Steeltown Distilled:

Extracting Hamilton's Latent Energies

by

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Author’s Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

For one hundred years, the mighty blast furnaces of Stelco have burned, melted, and forged the identity of Hamilton, Ontario, into the epitomic Steeltown of Canada. Now US Steel Canada, its recently announced closure has silenced the operation that once defined Hamilton itself, leaving in its wake an array of ruined machines upon a toxic wasteland. But is it really a wasteland? Could the energy latent in the site, its architecture, and its history be recovered? In order to propel the city towards a more sustainable future, could its degradation be used as an agent for change, to transform the site and even provide the basis for a new hybrid industry?

This thesis proposes an architectural design for a recalibrated steel industry on the site whose excess energy output is used to fuel a new industry of greenhouses. These greenhouses nurture plants to be used in the gradual bioremediation of the contaminated landscape into a site of both active industry and civic amenity. Through the re-ignition of the blast furnace and the subsequent design opportunities it creates, the site becomes an extension of the civic realm rather than an obstruction to it.

Three areas of focus define this thesis proposal. The first is an exploration into the opportunities latent in ruination, both architecturally through entropy and in landscape through toxic contamination. This is followed by an investigation into the century-old relationship between Stelco and Hamilton, and how this history has created the current state of tension between industry and city. Finally, through the re-imagination of the blast furnace and its output, this thesis positions the site as part of an energy flow that links industry with its landscape, and both with the city in which they reside.

Acknowledgements

I would like to thank my supervisor, Anne Bordeleau, for her tenacity during this thesis. Her thoughtful advice and support throughout has proved invaluable. I am also very grateful for the discussions and ideas shared with my committee members, Lola Sheppard and Ryszard Sliwka.

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To my friends, and especially the illustrious members of 2023 (both past and present), I owe an immense debt of gratitude for countless hours of discussion, debate, and distraction.

Finally, to my parents, Neil and Nancy, whose unwavering support is so often appreciated, yet seldom acknowledged.

For my parents

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All illustrations, maps, and photographs have been produced by the author unless otherwise sourced in this list.

Introduction

Part One

List of Plates

All photographs below are by the author.

“US Steel is shutting down all operations at the former Stelco, putting 1,500 employees in Hamilton out of work indefinitely.”

- The Hamilton Spectator, March 4, 2009

Introduction

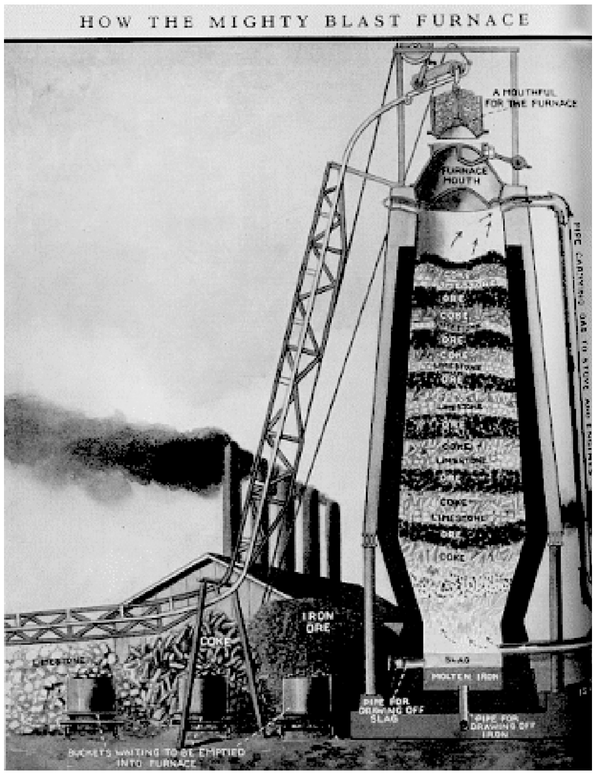
With that brusque statement, more than 100 years of steel manufacturing in the self-proclaimed Steeltown of Canada have come to a crashing halt. Hamilton, Ontario, has always had at its heart the local steel industry, which has been the source of the city’s growth and prosperity since the 19th century. Providing jobs, community involvement, and a strong sense of civic pride, the industry, led by the main companies of Stelco and Dofasco, has always been at the heart of Hamilton’s identity. However, with the recent announcement by Stelco’s new American owners, US Steel, that the plant would be idled effective immediately with no plans to reopen, a local icon has become just the most recent casualty of the new global economy. The fiery beast of industry has been silenced. In its place lay an expanse of toxic land, a polluted waterfront, and a vast network of man-made landscapes, infrastructures, and buildings. Now that these machines have been rendered obsolete, they form a wasteland that sits at Hamilton’s centre. But is it really a wasteland? Could the energy latent in the site, its architecture, and its history not somehow be recovered? Could its degradation somehow be used as an agent for change, to transform the site and even provide the basis for a new hybrid industry?

Fig.0.1 The Stelco blast furnace seen up-close from Hamilton Harbour

The first time I ventured within the shadow of the massive Stelco (now US Steel Canada) complex, I was instantly struck by the bombardment on my senses. Driving into the outskirts of the facility, the noxious smell of sulphur and various other odours invaded my nose, and as soon as the engine of the car was off, the rumbling of industrial productivity was audible. I walked along a chain-link fence to discretely take pictures of a seemingly abandoned set of buildings, when a loud BANG from within one of the darkened shells startled me. In the still-distant view of the main blast furnace, smoke wafted upward and the huge smokestacks and towers of the machine stood heroically silhouetted against the afternoon sky. Within four minutes, two security personnel were at my side telling me to vacate the premises. Driving away, I decided to try using an official route to experience the place more directly. However, five weeks later US Steel headquarters in Pittsburgh denied my request for a facility tour due to security, economic, and "frankly, political" reasons.

I was as surprised as anyone when, on the morning of March 4, 2009, I read in the news that US Steel was idling the entire Hamilton steelworks indefinitely. To glean a new perspective on the now-silent machine, I commandeered my family's boat and took it to the waters of Hamilton Harbour. From here, the howling wind disguised most of the sounds and smells experienced on land, while the proximity to the rusting corpse revealed a fantastic display of detail. Pipes and stairs wound endlessly through massive steel structures. Undulating landscapes of coal, iron ore, and limestone would alternately conceal and reveal glimpses of the industrial carcass lurking beyond, so that the situation resembled a sleeping dragon surrounded by his treasure. The raw power and energy of the blast furnace could be felt even in silence, and I wondered how much more fearsome it would be had it still spewed fire and molten iron. What once embodied all the might that made Hamilton a thriving industrial juggernaut was now a ruin revealing an economically and environmentally scarred uncertainty.

In this sentiment lies the paradoxical nature of the ruin, illustrating the blast furnace's foregone glory against its toxic legacy. The ruin exists at an architectural scale, but its impact on the landscape and the wider city, in which it is simultaneously absent yet present, is much broader. This introduction will look at ruination, both architecturally through obsolescence and in landscape through contamination, exploring the notion of energy persisting within them and the opportunities this presents.



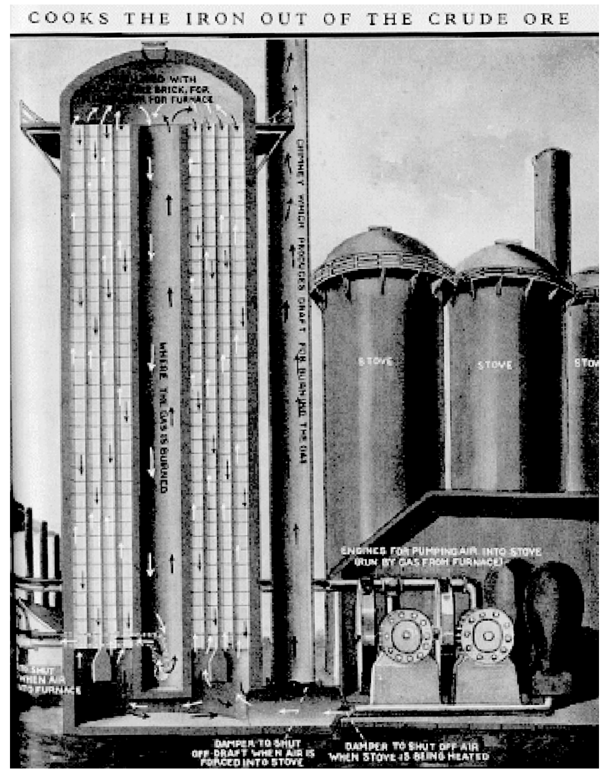


Fig.0.2 A diagram of a 19th century blast furnace. In describing his fascination with such technology, Bernard Forest de Belidor writes:

So here is the most marvelous of all machines; its mechanism resembles that of animals. Heat is the principle behind its movement; the circulation produced in its conduits is like of blood in veins, with valves that open and close according to need; it nourishes itself and excretes on its own at an established rate, and extracts from its work everything it needs in order to subsist (Luis Fernandez-Galiano, *Fire and Memory: On Architecture and Energy,* trans. Gina Carino. Cambridge: The MIT Press, 2000). 146).

A blast furnace is the heart of any integrated steelworks operation. Often the largest and tallest structure in sight, raw materials (namely coke, iron ore, and limestone) are consumed, melted and fused within it, and then excreted to produce that most critical of man-made materials – iron. Advances in blast furnace technology, coupled with improvements in raw material extraction and transportation, were central to the success of the Industrial Revolution[1]. The blast furnace stood as a symbol of strength in the 19th and early 20th centuries for countless cities – Pittsburg, Cleveland, Baltimore, the Ruhr, and Hamilton, Ontario. These cities were built upon the fires of industry and the life and death of these machines in recent years have affected the city as though a part of its own body has been removed, leaving it wounded and uncertain of its future.

The energy this industry represents, physically in output, architecturally in form, and symbolically in presence, illustrates how the blast furnace not only nourishes itself through exertion, but that of the greater city as well. The Spanish architect and theorist Luis Fernandez-Galiano explores the notion of energy in architecture in his book *Fire and Memory*, where he laments the loss of the hearth's role in organizing space, having been replaced by the empty monotony of mechanized systems and networks. Energy, he says,

Gives [architecture] a definitive place in the field of processes and life. Architecture can then be thought of as a transformation of the material environment by changing living beings, an artifact continuously altered by use and circumstance, in constant degradation and repair before the aggression of time, permanently perishing and renewing itself.[2]

The ever-changing nature, results, and ultimately, consequences of this energy flow act as a hearth around which the activities and organization of the city take place; the great machine becomes a critical organ in the network of the city. Energy accumulated in architecture – both in terms of material form and constructed order – is simultaneously part of both past and present; the former which it interprets, and the latter which it helps form. The blast furnace, for example, is concurrently energy stored as form, allowing an efficient way of manipulating raw materials into steel, and information resulting in the understanding of future furnaces through experience and memory[3]. When that energy is extinguished through obsolescence, it no longer contributes to the formation of the city and its identity. The accumulation and dispersion of energy (both physically and

mentally) might allow architecture, and specific elements like the Stelco blast furnace, to participate in the life of cities and their inhabitants.

While the removal of physical energy from the blast furnace changes the meaning of its relationship to the city at the macro level, at the micro level, as long as its physical form perseveres there will exist tangibly the possibility to experience it. Whether from afar on top of the Escarpment or more closely from the waters of Hamilton Harbour, it persists as an unmistakable presence in the city. To encounter an imposing and powerful structure such as the blast furnace belongs to the sublime.

The idea of the sublime, as something distinct from the idea of beauty, has existed since ancient Greece, when Longinus wrote his treatise *On the Sublime* to instill in authors that the aim of rhetoric was not merely to persuade, but to incite ecstasy in their readers[4]. Throughout the Renaissance, this notion of ecstasy was largely fulfilled through the creation of artworks of extreme beauty, craft, and religious veneration. During the 18th century, however, the idea of what was beautiful, and what effect certain objects could have on the observer, began to shift. In his 1757 essay *A Philosophical Enquiry into the Sublime and Beautiful*, Edmund Burke describes the evolving nature of aesthetics. Moving away from the traditional associations with beauty alone, the focus shifts from an emphasis on the object to an emphasis on the observer; that is, the central issue becomes what psychological effect an object has on the observer, as opposed to the formal qualities of the object itself. Reconceptualized in this way, Burke argues there are then many different types of aesthetic experience beyond beauty, and that the most important among them is sublimity. The idea of the sublime was a massive shift that allowed people, and especially artists in the Romantic movement, to look at objects, spaces, and landscapes in an entirely new light:

[…] *the experience of the sublime rests on a delicate psychological equilibrium. Pain and danger are simply terrible, but at certain distances, and with certain modifications, they may be, and they are delightful … sublimity is tranquility tinged with terror.*[5]

Burke seeks to define this emotion using a series of tests to determine whether an object or experience is capable of producing a sublime reaction. Those objects that are small, delicate, smooth, proportionate, and generally pleasing to the eye

Fig.0.3 *Monk by the Sea*, by Caspar David Friedrich. A haunting illustration of man in tension with nature rather than lounging comfortably within it. The 19th century author Heinrich von Kleist writes of the painting:

Nothing could be … more unnerving than this position in the world … With its two or three mysterious elements the picture hangs there like the apocalypse … and, since in its uniformity and boundlessness it has no other foreground than the frame, when one looks at it, it is as though one's eyelids have been cut away (John Leighton, *Caspar David Friedrich: Winter Landscape.* London: National Gallery Publications, 1990. 16).

Fig.0.4 *Coalbrookdale by Night,* by Philippe Jacques de Loutherbourg. One of the most powerful images of the industrial or technological sublime, this painting pits the intense glow of a round-the-clock ironworks against the pale light of the moon. The raw power this new technological existence exerts over the natural world, as well as ourselves, is strikingly sublime (Lori Pauli, *Manufactured Landscapes: The Photographs of Edward Burtynsky.* Ottawa: National Gallery of Canada, 2003. 35).

are considered to be beautiful. Burke argues this is a weak and inferior emotional experience since "we know by experience, that for the enjoyment of [beauty], no great efforts of power are at all necessary … pleasure must be stolen, and not forced upon us … we are affected with it by a force greatly inferior to our own"[6]. Accordingly, he argues that sublimity is a far greater experience since terror and pain are always inflicted by a power in some way superior, since we never submit to pain willingly[7]. The lack of control and element of danger experienced with the sublime is far more stimulating than the predictability of an emotion in which we maintain control.

While often the Romantic artists' sublimity was a result of a tension with nature, at the beginning of the Industrial Revolution years later, artists and philosophers began to grapple with the notion of man existing in a technological world. What was man's relationship with nature and the world as an individual when society was threatened by the mass of machinery? As the Revolution took hold of the western world, and man and machine entered into a very close relationship, artists began to look more closely at the aesthetic experience of machines and technology. In her book *Notes on the Underground*, contemporary historian Rosalind Williams references the ideas of Burke to describe how, over centuries, numerous objects and experiences have evolved into recognized modes of understanding. In her study of subterranean environments, she argues that, like them, mechanical and technological environments lack aesthetic value when judged by traditional notions of beauty based on organicism. Sublimity and fantasy, however, appeal to the superorganic; they exist outside of ordinary experience. As she states, "the sublime … [is] neither ugly nor beautiful, but something else entirely: obscure, but pleasingly obscure, terrible but delightfully so […][8]. The vocabularies of sublimity and magic that reveal superorganic value in the underworld expand the canon of beauty to include technological environments and the machines that inhabit them.

Today, oilrigs plunder the sea, great machines bore deep into the earth, and enormous facilities are constructed to burn, melt, and fuse natural elements for our use. But what happens when forces beyond our control silence the power of these "sublime" environments and we are left with their decaying remnants? Ruins were another core focus of the Romantic Movement, however, the notion of worthlessness and neglect associated with many present-day ruins differs from the historical veneration of highly aestheticized picturesque ruins. These usually

Fig.0.5 *The Bank of England in Ruins*, by Joseph Michael Gandy

focused on classical or archaic forms – abandoned medieval castles and villages, crumbling manor houses, even the faux ruins erected in the gardens of many 18th century English estates. According to historian Michael Roth, the ideal ruin had to be "well enough preserved (while retaining the proper amounts of picturesque irregularity) to produce the desired mix of emotions in the beholder"[9]. This description meant that a recently abandoned building, or an adhoc pile of debris for example, did not qualify for aesthetic appreciation as ruins. The classical ruin spoke to a sense of melancholy that viewed them as testaments to the natural cycle of life and death, and as a reminder of the inevitable expiration of order at the hands of entropy.

Entropy, as Fernandez-Galiano explains, is the thermodynamic principle that energy in a system will move from order to disorder (and therefore eventually to degradation) over time[10]. Humans, buildings, empires, epochs; nothing can escape dispersion and ultimately, death. In one of Joseph Michael Gandy's most famous works, a depiction of John Soane's Bank of England lying in ruins from 1830, a fantastical image is portrayed whereby the crumbling ruin simultaneously reveals the grandeur and futility of the architecture's orderly construction.

The sublime is piqued through this sense of the infinite power of Nature to counter and ultimately destroy even mankind's greatest constructs. This notion is blatantly illustrated in the transition of the iconic Stelco blast furnace from fiery machine to silent ruin. Does the blast furnace qualify as a picturesque ruin, and therefore something to be merely aestheticized and perhaps preserved as a sort of monument to Steeltown? While it is clear that contemporary or post-industrial ruins acknowledge a similar notion of Romantic ideas concerning the demise and inherent frailty of man's constructions, they are in fact part of a very different mode of history and experience.

What, then, is the difference between a classical picturesque ruin, and a contemporary or post-industrial one? The British author Dylan Trigg offers an interesting hypothesis to this question by looking at the cases of two cities both beset by war and abandoned by their respective citizenry. The first is the medieval Italian city of Ninfa, which during the Middle Ages was destroyed by numerous civil wars and reduced to a deserted village. As the city fell into ruin, nature gradually came to replace people as its occupants. Great rose bushes took root, winding their way up the crumbling stone walls, and the entire place took on an air of timeless serenity which Trigg describes as the

Fig.0.6 The ruins at Ninfa

Fig.0.7 Modern-day ruins in Pristina, Kosovo

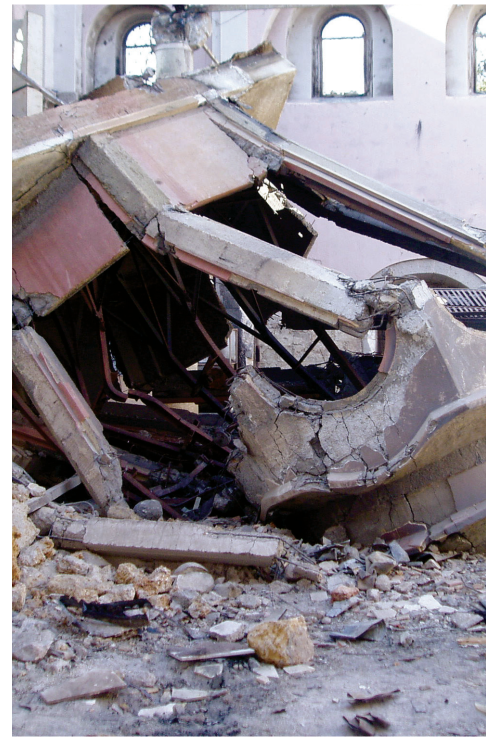


Fig.0.8 A close-up of a ruined church in Pristina

ideal position of a ruin "not entirely lost to dissolution, [yet] not entirely restored so as to appear prosperous"[11]. By floating in this passive timelessness, neither decaying further (as seen to by preservationists) nor being repaired, the ruin is wholly distinct from the present and removed from time, thus rendering our appreciation of it at a correspondingly passive level. We may enjoy it aesthetically only as distanced observers; we are removed from the ruin since it is removed from time. The second ruin discussed by Trigg, having a similar war-torn history to Ninfa but a far different outcome, is the Kosovar capital of Pristina. Savaged by North Atlantic Treaty Organization (NATO) bombing raids during the Bosnian war in the late 1990's, many of its citizens fled the carnage and left the city partially deserted. While today the city is being enthusiastically rebuilt, the notion of its ruined past is the focus for comparison (though the city could just as easily be Gaza or Baghdad). The pleasing image of Ninfa is starkly rebuked in Pristina by images of smouldering buildings and twisted steel, still smoking from collapse. Because ruination here has yet to cease, the ruins entail active volatility and danger, thereby negating the possibility of a timeless or inert beauty[12]. The passive delight found in the classical ruin here gives way to active precariousness, which, since the ruin is still actively evolving, precludes detached spectatorship.

With the possibility of collapse at any given time, and especially with the power industrial ruins wield over the earth in terms of their ongoing toxic impact, the contemporary ruin sublimely draws our attention and experience into the same temporal space in which it is actively decaying. Here, entropy is rendered tangible.

Just as the industrial ruin is in a state of unknown precariousness, so too is the broken landscape on which it sits. Less immediately tangible than the ruin, the landscape is perhaps even more damaged by years of industrial runoff and hazardous materials storage. How can this degradation be made appreciable for people to confront and experience? The photographs of Edward Burtynsky seek to do just this, capturing man-made landscapes and their subsequent degradation and then presenting them back to us in hauntingly alluring and powerful images. His series of photographs of Sudbury nickel tailings, taken in 1996, juxtapose the dramatic man-made contamination against the charred and deadened landscape upon which it is thrust:

There is a certain frisson of danger that we experience when we find ourselves looking peering over the brink of an open-pit mine or standing just above the path of a lava-flow of nickel

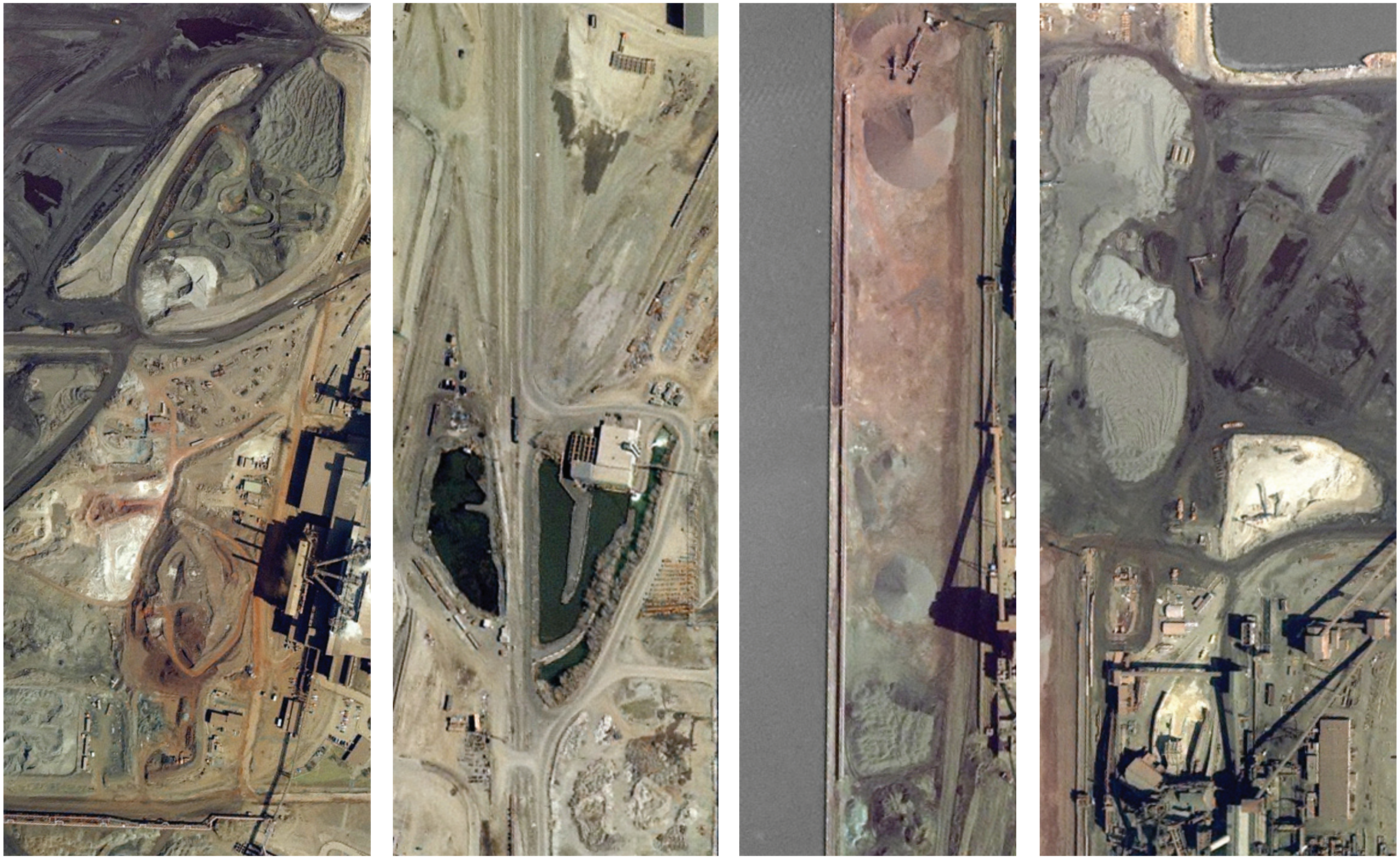


Fig.0.9 Snapshots of the ruined landscape at the Stelco site

waste, as we do in Burtynsky's photographs … In their own largeness and the largeness of the landscapes they portray, his photographs provoke a feeling of awe. But in the eighteenth and nineteenth century concept of the sublime, it is the grandeur of nature that is the source of the "outrage on the imagination." In Burtynsky's photographs, it is the work of human beings upon nature that is at the source of our amazement. [He] has altered our understanding of the sublime landscape, giving us a new aesthetic appreciation of the man-made sublime.[13]

Burtynsky's photographs pose an interesting question concerning the appropriateness of aesthetic appreciation of a subject that is environmentally ruined, as does viewing the unfinished urban ruination of Pristina. However, since his images are frozen moments in time, suspended on a wall in a gallery far removed from the event itself, their appreciation, like a classical ruin, cannot be active, only passive. The images implore us to consider our impact on the landscape and how much we as a society can consume at its expense. But what does that landscape look like today, in 2010, years after the photographs were taken? What does it smell like, what does the ground feel like beneath one's feet, what are its effects on one's body? The participation in these active experiences allows us to grasp for ourselves the physical effects our lifestyles have on the earth and the subsequent landscapes and environments they produce.

Energy in architecture is seen to be dynamic in both life and death. While that architecture is in action, it is stored as form and information to enlighten future decisions. As a ruin, that energy is latent in the architecture's demise at the hands of entropy, as well as its potential to be reborn. The Stelco site, as a ruined blast furnace and toxic expanse of land, is a prime opportunity to investigate the impact the life, death, and potential resurgence of an industrial icon has on a rust belt city like Hamilton. In order to understand the potent impact this ruination has on the city, the social and cultural energies that have formed and been tested over the years between Stelco and Hamilton will be explored to understand how a hybrid rethinking of the site might relaunch their relationship.

Hamilton’s Hearth

Fig.1.1 (Opposite) A view of the Stelco site burning into the night before its closure


SIEMENS
nofrills
nofrills

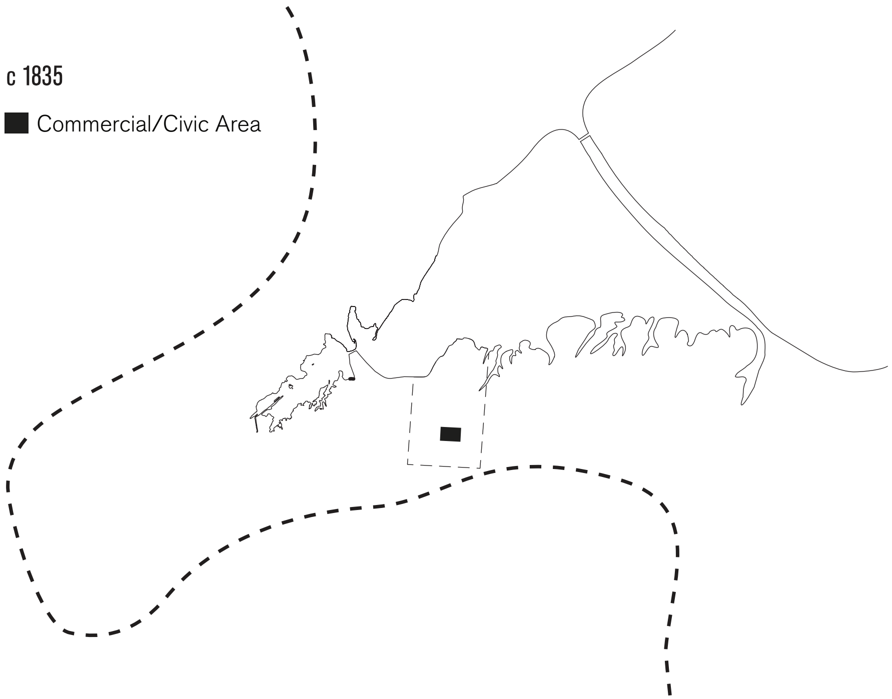


Fig.1.2 Hamilton initial urban footprint

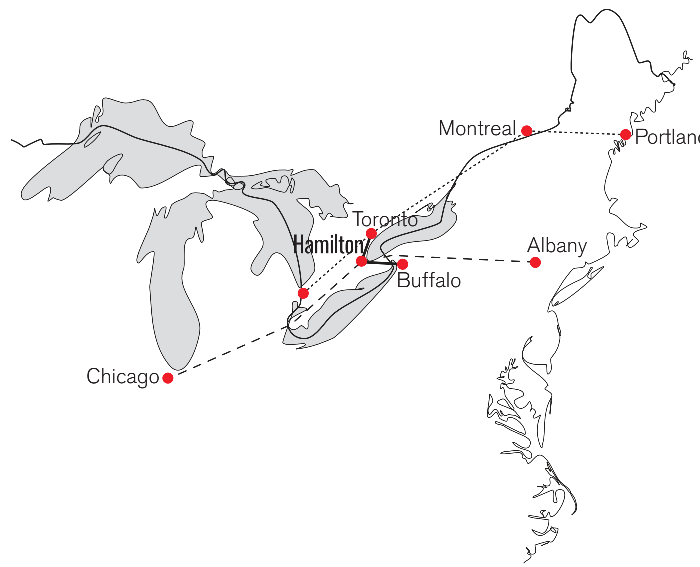


Fig.1.3 Map showing Hamilton's location within the emerging North American rail network

1.1 Burning

Modern Hamilton's history goes back to circa 1817 when it was known as Barton Township, population 800, and was chosen as the district seat of the region around the western head of Lake Ontario. The town was to be situated on property owned by George Hamilton, and it is his name that the city now calls its own. Due to its regional status, numerous businesses and commercial activities flocked to the town and it gradually grew out of the four blocks granted by Hamilton, encompassing a network of warehouses, ports, docks, and government buildings[1]. The city experienced rapid growth in trade-related port activities between 1844 and 1847 and had great dreams of becoming a bustling city based on commercial shipping centred around its port. However, the largest ships were all based in Toronto, a consequence partly of Hamilton's geography. The canal that linked Hamilton Harbour with Lake Ontario was very narrow and required constant dredging at great expense to maintain an appropriate depth for large vessels[2]. All of this hindered early shipping activity. Instead, a railway boom between 1853 and 1855 put Hamilton in the centre of the Great Western Railway (GWR) midway between Albany and Chicago, and the city's status as a trading node increased greatly. There was a corresponding boom in migration to the city, with many workers arriving from New York state and Ireland[3].

The success of the railway again caused a rift with Toronto, many of whose own rail promoters were highly critical of linking the United States while doing nothing to forge ties between Upper and Lower Canada. In response business leaders from both Toronto and Montreal financed construction of the Grand Trunk Railway (GTR) in 1859, which ran between Portland, Maine and Montreal, Toronto, and Sarnia. As a snub, it entirely bypassed Hamilton. The competition felt by the GWR was hard and fast and it began to suffer a loss in traffic. This was compounded by internal problems with the railway, such as profit scheming by its owners, shoddy workmanship as a result of its hasty construction, and several high-profile accidents. The decrease in trade-related work created a high level of unemployment, and the population of the city actually fell by nearly 20% between 1858 and 1862[4].

