent hazardous pollutants that includes recognized carcinogens and mutagens which can bioconcentrate and bioaccumulate in food chains. Although most of these contaminants can be produced naturally, their concentrations are magnified on petroleum service station sites, creating a substantial risk to human, plant, and animal populations due to the contamination of soil and goundwater (Kamath, R., rentz, J.A., Schnoor, J.L., Alvarez, P.J.J. 2004, 1-2). These contaminants create an additional inconvenience for prospective redevelopers, and the sites thus become overlooked in favour of less problematic locations.

> While many of these sites are located in prime areas for urban revitalization, private sector stakeholders have often been reluctant to invest in them for fear that they may be contaminated, and thus too expensive, time-involving and risky to redevelop profitably (De Sousa 2006, 2).

While these contaminated sites create a broad range of spatial and ecological issues, their resolution is bound to a narrow economic view where the fate of the site depends on whether its potential revenues outweigh the investment of time and money into a remediation process. Although there are dozens of physical, chemical, and biological treatment methods, most sites adhere to either of two dominant strategies: excavation followed by offsite treatment and replacement, or natural attenuation. Excavation exchanges a substantial up-front cost for a faster turnaround, and is the most reliable method of quickly redeveloping the site. Conversely, natural attenuation's low efficacy is outweighed by its extremely low cost. This strategy involves leaving the site fallow for an extended period of time and allowing the contaminants to slowly break down and dissipate over time while a thin, inert layer of soil and grass creates a barrier to prevent airborne exposure. The low costs of simply paying property taxes and the occasional assessment operation make this the most popular strategy. Unfortunately, this passive approach leaves a patchwork of unattractive and uninhabitable voids throughout the city, with some sites remaining

Figure 16. Three former service stations in Edmonton, Alberta. Though situated in highly visible and accessible areas within the city core, soil contamination restricts the sites' opportunities for redevelopment. Adapted from Google Maps, 2017.

inactive for twenty years or more as they wait to be repurposed (Figure 16).

Confronting the Production Model

This thesis asks how a community workshop can reconcile the physical and philosophical legacy of mechanized production with a more responsive understanding of the technological process. The community workshop represents a refuge from the modern workplace, a space where individuals can gather in their spare time to create at their own leisure, socializing and collaborating on large projects or sharing their expertise as they work on individual-scale projects. At the same time, we are slowly coming to terms with the amount of resources that the modern economic system of mass production and consumption requires, and the urgent need to redirect our infrastructures of production and provision to create a web of localized, self-reliant systems. Although new manufacturing technologies are capable of restructuring production at smaller scales, these tools come with an embedded philosophy of production that minimizes the potential to negotiate an unexpected outcome during the process of making. That process of negotiation, with all its embedded risk, is essential for the development of innovative solutions to local problems, as it forces the practitioner to thoughtfully engage with the process and tailor it to their own unique set of problems. Fortunately, these tools are just one part of the infrastructure that defines a technological process, alongside space and the social expectations of our peers. As such, a concerted effort to confront the production model of technology requires an approach that places the tools of production in harmony with spatial and social patterns that allow flexibility and reciprocity to flourish in the face of the technological system.

CHAPTER 2: DESIGN

The Growth Model

In the closing words of The Question Concerning Technology, Heidegger characterizes the technological mode of thought as a self-perpetuating entity with its own momentum. The best-known example of this phenomenon is Moore's law, which observed that the number of transistors per area on the typical integrated curcuit has doubled every year. The constant increases in computational power that are afforded by the chips' densification allow engineers to develop more efficient chips in a sustained positive feedback cycle. Likewise, the genesis and development of machine tools in the late 18th century follows this same pattern as each generation of machine tools was used to produce new interchangeable steel components at ever-increasing tolerances. This enabled the development of newer generations of both cutting tools and combustion engines to increase the tempo of production and development (Rao 2012).

Much like the machine tools that were developed within this philosophy, the technological process provides the means to further itself as incremental progress in one field is rapidly adapted into other arenas, multiplying the effect.

> The social history of the industrialization of clothing is similar to the current phase in the industrialization of eating. Food outlets put frozen or chemically prepared "unit meals" together like sleeves and collars for shirts - there are "McJobs" and no security of employment. Indeed, women sew less, cook less, and have to work hard outside the home to be able to buy clothing and food (Franklin 1992, 101).

The technological process is not limited to manual labour, but permeates throughout the modern workplace. Although Canada's dominant knowledge economy has replaced the conveyor belt with the computer, standardised software packages provide employers with new methods of fragmenting and reconstructing information in a process of *digital taylorism* that recasts information-based professions within the task-based metrics of prescriptive technology (Teaching and Learning Research Programme 2008, 11).

The technological system thus continues to integrate itself into our standards and practices, imposing itself on an ever-increasing domain of human experience. As a result, Heidegger argued, this mode of thought has engrained itself too deeply into modern culture for any systemic rejection to place.

> Enframing is the gathering together that belongs to that setting-upon which sets upon man and puts him in position to reveal the real, in the mode of ordering, as standing-reserve. As the one who is challenged forth in this way, man stands within the essential realm of Enframing. He can never take up a relationship to it only subsequently. Thus the question as to how we are to arrive at a relationship to the essence of technology, asked in this way, always comes too late. But never too late comes the question as to whether we actually experience ourselves as the ones whose activities everywhere, public and private, are challenged forth by Enframing. Above all, never too late comes the question as to whether and how we actually admit ourselves into that wherein Enframing itself comes to presence (Heidegger 1977, 12).

What we can do, however, is to confront it at every opportunity, to demonstrate that the technological method is not the only model of creation and that alternative understandings of *poesis* should be elevated as often as possible. While Heidegger cites other forms of *poesis*, such as the creative arts, as a meaningful alternative, Franklin is more direct in her contrast between the production model and an alternative growth-based model.

> Size is a natural result of growth, but growth itself cannot be commandeered; it can only be nurtured and encouraged by providing a suitable environment. Growth occurs; it is not made. Within a growth model, all that human intervention can do is to discover the best conditions for growth and then try to meet them. In any given environment, the growing organism develops at its own rate.
>
> A production model is different in kind. Here things are not grown but made, and under conditions that are, at least in principle, entirely controllable. If in practice such control is not complete or completely successful, then there is an assumption, implicit in the model itself, that improvements in knowledge, design, and organization can occur so that all essential parameters will become controllable. Production, then, is predictable, while growth is not. There is something comforting in a production model - everything seems seems in hand, nothing is left to chance - while growth is always chancy (Franklin 1992, 27).

Franklin thus posits two opposing models of creation. The dominant production model is borne out of the technological thought process, and it relies on planning, control, and the minimization of risk. In contrast, the growth model embraces risk, exchanging the cold comfort of certainty for the opportunity for reciprocal interactions and a final product created not just in accordance with one individual's intent, but through sustained negotiation between all the actors, materials, and purposes involved. Ezio Manzini illustrates this concept in his manifesto The Garden of Objects, where he argues that those constant negotiations are what provide true value to the work we produce.

> Today we live in a world of objects of rapid consumption. Objects which perform their service requiring minimum effort and minimum attention, but also, as I already mentioned, objects which pass us by without leaving any lasting impression in our memory. A disposable world made to require no effort, but which, at the same time, produces no quality.
>
> Imagine now a garden with some flowers and some fruit trees. Think of the attention, time and energy that are required and think of its products. Those flowers and those fruits, and the person who made them grow, do not have a measurable value in banally economic terms. Certainly the garden must produce flowers and fruits, but the person dedicated to this, does it for a more general reason: he/she does it because he/she loves plants. Try now to imagine an analogous relationship with objects. Think of some objects that are as beautiful and useful as a tree in a garden: objects that would last and would have a life of their own. Objects that, as a tree, would be loved for how they are and what they do. Objects that would render a service and would require tending (Manzini 1992, 2).

This project seeks to challenge the production model by exploring the occupation and construction of the community workspace as a deliberately slowed process, in constant negotiation with both the community and the site, and using time as a resource to be experienced rather than a variable to be minimized.

An Ensemble of Communities

In Grassroots Maker Spaces: A Recipe for Innovation? Wang, Dunn, and Coulton emphasize the difference between conceiving of a workshop as a “community space” or as a “space for communities”. While a “community space” is framed in terms of a single group of users, a “space for communties” allows for a plurality of user groups, with different expectations, experiences, and intentions. Many makerspaces follow the first model, where a single community of like-minded individuals gathers at the workshop to collaborate on individual or group projects, but a space that can be programmed to accomodate a broader range of community groups can create a confluence of producers with a well-rounded mix of perspectives that allow the community to incubate a more diverse set of ideas and to innovate in unexpected ways.

> When a glass, as illustrated by (Gilbert) Ryle, breaks, there is not just one, but many possible reasons, and they all relate to the dispositional property of the glass: brittleness. It might be erroneous to make the cause absolute, say the stone is the reason for the glass to break. A more rewarding way, according to Ryle, is not to isolate an effect and its cause in a 1 to 1 relation, but rather to "go beyond" the effect in order to unfold the rich network of multiple relations involved in the creation of the effect.
>
> Ryle's broken-glass illustration serves as the best possible metaphor, which imagines innovation as a dispositional property of the makerspace. Makerspaces, therefore, can be predisposed to produce all kinds of outcomes, but the innovation of/in makerspace is determined only after the confrontation between the space designer's intention and maker's perception ... From our research, we find that the value of makerspaces as social hubs should be bonded around a technology rather than subservient to the technology itself (Wang, Dunn, and Coulton 2015, 9).

The effects of this plurality of community groups can manifest not only in the way these communties inhabit the building, but also in a continual growth process that unfolds over years as these communities grow and their needs expand in different directions, creating a constant process of negotiation between the user groups and the emerging building. This thesis has been developed to serve five distinct modes of creation, in addition to providing public space for the broader community (Figure 17).

Tool Sharing Program

Tool sharing is a method that allows urban citizens to retain access to specialized tools that they may need for periodical or seasonal maintenance or renovation projects without having to pay and store devices that they use infrequently (Radio Active 2016). By pooling their resources through small monthly dues, a community of hundreds or thousands of consumers, amateurs, and experts can accrue a library of conventional construction tools such as shovels, folding table saws, or battery-powered drivers that they can rent as needed. This program would have the greatest reach in denser, low-income neighbourhoods where people may not have the space or finances to possess their own tools. Despite the program's broad user base, the tool sharing program has modest spatial requirements: storage space and a storefront area to accomodate donations and tool exchange.

Maintenance, Repair, and Restoration

Like many other Canadian cities, Edmonton has experienced an increase in its

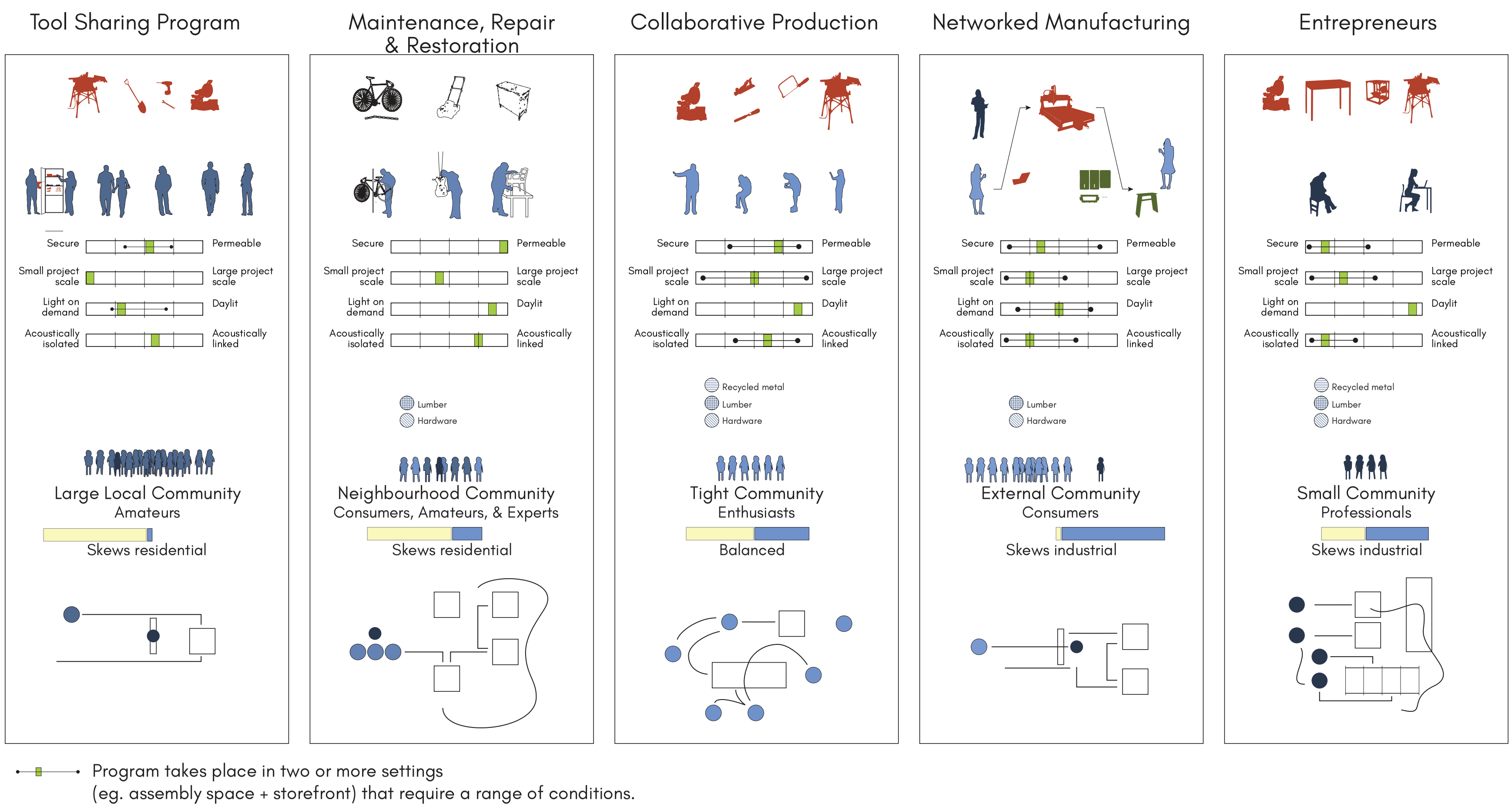


Figure 17. Program as a dialogue between five interrelated *maker* communities. Each programmatic element caters to a different community that grows at a different rate and requires its own spatial, experiential, and provisional considerations in service of distinct patterns of activity.

proportion of cyclists over the last twenty years. Sparked by a renewed awareness of the environmental health, and traffic decongestion benefits of cycling, grassroots organizations such as the Edmonton Bicycle Commuters' Association have persuaded the city of Edmonton to allocate millions of dollars to a more comprehensive cycling infrastructure, based on a transportation plan that:

> [...] identifies a transportation system that supports healthy, active lifestyles as an important priority. Encouraging cycling and active transportation and improving these networks will be a key strategy in achieving these objectives (Stantec 2009, 2).

Edmonton's cyclist population is just part of a regional network of individuals that use transparent tools and technologies as part of their everyday life. While many consumer products are restricted by planned or systemic obsolescence, these transparent objects can retain their value over time through a steady regime of maintenance and restoration. This program forms a bridge between the other communities; it is primarily a means of extending the lifespan of tools both within and without the community workshop, but it also becomes a critical point of knowledge transfer, where novices and consumers can develop the expertise and confidence to engage with their objects in more creative ways.

Collaborative Production

The "maker" movement was first popularised by Dale Dougherty, who created the first Maker Faire in 2006 in response to a growing community of technology enthusiasts that design and make things at home with the aid of digital fabrication technology and knowledge accessed from the internet (Fernández 2015). This movement, and the spaces that it inhabits, crystallized around the idea of local communities dedicated to the technologies of production, with a particular interest in digital and machine tools. Although some members of this community have developed their works into commercial products, most are hobbyists and amateurs. In the absence of constraints imposed by a business plan, these individuals collectivize and collaborate, sharing capital and expertise to create shared spaces where they can realize their creative aspirations. These spaces can take many forms, ranging from MIT's FabLab franchise to small garage operations and beyond. The most important characteristic of this program is the space's openness, as this community's vitality is based on fluid interactions furthering a limitless range of built objects.

Networked Manufacturing

This program serves as an interface between the workshop's users and a broader population of consumers that are interested in personalized, locally sourced products but do not have the time or skills to produce them for themselves. In this production paradigm, digitally packaged designs are dispersed through the internet for production at a local site, where a skilled operator uses digital manufacturing tools such as the CNC and 3D printer to ensure that all components are built to the exact specifications of the designer and consumer. The consumer then splits the cost of production between the global designer and the local producer. On-demand production of replacement components helps combat obsolescence and estabishes a more personal relationship between the consumer and producer. Although this is a strictly prescriptive form of production, it can become a valuable source of revenue for the workshop and another gateway for consumers to develop an interest in self-reliant production methods.

Entrepreneurship

A final technological community emerges from those that seek not just to design and innovate for themselves, but to direct their expertise toward the creation of new products and technologies on which they can stake their own financial independence. Stemming from the small communities of collaborative production, these user groups seek private space to develop their ideas while maintaining access to the infrastructure that nurtured their initial formation. Dedicated office/workshop suites, available for rent on a temporary basis, provide this security for small start-ups, while transparent access to each other as well as the technological community groups creates a peer safety net that can enable the entrepreneurs as they flourish and expand.Together, these five community groups create a chorus of voices that can push one another to create in innovated and expected ways as they negotiate a shared space dedicated to the generation of product and community.

Establishing a Test Site

The activity that would take place in the community workshop exists at the intersection between the residential and the industrial, blurring the lines between those who produce for a living and those who produce for themselves. The ideal test site for this project exists at the boundary between these two worlds, balancing access between communities and material provision. Although most petroleum service stations have been located with residential access in mind, the greater context surrounding each site is highy variable, and some are more suitable than others. Of the 210 service stations within the city of Edmonton, nineteen sites sit in limbo. These sites are no longer in service, but have not completed the remediation cycle necessary for redevelopment either. These sites were assessed in relation to land use and provision, financial indicators, and access.

Zoning and Provision

One of the most important criteria for the selection of a pilot site is its proximity to both high-density populations and manufacturing zones (Figure 18). Specialty hardware and other material provisions tend to be located within or close to these areas, and nearby businesses can also be a valuable source of expertise. On the other end of the spectrum, sites that are near high-density residential areas mean not just access to higher foot-traffic, but also to the populations that are least likely to have their own space for projects (eg. those occupying condos or other high-density housing).

Financial Indicators

Edmonton is Canada's 5th-largest city, with a population of 930 000 residents occupying 685 square kilometers. Like all large cities, financial indicators such as income (Figure 19), property values, and percentage of households that rent their homes are important means of targetting the neighbourhoods where a communal workshop could have the greatest impact on the local population. Low-income populations can benefit greatly from a program designed around self-reliance, and neighbourhoods with a large proportion of rented homes could also become

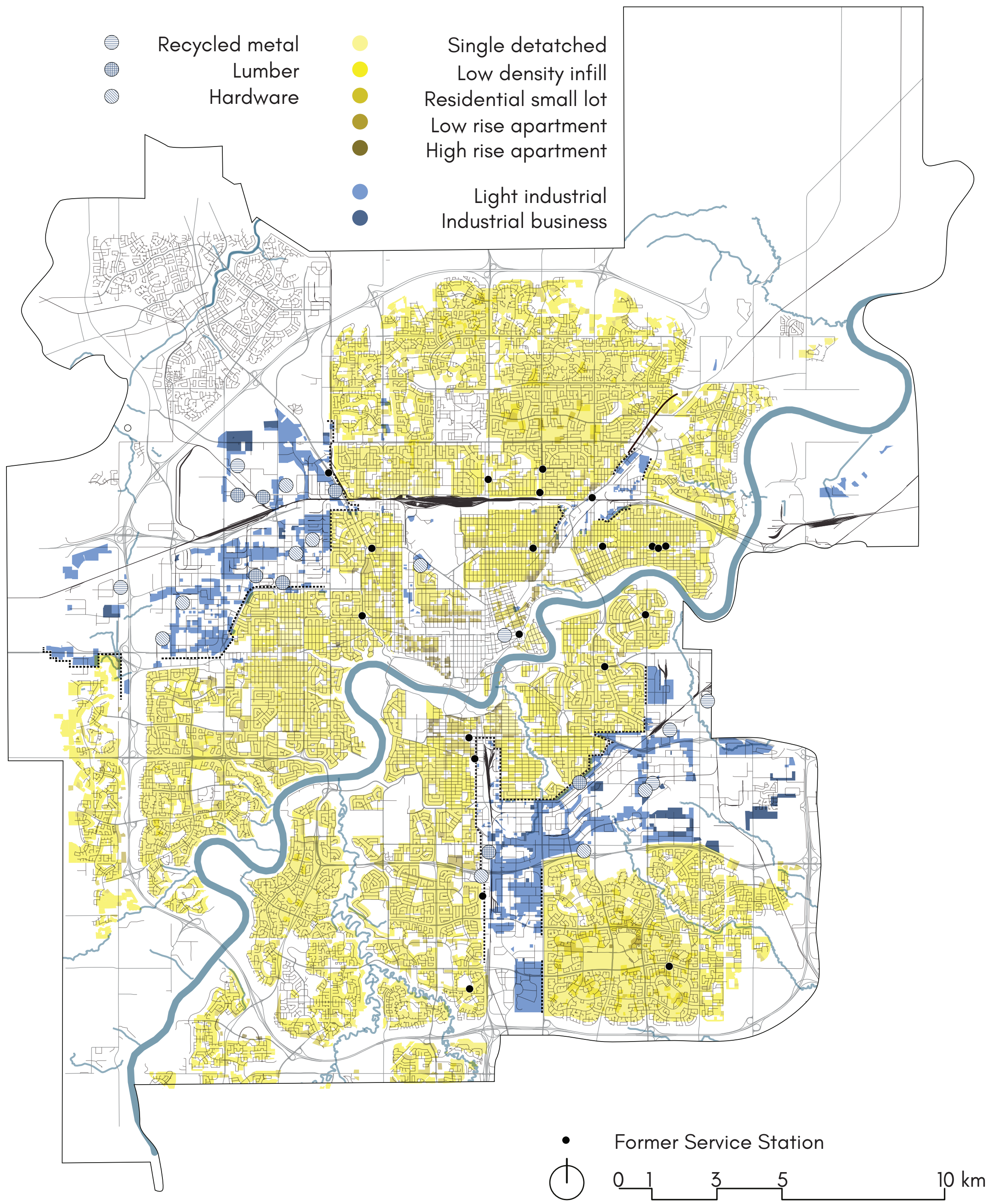


Figure 18. Map of Edmonton demonstrating city-scale context of chosen site. This site is nestled in a boundary condition between residential and light-industrial zones.

