Globe Park:

Hybridizing Cultural, Ecological, and Industrial Spaces on Hamilton's Bayfront Landscape

by

Michael Wesley Votruba

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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 my thesis, including any final revisions, as accepted by my examiners.

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

ABSTRACT Applying complex ecosystems theory, this thesis maps and analyzes the codependency of ecological and manufacturing flows affecting cities, the landscape, and the environment. Learning from this analysis, a prototype for a hybrid eco-manufacturing and urban park is proposed on degraded industrial lands. Its design is influenced by eco-industrial parks including Kalundborg and contemporary urban parks including La Villette, Downsview, and Fresh Kills. The prototype's design is motivated by the mutating spatiality caused by contemporary trends in North American manufacturing and the degrading environmental state of the Great Lakes.

The horizontal expansion of post-Fordist industrial areas on the urban periphery of North American cities has helped lead decentralization of core urban areas. This organization is becoming vulnerable to future energy and environmental concerns. In Hamilton, this trend has resulted in approximately 3,400 acres of underutilized contaminated land in its historical bayfront industrial areas. The hybrid park prototype will incubate reuse of a 576 acre site within this land by creating a network of eco-operations and public spaces.

As part of North America's Great Lakes, Hamilton Harbour drains into the head of Lake Ontario. The Port of Hamilton's manufacturing activity strains the ecological systems of these lakes. Some of the most problematic discharge into Hamilton Harbour occurs at Windermere Basin. The basin is surrounded by a twilight industrial area that contaminates its water, soil, and air. This will be the location of the hybrid park prototype. Light manufacturing spaces that treat industrial contamination will be designed. Their organization will hypothesize a new form of urbanization based on environmentally benign uses of energy and materials.

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This work is dedicated to my family who supported me through this process. I would especially like to thank my wife Jessica and my parents Sandy & Wes. I would also like to thank my sisters Sarah & Melissa, my in-laws Greta & Bryan, and the rest of my extended family here and overseas.

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GLOBE PARK

PREFACE

At the precipice of a predicted global environmental crisis, Globe Park emerges as a new symbiotic framework for cultural, ecological, and industrial space. Globe Park is an incubational catalyst that rises out of the degraded contemporary industrial landscape, proposing a hybrid form of eco-industrial reinhabitation. Globe Park is both new city and new nature simultaneously. It is a temporal process that exists for as long as it takes to reclaim the contaminated earth from which it emerges. As a space, it is preconfigured with self-organizing internal networks. It has the capacity to move laterally overtime constructing fertile ground for the contemporary city. The relative health of this space is successional. Its growth is responsive to synergies between cultural, ecological, and industrial inputs and outputs. The more codependency between these synergies the larger and more complex Globe Park grows.

fig. 0.1 Methane storage globe at Hamilton Sewage Treatment Plant

fig. 0.2 *Aggregate crusher at the mouth of the Red Hill Creek at Windermere Basin*

INTRODUCTION The port of Hamilton developed hastily during the mid twentieth century postwar decades without mandated environmental constraints. This thesis investigates this development in terms of its impact on the ecological, cultural, and energetic conditions affecting the Great Lakes Region's ecosystems. In response to the mapping of existing site operations, the thesis design will create a prototype hybrid urban park. The design will propose a new network of operations in the public and private sectors of Hamilton's manufacturing community. Responding successively over a fifty-year period, a new prototype for contemporary public parks will emerge from ecological redevelopment, storm water management, and intensification of occupational activity. The speculative technology of bio-systems, infrastructural morphology, and adaptable building typology will be the main facilitators of its development. The thesis design will adapt industrial artifacts as spaces that will attract public program. The outcome of this adaptation will reintegrate restored ecosystems, remediated industrial facilities, and healthy production operations to create an accessible public waterfront integrated with an extensive ecological infrastructural system. Public accessibility of this system will be central to maintaining environmental symbiosis. As part of a sustainable paradigm, there is an emerging urgency to repopulate manufactured space to avoid urban decentralization, to retrofit urban fabric, and to maximize existing transportation infrastructure.

URGENCY The North American Great Lakes are the largest body of fresh water on earth. Fresh water is one of the most fundamental natural resources required to sustain life. Thirty-three million people live within the watershed of the Great Lakes, making them one of the most valuable environmental resources on the planet. Emerging environmental pressures are influencing a new consciousness of the impact that the human settlements in the region have on the environmental health of the Great Lakes. Each city and town located within the watershed is responsible for its impact on the environment. The outcome of this growing consciousness suggests that environmentally responsible cities will be the ones that continue to grow and prosper.

Industry emerged within the Great Lakes Region as a means to supply basic commodities required for development, including low cost energy, iron ore, and limestone. Hamilton's heavy steel industry became a historical consumer of these commodities. Located at the head of Lake Ontario, Hamilton Harbour is itself a component of a larger ecosystem that comprises the Great Lakes. Nearly two centuries of industrial and manufacturing development within Hamilton Harbour's watershed have strained its environmental systems. This development, however, has created a historically significant manufacturing community in Central Ontario. This community is still an economic organism that governments and businesses capitalize on despite the strain it imposes on the environment.

Originally, manufacturing activity in the Hamilton region populated the western side of Hamilton Harbour's watershed. In the eighteenth century, Sulfur Creek developed gristmills for grinding wheat and sawing timber that supported an early Upper Canada settlement named Ancaster. In the nineteenth century, the town of Dundas became a central port of manufacturing activity with shipping becoming central to its economy through the construction of Desjardins Canal. In the 1960s with the opening of the Great Lakes Saint Lawrence Seaway, the Port of Hamilton became the prominent manufacturing area of the watershed. In the mid-twentieth century, with steel production having been de-emphasized in coastal areas in Nova Scotia during the two world wars and a post-war industrial boom sweeping across the Great Lakes Region, Hamilton Harbour became Central Ontario's center of heavy steel manufacturing.

The industrial port lands on Hamilton Harbour became home to the highest concentration of businesses involving metals-related manufacturing in Canada.[1] Late in the twentieth century, a multitude of culturally-driven changes redirected traditional industrial processes towards off-shore manufacturing led by globalization. This changed the dynamics of manufacturing in the surrounding Great Lakes Region, leaving Hamilton in the problematic economic position of being overly dependent on steel-related activity for its employment base. This development questions the relevance of Hamilton's role within the Great Lakes context from both economic and environmental perspectives.

Hamilton Harbour is listed as an area of concern on the Great Lakes International Joint Venture's List of Great Lakes Toxic Hotspots. This places the city's heavy steel industry as a significant contaminator of Great Lakes ecosystems.[2] The contaminated state of Hamilton Harbour's ecosystems complicated the city's efforts to alleviate the perceived twilight condition of its increasingly antiquated industrial operations. The fallout of heavy industrial development has had an overall negative social and economic impact on the immediately surrounding communities in Hamilton. For a Canadian city, these communities experience higher than average conditions of unemployment and urban poverty.

The eastern part of the Hamilton Harbour Watershed lies within the Niagara Fruit Belt, a rare agricultural area for Canada home to tender fruit growing orchards and vineyards. The presence of the Niagara Escarpment acts as a moderator to seasonal temperatures creating micro-climatic conditions that allow the region to have an extended frost-free season. The eastward sprawl of Hamilton's manufacturing hinterlands is still expanding into this territory and is generating a hybrid landscape of warehouses integrated with orchards and vine lands. Although providing a diversified economic base for the city, it threatens the limited supply of tender fruit crop fields. This hybrid landscape is a contextual departure point for the speculations of this thesis. The design of a new hybrid park speculates on a means to recentralize economic functions on a site located on Hamilton Harbour named Windermere Basin.

Windermere Basin is the mouth of the Red Hill Creek located at the eastern edge of the steel mill area of Hamilton Harbour, immediately to the east of ArcelorMittal Dofasco's mills. The Red Hill Creek drains into Windermere Basin as well as Van Wagner's marshland ponds and Lake Ontario. The creek has suffered from severe erosion, impacts of suburban development at its headwaters, and a lack of civic environmental sensitivity. The Red Hill Creek is an urban watershed that includes a sensitive riparian area, which was reconstructed to accommodate a new municipal expressway named the Red Hill Creek Parkway. Its construction involved the rerouting of seven kilometers of the creek's natural watercourse and attempted rebuilding hundreds of acres of displaced habitat for native plant and animal species. The Niagara Escarpment, which forms the southern edge of Hamilton's city center, is a preserved ecological feature of the Ontario Provincial Government's Greenbelt legislation. The Red Hill Creek Parkway's construction blasted several kilometers into the escarpment to accommodate appropriate road grading.

Today, Windermere Basin is an artificially created wetland at the mouth of the Red Hill Creek. Its function is to collect dirt and silt washed into the creek, soil eroded from its banks, and fine solids in effluent flowing from the Woodward Avenue sewage treatment plant, before they enter Hamilton Harbour. The Basin requires dredging periodically to ensure that silt overflow into Hamilton Harbour does not affect water depths, keeping it navigational for large sea vessels. The creek runoff decreases the depth of ship wharfs and increases the frequency of dredging activity. Last dredged in 1990, the basin has an estimated 218,000 cubic meters of sediment collected on its floor.[3] Dredging continually damages the ecosystems of the basin, which, despite its industrial context, is an acquired habitat for migrating birds and spawning fish. Since the 1960s, the dredged silt has been used to infill the native marshlands of the port area. This process has altered the state of the original ecosystems. Several scrap metal and gravel/slag yards surround the basin. Water and soil sample tests of Hamilton Harbour indicate that metals drain into the basin and the harbour from these inadequately designed land uses to create a high percentage of metal particulate that affect plant and animal species.[4]

LEVERAGE Industrial globalization has significantly increased the demands of energy production worldwide. Most traditional industry is supported by low energy costs, which typically come from the cheapest methods of production, most commonly, burning coal. The industrial community in Hamilton is affected by the globalized market and is a heavy consumer of coal and electricity imports. The industrial sector in Hamilton is a significant consumer of energy in Central Ontario where the largest suppliers are nuclear and coal power plants.[5] The energy sector is a key contributor to green house gas emissions. As reported in the Stern Review on the Economics of Climate Change prepared for the British Government, over 146.3 billion gigatonnes of carbon dioxide are released into the atmosphere from industry and power plant activity globally.[6] The Union of Concerned Scientists over Global Warming has stated that increased worldwide average temperatures are very likely to be caused by human interventions.[7] To further this concern, peak oil is expected to influence the creation of more carbon dioxide emissions due to the probability of more crude substances such as tar sands and oil shale being refined into gasoline.

A new appreciation has developed for renewable energy sources as environmental and economic concerns over the sustainability of fossil fuels have emerged. As reported by Biocap Canada, "energy from biomass in Canada has the potential to sustainably provide 20% of its energy needs from bioenergy by 2020, providing that the necessary policies and incentives are put in place to achieve this result. As a reference, 20% of 2003 energy consumption is approximately 2.1 EJ".[8] Bioenergy development is expected to have an impact on the built environment. The application of bioenergy technology has the potential to allow industrial processes to become more environmentally benign. This makes the possibility of public access and adjacency to these sites more likely. The extraction of energy from biological sources can involve the integration of restorative species in site restoration to become a method of organizing urban space symbiotically with natural process. Several species such as switchgrass, willow, and mustard plant are native species that restore soil conditions, reduce erosion, and are sources of significant bioenergy. Their integration into site remediation has the potential to influence future land use of manufactured sites into a more sustainable framework.

RESOURCES The research and discussion in this thesis is influenced by the self-organizing holarchic open systems (SOHO) approach toward understanding complex systems. This methodology derives from the work of University of Waterloo ecosystem theorist James J. Kay. SOHO theory, outlined in Kay's publication *An ecosystem approach for sustainability: addressing the challenge of complexity*, states that a system such as a natural ecosystem or a human urban system should be looked at as a whole, and draws upon the concepts from catastrophe theory, chaos and complexity theory, non-equilibrium thermodynamics, and self-organization[9]. In this framework, everything is connected to some degree and when a dissipative process emerges it has a tendency to manifest itself as a self-governing structure. This systems theory of ecology will be applied as a mode of analysis for understanding how ecological, cultural, and energetic systems are interrelated in the Great Lakes

Region. Taking the ecological systems understanding of SOHO systems and applying it to operational processes on the Windermere Basin will help to anticipate future interventions that will need to be made to avoid catastrophe, including the energy crisis created by the depletion of conventional fossil fuels and global warming.

Site remediation and the reconstruction of contaminated landscape take a central role in the design investigation. *Manufactured Sites* edited by Niall Kirkwood was another major influence on this work, with essays that describe projects with a similar scale and ecological background as the site prepared in this study. The widely read and influential essays investigate various projects of reclamation processes and in some cases discuss the application of design for rethinking the use of contaminated sites. Kirkwood's collection has been useful in locating the thesis in the context of landscape remediation and redevelopment projects with a varying range of results. The works also offer technical solutions that are applicable to the remediation, reoperation, and redevelopment that will be absorbed into the approach of this thesis. Another influential work that provided insight into site remediation is *Phytoremediation of Toxic Metals: Using Plants to Clean Up the Environment* a compilation of essays edited by Ilya Raskin and Burt D. Ensley. The work expands into the technical territory involved in site remediation using plants.

The growth and decline of cities is another significant preoccupation of this investigation. *Drosscape*, written by Allen Berger, examines the phenomenon of the incredibly fast decentralization and horizontal growth of American Cities since the 1990's. His hypothesis is that rapid growth is an entropic condition that inherently leaves behind waste landscapes. He examines the phenomenon of rapidly expanding peripheral areas of major US cities and shows them in relation to the types of contaminated, underutilized, and rapidly de-industrialized spaces that remain surrounding core city areas. Berger's investigation sets an appropriate lens under which to investigate the types of waste landscapes that have generated around the site chosen in this thesis. A comparison can be made between the Windermere Basin site and the landscapes that Allan Berger describes as ‘drosscape’. In retrospect, Jane Jacobs’ classic work *Cities and the Wealth of Nations* is returned to in investigating the qualities of a city that influence its economy. *Cities and the Wealth of Nations* is also returned to with an investigative lens to understand how city economics affect the urban environment.

The relationship between urban landscape and transportation infrastructure is another investigative facet of this thesis. *Organizational Space*, written by Keller Easterling, offers an architectural lens that applies network theory to conceptualize the emergence of US interstate highways, intermodal infrastructure systems, and foreign trade zones. Easterling’s investigation looks at territories that traditionally exist outside of the scope of architecture as a means to understand a system’s operation, organization, and influence on the built world. The relevance of her work to this thesis influences ways to mediate this territory conveying a means to describe large complex systems spatially. *Landscape Urbanism Reader*, edited by Landscape Architect Charles Waldheim, offers a collection of essays on transportation systems including “Synthetic Surfaces” written by Landscape Architect Pierre Belanger. The essays of the group of Landscape Urbanists offer discourse to locate interests in this thesis.

Finally, the conceptual symbiosis of ecology and industry is also investigated in this thesis. The most influential sources of industrial ecology were: *Linking Industry and Ecology: A Question of Design* edited by Ray Cote, James Tansey, and Ann Dale; *Greening of Industrial Facility: Perspectives, Approaches, and Tools* by Thomas E. Graedel and Jennifer A. Howard-Grenville; *Economics of Industrial Ecology: Materials, Structural Change, and Spatial Scales* edited by Jeroen C. J. M. van den Bergh and Marco A. Janssen. The discussion of Kalundborg, Denmark, one of the only operational eco-industrial parks in the world, was important in explaining that its emergence was based on local social networks. Industrial Ecology is speculated upon as a spatial proposition, one in which a designer can intervene. The conception of building symbiotic networks between industry, ecology, and cultural activity, is adapted as the organizational means of the new contemporary urban park.

The symbiosis of biologically extracted energy plays a secondary role in Globe Park's reconception. The most influential works investigated were: *Biohydrogen and Biomethane: Status and perspectives of biological methane and hydrogen production* edited by J.H. Reith, R.H Wijffels, and H. Barten , Biohydrogen III edited by Jun Miyake, Yasuo Igarashi, and Matthias Rogner, and *Hydrogen as a Fuel: Learning from Nature* edited by Richard Cammack, Michael Frey, and Robert Robson. These works provide evidence of the potential to recover energy from waste using microbiological species. This speculative technology could create an alternative delivery system for energy production and delivery.

Primary sources obtained from the City of Hamilton include: *State of the Basin Report prepared by Windermere Basin Steering Committee*, *Windermere Basin - Phase 1 Environmental site Assessment Final Report 2006* prepared by Dillon Consulting, *Feasibility Study for Establishing a Wetland in Windermere Basin* prepared by Dillon Consulting, *Windermere Basin Environmental Investigation* prepared by Conestoga Rovers & Associates, *Windermere Basin Supplemental Environmental Investigation* prepared by Conestoga Rovers & Associates, and *The Red Hill Valley Project Final Impact Assessment Report, March 2003* prepared by Blackport & Associates. The documents were all relevant technical and environmental resources used in this investigation. Documentation on the environmental condition of Windermere Basin was particularly necessary in framing the needs of ecological reclamation of the site. These environmental reports ground the thesis to the real conditions that are affecting the ecological state of Windermere Basin. They provide the necessary data and mapping analysis to project temporal environmental responses to the site.

STRUCTURE The thesis is organized into four parts. The first examination establishes the contextual framework for complex systems, global considerations, and the site of the prototype park. The discussion begins by tracing how complexity has influenced contemporary thoughts on ecology and industry. The global manufacturing ecosystem is investigated for its implication on cities, landscape, and the environment. Globe Park will be deployed in response to the urgency of these matters. Following this discussion, the site of Globe Park is investigated explaining its perimeter, reclamation process, and future opportunities.

The second examination discusses the precursors to Hamilton Harbour as an industrial port. This will project a narrative for the site within the context of the Great Lakes Region's industrialization and infrastructural development. Following this discussion, a complex manufactured ecosystems analysis is developed. The analysis maps watersheds that will be influential to Globe Park's future site and evaluates their effect on the environment. The term watershed is conflated to describe regions of influence created by large scale systems. The analysis extracts information related to abiotic, biotic, and cultural flows and describes how manufacturing systems intervene in these flows. The Great Lakes manufactured ecosystems analysis is followed by a timeline that traces historic Hamilton Harbour infilling.

The third examination explains Globe Park within the context of significant contemporary urban parks, eco-industrial parks, and landscape reclamation projects. It is conceived as a hybrid form of these three precedents. Significant contemporary urban parks looked at are Parc de la Villette in Paris, Downsview Park in Toronto, and Fresh Kills Park in New York. This is followed up with a discussion of Kalundborg, Denmark's eco-industrial park. Created by social self-organization, Kalundborg's eco-industrial park is an example of industrial and ecological symbiosis. The last part of examination three discusses the landscape reclamation of Fort Devens Bureau of Prisons Military Base. Fort Deven's reclamation is relevant for its bio-engineered methods for treating degraded water systems. The project reveals that strategic design of biological systems can improve both operational and ecological processes of a site.

The fourth examination proposes a prototype hybridization process for staging Globe Park. Within this section large regional operations are considered as a precursor to design. A highly specific approach examines site operations and proposes conceptual watershed areas to manage common design areas. These organizational watersheds are used to stage future site organization. To fulfill this organization structure, Globe Park is examined both as a hybridizational and successional timeline for site reclamation. From these examinations, Globe Park is staged within a series of layers including circulation, ecosystems, surfaces, and program. Each of these layers will be staged as a successional matrix. The future speculation of Globe Park will evolve around five central hybrid facilities. These five hybrid spaces include a hybrid biomass plant, seeding parkade, aggregate estuary, recreational piles, and sewage treatment botanical garden museum. These five hybrids will be linked through operations, process, and material exchange. Each of these speculations is derived from existing site operations found within Globe Park. In the end, Globe Park is revealed in its speculate future configuration within the city. It will be revealed within the context of regional ecological and industrial systems.

These four examinations are followed up by an appendix that speculates on the future adaptability of Globe Park. The appendix reveals biological systems that may operate within the preconfigured frameworks established by the hybridization process. The appendix provides a list of strategies typically deployed in site remediation.

fig. 0.3 Herring gull nesting adjacent to Mittal Steel Wire Manufacturing Plant on Windermere Basin

fig. 0.4 Site reclamation near Windermere Basin

01 FRAMEWORK: GLOBE PARK

1.1 COMPLEXITY + ECOSYSTEMS THEORY

Globe Park is influenced by an understanding of complexity and ecosystems theory. These theories form a broad understanding of how and why complex systems self-organize. They offer a methodology for anticipating potential outcomes for the park. These outcomes are outside of the control of the designer but within the scope of anticipation. In this sense, Globe Park should be understood as a general framework for spatial organization. It potentially seeds internal networks within the overall system and is not a depiction of the end result or predetermination.

An understanding of Complex Adaptive Systems Theory, Systems Ecosystems Theory, and Industrial Ecology can be looked on as three large frameworks that help project design intentions. These theories are useful in explaining what connection and interactions will go on within the larger system of organization. This section frames a discussion of these three categories of complexity science. This understanding is then expanded to build the thesis as a hypothesis within this realm of complexity science. In section 1.2 ecosystems theory is used to frame a discussion of how manufacturing facilities, operations, and networks influence conceptions of cities, landscape, and the environment. This framework is used to trace historical development of Windermere Basin in section 1.3. Also it is used as a framework to map ecological flows affecting Hamilton Harbour and the Great Lakes Region in section 2.1. A complex system analysis will be developed in section 2.2 to map and explain cultural, abiotic, biotic, and energetic flows within Hamilton and the Great Lakes Region. In section 2.3 this analysis is used to describe flows that formed Globe Park's contemporary site. This analysis will help decode intelligence necessary to advance the staging of Globe Park as a hybrid eco-industrial park on this site in section 4.

fig. 1.1 Symbiotic Relationship in Nature

COMPLEX ADAPTIVE SYSTEMS Complexity science originates from a collective of highly interdisciplinary theoretical frameworks that explain complex interactions among living, adaptable, and changeable systems. The Santa Fe Institute originally coined the term Complex Adaptive Systems (CAS), which looked for a broad interdisciplinary explanation for complexity in ecosystems, the biosphere, human bodies, cells, stock markets, insect colonies, politics, communities, and manufacturing businesses. American scientist John H. Holland helped pioneer the idea of complex adaptive systems as "dynamic networks of many agents that act in parallel constantly reacting to the actions of other agents. Holland's explanation accepts that control of CAS tends to be decentralized and dispersed. Coherent behavior in the system arises from competition and cooperation among these agents. The system's behavior is the result of a large number of decisions made by many individual agents' every movement".[9] Two theoretical branches of complex adaptive systems study synergy and symbiosis as the precursor to emergence and self-organization. To differentiate between synergy and symbiosis in the interactions of multiple entities, Peter A. Corning, director of the 'Institute for the Study of Complex Systems', offers the following explanation:

> ". . . there seems to be general agreement that symbiosis refers to relationships of various kinds between biological entities and the functional processes that arise from those relationships. Synergy, on the other hand, refers to the interdependent functional effects (the bioeconomic payoffs) of symbiosis, among other collective phenomena. In short, all symbioses produce synergetic effects, but many forms of synergy are not the result of symbiosis".[10]

The theory of symbiotic evolution was originally advanced by the American biologist Lynn Margulis as a major revision of Darwin's theory of evolution. In her early publication "Genetic and Evolutionary Consequences of Symbiosis" Margulis proposes that "evidence is accumulating that major groups of organisms have *fig. 1.2* Kisho Kurokawa's extension over Tokyo Bay

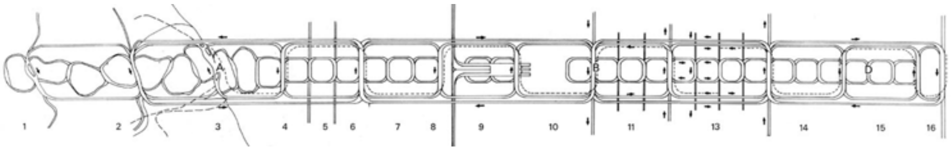
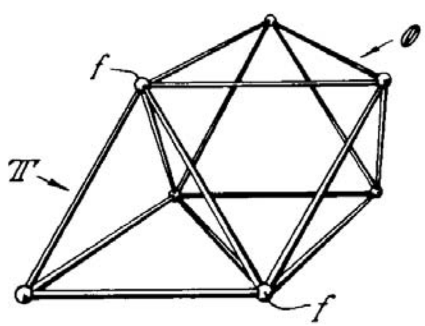


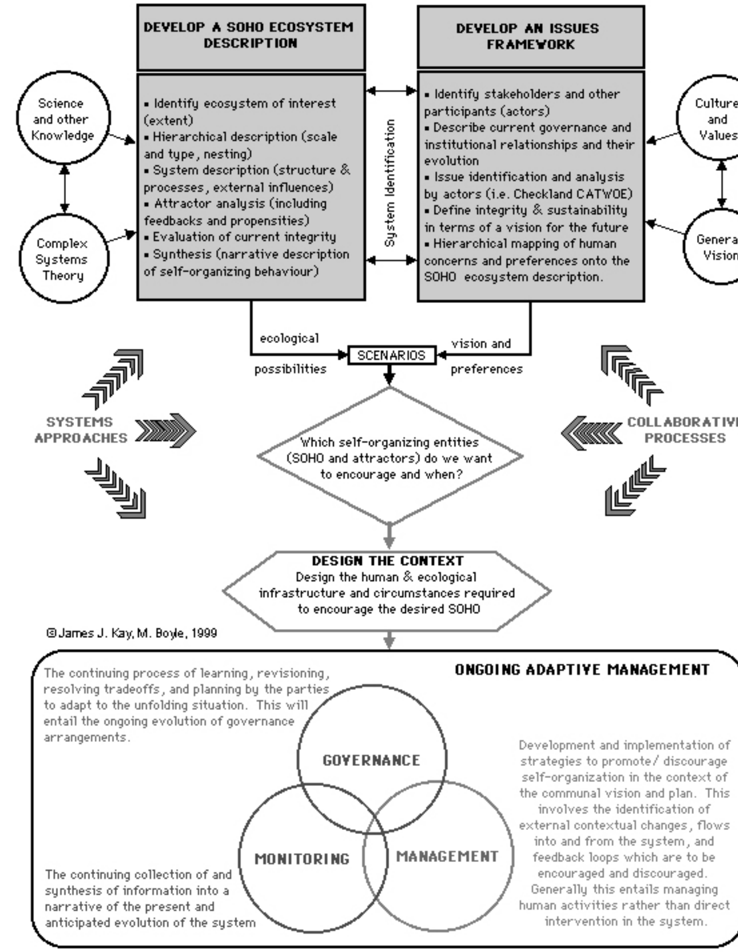
fig. 1.3 Buckminster Fuller's Octetrus



originated as products of symbioses between remotely related partners. It has been postulated that in certain symbiotic associations the genes of one partner may have been transferred to the second partner. Cases documenting hereditary retention not only of entire unrelated cells, but of parts of unrelated cells are appearing, that is, reports of hereditary retention of foreign organelles".[11] The theory anticipated that two competitive antagonistic species can be evolved through the creation of symbiotic relationships.[12]

Architect Kisho Kurokawa, in the 1960s, was the first to anticipate the theory of symbiosis in design. He foresaw that a major shift in architecture from 'Bourbakian' systems to 'non-Bourbakian' systems would parallel those occurring in other fields including science, economy, art, and culture. He saw that the established systems of thought of Euclid, Galileo, Descartes, Newton, and Darwin were being replaced.[13] Through design, Kurokawa attempted to replace modernism's concepts of dualism and established symmetry, with the theory of metabolism based on the principles of diachronicity and synchronicity.[14] Kurokawa saw that the 'age of life' would challenge the order of the 'age of machine' and complexity would replace reduction in contemporary disciplines.