As the railway industry lost primacy, the emerging manufacturing sector managed to flourish due to the cheap rent of factory space and surplus of unemployed skilled labourers pining

Fig.1.4 (Opposite) Aerial illustrated map of Hamilton circa 1894, documenting the equal importance of both civic and industrial buildings

CITY OF HAMILTON, CANADA.

PRINCIPAL BUSINESS BUILDINGS

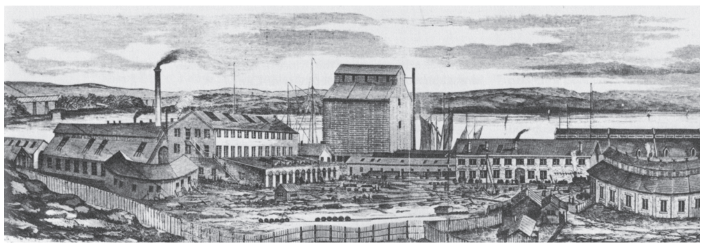


Fig.1.5 Great Western Railway Yards, circa 1863

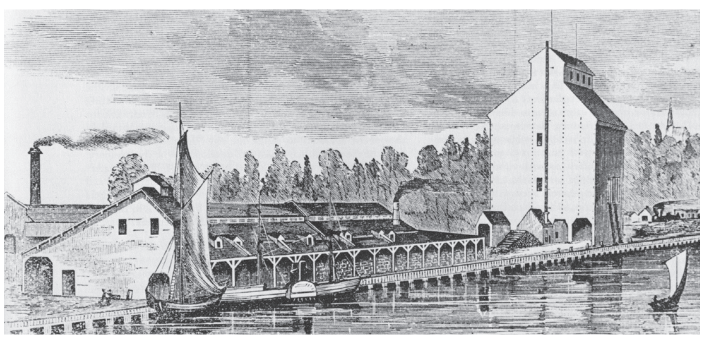


Fig.1.6 The city hosted a combination of industries as seen in this waterfront scene: agricultural, shipping, and rail

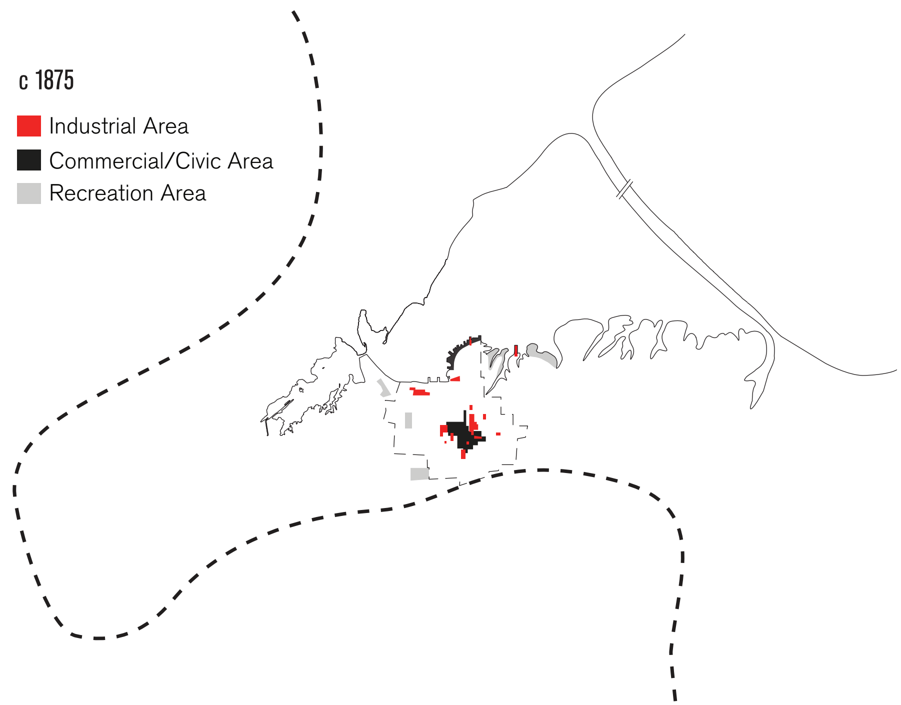


Fig.1.7 The city expands around a dense and mixed use centre

for work. During the 1860's, Hamilton's manufacturing industry grew steadily, specializing mainly in iron products – stoves, hardware, farm machinery, sewing machines, and furnaces[5]. It was here that the nerves of a Steeltown were forged. The Hamilton Spectator noted the change quite forcefully on August 18, 1871: "Then we traded, now we manufacture"[6]. The success of manufacturing saw a resurgence of the GWR, which despite its soot, noise, and hazard, was seen by citizens as a sign of economic well-being and civic pride. In the late 1880's, the Toronto-Hamilton-Buffalo railway was constructed and cemented the city's position in the North American transportation and infrastructural system. Factory loops were constructed for the larger industries along the waterfront in 1899, and between 1901 and 1917 traffic on the rails increased tenfold. When the GWR was absorbed and replaced by the GTR in 1888 it was seen as a great civic defeat by many in Hamilton, for they had grown proud of their industrial might[7].

Hamilton's role at the centre of the iron and steel industry was not just a result of happenstance. Initially, local companies did not manufacture their own iron and steel, which could not compete with cheap products from the Pittsburgh steel industry. Instead, scrap steel was imported from Scotland to be re-worked by the Ontario Rolling Mill Company, which had moved into an empty GWR mill and forged parts for carriages, machinery, sewing machines, and sleighs; by 1892 it employed 550 men[8]. The city's first blast furnace was financed in 1896 by the Hamilton Blast Furnace Company to support the growing needs of local stove and farm machinery manufacturers such as Ontario Rolling Mill. In 1899 Ontario Rolling Mill purchased Hamilton Blast Furnace to become The Hamilton Steel and Iron Company. The Hamilton Spectator again summed up the city's mood:

Today marks the beginning of a new era in the history and prosperity of the ambitious city, unless we are very much mistaken. Today the fires were lighted in the furnace of the Hamilton Iron and Steel Company.[9]

This new partnership developed an extensive product line of iron angles, plates, and rivets, as well as structural steel and various other grades defined by their shape, flexibility, and cross sectional properties[10]. Local iron and steel manufacturing flourished due to a strategic but equally lucky location in close proximity to all the necessary raw materials: local limestone from the Niagara Escarpment, iron ore from Lake Superior, and coal from both Pennsylvania and West Virginia[11]. Access to Hamil-

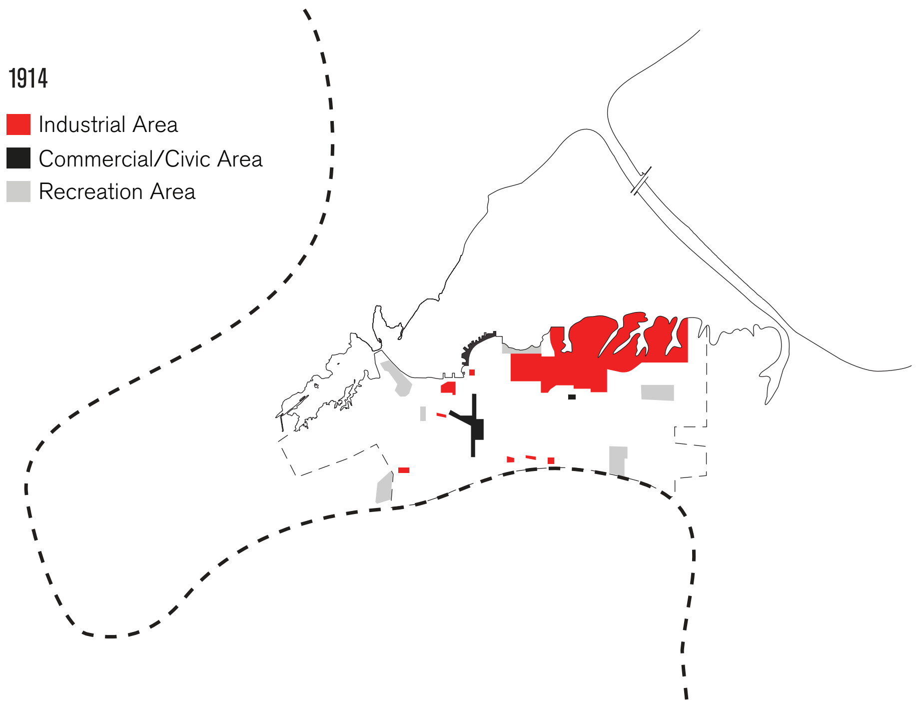


Fig.1.8 The city expands its industrial areas further east

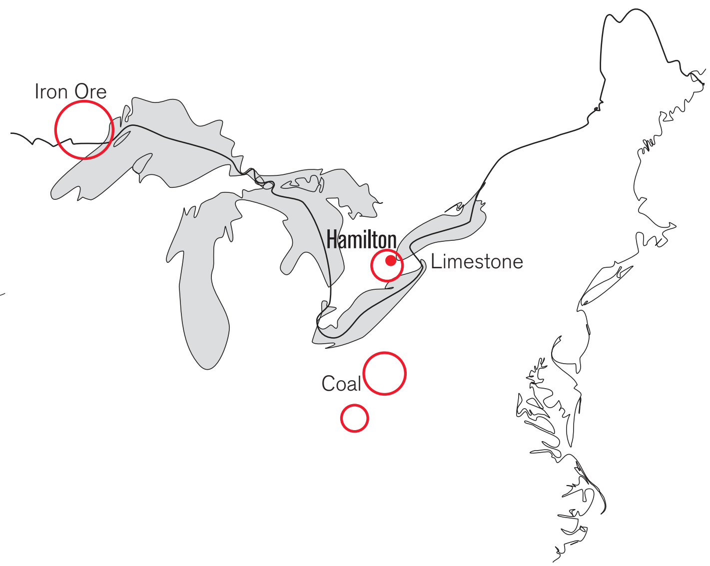


Fig.1.9 Map illustrating the relative distance of Hamilton from the main raw materials necessary for iron production

ton's increasingly sophisticated transcontinental infrastructure networks furthered the city's advantage. However, growing competition from American steel mills fostered the merger in 1910 of the major Ontario players, including the Steel and Iron Company, Ontario Tack Company, and Canada Screw Company, to form the new Steel Company of Canada (Stelco)[12]. Another company, the Dominion Foundries and Steel Limited (Dofasco) was founded two years later on lands adjacent to Stelco[13]. The presence of these industrial giants led to the founding of numerous tertiary factories and companies that solidified the central bay front of Hamilton as an industrial behemoth. These were beholden, however, to the fiery strength of the great steel-making blast furnaces that formed the core of this working landscape. In this aspect, the steel industry constitutes a *landschaft*, a productive landscape that, according to the landscape architect James Corner, collects significance through tactility, use and engagement over time[14]. In Hamilton's foundries, steel mills, and blast furnaces, men and women formed a strong bond with the productive and participatory phenomena of the every-day working landscape. The site emphasized the experiential intimacies of engagement, participation, and use over time, and created a strong and unified community.

Stelco boomed during the First World War (1915-1918), and to strengthen the bonds between city and industry, held large social events for their employees and extended families that offered fresh air, music, fraternal camaraderie, and civic pride. Stelco sponsored baseball leagues that promoted a sense of community between the plant and the city, and they became a fixture in the recreational life of the community[15]. However, during the wartime surge in production, skilled workers gradually became cast aside in favour of mechanical production and merely "dexterous" workers who could perform their work for a fraction of the cost. This was confirmed by wartime measures to speed up production and hire anyone to get the job done, and use the increased profits to invest only back into the company and not their workforce[16]. It was here that the roots of labour discontent were planted. The 1920's saw a slight return to normalcy, but during the Depression no sector of Hamilton's economy managed to escape the devastation. Those who manufactured heavy capital goods were especially hard-hit. Many steelworkers were laid off, production was trimmed, and expansion plans were put on hold. Hamilton stagnated and it wasn't until the boom of the Second World War that chronic unemployment was finally done away with[17].

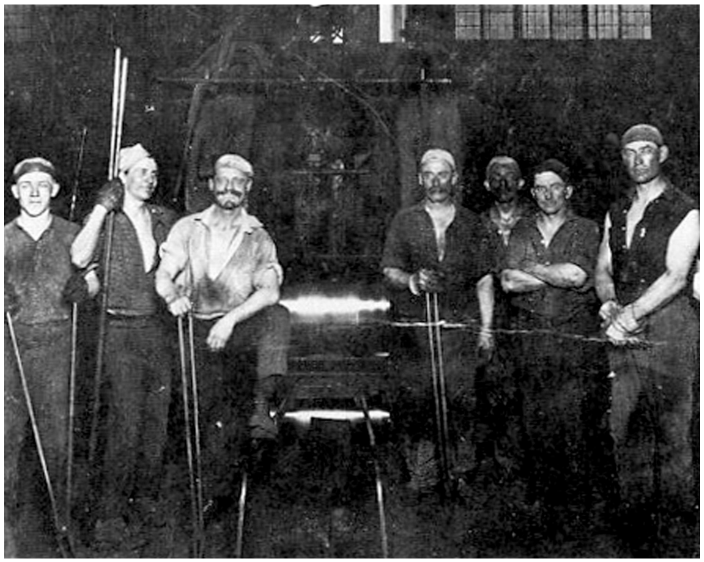


Fig.1.10 Those lucky enough to maintain jobs during the Depression endured intense working conditions, such as this sheet metal crew, circa 1936. Carmen Ciancone still remembers the excitement of his first day at the open hearth in the late 1920's. It was like "entering another world." His senses were bombarded with wailing sirens, charging cranes, and black clouds of smoke spewing out from locomotives. Men joined in pitched battle against dust and molten steel (Craig Heron, Shea Hoffmitz, Wayne Roberts and Robert Storey, *All That Our Hand Have Done*. Oakville: Mosaic Press, 1981. 48)

Fig.1.11 Workers gather at the Stelco steelyard to listen to an appeal for war bonds, 1940

The lingering frustration of workers from the first war, coupled with the devastation of the Depression, led to a new worker mindset during the Second World War. The steel industry was thriving once again and reaping the rewards. Workers came to realize that all of the enormous profit and expansion of their companies was impossible without the labour of their hands. Workers began to demand better treatment and compensation. The Ontario Collective Bargaining Act of 1943 sought to determine who would represent employees in negotiations with their employers. Stelco was uneasy about these employee unions, instead encouraging their own "company union" that was put to a vote in 1944 over the industry-sponsored United Steelworkers of America. The Independent Steelworkers Association touted by Stelco was soundly defeated, and the United Steelworkers of America Local 1005, the largest post-war union in Canada, was born[18]. The new union immediately started working for their members, including the key demand of paid vacation. Stelco refused to budge, often telling members there were hundreds of other men waiting at the gates for their jobs if they didn't want them. However by July 1946 the union had had enough and USW Local 1005 went on strike, putting 5,000 people out of work. The strike drove wedges between friends and families, and strained relationships between those "scabs" who stayed to work and those who walked out. The city was divided. After 81 days of intense standoffs, Stelco agreed to the main union demands, the blast furnaces were re-fired, and people went back to work[19]. Coming out of the war boom period, it was obvious that the city had changed. While Hamilton's industrial strength had grown even stronger, civic and residential growth had been stalled for nearly 15 years. The inter-war period was the beginning of the tension between city and industry that is still evident today.

Fig.1.12 *Dundas Valley and Hamilton*, by Robert Whale, 1855

Fig.1.14 Hamilton Beach, 1912. "The water in Hamilton Bay was so clear," one old-timer remarked, "that you could see Rocco Perri," a local mafia kingpin who mysteriously disappeared (John C. Weaver, *Hamilton: An Illustrated History*. Toronto: James Lorimer & Company, Publishers, 1982. 123)

Fig.1.13 An image of the burgeoning Gore Park area, circa 1900

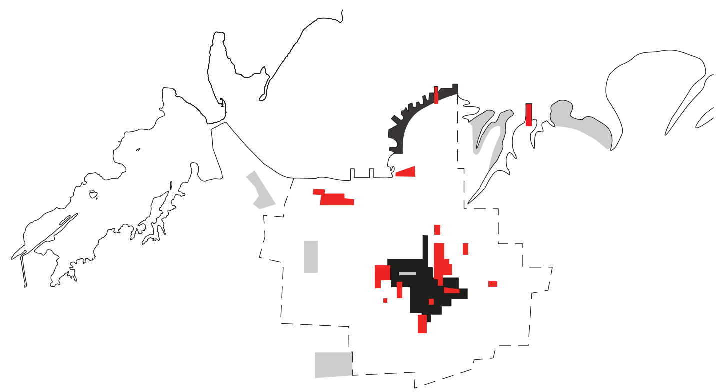


Fig.1.15 Gore Park is seen as the open space at the centre of the mixed use downtown area at the turn of the century

1.2 Waning

Looking at the original urban layout of Hamilton we can see how this tension began to emerge early on, and what led to its escalation in the post war period. In the 1850's, Hamilton was a pastoral town integrated into its natural surroundings. The lush landscape bled into urban boundaries, and the footprint of industry was well contained. The newly founded railroad brought trade and progress to the burgeoning city, which could be viewed in its Romantic entirety from the height of the Niagara Escarpment. From this lofty vantage point, the layout of the city could be readily appreciated. The waterfront areas contained many docks and trading warehouses, however much of the bay front was undeveloped and used recreationally by locals. There was excellent swimming in the summer, and the frozen waters allowed for ice-skating in the winter. The central business district was located midway between the waterfront and the Escarpment, and initially grew up around a void – the Gore. Eventually there came to be pressure to develop the property, however many local residents and even the Solicitor General of Canada stepped in and recommended it be instead developed as a public park. This recommendation was eventually adopted, and during the 1850's many splendid buildings of local material, built with local labour, began to be constructed around Gore Park[20]. Smith's Canadian Gazetteer described how buildings were built of "excellent freestone and limestone procured from the mountain . . . as the merchants [began] to build almost exclusively of stone; and the town promises in a few years to become one of the handsomest on the continent of America"[21].

Initially, the industrial areas of the city were very well mixed and integrated with the rest of the central business area. Most factories were small and thus intermediate transportation between the rail and port lands to the factory was not a significant issue. However, as industries expanded and grew, they began to steadily relocate to the waterfront periphery to be close to critical port and rail transportation links[22]. Recreational lands along the waterfront began to be displaced as more and more industry congregated there; the city was pulled inside out. Public parks and recreation space began to be assembled by the city along the south face of the escarpment in an effort to make up for a loss of the waterfront, a result of official city policy to concentrate industrial development there. The incompatibility of the two came to a head in 1911 when the Grasselli Chemi-

Fig.1.16 Westward suburban development around Coote's Paradise in the post-war period

Fig.1.17 Lakefill enlarges the Eastern Industrial Lands while the city fabric moves further west, eliminating the mixed use atmosphere of the core

cal Company made a proposal for a new plant on waterfront land that had been set aside as a rare piece of public space; the city gave their approval and the park was lost[23]. While the city's earlier central manufacturing base had located itself close to both its labour pool and local market, this second broadly oriented base required large plots of land and extensive transport connections. This necessitated the city of Hamilton to annex 650 acres of neighbouring Barton Township to the east to allow for as much expansion as necessary. Special tax rates were granted to those businesses that moved there, and the city's urban form responded in kind by gradually creeping eastward and subsequently pushing all public recreation areas westward[24]. The new residential and commercial development in the east, however, catered almost entirely to the lower classes that tended to live close to their jobs in the steel industry, and slowly an underserviced social group began to develop.

During the inter-war period, the East End came to resemble a kind of second city, unique from the central city in terms of distance, economics, and urban composition. The East Hamilton Industrial Lands, with Stelco at its heart, became the default dumping ground for industrial uses, hazardous materials, and trade operations for the entire city. Centred around the main steel manufactures, nearly all other industries, whether related or not, were relegated there by city planners, keen on keeping the smoke and pollution as far from the rest of the city as possible, a kind of 'no see, no say, no hear'. Even with the labour discontent that began in the early 1940's, the steel companies continued to grow, looking for even more land to expand facilities and keep up with demand. Production of basic staples continued, but in the 1950's and 60's many new products were introduced for growing industries such as appliances and the rapidly expanding automotive sector[25].

With the rapid expansion of one employment sector compared to the relative stagnation or decline of most others, the seeds were sewn for the city to become Hamilton: The Company Town. By the 1970's, Stelco was the largest steel producer in Canada, and the local industry produced 70% of Canada's steel as the local economy became ever more dependant on an industry that at its peak employed close to 30,000 people[26]. While other industries, such as Westinghouse and Hoover Vacuum, expanded operations outside of Hamilton, steel production necessitated expansion and development of a single concentrated site. The huge costs of land and dock facilities meant the companies invested in one site over time, funding transit improvements and

Fig.1.18 An accidental contaminant release from the Stelco blast furnace

Fig.1.19 Smoke billowing from Dofasco's steel mills

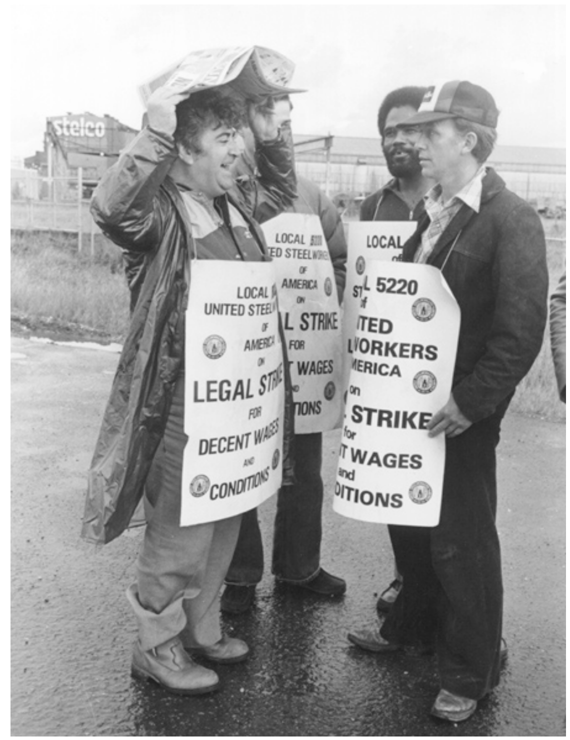


Fig.1.20 Stelco workers on strike, 1981

lake-fill operations to provide room to grow[27]. This Company grasp on the local economy created a situation where many people were uneasy or simply unwilling to confront the obvious growing problem of industrial pollution. It was much easier for some people to see the immediate benefits of well-paying jobs, as opposed to a perceived risk of environmental or health problems[28]. However, during the 1960's and 70's those local residents that were not involved in the steel industry sought to make their concerns known. Air pollution and toxic dumping began to catch the notice of both the press and interest groups, and disdain for the industry began to fester. As an example, in 1973 Stelco produced twice as much steel as Dofasco, but five times the amount of sulphur dioxide – one of the main catalysts of acid rain. There was a long string of corporate denial of wrongdoing, especially concerning the dumping of toxic waste into the once pristine Hamilton Harbour, and the companies complained that pollution-reduction strategies were costly and the money could be better spent creating more jobs. Pressure eventually led the steel companies to take some environmental responsibility, though it often lagged behind rising industry standards[29].

While the steel industry was isolating itself from its traditional civic supporters, there was also tension brewing from within. As the company with the largest post-war union ever formed in Canada, Stelco was to have many disputes with the United Steelworkers of America Local 1005. The company bore the brunt of labour negotiations for the entire industry, since its largest competitor, Dofasco, remained non-unionized. This came to a head in 1981 with a devastating 4 month long strike by the union that ground the entire industry to a halt[30]. In the years following, the local steel labour force was reduced by almost 30% (from 29,000 to 21,000), and eventually Dofasco came to employ more people than Stelco (11,400 to 9,700)[31].

The growth and expansion of the city in the postwar period further highlighted the growing divide and disconnect between the industrial heart of the old city and the aspirations of a new one. After the First World War the city began to slowly expand westward, away from the pollution and conditions of the East End. Cootes Paradise was a beautiful marshland and made a pleasing location to exploit a federal housing grant and begin the building of idyllic suburbs in what became known as Westdale. The founding of McMaster University in 1930 gave this new community a central nucleus and stronger identity. Shortly thereafter, a former rock quarry, used by local workers to con-

Fig.1.21 A view of the urban fabric surrounding the proposed City Hall site, 1957

Fig.1.22 A similar view of the new City Hall and Plaza, 1959

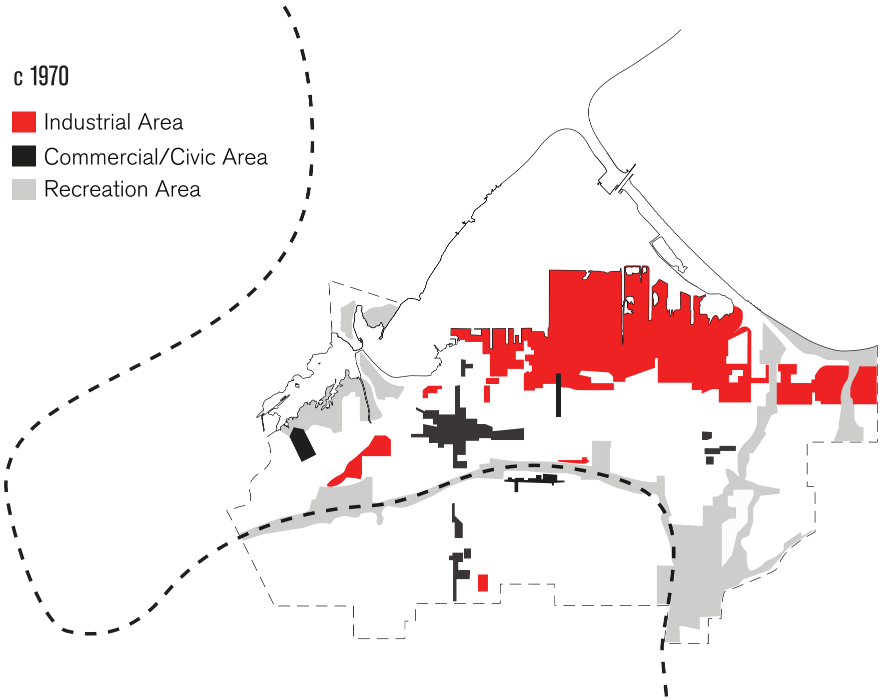


Fig.1.23 The city fills in more of its lakefront as urban growth flees up the height of the mountain in reaction

struct the new Toronto-Hamilton highway, was converted into a park and garden belonging to the nearby Royal Botanical Gardens[32]. After the Second World War there was another housing boom and the city exploded in all directions: further east, west, and for the first time, south up onto the mountain[33]. Between 1947 and 1957 the city nearly doubled its boundaries in terms of acreage, and by 1970 close to 100,000 people lived on the mountain[34].

These new areas of the city were typical of North American sprawl: singularly zoned residential areas with few employment or industrial areas, and commercial activity relegated to massive shopping plazas suspended within acres of parking. Suburban decentralization led to a steady decline in the fortunes of the original downtown, which lost business and activity to places such as Centre Mall, located in the East End, and Lime Ridge Mall, up on the mountain. The growth in these new areas only highlighted the blight suffered by many areas of the older city core, which suffered greatly at their expense. City officials yearned to bring vitality and attention back to the downtown, and so proceeded in the 1950's with an ambitious plan to build a shining new City Hall and civic square in the fashionable modern style. However this came at the expense of a massive swath of historical urban fabric, rooted in the brick and limestone of Hamilton's vernacular. Several blocks were completely demolished[35]. The new building was completely abstracted from the city; its smooth white walls and glass offered no meaningful connection to a specific time or place. It is one of the sharpest examples of the city beginning to lose a sense of meaningful identity, along with the severing of ties with its industrial heritage.

Fig.1.24 (Following left) Aerial view of Stelco site, 1954
Fig.1.25 (Following right) Aerial view of Stelco site, 2002

Fig.1.26 An imposing view from across the bay before the complex was shut down

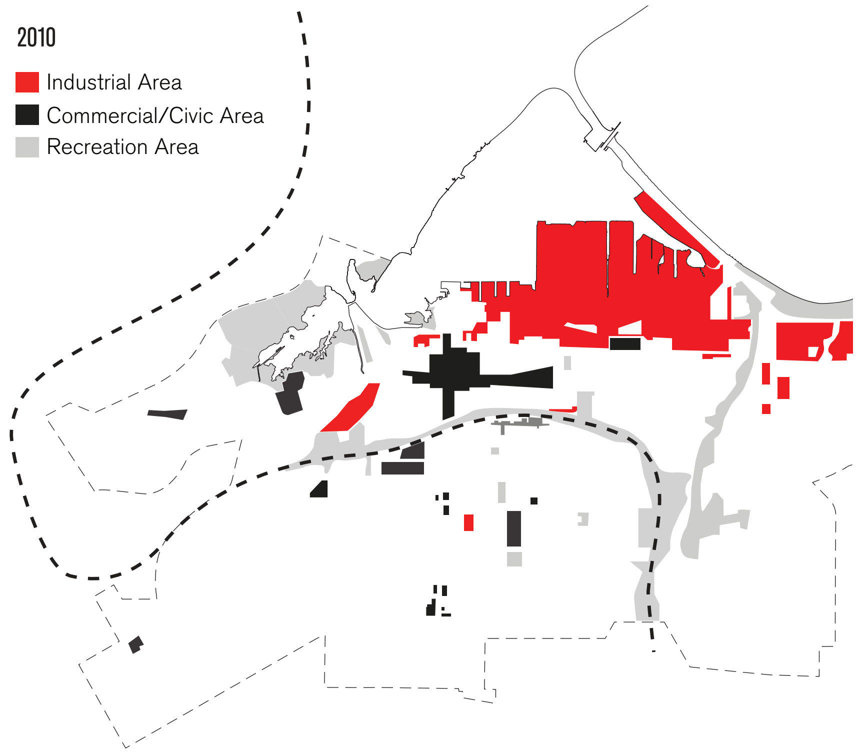


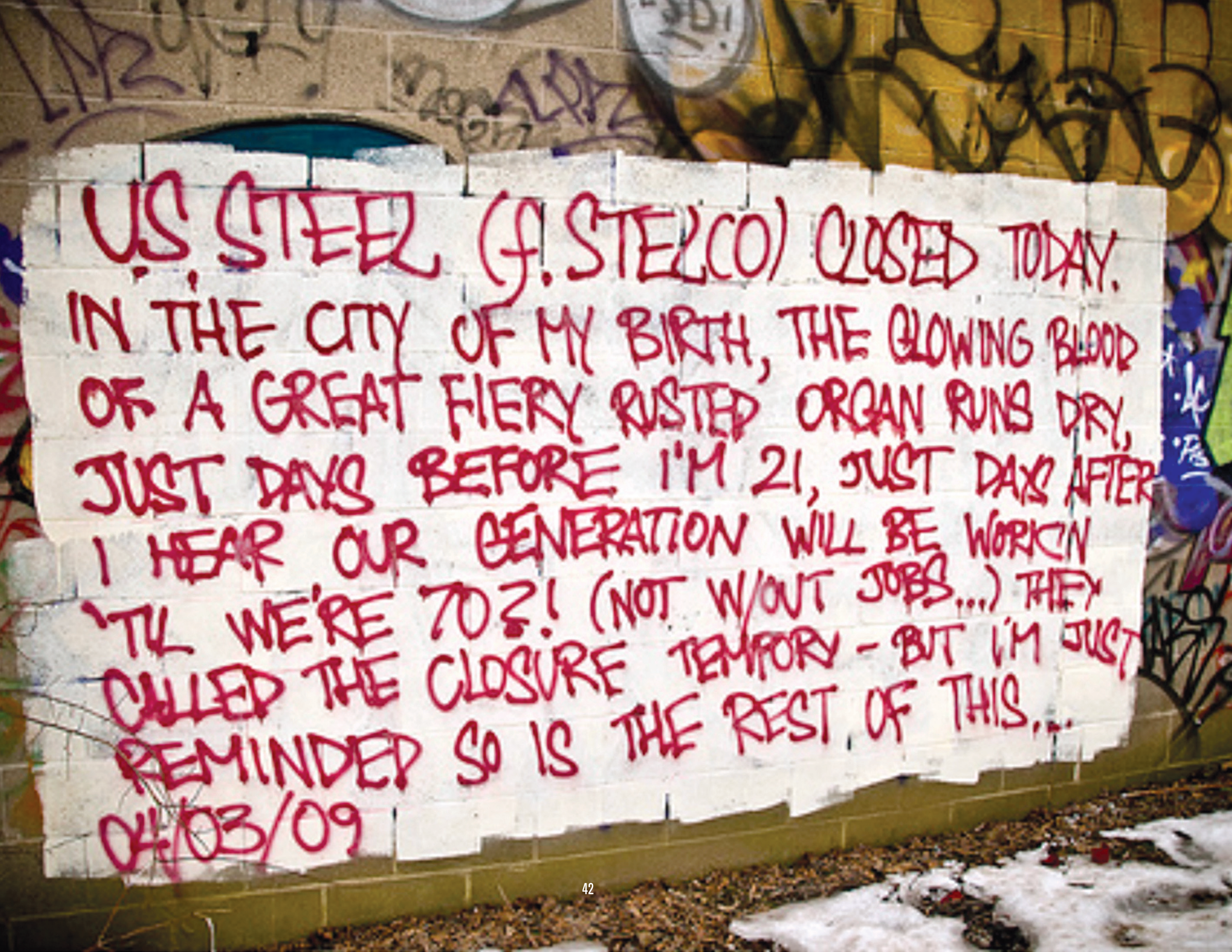
Fig.1.27 The city as it stands today

1.3 Extinguished

The evolution from Company Town is evident in looking at several current employment statistics. Up until 2009, Stelco employed 2,200 people at its Hamilton plant, and Dofasco close to 7,500. The reality of the city's changing economy and focus is evident in the rise of new employment sectors, namely Hamilton Health Sciences (10,000) and McMaster University (3,500)[36]. According to another report from 2005, there are 48,515 people employed in the broader health services and education sectors[37]. The city has actively sought to diversify its economy and change its image from that of a polluted 20th century industrial town to a progressive, knowledge-oriented 21st century city. In many ways, today it is not Hamilton's economy but its landscape that is dominated by steel. This lingering presence causes many of the new "progressive" citizens to voice their opinions about waterfront pollution and their city's perceived negative image. When the mountain that overlooks the city was colonized in the boom after the Second World War, people were shocked at what they saw when they looked out towards Lake Ontario. The waterfront of their city was almost entirely consumed by the belching beast of industry, spewing smoke and fire and ensuring no one ventured close to the eastern waterfront. But this appreciation remained at a safe distance. There was no first hand experience to understand the degradation and precariousness the landscape entailed. From this distance there remained a degree of ambiguity and subsequent non-specificity; the beast was easy to loath but much harder to engage and begin to understand. The site and blast furnace have become an example of what James Corner sees as the opposite of the working *landschaft* – *landskip*. This notion describes landscape as a contrivance, primarily visual and sometimes also iconic; it is the visual or framed landscape. As Corner argues:

The difference between working country as habituated place (landschaft) and landscape as objectified scene (landskip) [is], in the former, the subjects are fully immersed within their milieu, active, and distracted; in the latter, they are placed at a distance, passive and gazing. As a distancing device, landscape can be used by those in power to conceal, consolidate, and represent certain interests (whether of the aristocracy, the state, or corporate sector).[38]

This shift from experiencing the Stelco site as an active landscape to a passive one has had a profound impact on the city.