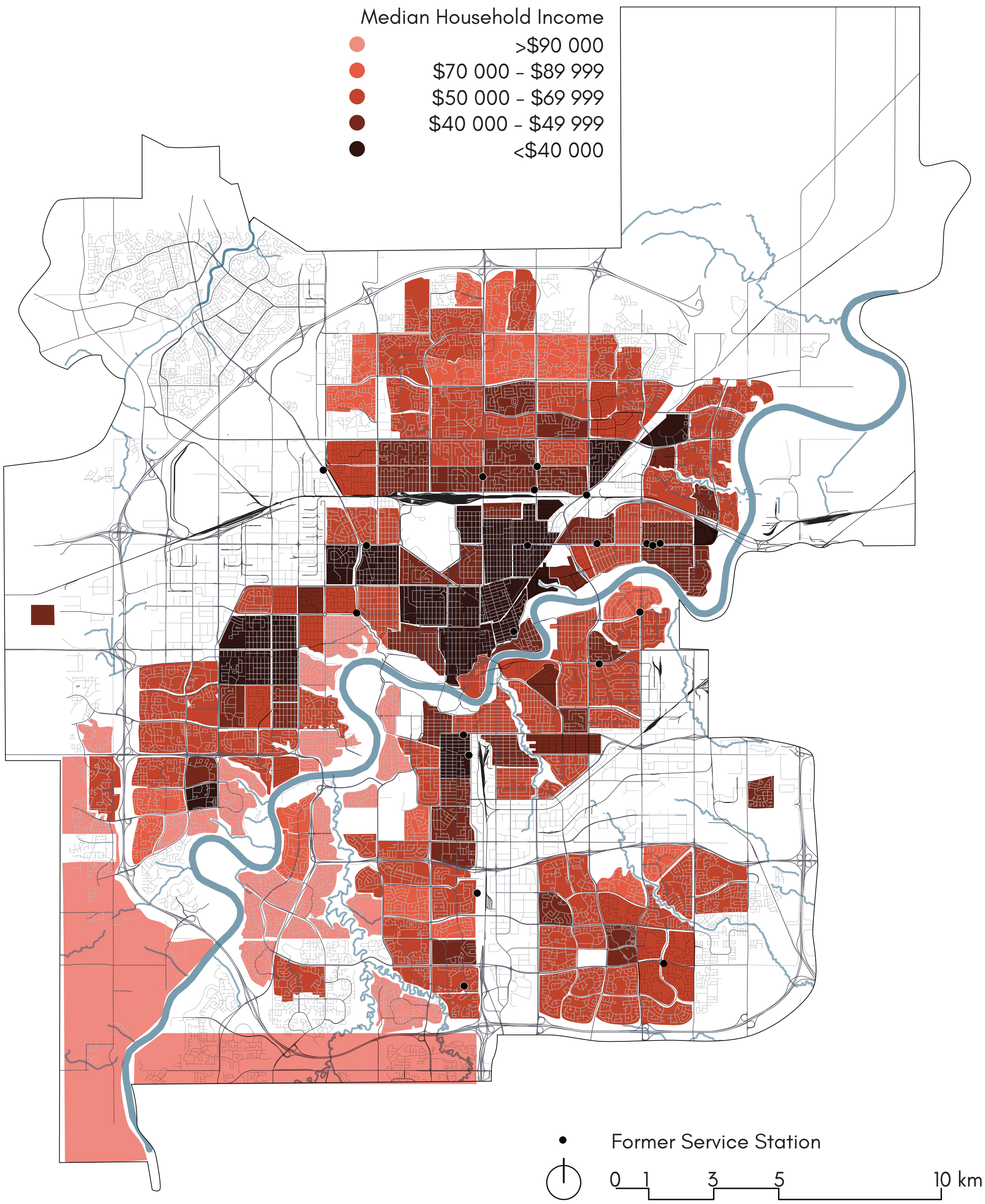


Figure 19. Distributed income levels within Edmonton, in relation to nineteen potential test sites.

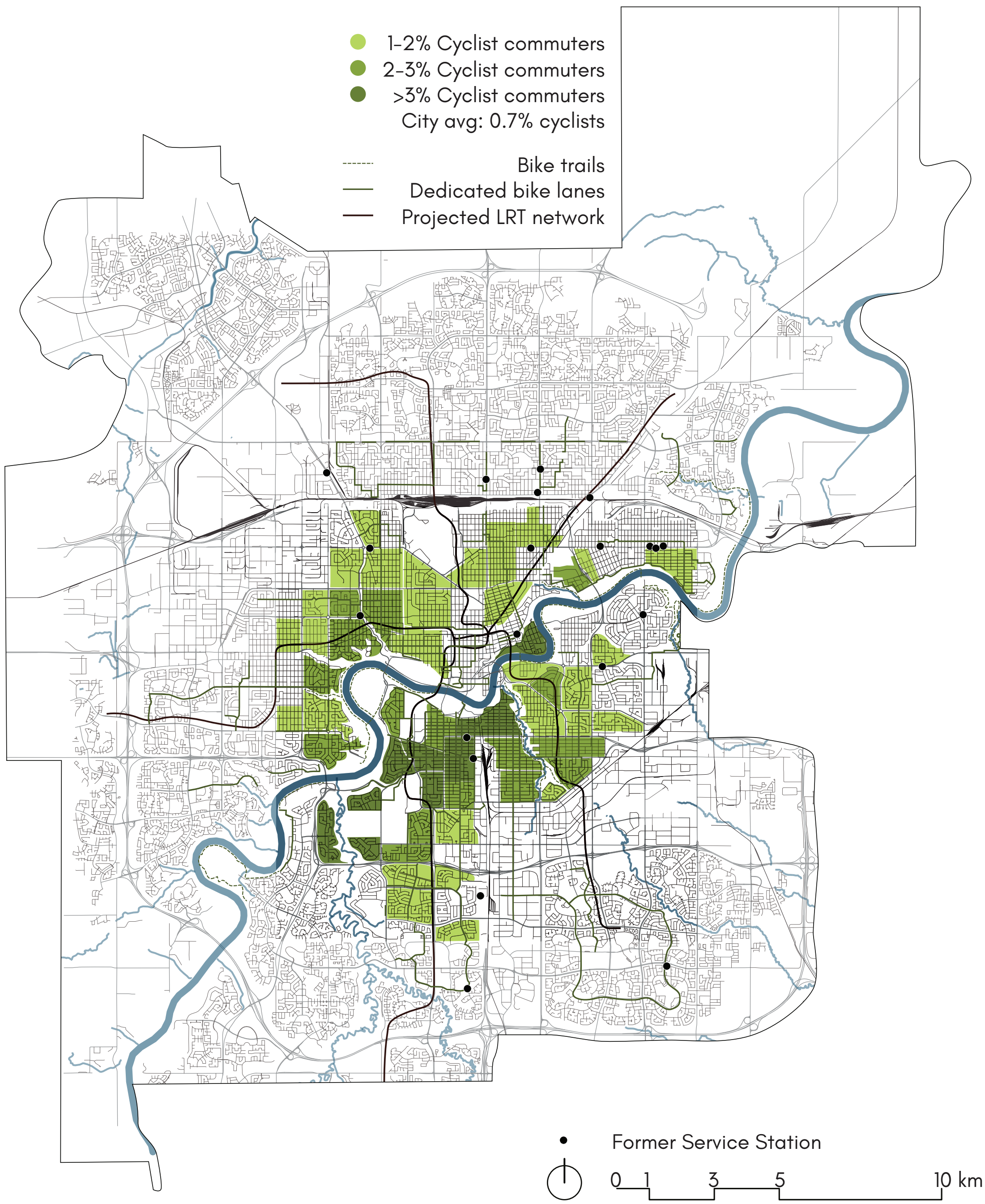


Figure 20. Neighbourhoods with a high proportion of bicycle commuters were mapped out in relation to dedicated bicycle routes, current and projected light rail transportation, and the nineteen potential test sites.

attractive locations for the same reasons as high-density areas.

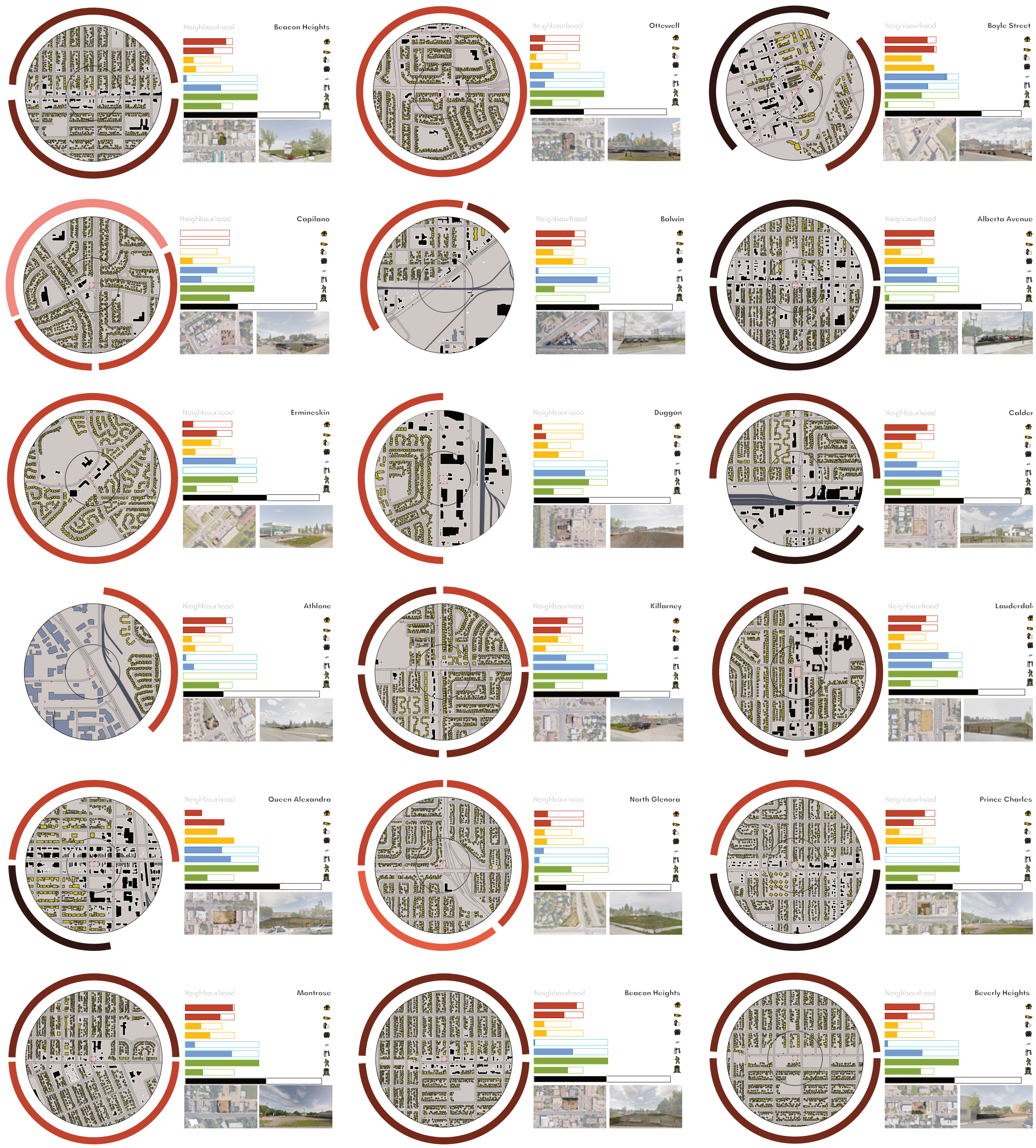
Transportation

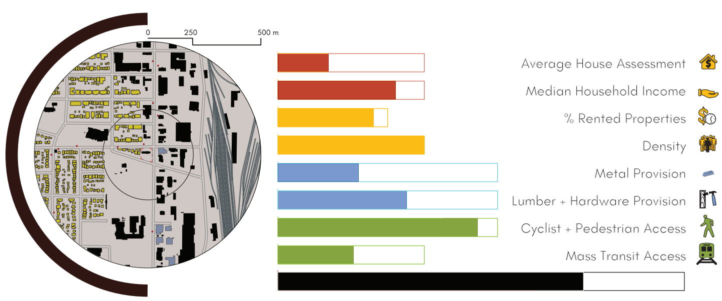
While the existing service station network developed alongside major streets and intersections, urban transportation takes a variety of forms and city life often involves foot, bike, or light rail transportation. While just 0.7% of Edmonton's residents cycle to work, the city contains concentrated hotspots where that proportion increases up to 6% (City of Edmonton, 2016). Light rail and bike paths form alternative networks that often intersect with the dispersed network of service stations (Figure 20). These networks are an important form of access for members of this project's target communities, who might not have regular automobile access either due to age, income, or ethos.

Assessment

Neighbourhoods adjacent to each of the nineteen potential sites (Figure 21) were quantitatively assessed according to eight factors: average house assessment, median household income, percentage of rented properties, density, recycled metal provision, lumber & hardware provision, bicycle & pedestrian access, and mass transit access (Figure 22). These criteria were weighted and combined, creating an aggregate score that revealed the site at the intersection of 95 Ave and 104 Street as the most viable location to test this project (Figure 23).

The test site is located between the Queen Alexandra neighbourhood and a light-industrial zone. It is located six blocks south of Whyte Avenue, a diverse and vibrant commercial district that established itself in the niche that emerged when the industrial zone receded alongside the decomissioning of the Strathcona Canadian Pacific Railway Station (Figure 24). While the industrial district itself is slated for redevelopment as a mixed-use commercial area, it still contains remnants of industry, including capital and expertise that could be revitalized by new communities of production. Queen Alexandra supports a population of 4600 residents, with a median household income of $37, 899 as of the 2010 Edmonton Municipal Census. A massive 73.3% of the households rents their living space, while 3.8% of the residents





Queen Alexandra	
Population:	4, 632
Median Household Income:	$37, 899
Average House Assessment:	$316, 115
% Rented Dwellings	73.3

Edmonton	
Population:	877, 9262
Median Household Income:	$57, 085
Average House Assessment:	$360, 723
% Rented Dwellings	32.13

Figure 21. Candidate sites were located in the Government of Alberta's Environmental Site Assessment Repository. Of these 23 sites, four had successfully transitioned to a new use and the remainder were assessed to determine a single pilot site for the project.

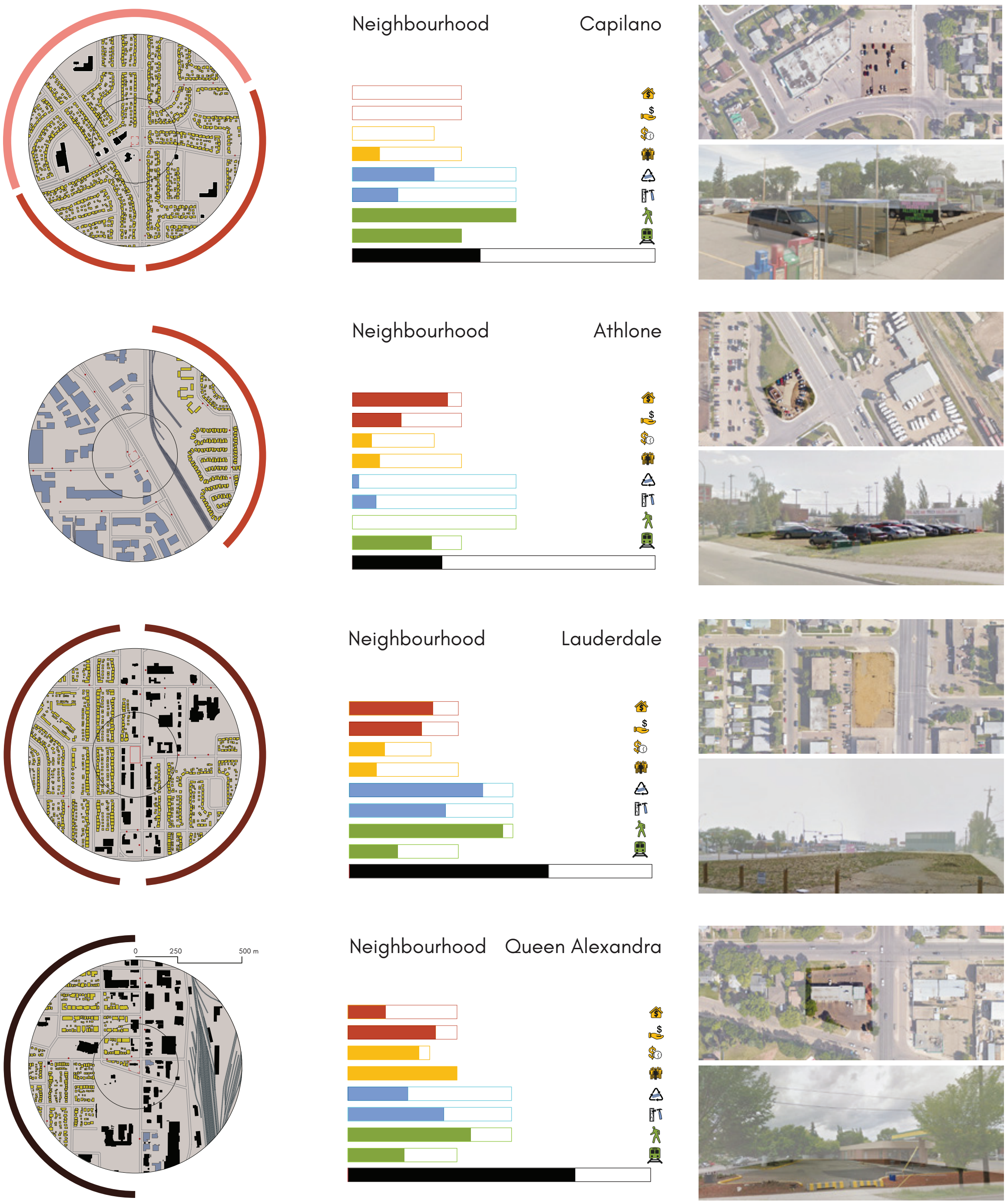


Figure 22. Four of the nineteen sites that were surveyed in figure 21, chosen to illustrate a range of demographic and infrastructural conditions.. Economic data was harvested from City of Edmonton, 2016. Material provision was located through Edmonton's GIS data, and information regarding both current and projected cycling and light rail infrastructure was adapted from the City of Edmonton, 2017.

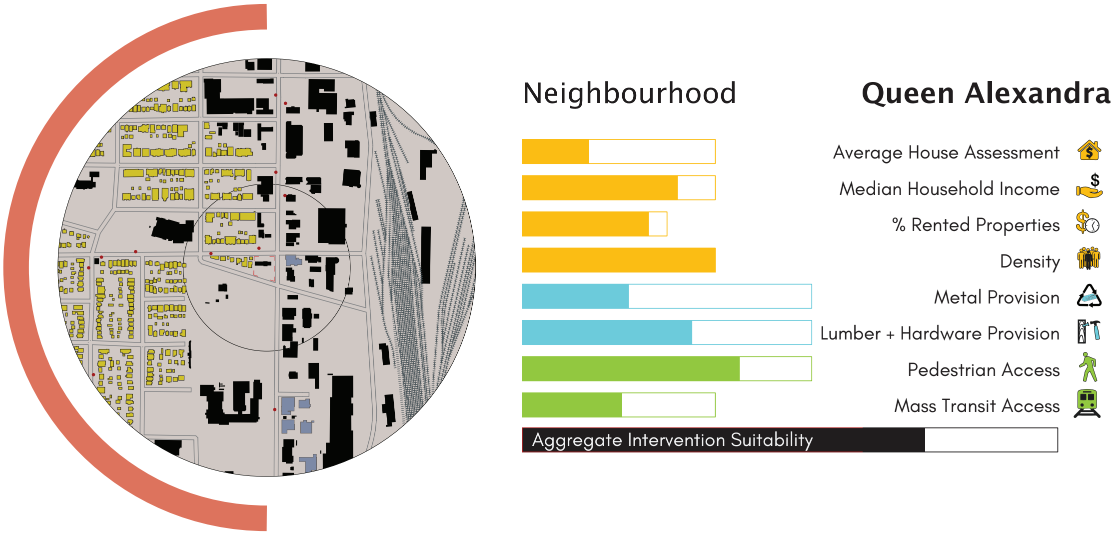


Figure 23. The test site is located at the boundary between the dense Queen Alexandra neighbourhood and a light-industrial zone that is projected to transition toward mixed-use. Across the street, to the north, lies an operational fuel service station. Photos adapted from Google Maps, 2017.