In the early 1970s, Hemann Haken founded the field of synergetics. His original interpretation of laser principles as non-equilibrium systems and self-organization were the precursor to synergetics. In ecology the theory helps hypothesize why natural systems gravitate toward subsystems that maximize energy and nutrient expedience. Peter A. Corning proposes that biological systems form synergetic relationships when more than one entity works towards a similar task to create a result that is more than if it were acting individually. To borrow from Corning's words, ". . . it is the proximate advantages (the payoffs) associated with various synergistic interactions (in relation to the particular organism's needs) that constitute the underlying cause of the evolution of cooperative relationships and complex *fig. 1.4* Schematic for James J. Kay's Ecosystem Approach



organization in nature".[15] Corning also claims that "synergy is found at the heart of the self-organizing phenomena; in effect, synergy may be the functional bridge that connects self-organization and natural selection in complex systems".[16] Architect Buckminster Fuller adapted the theory of synergetics into his work by interpreting "synergy as the behavior of the whole system that is unpredictable by the behavior of the parts taken separately".[16] His design of complex structural systems represented in [figure 1.3] expresses this underlying idea. Complex systems theory can be adapted to study how working relationships emerge in urban organization. This could help in the design of urban ecosystems that improve spatial and environmental quality. Complex Adaptive Systems theory is a precursor to systems ecology based on concepts of thermodynamics and exergy in self-organization.

JAMES J. KAY'S ECOSYSTEM THEORY James J. Kay's Self-Organizing Holarchic Open Systems (SOHO) approach advances the principles of complexity science. The methodology is outlined in Kay's publication *An ecosystem approach for sustainability: addressing the challenge of complexity*, that complex systems such as natural ecosystems and human urban systems should be looked at as wholes and draws upon the concepts of catastrophe theory, chaos and complexity theory, non-equilibrium thermodynamics, and self-organization.[18] In an open system, spontaneous behavior will occur as a precursor to change when a capacity threshold is approached. A capacity threshold is the actual point where sudden change occurs. An enduring flow of energy is referred to as exergy. Exergy is the term given to high quality energy exerted onto a system; it is the binding source that SOHO systems are organized around. At a capacity threshold a flip into a new coherent behavior will result.[19] If exergy becomes excessive, the system will move away from equilibrium. An open system responds with a spontaneous emergence of organization to dissipate the unbalanced excess energy. If it reaches beyond a critical distance from equilibrium the system becomes overwhelmed and can become chaotic.[20] There is a window between these occurrences where self-organization is probable. The specific processes that emerge are uncertain. Based on this understanding of complex systems, everything is connected and when a dissipative process emerges it manifests itself as a self-governing structure.[21] A holon is a behavior due to these interactions of the components of the system. In a nested network of holons holarchy is the makeup of the network. There is a hierarchy that makes up their organization. Holarchy can be a generalized version of the traditional hierarchy.[22] The link between the theory of self-organization in complex systems and urban ecosystems anticipates that cities evolve partly because of entropic forces such as cultural, economic, ecological, and political flows. The interest in complexity theory and self organization can help project future volatility and adaptability of urban systems.

James J. Kay's theory of self-organization suggests that after the critical point in a self-organized complex system is reached there will (a) be fluctuations in the global system followed by reorganization into a new SOHO system, or (b) a final tendency that reaches past the critical point and begins a state of chaos.[23] According to these definitions the system will reach the capacity threshold and perform one of the above-mentioned scenarios. Applying an understanding of SOHO systems to manufacturing ecosystems can anticipate the impact to the system when it reaches its capacity threshold. This threshold could be caused by a number of factors including global warming, peak oil, environmental degeneration, market volatility, terrorism, or a combination of these factors that will leverage change to the structures that allow the system to organize itself. The outcome would affect the spatial structures indicating that there will be a change in the self-organization of urban systems.

Systems ecology hypothesizes that natural ecosystems are part of complex relationships where dynamic activities form holarchic relationships between abiotic, biotic, and energetic flows. Adapting this lens of ecosystems theory can help influence the development of more environmentally benign manufacturing ecosystems. The design of this framework will need to facilitate both natural and manufacturing ecosystems as dynamic open systems. In "Is the US Economy dematerializing?", published in *Economics of Industrial Ecology*, industrial ecologists Robert U. Ayers, Leslie W. Ayres, and Benjamin Warr have hypothesized about the importance of ecosystems theory in developing industrial communities.[24] They state that:

> ". . . exergy is defined as the maximum amount of work that can be extracted from a subsystem as it approaches equilibrium reversibly with its surroundings. Thus a substance with little or no exergy content is almost indistinguishable from its surroundings, and conversely . . . exergy is a measure of distance from equilibrium. This means that some chemical exergy is embodied in all material wastes. But of course the most dangerous wastes, environmentally speaking, are the ones with the highest exergy content, meaning they are chemically reactive".[25]

These principles indicate that certain material discharged in industrial waste react more intensely with their environment. This theory helps explain why certain ecologies become more intense around industrial land use. The implications of exergy content can help inform how urban and natural relationships are spatially organized relative to industry. Speculatively, materials with higher exergy content would pose less environmental threat if stripped of their reactive content before contacting humans or the environment. Organizing ecological actors and industry based on comparable exergy content is another possibility to reduce impact. This could facilitate hybrid interactions among discharged materials and ecosystems.

The implications of urban manufacturing ecosystems can be studied as cultural actors impacting the ecological process at levels. James Corning in his essay entitled "Landscape Urbanism" published in *Landscape Urbanism: A Manual for the Machinic*

Landscape, claims that for designers ". . . ecology teaches us that all life is bound into dynamic and interrelated processes of codependency. Changes in the effects produced by an individual or ecosystem in one part of the planet can have significant effects somewhere else".[26] Corner recognizes that engaging ecosystem process in design can have positive large-scale implications environmentally and culturally. This is a critical position since industrialization is increasing globally and creating new friction between cultural values and the environment.

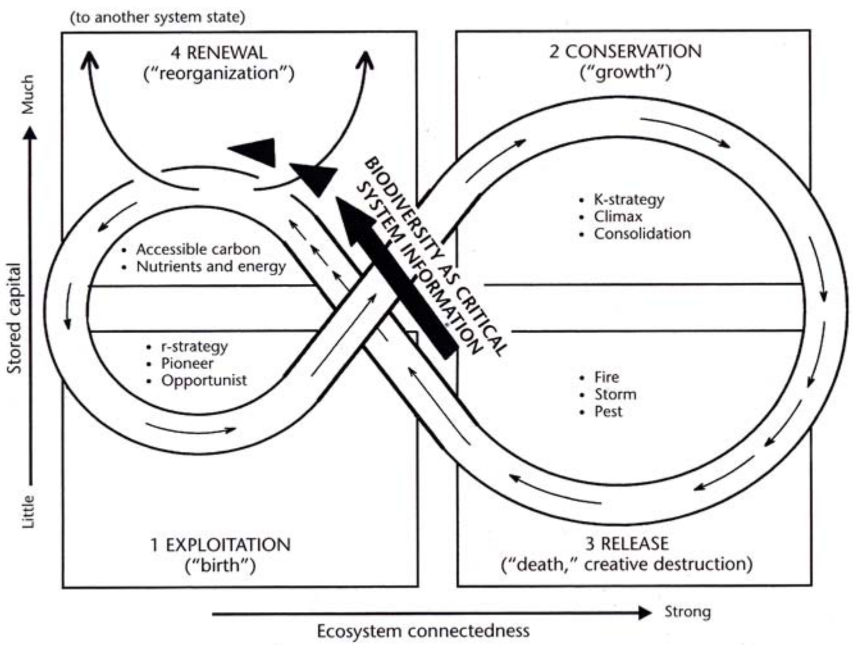


fig. 1.5 Schematic for ecosystem dynamics: Holling's modified figure eight — Represents the succession of an ecosystem. This general framework is adapted by industrial ecologists to generate self-organizing networks of more environmentally benign industrial systems.

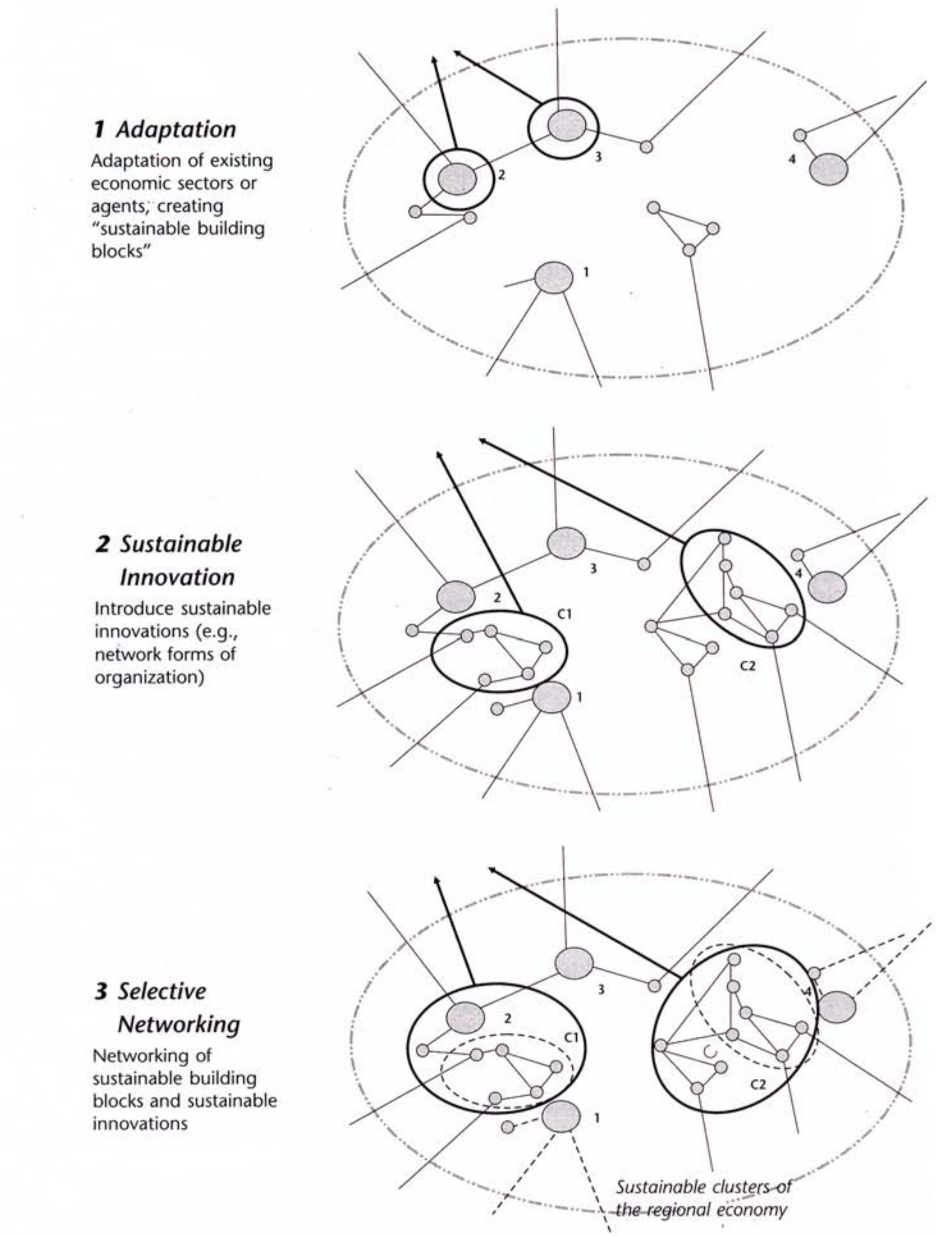
INDUSTRIAL ECOLOGY Industrial Ecology is a multidisciplinary framework based on ecological, technological, and cultural studies of industry as an ecological actor. It builds on knowledge that ecosystems and industry coexist and that their material exchanges affect one another. Industrial systems like factories, eco-regions, and global economies are proposed by Industrial Ecology as each part of an ecosystem that interacts with the biosphere. Ann Dale who studies the dependency of industrial systems on nature describes the scale at which industrial systems have altered global ecological process. In her essay "Linking Industry and Ecology in Canada" published in *Linking Industry & Ecology: A Question of Design*, she explains that there is evidence that human systems are coevolving with ecological systems:

> "Given our current appropriation of over 50 percent of the carrying capacity of the earth's terrestrial and aquatic systems for human use, it is clear that we are now approaching critical biophysical limits and that we have become the most dominant species on the planet. This dominance, coupled with evidence that human systems are coevolving with ecological systems, means that we need to engage in deliberative design and redesign of our present industrial systems; industries can no longer muddle along independently of one another, in isolation of other communities, and with disregard for the cumulative impacts of our activities on natural systems".[27]

Industrial ecologists seek to develop industrial exchange networks that mimic natural ecosystems through synthesizing ecosystem process. Their intention is to generate sustainable industrial operations with more imbedded ecological sensibility. Symbiosis among industrial and ecological disciplines has the capacity to help create more environmentally benign production practices. Frank Boons and Marco A. Janssen articulate in their essay “The Myth of Kalundborg: Social Dilemmas in Stimulating Eco-Industrial Parks”, published in *Economics of Industrial Ecology* that, “in the field of environmental sciences, the concept of “industrial symbiosis” and “industrial ecology” refer to the idea that the negative ecological impact of economic activities may be reduced more efficiently and effectively if the boundary of the system submitted to environmental management is drawn not around an individual firm, but instead around a group of firms”.[28] Industrial ecologists Noel Brings Jacobson and Stefan Anderberg describe comparable symbiotic relationships that occur in industrial operations in their essay entitled “Understanding the Evolution of Industrial Symbiotic Networks: The Case of Kalundborg” published in *Economics of Industrial Ecology*.

> “No matter the level of improvement of technology, every production process generates, in addition to the useful product, some waste. If total material efficiency is to increase and overall material use to decrease, these wastes must find productive use. This is why networks based on exchange of by-products and resource sharing have attracted increasing attention during the last decade in many countries all over the world. This type of network activity – “industrial symbiosis” – seems often to have both economic and environmental benefits . . . Industrial symbiosis typically emerges spontaneously through the establishment of bilateral exchange relations among industrial manufacturers in an industrial district. This process may go very slowly, but as more actors get involved, an integrated network is established”.[29]

fig. 1.6 Three critical strategies for adapting sustainable industrial ecology



As disciplines, industry and ecology traditionally operated in conflict. Industrial ecology attempts to mediate this relationship. Dale refers to eco-industrial design as "... a critical approach for navigating a new interface between culture and nature".[30] It seeks to lessen the impact that industrial systems have on the environment by reprocessing the maximum amount of reclaimed materials and through optimizing precision and efficiency. Industrial ecologists place an emphasis on design since "eighty to ninety percent of the costs of a typical product, and 80 percent of its environmental impact, are determined during the design stage".[31] The concept of Industrial Ecology can help organize sustainable priorities in urban design.

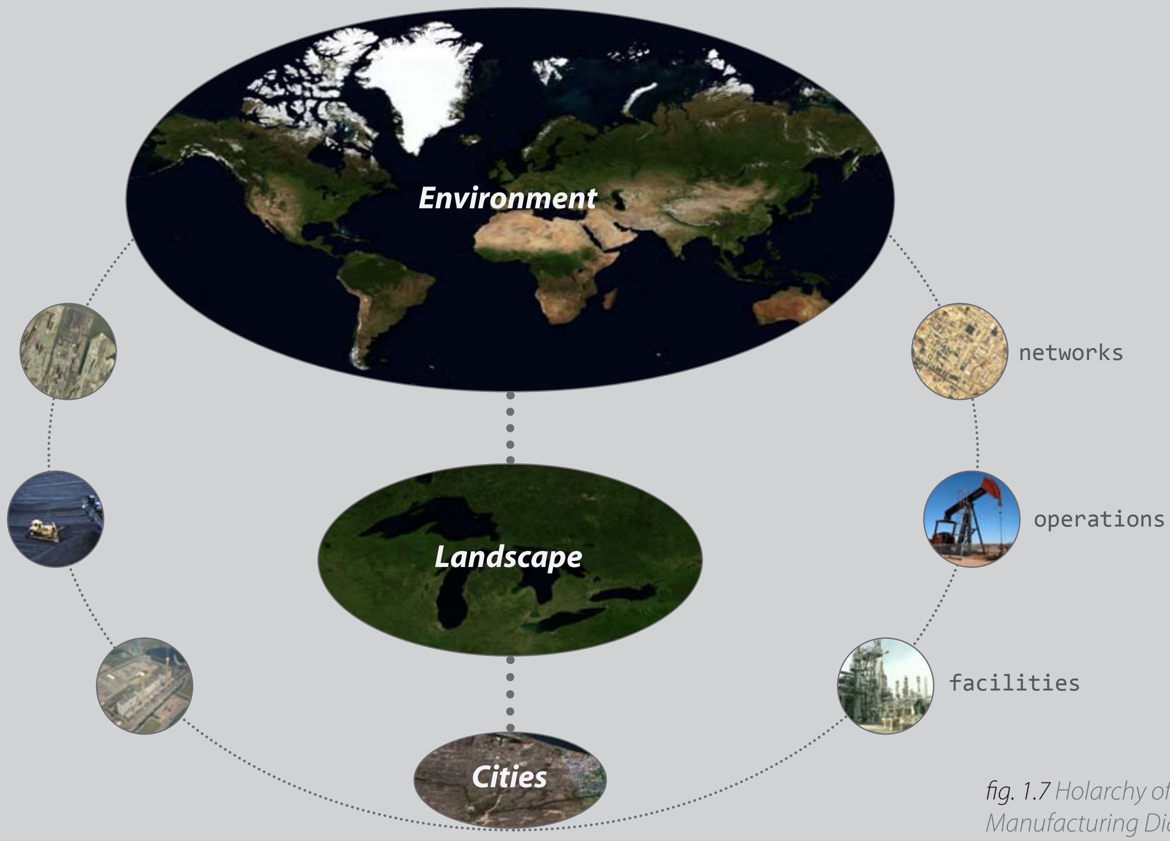


fig. 1.7 Holarchy of the Implications of Manufacturing Diagram

1.2 GLOBAL CONDITIONS

Globe Park offers a new consideration for the way that an urban park responds to its surrounding environment. As an urban space it is interested in the way that cities, landscape, and the environment are manufactured by human intervention. This section frames an understanding of how these three conditions are impacted by industrialized urban environments. First, the discussion of cities is framed by looking at the work of Jane Jacobs, Keller Easterling, and Alan Berger, who present strong explanations for the way cities are formed by predominant interregional economic and infrastructural systems. Second, a discussion of manufactured landscape is discussed based on influence from Alan Berger and several industrial ecologists including Nina-Marie Lister, Stuart B. Hill, and Thomas E. Graedel. As a collective discussion, a case is presented regarding how urban environments are influenced by industrialized landscapes that typically operate within a large hinterland outside of the city. Third, a discussion of the manufacturing of the global environment is framed in terms of global warming, peak oil, and pollution from industrial outputs. These conditions frame Globe Park's interests as it intends to hybridize a more sustainable codependency between industrial and ecological systems. These large global environmental concerns create urgency for rethinking the urban environment and the role of urban park, which Globe Park will be responsive to.

fig. 1.8 *Manchester Cottonopolis — The number of cotton mills in Manchester peaked at 108 in 1853 inspiring the title Cottonopolis*

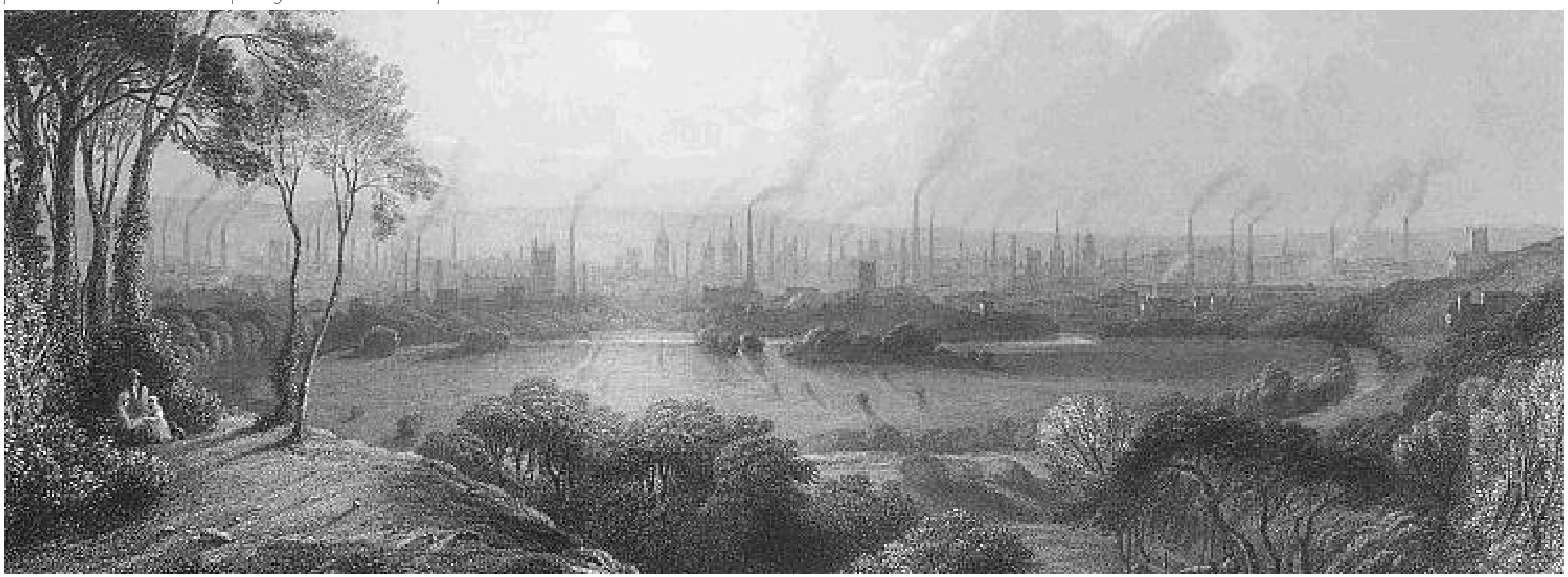
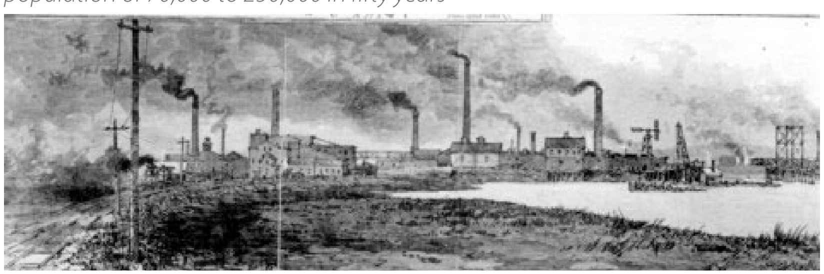


fig. 1.9 *Manchester Newton Creek Factories — During industrialization, it is estimated that Manchester grew from a population of 70,000 to 250,000 in fifty years*



MANUFACTURING CITIES Tracing the origins of manufacturing ecosystems in cities, 18th century Manchester, England is a necessary departure point. Manchester existed as a nondescript northern-England borough that remained secondary to the neighboring town of Salford for hundreds of years. In the 1600s, Manchester had become a hub for wool trade with no indication that the city would launch as a center of technological and commercial revolution.[32] The industrial emergence of Manchester between 1700 and 1850 made it the first industrial boom city. The population of the city in 1173 was estimated at 24,000, in 1801 it grew to 70,000, and by the mid 18th century it reached 250,000.[33] The growth rate was propelled initially by the invention of the steam engine and its attendant labour force. During this boom period, Manchester operated outside the control of British parliament as a feudal manor.[34] The city was without representation in local government and lacked city planners and public health authorities. Steven Johnson in Emergence explains that Manchester was not politically governed until its growth subsided:

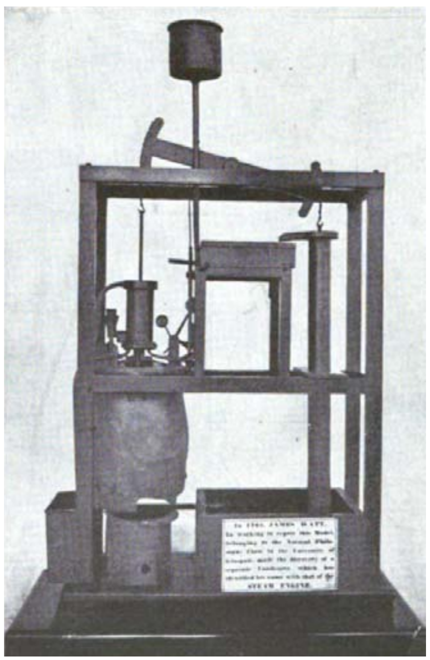


fig. 1.10 Newcomen Steam Engine — Innovations like the Newcomen engine are attributed to the explosive growth of Manchester

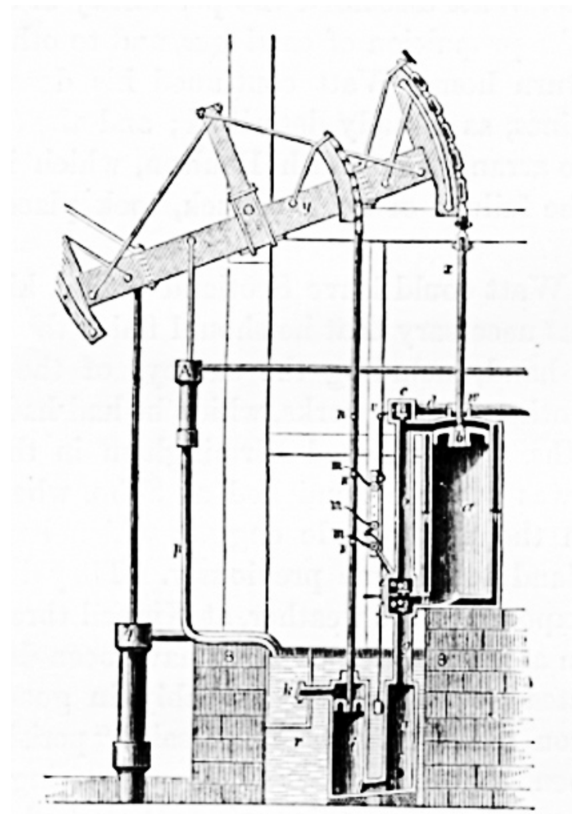


fig. 1.11 Watt's Engine 1774 — Revisions to original innovation are attributed to ongoing industrial expansion

> "By the early 1840s, the newly formed borough council finally began to institute public health reforms and urban planning, but the British government didn't officially recognize Manchester as a city until 1853. This constitutes one of the great ironies of the industrial revolution, and it captures just how dramatic the rate of change really was: the city that most defined the future of urban life for the first half of the nineteenth century didn't legally become a city until the great explosion had run its course".[35]

Manchester illustrates the notion of city as a dynamic self-organizing system. The result of the political disorder of its self-organization arguably created one of the least planned cities in the recorded history of urban settlements. French historian Alexis De Toqueville wrote the following to describe what he observed in Manchester in 1835:

> "From this foul drain the greatest stream of human industry flows out to fertilize the whole world. From this filthy sewer pure gold flows. Here humanity attains its most complete development and its most brutish; here civilization works its miracles, and civilized man is turned back almost to savage".[36]

Emerging roles of urban occupation were originally created by hasty processes of innovation. The role of innovation and manufacturing in cities is crystallized by Jane Jacobs's idea that the most vigilant cites are the most productive in their ability to innovate and develop ideas through a process she calls 'import replacement'. Her idea is consistent with the conditions that influenced Manchester's growth. It also continues to be relevant to explain the economic flows of contemporary cities. To begin this process of 'import replacement' a city must internally innovate new and unanticipated processes for the persons of the city to work. This process creates affluence for the city's citizens and adds value to imported goods and materials. Jacobs witnessed that larger, more complex cities developed a broad region of hinterland cities that 'import replaced' as part of this process. Jacobs also saw that innovation originated from ideas of persons that considered unanticipated operations in design claiming the following:

> "Economic life develops by grace of innovating; it expands by grace of import-replacing. These two master economic processes are closely related, both being functions of city economies. Furthermore, successful import-replacing often entails adoptions in design, materials or methods of production, and these require innovating and improvising, especially of producers' goods and services".[37]

There is a relationship created between a city's processes of innovation and manufacturing that ensures future occupations are developed and maintained for its citizens. These occupations derive continuous, ongoing economic processes in an array of service sectors. The implications that these processes have on employment within the city is congruent to its innovative and productive capacity. Cities can be interpreted as dynamic and self-organizing with their inhabitants generating processes of an urban ecosystem.

fig. 1.12 Manufacturing in China image by Ed Burtynsky — A contemporary consideration of Jane Jacobs' idea of import replacement questions how these processes can be more meaningful and sustainable

A contemporary consideration of Jane Jacobs' idea of 'import replacement' questions how urban manufacturing operations should develop a sustainable relationship to the environment. An indication could be the transition of imports as material goods to knowledge and information. Knowledge and information have surpassed material goods in terms of value which is organized and transferred by technology. Observations about the capacity of technology and innovation in economic activity are paraphrased by Jane Jacobs here:

> "The innovative capacity of this type of firm," Sable goes on, "depends on its

> flexible use of technology; its close relations with other, similarly innovative firms in the same and adjacent sectors; and above all on the close collaboration of workers with different kinds of expertise. These firms practice boldly and spontaneously the fusion of conception and execution, abstract and practical knowledge, that only a few exceptional giant firms . . . have so far been able to achieve on a grand scale".[38]

fig. 1.13 The North American expressway — Published in 'A National Plan Study Brief' the expressway was conceived as an organizer of industrial development

Sable observes the complexity of manufacturing operations and attempts to understand human occupation in these relationships. Network developments parallel the co-evolution between manufacturing and humanity. The relationship between the import and manufacturing process are networked by logistic and intermodal infrastructure. The contemporary differential of this network its created by switch points in the system. Keller Easterling, in *Organization Space Landscapes, Highways, and Houses in America* recalls that networks of infrastructural intermodality were proposed first as a means of organizing industrial development.

> "One of the first highway proposals that looked opportunistically at redundancy and possible intermodality among various transportation networks was made not by a traffic engineer but by a landscape architect. In 1923 Warren H. Manning (1860-1938) published what he called 'A National Plan Study Brief' that, similar to the proposed studies of the technocracy movement, surveyed water power, mineral resources, soils, factory centers, rainfall, forested areas, and infrastructure in the United States and proposed a new plan for their management".[39]

The processes that produce items used within a city are central to the economic and sociological constructs of its citizens. In this sense, a city is permanent as long as its transient activities remain operational. The organizational activities in manufacturing, are embedded in modern urban settlement patterns. The outcome of

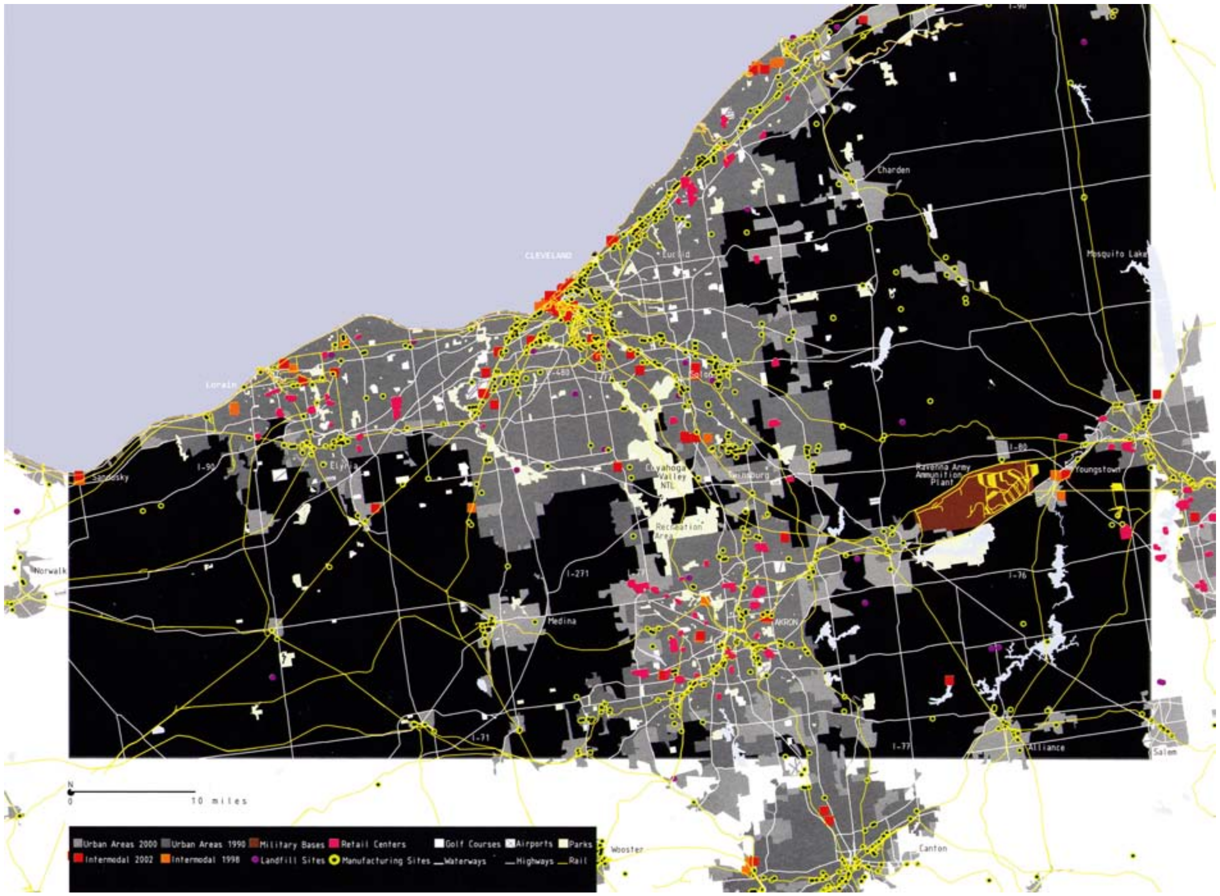


fig. 1.14 Cleveland Entropic Indicators by Alan Berger 2006 — The mapping analysis represents a series of major intermodal infrastructures that influenced growth patterns

this activity assembled industrial facilities close to cities where they were supported by work forces linked by distribution infrastructure. Keller Easterling examines the network of the North American highway to claim that “the highway was legislated as an intercity network, yet it was not specialized to interface with the complexities of the city, and was simply designed to pass uninterrupted through urban fabric. Rather than becoming differentiated at its intersections, the system replicated itself, generating products and morphologies of its own structure within more complex urban environments”.[40] The intercity linkage of highways created opportunities for municipalities that neighbored the older core cities to organize new industrial land along these networks. The traditional urban fabric was modified by the organization of highway space. A new urban morphology centered on the highway challenged the conventional modes of urbanism established by core industrial operations. The change in urban morphology [fig. 1.14 and fig. 1.15] for Cleveland, Ohio between 1904 and 2006 was influenced by this shift in centrality. The organization of the city mutates and sprawls to accommodate the development of major highways and intermodal infrastructure.

fig. 1.15 Cleveland in 1904 — A significant change between 1904 and 2006 can be observed in the location of major industrial sites from centralized to decentralized

fig. 1.16 Oxford Tire Pile photograph by Ed Burtynsky — Stockpiles of wasted manufactured product form outside of major cities

fig. 1.17 Hagersville Tire Pile Fire — The stockpiles are waste landscapes that pose significant environmental risk if not tended to in a responsible matter

MANUFACTURING LANDSCAPE Urban industrialization modifies natural landscape because its progress is tangential with its spatial ingestion of raw materials. Contaminated altered landscape has implications on the health of both urban and natural environments, which raises cultural concerns over its long-term implications. Alan Berger writes in *Reclaiming the American West* that concerns over altered landscape are at least 2000 years old, citing Pliny the Elder's writings in 76 A.D.:

> ". . . in regard to nature's elements we have no gratitude. For what delights and for what outrageous uses does she not subserve to mankind? She is flung into the sea, or dug away to allow us to let in the channels. Water, iron, wood, fire, stone, growing crops, are employed to torture her at all hours, and much more to make her minister to our luxuries than our sustenance".[41]

fig. 1.18 Nickel Tailings photograph by Ed Burtynsky — Represents industrial effluent layered over obstructed natural process

Industrial operations intrinsically modify landscape while catering to economic means. Industrial ecologist Rebecca Krinke offers the idea that the industrial revolution changed the human relationship with the environment. She explains that, ". . . as the world moved from agriculture to industry, a mechanic view of the universe began to supplant the idea of an organic nature".[42] The idea of an organic nature replaced by a mechanic nature is evident in the activities generated by western settlements during the industrial revolution. During this time period a shift in consciousness mediated a new conception of landscape. The natural landscape was abstracted as currency. This abstract relationship created the financial infrastructure for industrial society to center the economics of land as its foremost operation. Industrial ecologist Nina-Marie Lister offers the following summarization of these changes:

> "The modern industrial notion of the world viewed nature as a commodity. Something that was infinite and separate from humanity. The "modern condition" is founded on the notion that humans are separate, distinct from nature. Whereas nature is raw, disordered, unkempt, and dirty, humans are cultured, refined, clean, ordered, and neat".[43]

The abstract notion of land as commodity placed economic prosperity before environmental health. These implications have lead to degraded environmental conditions on industrial sites and their affected ecosystems. The project of minimizing the impact of these conditions through design and reclamation has the capacity to generate new conceptions for landscape occupation. Alan Berger offers that this reclaimed "landscape space is unique because it transforms through its occupation and production as well as through its natural environment. As humans produce space (and alter the landscape to suit their purposes), other forces in the form of natural processes, are simultaneously deployed, autonomously in and around the space".[44] This congruency between human activity and ecological activity is identified by Jane Jacobs in the following description:

> "Many of the root processes at work in natural ecologies and our economies are amazingly similar and we can learn much about success and failure in our own arrangements by noticing for example, that the more niches that are filled in a given natural ecology, other things being equal, the more efficiently it uses the energy it has at its disposal, and the richer they are in means for supporting life".[45]

With the identification of the common relationships between human and natural systems, this direct engagement shows urban operations unavoidably manufacture altered landscape. The growing world population, expected to increase by approximately fifty percent over the next century, is an indication that industrial activity will continue to grow in the future. Statistical trends from the World Bank in 2003 indicate that:

> ". . . in heavily indebted poor countries, the proportion of GDP provided by industry grew quickly from 22 percent to 26 percent between 1998 and 2002. In rich countries, by contrast, the proportion of Gross Domestic Product (GDP) coming from the production of manufactured goods is slowly declining, currently providing some 29 percent of GDP, with services making up the bulk of the economy. Overall however, industrial production continues to grow worldwide, as economies grow".[46]

fig. 1.19 Worlds largest mine — Mirny's diamond mine in eastern Siberia is so deep that the surrounding air zone is closed for helicopters after a few accidents when they were sucked in by downward air flow

Summarizing these implications of this Industrial ecologist, Thomas E. Graedel writes in *Greening the Industrial Facility* that:

> "some critics tend to desire that less industrial activity be prevalent, however, urban population growth is inherently the main component in industrial development. To add to the issue, the consumption of resources both individually

fig. 1.20 *Urban mining operations approximately 750m from Windermere Basin in Hamilton, Ontario*

and as a society continue to increase".[47]

This further illustrates that altered manufactured landscape will consume more territory as industry expands. Its growth will continue to mine for more material input in new ways, becoming more inventive in finding and using resources. Industrial expedience is dependant on nature through the medium of technology. The dependence on nature is amplified by technology's increased material input from manufactured landscape. Urban life is mediated by the technologies made possible by materials mined from these sites. Graedel expands on this co-evolution between technological development and altered landscape:

> "Most technology is involved in the trade between the materials that provide products for modern industry. Significant energy is required to gather these materials and put them into suitable form. These materials are ultimately extracted from nature and require significant transportation systems that interrupt natural systems on their way towards their ultimate destination".[48]

We are confronted with a paradox between the use of technology and the environment. Technology seems to allow us to lead lives with higher standards while the millions of manufacturing processes that make it possible threaten the environment we require to survive. For example, technological innovation has replaced repetitive manual labor in productive tasks, while contributing to global warming and soil contamination simultaneously. Technology is not the root cause of the degraded state of natural landscape. Environmental disturbances are an inevitable result of human activity. The underlying issue is the relationship between technology and societal values.[49] If the physical state of the environment is not valued, it will not be reclaimed. The role of design is to mediate this reality by generating cultural interest in spaces that facilitate public landscape reclamation.

fig. 1.21 *Slag and aggregate piles adjacent to Windermere Basin in Hamilton, Ontario*

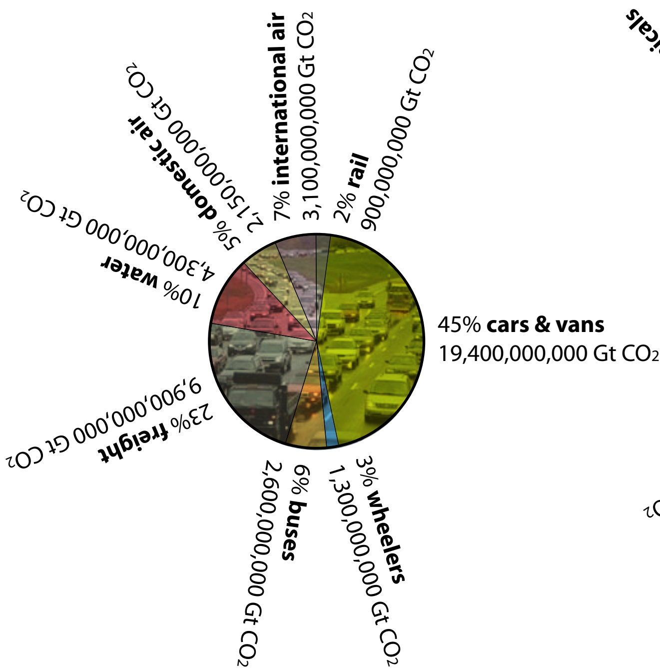


fig. 1.22 Transportation based global carbon dioxide emissions

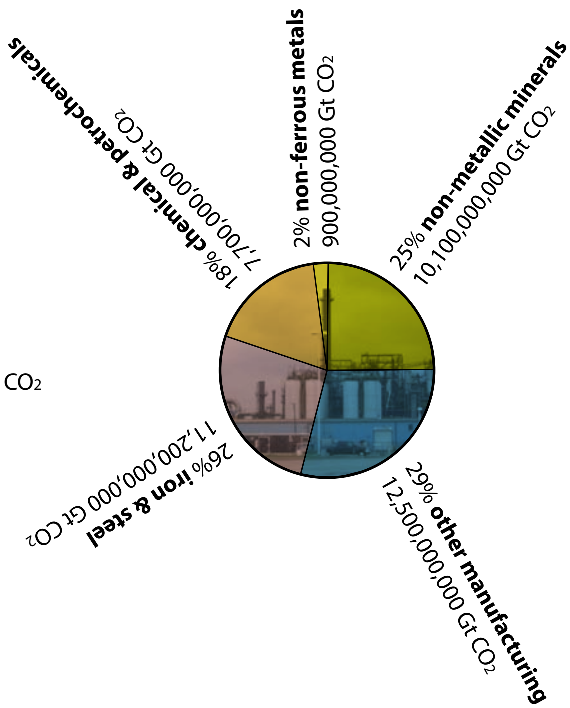


fig. 1.23 Industry based global carbon dioxide emissions

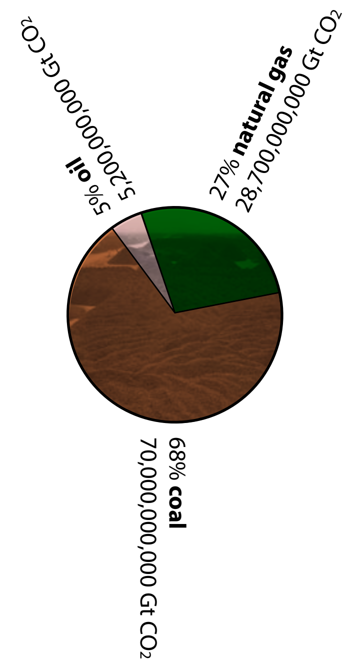


fig. 1.24 Energy based global carbon dioxide emissions

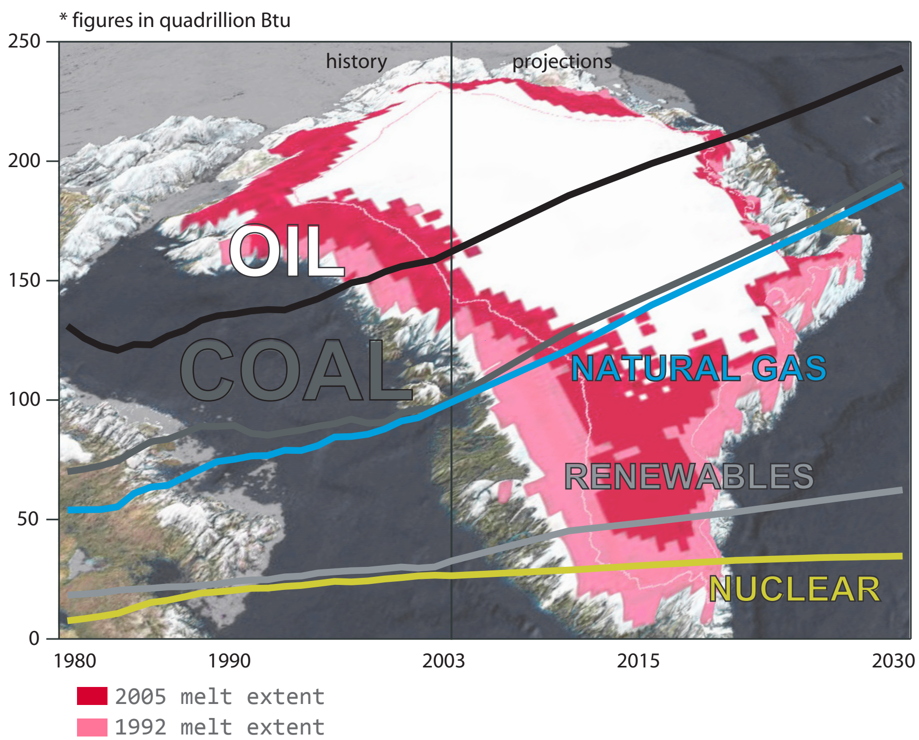


fig. 1.25 Projected global energy use until 2030 by fuel type vs. melting Greenland Ice Shelf

MANUFACTURING ENVIRONMENT Global industrial society has entered a time period in which it consciously alters the global environment. Science confirms that living systems across the planet respond to the operations of industry, indicating that industry is in fact an ecological actor. Industry is an analogous system for manufacturing both individual and collective relationships to nature. As Stuart B. Hill states in his essay in *Industrial Ecology: Linking Industry and Ecology* that "money and economic systems, like politics, technology, and even religion, are human constructions (in a sense, merely tools) that enable us to act on our values".[50] Hill further explains that, "Industry, like economics, politics, and religion, is a social construct. Designed and used appropriately, industry can serve us in supporting the well being of both people and the planet".[51] In its contemporary configuration, industrial production is streamlining both social and empirical doctrines for profit and GDP. Reported by the United Nations ,"industry is a significant engine of growth providing 48 percent of GDP in East Asia/Pacific, 26 percent of GDP in lower-income countries and 29 percent of GDP in higher-income countries, although this last figure is declining".[52] Modern industry is a volatile organism whose flows of commodity lineate from economic determinacy devoid of spatial or environmental doctrines. This is formulating urgency for understanding three of its negative environmental alterations: global warming, land pollution, and water pollution. Globe Park is inherently interested in mediating these alterations to the maximum of its ability.