U.S. STEEL (f. STELCO) CLOSED TODAY.
IN THE CITY OF MY BIRTH, THE GLOWING BLOOD
OF A GREAT FIERY RUSTED ORGAN RUNS DRY,
JUST DAYS BEFORE I'M 21, JUST DAYS AFTER
I HEAR OUR GENERATION WILL BE WORKIN
'TIL WE'RE 70?! (NOT W/OUT JOBS...) THEY
CALLED THE CLOSURE TEMPORY - BUT I'M JUST
REMINDED SO IS THE REST OF THIS...
04/03/09

Compounding this, changing economic conditions both locally, especially in the automotive sector, and internationally have caused a steady decline in steel output and profits. Layoffs became common and gradually the company began to idle parts of its production line, but by 2005, little more could be done and Stelco filed for bankruptcy. After intensive restructuring and the selling off of most subsidiaries, the company emerged from protection in 2006 only to be embattled once again and resort to publicly offering itself for sale in 2007. US Steel, the Pittsburgh-based giant that had been Stelco's biggest competitor since the 19th century, offered $1.9 billion dollars for the company and Stelco ceased to exist, becoming US Steel Canada[39]. The fires in the blast furnace were re-ignited, and The Hamilton Spectator said of the newly restructured plant:

Love it or hate it, [the] Stelco skyline is a symbol of our pride . . . Whatever your take, there's no city in the country with a skyline like Hamilton's. Its fiery face, seen so vividly by millions sailing south on the Skyway, frightens many.[40]

However, this impact was not to last. In November 2008 US Steel Canada announced it was closing down its main blast furnace, which had been the fiery face of the city for more than 110 years; 700 workers were laid off, but still the plant plodded on. However on March 4, 2009, US Steel announced it was idling indefinitely all Canadian operations, as well as several in the US, and that the Hamilton facility would become dormant. Hamilton Mayor Fred Eisenberger said: "I was stunned," noting he has family working at the company. "It's hitting pretty close to home"[41]. Rolf Gerstenberger, president of the United Steelworkers of America Local 1005, was far more blunt:

This is going to devastate Hamilton. Not that long ago, they were telling me how lucky we were to have U.S. Steel buy us. Now a year and four months later we're shut down completely. We were the last Canadian steel company and now all the decisions are being made outside the country as far as what's good for Hamilton and what's good for Canada.[42]

Quite suddenly, the fiery beast that had fueled the city for over a century was dead. While people involved in public office and those who maintained some personal connection with the industry were obviously upset, many in Hamilton felt quite the opposite. To them, the city had been freed of a massive blight – good riddance. But what of how Stelco has contributed to their city's identity? Within the aging iron and rust of Stelco's

Fig.1.28 (Opposite) A graffiti message expresses the strong emotions felt by many citizens of Hamilton in the wake of the Stelco closure

Fig.1.29 A zoning map of the Maasvlakte on Rotterdam's urban edge


Fig.1.30 Adventure-seekers utilizing the Maasvlakte landscape

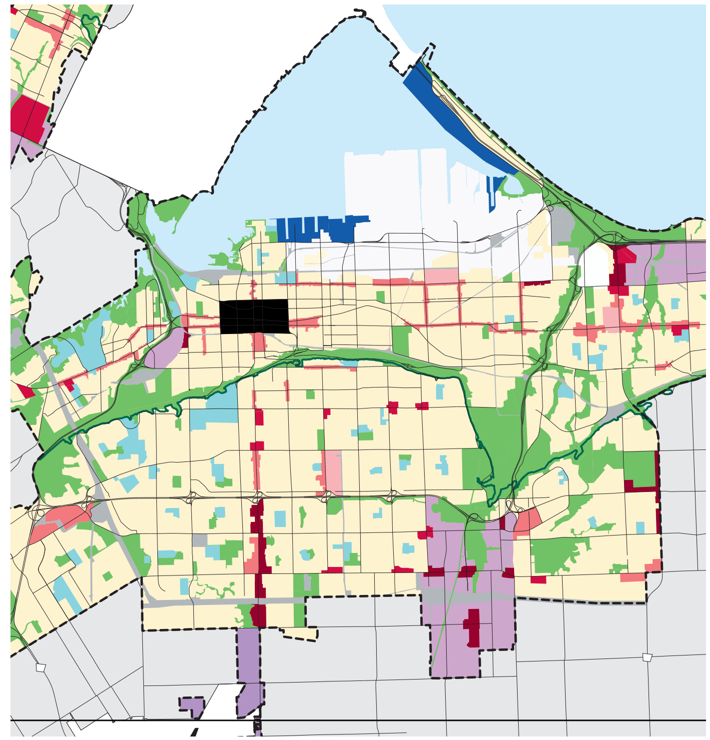


Fig.1.31 A current zoning map of Hamilton, expressing the Industrial Lands as completely blank in a similar fashion to the Maasvlakte

corpse lay the energy and memories of tens of thousands of people and that, despite what proponents of examples such as the City Hall project might believe, should not be forgotten or erased from the life and growth of a city.

In the wake of the Stelco closure lies a ruined blast furnace, a ruined landscape, and in many ways, a ruined city. But there are ways in which one might tap into the opportunities latent in such an unbounded urban site. A similar site condition exists in the Netherlands, where urban designers are obsessed with officially planning every corner of a city, allotting to it a specific function and usage that all who find themselves there must adhere to. According to Dutch landscape architect and theorist Adriaan Geuze, planning maps in Holland are of great political significance as well, since only desirable functions are mapped out on them. But where, he asks, are "the undesirable, unforeseeable, or intractable allocations programmed? The planning maps always contain a few patches of white, sans code, sans allocation. Remote corners, wastelands, the Maasvlakte. The Maasvlakte became the planning orphanage of the Netherlands"[43]. The Maasvlakte (or Maas Plain) is a large reclaimed industrial area to the west of Rotterdam where the river Maas empties into the North Sea. Since it's inception in the 1960's, it has come to house many functions and programmes that neighbouring municipalities shun, such as several power plants, a uranium ore terminal, a rail shunting yard, sludge basin, chemical waste depot, a trout farm, wind turbines, and the detonation zone of the Dutch bomb disposal unit. Clearly not an area meant by planners for civic occupation, it has nevertheless developed into an extremely popular recreation and public gathering place. As Geuze says:

This planning Free State may have developed without benefit of any form of architectural or aesthetic review, but it appears to possess enormous drawing power. Despite the absence of special provision and the lack of PR, the city dweller has discovered this area. Mazda and Nissan families with surfboards and bikes confidently join the convoy of trucks and semi-trailers.[44]

Planners and policymakers are shocked and dismayed to witness the mass exodus by the public away from official recreation areas and facilities to this seemingly un-serviced zone. Part of the reason people are so uninspired by what the official plan offers in terms of amenity and opportunity is the extent to which these spaces of officialdom are over-regulated, sanitized, and built for the masses instead of individual exploration. The

annexation of areas such as the Maasvlakte demonstrates the evolution of a city dweller who has become a probing, well-equipped, inquisitive explorer that "yearns for meaningful experiments that go beyond the development of new park fashions, for experiments that lead to a new genre of public space"[45].

Much like the Maasvlakte in Rotterdam, the East Hamilton Industrial Lands have grown at breakneck speed in only one direction and with only one purpose – to produce, burn, and manufacture the waterfront of the city into a complete industrial behemouth. Citizens have essentially given up their waterfront and abandoned these scarred lands. But examples such as the Maasvlakte illustrate some of the hidden potential latent in these assumed wastelands. The energy they possess, both in terms of their form and output, can be embraced by a citizenry and enhance, not stifle, the civic realm. Hamilton is a city rich with history and identity and the ruined landscape and architecture of Stelco are a fundamental part of both. Whether that identity is represented in a splendid old building that harkens back to a glorious past, or a contaminated reminder of a more recent one, it must be appreciable for the people who live there.

It is the ambition of this thesis to explore alternative uses and occupations for the defunct Stelco site that acknowledge both the city's industrial heritage as well as its aspirations for a more sustainable future. Through programmatic, experiential, and remedial interventions, the following work will offer a re-imagining of Stelco so that it might once again serve as the hearth upon which a city's pride is placed. Following is a visual essay of the site in its current state, as viewed from the height of the Escarpment, throughout the lower city, and across the waters of Hamilton Harbour.

Plate 1.

Plate 2.

Plate 3.

Plate 4.

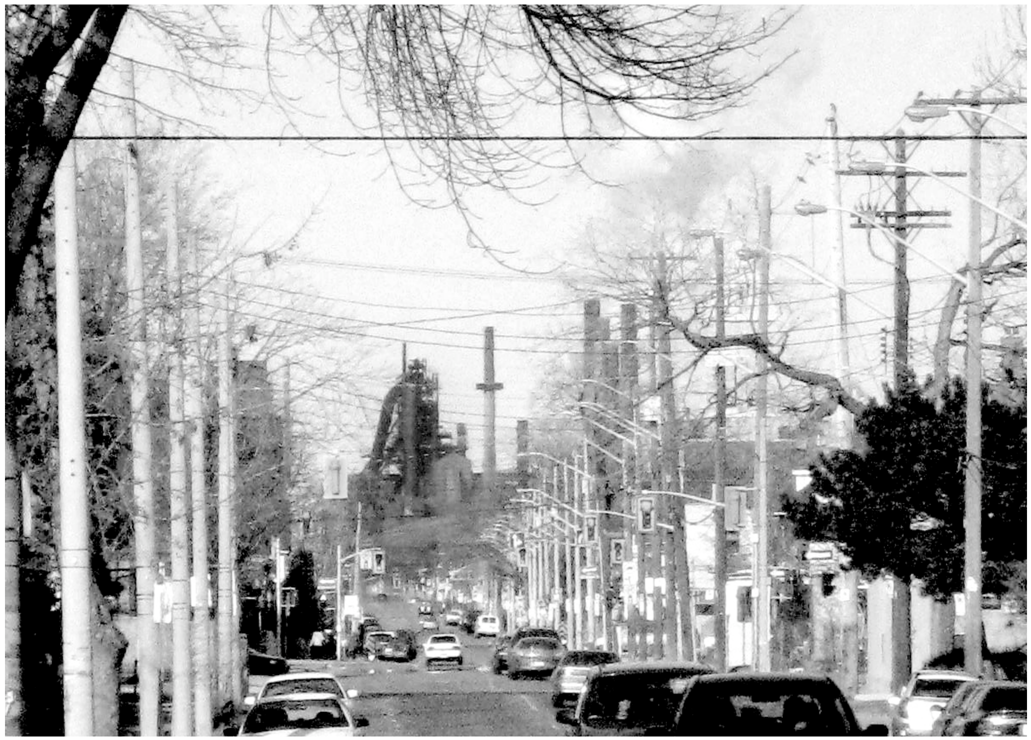


Plate 5.

Plate 6.

Plate 7.

Plate 8.

Plate 9.

Plate 10.

Plate 11.

Plate 12.

Plate 13.

Plate 14.

Plate 15.

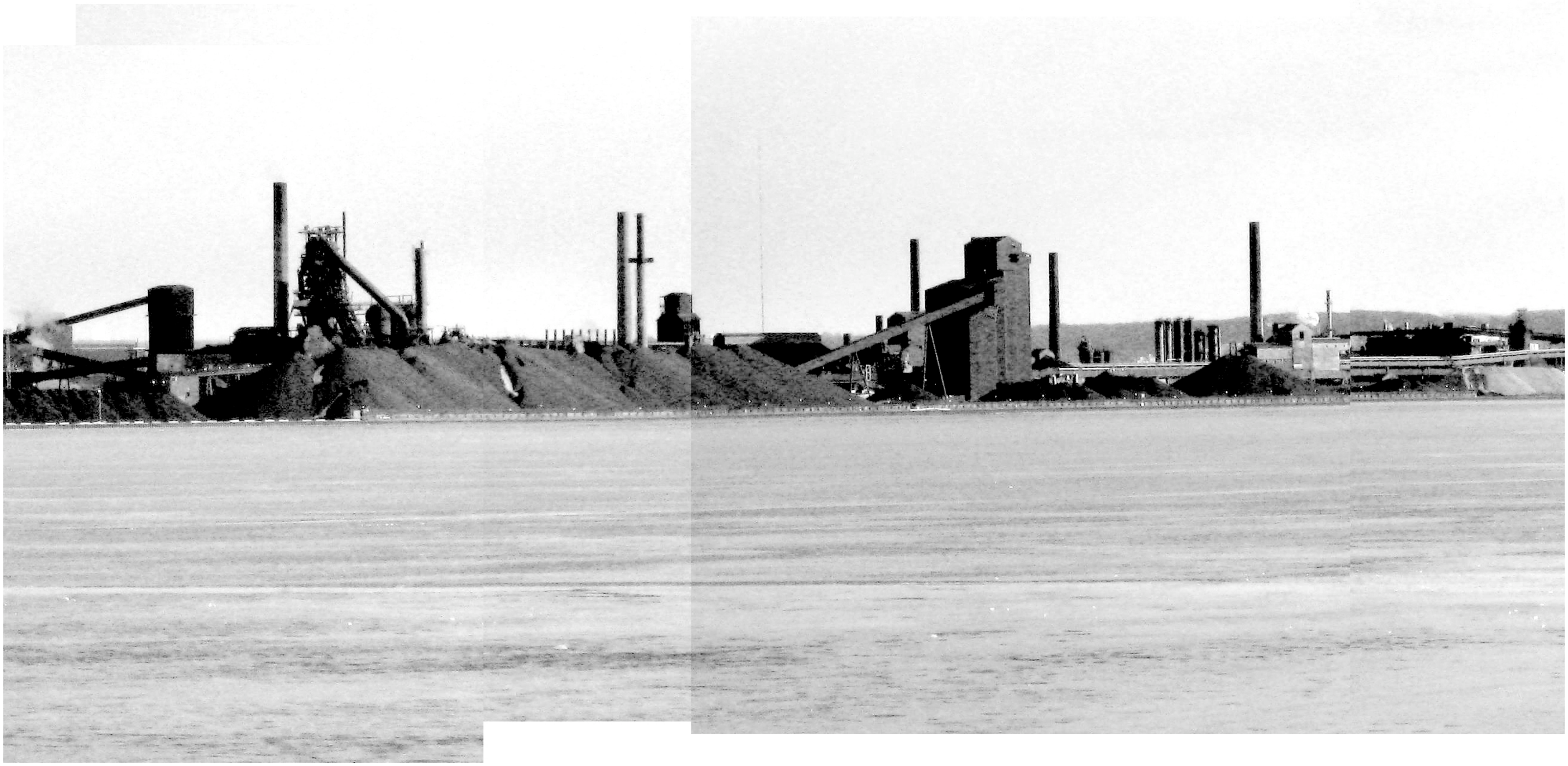


Plate 16.

Energies

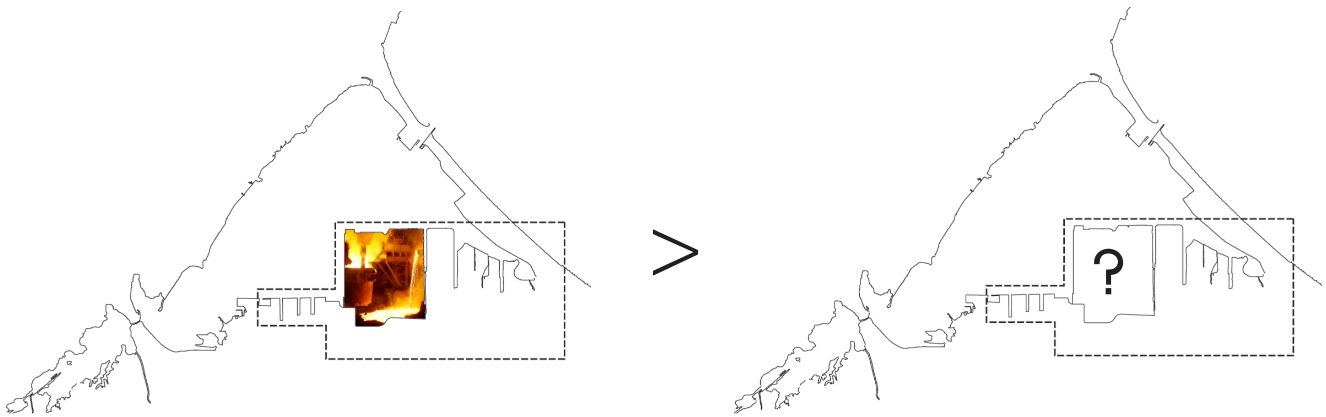


Fig.2.1 What is the future of the site?

At their height, the Stelco lands were serviced by a self-supporting network of railways, roads, and canals, and even its own police force to produce millions of tons of finished steel annually; essentially, a city within a city. With the idling of Blast Furnace E, however, large portions of the site, both built and landscape, have been rendered obsolete. These include all ancillary buildings to support the blast furnace, the coal washery (where coal is rid of soil and rock), the coke ovens (where the washed coal is burned of other impurities to become coke), and the sinter plant (where waste particles from the blast furnace are agglomerated into solid masses for re-use). The approximately 100 hectares of land used to store piles of iron ore, coal, coke, limestone, and slag are also now superfluous. These spaces join several older abandoned buildings at the original south end of the site, as well as the remnants of Blast Furnace D, which was demolished in 2004 for 15,000 tons of scrap steel[1]. The energy latent in these abandoned buildings and landscapes, and their current disengagement with wider urban infrastructures, will be the focus of the first part of this chapter. The second part will turn to the recoverable energy that might be extracted from new hybrid industries on the site, and the final part will focus on the remedial possibilities this new industry presents.

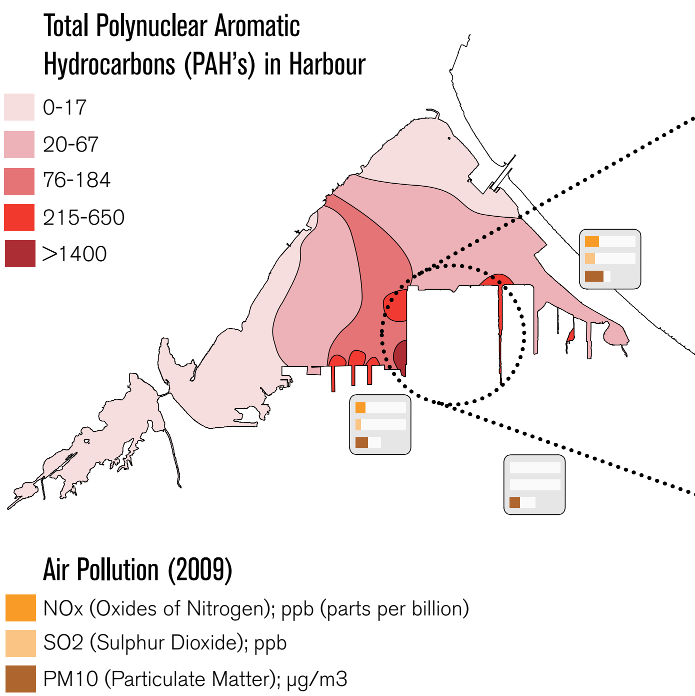


Fig.2.2 Water and air pollution in Hamilton

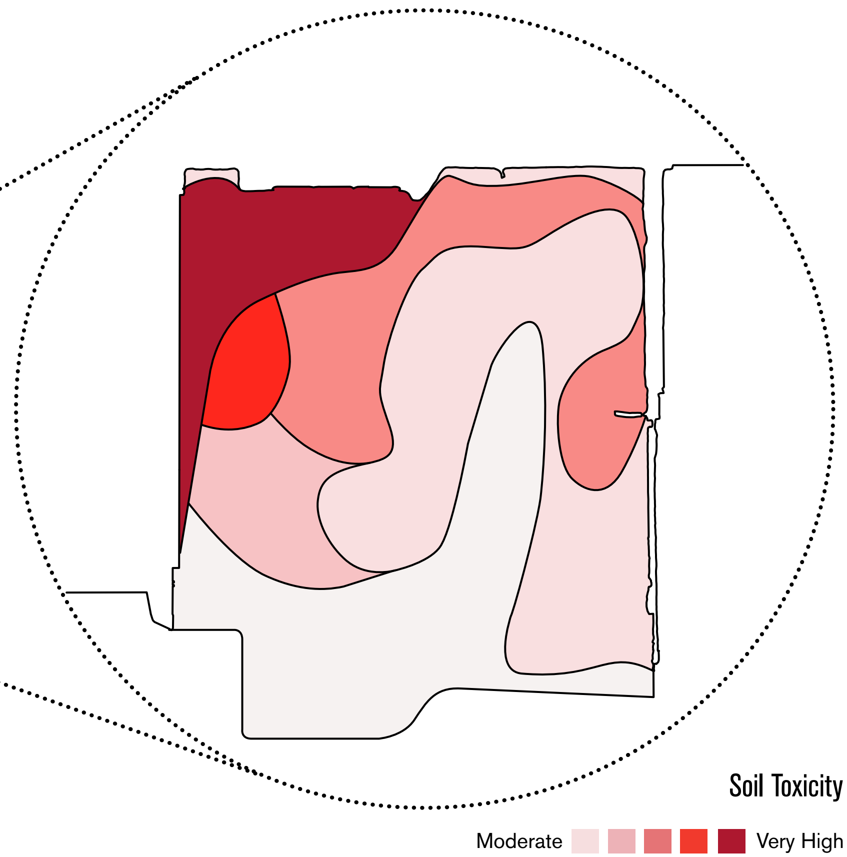


Fig.2.3 Soil contamination based on site varying site occupations

2.1 Latent

Site

The physical composition of the Stelco site is extremely degraded. The ground, comprised of both soil and rubble-based lake fill, is polluted with run off from the storage of raw material – namely piles of iron ore, coke, and slag (a byproduct of the steelmaking process consisting largely of metal oxides and limestone). These substances leach into the soil, and through both natural processes and the aid of storm sewers, into the waters of Hamilton Harbour.

The harbour contains very high levels of iron and zinc, as well as unhealthy levels of other metals, oil, grease, and polynuclear aromatic hydrocarbons (PAH) - a toxic byproduct of fuel burning[2]. PAHs are organic pollutants that bioaccumulate in the environment, and are carcinogenic in high concentrations. The area known as Randle Reef, at the southwest corner of the Stelco site, contains the highest levels of PAHs on the Canadian side of the Great Lakes. The harbour has a high rate of exchange with the lake, and maintains a short retention time of approximately three months, carrying many of these pollutants out into the broader Lake Ontario ecosystem[3]. The piles of raw material also contribute to air pollution. When they are sprayed with water to prevent dust erosion, particulate matter circulates through the air. Within the ground level vicinity of the Stelco lands, levels of various air pollutants have been noted, namely: carbon monoxide, a toxic colourless and odourless gas; hydrocarbon compounds, an organic compound the solid form of which is asphalt; reduced sulphur compounds, which are non-toxic but produce an offensive rotten egg odour; and the highly toxic nitrogen dioxide, a reddish-brown gas with a biting odour[4].

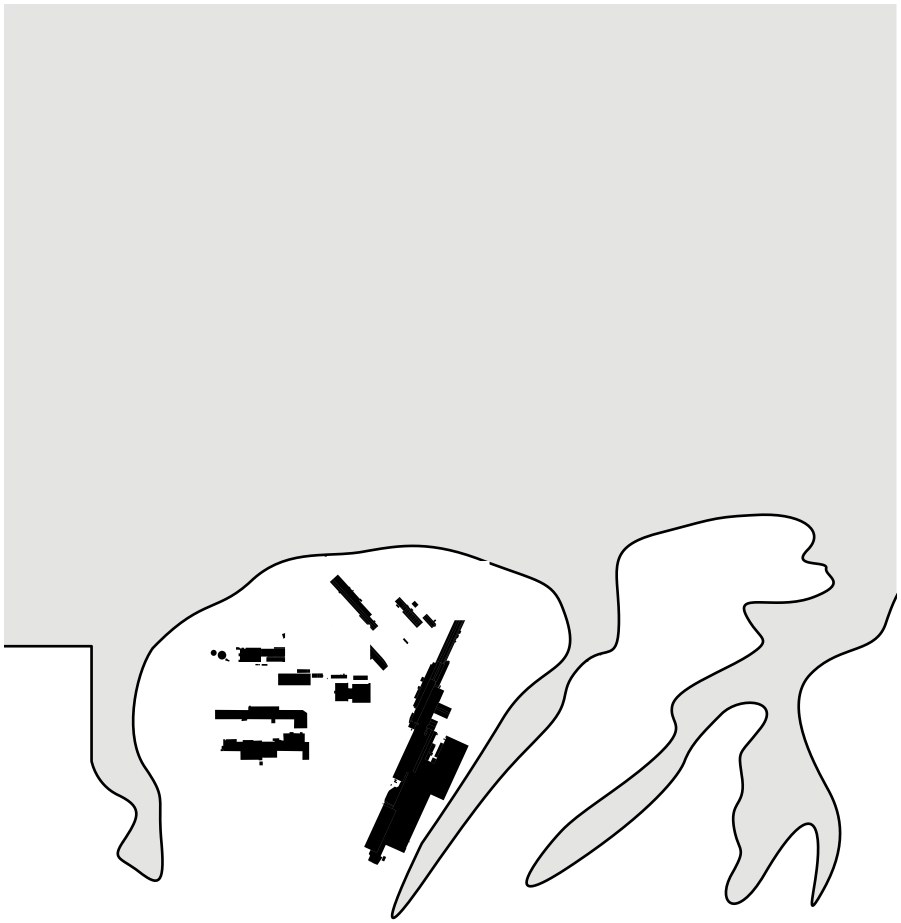

Fig.2.4 Slag


Fig.2.5 Iron Ore pellets


Fig.2.6 Limestone


Fig.2.7 Coke

Fig.2.8



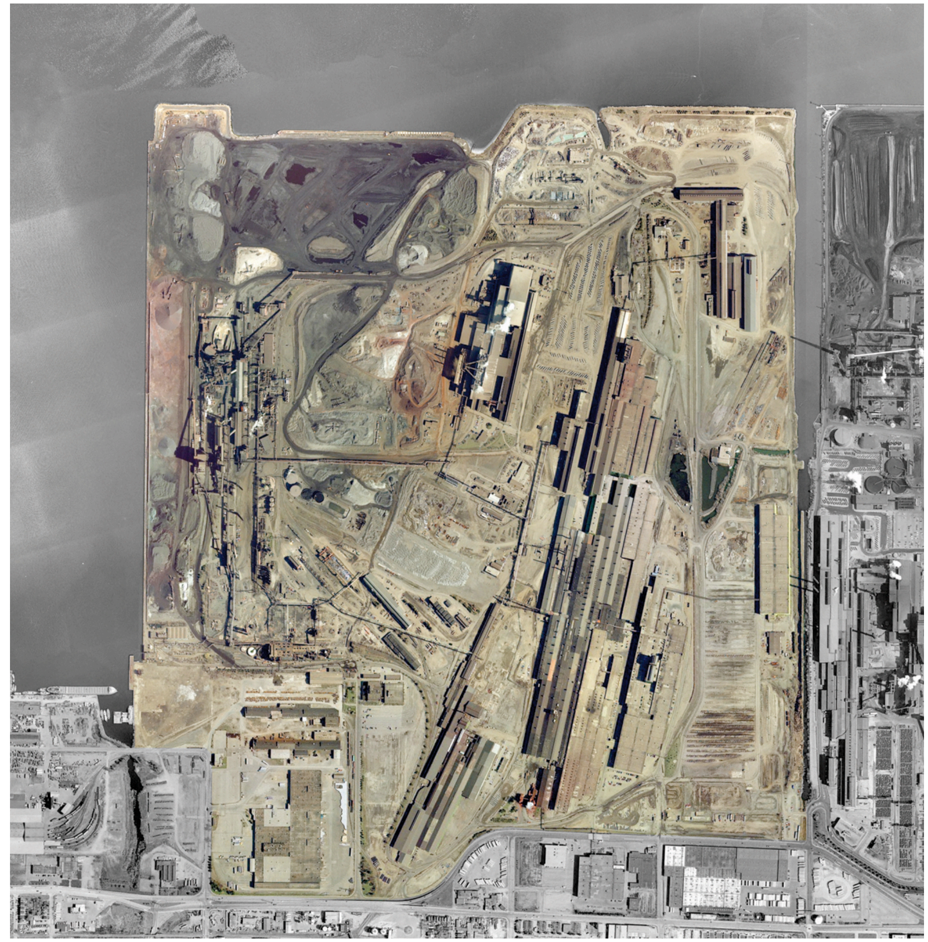
Site Plan c. 1914

Fig.2.9

Site Plan c. 1955

Fig.2.10

Fig.2.11



Existing Site Plan 2010

Site Boundary (dashed red)	
Rail line (dotted)	
Road (line)	