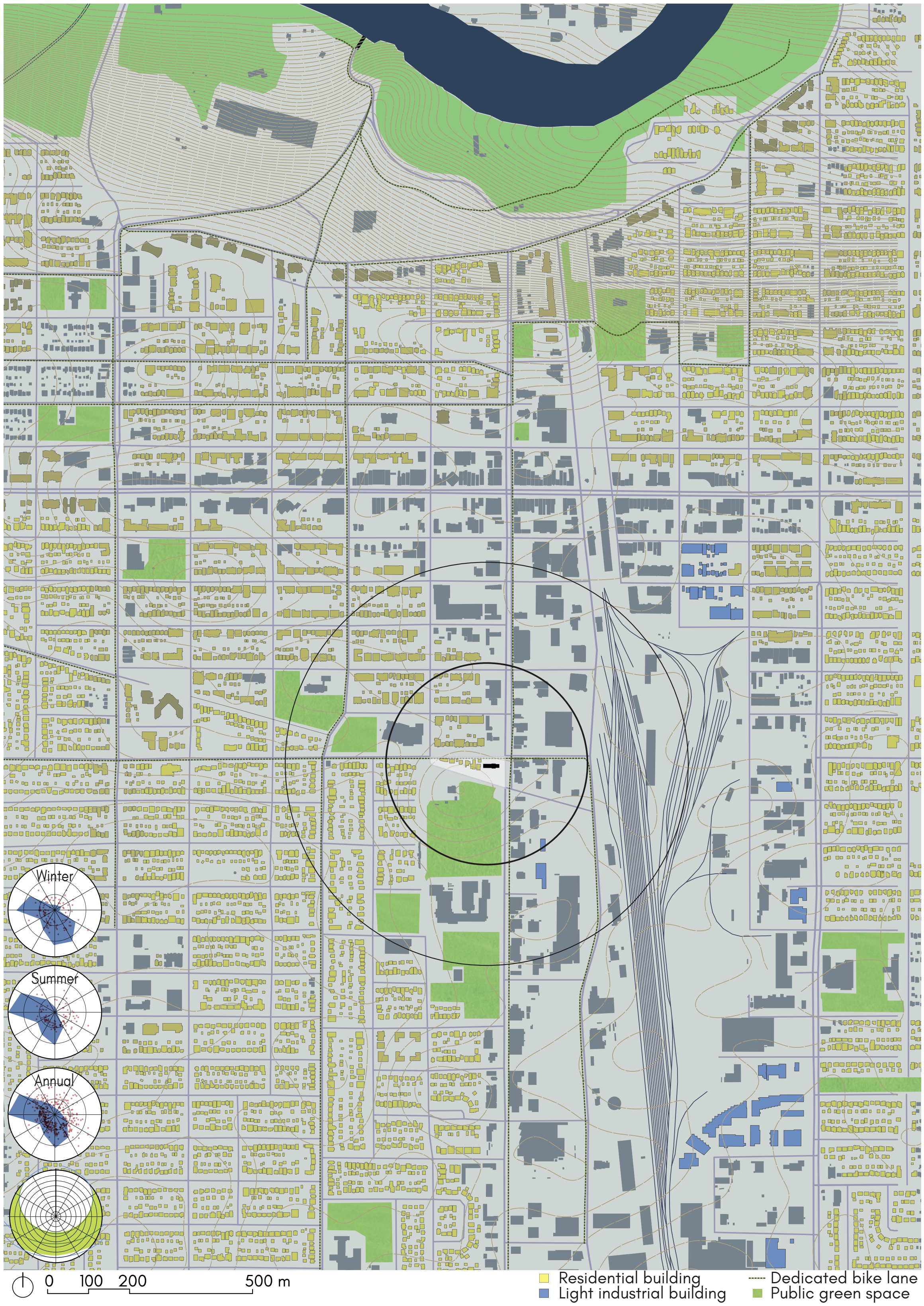


Figure 24. Local site context. The site occupies a boundary condition where a medium-density neighbourhood meets light industry near the site of a former railyard.

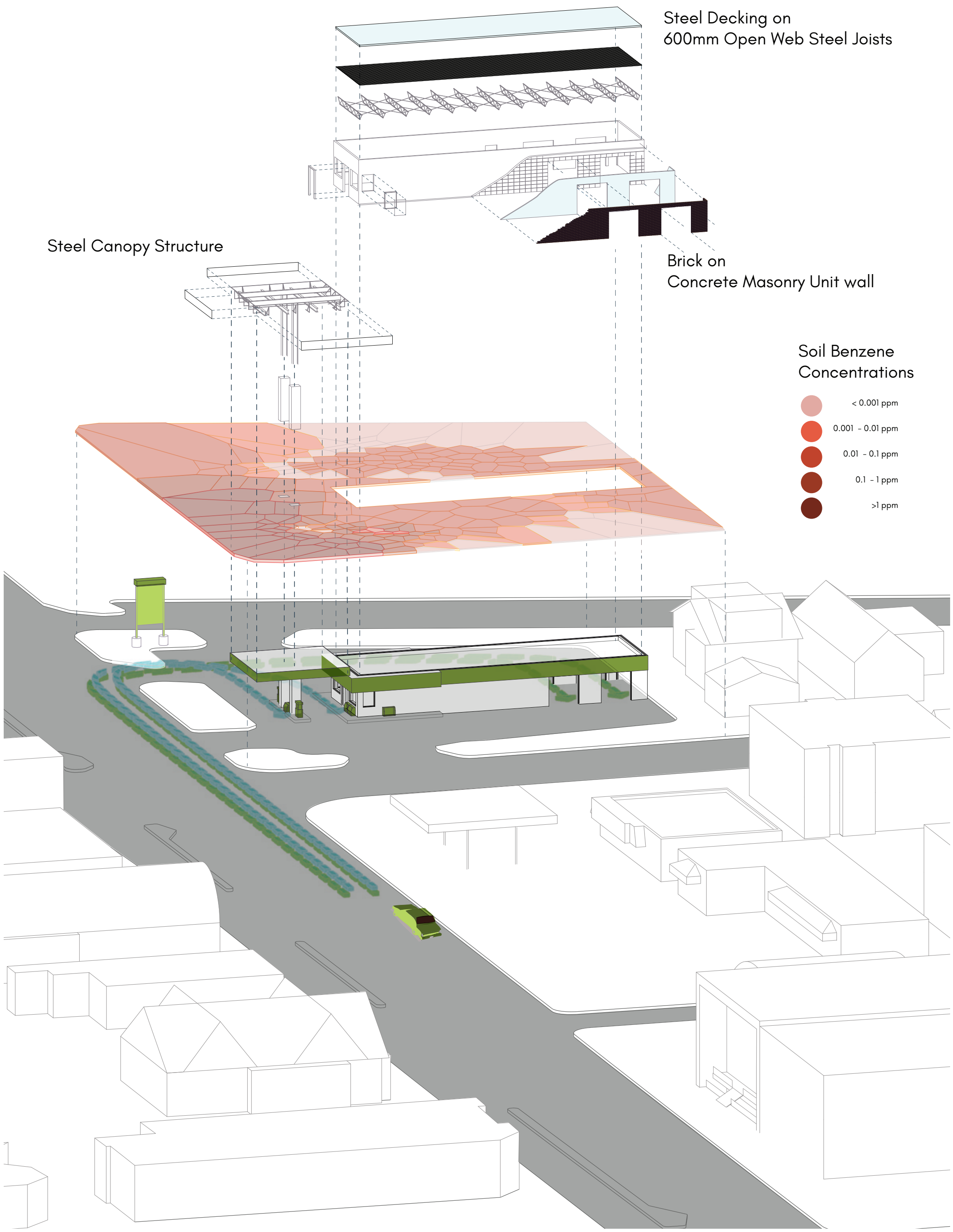


Figure 25. The extant service station is typical of the oblong box typology, featuring a standardized assembly that defers to the *place-product-packaging* paradigm and an extensive aspalt lot that ensures a continuous flow of traffic through the site.

bike to work. All these factors place the Queen Alexandra in the upper-echelon of prospective sites, diverging from Edmonton's average indicators of ($57, 085 median household income, 32.2% rented dwellings, and 0.7% cycling commuters as reported in the Edmonton Municipal Census, 2006 and Edmonton Municipal Census, 2009). The site is occupied by a four-bay oblong box (two garage bays have been filled in to expand the storefront area) that has been left intact, save for the removal of the pump infrastructure. Stripped of its advertising, this building reveals the bare structure of *place-product-packaging*, an interchangeable platform that waits in anticipation of an applied context. The landscape, too, is dominated by a flat expanse of asphalt that once enframed an orderly flow of automobiles, now serving as a cap to prevent the release of petroleum hydrocarbons into the environment (Figure 25).

Phytoremediation: Revealing Site

Phytoremediation is a technology that harnesses four physical, chemical, and biological processes associated with plants to sequester, degrade, and stablize contaminants in soil and groundwater. These processes are hydraulic control, rhizosphere degradation, uptake and transformation, and phytovolatilization (Figure 26). During the process of hydraulic control, trees and grasses pump water upward to prevent the off-site migration of contaminants from deep soil and aquifers. This process pulls contaminants toward the plants' root structure where the process of rhizosphere degradation, in which microbes that inhabit the thin layer of air between the root and soil metabolize those contaminants, occurs. During the phytovolatilization process, a mixture of degraded and active contaminants are released from plant stomata into the atmosphere where they either dissipate or are subsequently oxidized and degraded. In the final process of uptake and transformation, hydrocarbons are absorbed and detoxified by the plants themselves. This technique has achieved demonstrable success in contaminated sites where the source of contamination has already been removed, and where the contaminated soils are root accessible at depths of 5 meters or less. (Kamath, R., Rentz, J.A., Schnoor, J.L., Alvarez, P.J.J. 2004, 4-12, 15)

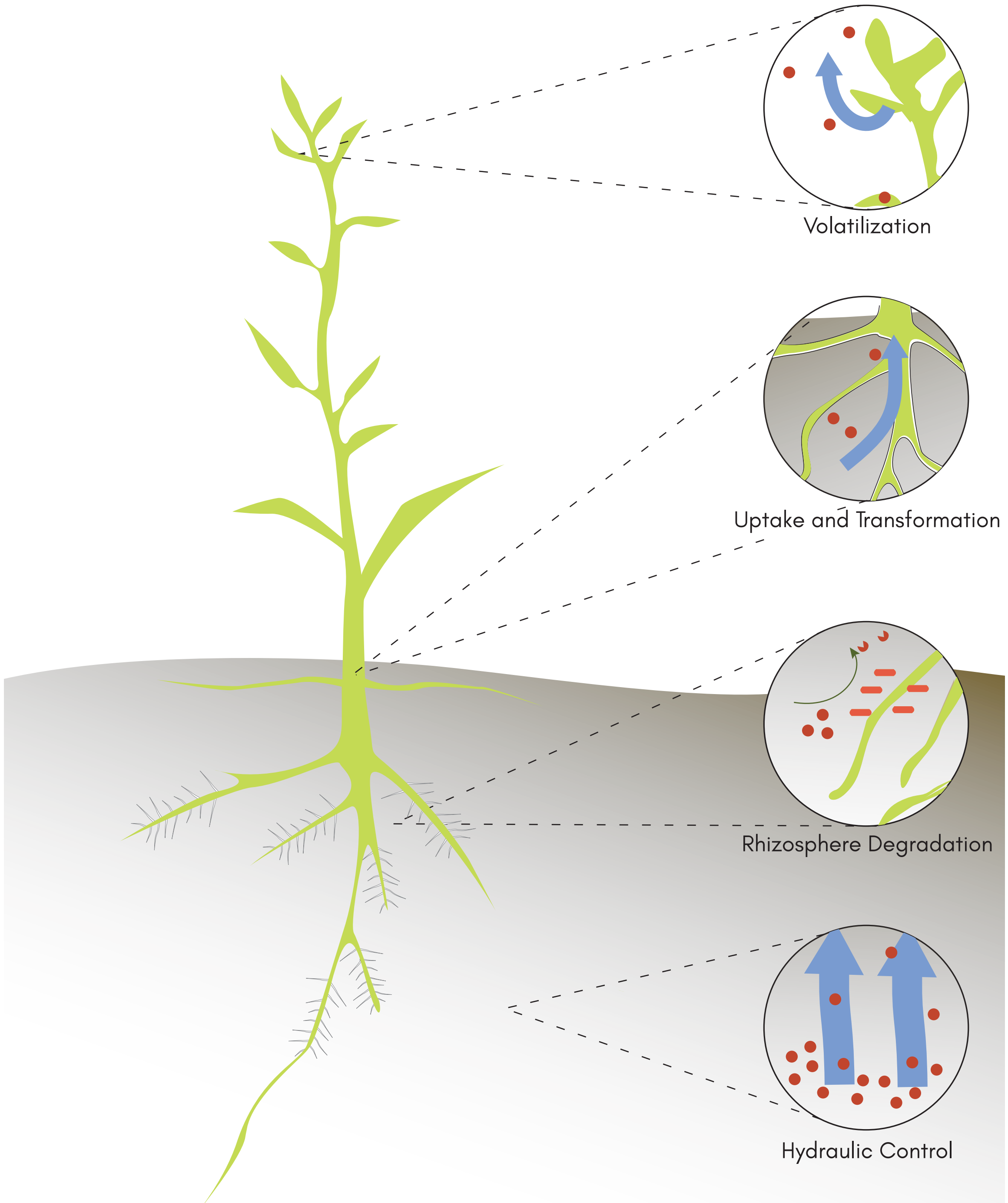


Figure 26. The primary mechanisms of phytoremediation include: hydraulic control, where plants draw water upward and slow or reverse the migration of toxins away from the site; rhizosphere degradation, where microbes metabolize complex hydrocarbons; uptake and transformation, where the plant species absorb and store these toxins before detoxifying them through the "green liver process"; and volatilization, where a small proportion of hydrocarbons are dissipated into the atmosphere.

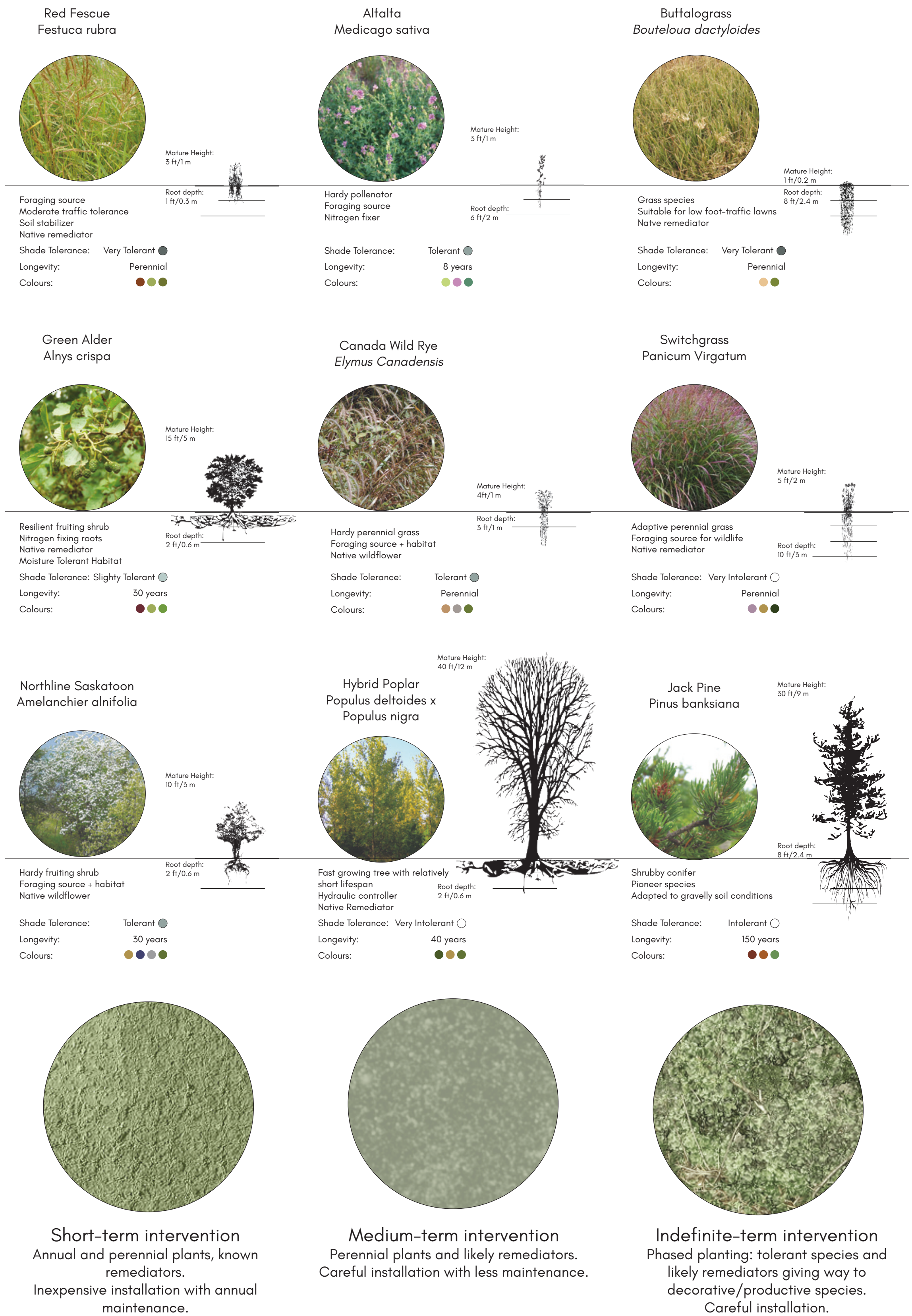


Figure 27. Native plants, chosen for their ecological, qualitative, and remediation properties, form the basis of three landscape interventions.

Slow Cleanup: Lessons from Chicago

One example of phytoremediation's potential is Slow Cleanup, an ongoing brownfield remediation project in Chicago that transforms a vast network of former service stations into productive community space through innovative use of phytoremediation. The project is spearheaded by a multidisciplinary team that includes an art professor, a soil chemist, and a brownfields geologist, and taps into their diverse backgrounds and perspectives to transform these lots into multifunctional garden spaces. Although much of the literature on phytoremediation had been focused on the functional capacities of various plants, this project sought to expand the scope of research to investigate remediatiors that could also play broader roles in the urban ecosystem, contributing to agriculture, habitat, biofuels, and aesthetics. These sites thus became both garden plots and testing grounds, occupied by a mixture of greenhouses and beds, where productive landscapes can be the sites of soil research and community spaces at the same time. This project demonstrates the potential of a dispersed network of abandoned gas stations to become urban ecosystems, laboratories, and community spaces at the same time. It is founded on the concept that time can be an asset in the remediation process; where most would treat remediation as an end to be reached by the most efficacious means available, Francis Whitehead and her team have recast the process as an opportunity to savour a growth process (Ingram 2012, 26-27).

Treatment Strategy

The remediation process developed in Slow Cleanup used a broad range of plants, often mixing remediating species with those that are merely tolerant of petroleum hydrocarbons in areas where the threat levels are less urgent. This model can be translocated to any site where enough known remediators (or analogous species that are likely to behave like their relatives) exist. Edmonton falls within the prairies ecozone, where the University of Saskatchewan has developed a library of known native remediating species (Farrell, R.E., Frick, C.M., Germida, J.J. 2004, 6-10). Three treatment groups were developed from plant species within this library, which include the grasses Red Fescue, Canada Wid Rye, Buffalograss, Switchgrass, and Alfalfa, Green Alder shrubs, and the Hybrid Poplar tree (Figure 27). Having been adapted to prairie climate conditions, these plants will be active in the greatest range of seasons and present a low risk of overwhelming other local plant species. These plants could be supplemented with a selection of non-remediating native plants, chosen for their aesthetic or productive qualitites, such as violas, geraniums, pink roses, monarda, and asters, which all provide important roles in the prairie ecosystem as pollenators and habitats.

These three treatment groups are based on the immediacy of the remediation requirements, as determined from soil probe data available from Alberta's Environmental Site Assessment Repository. This assessment data described benzene concentrations at twenty borehole locations, and was plotted and interpolated to give a sense of the spread of contaminant concentrations throughout the site (Figure 28). This plot provides the basis for the initial treatment pattern (Figure 29)(Figure 30). Lower contaminant concentrations can be treated by a short-term treatment program composed mostly of annual species while medium-term landscape interventions, composed mostly of hardy perennial plants, are available for more contaminated areas of the site. The third treatment option is an indefinite-term landscape intervention, meant for the most contaminated parts of the site. Here, the ideal of fast and efficient treatment is ignored in favour of the development of a productive landscape that lasts past the treatment timeframe, and into perpetuity. While this treatment group is composed of a loose collection of known and likely remediators, petrochemical-tolerant species, and non-remediating species that can contribute to local ecosystems, the most important part of this group is the hybrid poplar, a tree species whose rapid growth and deep roots allow the hydraulic control mechanism effect to take place within a short timeframe and reduce the urgency of the decontamination process (Kamath, Rentz, Schnoor, and Alvarez 2004, 15).