GLOBAL WARMING IS MANUFACTURED BY THE OPERATIONS OF INDUSTRIAL ACTORS. The Intergovernmental Panel on Climate Change (IPCC) concludes, "most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations".[53] From the beginning of the Industrial Revolution consumption of fossil fuels has increased carbon dioxide levels from a concentration of 280 ppm to 380 ppm. The IPCC's special report on emissions scenarios places the range of future CO2 scenarios between 541 to 970 ppm by the year 2100.[54] The Union

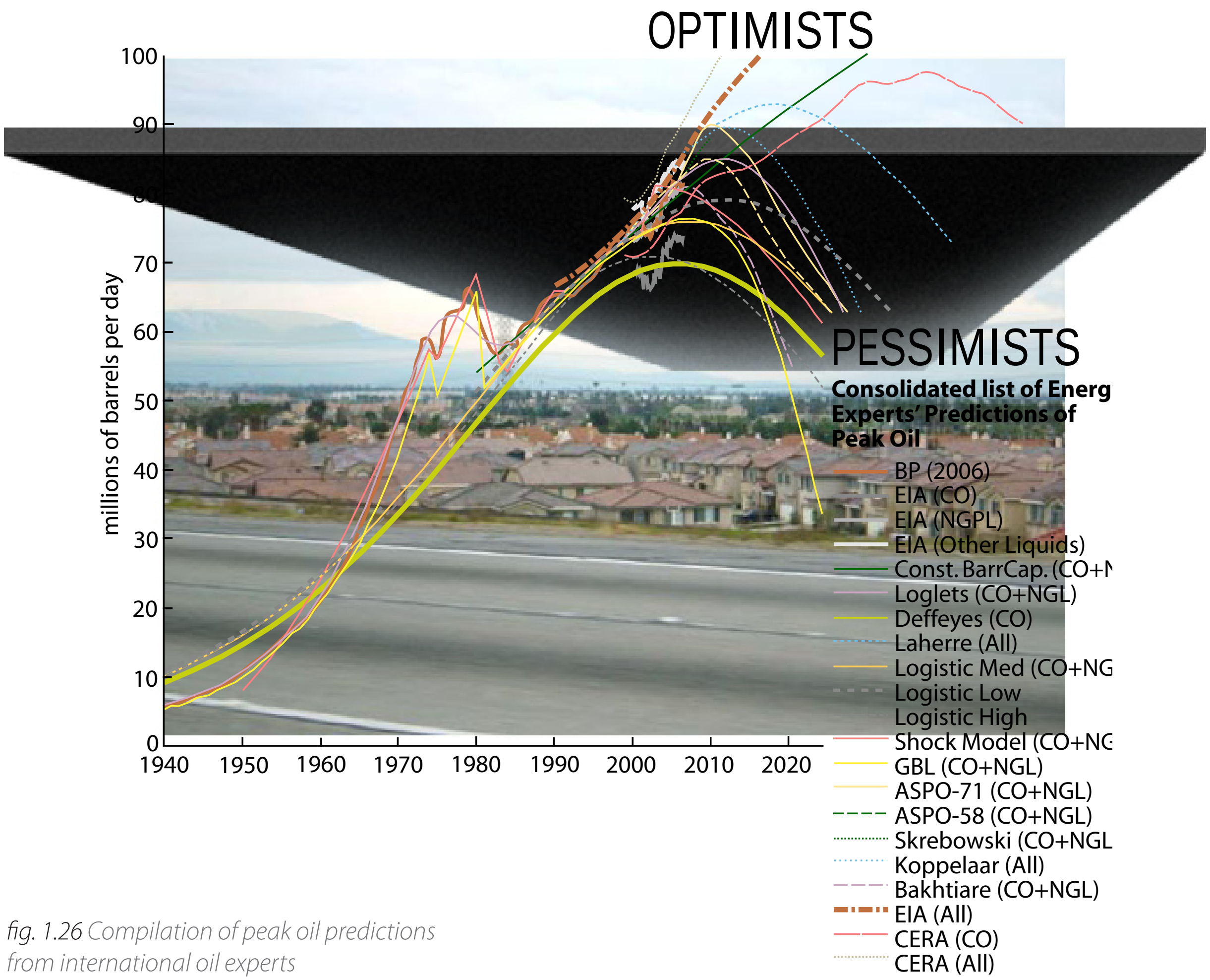


fig. 1.26 *Compilation of peak oil predictions from international oil experts*

of Concerned Scientists concludes that warming global climates will affect the Great Lakes .[55] Outlined in the Stern report, the economic concerns of global warming are projected to be substantial if future catastrophic weather scenarios occur. Concerning climate change Stern substantiates that, "our actions over the coming few decades could create risks of major disruption to economic and social activity, later in this century and in the next, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century".[56] Statistically, net global production of carbon dioxide has only increased since the scientific discovery of global warming. Hydrocarbon fuel burning is propelling services, tasks, and mobility to increase energy use. Cultural irrationality is also accelerating these trends with spatial organizations that maximize energy consumption. Contemporary living and working arrangements are compounding this by creating differentials for speed, delight, and productivity. As part of the global network of space, these operations perilously impact urban dynamics, while at a primary level they act as conduits of individuality.

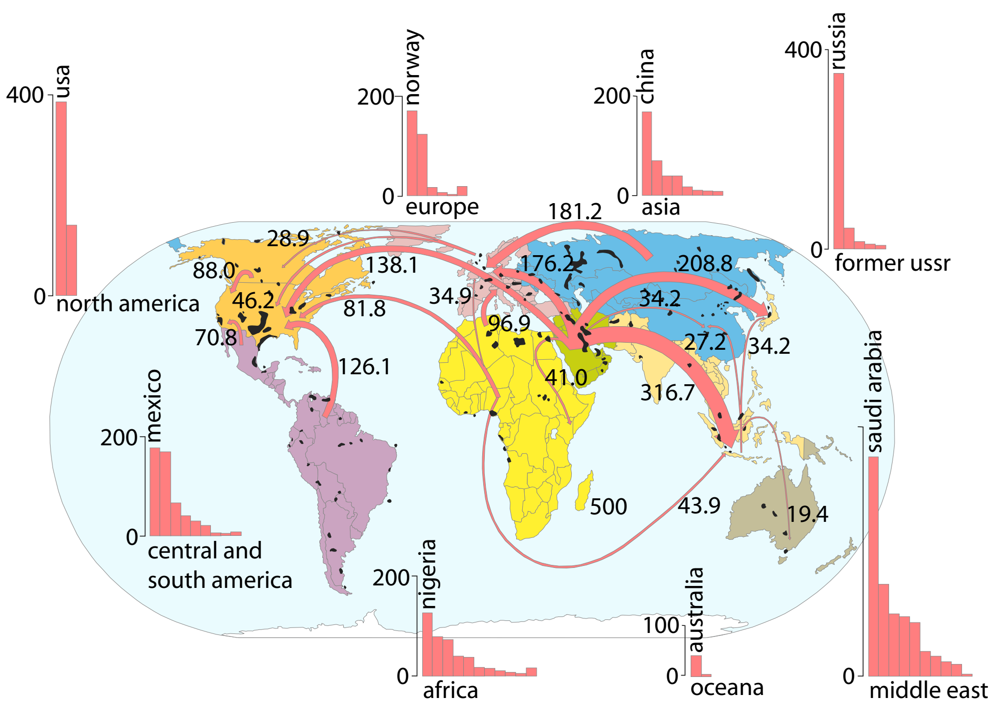


fig. 1.27 Global energetic flows of conventional oil

The energy sector has been increasingly scrutinized throughout the early 21st century for its greenhouse gas emissions. As reported in the *Stern Review on the Economics of Climate Change*, prepared for the British Government, over 146.3 billion gigatonnes of carbon dioxide are released into the atmosphere from global industry and power plant activity.[57] The expansion of global industrialization is increasing energy production demand. Accelerated peak oil will be the result which will have the capacity to hasten global climate change. As outlined by geologists such as Kenneth S. Deffeyes, peak oil generally refers to the science of peak oil, when the peak of oil extracting surpasses the peak of oil exploration. The original theory was proposed by M. King Hubbert, an oil geologist who predicted that in a given geographical area, from a single oil field to the collection of world oil fields, the rate of petroleum production tends to follow a bell-shaped curve.[58] Hubbert projected that production of oil from conventional sources would peak in the continental United States around

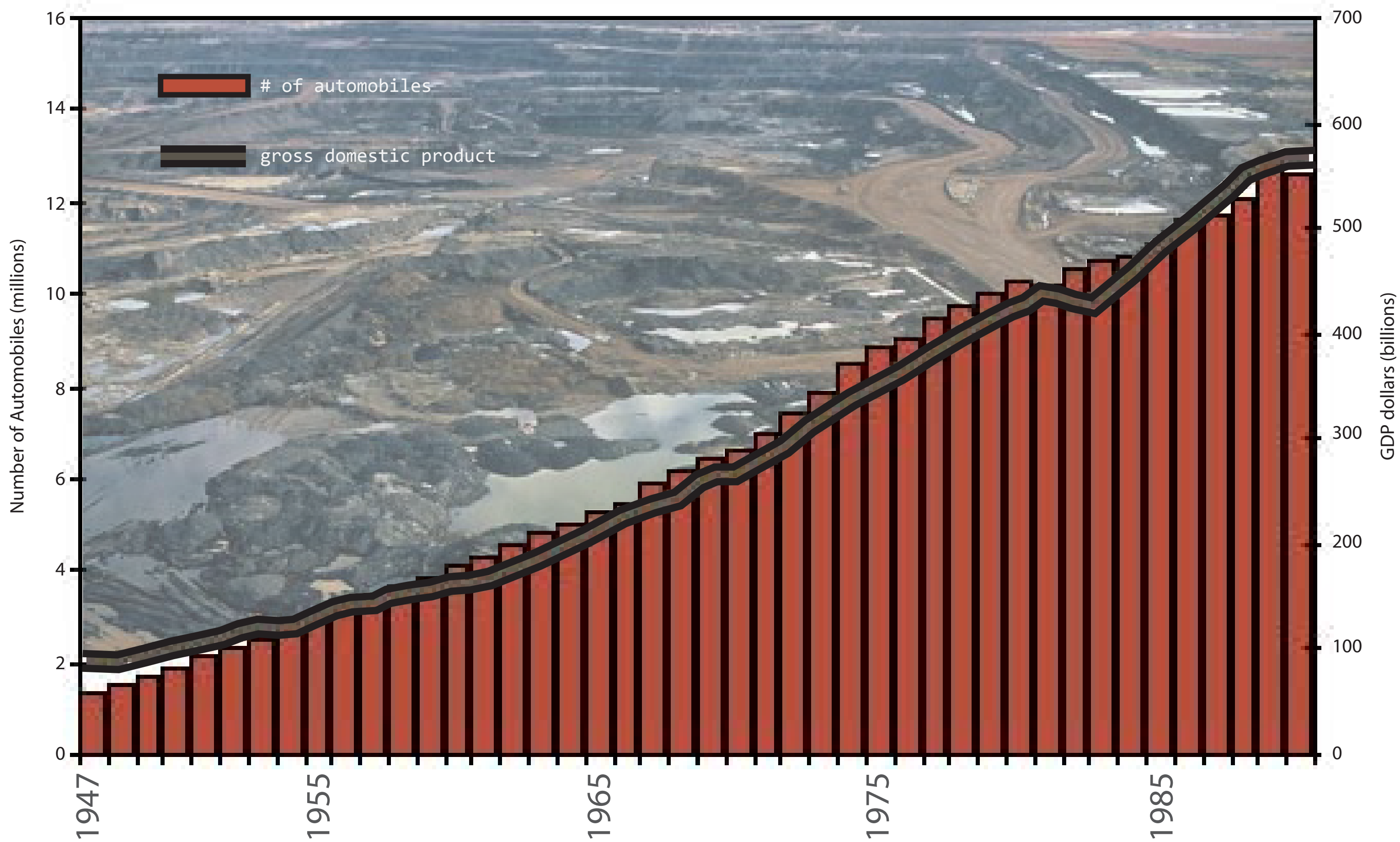


fig. 1.28 *Canadian automobile ownership vs. GDP compiled with tar sand exploration near Fort McMurray, one of the largest petro-mining operations in the world*

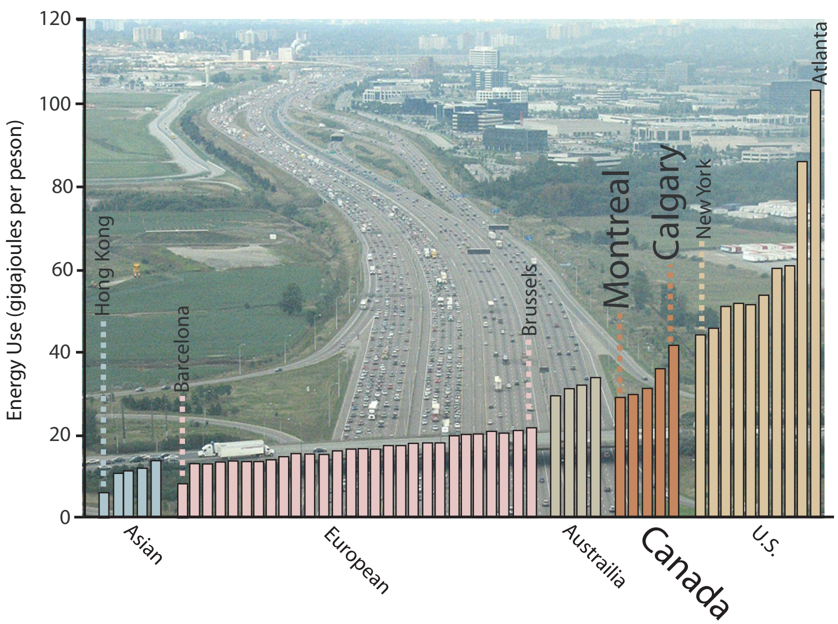


fig. 1.29 Energy use for mobility by major international urban center compiled with the 401 through Toronto — One of the widest expanses of highway in the world

1965-1970.[59] The actual date of American peak oil was 1970, the consequences were transportable production fuels becoming more costly and extraction industries exploiting more unconventional landscape resources internationally. When global peak oil occurs, public concern may propel rapid development of technology to extract fossil fuels from more polluting and non-conventional resources. These could include extracting transportable fuel from coal, tar sands, oil shale, and heavy oil resources. The industrial process required to achieve this will significantly increase green house gas emissions during conversion processes.[60] Redesign of cultural energy use will be one of the methods used to help render these possibilities intelligible.

Contemporary living arrangements are increasing consumption of oil resources despite scientific concern for global warming and peak oil. In Canada, automobility is continuing to grow as the status quo of personal transport; the number of automobiles owned is consistent with national GDP [fig. 1.28]. Environment Canada reports that:

> "More than 12 million cars now traverse Canada's roads — one for nearly every two Canadians, one of the highest ratios of car ownership in the world. Each of these cars travels, on average, more than 16 000 km per year, a total of some 200 billion kilometers, or more than 1 000 times the distance between the Earth and the sun".[61]

The growing status quo, is an opportunity for design to format new possibilities for urban life through moderating growing automobility and fossil fuel energy use. By doing this, there may be opportunity to adapt spatial solutions to slow global warming. A possibility is to intervene using design that is responsive to cultural energy use by supplying alternative fuels as a form of urban organization. An opportune response to the urgency of global warming and peak oil will be designed in section 4.

fig. 1.30 Large coal fields at Tanggu Port in China photo by Ed Burtynsky — Large coal deposits and associated coke manufacturing are typically related to high levels of PAHs in the surrounding environment

LAND POLLUTION IS MANUFACTURED BY THE OPERATIONS OF INDUSTRIAL ACTORS. Soil contamination is caused by the alteration of natural soil environments by the presence of man-made chemicals. Soil contamination typically occurs from scenarios including direct discharge of industrial wastes to the soil, rupture of underground storage tanks, leaching of wastes from landfills, application of pesticides, and percolation of contaminated surface water to subsurface strata. Statistically, the chemicals that are most often responsible for soil contamination include lead and heavy metals, petroleum hydrocarbons, solvents, and pesticides. Industrialization and chemical usage often correlate to the concentration of contamination. Historically, this degradation occurred because health and environmental coincidences were unknown, which meant that no agency managed environmental constraints on manufacturing properties during operation. This was followed by weak regulatory policies allowing industries to vacate sites without remediating toxic damage. Contaminated sites are left with the communities that the industrial facility originally helped build and employ. These emerging sites are affecting new landscapes in countries where there are fewer regulations to reduce risks of future contamination. In China, the State Environmental Protection Administration (SEPA) reports that:

> ". . . soil pollution presents a genuine danger. An estimated 12 million tonnes of grain are contaminated by heavy metals every year, causing direct losses of 20 billion yuan (US$2.57 billion)".[62]

Contaminated soils remain interlaced with complex compounds that are dangerous to human and ecosystem health. Health risks can occur through both direct contact and residual contamination of water supplies. Conducted by the US Environmental Protection Agency, the *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual* reports that soil contamination has certain health effects on humans. The manual reports the following impacts on human health:

fig. 1.31 *Engineers drilling out a soil sample to check its condition at Bruin Lagoon, which was contaminated with heavy metals, sulfuric acid, and crude oil waste. Protective suits are worn to prevent exposure suspected of carcinogens and endocrine disrupters.*

> Chromium, a chemical agent in many pesticides and herbicides is carcinogenic to all human populations. In children, exposure to concentrations of lead poses the risk of developmental damage to brain and nervous system. Exposure to high concentrations of lead can also lead to kidney damage in all human populations. Benzene in certain concentrations, can be associated with high leukemia incidence. Exposure to cyclodienes and mercury is known to increase the incidence of kidney damage, which is sometimes irreversible. Liver toxicity is linked to PCBs and cyclodienes, while carbamates and organophosphates induce responses that can lead to neuromuscular damage. Concentrations of chlorinated solvents cause kidney and liver changes and depress the central nervous system. Other health effects include fatigue, skin rash, eye irritation, headache, and nausea are cited to be caused by exposure to the contaminates listed above.[63]

The US Environmental Protection Agency concludes that soil contamination also has deleterious implications on natural ecosystems. Soil chemistry alterations can occur with the presence of hazardous chemicals, which can modify the metabolism of arthropods and endemic microorganisms in a soil environment. This can cause eradication of the primary food chain causing predator or consumer species harm. Contamination in soil causes lower pyramid levels of the food chain to ingest alien chemicals increasing the concentrations consumed at each level in the food chain (Computer modelling of pesticide transport in soil for five instrumented watersheds).

Despite the severe impact that land pollution is creating, an economic trend is emerging to deal with its cleansing. Environment Canada reports that:

> “. . . in 2001, the global environmental market was reported to be approaching

fig. 1.32 Mobile material sorting, processing, and screening operation — Demand for soil remediation is encouraging design innovation

> $1 trillion. Based on current literature, the global market for remediation ranges from US $12 -35 billion. Based on figures for the main country/regional markets and discussions with key informants, QES estimates the international market for remediation to be US $25-30 billion".[64]

Additionally, Environment Canada reports that:

> ". . . the Canadian environment industry has annual sales of over $20 billion and contributes 2.2 percent to Canada's GDP. Remediation is considered a part of the solid and hazardous waste management sector. The solid and hazardous waste management sector comprises the second largest component (24%) of Canada's environment industry".[65]

This statistical evidence shows that reclaiming de-industrialized sites in North America is an opportunity to moderate the healthy state of the environment of core urban communities.

WATER POLLUTION IS MANUFACTURED BY THE OPERATIONS OF INDUSTRIAL ACTORS. Water pollution is a consequence of human activities, including industry, adversely effecting lakes, rivers, oceans, and groundwater. Traditional manufacturing systems place undue stress on water systems by discharging harmful pollutants in their wastewater including heavy metals, resin pellets, organic toxins, oils, nutrients, and solids. Wastewater discharges from power stations or steel mills can have thermal effects that can modify their local ecosystems or reduce available oxygen. Hot discharged industrial wastewater creates thermal pollution that can affect downstream aquatic ecosystems, causing them to adjust or collapse.[66] Environment Canada recognizes "over 360 chemical compounds that have been identified in the Great Lakes, which are persistent toxic chemicals – alkylated lead, benzo(a)pyrene, DDT, mercury and mirex – potentially dangerous to humans

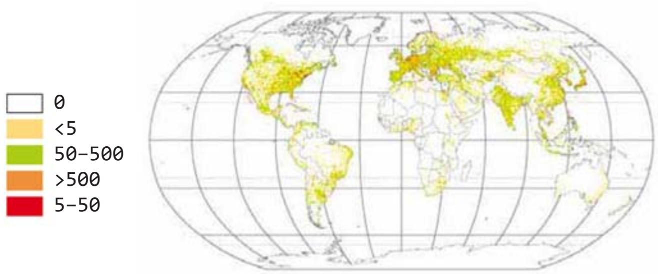


fig. 1.33 Annual global industrial water use (2000) in millions of cubic meters per grid cell

fig. 1.34 Contaminated water in a town in India — Untreated waste and garbage are deposited directly into urban water systems a cause of significant water born disease

and already destructive to the aquatic ecosystems".[67] Historic industrialization in the Great Lakes region are attributed to this. Globally, according to the *2nd UN World Water Development Report*, over 1.1 billion people lack sufficient access to safe drinking water, and 2.6 billion people lack access to basic sanitation, contaminated water from industrial discharge is compounding this problem.[68] The report also states that, "major demographic changes are also seriously affecting the quality and quantity of available freshwater on the planet".[69] This demographic change is lead by rapid urbanization in developing countries, which is instigated by industrialization in most cases. The allocation of quantifiable quality water has an impact on the health and livelihood of urban settlements. This is evident in the supply of quality water distributed in various sections of the world. The UN estimates "that daily water use per inhabitant totals 600 L in residential areas of North America and Japan and between 250 L and 350 L in Europe, while daily water use per inhabitant in sub-Saharan Africa averages just 10 L to 20 L".[70]

Internationally, industrial pollution is deteriorating the water quality in many rivers and marine environments due to improper wastewater disposal. The UN reports that industry usually disposes waste water 'to drain', which translates into one of the following discharge methods: (1) industrial wastewater is deposited directly into a stream, canal or river, or to sea, (2) industrial wastewater is disposed to sewer, which may be discharged, untreated, further downstream, or may be routed to the nearest municipal swage treatment plant, or (3) industrial wastewater is treated on-site by a waste water treatment plant before being discharged into a watercourse or sewer treatment in a series of open ponds.[71] The situations in which untreated or inadequately treated industrial waste water is discharged directly to the water cycle is a major human and environmental concern. Often if the water is contaminated with heavy metals, chemicals or particulates, or loaded with organic matter, there are affects to the aquifer or receiving water system.[72] Industrial accidents compound the problem of international water pollution, which often has transboundary effects

on shared river, lake, and ocean ecosystems.

In Canada, water pollution from industry contributes to the degradation of global water quality. Environment Canada reports that "contamination problems are increasing in Canada primarily because of the large and growing number of toxic compounds used in industry and agriculture".[73] Environment Canada predicts that because of this, ". . . in the next few decades more contaminated aquifers will be discovered, new contaminants will be identified, and more contaminated groundwater will be discharged into wetlands, streams and lakes".[74] Despite growing concerns over water quality the UN claims that manufacturing activity can be both clean and profitable by leading 'true-value' water pricing and conserving high- water resources.[75] Management and governance can play an important role in promoting healthy and sustainable industrial growth. Mediating new relationships to water resources through design is needed to reduce future damage to water systems. There are opportunities for designers to revise the way industry is organized by galvanizing the environment as one of the central considerations in organizing future development. This will include adapting processes that maintain sustainable relationships to local and regional watersheds. A speculative approach to this will be developed in section 4.

fig. 1.35 Combined sewage overflow discharge point into Windermere Basin – In a combined discharge system raw sewage is mixed with rain water. When there is a heavy backup the combined water is discharged into the environment.

fig. 1.36 Windermere Basin and surrounding impact zone

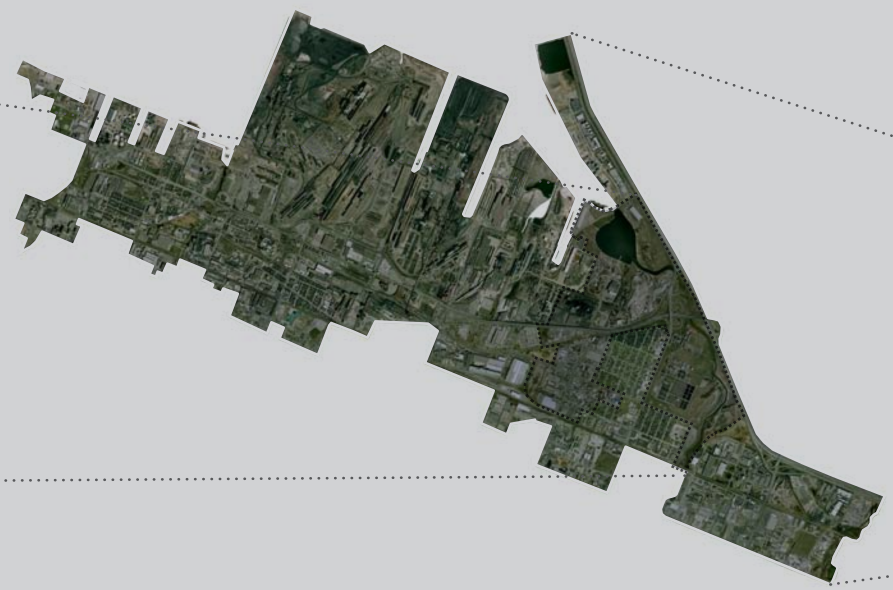


fig. 1.37 Hamilton's Historic Bayfront Industrial Area

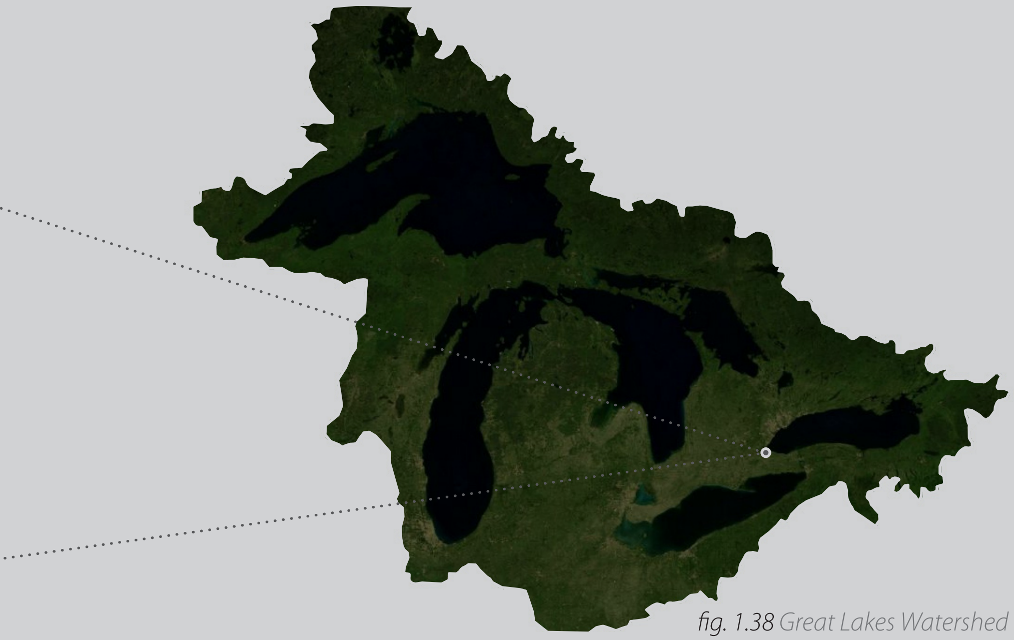


fig. 1.38 Great Lakes Watershed

1.3 GLOBE PARK'S SITE

Globe Park is interested in the larger implications of industrialization within the Great Lakes Region. The site of the park is selected at a hinge point between industrial and ecological operations. The perimeter of Globe Park will include 576 acres of public and private land within Hamilton's historic bayfront industrial area. This area is a combination of vacant publicly held green space associated to Hamilton's sewage treatment plant and several privately held underutilized twilight industries. The public green space forms part of a large circuit that is connected to the Red Hill Creek Valley, the Niagara Escarpment, and Hamilton's beachfront on Lake Ontario. At this critical point, the site is at an important juncture between recreational, ecological, and industrial land uses. The following discussion will introduce the park's perimeter, reclamation process, and future opportunity within the context of the Great Lakes, Hamilton Bayfront, and Windermere Basin.

fig. 1.39 *Red Hill Creek Valley in 1875 — The water course is primarily inhabited for agricultural uses. The mouth of the creek is in its original marshland form.*

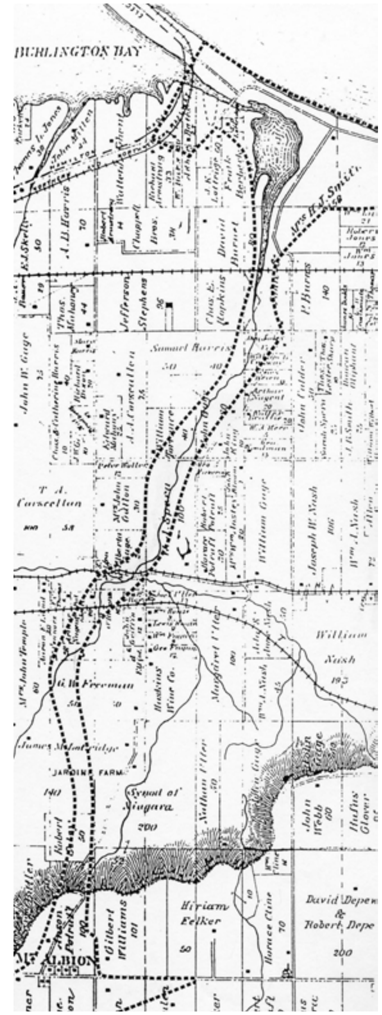


fig. 1.40 *Red Hill Creek Valley in 1903 — Modifications to the mouth of the creek are first witnessed as it is settled by the first industrial mills*

fig. 1.41 Red Hill Creek Valley in 2007 — The aerial reveals construction of the new parkway. A large interchange is constructed at the creek's headwaters. Over 10,000 dwelling units will be constructed in relation to this interchange. Increased sediment flow from development is to be expected.