1 Blast Furnace E
2 Hot Blast Stoves
3 Coke Ovens
4 Coal Washery
5 Sintering Plant
6 Rolling and Finishing Plants
7 Abandoned
8 Former Blast Furnace D
9 Administrative Building
10 Shipping Terminal
11 Coke
12 Coal
13 Limestone
14 Iron Ore
15 Slag Deposits

Fig.2.12

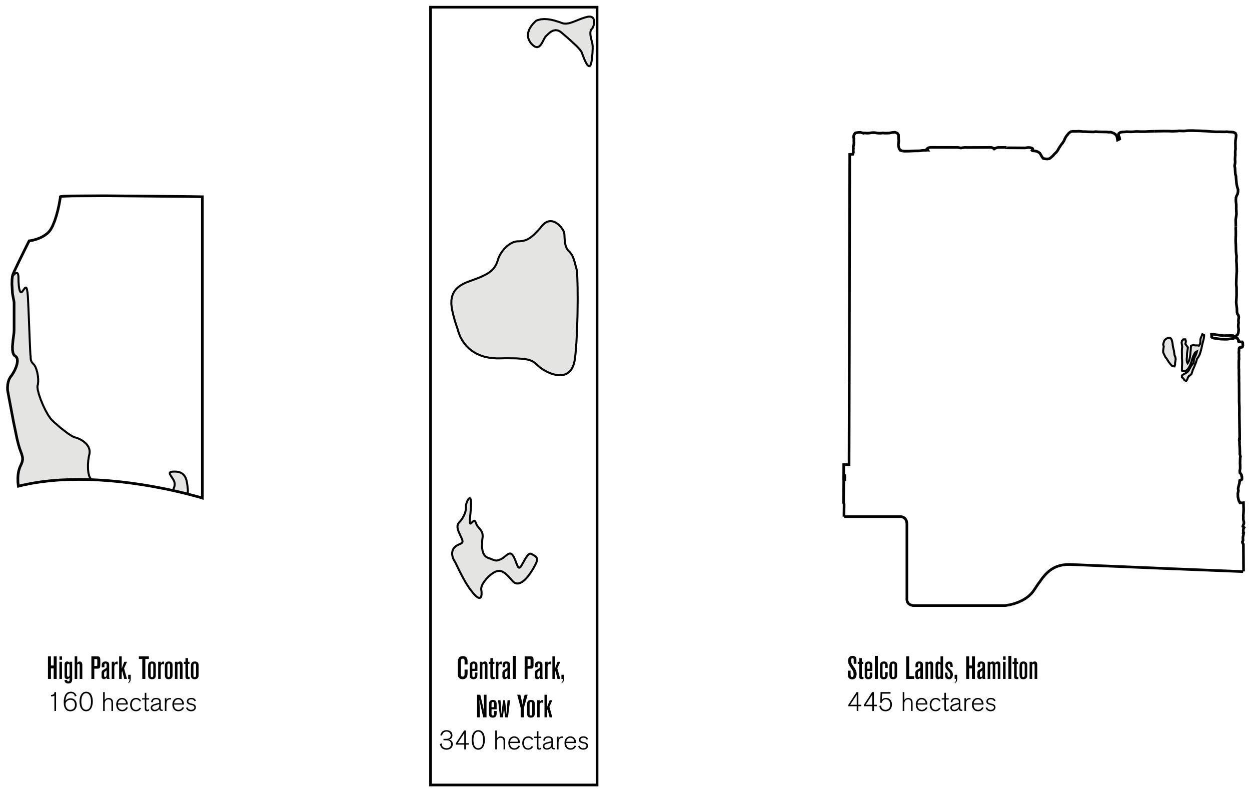
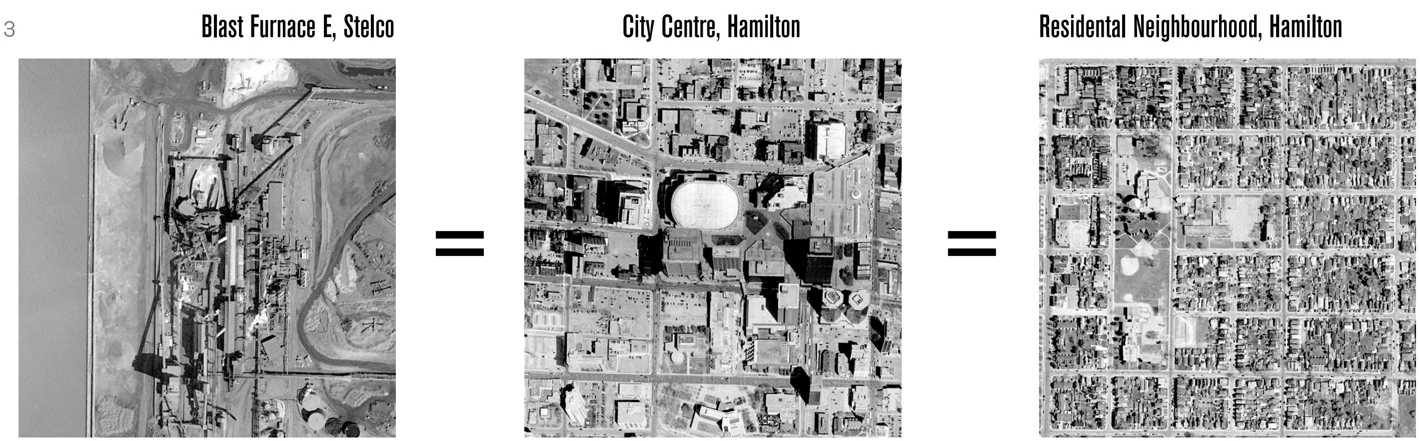


Fig.2.13



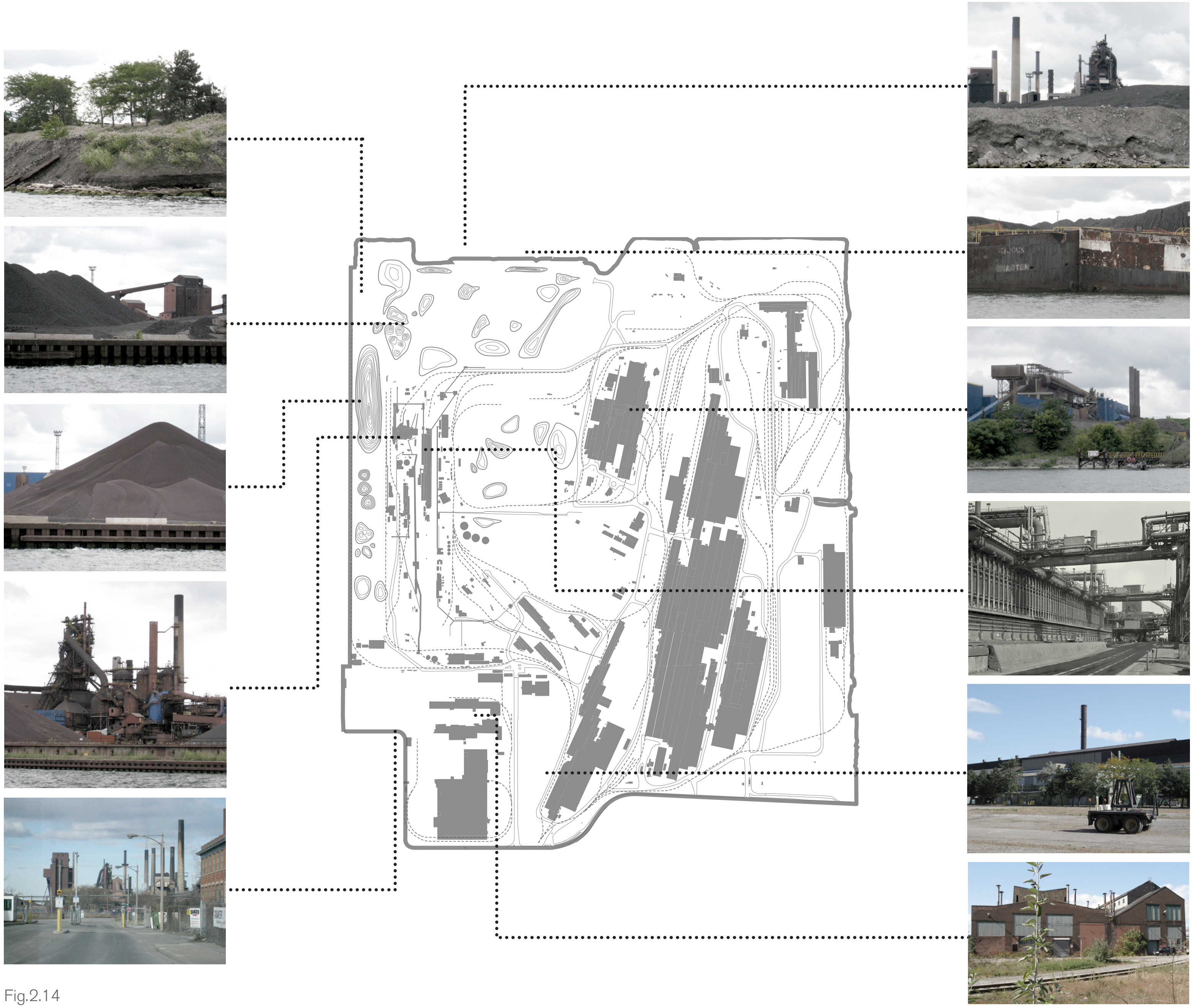


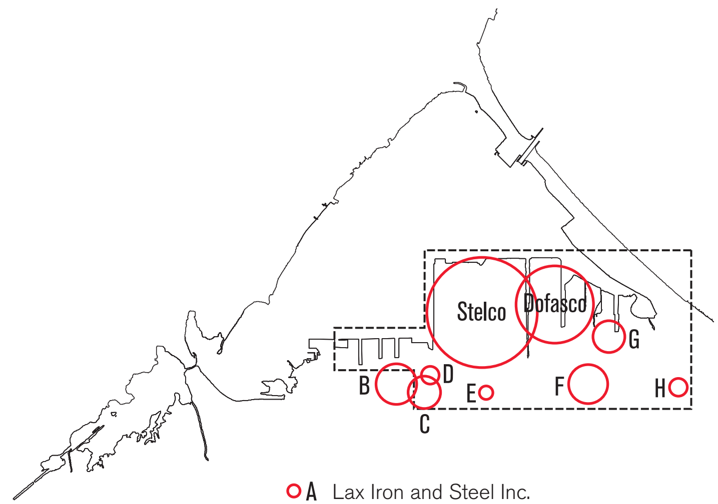
Fig.2.14

Fig.2.15 Wentworth St. N.

Fig.2.16 Sherman Ave. N.

Fig.2.17 Gage Ave. N.

Fig.2.18 Kennilworth Ave. N.



A Lax Iron and Steel Inc.
B Wentworth Metals (Scrapyard)
C Hotz Ferrous Inc. (Scrap Metals)
D Brant Hill Recycling
E Regional Disposal Services Inc. (Waste)
F Posner Metals (Scrapyard, Metals Sorting)
G Thomason Metals (Scrapyard)
H Beach Road Steel (New/Used Steel products)

Fig.2.19 The major players in the East End steel industry

Neighbourhood

Stelco, and its neighbour Dofasco, are the two largest complexes in the East Hamilton Industrial Lands. As previously discussed, this area is a mixture of everything industrial. Upon closer inspection however, the area reveals a number of commercial uses, industrial conversions, abandoned buildings, and a surprising component of residential. Nearly all tertiary businesses involved in the steel industry are located in close proximity. The area is bounded firmly to the north by the artificial edge of Hamilton Harbour and on the south by the CN rail lines, while its east and west edges are somewhat ambiguous and bleed in and out of the general city fabric. Burlington St. E is a busy infrastructural road that links the industrial residents together, while just to the south of the area is the more commercial Barton St. E, anchored by Centre Mall.

Barton St. essentially allows civic traffic to bypass the area, and the existing north/south streets do little to tie it into the larger city fabric. The four main roads (Wentworth St., Sherman Ave., Gage Ave., and Kennilworth Ave.), are peppered with mixed industrial uses, large open or derelict spaces, residential homes, and bisected by two sets of railway tracks. Only one, Sherman Ave., is largely three lanes of traffic (instead of four), and contains areas of dense urban fabric. Once a busy commercial strip populated by establishments that catered to the area's steelworkers, the avenue's fortunes, named after Dofasco founder Clifton W. Sherman[5], have mirrored that of the industry and fallen on hard times. Some of the avenue's old industrial and warehouse buildings have been converted into commercial and office uses, bringing new people to the area and beginning to improve its fortunes.

These north/south streets are an important element in connecting the Industrial Lands with the larger urban network. With the recent changes to its largest neighbour Stelco, attention must be paid to ensure they act as supportive thresholds instead of ghettoized barriers. As illustrated in the figure-ground maps on the following page, Sherman has the greatest density of existing built fabric and mixed use, and is therefore the street with the greatest potential to weave the industrial East End into the fabric of the city. The avenue will be the focus of a revitalization campaign to encourage new mixed-use developments and the reoccupation of existing buildings, while infrastructure improvements (such as bicycle lanes) will facilitate different modes of traffic flow to and from the Stelco site.

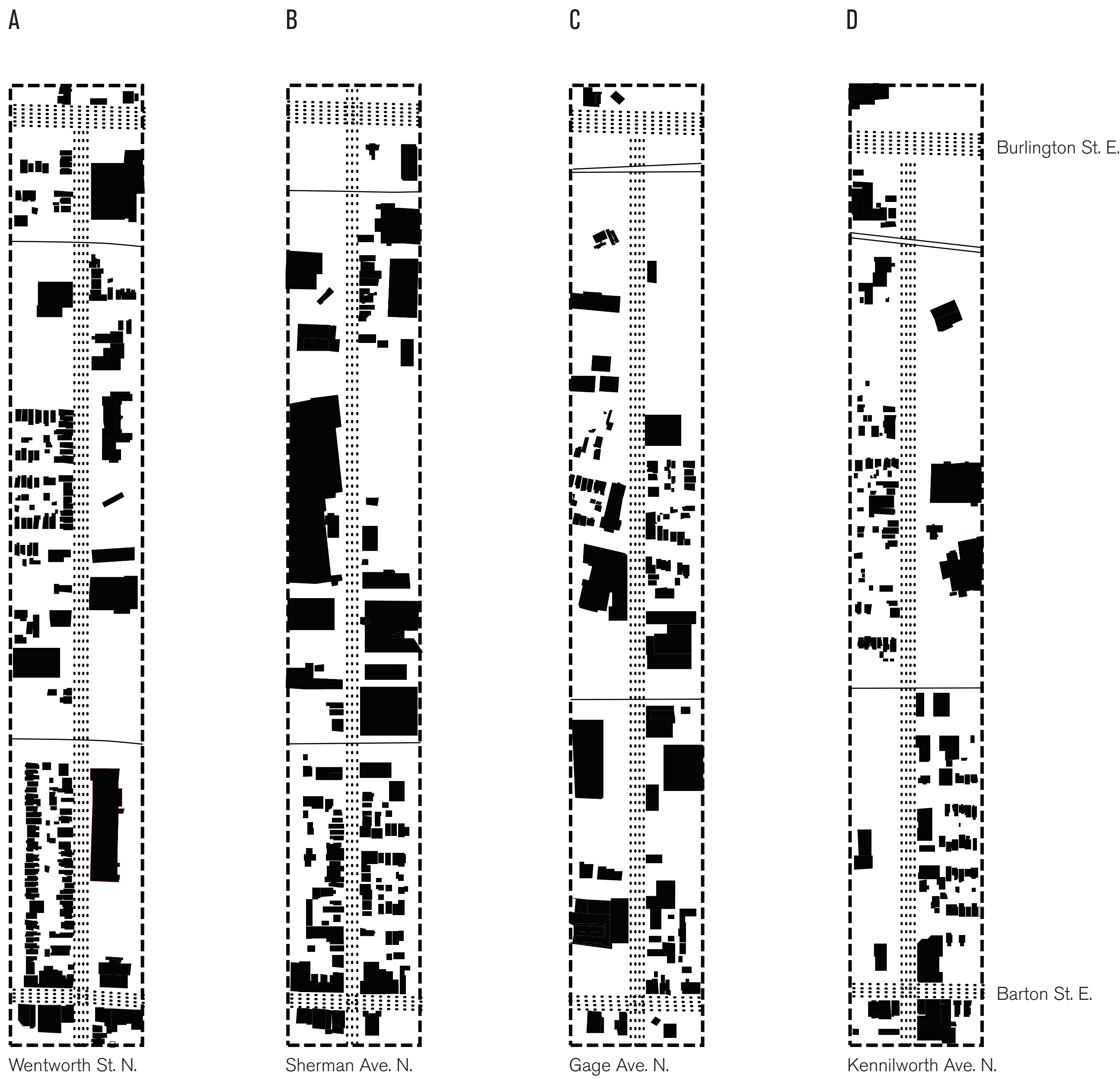


Fig.2.20 Figure-ground diagrams illustrating the existing built fabric of the four streets

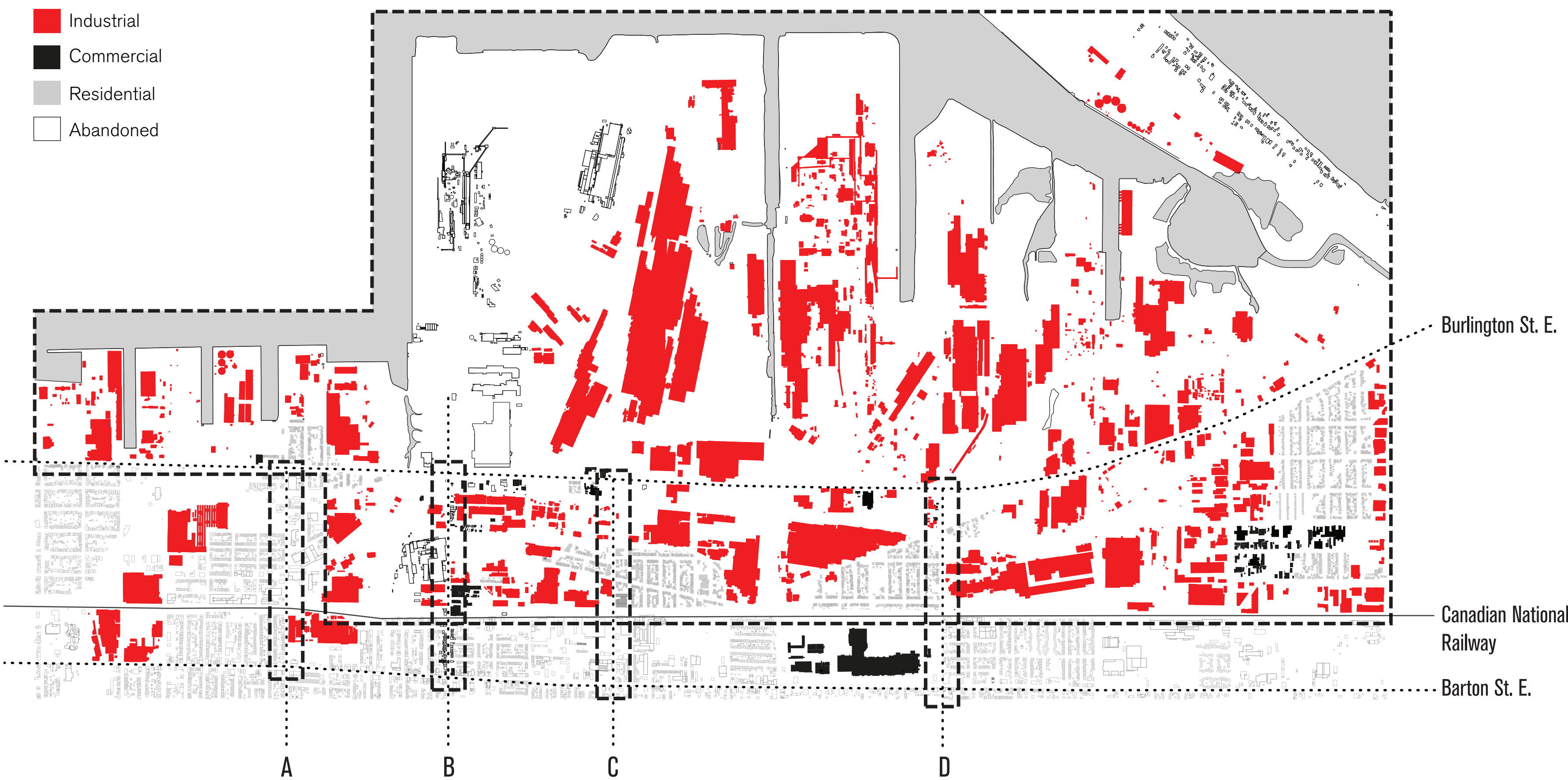


Fig.2.21 The East Hamilton Industrial Lands

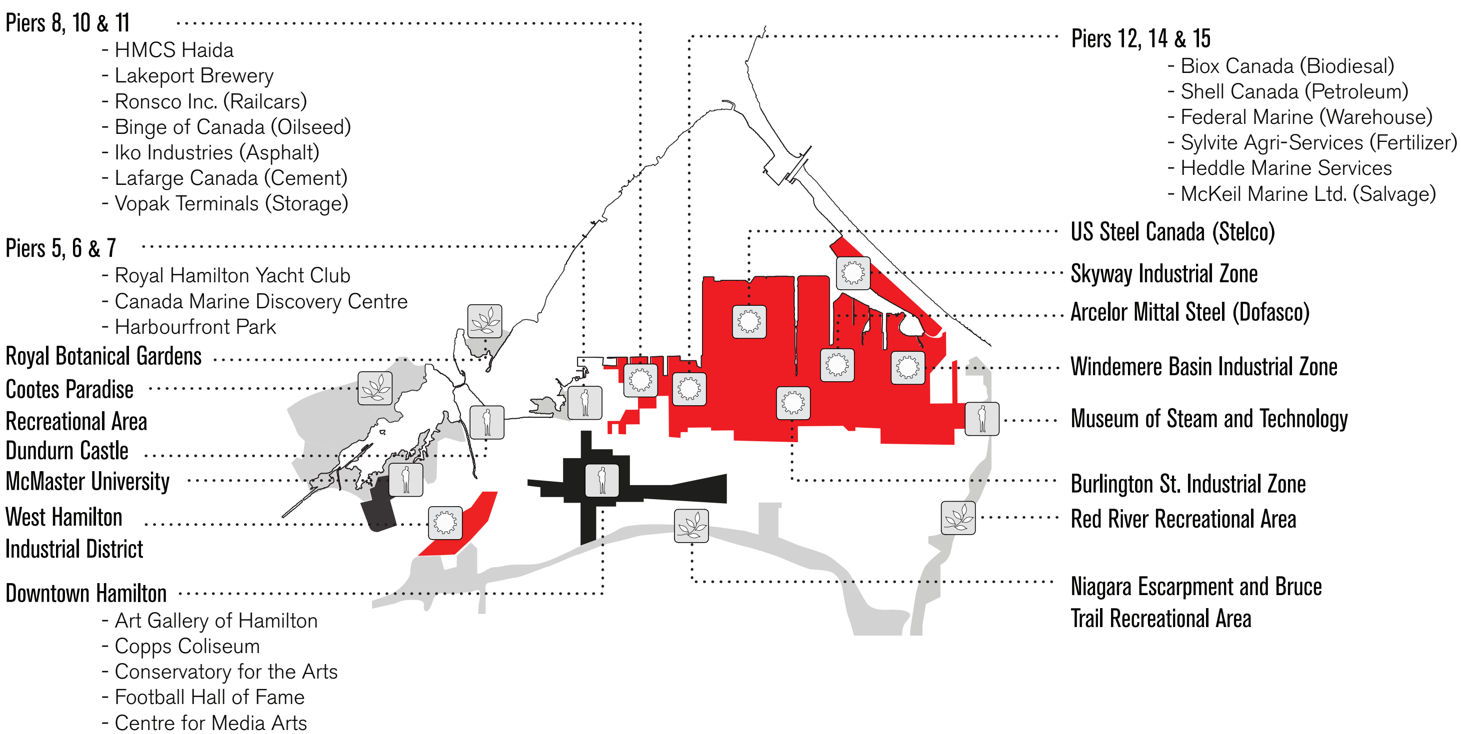
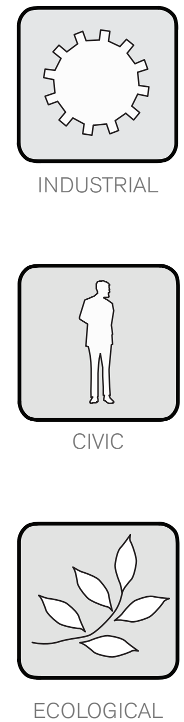


Fig.2.22 Hamilton's key industrial, civic, and ecological areas

City

The wider urban networks of Hamilton fall into three main categories: Industrial, Civic, and Ecological. Having looked in detail at the main components of the industrial sector, the infrastructures that link – but largely segregate – it from the rest of the city are here mapped out.

The Industrial Lands maintain an insular system of infrastructures that largely bypass the city and render it even more of a self-sustaining entity. Concentrated in the downtown core, civic and cultural networks are expanding, while the city's ecological and recreational areas exist largely on the urban periphery. Complimentary systems exist for both public and industrial networks and remain as separate entities - built up areas, roads, rail, and even the harbour are divided. Currently, there are no hybrid systems that attempt to mediate between the two sides.



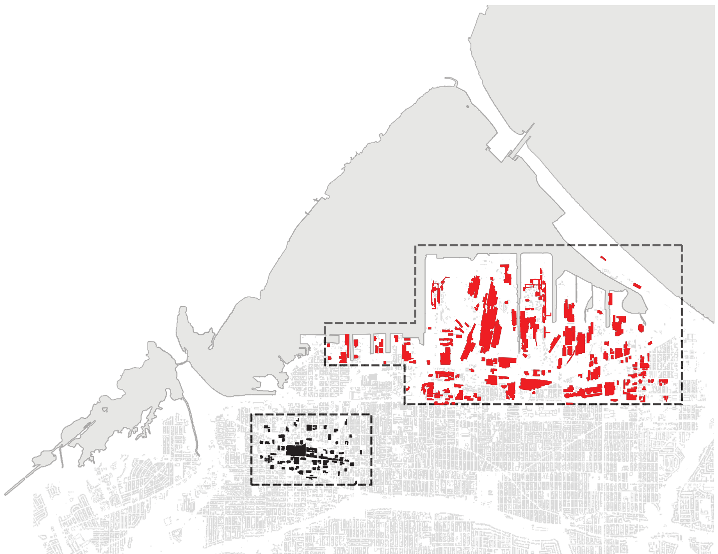


Fig.2.24 Two morphologies - the Industrial Lands vs. Downtown Hamilton

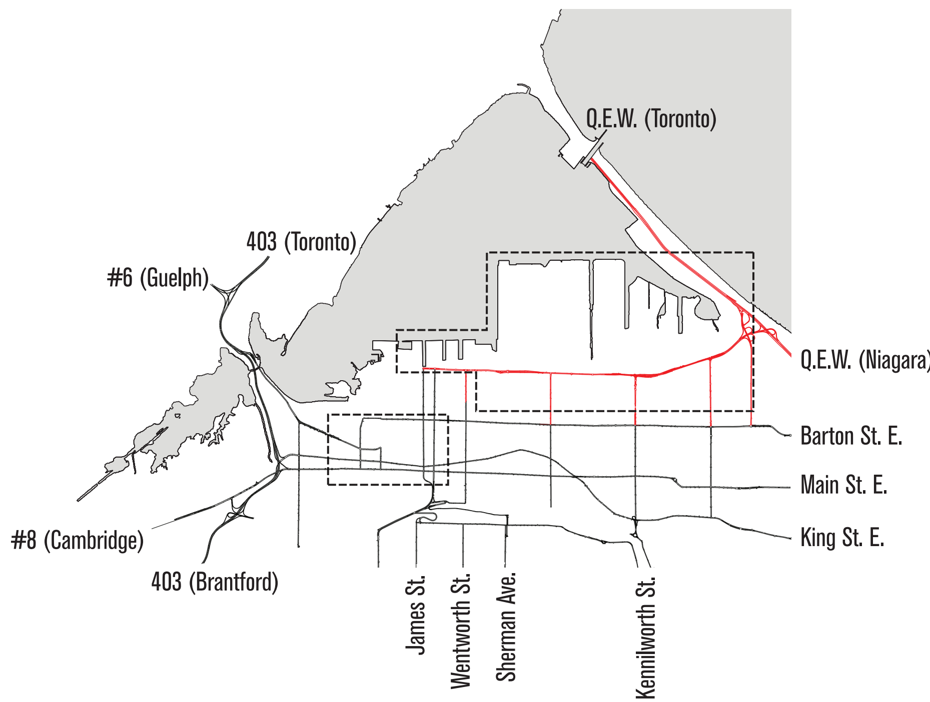


Fig.2.25 Hamilton's main roads and expressways

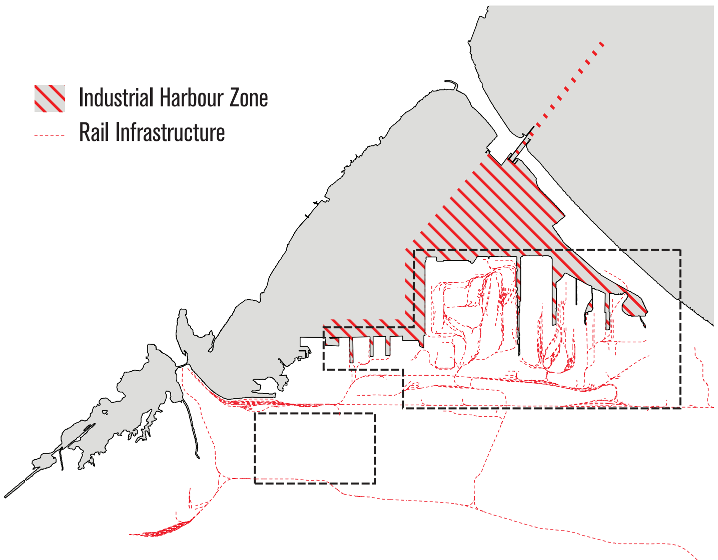


Fig.2.26 Industrial infrastructures

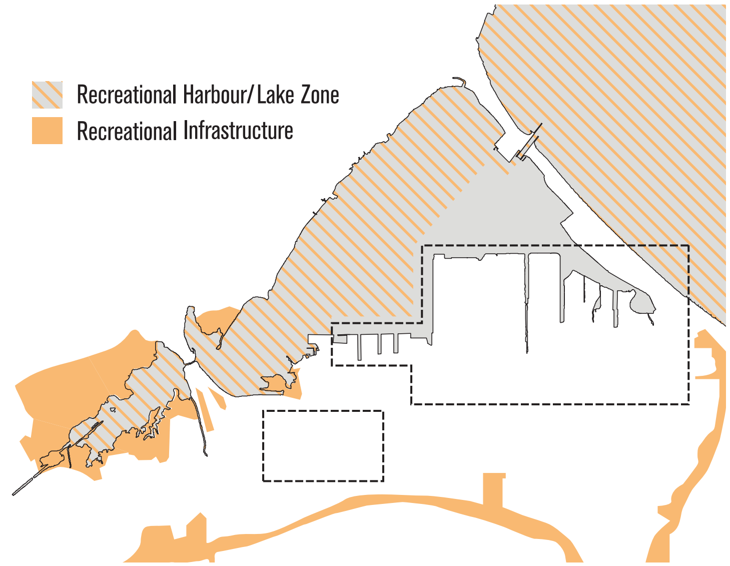


Fig.2.27 Recreational infrastructures

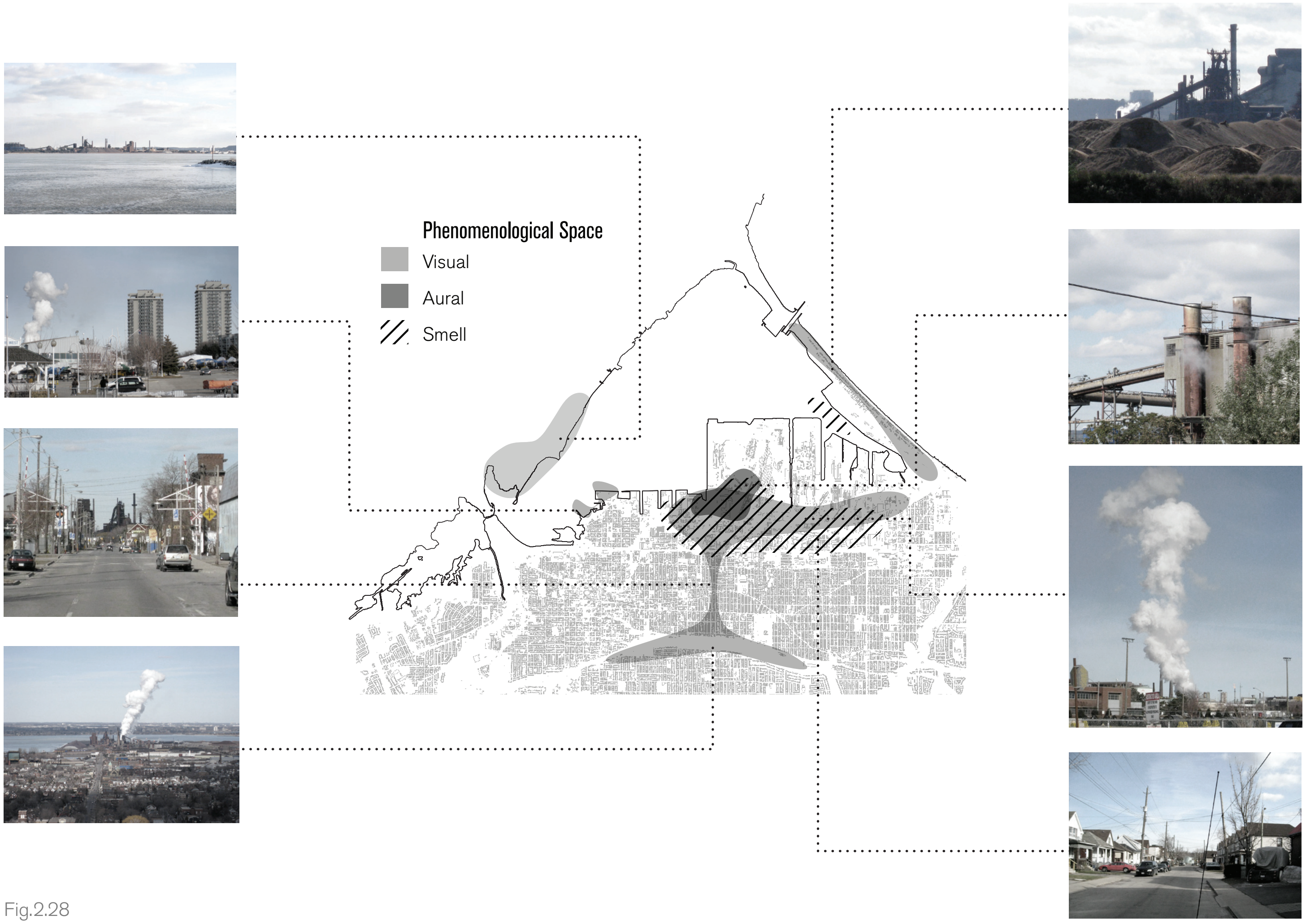


Fig.2.28

The one system that acts as an overall urban armature, linking both sides geographically as well as experientially, is the rendering of the site's processes at a phenomenological level.