Recasting Site as a Growth Process

This phytoremediation process stands between the two models of technology. As in the production model, this remediation strategy has an expected outcome, and the system is planned in response to information that has been gathered ahead of time. As in the growth model, however, many elements of the strategy are left up to chance. The three treatment strategies anticipate three different decontamination rates, but

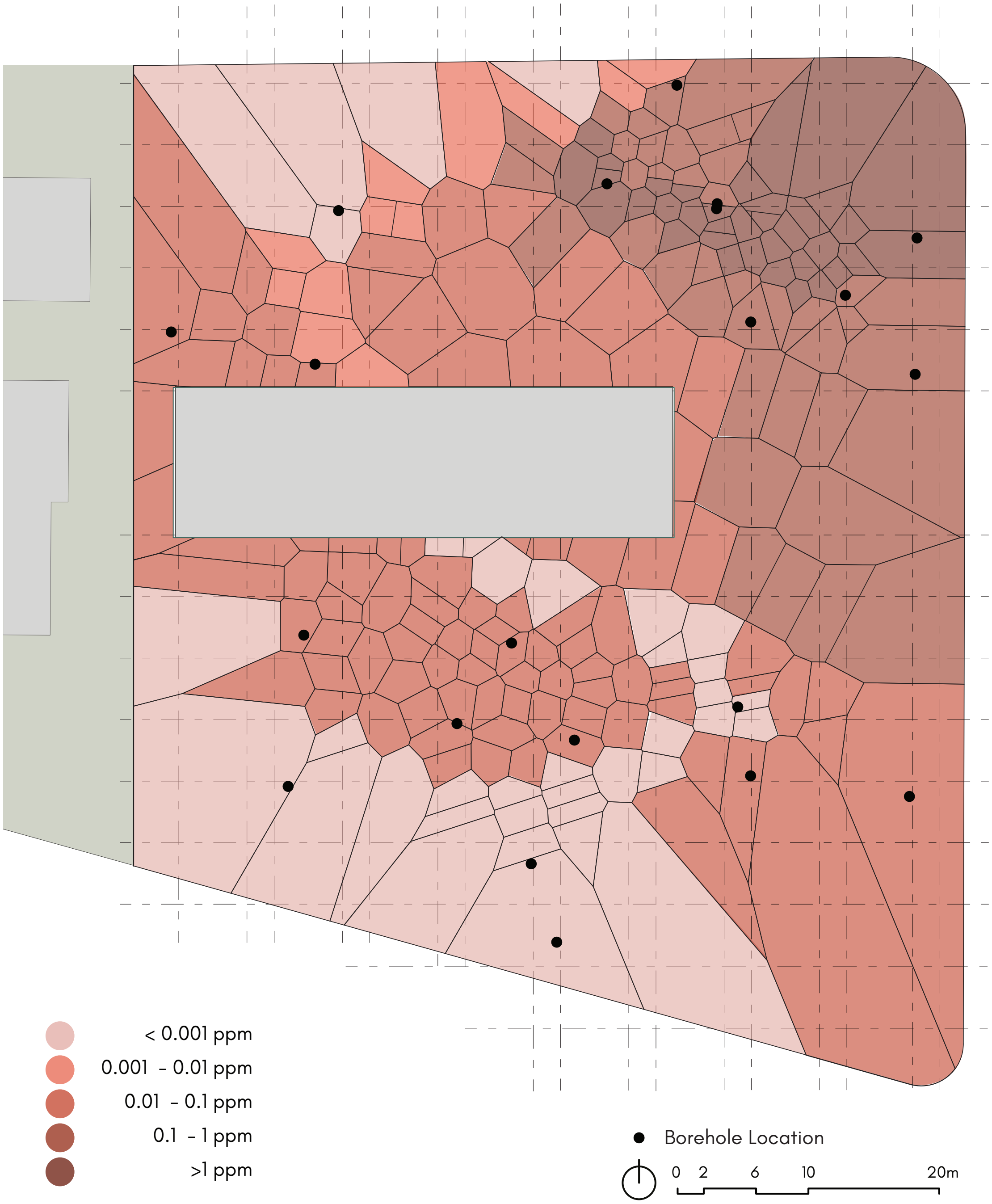


Figure 28. Distribution of benzene contaminants on site. The recommended dermal exposure limit for benzene is 0.5 ppm or less (Canadian Centre for Occupational Health and Safety, 2017). Contamination data harvested from Alberta Environment and Parks, 2016.

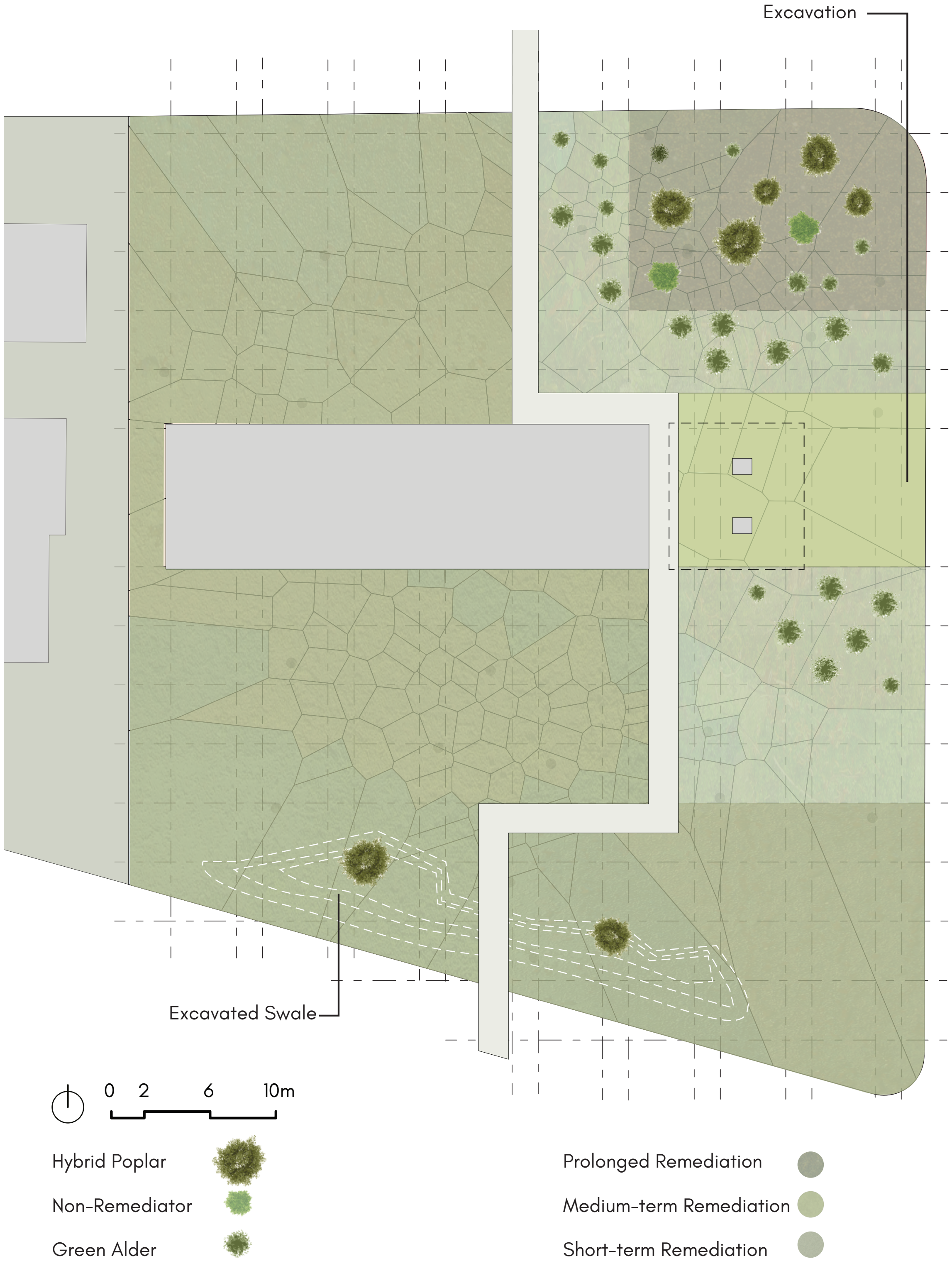


Figure 29. Treatment strategies are assigned in response to contaminant concentrations. While most of the site receives one of the three phytoremediation treatments, a small amount of excavation is required early in the process. These excavated areas include the heavily shaded region beneath the service station canopy, and a drainage swale that is carved into less polluted soil on the south side of the site.

Figure 30. Site sections AA and BB show the immediate context of the site as well as the treatment schedule during the early stages of occupation.

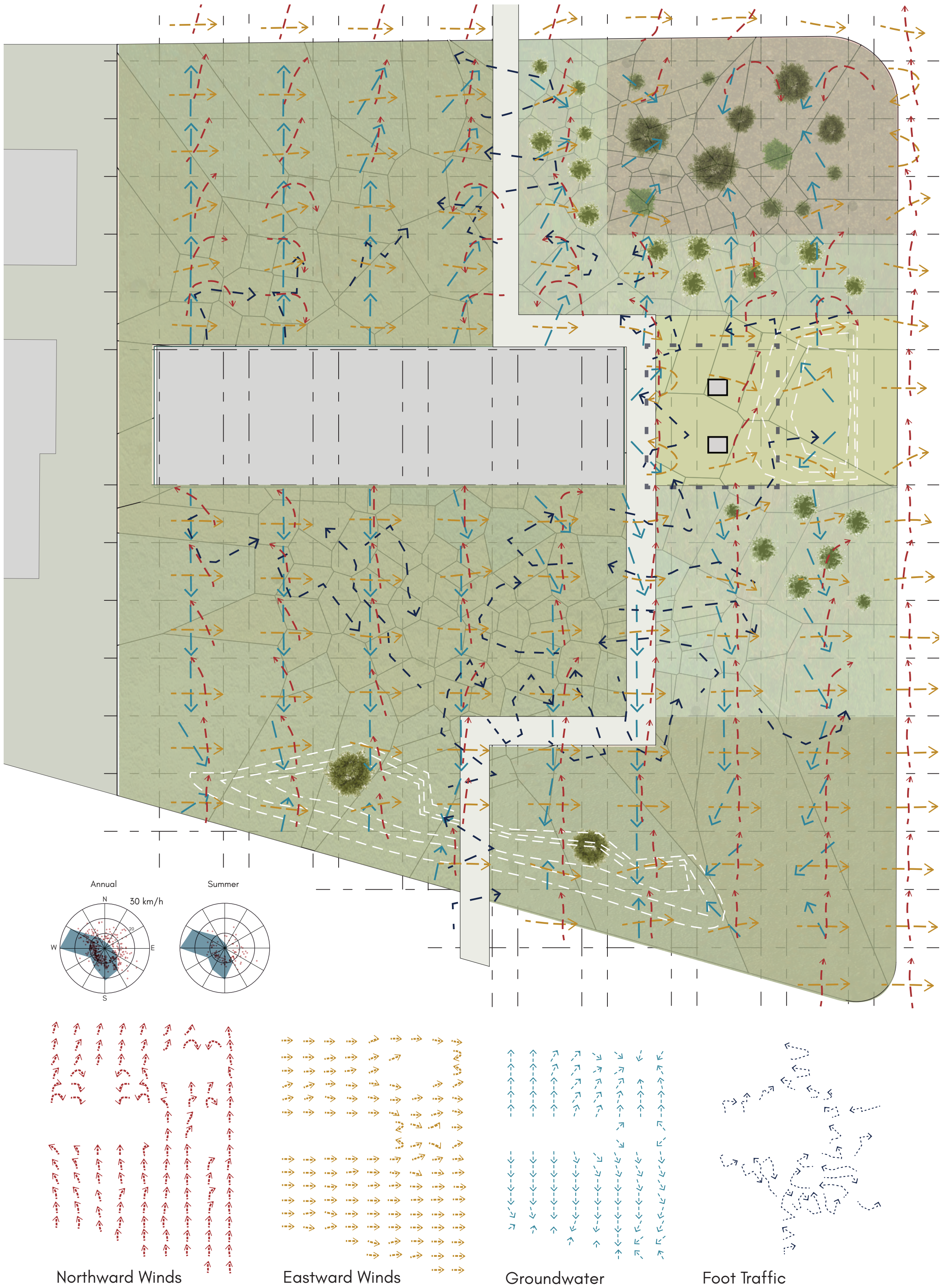


Figure 31. Four anticipated forces (prevailing winds during the growing seasons, groundwater flows, and foot traffic) were mapped onto the pilot site to provide an idea of how the initial treatment scheme might change over time.

the exact timelines are extremely fluid. While external factors such as the weather will directly influence the remediators' efficacy, the slow speed of the overall process opens the landsape up to entropy. Various forces – natural, human, and animal – act directly on the site, disturbing soil, spreading seed, and altering growth patterns of flora (Figure 31). These activities provide another source of chaos, creating a limitless set of site conditions that might develop as the site progresses over time (Figure 32). This entropic landscape takes on the qualities of a garden: a space that mediates between the indeterminate tendencies of nature and the intentional actions of its

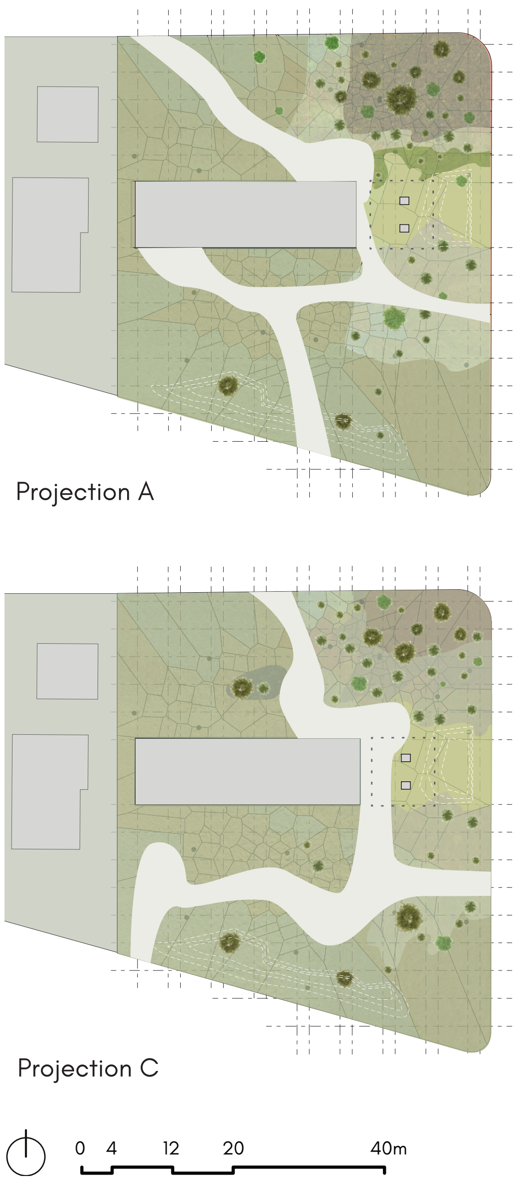


Figure 32. Four potential landscape projections. The maturing landscape will begin to trace natural forces and human activity, and will in turn influence the activity that takes place on the site.

tenders.

> Order and entropy represent two poles on a scale. In the end, or so say the physicists, entropy will always win. Ultimately, no matter how sophisticated the system of order, it will deteriorate in time. For at best, nature gives the gardener a reprieve and the garden a stay of execution. The lion tamer, the gardiner with his pruning shears, can only gain some time through constant maintenance. He must be vigilant and constantly aware, and on his guard. The lion – in this case the natural order – is always ready to jump, always ready to reclaim the land from the intruding hand (Treib 2005, 49).

Structure

A structure that is intended to grow requires a reliable method of reproducing itself. Just as the introduction of interchangeability by John Hall kicked off an intense period of mechanical innovation and reproduction, a colony of interchangeable spaces can become a seed for growth. Within this project, these spaces take on the form of a repetitive post and beam structure established in response to the extant service station to create a major/minor rhythm (Figure 33). The structural sytem was developed through physical models (Figure 34) to create an modular system at a scale that is appropriate for continuous growth, maintenance, and adaptation (Figure 35). These adaptations take the form of floor, wall, and roof assemblies that are built and attached to the emerging structure as the ensemble of communities decide how to use the expanding space (Figure 36). While early versions of these infill assemblies might incorporate a significant amount of prefabricated material, a more experienced community will be able to make use of the tools, materials, and expertise available on site to create a significant amount of the expanding building without relying on external producers (Figure 37). As the site matures, its inhabitation unfolds in a continuous, holistic process that follows a similar rhythm regardless of the specific site. Following the initial occupation of the building, the layer of asphalt that covers most of the lot would be removed and replaced with layers of gravel and fertilizer to accomodate the new plants that make up the phytoremediation treatment. This intervention sets the stage for a continuous cycle of growth and renewal as the landscape, the community, and the building develop alongside one another (Figure 38).

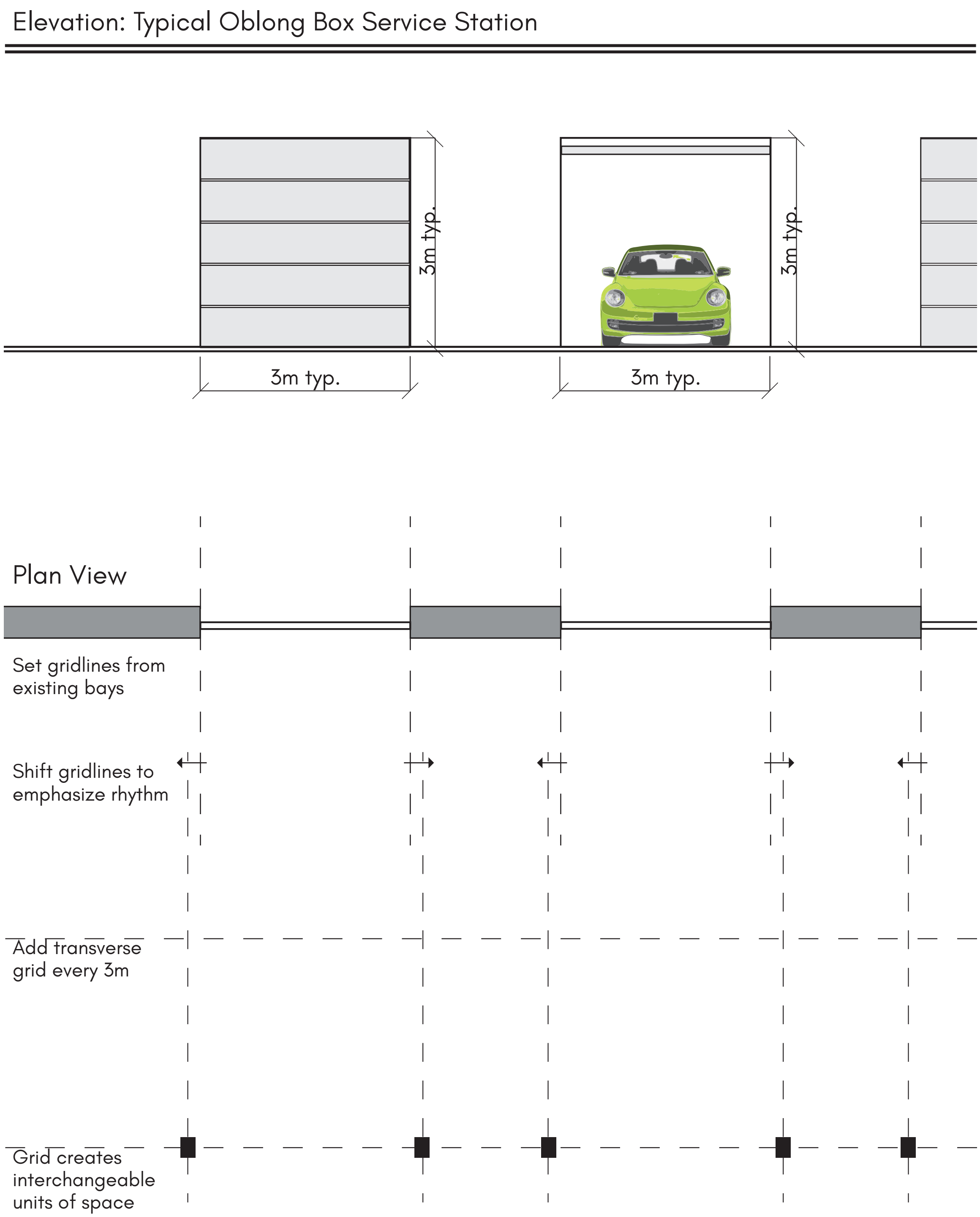


Figure 33. A major-minor grid, based on the repetitive design of the existing oblong box typology, becomes the basis for cellular system of construction.

Figure 34. Development models.