GLOBE PARK PERIMETER Globe Park is located in east Hamilton at the mouth of the Red Hill Creek. It is at the junction of four major expressways including the Red Hill Creek Parkway, Burlington Street Expressway, and Queen Elizabeth Way (QEW). The proposed park will be made up of several component sites. Globe Park is the official name of a series of baseball diamonds adjacent to the Woodward Avenue Sewage Treatment Plant's spherical methane storage tank. It is adapted for the name of the full site proposal and metaphore for its larger intentions. For the purposes of this thesis the boundary of future Globe Park is to include: the official Globe Park, Woodward Avenue Sewage Treatment Plant, the former Rennie Landfill site, Windermere Basin and surrounding green space, Lafarge aggregate storage, Steelcare steel logistic facility, Poscor scrap metal yard, American Iron scrap metal yard, Columbian Chemicals carbon black production plant, Petro Canada diesel fueling station, and several logistics and manufacturing warehouses. An analysis of each of these sites is included in section 4. The boundary of the park is speculative. It involves potential remediation sites from the maximum number of contamination

fig. 1.42 Peregrine Falcon (Falco Peregrines) with artificial perch adjacent to Windermere Basin, April 2007

types. Windermere Basin is the binding site with respect to the selection of all of these components. The intension is to build an understanding of each of their operations to project a design process that is able to bring this area of waterfront to a healthy cultural, ecological, and industrial state.

Located at the eastern end of Hamilton Harbour at the mouth of the Red Hill Creek, Windermere Basin consists of approximately 17.7 hectares of water area and 24.4 hectares of land around the water.[76] Created and sustained by the overflow of the Red Hill Creek into Hamilton Harbour, the basin originally was a natural wetland and mud flat area that provided a natural habitat for wildlife.[77] The wetland area served to naturally filter the outflow from the Red Hill Creek prior to flowing into Hamilton Harbour and exiting into Lake Ontario.[78] The *State of the Basin Report* conducted by the city of Hamilton to investigate the potential on a new park surrounding the basin states that it is reasonable to conclude that the resulting land base under the clean fill is contaminated.[79]

fig. 1.43 *Artificial nesting and feeding area for passerine birds*

The Red Hill Creek watershed itself covers an area of 64 square kilometers and feeds into Hamilton Harbour substantially through Windermere Basin. The watershed supports a diverse community of 300 animal species and nationally rare plant communities despite being over 77% developed.[80] As an urban stream the reported concern is that the general water quality of the Red Hill Creek can be described as poor.[81] Windermere Basin is a breeding location for 26 species of birds, some regionally significant, and is recognized as an important regional breeding habitat.[82] In spite of its vastly altered environment Windermere Basin continues to operate as an important wildlife habitat.[83] This has made the study of impacts of industrial development on wildlife one of the temporal occupations of the site.

When the International Joint Venture listed Hamilton Harbour as an ‘area of concern’ on the Great Lakes in the 1980s, some of the worst pollution was recorded

fig. 1.44 *Typical fence condition separating industrial use from the open space that surrounds Windermere Basin*

in Windermere Basin with contaminated sediment coming from water runoff, city sewage, water treatment plants, combined sewer overflows, industrial waste discharges, and erosion from the Red Hill Creek watershed.[84] The basin was last dredged in 1990, resulting in the creation of a sediment trap which continues to operate today.[85] The sediment trap requires periodic maintenance to continue functioning effectively. As indicated by recent surveys, a total of 218,000 cubic meters of sediment has accumulated since the last dredging in 1990 and has surpassed 1989 levels.[86]

Heavy industrial freight shipping and bulk commodity storage (scrap metal, rolled steel, grain, fuel, aggregate, and slag) are the general land uses found on the north, west, and south sides of the basin.[87] Currently, heavy industrial manufacturing facilities including, US Steel Canada, Lafarge, Columbian Chemicals, and POSCOR operate on properties south and west of the site. The flow direction of regional groundwater is subject to potential environmental concern as contaminated groundwater may be migrating beneath the site from these properties and filtering in a northerly direction towards the Basin and Lake Ontario.[88] Three areas of relic sedimentation containing PCB's, iron, nickel, lead, zinc, cadmium, copper, and chromium, which exceeded the provincial sediment quality guidelines were reported in a 1993 Environment Canada study of sedimentation in the basin.[89]

RECLAMATION PROCESS The reclaiming of Windermere Basin began as an attempt to mediate runoff from the Red Hill Creek in an attempt to improve the water quality of Hamilton Harbour. In 1982 the City of Hamilton Official Plan designated the basin and lands surrounding the basin as a special policy area which had implications for preserving a strip of open space adjacent to the water area.[89] A very slow process has begun in the reassessment of the site which stems from the early policies made in the 1980s. In 1999 an environmental assessment was conducted to look at the future constraints of the site and to assess the best way to *fig. 1.45 Typical sediment core sample taken from Windermere Basin. A 2006 consultant report indicates that the basin is now brought up to a healthy enough state to support aquatic plants.*

deal with its problematic qualities in terms of the condition of water flowing through, the environmental disruption from dredging activity, and the isolation imposed on the site caused by surrounding industrial development.[90] In 2001 a steering committee was formed to present potential solutions for the environmental redevelopment of the site and to install permanent input to lead the process of renewal.

The need to renew the site is widely supported by key members of the Hamilton Harbour Remedial Action Plan (RAP) as a working process to restoring the Harbour to a healthy ecological state. The end goal is to create a wetland at the basin that maintains a hybrid natural state to allow the filtering of sediment as it passes from the Red Hill Creek Watershed into Hamilton Harbour. The objective of the City of Hamilton is to reduce the frequency of dredging, which has become a financial burden on the Hamilton Waterfront Trust and an ecological burden on the basin. Opportunistically, there is intent on the behalf of the Hamilton Waterfront Trust to create an attractive public environmental space in its general area. This public environmental space has the capacity to incubate a larger renewal process on manufacturing sites around the basin.

A 2006 consultant report indicates that the restoration process shows that Windermere Basin has been brought up to a healthy enough state to support aquatic plants.[92] Greenhouse trials indicate that the sediment in the basin is suited for wetland plants. An ecological risk assessment concluded that current levels of contaminant are low and are not expected to result in direct mortality to aquatic organisms.[93] The report also indicates that exposure to the environment from waterfowl and wildlife will not cause mortality or severe adverse health effects.[94] A wetland is feasible in the Windermere Basin area with proposed modifications of more frequent, less intrusive dredging activity.

fig. 1.46 *Mouth of Windermere Basin, June 2007 — Characterized by a hard rock lined edge*

fig. 1.45 *Aerial of Bayfront Park on Hamilton's southwest bayfront — The landscape was originally to be developed as an industrial pier. Filling was stopped due to public unrest. The result is an amoebic shaped landscape form now adapted as a public park.*

FUTURE OPPORTUNITY The reclaiming of Bayfront Park, originally a contaminated landfill site, helped renew neighborhoods on the west side of Hamilton Harbour. Bayfront Park [fig. 1.45] incubated public cultural and recreational interest in the west waterfront through increasing the capacity of green space and trails. Reclaiming Windermere Basin as a process that generates Globe Park has the potential to replicate this renewal on the east side of the Harbour. Some limitations originate from facility owners, development staff, and industrial realtors who fear facilitating public access around Globe Park could restrict the operations of land owned by heavy industry. Design has the capacity to mediate this territory by spatially reorienting relationships between public and private use. Framing heavy industrial operation optically could become a temporal way for the public to engage in some of the raw historic occupations of the city. Globe Park will offer the opportunity to attract local, regional, and global interest in the Hamilton Waterfront. Experimenting with the site's spatial configuration is an opportunity to integrate manufacturing, restorative activity, and public space. Integrating these varied programs will be a long-term endeavor. However, if implemented successfully this integration could become a new way of reorganizing urban development in a more sustainable way.

Globe Park's location on Hamilton Harbour is at the confluence of industry and ecology. It is a site where short term profits and the risk of economic decline are weighed against pure environmentalism. Various actors such as the Hamilton Harbour Remedial Action Plan and Harbourfront Trust have improved some of the environmental degradation. This activity has attracted growing interest from local, provincial, and federal agencies. This interest is an indication that the site has the capacity to draw a large audience as a reclamation project. Its contamination and enclosure, created by heavy industrial operations, opens up future possibilities for experimental re-occupation. The plateau of heavy industrial activity, in which Windermere Basin site is imbedded is an opportunity for experimenting with new forms of hybrid site reclamation. Serious contaminate in water and soil will provide *fig. 1.47 JRI Grain Terminal — The dredging of Windermere Basin occurs to maintain freight ship access to Windermere Arm. Windermere Arm is a prominent shipping pier for grains, cement, and asphalt.*

fig. 1.48 *Boundary of Hamilton's ERASE Community Improvement Area — The area is approximately 3400 acres of heavy industrial land. No historical information is available to the public regarding known contaminates. A number of properties are in tax arrears, vacant or underutilized. Hamilton lists 61 sites as vacant brownfield.*

fertile testing ground for new enterprise to mine these toxins for future uses and academic discovery. Potentials can be explored within the vicinity of the basin to develop facilities that innovate new reclamation processes. An approach that utilizes contemporary knowledge in biotechnology to recover these sites has the capacity to incubate temporal occupations for a new economic framework.

There is an opportunity for an aggressive development agency to work more closely with the industrial processes of industrial facilities in this area to consume potential toxins in air and soil. Treatment of soil toxins using this agency will reduce leaching of contaminated toxic plumes into Hamilton Harbour. Carolyn Reid the current Brownfield Coordinator at Hamilton City Hall notes that the city offers grants for redevelopment of contaminated brownfield sites through Hamilton's Environmental Remediation and Site Enhancement (ERASE) program. There are 3,400 acres [fig. 1.48] of property available in the ERASE Community Improvement Project Area.[95] The entire Windermere Basin site is located within these boundaries. With this type of subsidization available, there could be innovative ways to bring new economic vitality to contaminated sites through remedial technology, soil brokering, and decontaminated property sales.

Hamilton Harbour's port facilities require that standard depths be maintained to remain navigational for laker freight ships. Windermere Basin also requires periodic dredging so that its sediment overflow into the Harbour maintains these standard depths. These conventional dredging operations cause harm to the basin's wetland ecosystems. There is the opportunity to redevelop a more sustainable dredging process for Windermere Basin to minimize this impact. New possibilities are available to address the storage and treatment of contaminated dredged soil. Dredged lake fill is high in mineral composition and can be used as fertilizer. Relationships with local farmers could be created by exchanging this sediment for agricultural use by stabilizing contamination levels using bio-treatment.

fig. 1.49 Construction of Red Hill Creek Parkway in 2006

The Ministry of the Environment (MOE) now controls the environmental constraints of land zoned for heavy industrial use around Windermere Basin. According to Steve Miazga, CEO of the Hamilton conservation authority, future modification to industrial sites require site plan approval from the ministry. With more opportune environmental policies established, industrial facilities adjacent to Windermere Basin are required to clean their operations as they expand. This adaptation requires knowledge of available technology and education for facility operators. An educational agency that develops this type of network is an opportunity to encourage a sustainable knowledge exchange between industrial actors. This type of establishment could develop synergies between industrial actors in order to network waste materials for reprocessing. This educational agency could develop a central facility for collecting data related to material availability, which would maximize the differential and flexibility of the exchange network. Self-organizing activity within the network could also increase the capacity for more intimate management. In the future this agency could operate as an incubator for skills training, knowledge banking, and information exchange for the industrial ecosystem. The possibility for this institution could be centralized with amenities to encourage social networking between facility operators locally and regionally.

The completion of the Red Hill Creek Expressway [fig. 1.49] will add a new layer of complexity to reclaiming Windermere Basin. This highway will require development of ecological processes to reduce tension on Windermere Basin. Runoff from the new highway will be an opportunity to develop remedial landscape to treat salt, tire dust, break dust, and petroleum in the water. Bioengineering of over seven kilometers of the watercourse of Red Hill Creek is expected to reduce the quantity of affluent originating from its watershed. Newly constructed overpasses that link the Red Hill Creek Expressway with the QEW will create a new barrier for site access for bikes and pedestrians. The residential neighborhoods adjacent to Globe Park are divided from

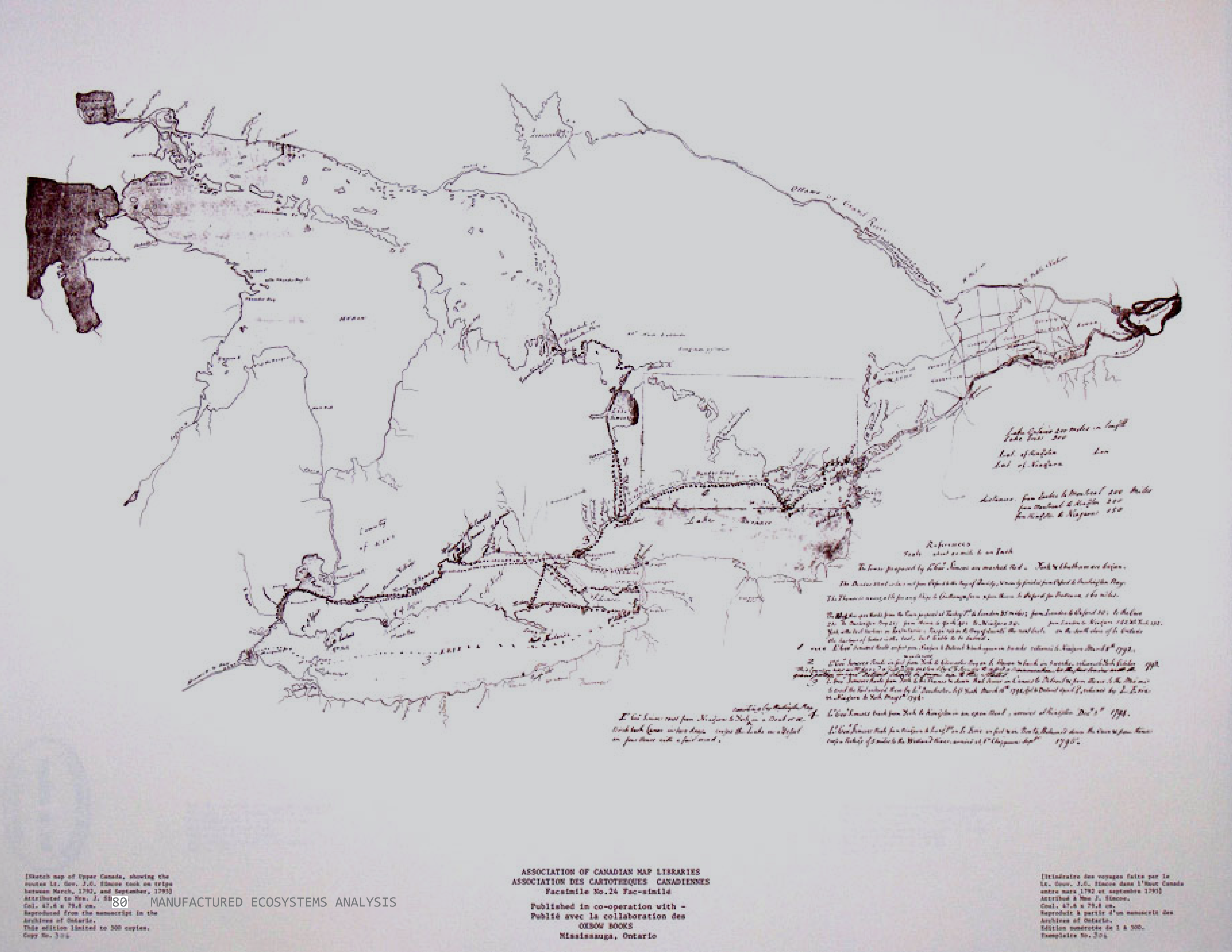
fig. 1.50 *Columbian Chemicals Facility — Manufacturer of carbon black, a petrochemical used to seal tires, and a confirmed carcinogen to humans. It is one critical site that Globe Park intends to acquire.*

fig. 1.51 Red Hill Creek approximately 750m from Columbian Chemicals — The chemical facility has site controls original developed in the 1960s before carbon black was determined to be carcinogenic. It impact on the surrounding environment is uncertain.

the site by heavy rail and highway infrastructure systems. The disconnectivity of the site is intensified by the Burlington Street Expressway, QEW, a trucking diesel station, and freight rail lines. To the east of Windermere Basin, a chain-link fence divides the city from industrial facilities, blocking access to the basin. These constraints justify designing a spatial strategy to innovate access points to the site. The design of a perimeter that permeates the fragmented landscape is an opportunity to intensify its future regional allure.

The ownership of Globe Park's manufacturing sites will need to be considered as part of the park's bureaucracy. Engaging property owners to participate in the landscape reclamation process will be an opportunity for social collaboration. This will enable property owners to become shareholders in the reclamation project. Their involvement has two advantages: accelerating the pace of the project and bringing in actors for closer management of their industrial activity. Developing a co-operative involving the property owners has the capacity to create a collaborative agency that manages public and private initiatives of the site.

02 MANUFACTURED ECOSYSTEMS ANALYSIS



Lake Ontario
References
[Sketch map of Upper Canada, showing the routes Lt. Gov. J.G. Simcoe took on trips between March, 1792, and September, 1793]
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[Itinéraire des voyages faits par le Lt. Gouv. J.G. Simcoe dans l'Haut Canada entre mars 1792 et septembre 1793]
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2.1 CITY + GREAT LAKES REGION NARRATIVE

fig. 2.1 Early Southern Ontario Great Lakes footpaths and watershed — Hamilton was one of the early hubs linking the populated areas at the head of Lake Ontario to major trade corridors. As Benton Mackay's original hypothesis for the Appalachian Trial presumed, these footpaths and associated conceptual watersheds were precursors to urban expansion. Under this lens, Southern Ontario's historic trade paths are arguably a precursor to the Golden Horseshoe's expansive urban agglomeration. Historically, Toronto managed trade relationships through this network from the north and east while Hamilton managed trade from the south and west. The path through Central Ontario is now adapted as highway 401 and 403. The path that connects Hamilton to the north shores of Lake Erie is now adapted as highway 6. The road that connects Hamilton to America through the Niagara Peninsula is now the QEW. Globe Park is located near the geographic center of this historical regional trail system. Culturally, it will mediate new relationships to this historical organizational network.

The historical development of Hamilton Harbour is rooted to complex political, cultural, and economic processes. As a precursor to the design of Globe Park, it is necessary to build an understanding of these processes. Heavy industrial development transformed the natural condition of Hamilton's east bayfront into a heavy manufacturing landscape from the mid 1800s onward. Tension was created between the spatial territory of industry and the native marshlands that colonized the predeveloped bayfront. This is a typical historical condition in most major Great Lakes port cities. The landscape surrounding Windermere Basin at the mouth of the Red Hill Creek is speculated upon as an industrial ecosystem that can be reclaimed as a new hybrid form of public space and productive landscape. To develop a process for this, first, a comprehensive narrative of these historical changes is needed to validate future preservation and recovery of the sites. Second, it is necessary to map the large-scale conditions that manufacture ecosystems within the Great Lakes Region. Third, it is necessary to map the historical interventions and flows of material that created Globe Park's landscape in the first place. With this analysis, the information needed to invent Globe Park is expected to help stage the park. The experience of the park will be a continuation of these ecological flows manifest through design.

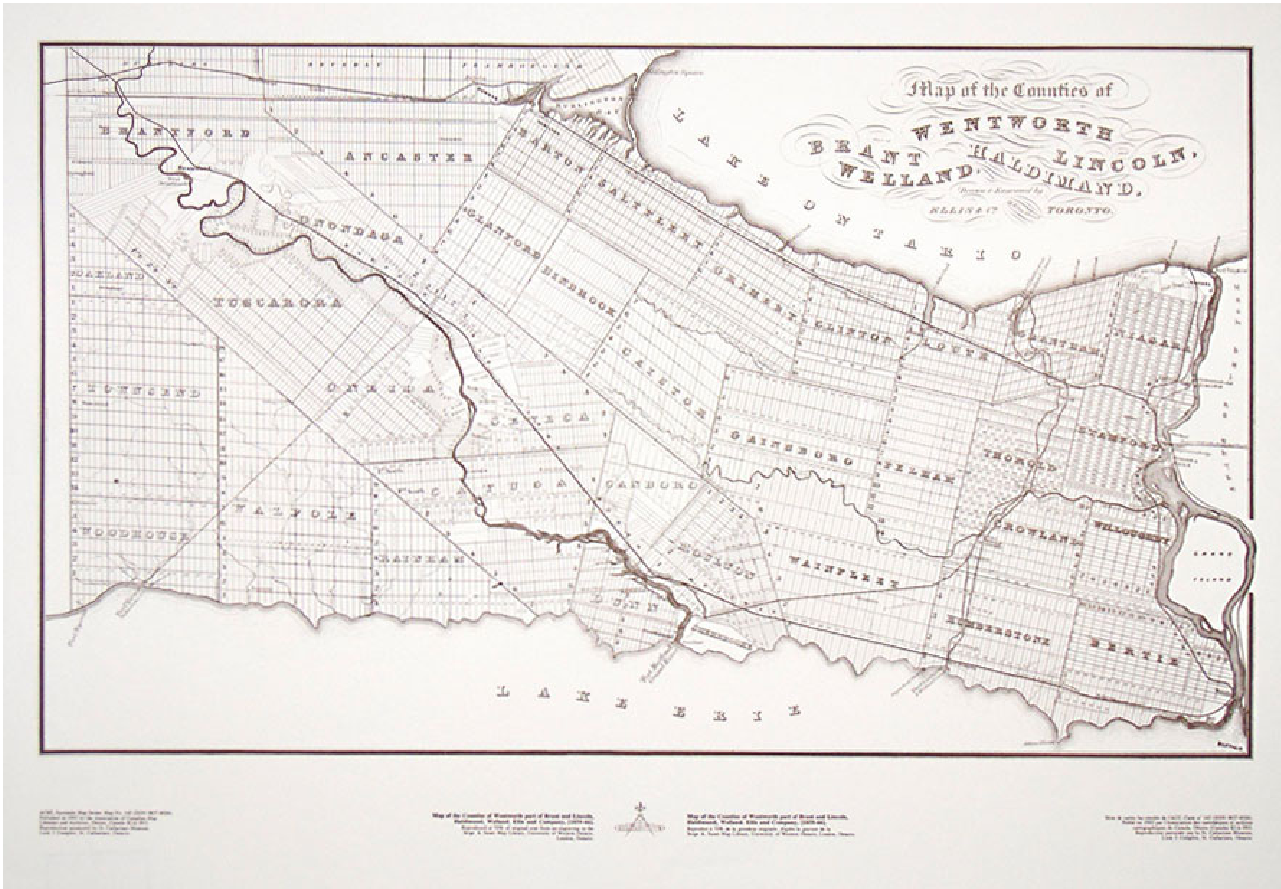


fig. 2.2 Early Grid Network of the Niagara Peninsula — Represents the preconfigured organization pattern of the Niagara Peninsula. The grid concession becomes tighter closer to Lake Ontario. This is where a unique micro climate gives the northern edge of the peninsula an extended frost free season. In this micro region a wine and tender fruit growing area exists. This preestablished pattern is the reason that major Hamilton street grids are one quarter the size of Toronto's. Most of the southern portions of the Globe Park site were originally inhabited by orchards. Globe Park learns from the adaptation of preconfigured regional infrastructure and how it sets the framework for urban organization.