During my numerous visits to the site and its vicinity, I experienced these sensations firsthand. In the area of the Industrial Lands, smoke and steam could almost constantly be seen rising from the site, and in the area immediately north of Burlington St., it could be heard rumbling. In the residential areas to the east of the site, noxious odours were at times overwhelming and even began to induce headaches. These smells were even noticeable on the water, notably at the canal separating Stelco from Dofasco. Visually, the site maintains a presence far and wide across the city, from the top of the Escarpment to the far shore of Burlington to the speeding lanes of the QEW.

With the processes of the site now obsolete, an important presence and spatial armature within the city has been lost. The smoke and steam released during the steel-making process remind the city of its industrious roots. Through the proposition of a reconfigured steel industry on the site, this connection might be reinstated and the blast furnace may again serve as the city's hearth.

2.2 Recoverable

In most current industrial operations, any excess energy created during production is re-ingested in an attempt to improve operational efficiency, or due to economics merely left to dissipate. While we have seen that the impacts of that energy flow have a profound impact on the city, the latent potential within the idled ruin offers the opportunity to recalibrate that energy source and redirect its flow for more sustainable industries and larger civic and ecological purposes. The energy used, stored, and recovered in the creation of a new hybrid process will promote Hamilton's growth in a new direction.

Having seen the architectural, infrastructural, phenomenological, and ecological conditions of the existing Stelco site, the energy latent within these systems may be used as a basis to inform its future. The process of steel manufacturing is clearly central to both the site and Hamilton as a whole, but as we have seen that process has run into problems economically, socially, and environmentally. The following diagrams break down the steel manufacturing process and explore where changes can be made to the existing system in order to consolidate spatial requirements and improve environmental conditions – both integral to the new system and lingering from the old. The recoverable energy inherent in this new process will be used as the basis for launching a hybrid industry that directly addresses those lingering environmental conditions and begins the task of remediating the site as a public process.

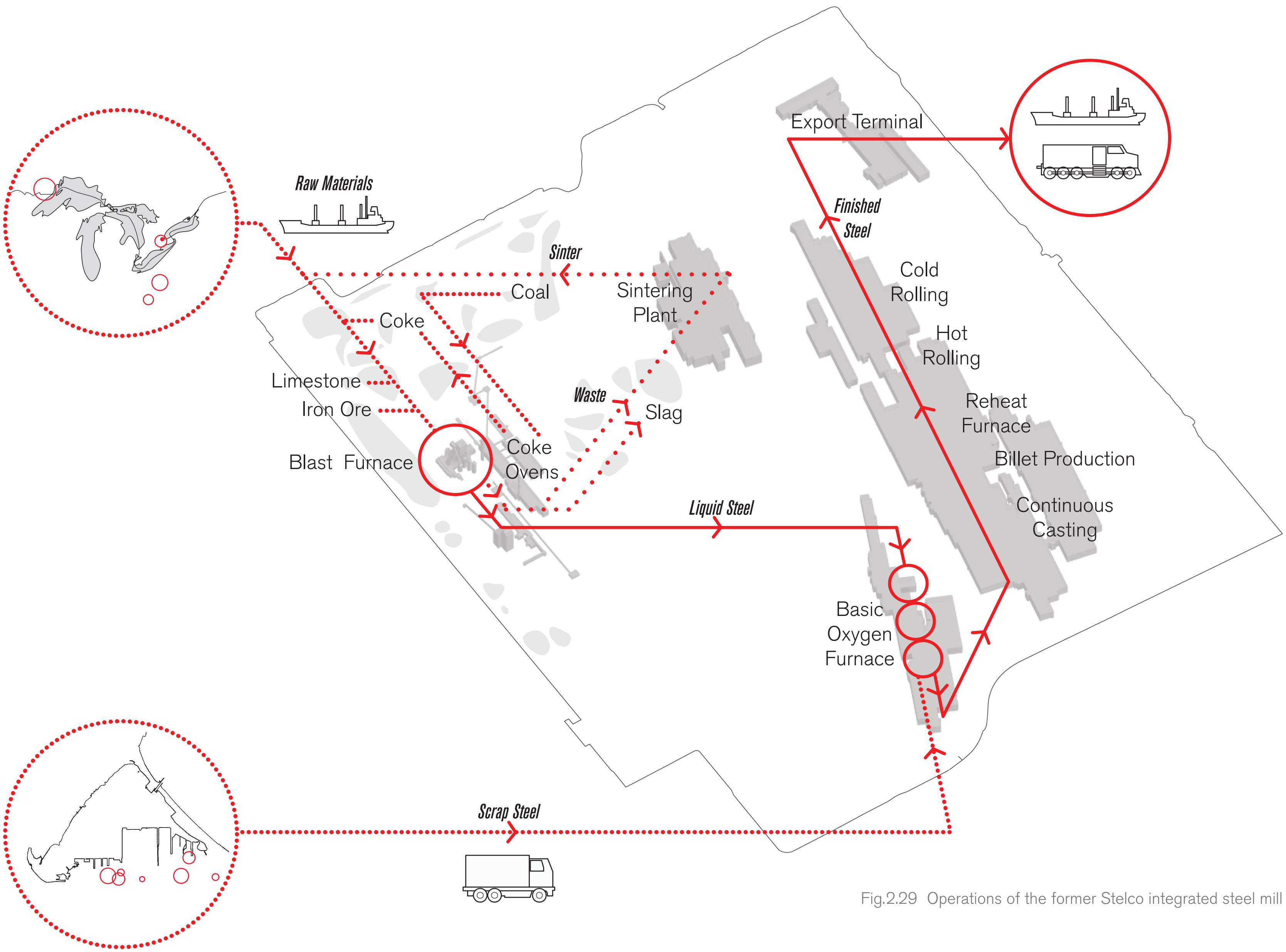
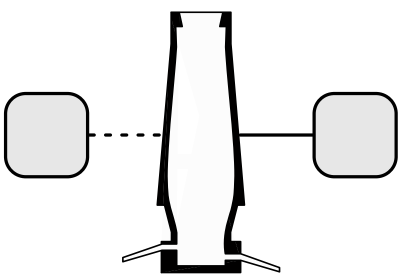


Fig.2.29 Operations of the former Stelco integrated steel mill

The Integrated Steel Mill

An integrated steel mill processes raw materials into finished steel suitable to be worked into consumer products. Until 2009, Stelco was a fully operational integrated manufacturer that employed 2,200 people and produced 2,000,000 tons of semi-finished steel annually[6]. An integrated mill produces molten iron by melting a mixture of iron ore, coke, limestone, and other fluxes in a blast furnace at temperatures of 1,450 C. The blast furnace is a large source of pollution, especially from the use of coke; off-gases are captured and treated to remove harmful contaminants and particles, but many are still released into the environment as described in Section 2.1. After molten iron is produced, it is further refined in a basic oxygen furnace (BOF), where 99% pure oxygen is injected to lower the mixture's carbon content and thereby increase it's strength; the existing mill contains three such vessels at 150-tons each. From here the liquid steel is cast into billets or bars and then hot rolled into sheets, pickled to remove impurities, and cold rolled to reduce thickness and improve tensile strength. The steel is then galvanized and destined for application in the automotive, construction, pipe/tube, and manufacturing sectors[7]. The large scale at which an integrated steel mill operates necessitates a similar scale of infrastructure: road, rail, and shipping networks are all indispensable on both site and regional levels; vast tracts of land are required for the storage of raw materials; extremely large and long buildings are required for processing and refining; and the mill requires a separate network of industries in it's vicinity to both provide tertiary services and utilize it's byproducts (slag, for example, is recycled and used as aggregate in concrete and asphalt).

As of March 2010, one year after the entire mill was shuttered indefinitely, the Stelco site has resumed some production. The blast furnace, coke ovens, BOF's, and associated infrastructures remain obsolete, while semi-finished steel is processed at a reduced scale of production. The processing and refining operations therefore will remain as is, while the focus of reoccupation will be the front end of the process; that is, the production of liquid steel and its processing into semi-finished billets.



Blast Furnace

Fig.2.30

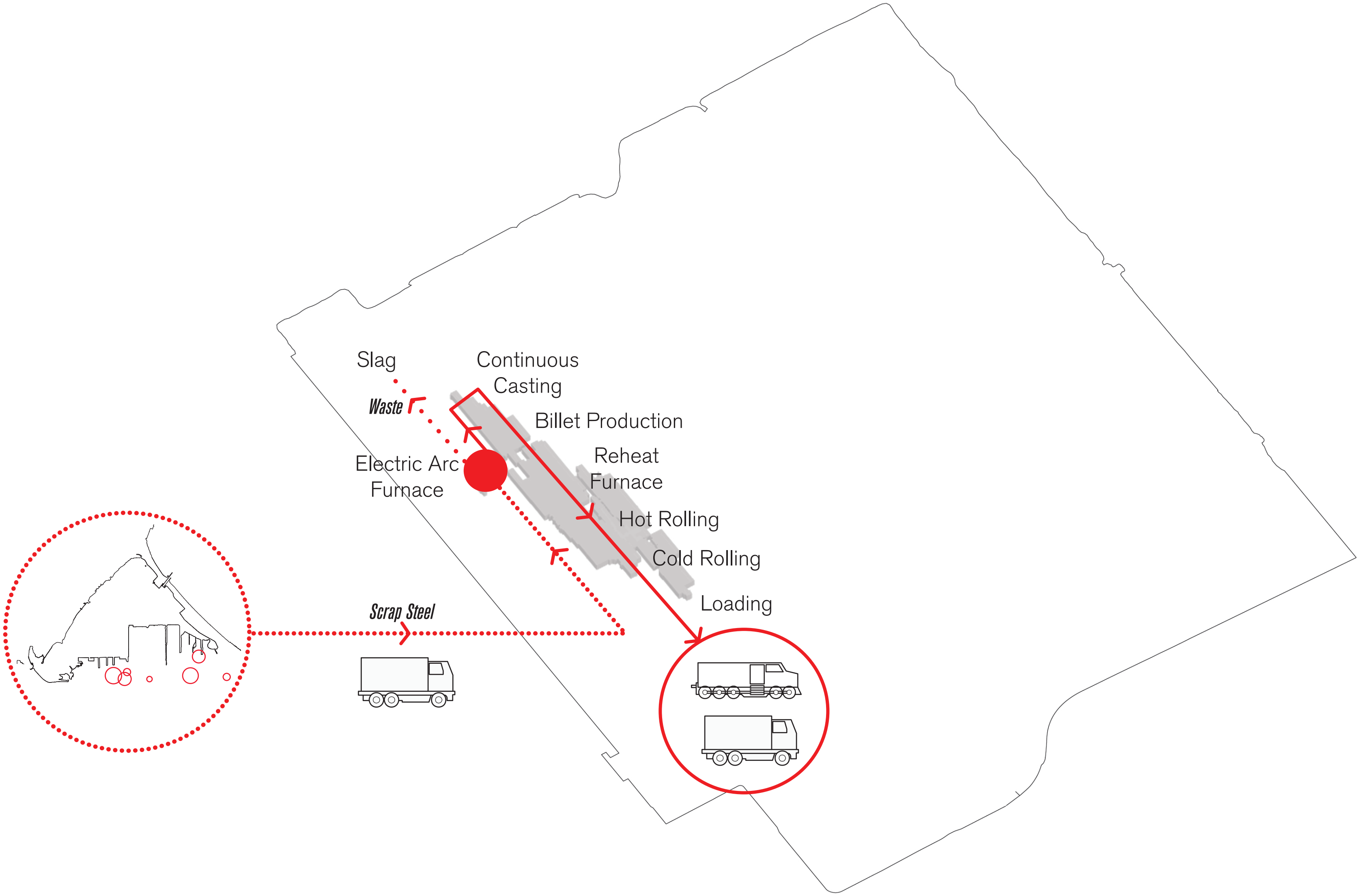


Fig.2.31 Operations of a typical steel mini mill, and their relative scale on the site

The Mini Mill

The other way to produce steel is through what is known as a mini mill, which is typically much smaller than an integrated steel mill. The main difference between the two is the source of raw material, and the type of furnace through which it is processed. An electric arc furnace (EAF) that uses an electric charge to melt scrap steel replaces the blast furnace, associated raw materials, and basic oxygen furnace of the integrated manufacturer. The mini mill imports scrap steel from a scrap yard, typically by truck, to charge the furnace. The main benefits of an EAF are the fact that it uses 100% recycled material – which greatly decreases raw material consumption, transportation, and storage – and its operational flexibility. While blast furnaces cannot vary their production levels and are never stopped, EAF's can be rapidly started and stopped, allowing the steel mill to vary production according to demand[8]. The downside of an EAF is the dust and gas produced during melting. The dust, containing lead, cadmium, chromium, and nickel, is classified as a hazardous waste and therefore must be captured and treated. Large quantities of carbon monoxide (CO) gas are also produced as carbon (C) is released from the scrap during melting. Oxygen is injected into the furnace to combust this CO into carbon dioxide (CO2), which produces three times as much heat as the combustion of C to CO. This allows significantly more heat in the off-gas to be recovered, increasing efficiency[9]. Since the production level of a mini mill is typically a fraction of an integrated mill, overall pollution is significantly reduced. Compared with producing one ton of steel from virgin materials, the use of recycled scrap creates 86% less air pollution, and 76% less water pollution[10]. There is also a corresponding 60-70% reduction in total energy usage[11]. Along with a reduction in pollution comes a reduction in land requirements, and mini mills are therefore often operated in denser urban settings with minimal impact on their surroundings.

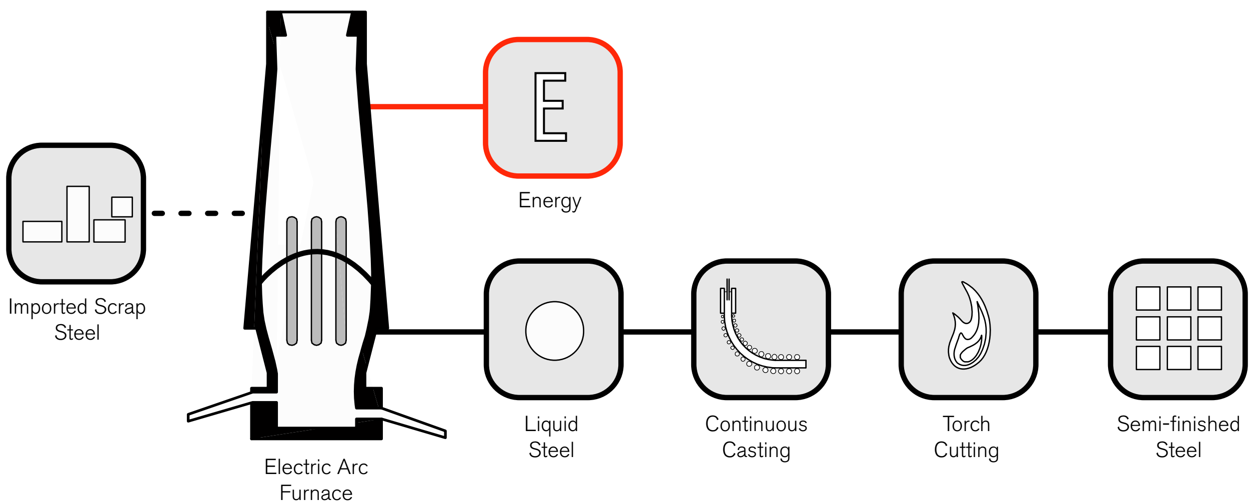


Fig.2.32 Operations of the proposed modified steel mini mill

Reignite: A new 150-ton electric arc furnace will be inserted within the shell of the existing blast furnace to continue producing steel, but in a more efficient and environmentally conscious manner. The flexibility of this mode of fabrication will also allow the mill to tie production to economic demand and therefore not follow the same route as the old Stelco. According to a report published by the United Nations, it takes 3.01 giga joules (GJ) of energy to melt one ton of steel in an EAF, and during that melting 1.35 GJ of energy is produced through exothermic reactions; 0.21 GJ of that energy is feasibly recoverable[12]. With a third the capacity of the original furnaces (at 2,000,000 tons/year), a new EAF operation has the potential to melt 650,000 tons of steel and therefore produce 136,000 GJ of recoverable energy each year. The semi-finished steel billets produced will be further processed in the rolling mills of the remaining Stelco operations.

Fig.2.33 An electric arc furnace melting steel scrap

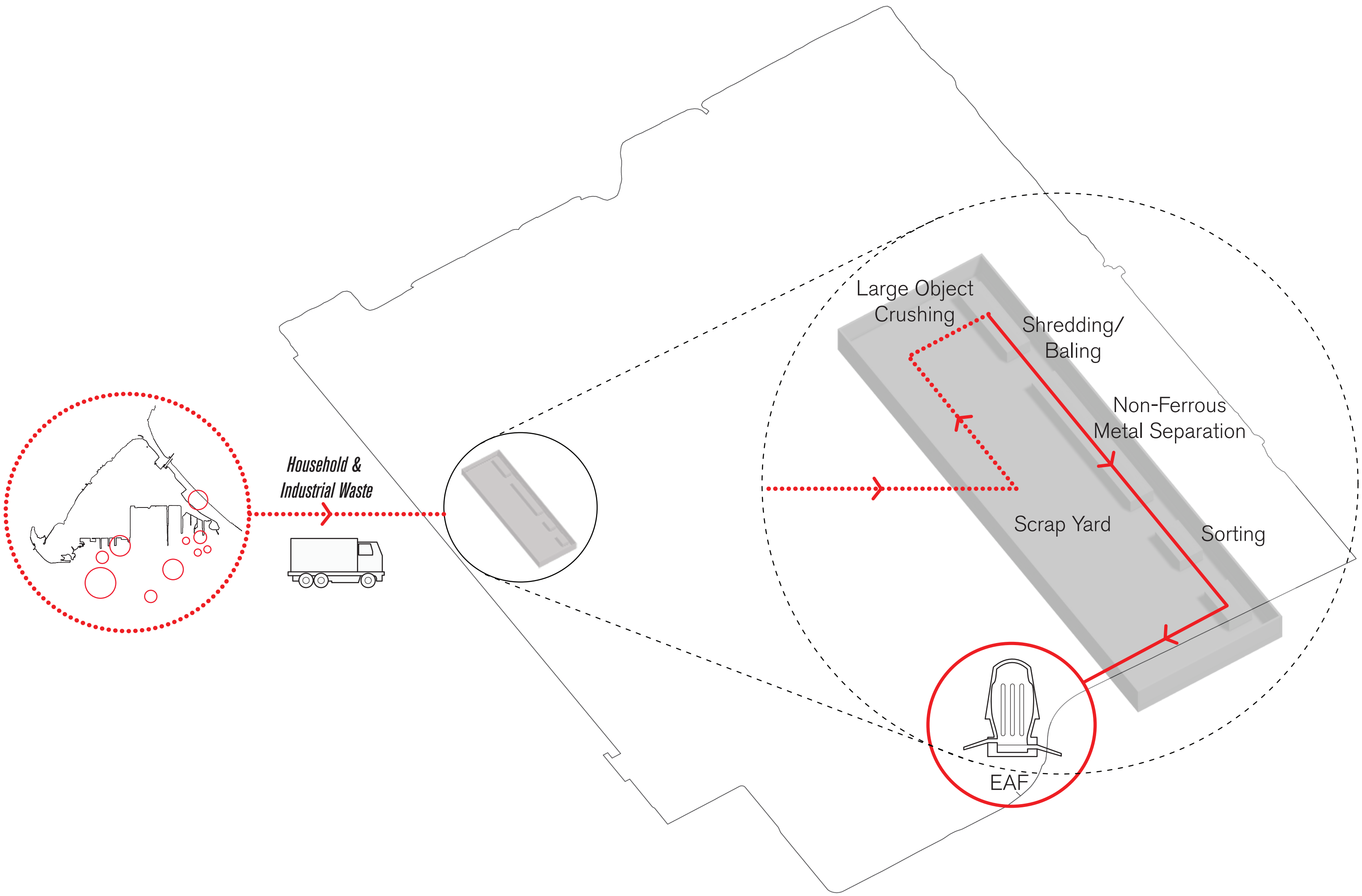


Fig.2.34 Operations of a typical scrap yard, and its relative scale on the site

The Scrap Yard

A scrap yard imports, processes, stores, and eventually exports both ferrous and non-ferrous scrap metal to other industries where it holds tremendous secondary value. The largest users of ferrous (iron) scrap are steel manufacturers. In order to export a quality product, scrap processors must separate valuable ferrous scrap from both non-ferrous metal and hazardous materials contained in what are known as complex consumer products (CCP), of which the automobile is a prime example. Cars contain PCB's, CFC's, oil, solvents, acids, lead, cadmium, asbestos, and within airbags the carcinogen sodium azide. Before stricter environmental laws were enacted in the 1970's, the scrapping of automobiles released these hazards directly into the environment: non-ferrous materials were frequently burned away from ferrous scrap contaminating the air, and the storage and shredding of car bodies released these hazards into the ground and degraded the water table[13]. Today, great care is taken in the disassembly of CCP's, however the relatively slow turnover in a typical scrap yard means these materials are still stored upon the ground for long periods of time and contamination is still a very real concern; citizens groups in California have taken several scrap yards to court over concerns their operations and disposal techniques pollute the local groundwater[14]. In the United States, the Environmental Protection Agency has determined that scrap yards have the potential to contaminate local water sources, and therefore all industrial wastewater must be properly stored and treated before being discarded[15]. Owing to the nature of a scrap yard's less obvious pollution over longer periods of time, they are often located in urban areas, though due to their size often on subprime land in otherwise industrial or outlying areas.

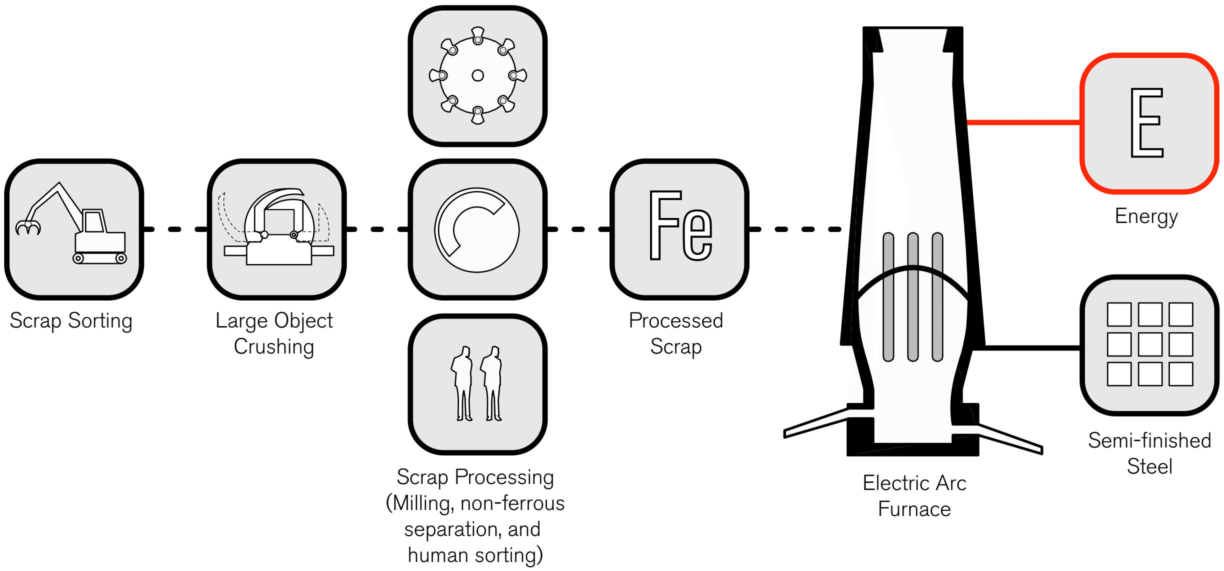


Fig.2.35 Operations of the proposed consolidated scrap yard and mini mill

Consolidate: To fuse the necessary industries in mini mill production, a scrap yard will be built surrounding the reignited blast furnace complex and enclosed within a concrete shell to ensure all contaminants are properly controlled and recycled. A thickened floor slab will act as the container of these contaminants and recyclables. Consolidation will improve traffic flows and free up space in the site's vicinity currently used for scrap to be used for alternate uses.

Fig.2.36 Sorting at a scrap yard

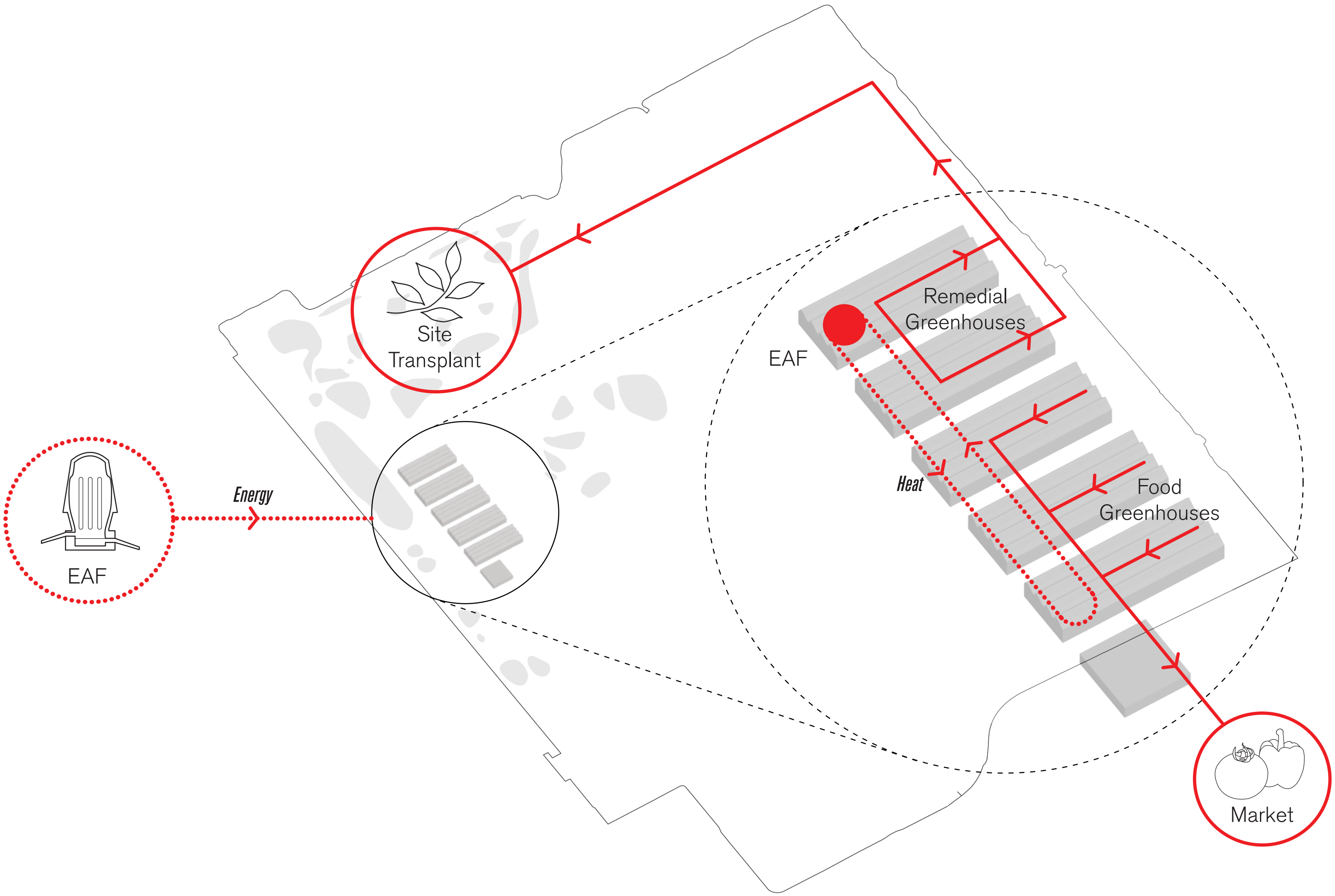


Fig.2.37 Operation of the proposed greenhouses, and their relative scale on the site

The Greenhouse

With the creation of a reorganized steel industry on the site, there exists the opportunity to recover the excess energy that industry produces and use it for another purpose. This recycled energy could be used as the basis for a new industry that focuses on an interaction with the larger civic realm through the remediation of the degraded Stelco landscape. As an industry reliant on heat, greenhouses have an insatiable need for energy and therefore act as prime consumers of the steel process' recoverable energy.

Greenhouses are frequently used to grow plants in the phytoremediation process. Phytoremediation (or bioremediation) utilizes plants to improve the soil and water quality of a degraded site. They are often grown in greenhouses to test different soil and water conditions under controlled conditions, or until they reach maturity. They are then transferred to the degraded site where remediation may begin[16]. Greenhouses thus have the potential to use the energy generated by the new steel industry to remediate some of the damage caused by the old.