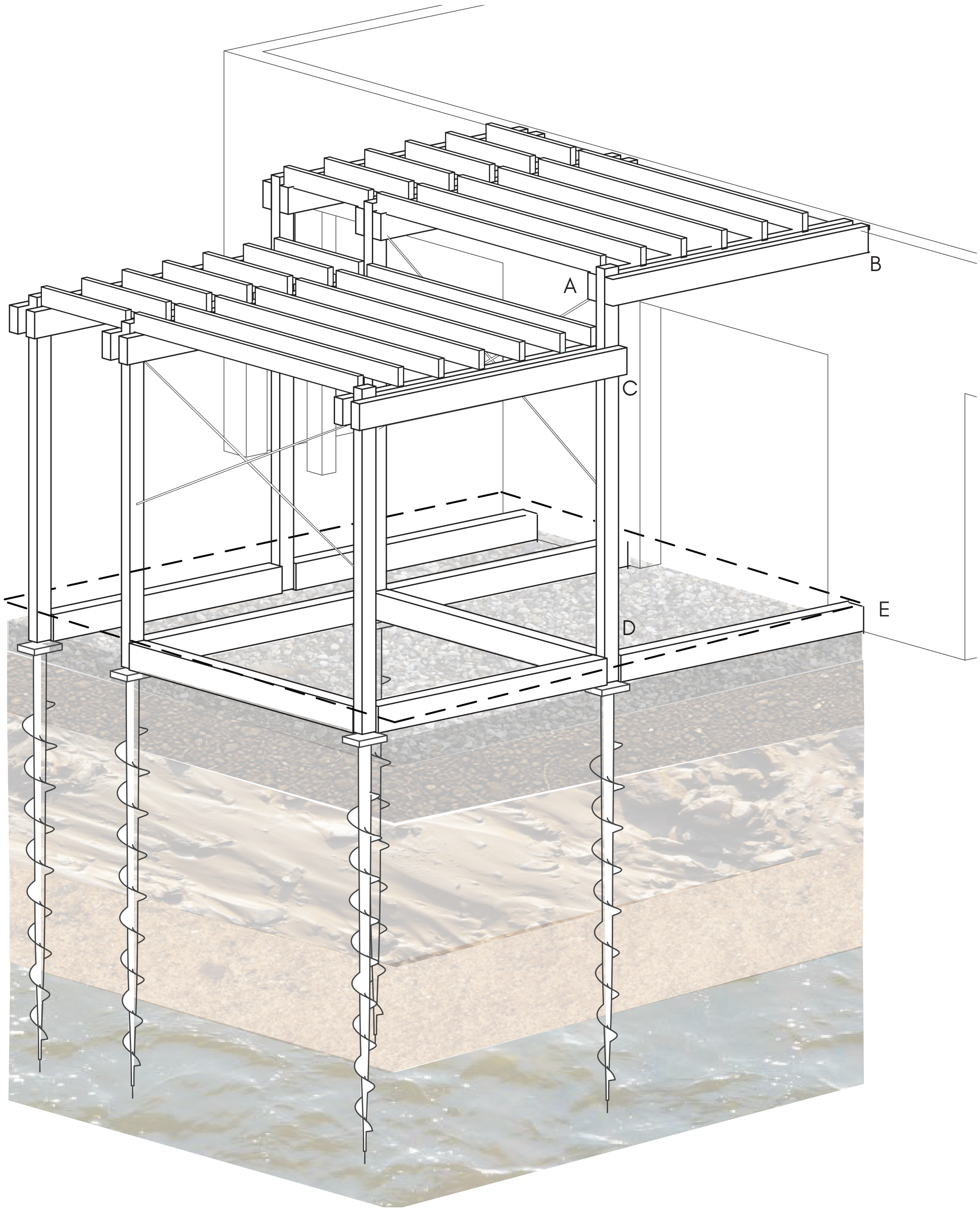


Figure 35. Axonometric projection of four typical structural bays. Structural beams are attached on either side of timber columns (A) or fastened to steel brackets embedded into the extant building's bond beams. Offsetting the beams on either side of the column allows the structure to grow upward (C). At the ground level, the structure is secured either to helical piles (D) or back to the service station's foundation (E).

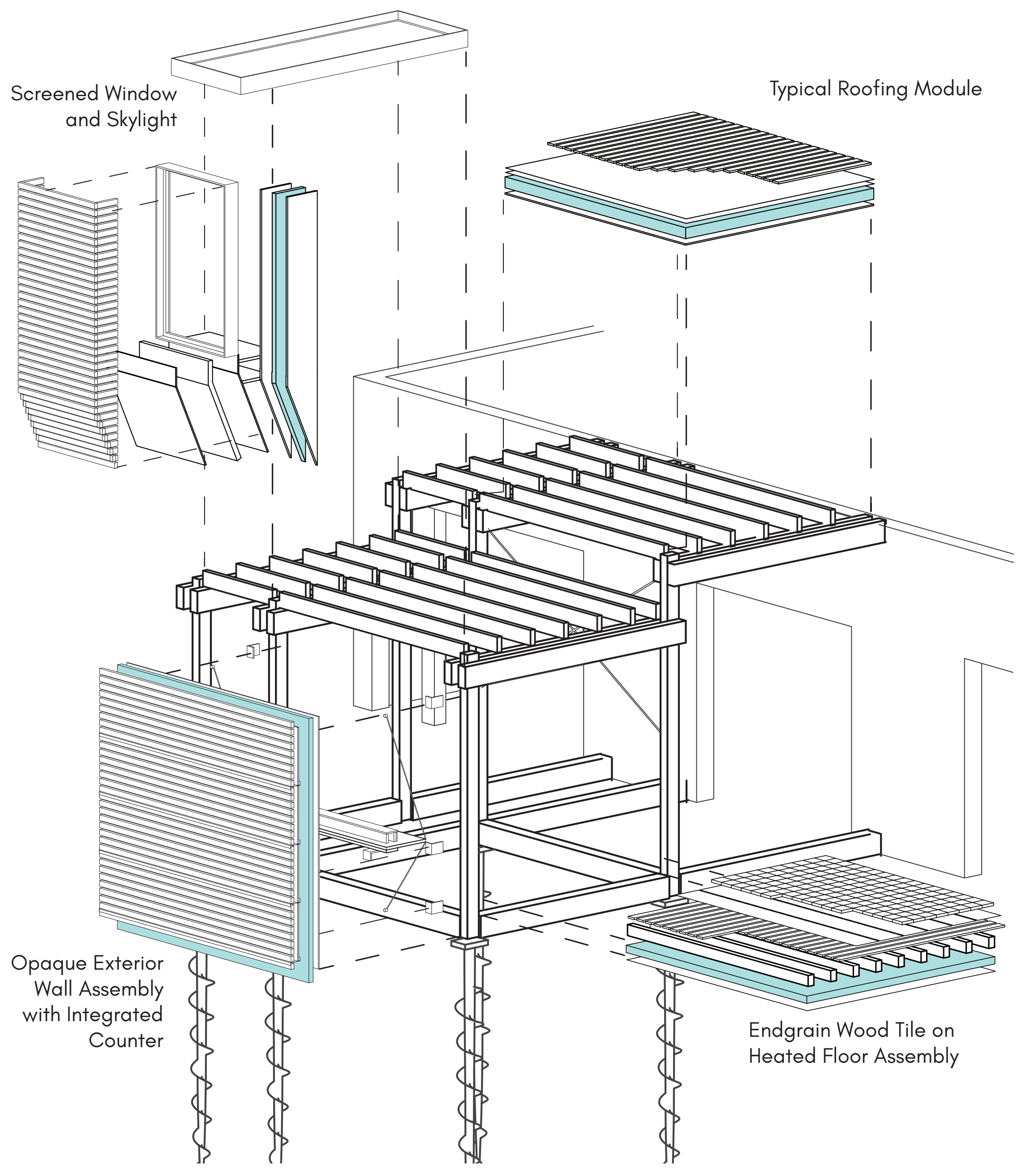


Figure 36. Exploded axonometric, infill diagram for structural bays. Floor, wall, and roof are fabricated on site and fastened to structural bays. Floor assemblies remain mostly typical, while exterior walls, interior walls, roof, and openings are at an adaptable scale that can be modified as per the users' intent.

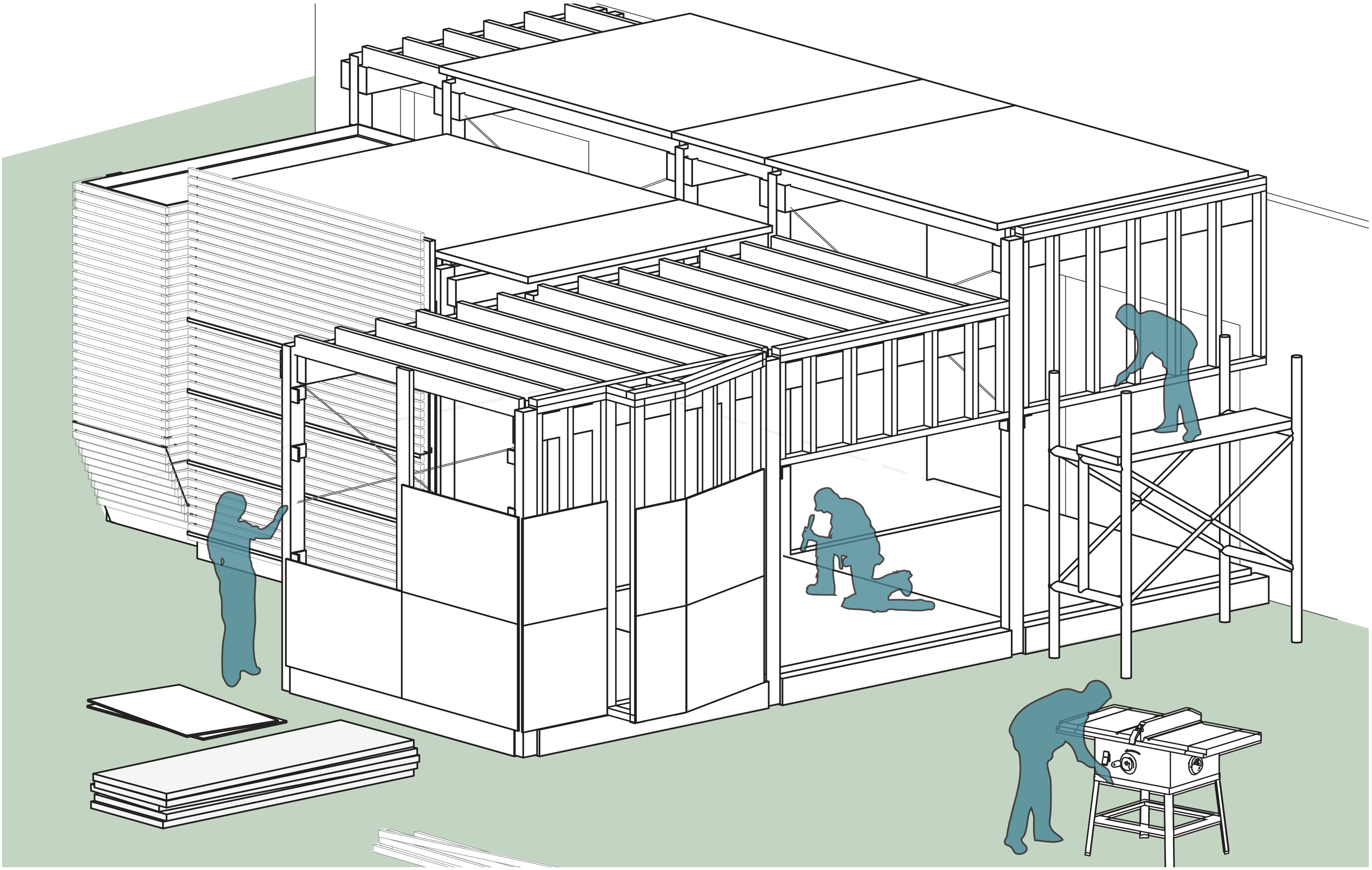
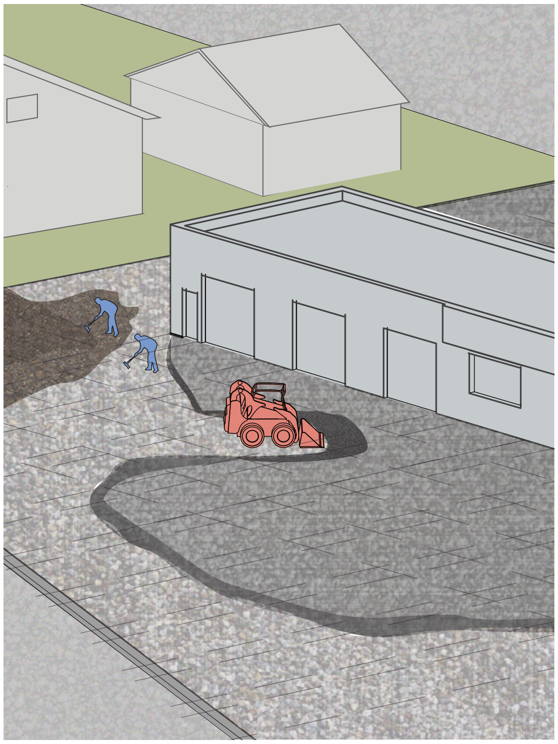
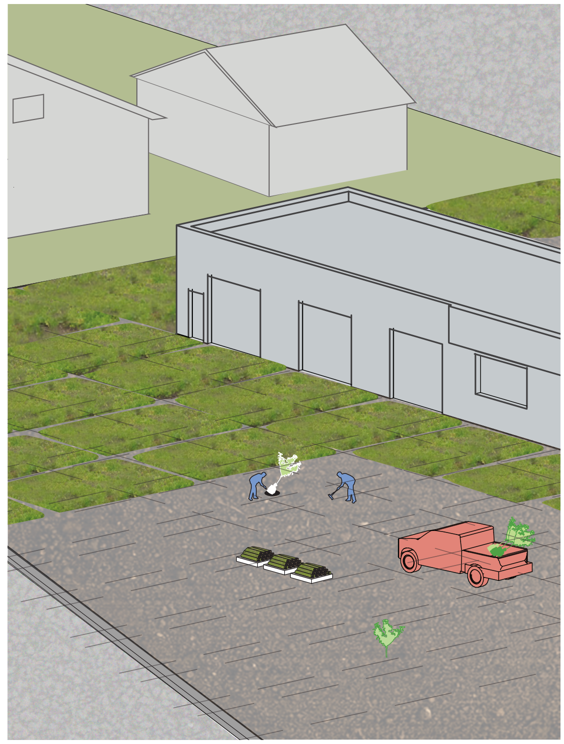


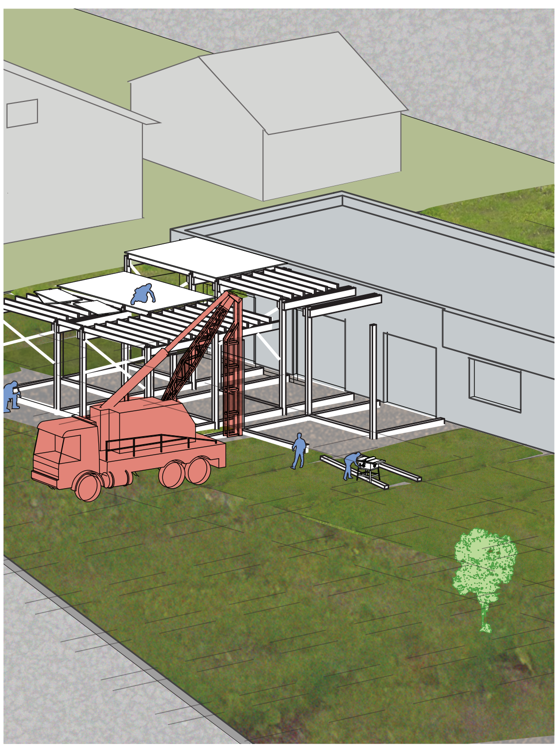
Figure 37. After the structural system has been erected by professionals, the user communities are free to finish assembly on their own terms.



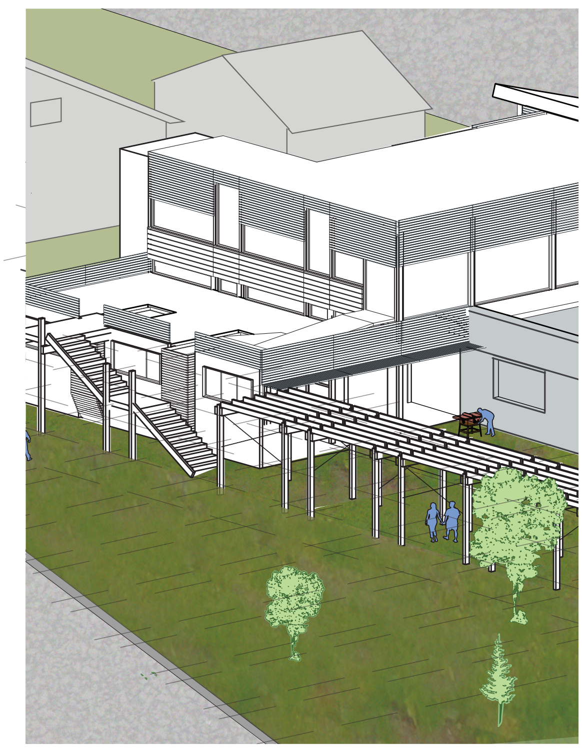
Occupy



Cultivate



Grow



Renew

Figure 38. The construction process occurs in parallel with remediation, following a logic of growth that allows the building to slowly unfold over time.

Structure as Process

The grid system becomes not just a method of creating enclosed workspaces, but it can also be a means of interfacing with the landscape and the greater community. While the expanding structure's developing bays might eventually become interior workspace, this construction process can also be slowed dramatically to provide a sheltered seasonal workyard that thickens the interface between the community of producers, the landscape, and the greater community (Figure 39)(Figure 40). The ephemeral nature of these spaces also adds an important philosophical departure from the production model of technology. While the transitional space fits within Heidegger's concept of *enframing*, which reduces a subject's identity to capacity as an intermediate, that transition is not inevitable. The building could progress indefinitely, and as such there is no predetermined outcome, no final form (Figure 41). These transitional states thus take on their own identities as spaces that are at once incomplete and sufficient.Though the interchangeable nature of the structural bays represent an overbearing, production model of technology, their simplicity and scale lend themselves to limitless patterns of occupation and adaptation. This cellular structure thus contrasts the interchangeable nature of the extant oblong box with a second interchangeable structure that is designed to accomodate autonomous spatial adaptations, forming a new urban landscape that juxtaposes the two philosophies of production.

Projection

The extant service station that occupies the site creates an initial form that structures the growth process. From this initial condition, an incredible range of formal strategies and configurations that could emerge in response to the forces and activities that might take place on the maturing site (Figure 42). This thesis projects just one possibility as a point of depature from which the potential of this growth process can be explored. This projection is based on a fifteen-year timeline that oversees the process from the initial occupation of the existing service station to its maturation as a fully-developed landscape and building (Figure 43).

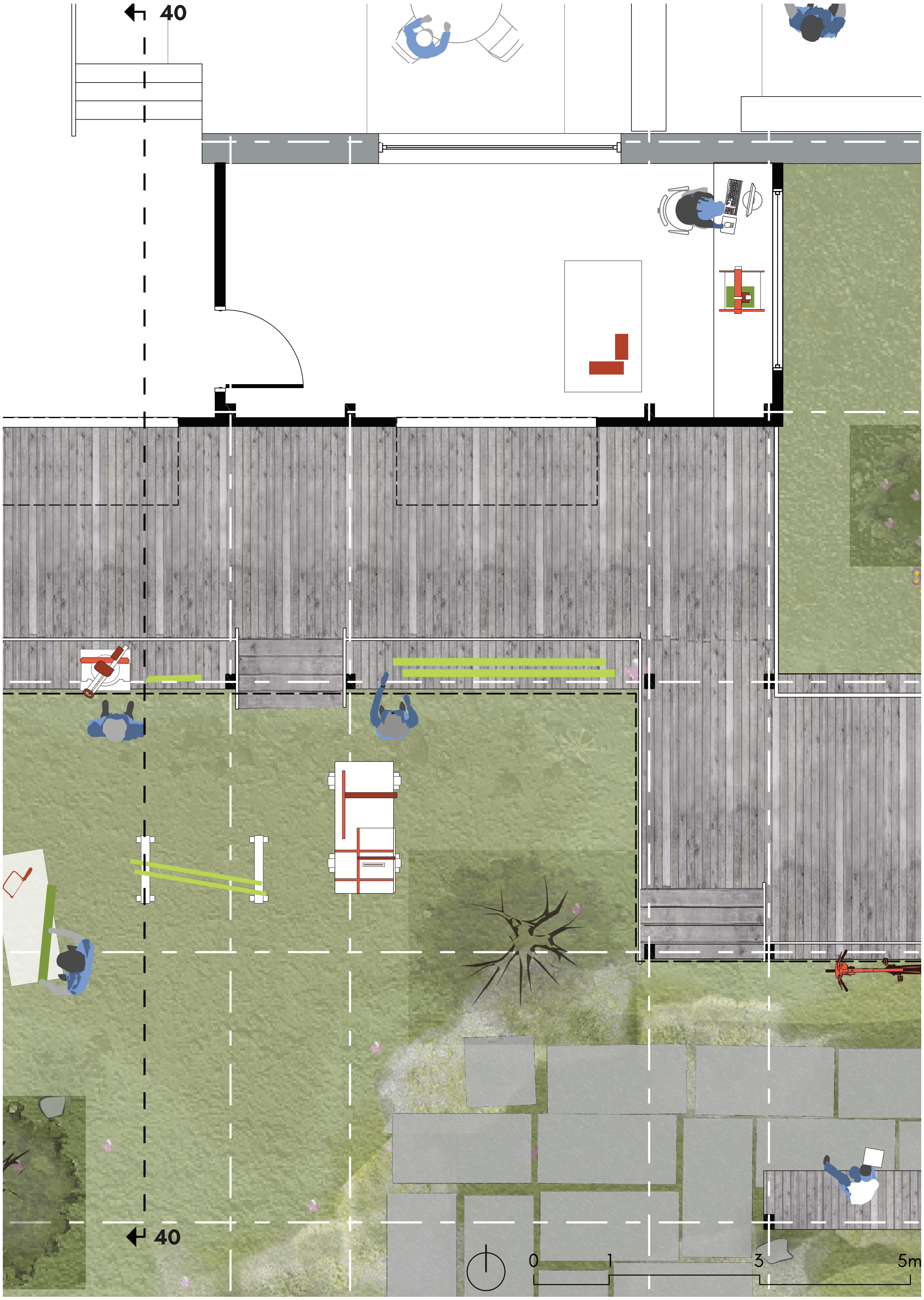


Figure 39. The workyard mediates between the private and the public, creating an informal social space where members of the community ensemble can engage with the landscape and the local community.