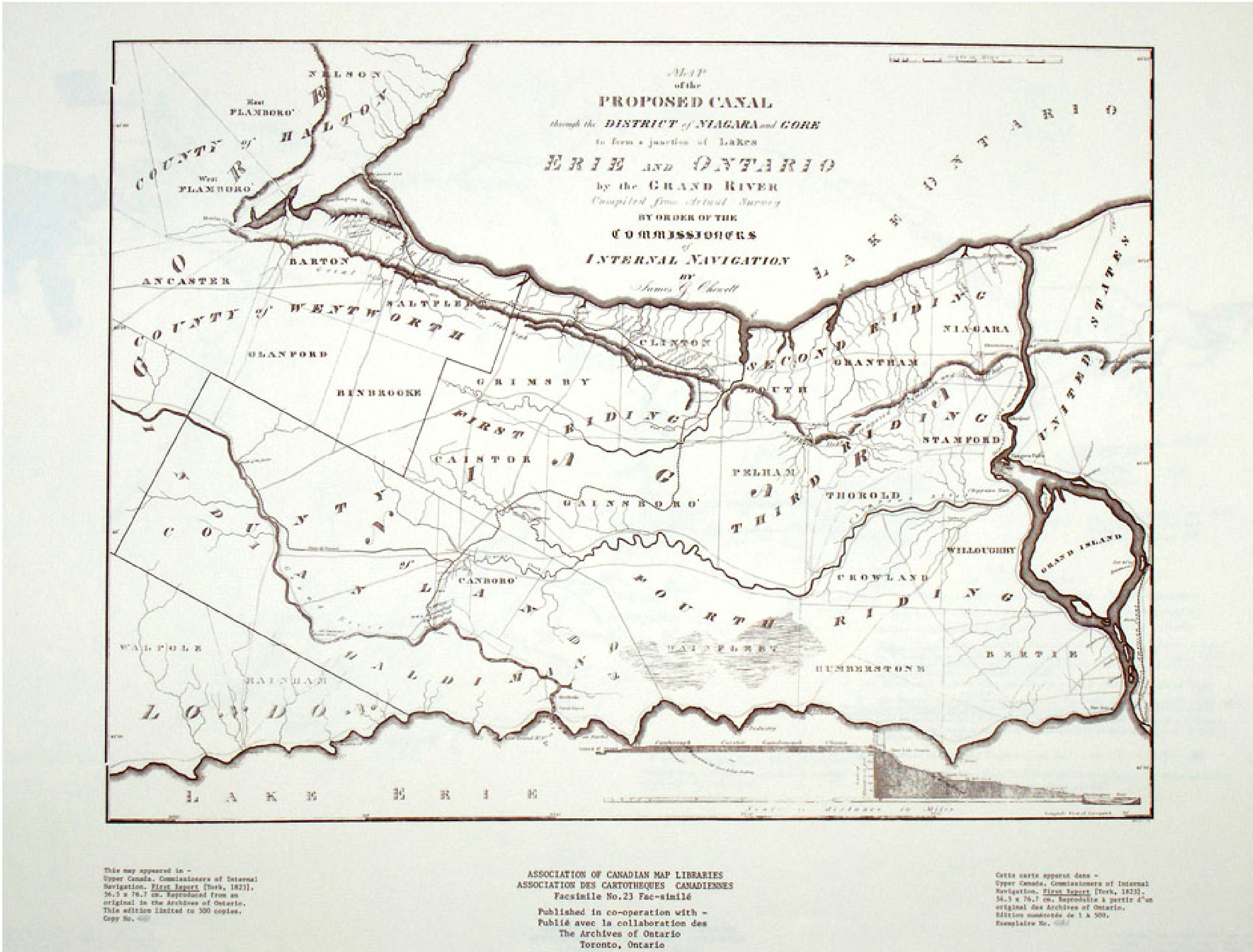
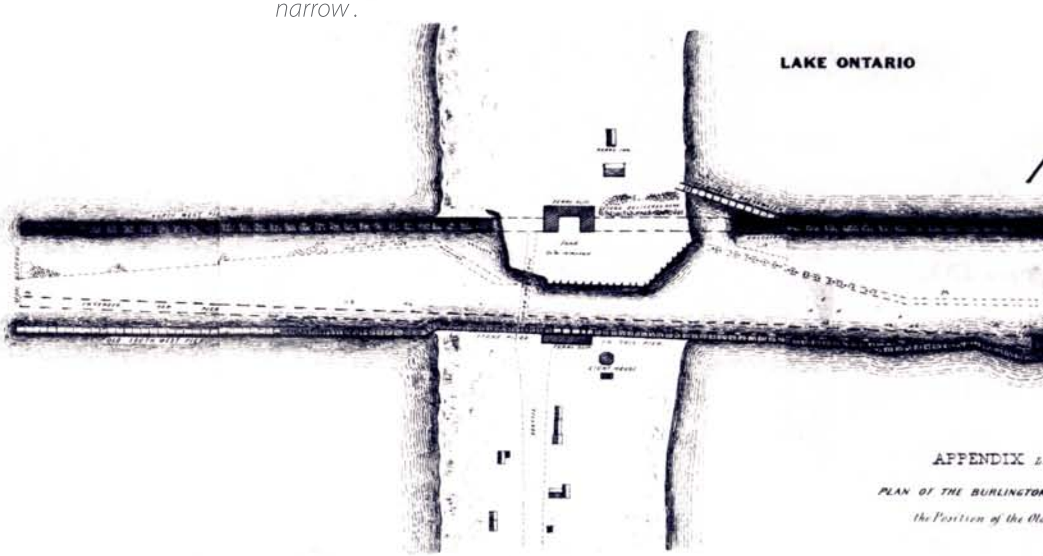


fig. 2.3 Early Depiction of the Watershed of the Niagara Peninsula — As a precursor to the Welland Canal's construction, the river and stream systems were studied to select the ideal route through the landscape of the Niagara Peninsula. Originally the Erie Canal was a boon to the city of Buffalo. After the opening of the Welland Canal, Buffalo declined substantially as a major shipping hub. Shipped materials, were absorbed by Ontario cities along the canal, redirected to Hamilton, or redirected to American cities on the north shore of Lake Erie. Globe Park will be a facilitator of historic regional shipping and fulvial flows.

fig. 2.5 *Burlington Bay Canal Network — Represents the tight entry threshold that controlled cargo ship access into the bay. For defensive reasons the entry was kept narrow .*



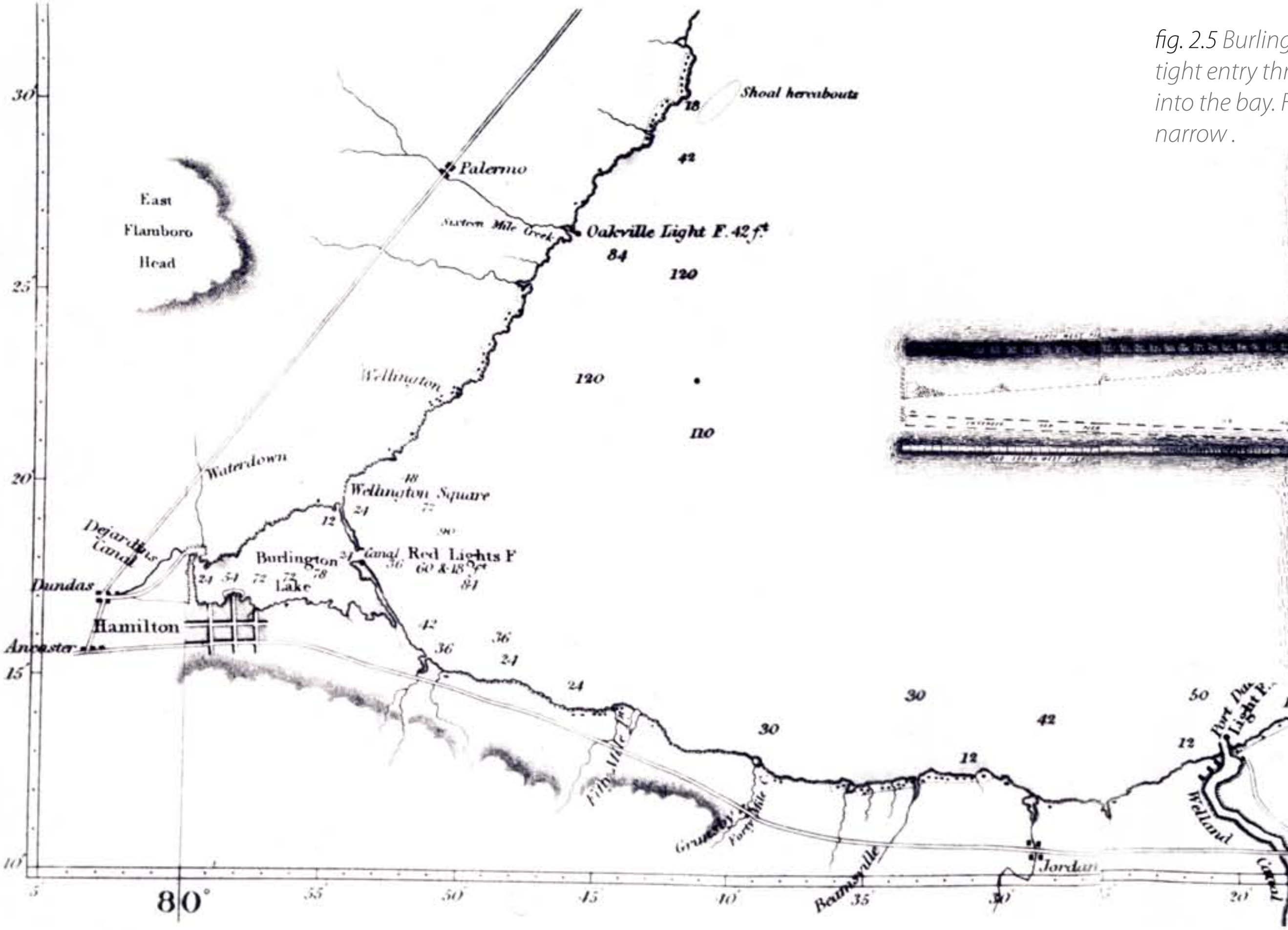


fig. 2.4 *Early Nautical Map of the Head of Lake Ontario — The city and port areas are located primarily to the southwest of Burlington Bay. The grid pattern that signified the original layout of the city represents its key operations as importer and organizer. The trail that is represented to the top of the map is the precursor to Dundas St. This was the original connection between Hamilton and Toronto that ran through the town of Dundas.*

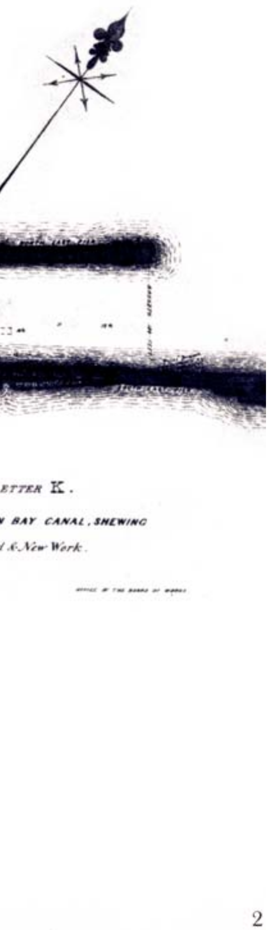


fig. 2.6 *Burlington Canal in 1838 after the emergence of steam technology — Initially the canal was crossed by a modest swing bridge*

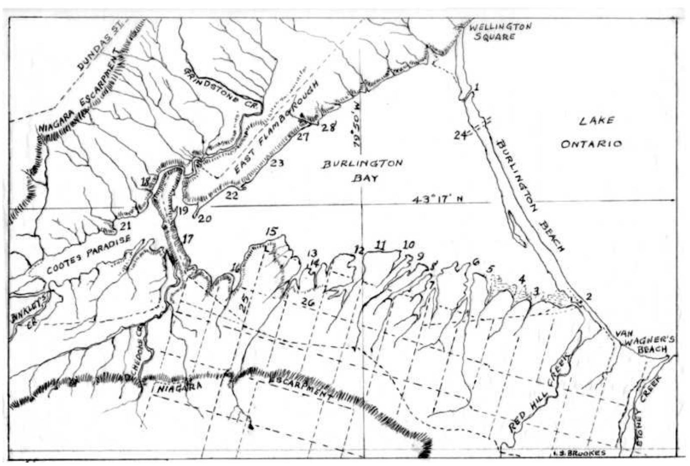


fig. 2.7 *Plan of Hamilton's City Docks in 1836 — As a precursor to major industrial port development, a numbered system of informal docks were already established. These were used as landing areas for ships into the city primarily for agricultural goods.*

PORT OF HAMILTON Hamilton's position at the head of Lake Ontario, in a deep sheltered bay, had the ideal natural conditions to construct an industrial fresh water port. Before the industrialization of the harbour, the landscape that encircled the bay was characterized by a large marshland. The earliest European settlers to Hamilton were loyal to the British Crown during the American Revolutionary period; they settled the land during the late eighteenth and early nineteenth centuries.[96] The city was originally established as a commercial trading post. Textiles were Hamilton's predominant manufacturing activity at the time. The original city began, where the King and James Streets now intersect. The initial settlement was as a small village at a significant distance from the bay to protect it from American lake born-attack. Enterprising area merchants in the 1820s supported the construction of the Burlington Canal that was to cut through the beach strip that separated Lake Ontario and the bay's eastern shore.[97] The canal's opening in 1932 converted the sheltered bay into a shipping hub that allowed industries to access the southern banks of the

1894

fig. 2.7 Illustrative depiction of Hamilton West Harbour, 1894 — Initially the larger established industries in Hamilton populated the southwest shores of Burlington Bay. During this time docks on the eastern bayfront were informal and used for agricultural goods.

1954

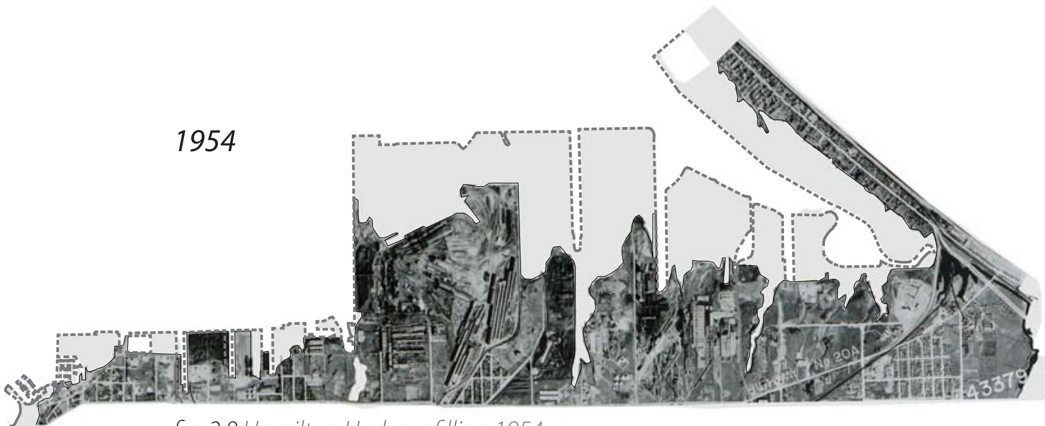


fig. 2.8 Hamilton Harbour filling,1954.

2005

fig. 2.9 Hamilton Harbour filling, 2005 — The most substantial filling of Hamilton Harbour occurred during the 1950s to 1960s. During this time it was decided that the Canadian National steel industry would be located in Southern Ontario to compete with larger US operations. Ironically, in 2007 US Steel purchased Stelco Inc. the last remaining Canadian Steel Company.

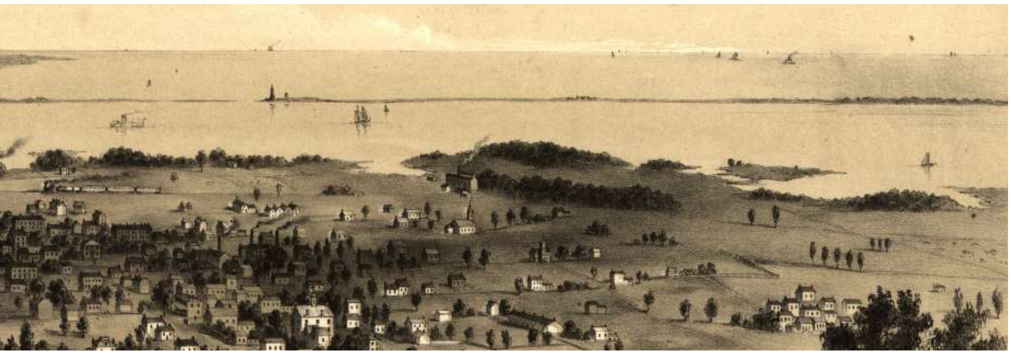
water body. This new interest in the bay, combined with a reduced military threat from America, attracted industries to the waterfront. In the 1850s the arrival of the Great Western Railway and its rail yards connected Hamilton's and Toronto's ports to American border cities.[98] Development of the industry quickly transformed the Harbour's landscape and the shallow marshland that existed in the area began to be filled in by industrial port developers. The Hamilton Harbour Commissioners, originally created by the federal government, made available water lots that were developed for heavy industrial use. Industrial developers sought out these water lots and infilled the shoreline on the south edge of the harbour to construct port properties for steel manufacturers. The operations of the steel industry were carried out at the scale of the Great Lakes. Iron ore and coal were shipped using the lakes via a network of locks and canals. The entire southeast portion of the Harbour emerged as a manufactured urban landscape of shipping wharfs. Inlets were carved into the shoreline to provide shelter for the deposit locations of large freight ships that mainly carried coal, iron ore, and limestone for the steel industry.

The expansion of the city's industry and port eastward began the development of new urban neighborhoods designed particularly for steel workers. In a short period of time these communities were established allowing workers to live a short distance away from their workplace. This residential growth converted the land south of the steel mills into rows of similarly sized parcels of land with modest single detached homes. A local working class culture grew out of this relationship between working and living space. The industrialization provided employment at a regional scale as the city's population grew quickly with an influx of predominantly European immigrants.

With the establishment of Hamilton as a manufacturing hub, Hamilton Harbour had become, by the 1970s, an important piece of infrastructure. On an international scale, it was one of the largest inland Canadian ports on the St. Lawrence/Great Lakes *fig. 2.10* *Illustrative depiction of Hamilton's Bayfront,* *1839*

fig. 2.11 *View of Hamilton's Bayfront,* *2008*

Substantial port development over the past 100 years have converted most of the southern banks of Hamilton Harbour into a landscape of aging industrial facilities. This industrial sector is perhaps one of the most complete condensed collections of modern North American industry. With its apparent contemporary decline, the question of what its future roll is quickly growing urgency.



Seaway. As such, the bay required the linkage to other notable pieces of urban and regional infrastructure. The pre-existing grid of farmland, Ontario's typical pattern, became the organizing principle to the new networks of infrastructure. A tight entry threshold to the bay, the Burlington Canal, allowed large break bulk ships to access Hamilton Harbour. Originally, a small swing bridge that was later replaced with a lift bridge that allowed cargo ships to enter the port crossed the canal. In 1958, the addition of the Burlington Bay James N. Allan Skyway Bridge provided a highway connection to the cities of Burlington, Oakville, and Mississauga by extending the QEW. The Burlington Street Expressway, a raised four lane divided city road, was constructed to transport manufactured goods from the port area to the QEW. The expansion of the steel industry continued until the late 1980s when North America was affected by a recession. Through the mid 1990s the emergence of scrap metal industries brought some new industrial activity but nothing to scale of expansion seen in the 1960s and 1970s. In 2007 a parkway named Red Hill Creek was opened. The site of Globe Park is at the junction of significant Hamilton Harbour shipping piers, QEW., Burlington Street Expressway, and the Red Hill Creek Parkway.

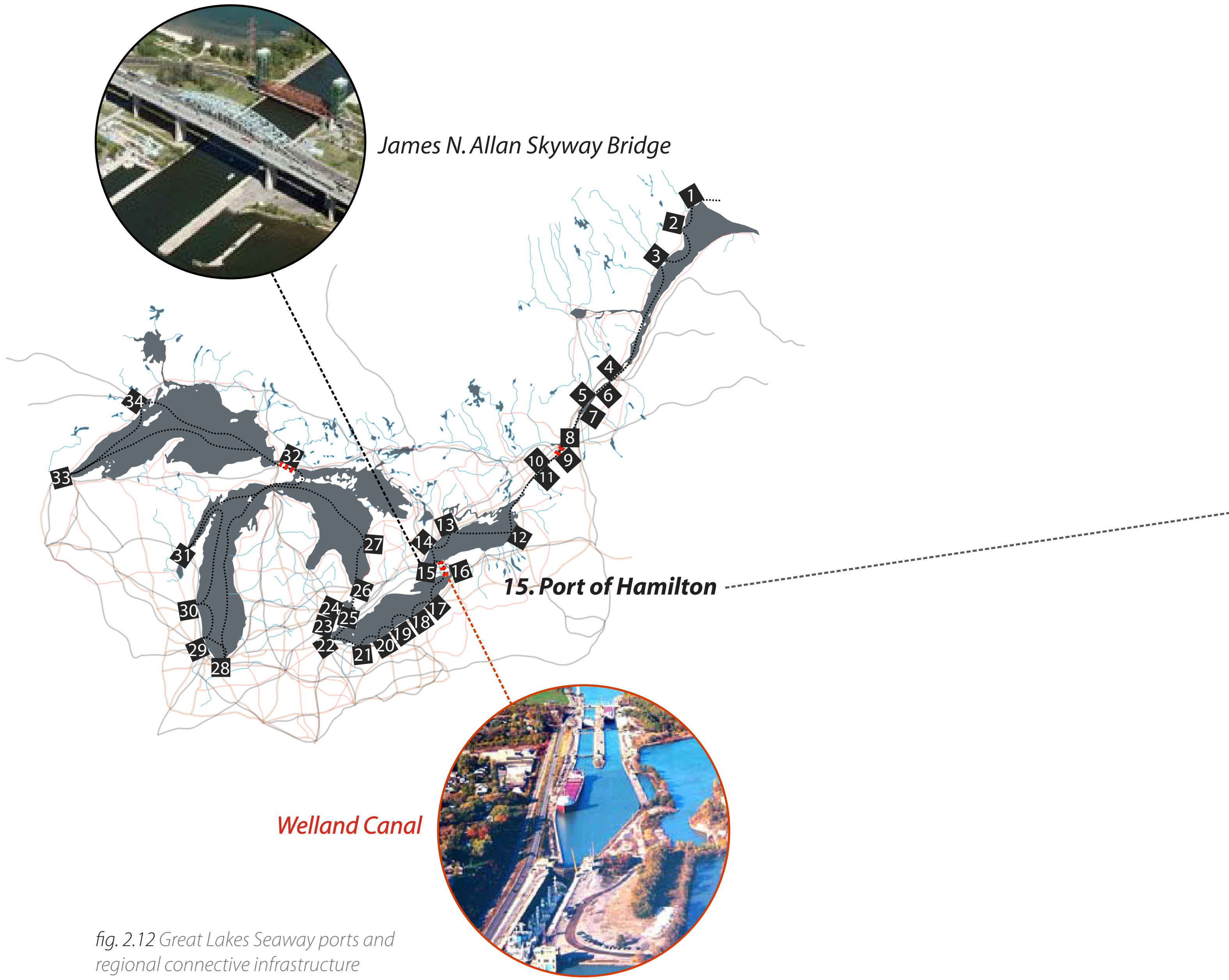


fig. 2.12 Great Lakes Seaway ports and regional connective infrastructure

fig. 2.13 Hamilton Harbour's major port uses are importing iron ore, coal, coke, limestone, slag, and exporting steel related manufactured products

GREAT LAKES REGION By the late nineties big steel related manufacturing in other major Great Lakes region cities had seen stagnation including the cities of Detroit, Cleveland, Toledo, Gary, Milwaukee, and Buffalo. Allan Berger in *Drosscape* describes the depopulation of the core areas of American cities in relation to the decentralization of old manufacturing areas. Berger describes that between the early 1900s and 1950s Fordist systems fuelled the organization of cities and stressed automation, standardization, economies of scale, and technical divisions of labor communication, which were supported by hierarchical organized infrastructures.[99] The accumulation of the Fordist regime can be described as influencing economic organization made possible by a set of production and regulatory mechanisms geared toward production of an expanding homogenous mass consumer market.[100] The current stagnation of Hamilton's manufacturing, especially the near obsolescence of much of its steel manufacturing, was not an isolated condition in the Great Lakes Region. Distaste related to the working conditions of factory labor and environmental damage caused by heavy industrial activity were two central components in this shift. This meant that these cities lost a large percentage of their manufacturing employed middle class that traditionally lived in near proximity to industrial areas. The changing values in North American culture adapted to new technology and flexibility in manufacturing operations. The peripheral hinterlands appealed to migrating workers by promoting their distance from centralized industrial workspaces and more congested worker's housing. A large percentage of citizens from core urban neighborhoods moved to the city periphery, along with their manufacturing employment, from the 1950s onward.