The greenhouses can also be used as a source of local food, and support a market that brings people to the site on a regular basis to obtain fresh produce. Ontario leads all of North Americcan in greenhouse vegetable production, with more than 1,820 acres devoted to its main crops of tomatoes, cucumbers, and peppers. Crops are typically grown in hydroponics – meaning nutrient rich water instead of soil – and use integrated pest management instead of pesticides to produce a more organic crop. Greenhouse growth protects the crops from harmful UV, run-off, and acid rain[17]. In this case it will also protect them from the toxicity of the surrounding landscape. Their central heating systems use water as the heat transfer medium, which is circulated through heating lines either as hot water or steam. In high latitudes, in which Ontario lies, an east-west orientation is best for optimal use of the low winter sun and maximum passive heat gain[18].

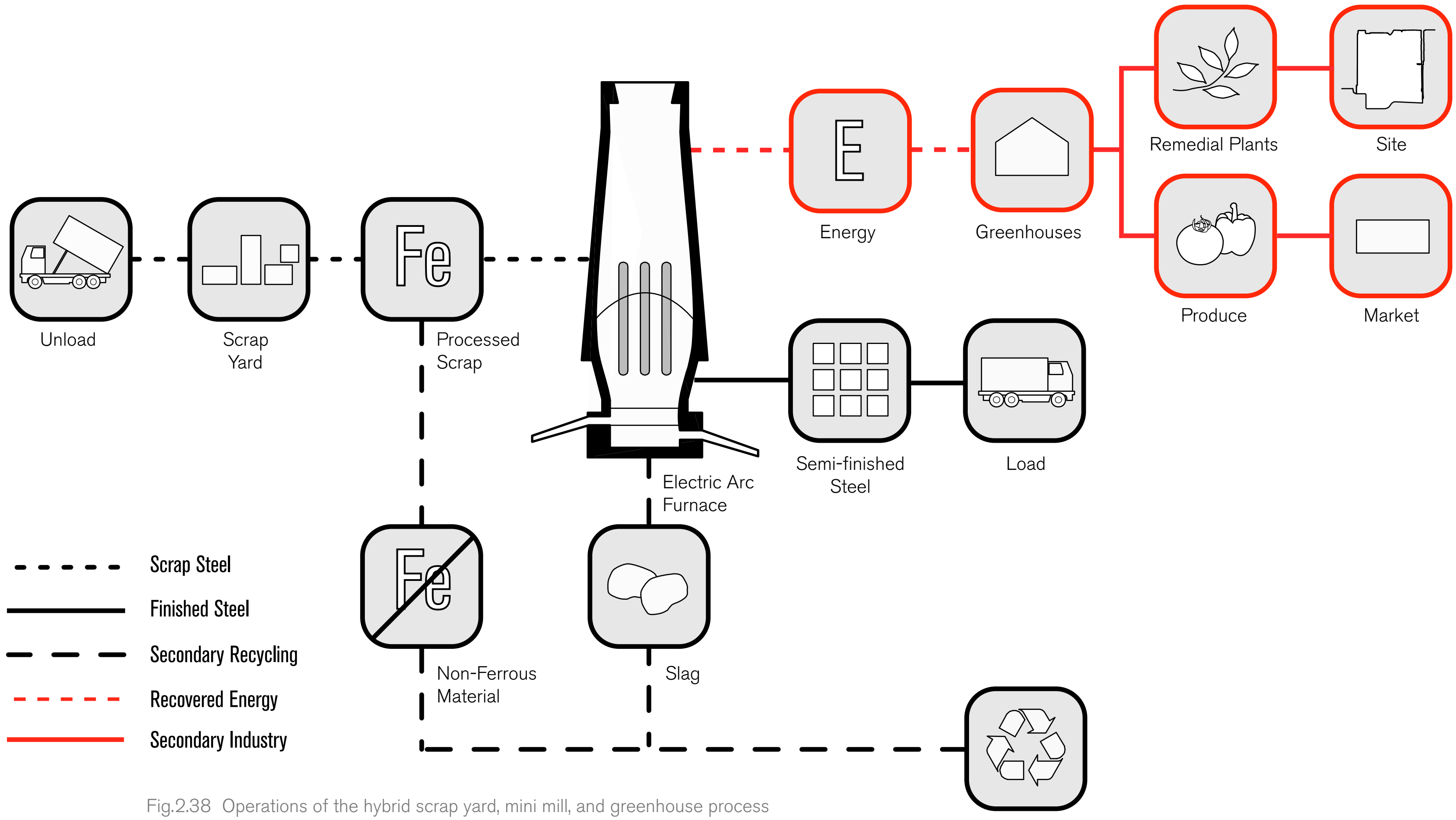


Fig.2.38 Operations of the hybrid scrap yard, mini mill, and greenhouse process

Hybridize: The energy latent in the steel making process is to be recovered as heat through water circulated around the EAF and used to fuel a new industry of greenhouses that will grow both food and plants to be used in the remediation of the larger site. According to an energy survey conducted by the Ontario Greenhouse Alliance, the average greenhouse requires 1.82 GJ of energy per m2 of area each year[19]. Having estimated the steel facility to produce 136,000 GJ/year, it is possible to provide the necessary energy to heat approximately 75,000 m2 of greenhouses. The interconnectivity of the two processes means that an increase in one necessitates an increase in the other, ie. more steel must be melted to heat more greenhouse area.

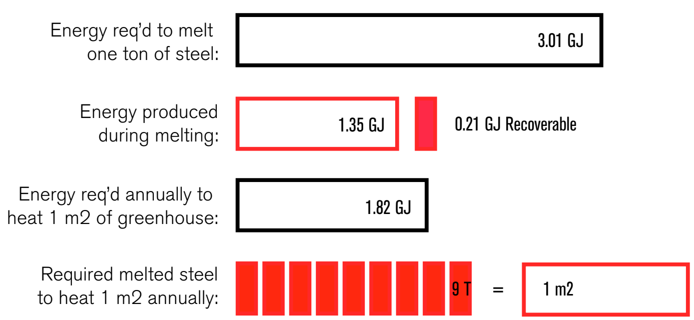


Fig.2.39 Diagram illustrating the relative amount of steel melting, by weight, to greenhouse energy requirements

Fig.2.40 A commercial scale greenhouse facility

Fig.2.41 The top of the greenhouses peak over the urban clutter and make their presence known on Sherman Ave.

The Hamilton Steel and Landscape Reclamation Facility

As a hybrid building type, the new facility seeks to bring together various players in the local steel industry with civic interests. Stelco, as US Steel Canada, will grant access to the western half of its property, including the obsolete blast furnace complex, to the city of Hamilton in exchange for tax incentives to aid its ongoing internal restructuring. The company will partner with existing steel scrap and processing operations in the vicinity (outlined in 2.1) to create a consolidated steel mini mill that will produce unfinished steel to be further processed in Stelco's remaining operations on the eastern portion of the site. The knowledge brought together by large and small-scale steel operations, coupled with a more efficient facility, will breathe new life into a stalled industry and open up tracts of land that could be used for other new or hybrid industries. The greenhouses will be operated in conjunction with the city, McMaster University, and the Royal Botanical Gardens to maximize public and private benefit.

The new reclamation facility will have two main aims. First, to continue the tradition of steel working in the city using a recalibrated process, and second, to use that process as the starting point to remediate the site both physically and socially with the wider city. Conceived as a concrete shell sunk into the ground, the facility will stand in contrast to its surroundings both materially and temporally. As the building ages, the concrete will register the passage of time quite differently than the existing rust of the blast furnace. Providing alternating spaces of light and dark, the delicate glass structure of the greenhouses hover over the sunken scrap yard below. As they rise in height towards the blast furnace, more space is created below for the storage of steel scrap. As more scrap is melted and more energy recovered, the greenhouses begin to extend in phases from above the scrap yard directly onto the landscape. With their variation in height, different species of plants and trees can be cultivated for transplantation to the site, illustrated later in Section 2.3 of the thesis.

The reclamation facility will allow Sherman Ave. to bring the public directly into the site, while Gage Ave. will be extended for truck traffic carrying scrap to and from the facility. The two converge infront of the building to facilitate the transport of household scrap to the facility by its owners so that they may participate in the processes of the site. A public route wraps around the entire facility, passing through the greenhouses and hovering over the scrapyard and steel processing areas.

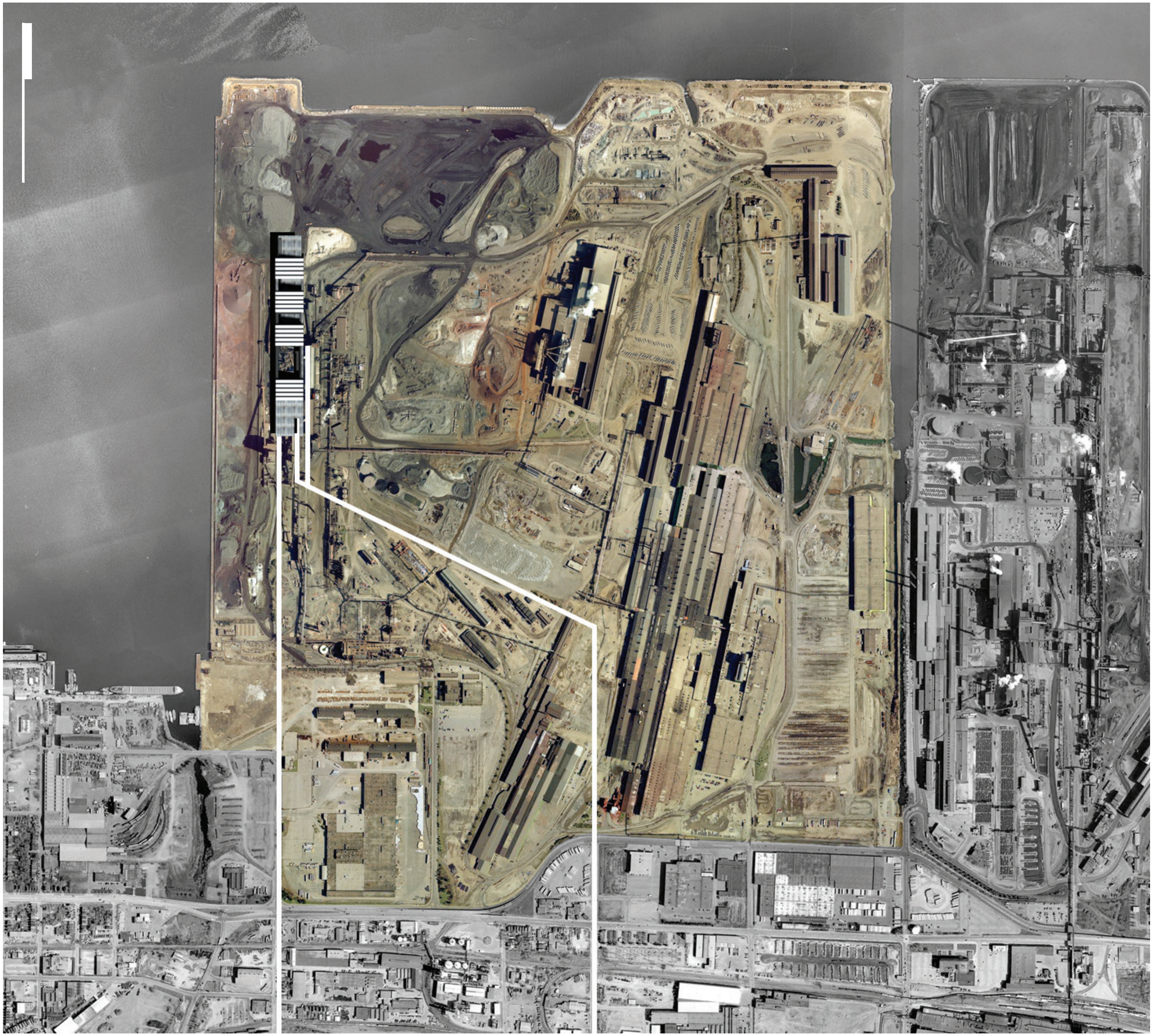


Fig.2.42 Site plan and extension of Sherman and Gage Avenues

Phase One (2010)

The initial construction will sit the new building amongst the ruins of the existing blast furnace complex. Reignited, the furnace will serve as the anchor, both visually and functionally, of the new building.

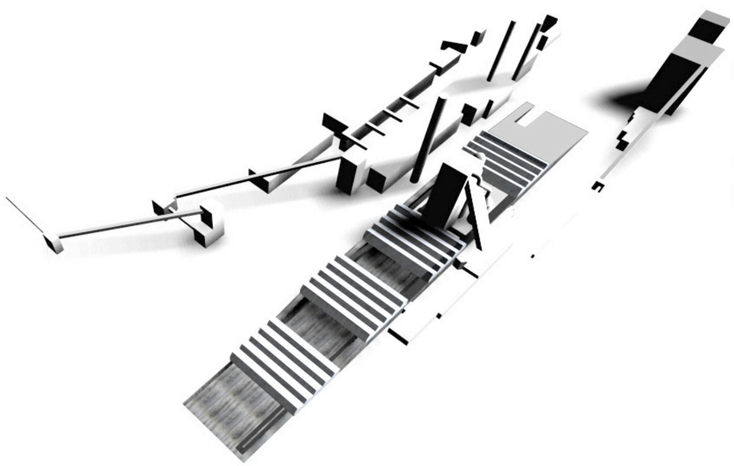


Fig.2.43

Phase Two (2010-2015)

The first phase of remedation will begin to occur as the greenhouses extend from above the scrap yard onto the landscape and test and harvest bioremedial plants suitable to the unique conditions of the site, here formerly used to store iron ore. For the purposes of this thesis section, all drawings illustrate Phase Two of the proposal.

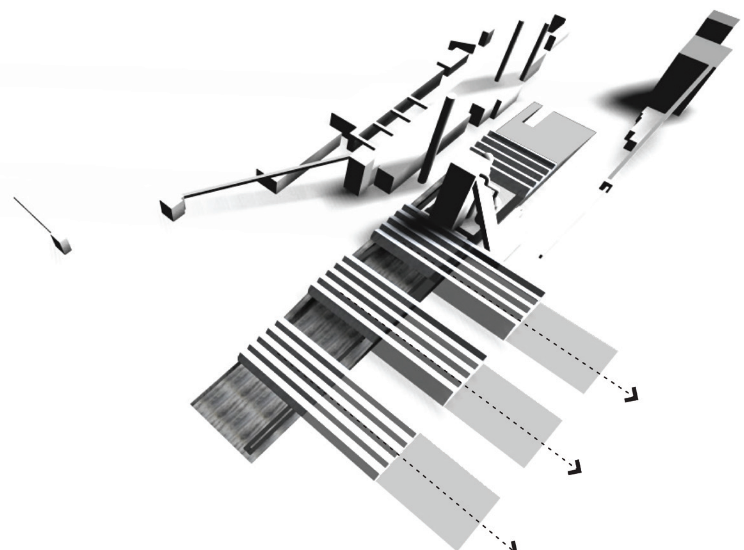


Fig.2.44

Phase Three (2015-2035)

As entropy begins to claim some of the ruined Stelco buildings, the reclamation facility can increase production and therefore increase greenhouse area. This phase will extend in the other direction to the large central portion of the site formerly used to store slag and coke.

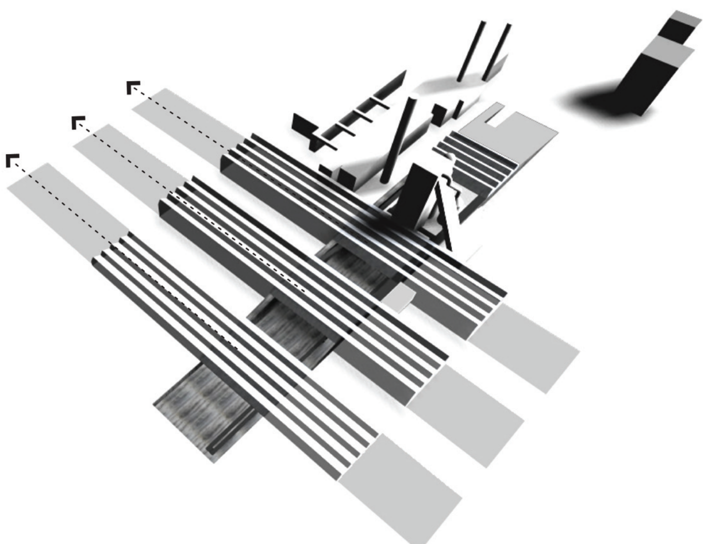


Fig.2.45

Phase Four (2035-2065)

The final extension will push towards the most polluted area of the site, where coal has been stored for decades. With the greenhouses operating at full capacity, the entire site can be targeted for remediation.

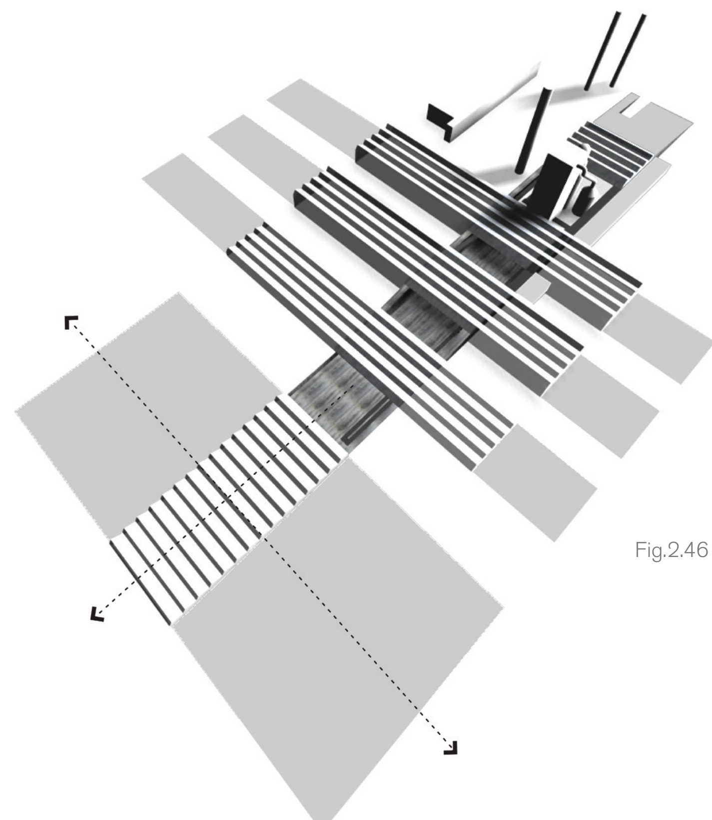
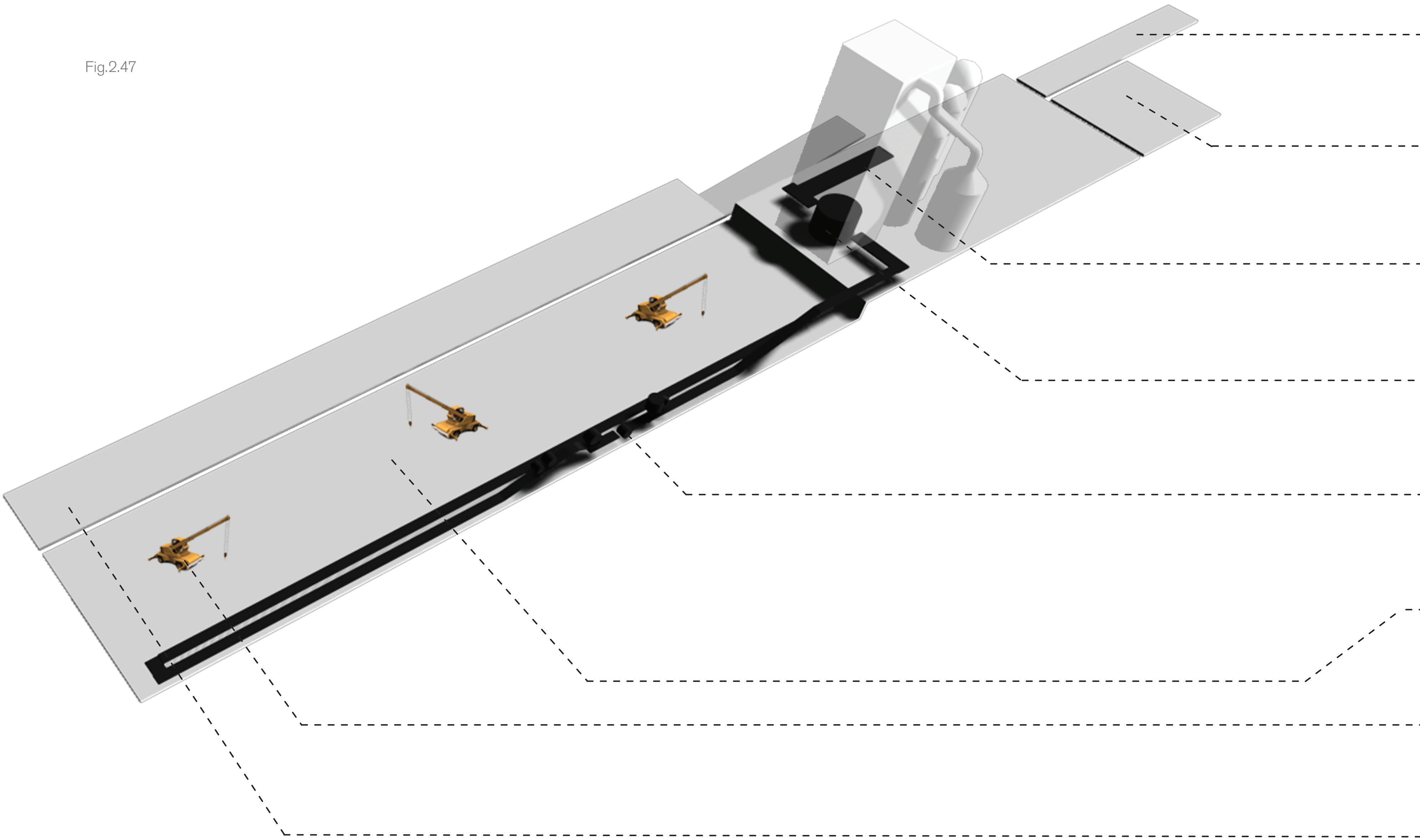


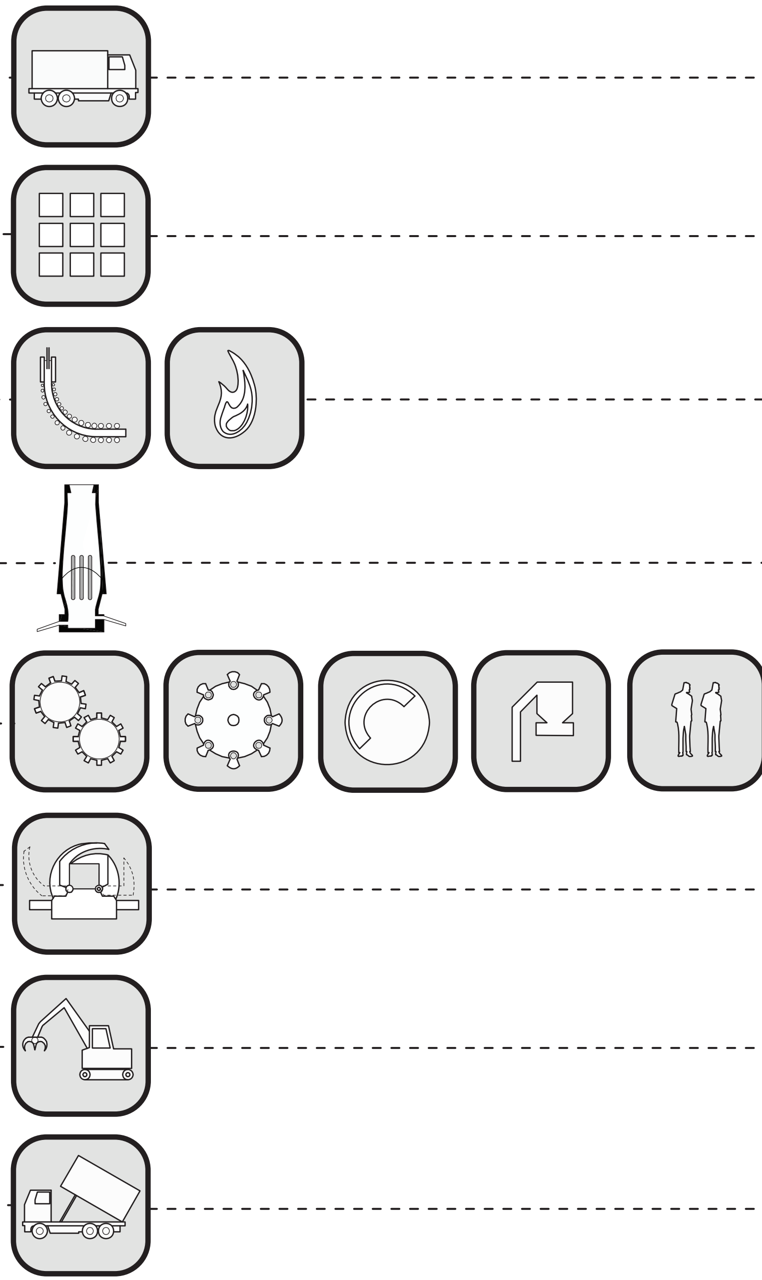
Fig.2.46

Steel Reclamation

Fig.2.47



Processes	Description
	The billets are loaded onto trucks and taken to steel mills where they are processed into finished steel products
	Billets are taken to a storage area to be inspected for quality
	The liquid steel is fed into a continuous caster which creates square sections of semi-finished steel that is torch cut into billets
	Scrap is fed into the EAF where it is melted into liquid steel
	Sorted scrap is put onto a conveyor belt that leads it through the sorting process: rolling and hammer mills shred the scrap into fist-size pieces which are then separated from non-ferrous material by way of magnets and vacuums before being looked over in person at a final sorting line
	Large objects (vehicles for example) are crushed into cubes to enable easier handling
	The scrap is sorted into large, complex, industrial, household, etc categories and stored in the appropriate area of the scrapyard
	Unprocessed scrap is brought by truck or car to the site and taken 7m below grade to the sorting area



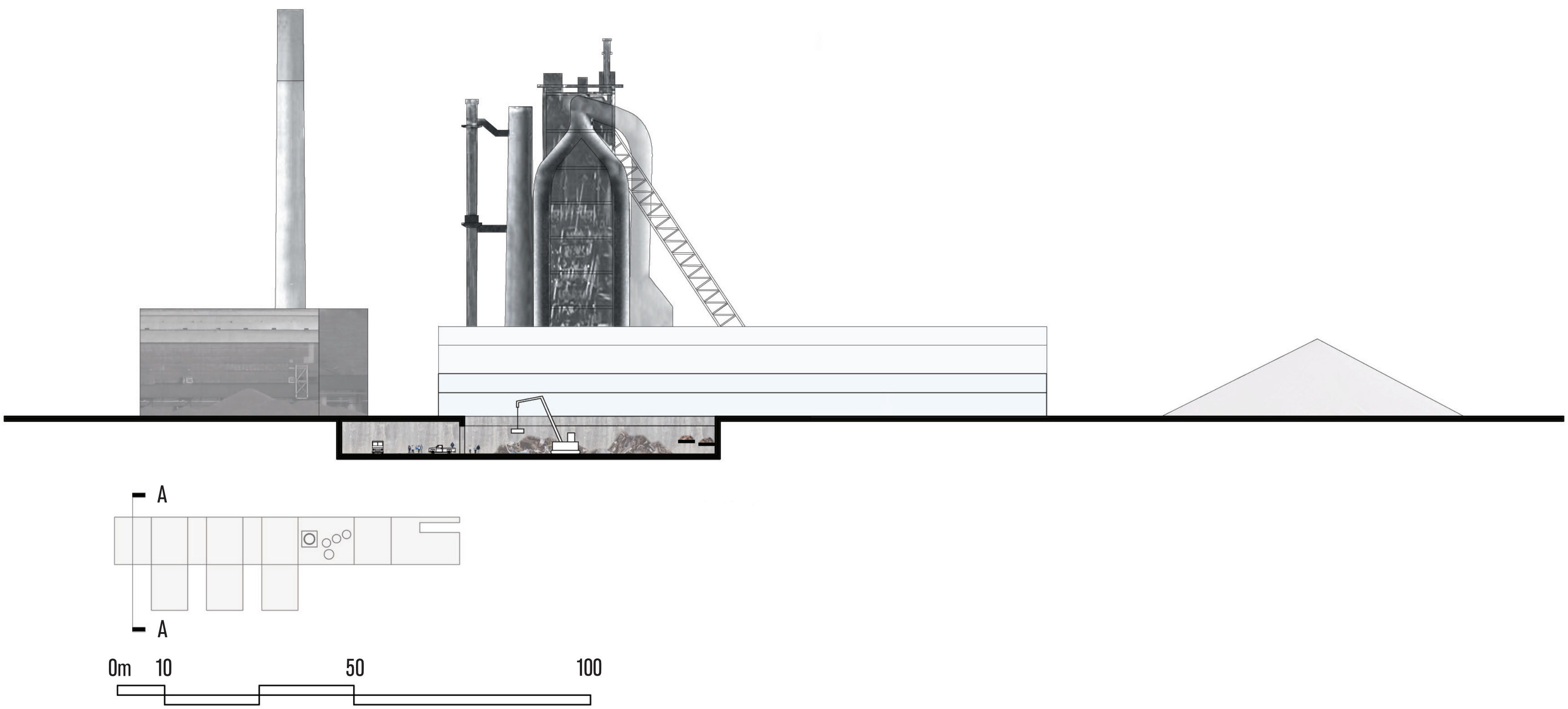
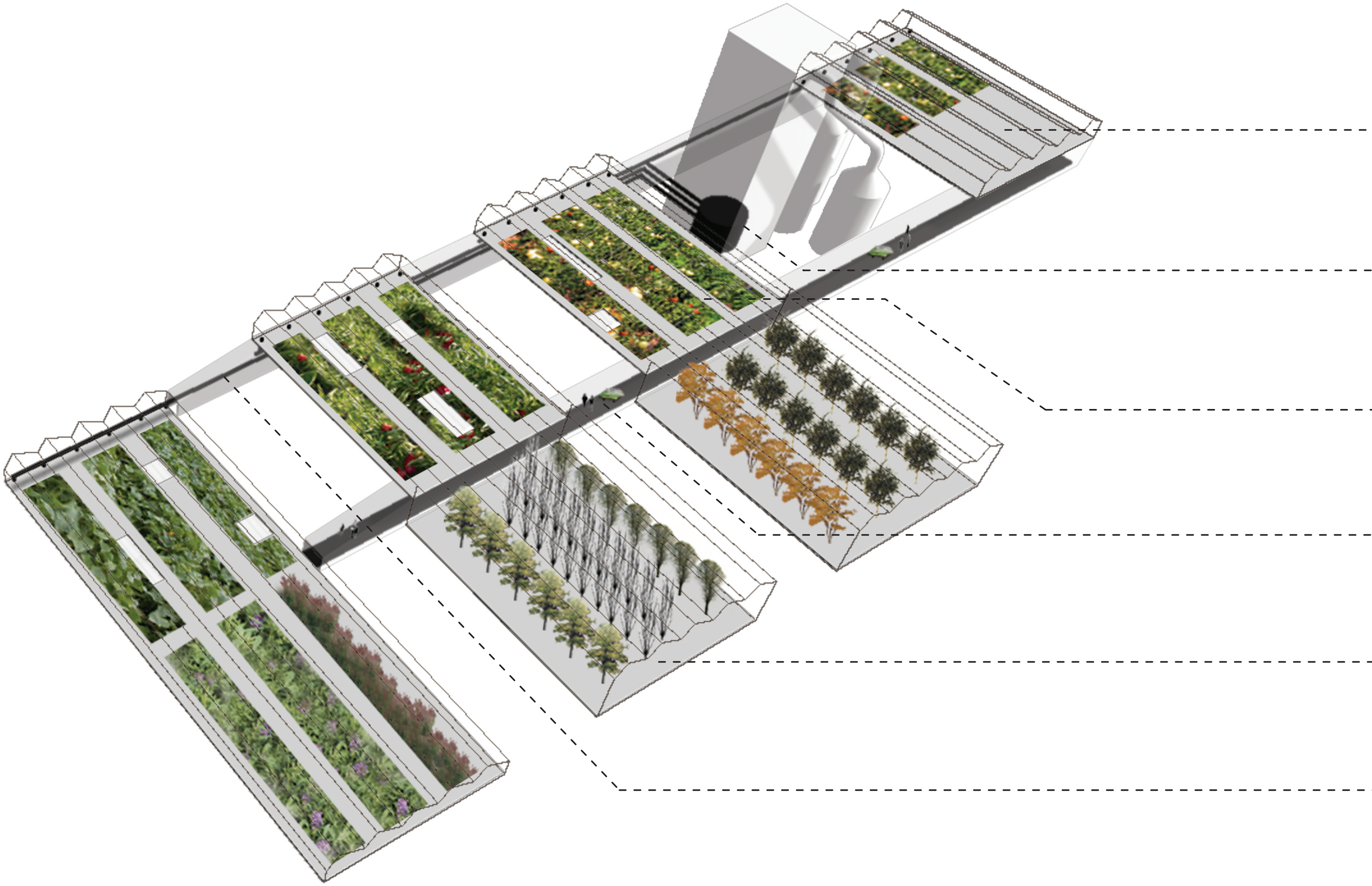