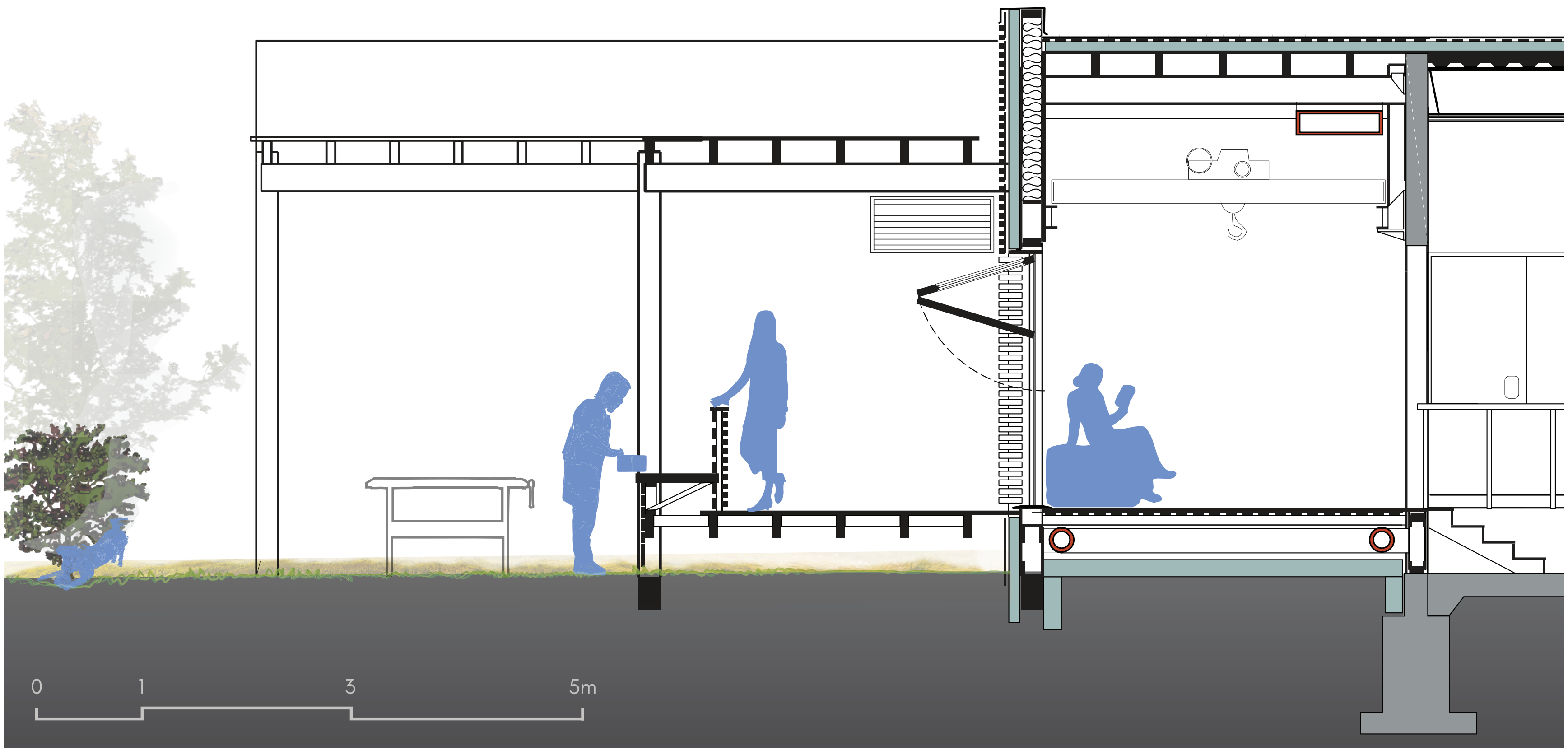


Figure 40. Section through the workyard as it transitions from a sheltered exterior workspace to the new building enclosure and into the repurposed service station.

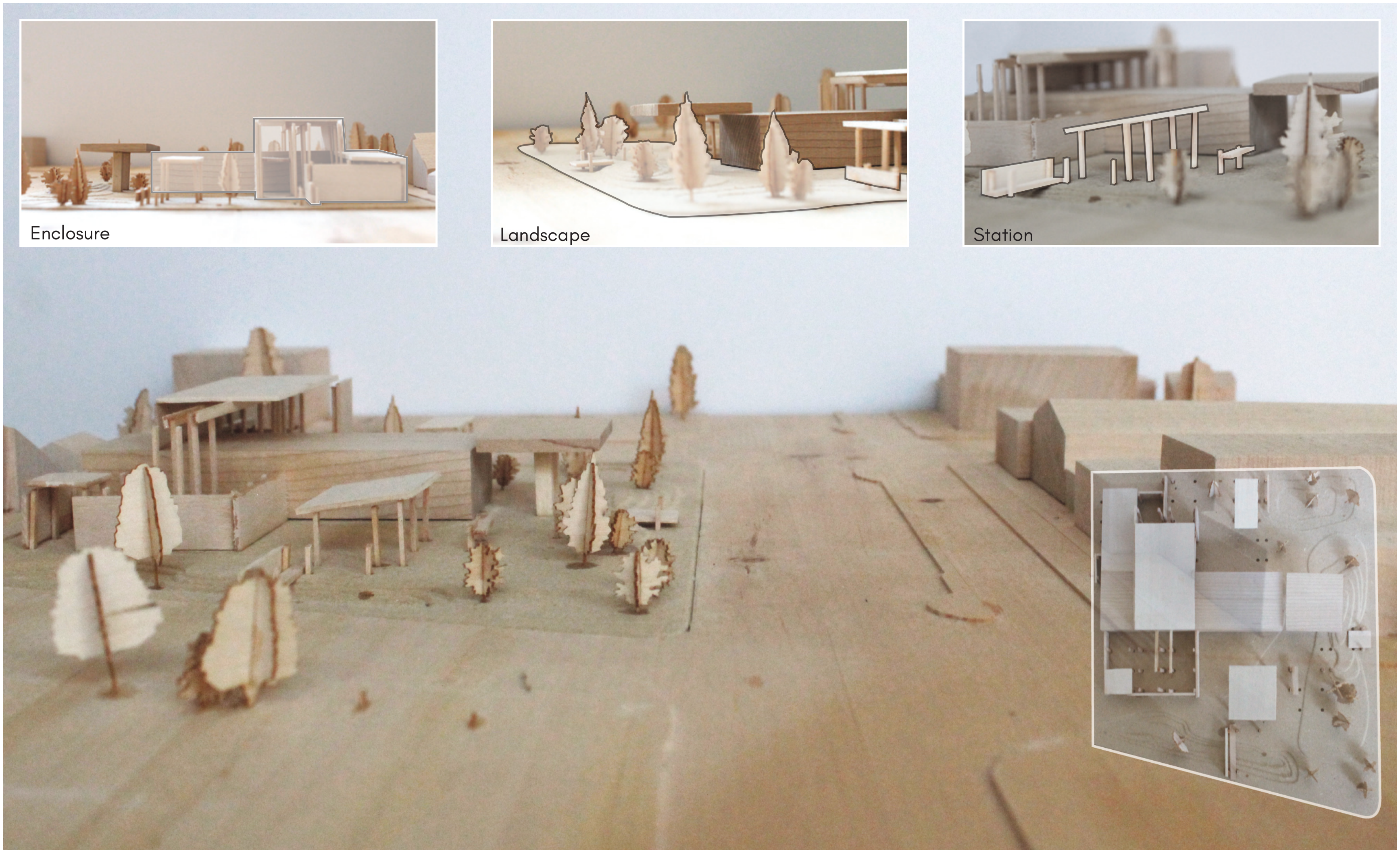


Figure 41. Conceptual massing model, 1:250 scale. This model describes three basic situations that would arise on the developing site (building enclosure, open landscape, and a series of sheltered “stations” that reconcile the two extremes) and suggests how the system coud integrate all three relationships at an appropriate scale.

Figure 42. A small selection of potential site plans that might emerge from the dialogue between the existing building and the new grid.

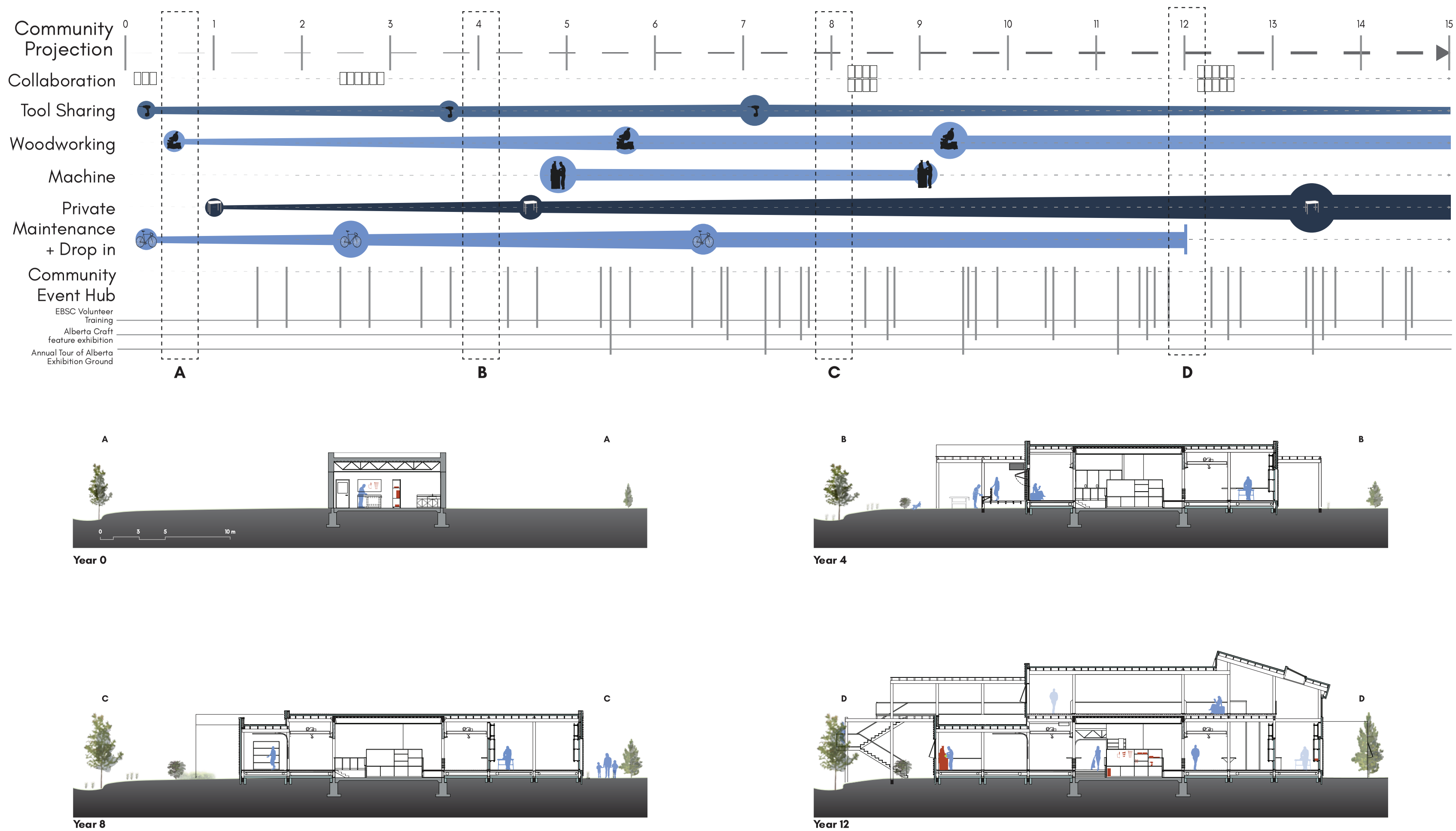


Figure 43.The gradual development of the structure traces the interaction and growth of five communities in coordination with the maturing landscape.

Year 0

The process begins when the southern branch of the Edmonton Bicycle Commuter's Society (EBCS) moves out of the former storefront that they had been leasing. After discovering the well-located former service station, the community applies for a grant to begin remediation and partners with an emerging community tool library to help share some of the expenses. Some recent graduates from the Northern Alberta Institute of Technology buy some second-hand tools and establish a small workshop in the back of the existing building where they collaborate on small projects after work (Figure 44).

Year 4

The collaborative community develops an interest in machine tools and start producing simple parts for the EBCS' bicycle repair workshops. As these groups outgrow the existing building, they upgrade the building's roof and start building outward. New structure projects from flanks of oblong box, extending into the fully remediated parcels to expand the workshop space and provide new infrastructure for the steadily expanding user groups (Figure 45).

Year 8

Although membership fees, commissioned work, and small event hosting help to pay for the expansion, the partner communities look toward new methods to increase their revenues. Studio space is rented out to creative professionals and these new voices help round out the range of experience and expertise within the building. A CNC is purchased and two members of the original workshop community oversee the networked manufacturing business and run the building full-time (Figure 46).

Year 12

After ten years, the campus is thriving. The adjacent service station becomes available and the remediation program expands to begin treatment of the new site. Two years later, a satellite structure is established across the street. The maintenance, repair, and restoration program relocates into this new building, continuing to share resources and personnel with its sister site (Figure 47).

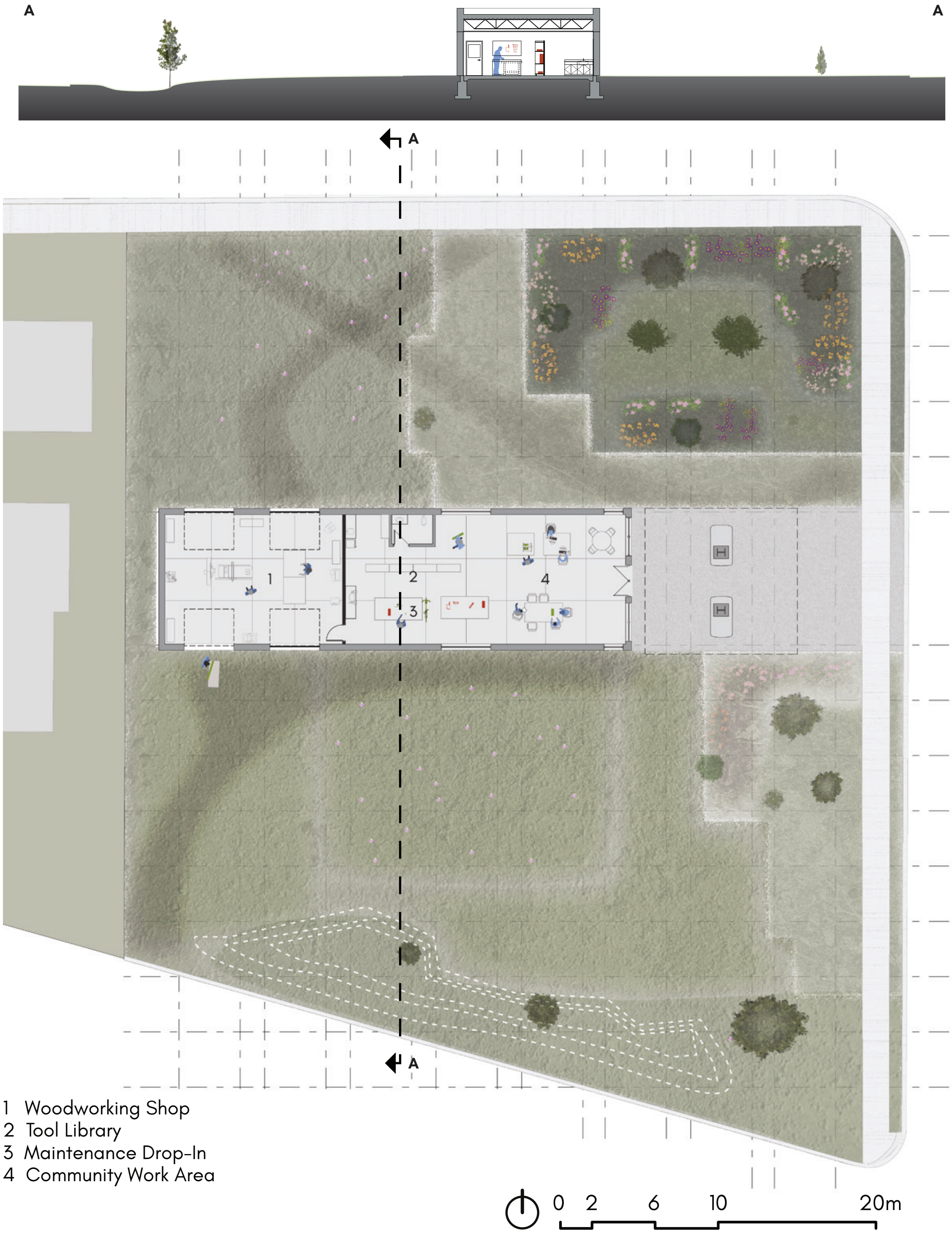
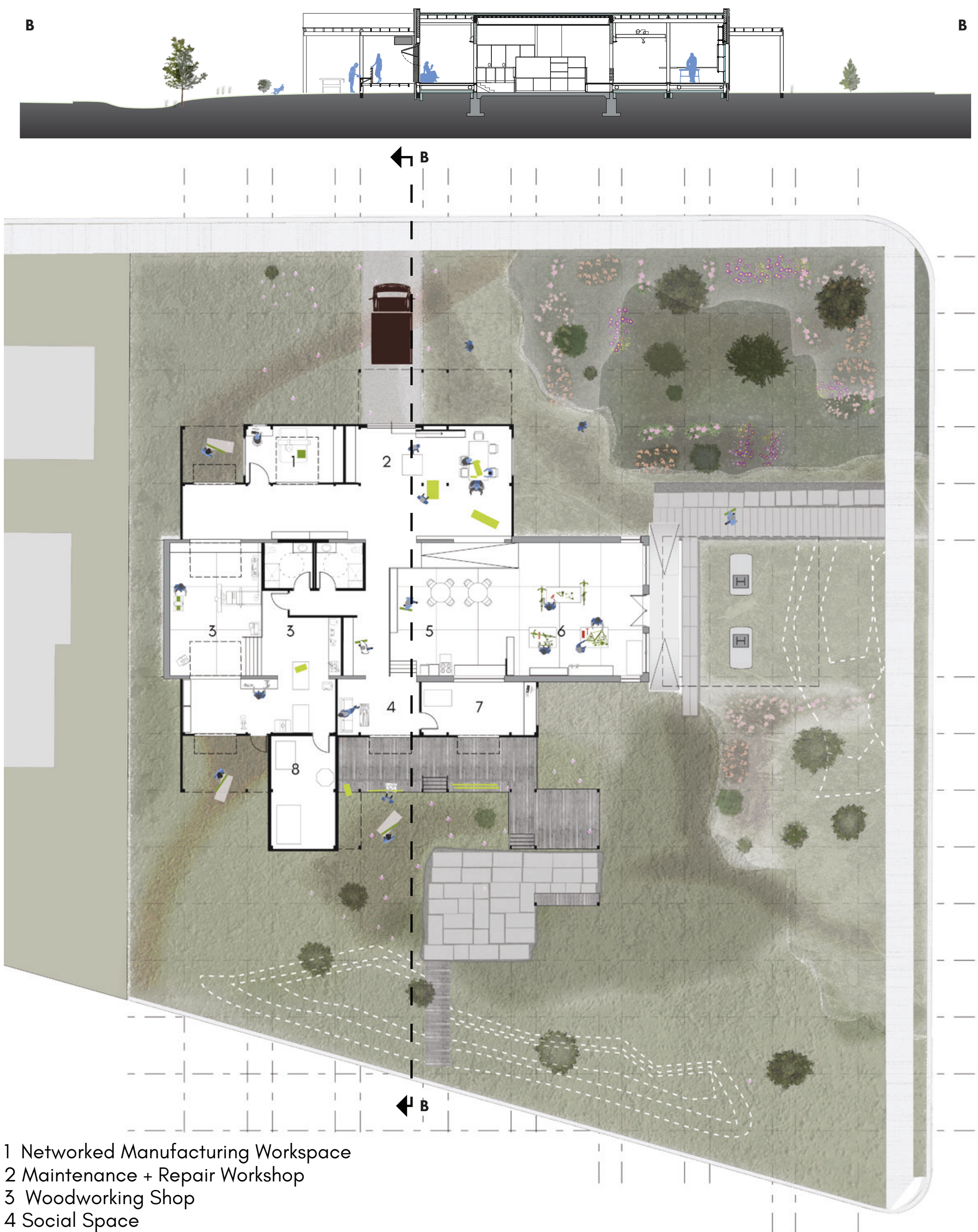


Figure 44. Projected plan of the building and landscape immediately following the initial occupation of the extant service station.