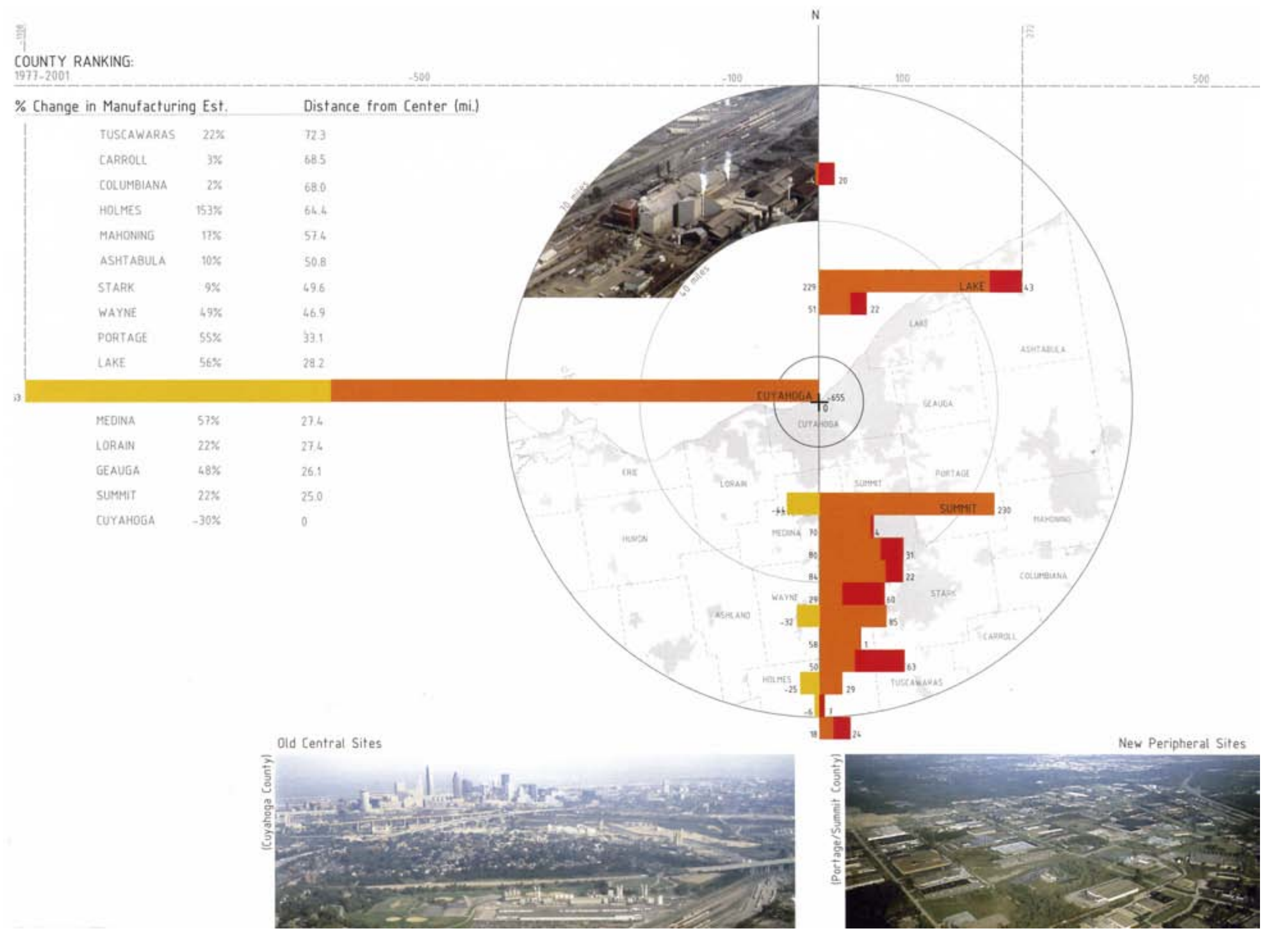


fig. 2.14 Cleveland Spindle Chart by Alan Berger

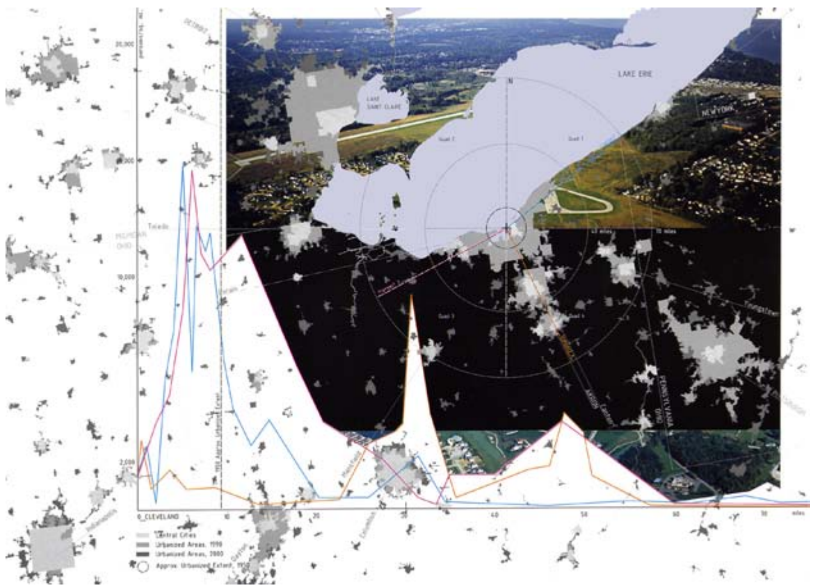


fig. 2.15 *Cleveland Dispersal Graph by Alan Berger*

The decentralization of American Great Lakes cities according to Alan Berger was caused by the entropic rapid horizontal growth of the city periphery. Alan Berger examines this growth by tracing the transplantation of manufacturing activity from central manufacturing areas to the periphery using a mapping analysis. The spindle chart [figure 2.14] shows the change in manufacturing activity relative to the city center in Cleveland, Ohio.[101] The dispersal graph [fig 2.15] maps the change in population density relative to the city's urban center. Berger reasons that the expansion of the urban periphery was lead by the substantial growth of employment in those areas, and that the landscapes of waste left behind in the older cores were a natural result of horizontal urban growth. Waste around the periphery of the city is an unavoidable result of its rapidly "horizontalizing" economic conditions.[102] The term horizontalization is a term used to describe new low density construction that is predominantly one level in height. The outcome is a trend that leaves large expanses of land in the central manufacturing regions of cities heavily contaminated and difficult to redevelop.[103] Berger uses the term 'drosscape' to describe these landscapes of wasted under-utilized urban space. Nial Kirkwood points to the limitations that these sites have concerning their impact on surrounding neighborhoods:

> "Virtually every city in the nation's older industrial regions, no matter its size, grapples with the challenge of unused manufacturing facilities and other industrial sites . . . Public concern about health effects from hazardous chemicals, stricter environmental laws, and changing private-sector development priorities have made it increasingly difficult for communities to restore and reuse former manufacturing sites".[104]

Kirkwood reveals the complexity involved in reclaiming the wasted urban land and remediating contaminated natural systems. Alan Berger points to the potential these sites have for future urban renewal claiming that "future urban infill and growth depend on salvaging and re-imagining the collective body of in-between

fig. 2.16 Van Buren Street, West Phoenix, Marcopa County, Arizona showing horizontal expansion of the industrial urban periphery.

landscapes".[105] The relationship between urban activity and environmental responsibility is at a crossroad when it comes to mining the future potential of these sites. The lessons of past industrial development are most fertile only if learned from, which is vital to remember as future manufacturing roles emerge. This will help inform the future role of design in redeveloping dross spaces.

The evolving operation of flexible 'just in time' manufacturing, transportation, and delivery has replaced the Fordist central production machine of the early 20th century industrial city. Berger describes that this flexibility is associated with the term post-Fordism. Flexible post-Fordist plant processes of production and consumption produce smaller, more customized batches of goods which are adaptable to shifts in consumer demand.[106] More wasted landscape, which Berger terms 'drosscape', around the peripheral areas of cities is produced in post-Fordist industrial cities because more firms require capacity and larger facilities to meet demand for customized production and fluctuating consumer tastes.[107] The facilities are less efficient because they provide capacity for drops in demand, equipment is less dedicated, and facilities are easily closed or adapted to new uses when required. More facilities, buildings, roads, and sites, are required in this flexible manufacturing model consuming more land in the urban periphery of cities.[108] As Allen Scoot, professor of geography at UCLA, describes that in a post-Fordist economy industries need to agglomerate in districts outside the city core on the periphery in order to accommodate flexible production.[109] In contrast to the rust belt cities,

> "Phoenix and other Sunbelt cities are ripe for attracting flexible industries because they offer special economic and free trade-development zones, tax incentives, inexpensive land, publicly financed infrastructural connections for the transportation of goods and services, and in-migration of low-wage labor".[110]

With emerging trends in decentralization and post-Fordism in North American manufacturing it has become questionable what the prominent 'de facto' working condition is. The examples set by other American cities that have followed this approach point to a clear trend in which the decentralization of manufacturing leads to the outflow of employment from the central city, as was the case in Cleveland represented earlier [figure 2.14 and 2.15]. The centrality of employment operations in Hamilton is worth studying because it may provide a sustainable context for balancing human production and consumption through work activity, while defining a clear case for retaining the centrality of core urban functions.

Hamilton's ability to retain the concentration of its population and employment within its core areas is partly because it has found it unnecessary to adapt to this trend due to enormous historic investment in port-related manufacturing areas. Retaining its core manufacturing areas, especially in the harbour, continues to be challenged by overall economic stagnation and environmental degradation due to a resistance to radical change. Hamilton's industrial community is an interesting case because its centralized manufacturing operations have become stagnant but have not collapsed entirely. It has mostly retained its economic role while willfully degrading the immediately surrounding urban environment. If Globe Park could help retain the centrality of manufacturing activity by facilitating strict environmental regulation and more benign industrial operations, it could be beneficial to the quality of life of neighboring residents. Doing so, the park would boost local employment and health. If manufacturing operations could be rebuilt upon a sustainable foundation, there could be a re-emergence of innovative processes within local manufacturing cities like Hamilton with embedded principles of sustainability. For Globe Park, understanding these conditions will help speculate upon a reclamation process and an improved future for East Hamilton.


fig. 2.17 Cleveland Cuyahoga River Valley Industrial Area representing a Fordist format of industrial development

fig. 2.18 South of Ontario International Airport, San Bernardino County California representing a post-Fordist model of industrial development

2.2 MANUFACTURED ECOSYSTEMS MAPPING

Influenced by James J. Kay's methodology for an ecosystems approach to understanding complex systems, this large-scale analysis maps the implications that historical industrial development has inflicted on the Great Lakes Region. The focus of this mapping analysis is on Hamilton, Ontario. The systems looked at are the Great Lakes Watershed, Central Ontario Subwatersheds, Hamilton Subwatersheds, and Hamilton Harbour Subwatersheds. The term watershed is conflated to describe the region of influence caused by a system. Watershed is a term applied to both ecological and industrial systems. This Manufactured Ecosystems Mapping (MEM) analysis illustrates abiotic, biotic, and manufactured flows that have implications on the operations and ecological processes of Globe Park. Globe Park is concerned with its holistic implications for the Great Lakes and intends to become a manufacturing ecosystem that has positive implications for the environment. The MEM will trace relevant data that corresponds to mapping analysis. As Globe Park is deployed, the MEM will require updating to remain relevant. It is intended that the park is an indeterminate process that is influenced by large-scale ecological-industrial flows.

GREAT LAKES ECOLOGICAL WATERSHEDS: PERIMETER + RELIEF

fig. 2.19 Great Lakes Watershed

ABIOTIC FLOWS

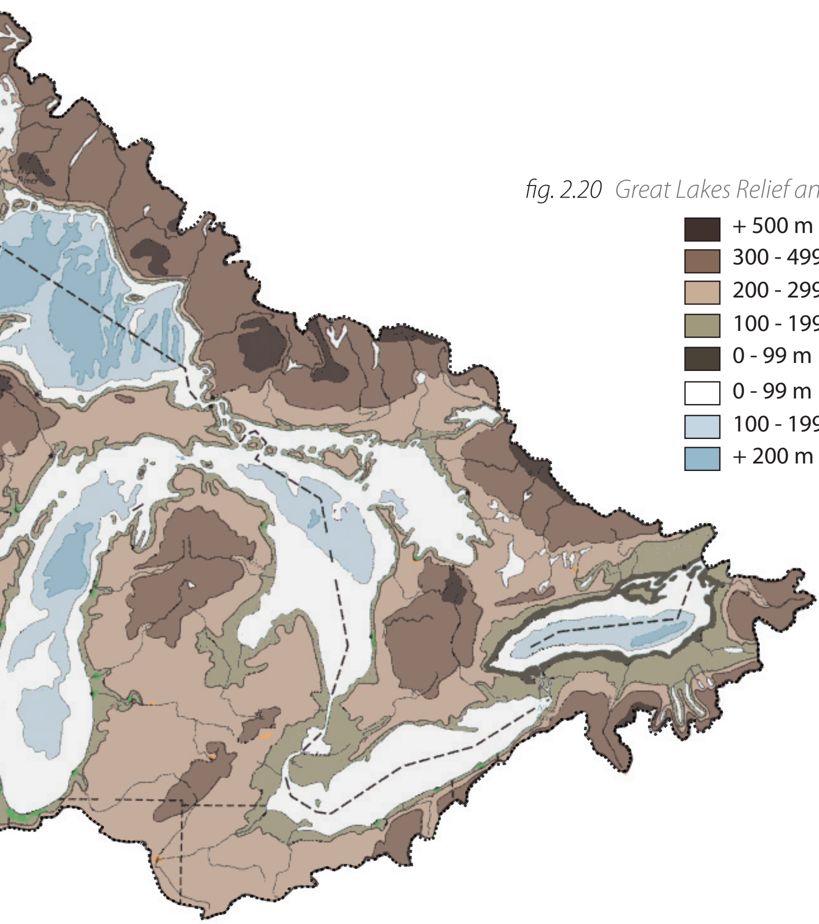


fig. 2.20 *Great Lakes Relief and Drainage*

fig. 2.21 Aerial view of Great Lakes shore line in Canadian Shield region

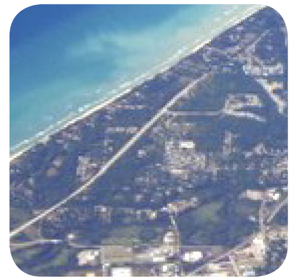


fig. 2.22 Aerial view of Great Lakes shore line in Southern Heartland Region

fig 2.23 Aerial view of the Bruce Peninsula edge of the Niagara Escarpment

GEOGRAPHY

Geographic Location
North America, bordering the United States and Canada. In the south east portion of Canada and in the north east portion of the United States.

Geographic Coordinates
Located between 76° and 93° W Longitude and between 42° and 47° N Latitude

Geographic Area
Total: 1,011,000 km^2
Land: 767,000 km^2
Water: 244,000 km^2

GEOMORPHOLOGY

Terrain
Lowlands with river valleys and moraines, escarpments, highland plateaus, exposed rock, and flat plains, shoreline of 18,000 kilometers intermixed with 35,000 islands.

Water
2300 cubic kilometers of fresh water 18% of world supply,

Elevations
Lowest Point: 100 meters
Highest Point: 700 meters

CLIMATE + PRECIPITATION

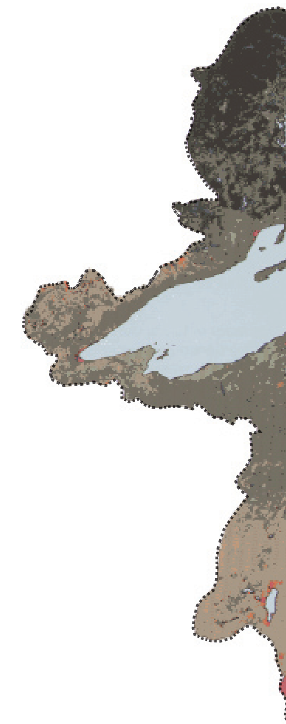
Temperate climate, precipitation all year, snow in winters, warm summers 20° to 25°, cold winters -10 to 0. The Great Lakes cause a lake effect that moderates seasonal temperatures absorbing heat and cooling the air in summer, then slowly radiating that heat in autumn.

NATURAL HAZARDS

Blizzards, freezing rain, flooding, tornados

GREAT LAKES ECOLOGICAL WATERSHED: ECOREGIONS + EROSION

fig. 2.24 Great Lakes Ecoregions



BIOTIC FLOWS

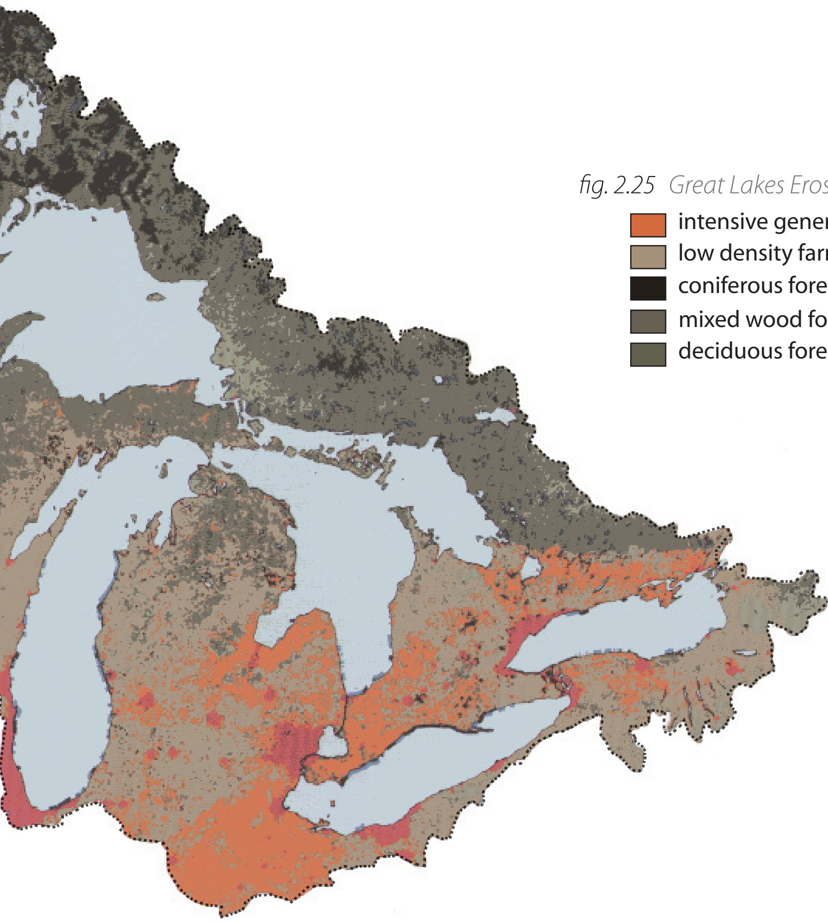


fig. 2.25 Great Lakes Erosion

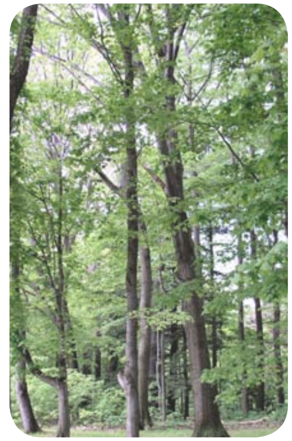


fig. 2.26 Maple trees part of Deciduous Forest Ecosystems

fig. 2.27 Northern Ontario Caribou

fig. 2.28 Snapping turtle at risk

ECOREGIONS

The Great Lakes ecoregion is divided into 20 distinct ecozones as illustrated by the Ecological Society of America. These regions are the Thunder Bay Plains, Nipigon Plains, Lake St. Joseph Plains, Superior Highlands, Matagami, Chapleau Plains, Nipissing, Hurontario, St. Laurant, North Eastern Highlands, Erie/Ontario Lake Plain, Erie, Northern Appalachian plateau and uplands, Eastern Corn Belt Plains, Huron/Erie Lake Plain, Southern Michigan/Northern Indiana Clay Plains, Central Corn Belt Plains, Southeastern Wisconsin Till Plain, North Central Hardwood Forests, and the Northern Lakes and Forests.

BIODIVERSITY

Terrestrial Biodiversity

The Great Lakes watershed is home to numerous mammal and plant species adapted to the seasonal condition of the temperate region.

Aquatic Biodiversity

It is estimated that over 180 fish species are indigenous to the great lakes, the most common species that inhabit shore areas are small mouth and large mouth bass, muskellunge, northern pike, and channel catfish. The most common species that inhabit open water areas are herring, blue pike, lake whitefish, walleye, sauger, freshwater drum, lake trout, and white bass.

Threats To Biodiversity

In the Great Lakes Bioregion the key contributors to threaten Biodiversity are habitat loss, landuse & development, incompatible recreational uses, exotic & invasive species, point & non-point pollution, and climate change. Over the last 150 years human inhabitation and development has significantly altered the landscape and watersheds of the Great Lakes Bioregion. Some of the damage that has taken place in Southern Ontario converted to developed uses 70% of wetlands, 99% of prairie/savanna, and 94% of upland forest.

GREAT LAKES CULTURAL WATERSHEDS: PHOSPHORUS + POPULATION

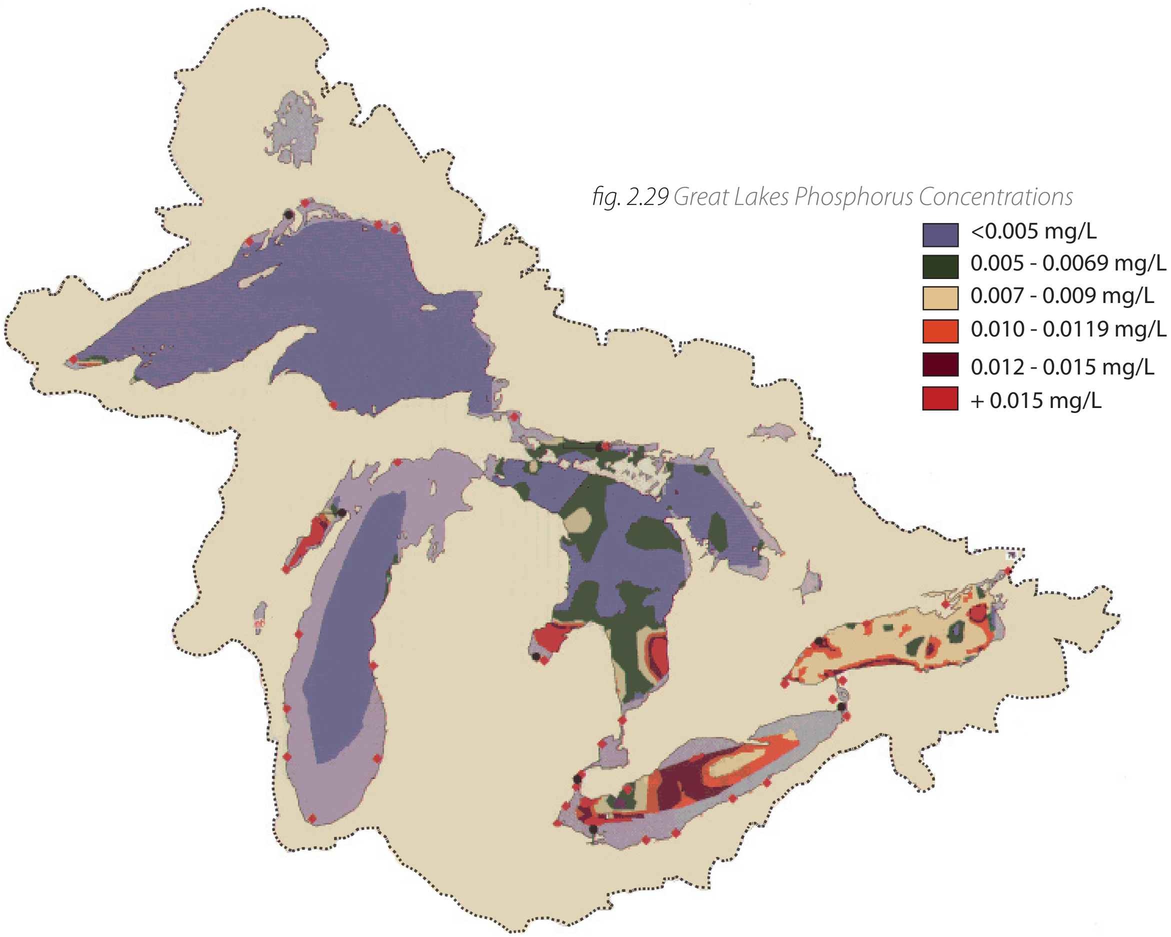
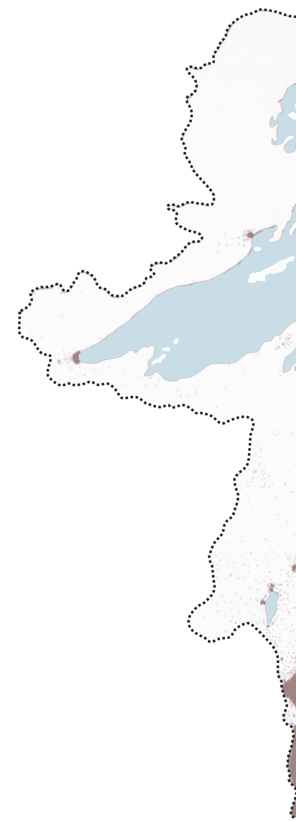


fig. 2.29 Great Lakes Phosphorus Concentrations



MANUFACTURED FLOWS

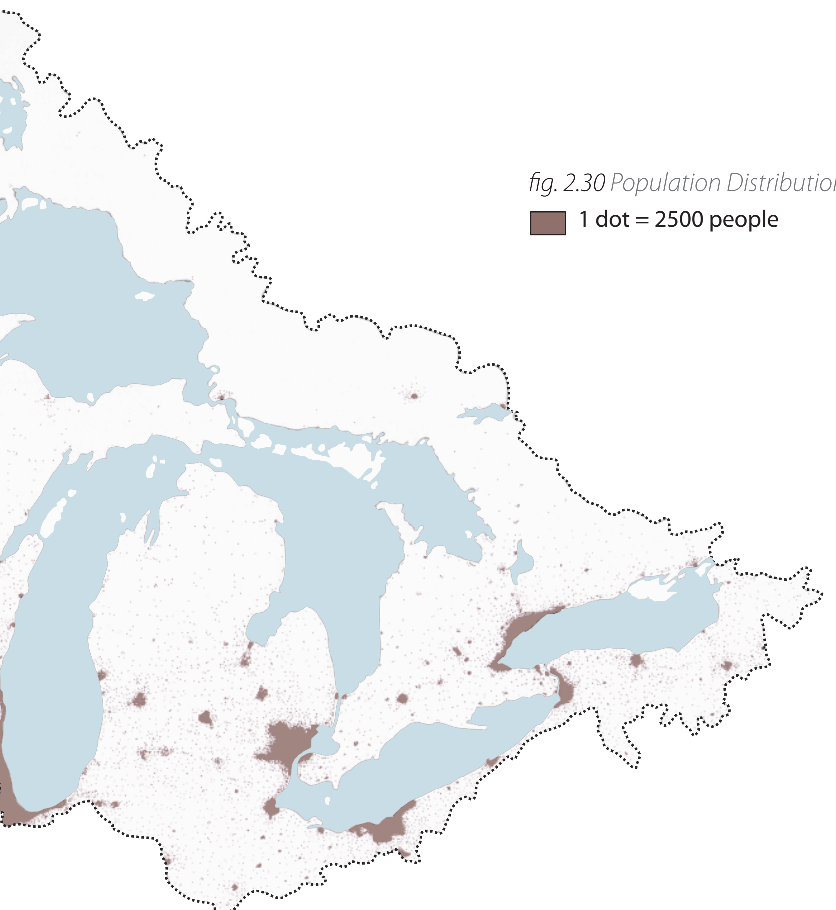


fig. 2.30 Population Distribution

1 dot = 2500 people

fig. 2.31 Carbon dioxide emissions from Sinter Plant in Hamilton

fig. 2.32 Smog from former Lakeview Coal powered thermal power plant

fig. 2.33 Coal berm formation in Nanticoke

ENVIRONMENTAL ISSUES

Pollution

Toxic contaminates pose a threat to both terrestrial and wildlife species in the Great Lakes Bioregion. Humans have depended on the natural environment for waste disposal. The watershed's rivers, lakes, and terrestrial lands have become repositories for industrial and residential waste. The sediments from sewage, run off, and industrial waste contaminate have resulted in lost and destroyed habitat for an array of species. Air pollution is another significant factor that has resulted in the acidification of soils and watershed destroying natural ecosystems.