Fig.2.48 Section AA through scrap yard

Fig.2.49 A view within the scrap yard looking north towards the greenhouses which pass overhead

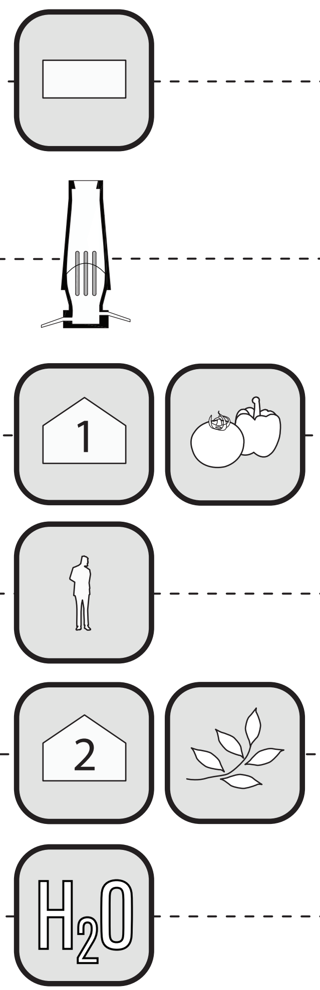
Landscape Reclamation

Fig.2.50



Processes

Description



A market serves as the destination point for produce grown in the greenhouses

The energy generated by the scrap melting process is collected as heat by pipes that encircle the EAF

The lower height greenhouses grow produce that is sold in a public market at the entrance to the building

The walls of the scrapyard contain a circulation route that links the greenhouses with each other and with the market

The extended greenhouses grow plants of varying heights that are used in the remediation of the site

The other side of the scrapyard wall contains the pipes that circulate water between the EAF and the greenhouses

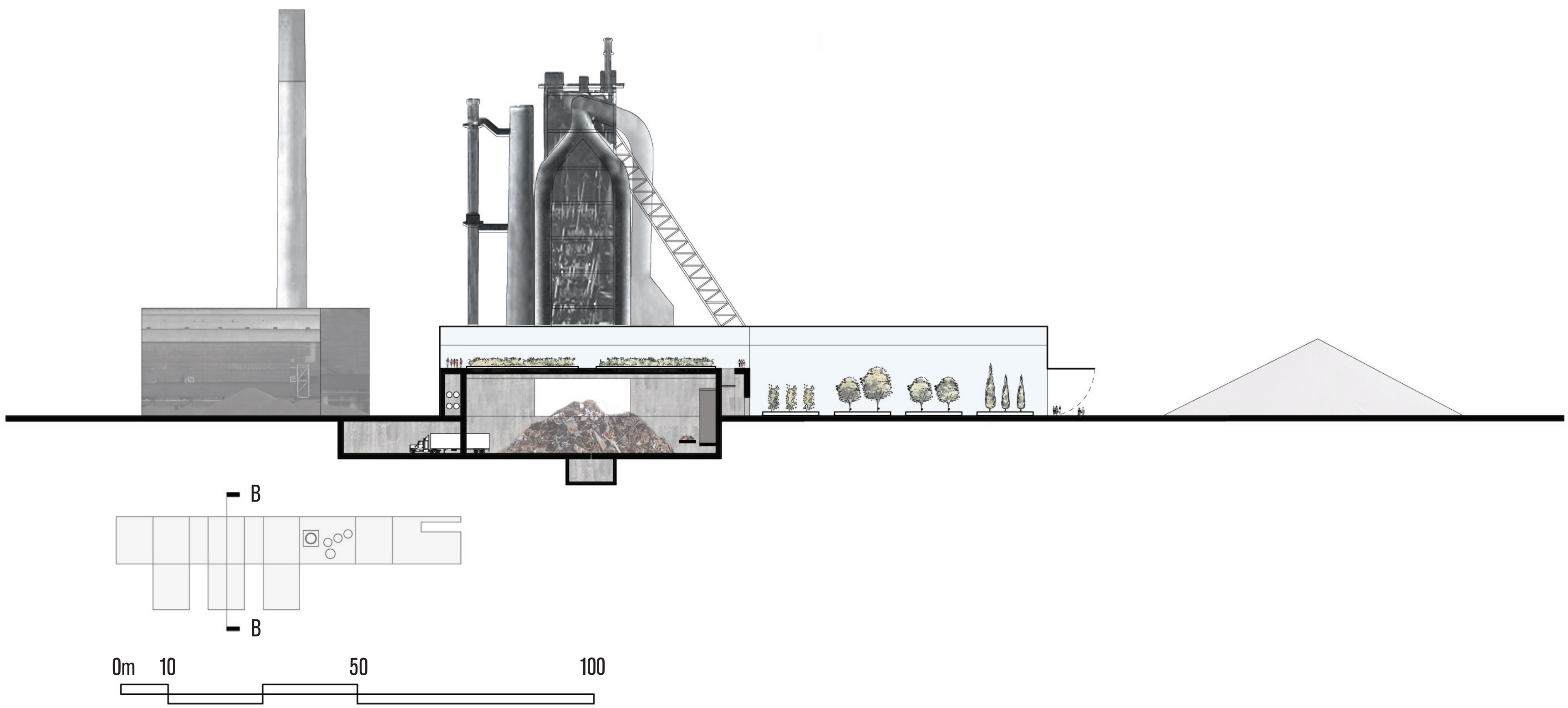
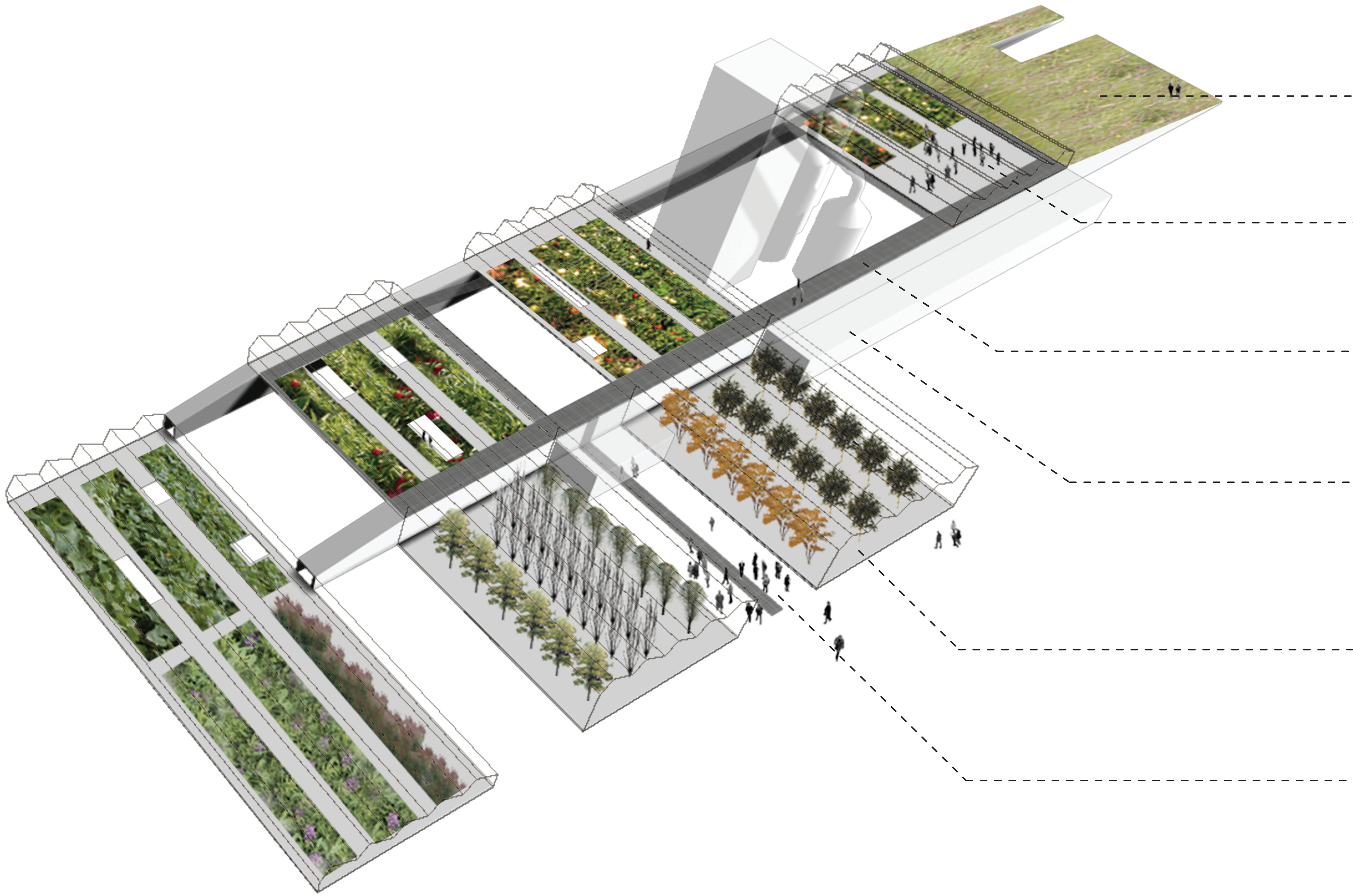


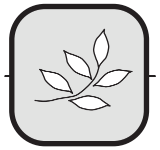
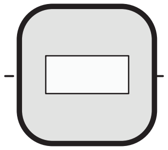
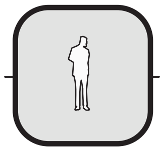
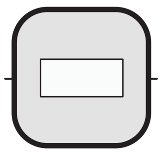
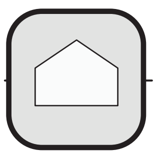
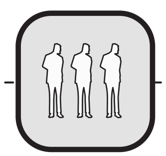
Fig.2.51 Section BB through scrap yard and greenhouse


Fig.2.52 A view from within a food-producing greenhouse adjacent to the blast furnace

Civic Reclamation

Fig.2.53



Processes	Description
	The public entrance to the building is planted with species that will eventually be used in the remediation of the site
	The market serves as a public incentive to obtain locally grown produce and learn about greenhouses and their possibilities
	A public route made of metal grate leads visitors around the building to understand how the steel and greenhouse processes are inter-linked, as well as take them close to the heat of the reinhabited blast furnace
	In future growth stages, research labs, test areas, and public learning facilities will create a strong civic front along the water that encourages people to explore ground level
	Greenhouses that extend to the ground level are kept as open as possible to facilitate public movement through them and create a link with the upper level public route
	The spaces between the greenhouses are envisioned as public spaces with hard surfaces and seating that the research and public areas can spill out onto

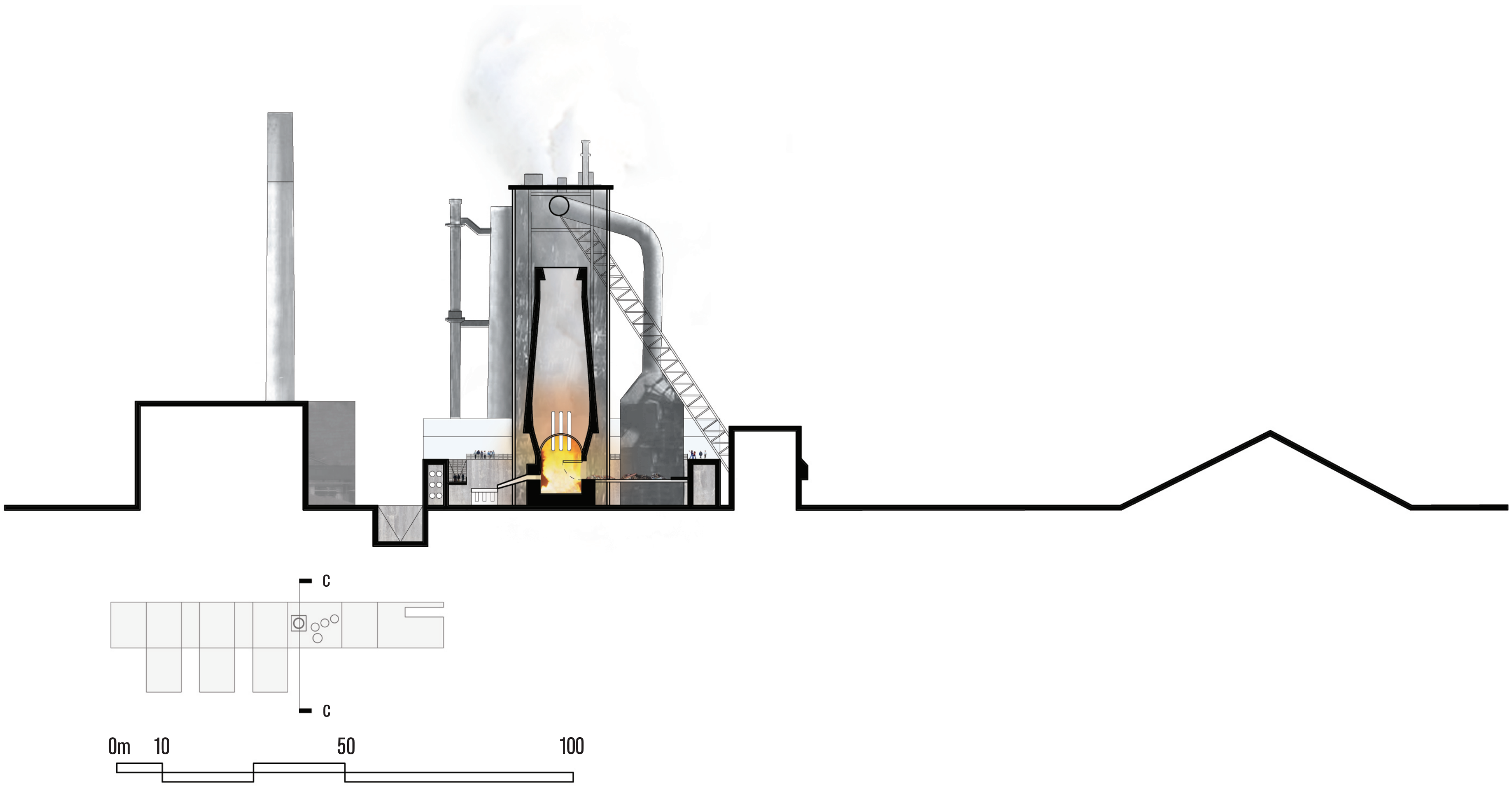


Fig.2.54 Section CC through public walkway and EAF

Fig.2.55 A view from within a remediation greenhouse, looking out across the landscape and city beyond

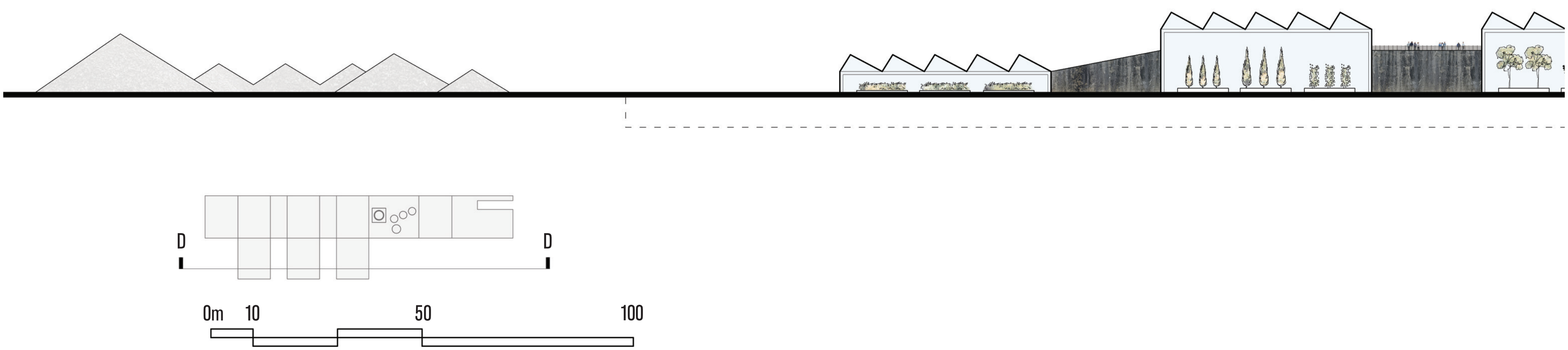
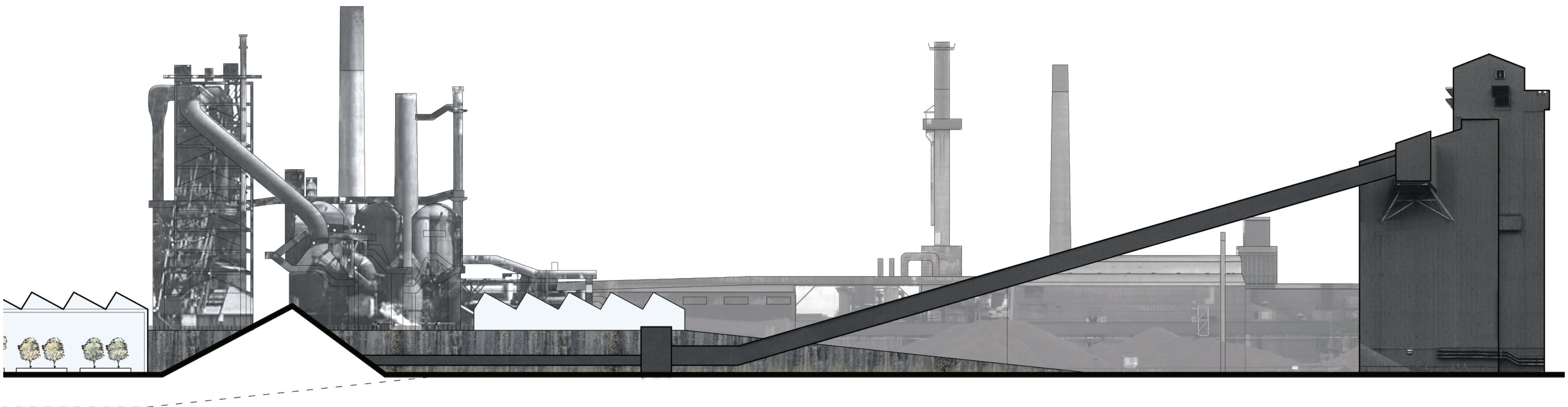


Fig.2.56 Section DD through extended greenhouses



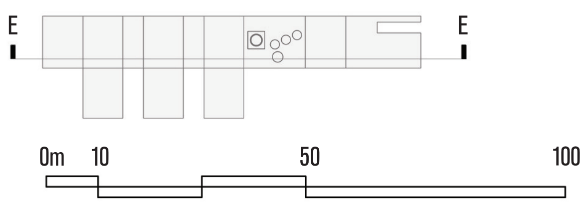
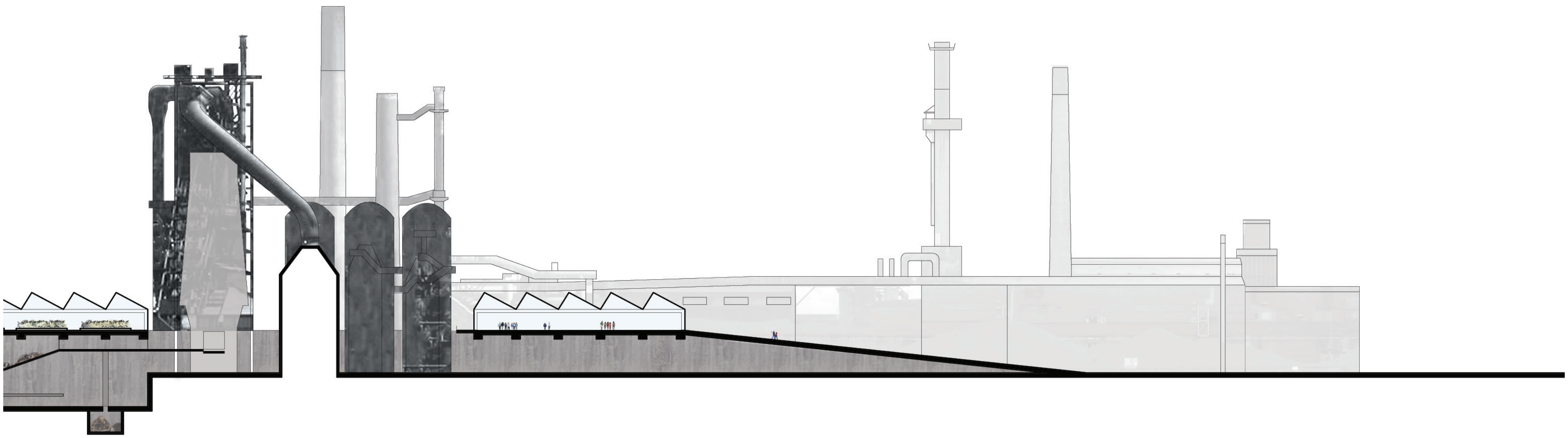
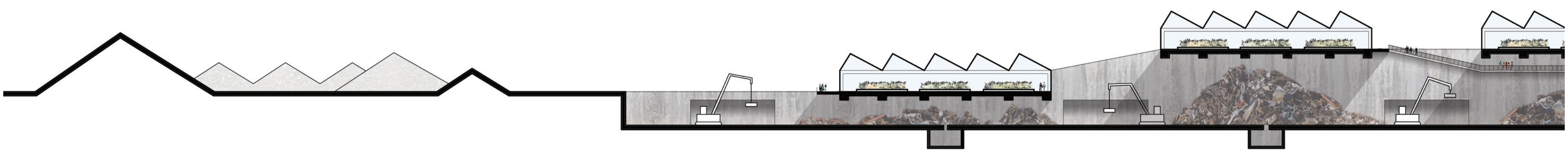
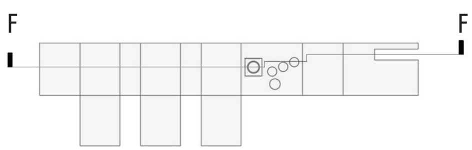


Fig.2.57 Section EE through scrap processing belt and greenhouses







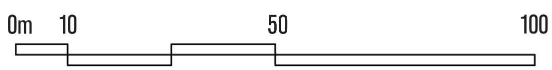


Fig.2.58 Section FF through scrap sorting areas and EAF

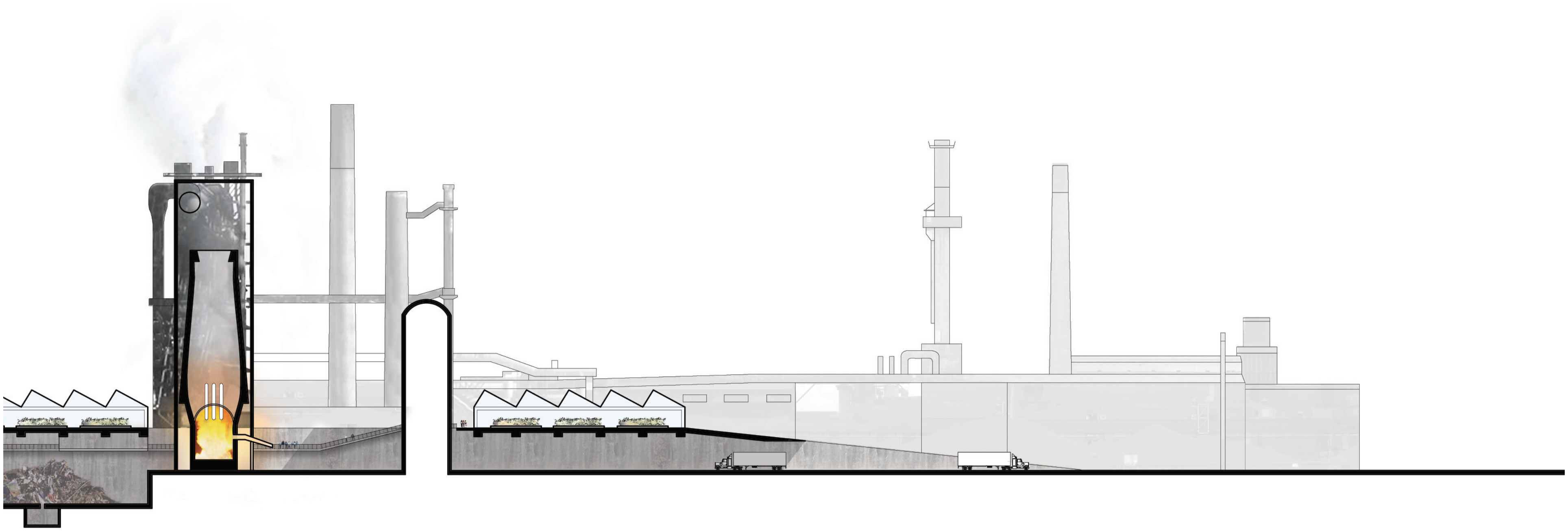


Fig.2.59 A panoramic view of the site from across Hamilton Harbour


21
103
CRICKET

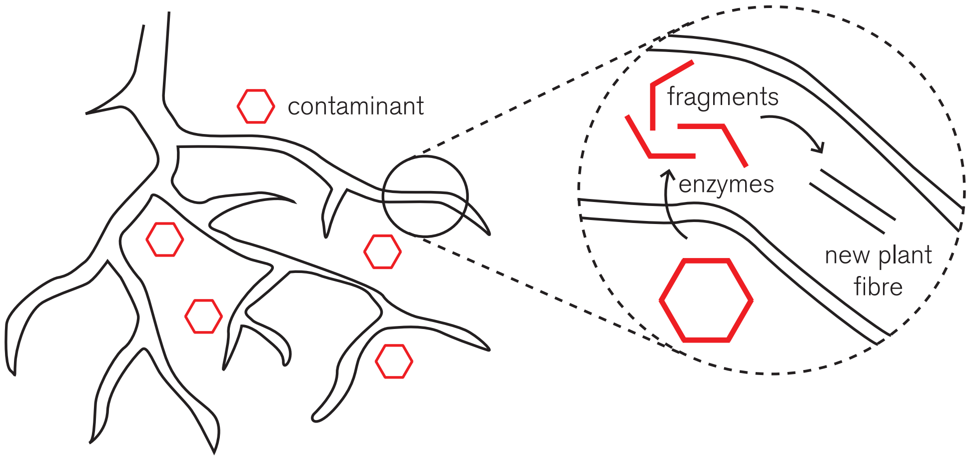


Fig.2.60 Phytodegradation

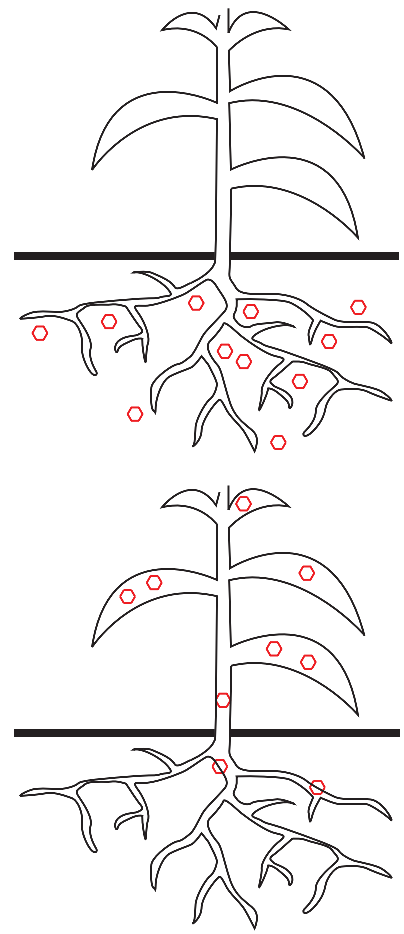


Fig.2.61 Phytoextraction

2.3 Remedial Energies

The site is toxic, filled with smells, rats, leachate, off-gassing, and differential settlement – a site of degradation and death covered with a thin lid of plastic and soil. The covering over of the dark and disordered inside of Fresh Kills is part of a history of Americans being willing to wipe almost any slate clean and start over. Yet this dark inside persists. To the extent that the Fresh Kills landscape is a consequence of our own material desires and consumption, it also reflects a desire to ignore our waste and abject products, to look in a different direction rather than risk being identified with them, to have them go away.[20]

Linda Pollak's reaction to several proposals to cap and fill the Fresh Kills landfill site outside New York City underscores the argument that toxicity and contamination must be rendered tangible for people in order to affect change. Without confronting it, it can too easily be passively ignored. The landscape of the Stelco site, as noted previously, is one fraught with contamination. With the introduction of a new hybrid reclamation industry, however, there exists the potential to remediate the site using recoverable energy from the very industry that destroyed it.

In refusing to erase the site through a cap and fill strategy, bioremediation exists as a potent alternative. Bioremediation utilizes plants to improve the soil and water quality of a degraded site. This typically takes a long period of time, as plants either thrive in or are overcome by the contamination, and various tests are conducted to determine optimal solutions and configurations specific to site conditions. There are two main types of bioremediation: those that deal with organic pollutants (specifically hydrocarbons), and those that target metal contaminants. The most common method for dealing with organic pollutants is called *phytodegradation*. This process breaks down contaminants taken up by plants, or the in the vicinity of the plant through enzymes that it produces naturally. Complex organic pollutants degraded into simpler molecules and incorporated into the plant tissue to help it grow faster. In order to combat metallic contamination, there are three main strategies. *Phytoextraction* is the uptake of metals from soil by plant roots into above ground portions of the plant. After the plants have been allowed to grow for some time and accumulated a large amount of pollution, they are harvested and either incinerated or com-


Fig.2.62 Community volunteers spreading limestone to prepare the landscape for remediation


Fig.2.63 The Copper Cliff area before remediation


Fig.2.64 The same area 30 years later

posted to recycle the metals. Metals such as nickel, zinc, and copper are the best candidates for this strategy. *Rhizofiltration* is the absorption by plant roots of contaminants in the water surrounding the root zone. The plants to be used for cleanup are raised in greenhouses with their roots in water. Contaminated water is then either collected from a waste site and brought to the plants, or the plants are planted in the contaminated area where the roots then take up the water and the contaminants within it. For example, sunflowers were successfully used to remove radioactive contaminants from pond water in a test at Chernobyl, Ukraine. The last method, *phytostabilization,* immobilizes contaminants through absorption and accumulation by roots, and prevents migration to the groundwater or air. Metal-tolerant species can be used to restore vegetation, thereby decreasing the potential migration of contamination through wind erosion and leaching to groundwater[21].