1 Networked Manufacturing Workspace
2 Maintenance + Repair Workshop
3 Woodworking Shop
4 Social Space
5 Tool Library
6 Collaborative Workspace
7 Leased Workspace
8 Mechanical Space

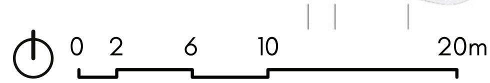
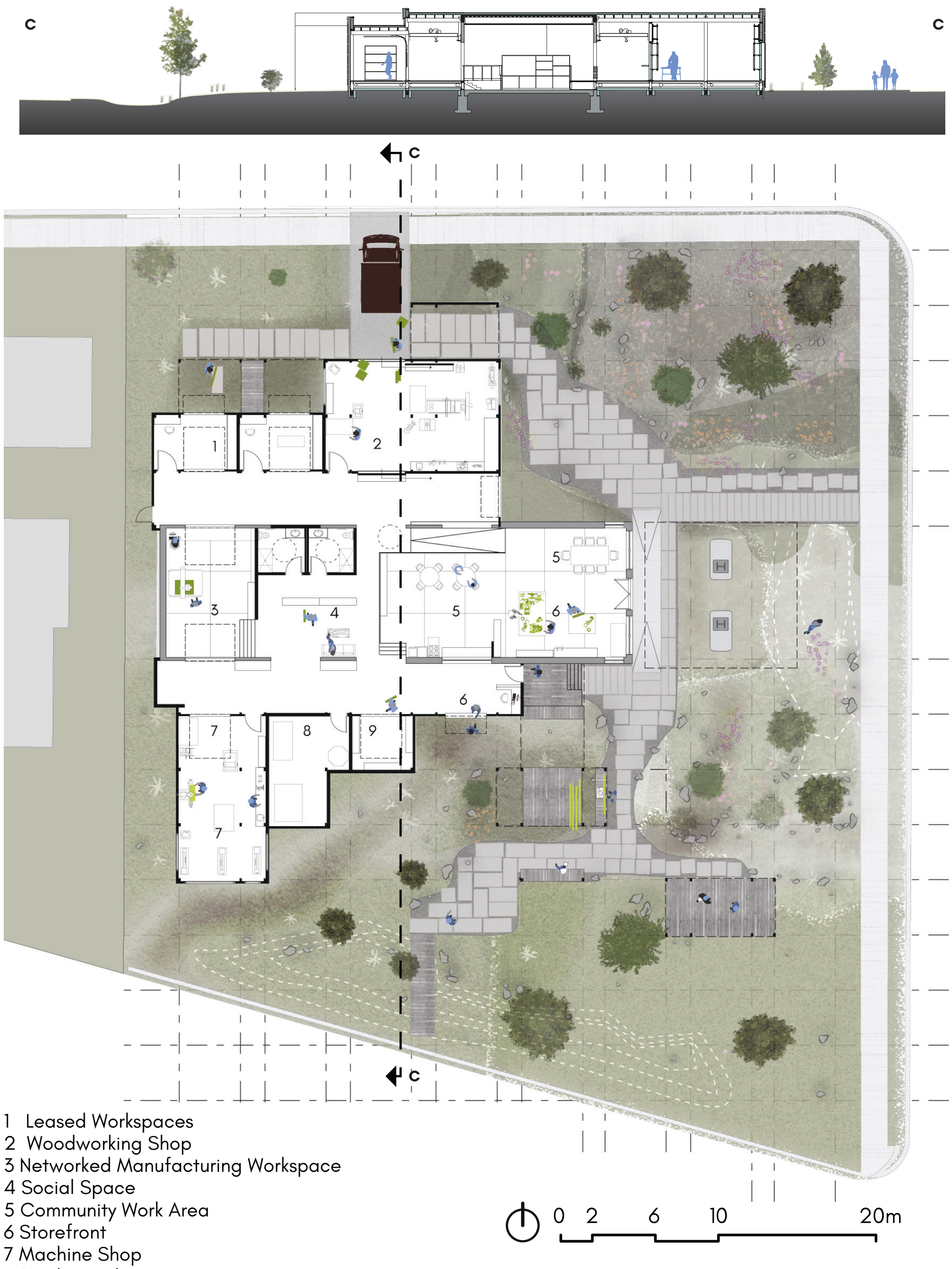


Figure 45. Projected plan, with accompanying section, of the building and landscape four years after the initial occupation.



1 Leased Workspaces
2 Woodworking Shop
3 Networked Manufacturing Workspace
4 Social Space
5 Community Work Area
6 Storefront
7 Machine Shop
8 Mechanical Space
9 Tool Library

Figure 46. Projected plan, with accompanying section, of the building and landscape eight years after the initial occupation.

1 Woodworking Shop
2 Community Work Area
3 Networked Manufacturing Workspace
4 Tool Library
5 Storefront
6 Mechanical Space
7 Leased Workspaces
8 Machine Shop

Figure 47. Projected plan, with accompanying section, of the building and landscape twelve years after the initial occupation.

Deconstruction

This thesis is not about a final scheme, rather it is a system that can adapt and accomodate the uncertainty and entropy that defines the growth process. In order to better develop this process, the previously described projection was deconstructed to create two alternative timelines. A fragmented model was produced from the previous plans and sections, and these pieces were reconfigured to demonstrate how the building might unfold under different circumstances (Figure 48).

Timeline B

A second timeline was developed and modeled as described above (Figure 49). This alternative timeline begins as when a small collective of makers combines with a local tool library initiative to develop a community workshop. Several years later, the local chapter of Habitat for Humanity begins holding training sessions on site and frequently recruits from the expanding maker community. Over time, the ensemble of communities develops a wide breadth of interests with little expertise in any one area. The collaborative producers favour large, multi-disciplinary projects over individual works. While the emerging structure has some dedicated shop space for digital fabrication, basic woodworking, machining, and plastics/curing, most of the group's work takes place in an open environment with smaller, private workspaces on the periphery. This timeline resulted in the development of an open courtyard scheme, suitable for a wide range of creative activities (Figure 50)(Figure 51). This open configuration invites passersby to so stop and enjoy the sheltered exterior spaces, and the site develops as an important community space that hosts public exhibitions and events.

Timeline C

In a third timeline (Figure 52), the building is initially occupied by the tool library and free space is used for small repair classes, hosted in partnership with small clubs such as the Edmonton Bicycle Commuter's Society. A few years later, a community of makers joins the ensemble. Although some members are interested in conventional methods and products, part of the group is very interested in electronics. As this group grows, the collaborative producers become preoccupied with the intersection

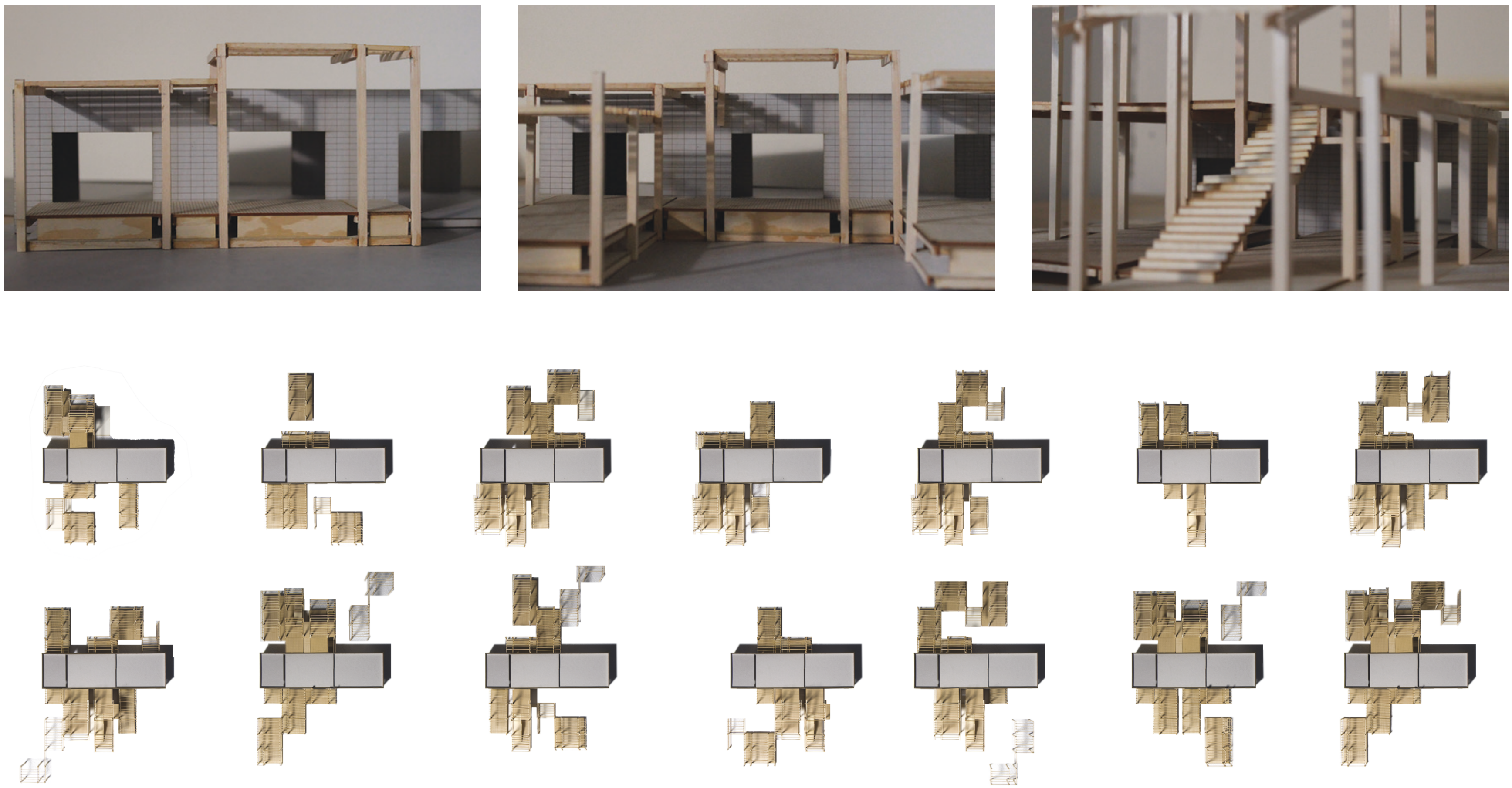


Figure 48. Spaces that had been developed in the first set of projections were adapted into a fragmented physical model that was reorganized and modified to create a new set of spaces that represented diverging patterns of growth.

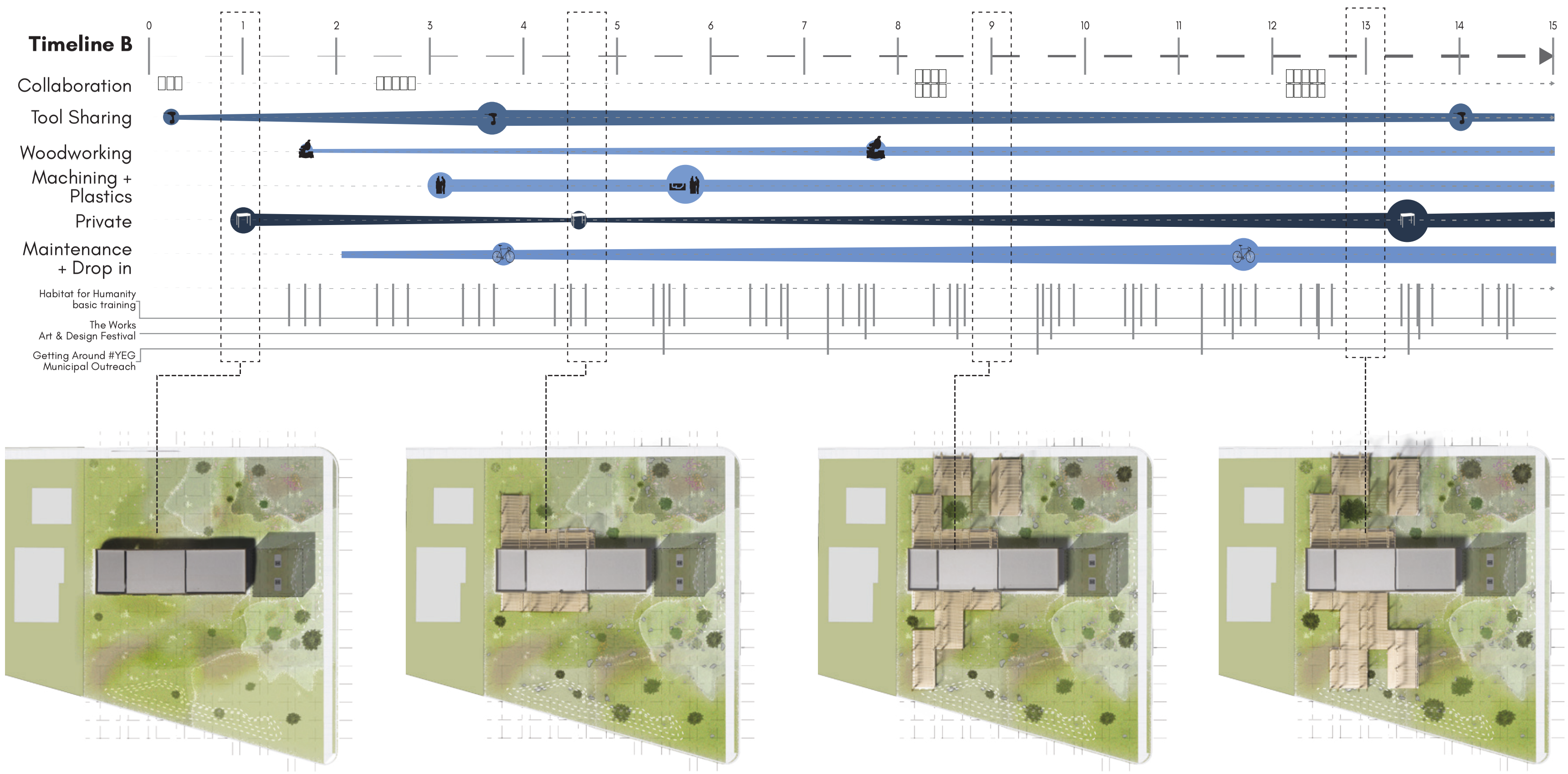


Figure 49. Alternative timeline B, with accompanying plans.

of digital and physical making. These producers invest heavily in digital fabrication tools and training. As the space grows, the digital producers play a dominant role in the direction that it takes, providing a steady revenue stream through commissioned works. While the tool sharers and maintenance program maintain a significant role in the building, much of the enclosed space becomes a mixture of open and

Figure 50. This courtyard scheme, based on timeline B, creates a large variety of spaces for interaction with the landscape and community, and can accomodate a wide range of unscripted activities.

private workplaces for the digital fabricators as their initial venture develops into a profitable business. In contrast to the courtyard scheme developed for timeline B, the resultant workshop scheme (Figure 52)(Figure 53) allows a large group of individuals to work privately, and is most suited to the entrepreneur and collaborative producer communities.

Figure 51. Exterior perspective of public courtyard space.

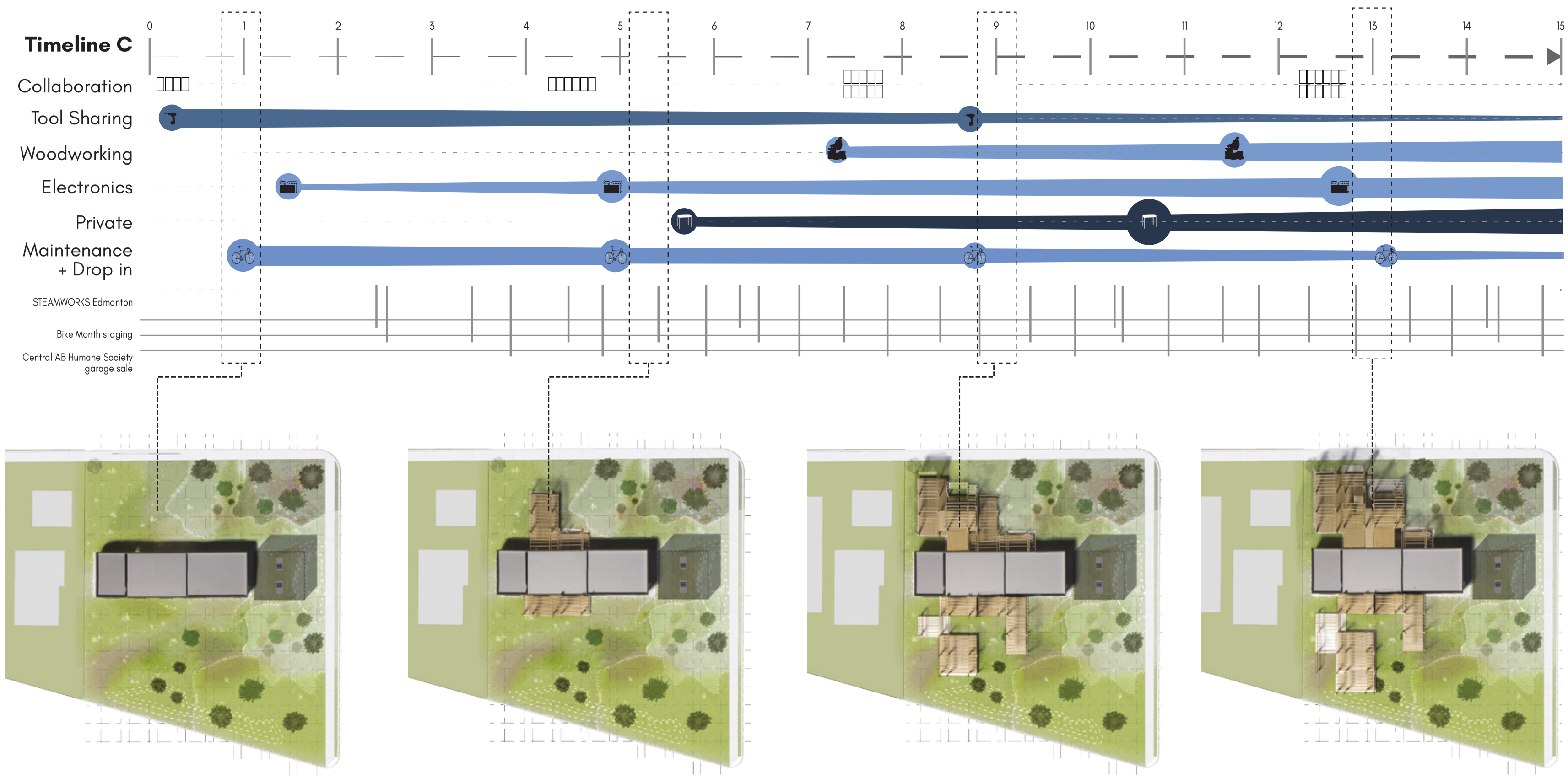


Figure 52. Alternative timeline C with accompanying plans.

Figure 53. This workshop scheme, based on timeline C, features a double-height open workspace with private workspaces on the west side. This scheme is more introverted than the courtyard plan in figure 50, and is better suited to the activities of a single, collaborative group.

Figure 54. Cutaway perspective of workshop.

Synthesis

The two fragmented schemes were combined to further model and explore the spatial potential of this method (Figure 55)(Figure 56). This speculative scheme is designed with an emphasis on on-site production and assembly, and highlights the flexibile range of activities that could take place within the system (Figure 57). A common pattern throughout all of these projections is the design of a dedicated circulation space immediately flanking the bay doors of the existing oblong box (Figure 58). This space is conceived to accomodate the circulation of individuals and materials between the spaces of the old building and new structures that project into the landscape. In addition, these spaces serve as material bridges that link the function-oriented qualities of the existing building with the forms and materials that emerge through the process of occupation and construction. These projections emphasized the use of wood as a warm, sustainable material that complements the steel, CMU, and brick of the extant structure, and as a pliable material with a strong tolerance for novice craftsmanship. As the building matures and techniques spread, novel materials such as sustainable bioplastics (Figure 59) can gradually become integrated into the emerging building. Although these circulation flanks are dedicated to movement, they can still be developed as activity nodes (Figure 60). Just as these spaces establish a consistent material and structural rhythm for the rest of the architecture to follow, their proportions also provide ample space for the improvisations that give individual cells their own autonomous character within the rhythm of the whole.

The ideal workshop strikes a balance between storage space and the circulation of large materials and assemblies. Figure 61 describes a sliding doorway with integrated storage space, accomodating both needs at once. Inspired by the automobile, this door operates similar to the sliding door of a minivan, using a sliding mechanism based on ball-bearings and steel pipes (Figure 62). It has been designed as an assembly of dimensioned lumber and machined hardware that could be fully produced and assembled by the building’s inhabitants, given access to standard woodworking tools as well as basic machining tools such as a lathe, a mill, and a tapping kit.

Figure 55. Fragmented spaces were reassembled to develop a composite scheme.

Figure 56. Interior of double-height workspace.

Figure 57. Sectional perspective through composite scheme.

Figure 58. Key plan of workshop space. Spaces immediately adjacent to the existing building (hatched) become dedicated circulation space that can also be part of larger social or work spaces.

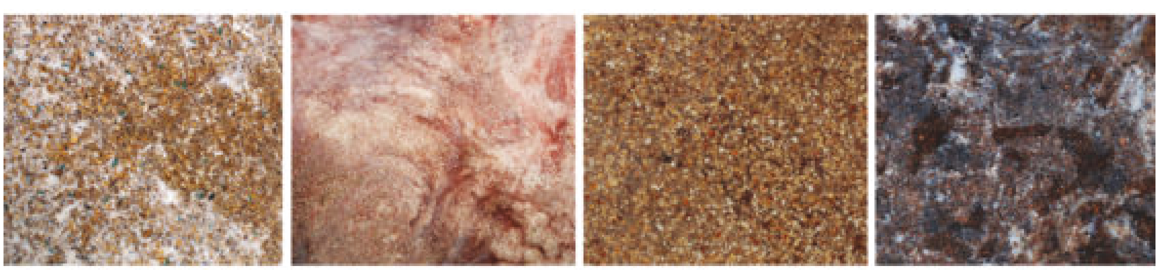


Figure 59. Shell Homage, designed by Rania Elkalla (Berlin Technical University) is a biodegradable plastic material produced from egg and nutshells. Experimental bioplastics such as this are not currently available, but represent a future where waste products can be processed to produce durable materials that could be cured, shaped, or printed for both interior and exterior finishes. Images from Materia, 2017.

Figure 60. Interior elevation of circulation space at transition between existing and new construction.