Two case studies that utilize various modes of bioremediation at different scales are explored to see how strategies might be developed and applied to the new hybrid condition at Stelco. The first is Sudbury, Ontario, a town also defined by its industry – nickel – and a landscape that has paid the price accordingly. Vast tracts of deadened fields and nickel tailings, dramatically captured in the photographs of Edward Burtynsky, surrounded the city as if it were on the moon. During the peak of the pollution in the late 1960's, local community groups and the newly founded Laurentian University began working on solutions to address the gaping problem. In 1971, the university scientists began setting up test plots to experiment with various combinations of soil amendments and plant species. Their testing confirmed that the application of crushed limestone neutralized acidic soil, inhibited the uptake of metals, enhanced bacterial activity, and allowed certain types of vegetation to thrive[22]. Over the following years, as the nickel industry fell into decline and the town yearned to diversify it's economy, the movement to re-green Sudbury's landscape picked up steam. The toxic landscape offered an opportunity where non previously existed. The region hired laid-off workmen, as well as hundreds of student and community volunteers, to spend the late 1970's spreading vast quantities of crushed limestone, fertilizer, and grass seed over the barren landscape. Year after year, this process continued. By 1984, over 2,600 hectares had been greened and more than 4,000 trees planted[23].

This grassroots movement, partnered with both public and private interests, has transformed the local landscape as well as

Fig.2.65 New recreational opportunities

Fig.2.66 New plantings amongst the industrial ruins

the psyche of its inhabitants over the last four decades. Interestingly, the city has preserved a 1,300 hectare area called the Barrens, an untreated site of blackened rock devoid of life that acts as a stark reminder of how far the city has come[24]. It is also a reminder of what the city had allowed to happen to the landscape, so that future generations do not repeat it.

The second case study is the Duisburg-Nord Landscape Park in the German Ruhr area, designed by Peter Latz and Partners. A 230 hectare acre post-industrial cultural and recreation zone, the park inhabits the site of the former Meiderich blast furnace complex. Decommissioned in 1985, the site contains a huge repository of industrial buildings including highly complex industrial plants, blast furnaces, turbines, cooling towers, ore bunkers, sewerage facilities, railways, and roads – in other words, a site very comparable to Stelco in Hamilton. The architectural remnants are injected with minimally invasive programmatic uses; for example, climbing walls on the sides of concrete bunkers and a diving tank housed within an old gasometer. The blast furnace serves as an observation deck[25]. Frozen in time, the industrial ruins are preserved and not allowed to succumb to entropy.

The site itself, however, is far more active and meant to change and evolve over time. It is intended to illustrate to visitors the varying levels of degradation inherent in the landscape. Species such as a lichens and moss grow on heaps of slag; steppe-like vegetation (dry shrubs and grasses) grows on the meager soil of coal-soot mixes; the tree of heaven grows in demolition rubble; and the lilac thrives in moderately polluted areas. Vegetation does not cover the park evenly as it might in natural landscapes. Instead, vegetation fields lie like different clumps between the structures of the railway and waterways, covering isolated areas with differentiated forms and colours. In areas too heavily contaminated for bioremediation to be utilized, two methods are employed. One is a sort of cap and fill method where the area is layered with clay to form an eternal grave of contamination, while the other is to have light gas diffusion over the course of several generations with a corresponding reduction in pollution and limited utilization (only walking, cycling, etc). In this way the design maps the contamination, responding to the patterns of ecological disruption and using these patterns to determine the shape of an evolving site ecology[26]. There is an inherent belief in Duisburg that time will transform the site, that the process is a continuing one that evolves as site conditions change, and that the designer is simply a facilitator.

The grassroots community involvement in Sudbury, coupled with the evolving remediation strategy at Duisburg, are two key points to be applied in Hamilton. Public interest in the Stelco site is captured through the opportunity to observe growth in the greenhouses, and subsequently participate in the testing and planting of the site. The bioremediation strategy will utilize the greenhouses to grow plants in specific conditions that can then be applied on a larger scale to the site. Instead of importing plants from around the region, they will be grown in situ. As the scale of remediation grows over time, the greenhouses can be expanded and enlarged to suit new and larger plant species or even trees. In conjunction with anticipated new agri-tech faculties at McMaster University, the optimal plant species and soil mixtures will be determined for the site's many unique toxic areas. Greenhouses are also used to grow produce that is sold at a new market on the site. As remediation gradually occurs, the site draws people to its paths, its mounds, and its potential as a recreational outpost on the waterfront. In this manner Stelco returns to its original condition of being a working and productive landscape, in the sense that it actively engages the local community. The experience of observing the site change and evolve over the years, of knowing what used to be black and is now green, is sublime.

The energy latent in the site's abandoned buildings is recovered through this process as well. Instead of preserving obsolete buildings, the ruins will be allowed to succumb to entropy and dissolution, and as they do to become a part of the energy cycle through the recycling of their parts in the scrap yard and eventual melting in the furnace. The entire site becomes part of an energy flow that links industry with its landscape, and both with the city in which they reside.

Fig.2.67

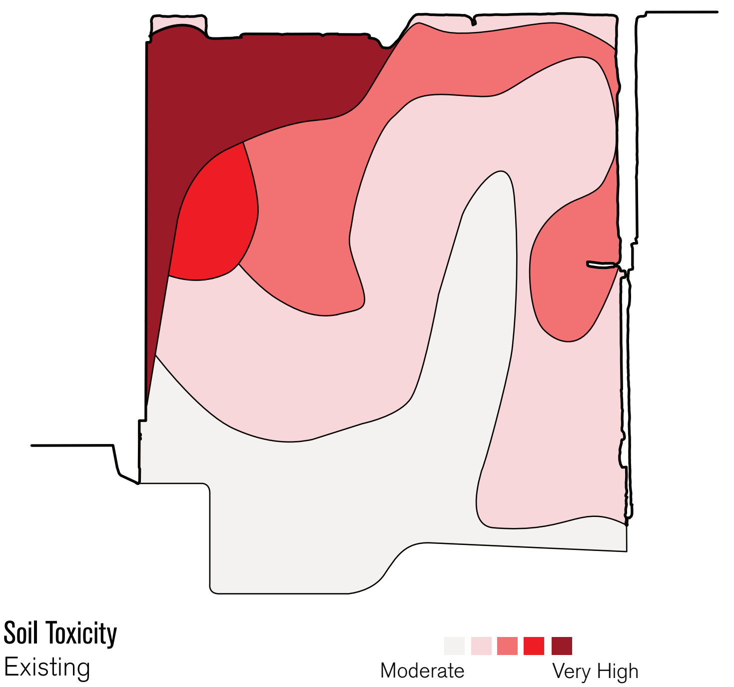


Fig.2.68 Existing site section through slag and coal piles


Fig.2.69 Maple


Fig.2.70 Birch


Fig.2.71 Lavender


Fig.2.72 Tree of Heaven

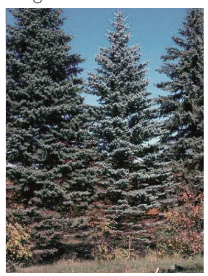


Fig.2.73 Spruce


Fig.2.74 Blueberries


Fig.2.75 Cottonwood


Fig.2.76 Poplar


Fig.2.77 Alfalfa


Fig.2.78 Existing site

Planting Strategies

Native Species
ex. maple, birch, lavender, wild strawberries, native grasses; suitable for all uses

Pollution Tolerant Species
ex. tree of heaven, wild blueberries, clover, kentucky bluegrass, spruce and pine; suitable for general use

Bioremediation Species
ex. cottonwood, poplar, juniper, sunflowers, alfalfa; vegeation and occupation vary with contamination level

No Vegetation
off-gasing of highly toxic areas; limited occupation

Phase One (2010)

Existing buildings | Obsolete buildings | New and reoccupied buildings | New road infrastructure | New and reconfigured recreational infrastructure

Site Morphology

- New reclamation facility constructed
- Gage Ave. N. is extended and directed towards mini-mill to handle truck traffic
- Sherman Ave. N. is extended to the market/greenhouses to link building with East End and wider city

Soil Toxicity and Remediation

The new building acts as a cap for its footprint; in the first phase no remediation occurs.

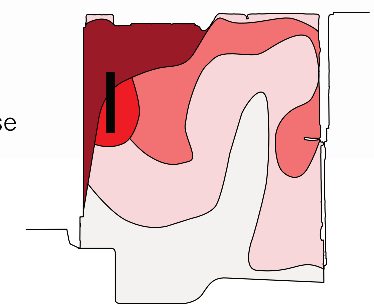


Fig.2.79

Phase Two (2010-2015)

Existing buildings | Obsolete buildings | New and reoccupied buildings | New road infrastructure | New and reconfigured recreational infrastructure

Site Morphology

- A public promenade is built along the western waterfront rail to initiate public occupation of the site
- Greenhouses extend towards the water and accomodate plants to be used in the remediation process
- A canal is dredged between the new site and Stelco operations to create a new public pier
- A marina is created to facilitate public harbour usage amongst the industrial area
- Soil and debris from the new dredging projects are distributed throughout the site to create new hills and landscapes that equally require remediation

Soil Toxicity and Remediation

Plants from the new greenhouses are moved into the landscape to begin their remediation work along the heavily polluted western waterfront.

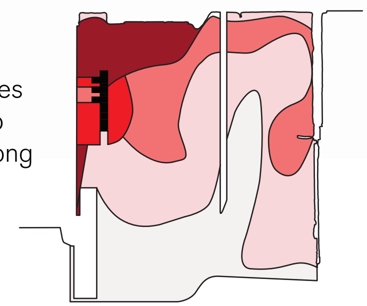
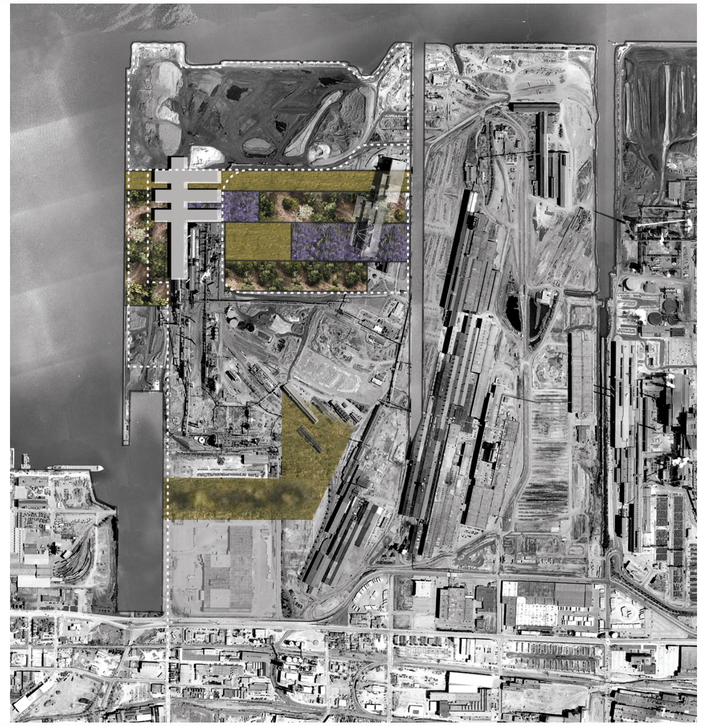


Fig.2.80

Phase Three (2015-2035)

Existing buildings | Obsolete buildings | New and reoccupied buildings | New road infrastructure | New and reconfigured recreational infrastructure



Site Morphology

- Greenhouses extend to the east
- Public circulation is built around existing road and rail infrastructure
- New buildings are constructed and existing ones reoccupied as high tech industrial and commercial operations to encourage new uses on the site

Soil Toxicity and Remediation

Remediation planting shifts to the east and greenhouse production increases to handle the increase in targeted site area

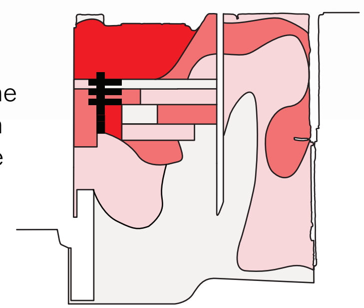


Fig.2.81

Fig.2.82 An image of the site during remediation in Phase Three, with the reclamation facility in the distance

Phase Four (2035-2055)

Existing buildings | Obsolete buildings | New and reoccupied buildings | New road infrastructure | New and reconfigured recreational infrastructure

Site Morphology

- Greenhouses extend north
- New roads are built to prepare for future development
- Urban blocks are filled in with various buildings, including important outposts of public institutions such as the Royal Botannical Gardens and McMaster University

Soil Toxicity and Remediation

Remediation focuses on the highly toxic northern edge which has been off-gasing for several decades to prepare for remedation

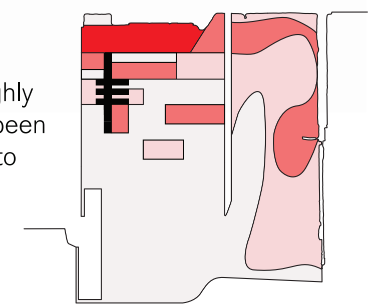
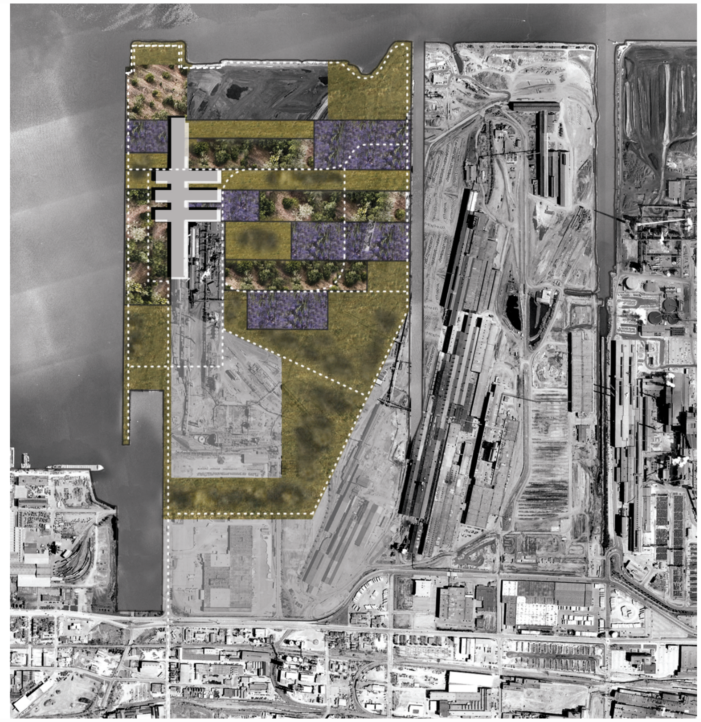


Fig.2.83

Phase Five (2055+)

Existing buildings | Obsolete buildings | New and reoccupied buildings | New road infrastructure | New and reconfigured recreational infrastructure



Site Morphology

- Urban blocks are extended and diversified to include various office, commercial, and residential uses

- A large existing building is to be reoccupied for a major civic purpose, perhaps the arena for Hamilton's future NHL team

Soil Toxicity and Remediation

The site's northern edge is remediated slowly to maintain evidence of the original contamination for future generations

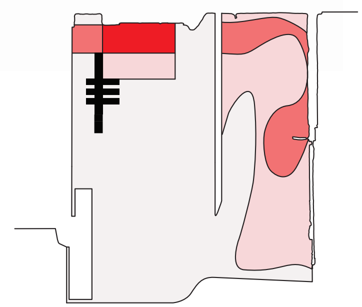


Fig.2.84

A future site section illustrates potential final planting location and density, in relation to the original toxicty and subsequent remedial activity. The denser treed areas are older growth where contamination was less of a concern early on, and the plants have thus had time to grow and flourish. Areas with less dense green space illustrate zones more recently planted due to various phases of planting and harvestation during remediation over the years. Those areas that remain sparsely planted are still in the process of off-gasing or partially contaminated, serving as a reminder of the landscape's original condition. The new mosaic landscape acts as a register of the site's former contamination while offering new occupation opportunities for the future.

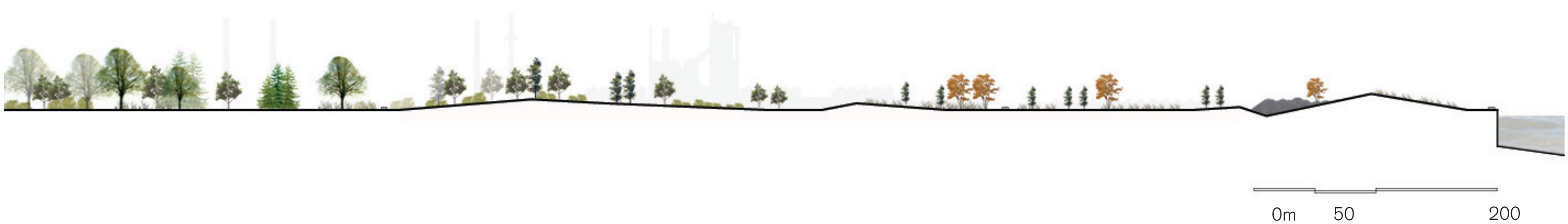


Fig.2.85 Phase Five site section illustrating variation in plant growth and new landscape

Fig.2.86 A view of the site during Phase Five, illustrating the effects both entropy and remedation are having on the experience of the site

Conclusions

"If it isn't Steeltown or a centre of industry any more, what is it? What could it be? Nobody's quite sure. The comparison often made to Pittsburgh just doesn't hold. Pittsburgh got the chance to reinvent itself from scratch. The disaster for that city—the demise of its steel industry—was also its blessing. The industry simply left, and allowed Pittsburgh to begin imagining how else to use those old buildings and brownfields. In Hamilton, the industry limps along, with no end nor glory in sight, while city politicians cling to the idea of manufacturing like a security blanket."

- The Globe and Mail, August 26, 2009

A fundamental belief that runs throughout this thesis is that time will transform the Stelco site, that the process is a continuing one that evolves as site conditions change, and that the designer acts as a facilitator for future events and circumstances. This is true of the status of the Stelco operations as well. When I began this thesis in 2008, the site was in a state of uncertainty, existing almost shift by shift in an attempt to cut costs; I felt it a relevant and interesting opportunity to propose a situation where the mill was shuttered completely and explore how the city might respond. In March 2009, that proposition became a reality when US Steel idled the entire Hamilton operation and the thesis work began to evolve and respond to events happening in real time. Now in 2010, economic conditions have improved, the Canadian government has threatened to sue US Steel for non-compliance with production and job promises, and the Stelco operations have been returned more-or-less to full capacity.

However, the city is not back on its feet. Hamilton remains at a crossroads, just as it did when the initial closure was announced, reluctant to evolve and embrace a new vision and identity for itself. The city yearns for a clear image of itself as it moves into the future, unsure of how to reconcile the glory of its

industrious manufacturing heritage with its contemporary toxic manifestations. The city requires a permanent and meaningful solution to this paradox, whether it is now, in a year, or ten years down the road.

This thesis proposes a re-imagination of the site in a post-Stelco context. Energy, latent in the abandoned architecture and landscape degradation, and recoverable from a reconfigured steel industry, is used as the launching point for a new greenhouse industry. This hybrid operation becomes integral to the phased bioremediation of the site, linking industry and ecology in a symbiotic way. The Hamilton Steel and Landscape Reclamation Facility is an engine that fuels the transition of the site from one of homogeneous industry, ostracized from the surrounding city, to one of hybrid industry and public amenity that embraces the city and its population. Rooted firmly in the legacy of the mighty Steeltown, the reclamation facility offers a new reading of how industry can contribute to civic life and continue to fuel the evolution of a city.

Contemporary cityscapes are often purged of industrial and other "undesirable" uses, with planners locating them in urban extremities away from the eyes (and noses) of the population. If and when operations cease, they are usually erased from the active life of the city through demolition or the injection of unrelated program, a favourite being the museum or "cultural centre". These uses ignore the potential to recalibrate these sites in more meaningful ways. Industry is a necessary component of any thriving city, and as such has specific requirements and flows: economically through money, environmentally through its processes and output, socially through jobs, and spatially through urban occupation and presence. Likewise, the city has its own economic, ecological, social, and spatial needs, and they do not always align with those of industry. Reconciling the two is a way to inform the future development of productive cities with enhanced senses of ecological responsibility, community involvement, and civic pride.

End Notes

Introduction

1 Bernd Becher, *Blast Furnaces* (Cambridge: The MIT Press, 1990). 7.
2 Luis Fernandez-Galiano, *Fire and Memory: On Architecture and Energy*, trans. Gina Carino (Cambridge: The MIT Press, 2000). 4.
3 Fernandez-Galiano, 64.
4 Edmund Burke, *A Philosophical Enquiry into the Sublime and Beautiful* (New York: Routledge, 2008). 50.
5 Rosalind Williams, *Notes on the Underground: An Essay on Technology, Society, and the Imagination* (Cambridge: The MIT Press, 1990). 85.
6 Burke 65.
7 Burke, 65.
8 Williams, 83.
9 Tim Edensor, *Industrial Ruins: Spaces, Aesthetics and Materiality* (New York: Berg, 2005). 11.
10 Fernandez-Galiano, 89.
11 Dylan Trigg, *The Aesthetics of Decay : Nothingness, Nostalgia, and the Absence of Reason* (New York: Peter Lang, 2006). 141.
12 Trigg, 147.
13 Lori Pauli, *Manufactured Landscapes: The Photographs of Edward Burtynsky* (Ottawa: National Gallery of Canada, 2003). 22.

Part One

1 Lois C. Evans, *Hamilton: The Story of a City* (Toronto: The Ryerson Press, 1970). 80.
2 John C. Weaver, *Hamilton: An Illustrated History* (Toronto: James Lorimer & Company, Publishers, 1982). 42.
3 Weaver, 49.
4 Weaver, 52.
5 Weaver, 55.
6 Weaver, 55.
7 Weaver, 80.
8 Weaver, 85.
9 Evans, 177.
10 Weaver, 87.
11 Weaver, 80
12 Weaver, 87
13 Evans, 180.

14 James Corner, *Eidetic Operations*, in *Recovering Landscape: Essays in Contemporary Landscape Architecture* (New York: Princeton Architectural Press, 1999). 11.

15 Craig Heron, Shea Hoffmitz, Wayne Roberts and Robert Storey, *All That Our Hand Have Done* (Oakville: Mosaic Press, 1981). 84.

16 Heron et al, 110.

17 Weaver, 131.

18 Weaver, 153.

19 Weaver,155.

20 Weaver, 64.

21 Evans, 117.

22 Weaver, 60.

23 Weaver, 107.

24 Weaver, 99.

25 Weaver, 162.

26 June Corman, Meg Luxton, D.W. Livingstone and Wally Seccombe, *Recasting Steel Labour: The Stelco Story* (Halifax: Fernwood Publishing, 1993). 27.

27 Weaver, 167.

28 Weaver, 161

29 Weaver, 164

30 Weaver, 166.

31 Corman et al, 27.

32 Weaver, 141.

33 Weaver, 172.

34 Weaver, 175.

35 Evans, 207.

36 *The Hamilton Spectator*, October 31, 2007.

37 *The Globe and Mail*, August 26, 2009.

38 Corner, 11.

39 *The Toronto Star*, March 4, 2009

40 *The Hamilton Spectator*, March 16, 2009.

41 *The Toronto Star*, March 4, 2009

42 *The Hamilton Spectator*, March 4, 2009

43 Adriaan Geuze, *Accelerating Darwin*, in *The Artificial Landscape: Contemporary Architecture, Urbananism, and Landscape Architecture in the Netherlands* (Rotterdam: NAi Publishers, 2000). 255.

44 Geuze, 255.

45 Geuze, 256.

Part Two

1 Daily Commercial News, *Towering Stelco blast furnace bites the dust*, http://www.dailycommercialnews.com/article/id29180 (accessed March 15, 2010).

2 Heather E. Harlow and Peter V. Hodson, *Chemcial Contamination of Hamilton Harbour: A Review* (Burlington: Great Lakes Laboratory for Fisheries & Aquatic Sciences, 1988). 68.

3 Government of Canada, *Randle Reef Sediment Remediation Project,* http://sustainabilityfund.gc.ca/default. asp?lang=En&n=FD93ACFA-1 (accessed March 15, 2010).

4 R.W. Bell, *Air quality survey in the vicinity of Domtar, Dofasco, Stelco, Columbian Chemical and the industrial sector of Hamilton*, Government Publication (Toronto: The Region of Toronto, 1986).3.

5 John C. Weaver, *Hamilton: An Illustrated History* (Toronto: James Lorimer & Company, Publishers, 1982). 131.

6 US Steel Canada, *Profile*, http://www.hamiltonsteel.ca/hamiltonsteel/corporate.asp (accessed March 15, 2010)

7 US Steel Canada, *Operations*, http://www.hamiltonsteel.ca/hamiltonsteel/operations.asp (accessed March 15, 2010).

8 *The Electric Arc Furnace* (Brussels: International Iron and Steel Institute, 1981). 2.5.

9 EPRI Centre for Materials Production, *Understanding Electric Arc Furnace Operations*, 1997, http://www.p2pays.org/ref/10/09047.pdf (accessed March 15, 2010).

10 The David J. Joseph Company, *About Recycling*, http://www.djj.com/industry/aboutrecycling/ (accessed March 15, 2010).

11 Terry J. Veasey, Robert J. Wilson and Derek M. Squires, *The Physical Separation and Recovery of Metals from Wastes* (Langhorne, Pa: Gordon and Breach Science Publishers, 1993). 5.

12 *The Recuperation and Economic Utilization of Byproducts of the Iron and Steel Industry* (New York: United Nations, 1990). 115.

13 Carl A. Zimring, *Cash for your trash: Scrap Recycling in America* (New Brunswick, N.J.: Rutgers University Press, 2005). 152.

14 All Business, *Environmental group sues scrap yards*,

http://www.allbusiness.com/north-america/united-states-california-metro-areas/640452-1.html (accessed March 15, 2010).

15 Small Business Environmental Assistance Program, *Pollution Prevention for Auto Salvage Yards*, (Kansas State University, 1990). 23.

16 United Nations Environment Programme, *Phytore mediation: An Environmentally Sound Technology for Pollution Prevention, Control and Redmediation*, http://www.unep.or.jp/ietc/Publications/Freshwater/FMS2/2.asp (accessed March 15, 2010).

17 *Ontario Greenhouse Vegetable Growers*, http://www.ontariogreenhouse.com/ (accessed March 15, 2010).

18 Joe J. Hanan, *Greenhouses: Advanced Technology for Protected Horticulture* (Boca Raton: CRC Press, 1998). 31.

19 Agviro Inc., *Greenhouse Energy Survey*, 2009, http://www.powerauthority.on.ca/Storage/95/9057_Greenhouse_Energy_Survey.pdf (accessed March 15, 2010). 44.

20 Linda Pollak, *Sublime Matters: Fresh Kills*, in *Praxis*, 2002. 59.

21 United Nations Environment Programme, *Phytoreme diation: An Environmentally Sound Technology for Pollution Prevention, Control and Redmediation,* http://www.unep.or.jp/ietc/Publications/Freshwater/FMS2/2.asp (accessed March 15, 2010).

22 Nicola Ross, *Healing the Landscape : Celebrating Sudbury's Reclamation Success* (Sudbury: City of Greater Sudbury, 2001). 45.

23 Ross, 59.

24 Ross, 88.

25 Udo Weilacher, *Syntax of Landscape : the landscape architecture of Peter Latz and Partners* (Basel: Birkhauser, 2008). 120.

26 Peter Latz, *Landscape Park Duisburg-Nord: the metamorphosis of an industrial site*, in *Manufactured Sites: Rethinking the Post-Industrial Landscape* (New York: Spon Press, 2001). 155.

References

Books

Becher, Bernd. *Blast Furnaces*. Cambridge: The MIT Press, 1990.

Burke, Edmund. *A Philosophical Enquiry into the Sublime and Beautiful*. New York: Routledge, 2008.

Corman, June, Meg Luxton, D.W. Livingstone, and Wally Seccombe. *Recasting Steel Labour: The Stelco Story*. Halifax: Fernwood Publishing, 1993.

Corner, James. "Eidetic Operations." In *Recovering Landscape: Essays in Contemporary Landscape Architecture,* by James Corner. New York: Princeton Architectural Press, 1999.

Edensor, Tim. *Industrial Ruins: Spaces, Aesthetics and Materiality*. New York: Berg, 2005.

Evans, Lois C. *Hamilton: The Story of a City*. Toronto: The Ryerson Press, 1970.

Fernandez-Galiano, Luis. *Fire and Memory: On Architecture and Energy*. Translated by Gina Carino. Cambridge: The MIT Press, 2000.

Geuze, Adriaan. "Accelerating Darwin." In *The Artifical Landscape: Contemporary Architecture, Urbananism, and Landscape Architecture in the Netherlands*, by Hans Ibelings. Rotterdam: NAi Publishers, 2000.

Hanan, Joe J. *Greenhouses: Advanced Technology for Protected Horticulture*. Boca Raton: CRC Press, 1998.

Heron, Craig, Shea Hoffmitz, Wayne Roberts, and Robert Storey. *All That Our Hand Have Done*. Oakville: Mosaic Press, 1981.

Latz, Peter. "Landscape Park Duisburg-Nord: the metamorphosis of an industrial site." In *Manufactured Sites: Rethinking the Post-Industrial Landscape*, by Niall Kirkwood. New York: Spon Press, 2001.

Leighton, John. *Caspar David Friedrich: Winter Landscape*. London: National Gallery Publications, 1990.

Pauli, Lori. *Manufactured Landscapes: The Photographs of Edward Burtynsky*. Ottawa: National Gallery of Canada, 2003.

Pollak, Linda. "Sublime Matters: Fresh Kills." In *Praxis No. 4*, 2002.

Ross, Nicola. *Healing the Landscape : Celebrating Sudbury's Reclamation Success*. Sudbury: City of Greater Sudbury, 2001.

Sawyer, James W. *Automotive Scrap Recycling: Processes, Prices, and Prospects*. Baltimore: Johns Hopkins University Press, 1974.

Trigg, Dylan. *The Aesthetics of Decay : Nothingness, Nostalgia, and the Absence of Reason*. New York: Peter Lang, 2006.

Veasey, Terry J., Robert J. Wilson, and Derek M. Squires. *The Physical Separation and Recovery of Metals from Wastes*. Langhorne, Pa: Gordon and Breach Science Publishers, 1993.

Weaver, John C. *Hamilton: An Illustrated History*. Toronto: James Lorimer & Company, Publishers, 1982.

Weilacher, Udo. *Syntax of Landscape : the landscape architecture of Peter Latz and Partners*. Basel: Birkhauser, 2008.

Williams, Rosalind. *Notes on the Underground: An Essay on Technology, Society, and the Imagination*. Cambridge: The MIT Press, 1990.

Zimring, Carl A. *Cash for your Trash: Scrap Recycling in America*. New Brunswick, N.J.: Rutgers University Press, 2005.

Reports

Bell, R.W. *Air quality survey in the vicinity of Domtar, Dofasco, Stelco, Columbian Chemical and the industrial sector of Hamilton*. Government Publication, Toronto: The Region of Toronto, 1986.

Harlow, Heather E., and Peter V. Hodson. *Chemcial Contamination of Hamilton Harbour: A Review*. Burlington: Great Lakes Laboratory for Fisheries & Aquatic Sciences, 1988.

Small Business Environmental Assistance Program. *Pollution Prevention for Auto Salvage Yards*. Kansas State University, 1990.

The Electric Arc Furnace. Brussels: International Iron and Steel Institute, 1981.

The Recuperation and Economic Utilization of By-products of the Iron and Steel Industry. New York: United Nations, 1990.

Online

Agviro Inc. "Greenhouse Energy Survey." 2009. http://www.powerauthority.on.ca/Storage/95/9057_Greenhouse_Energy_Survey.pdf (accessed March 15, 2010).

EPRI Centre for Materials Production. "Understanding Electric Arc Furnace Operations." 1997. http://www.p2pays.org/ref/10/09047.pdf (accessed March 15, 2010).

Government of Canada. *Randle Reef Sediment Remediation Project*. http://sustainabilityfund.gc.ca/default.asp?lang=En&n=FD93ACFA-1 (accessed March 15, 2010).

United Nations Environment Programme. *Phytoremediation: An Environmentally Sound Technology for Pollution Prevention, Control and Redmediation*. http://www.unep.or.jp/ietc/Publications/Freshwater/FMS2/2.asp (accessed March 15, 2010).

US Steel Canada. http://www.hamiltonsteel.ca/hamiltonsteel/corporate.asp (accessed March 15, 2010).