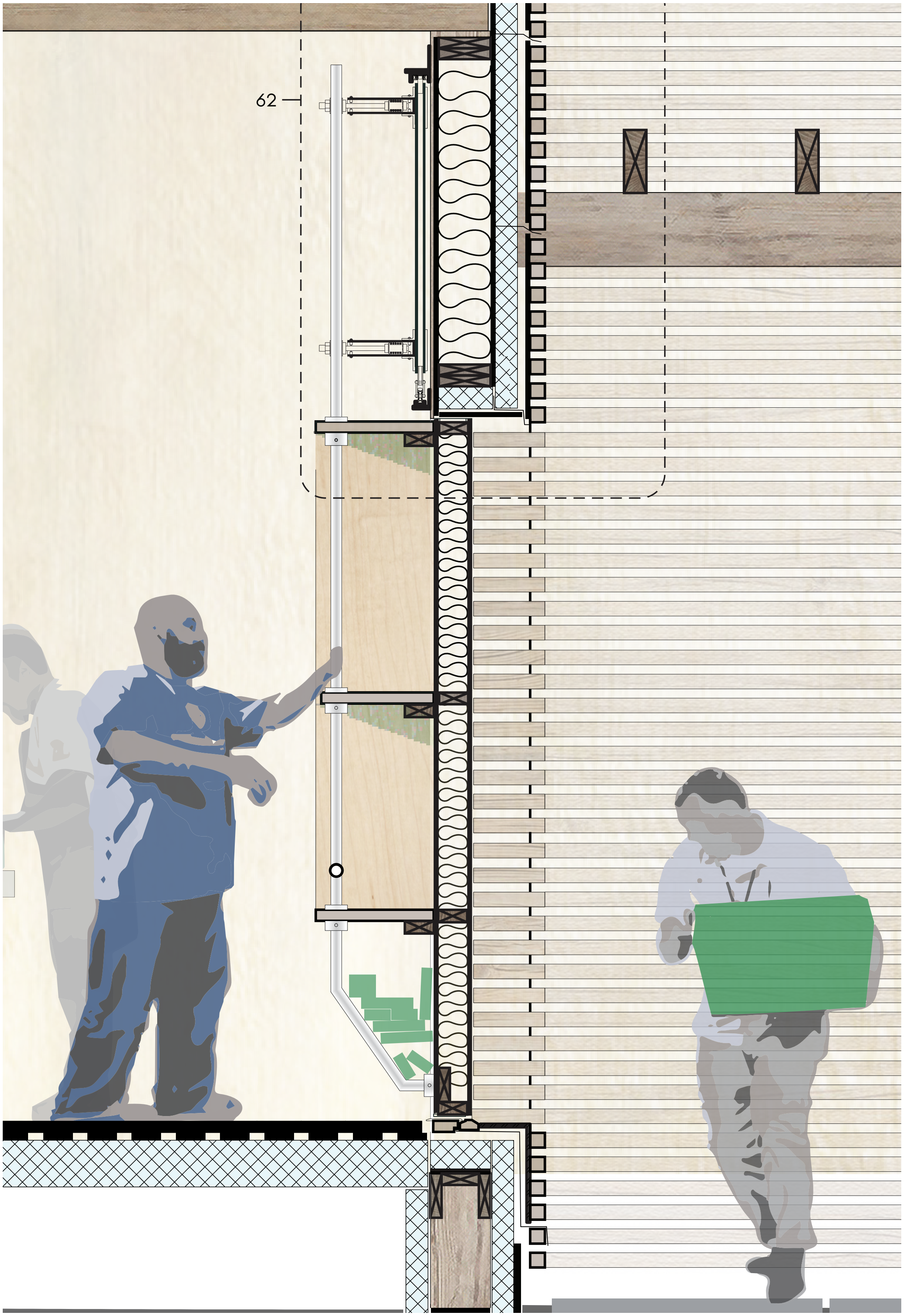


Figure 61. Section through sliding “industrial barn”-style delivery door with integrated storage.

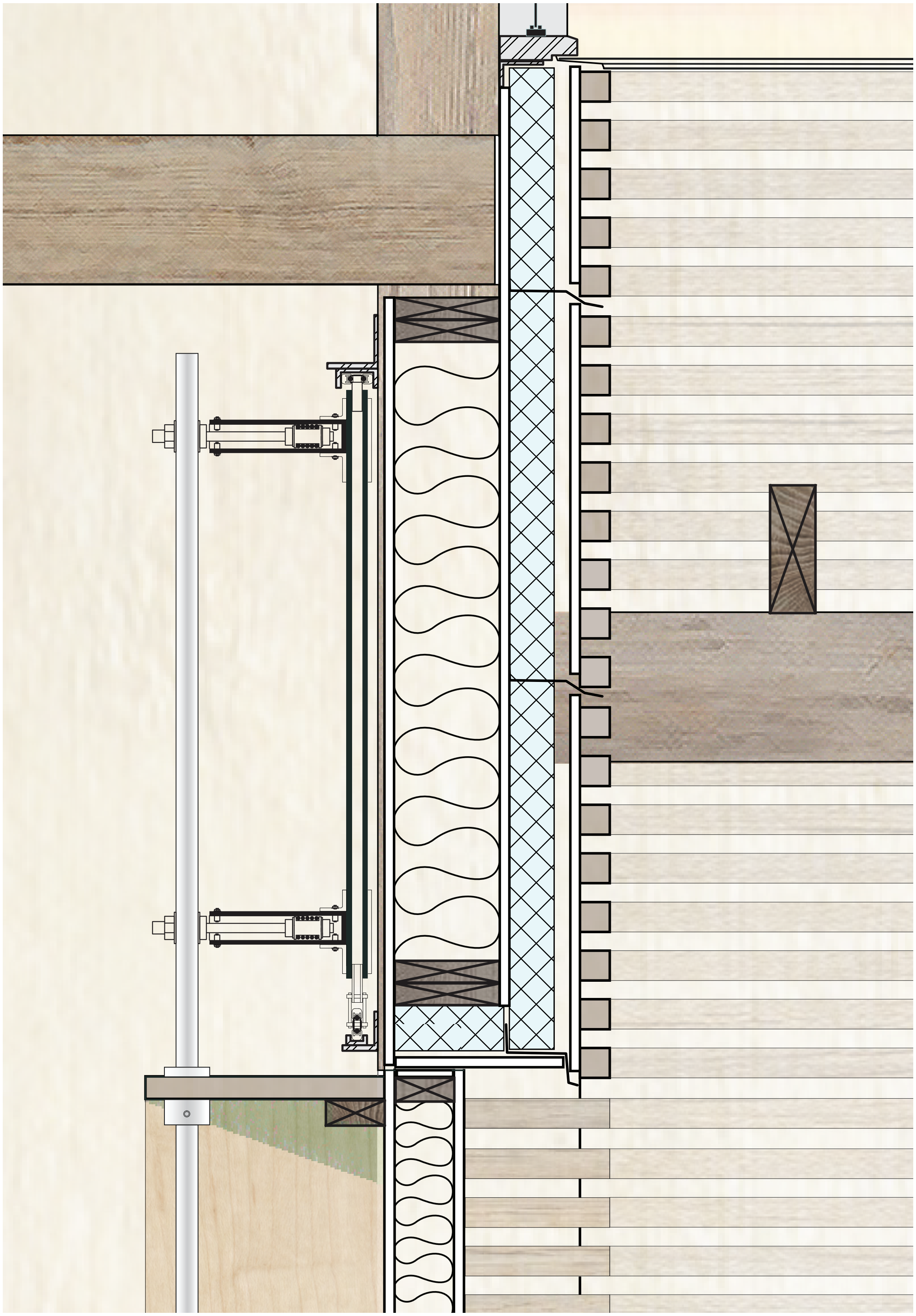


Figure 62. Enlarged section through sliding door assembly and door header.

Rules of Engagement

The concept of reciprocity, a constant and unscripted process of negotiation that takes place between all agents and actors on site, establishes a basic set of rules through which individuals should engage with the site and building. In order to maximize the amount of perspectives brought to bear on any given problem, individuals should not be barred from membership into the community ensemble based on any discriminatory factors such as age, gender, ethnicity, or skillset. As a growth-based method, this system thrives with a growing user base, and the ideals of openness and inclusion are paramount.

While the production model of technology often carries an implicit power relationship, the alternative growth model works best when there is no external hierarchy to impose an externally-determined outcome. Although the self-employed creator can work within this model, amateurs - individuals who are motivated by the internal satisfaction of creation itself - are more ideal agents to carry out this process. One of the most important characteristics of the community workshop is its capacity as a venue for learning and knowledge transfer. This mandate should be achieved through a continuous commitment to training, which could take place in either formal settings, such as regular workshops and training courses, or informally, through the day-to-day interactions of different user groups. A *maker in residence* program, where an individual or small group receives private space and facility access in exchange for their leadership in a series of training sessions, is an additional vehicle for knowledge transfer.

As a place for local production, the building itself should grow according to the skills and interests cultivated within. Although some structural technologies, such as the helical piles and the drivers that install them, require external expertise, the scale, span, and materials of the structural bays are suitable for on-site construction. A mature community ensemble, with appropriate guidance from local architects and engineers, could generate and adapt the growing building system using local tools and materials. Novel methods and materials (such as Selective-Laser-Sintered structural steel components or locally produced waste-derived bioplastics) should be integrated into the design to localize the provision and construction processes.

A final guideline that is critical to the success of this system is the maintenance of the building exterior and landscape as both a productive system and an interface with the surrounding communities. As described in Manzini's Garden of Objects, the rituals of maintenance and tending are an important method of engaging with the world. Whether they are tools, landscapes, or buildings, this type of care and engagement allows the user to cultivate a relationship with their surroundings so that it becomes more than a standing reserve. As such, part of the community ensemble's directive should be dedicated to the tending of the landscape, building, and tools. This form of tending should not be limited to maintenance or the suppression of entropy, but should also include proactive measures , such as the creation of refuges or stations within the landscape, that cultivate the site as a welcoming space for communities. Even as the user community grows and the issues of remediation are resolved, decision makers should ensure tat a generous portion of the site is maintained as public green space in the spirit of openness, inclusion, and the pursuit of reciprocity.

Dispersal

As the pilot site establishes itself as a viable staging ground for the growth and development of the repurposed service station, nearby communities can take advantage of this wealth of expertise. Starting with the adjacent service station (Figure 63), this new type of community centre expands organically through the existing network, importing the strategy, system, material, and personnel to opportunistically locate new sites as existing service stations slowly recede (Figure 64)(Figure 65).

The method described in this thesis is not confined to the test site in South Edmonton, but demands to be exported and adapted to any place where interested communities meet the urban voids created by an aging network of petroleum service stations. As a sprawling network that matches Canada's population distribution, this system contains thousands of viable venues for adaptive reuse across the country (Figure 66). A national network of local community workshops, each tailored to the resources, skills, and perspectives of their individual communities, can create a social infrastructure that promotes self-reliance by forming local nodes of production and consumption that are resilient to changes in the global economy.

Figure 63. As the landscape, building, and communities mature, the system can be applied to new sites in a continuous growth process. The operational service station immediately to the north of the test site provides one such opportunity.

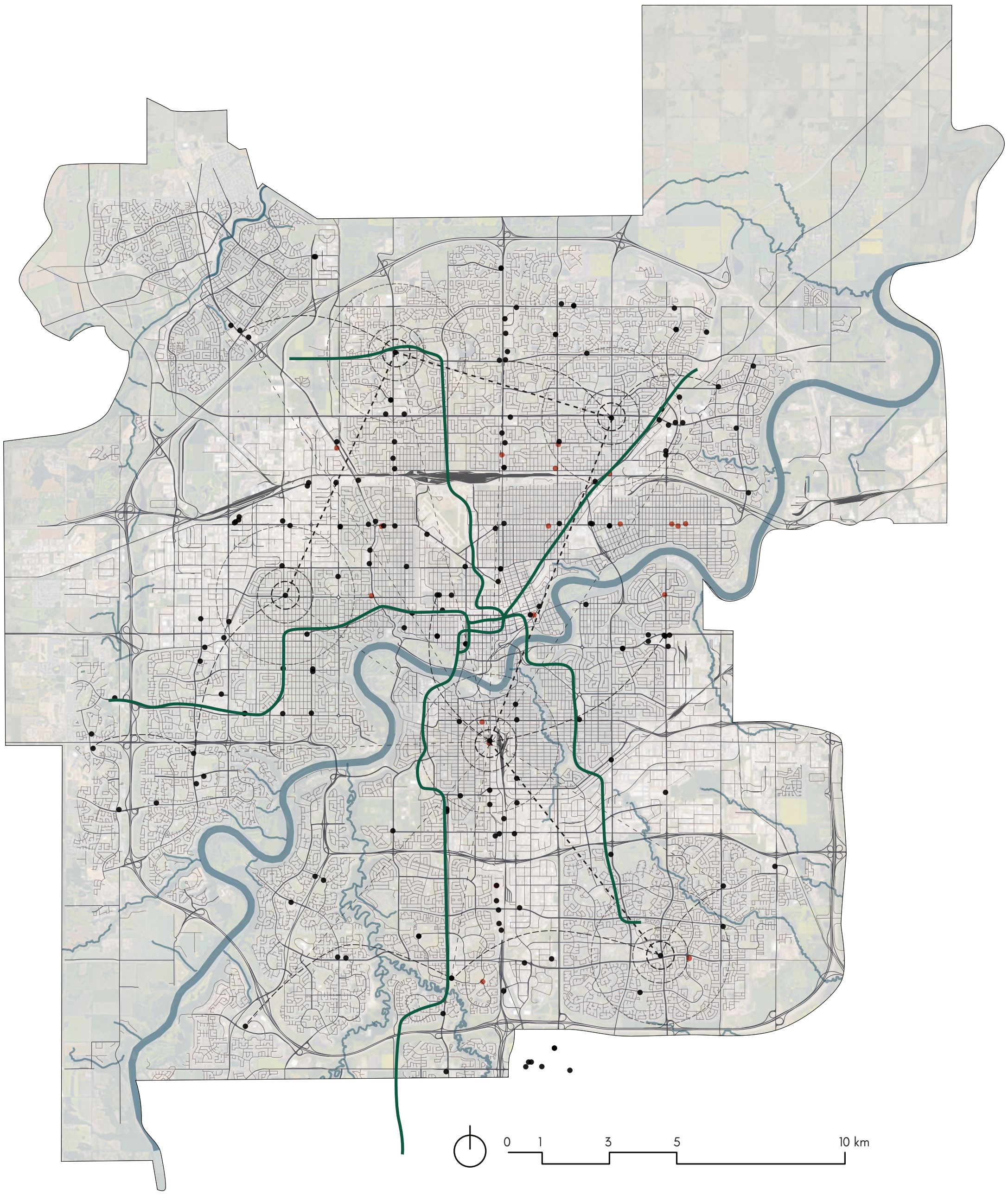


Figure 64. A new constellation of productive sites emerges to create a new technological network that services an expanding cluster of self-sufficient communities.

Figure 65. The network expands across the city of Edmonton, transforming retail service stations into local centres for socialization and making.

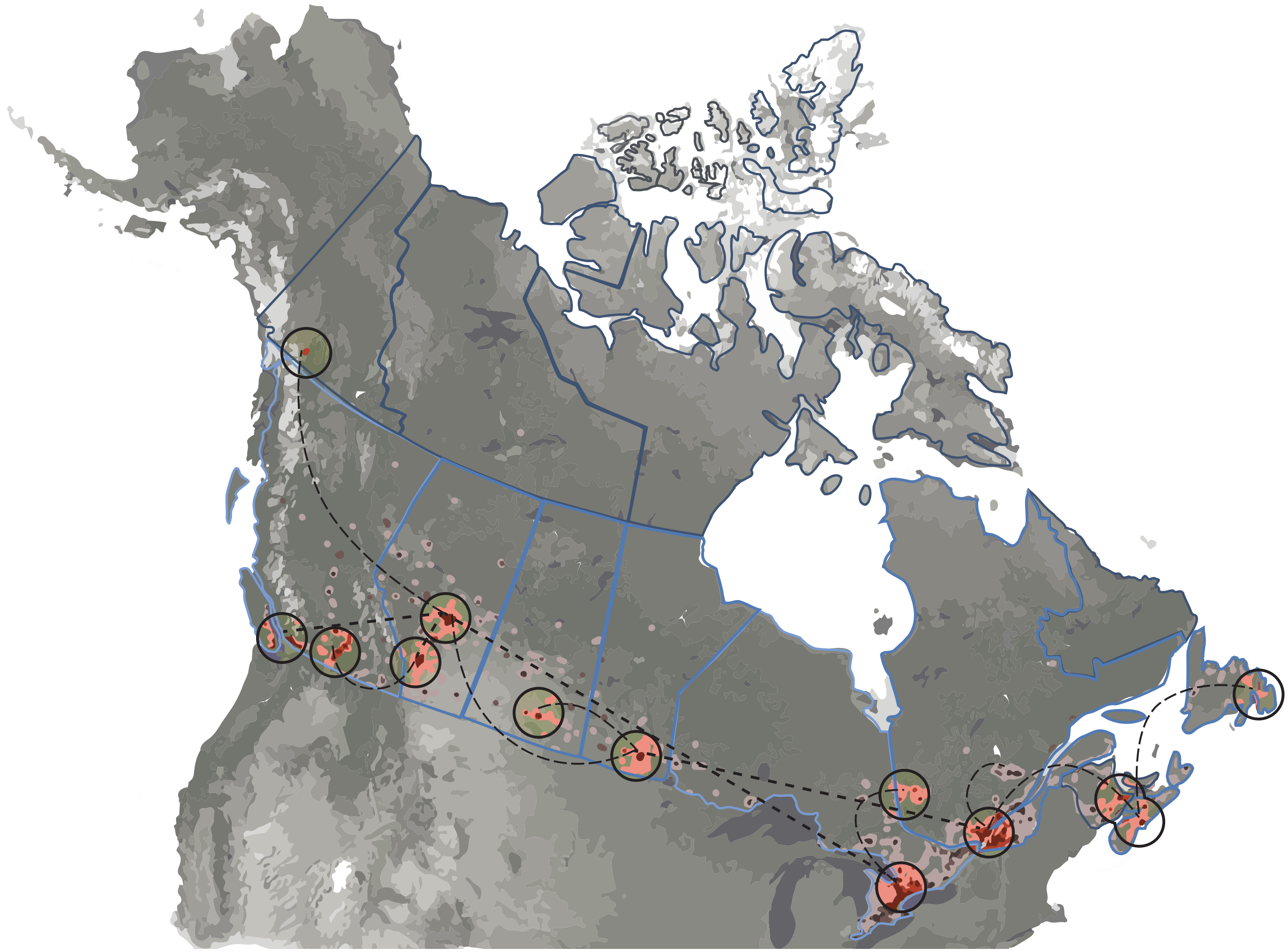


Figure 66. Although the system starts in Edmonton, Alberta, there is little difference between service stations across the country, and the method expands throughout Canada, adapting to local needs and interests.

CHAPTER 3: CONCLUSION

This thesis proposes the production of a series of community workshops as a meditation on the relationships between technology, community, and the growth of a renewed urban landscape. It was undertaken from a critical point of view, examining how production has changed over the last 200 years and how it has affected the way we understand the world. The contemporary ideal of a community workshop manifests in the *maker movement*, a dispersed community of consumer-producers that communicate across global networks to share emerging design and production strategies centred around emerging technologies such as additive manufacturing and computer numerical control. Although most discourse surrounding these technologies focuses on their potential to usher in a new era of localized self-sufficiency, these technologies currently occupy an untenable position between the open ideals favoured by *makers* and a history of market forces that drive toward opacity and prescribed methods of use. Within this context, the community workshop becomes the site of a confrontation between two philosophies of technology: a production model based on interchangeability and determinacy, and a growth model that relies on constant feedback to negotiate with the uncertain.

The petroleum service station is an abundant urban archetype that is well positioned to accomodate this dialogue. These sites form a dispersed urban and global network that distribution of urban maker communities. The dominant *oblong box* archetype reflects the production model of technology through its adherence to interchangeability, enframing the site as a vector for perpetually changing advertising strategies. The petroleum service station is at once a target for urban renewal and a symbol of the technological system.

This thesis does not reject the productive model of technology. Rather, it seeks to juxtapose its defining principles (opacity, interchangeability, and planning) against those of the growth model (openness, fit, and negotiation) to instill a greater awareness of these conflicting paradigms within the communities that would inhabit this space. The design achieves this by embracing time as a fundamental force that recasts the building as a process rather than a discrete space. The process begins with the occupation of an existing petroleum service station, which is subjected to two indeterminate processes: the renewal and revealing of the site through the process of phytoremediation, and a slow crescendo of activity that develops as a heterogeneous ensemble of communities grows into the space. Unfolding over the course of two decades, these processes establish the building itself as an impermanent collection of spaces and relationships that expand and recede in response to changing conditions.

Following the initial occupation, a new structure slowly emerges from the existing, based on a tartan grid that follows the rhythm set by the oblong box's garage bays. This regular post and beam pattern establishes a cellular structure that becomes the basis for expansion and contraction. While this regular structure reflects the interchangeability that defines the production model, it can also become a stage for improvisational dialogues that respond to changing contexts of site and community.

The resultant building becomes more than a space for making, it also serves as a living, growing venue for innovation and exploration. Like Ezio Manzini's *Garden of Objects*, it demands a more active relationship between the users and the space they occupy, rejecting the modern doctrine of mass-produced components in favour of a system that is to be endlessly maintained, modified, and nurtured. This project builds on that idea by establishing the site, building, and community as three interwoven processes that unfold over time to create a space in constant flux.

One of this century's greatest challenges will come from the world's finite fossil fuel reserves. Although we cannot project when and how these reserves run out, the era of petroleum dependence is coming to an end. This scenario will trigger two likely outcomes: the first is a decrease in the survival rate of petroleum service stations, leaving a dispersed network of voids as they disappear; the second is the demand for more localized infrastructures of provision in response to the diminishing viability of the fuel-based transportation networks that service the current system of production and consumption. This project addresses both problems at once, merging a network of sites that will require decades to mature with a method and program that accepts this slowly unfolding process, fostering an emerging community of self-reliant citizens.

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