Climate Change

The biotic systems of the Great Lakes will be greatly affected by large increases in carbon dioxide and green house gas due to increasing industrialization and urban sprawl. Temperatures are expected to rise in winter by 3 to 7 degrees and in summer by 3 to 10 degrees. The warmer climate will cause an increased level of evaporation and precipitation to occur and in effect the supply basin of the watershed to decrease by 23% to 50%. As a result, greater frequencies of diseases spread by insects are to be expected. Massive changes to the composition of ecosystems of the Great Lakes forests also will occur. The warming climate will favor herbaceous plants over woody plants. Plant species will begin migrating northward. Species like oak-hickory will invade northern boreal forests. As well the extension of the fire season is to be expected. Another direct impact with affect migratory birds, causing a reduced food supply due to earlier resident bird breeding. The food supply will be consumed by resident birds prior to the arrival of migrating birds. In effect, bird diversity is expected to be lost.

Resource Extraction

Natural gas, hydropower, gypsum, zinc, asbestos, aluminum, magnesium, gold, silver, sulphur, titanium, iron, lead, salt, nickel, copper, coal (us)

GREAT LAKES TRANSPORTATION WATERSHEDS: HIGHWAYS + RAIL

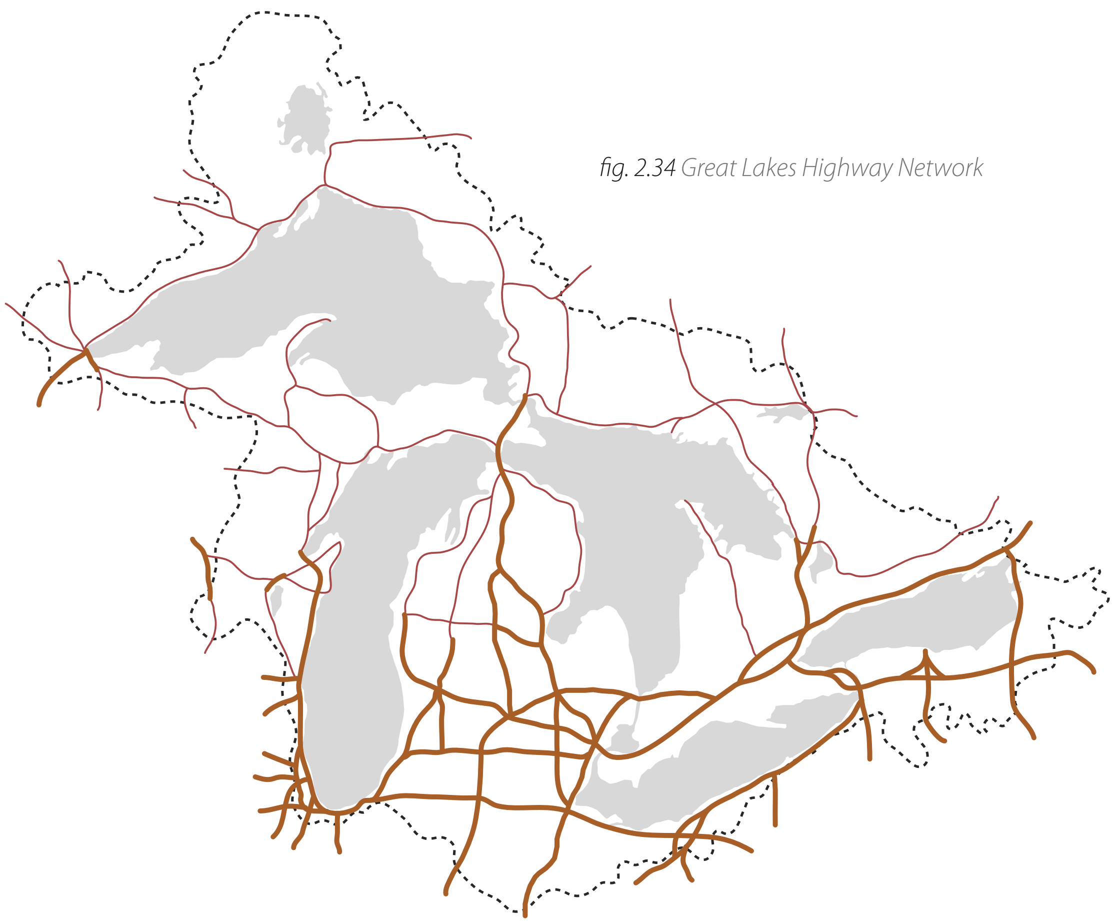
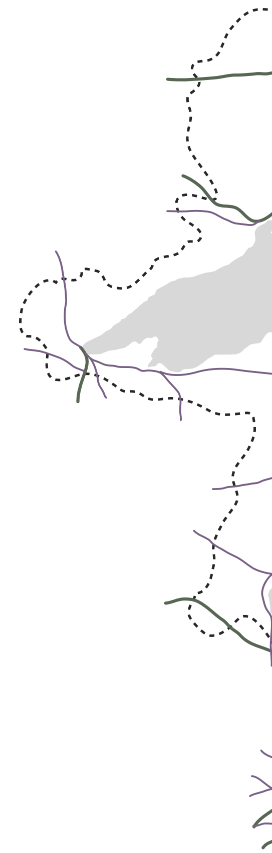


fig. 2.34 *Great Lakes Highway Network*



MANUFACTURED FLOWS

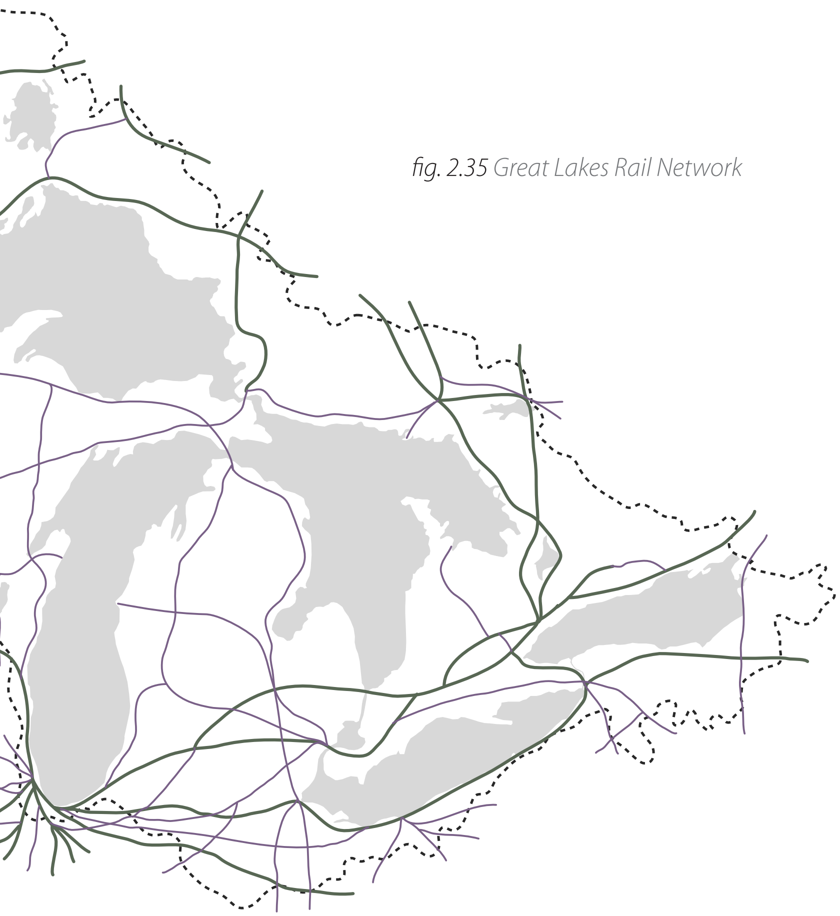


fig. 2.35 Great Lakes Rail Network

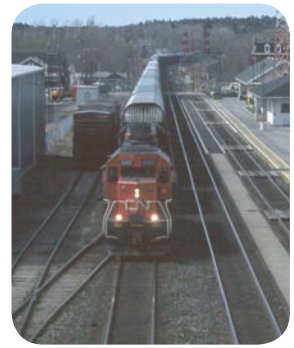


fig. 2.36 CN Rail lines in Burlington

fig. 2.37 407 Highway overpass in Toronto

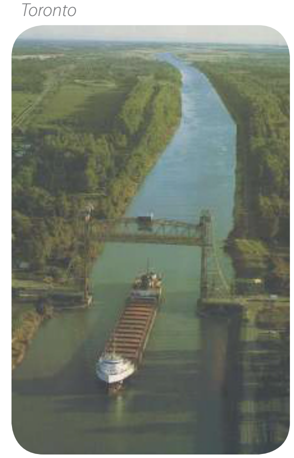


fig. 2.38 Great Lakes St. Lawrence Seaway Welland Canal

INFRASTRUCTURE

Railways

The region is interlinked by a heavy network of rail lines. In Canada the CN and CP lines link cities creating a strong transportation network for industry. These lines link the region with the rest of the United States and Canada. Northern mining cities which are relied upon for raw material supply are linked by rail. Railways connect major seaway ports. Rail transportation is in decline although it is 30% - 40% more energy efficient than truck shipping.

Highways

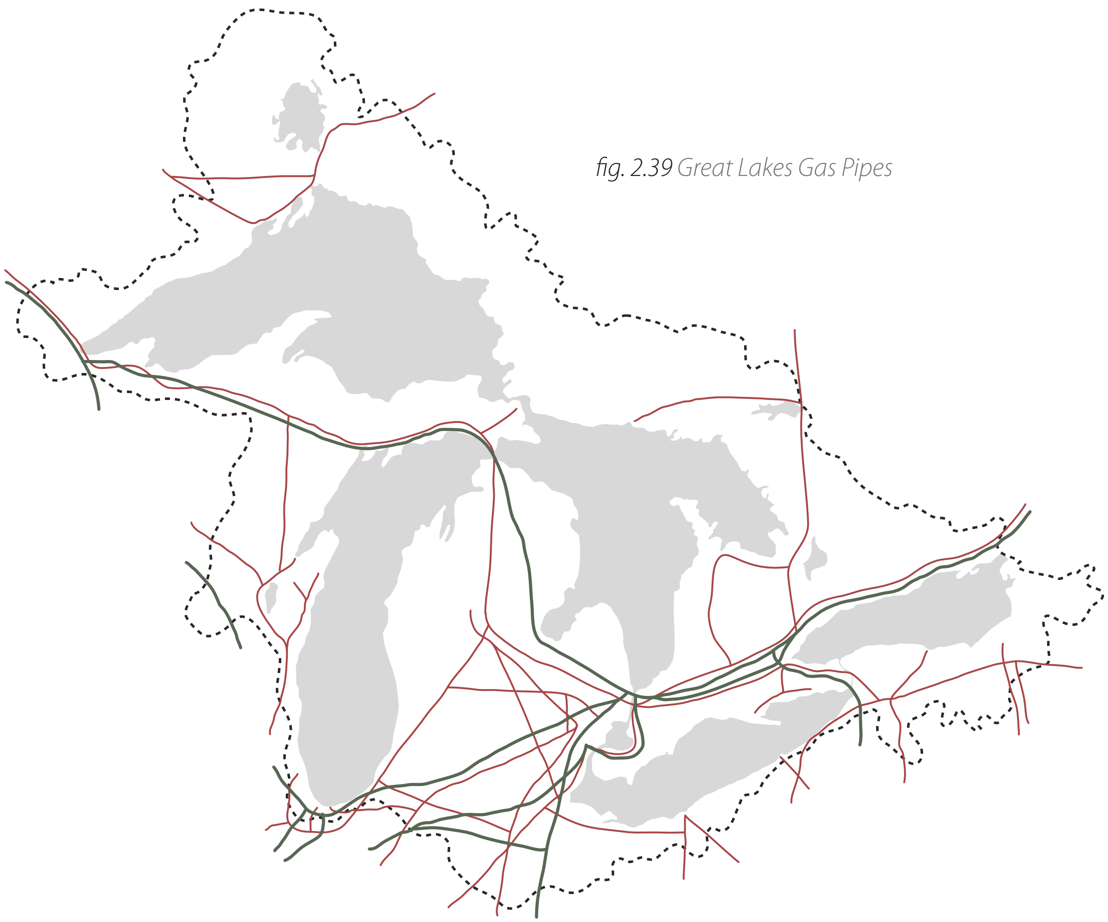
The region is interlinked with a strong system of Highways. In the Canadian portion of the region main throughways are components of the 400 series and Trans Canada Highways linking the manufacturing heartland with the rest of Canada. Transportation by truck is the fastest growing portion of shipping segments, however, it consumes the greatest portion of fuel and creates the largest amount of CO^2 emissions.

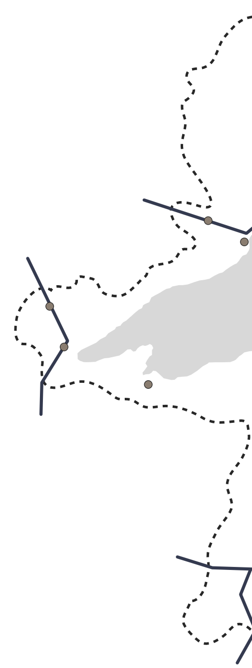
Seaway

The St. Lawrence / Great Lakes Seaway opened in 1959. Approximately 2 billion metric tonnes have since been shipped using it. In total, over 250 million tonnes of cargo traverses the combined St. Lawrence Seaway / Great Lakes System every year. Over 162 million net tons of dry bulk cargo is moved on the Lakes over the course of a year. Volumes shipped in order are: iron ore, coal, stone, grain, salt, cement and potash. The iron ore, stone, and coal are used in the steel industry. There is also some shipping of liquid and containerized cargo but most container ships cannot pass the locks on the Saint Lawrence Seaway because they are too wide. The maximum vessel able to travel the seaway is: 225.5 m length, 23.7 m beam, 8.08 m draft, and 35.5 m height above water. This method of transportation is in decline although it is the most efficient in terms of energy use and produces the least amount of CO^2 emissions.

GREAT LAKES ENERGY WATERSHEDS: GAS PIPES + TRANSMISSION LINES

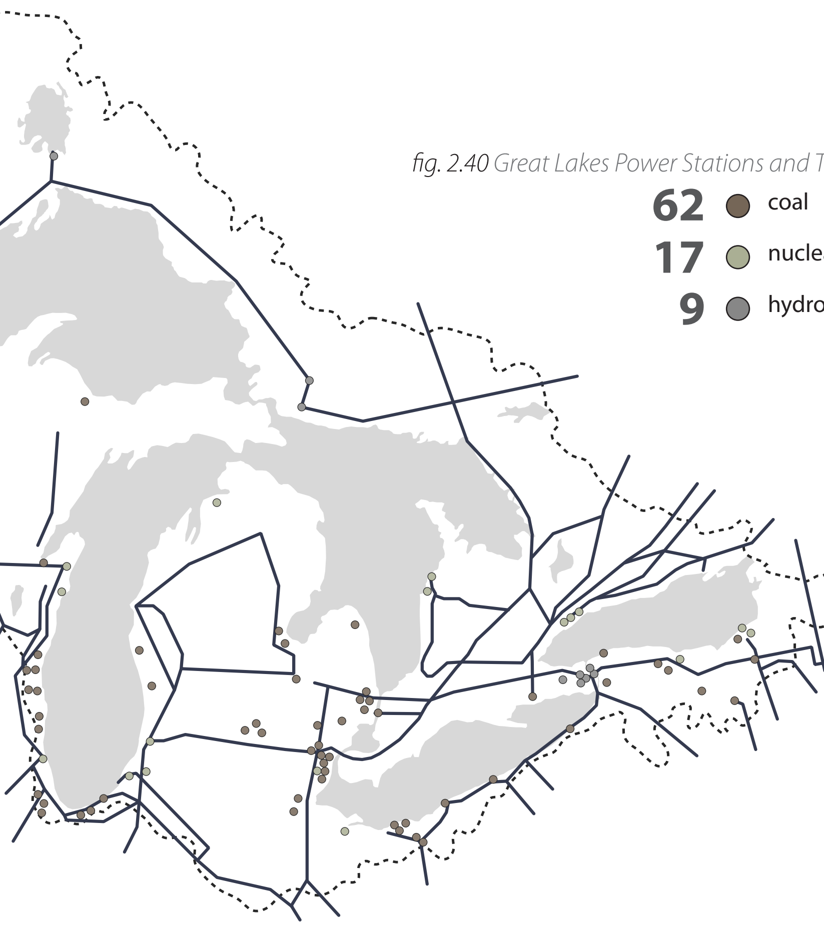
fig. 2.39 *Great Lakes Gas Pipes*





MANUFACTURED FLOWS

fig. 2.40 Great Lakes Power Stations and Transmission Lines



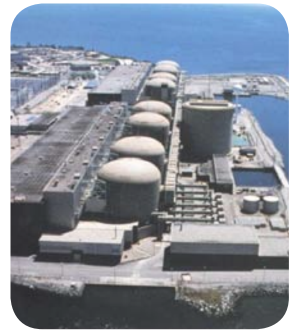


fig. 2.41 Pickering Nuclear Power Plant

fig. 2.42 Darlington Nuclear Power Plant

ENERGY

Energy Production

Approximately 14,547 kg oil equivalent per person (Canada)

Energy Consumption

Approximately 10,447 kg oil equivalent per person (Canada)

WATER USAGE

Water Withdrawls

Municipal - 6,716 million m3 yearly

Manufacturing - 24,652 million m3 yearly

Power Production - 43,796 million m3 yearly

Water Consumption

Municipal - 783 million m3 yearly

Manufacturing - 2,479 million m3 yearly

Power Production - 673 million m3 yearly

TRANSPORTATION WATERSHED: GREAT LAKES / ST. LAWRENCE SEAWAY

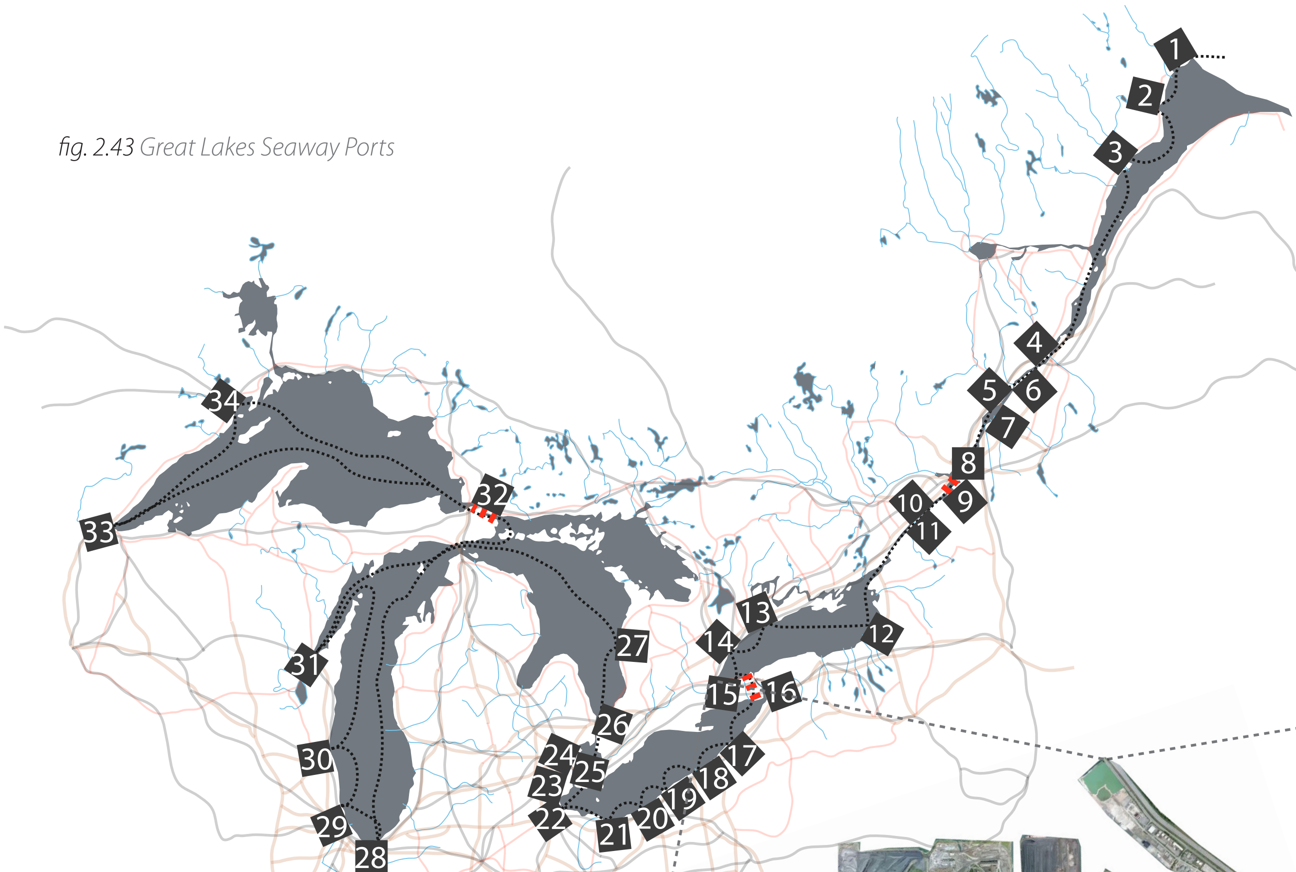


fig. 2.43 Great Lakes Seaway Ports

fig. 2.44 Port of Hamilton Aerial

1 - St. Iles, Que.
21,101,645 tonnes

IN: alumina, petroleum, dolomite, **coal**, coke

OUT: iron ore, aluminum, **coal**, limestone

2- Port Cartier, Que.
21,101,645 tonnes

IN: bentonite, coke breeze, dolomite,

OUT: iron ore, aluminum, **coal**, limestone

3 - Baie-Comeau, Que.
5,900,000 tonnes

IN: car ferry terminal, rail ferry terminal

OUT: manufactured goods

4 - Quebec City, Que.
21,825,000 tonnes

IN: crude oil, grain, iron ore, salt, coke

OUT: petroleum, grain, iron ore, scrap metal

5 - Trois Rivieres, Que.
2,400,000 tonnes

IN: alumina, clay, salt, coke, coal

OUT: wood, pulp, paper

6 - Becancor, Que.
1,800,000 tonnes

7- Sorel, Que.
4,777,505 tonnes

IN: steel, building materials, lumber

OUT: steel, lumber

8 - Montreal, Que.
22,700,000 tonnes

IN: dry bulk, grain, iron, copper, ore, salt, liquid bulk, petroleum, asphalt, molasses, chemicals, oil

9 - Valley Field, Que.
376,000 tonnes

10 - Prescott, Ont.
517,664 tonnes

IN: grain, road salt

OUT: grain, aggregate

11 - Ogdensburge, N.Y.
108,488 tonnes

IN: talc, road salt

OUT: limestone, grain, wolla stonite, zinc

12 - Oswego, N.Y.
457,770 tonnes

IN: aluminum potash, urea, limestone, salt

OUT: project cargos

13 - Oshawa, Ont.
197,575 tonnes

IN: steel (rebar, coils, plates, beams, bars)

OUT: special projects

14 - Toronto, Ont.
2,536,078 tonnes

IN: cement, salt, sugar, aggregate, general cargo

OUT: break bulk, general cargo, heavy cargo

15 - HAMILTON, Ont.
12,359,511 tonnes

IN: coal, iron ore, liquid bulk, dry bulk

OUT: steel, machinery, bulk materials

16 - Buffalo, N.Y.
750,000 tonnes

IN: salt, coal, coke, petcoke, stone, aggregates, machinery

17 - Erie, Penn.
1,250,00 tonnes

IN: ore, aggregates, lumber, salt

OUT: scrap, machines, mill ends

18 - Conneat, Ohio

19 - Ashtabula, Ohio

20 - Cleveland, Ohio
11,466,973 tonnes

IN: steel, machinery, liquid, dry bulk

OUT: machinery, steel

21 - Lorain, OH.

22 - Toledo, Ohio
9,794,135 tonnes

IN: iron ore, general cargo, cement, petroleum

OUT: coal, grain, cement, petroleum products

23 - Monroe, Michigan
1,088,446 tonnes

IN: coal, asphalt, equipment, coke, petroleum

OUT: marine, construction materials, stone

24 - Detroit Michigan
15,413,398 tonnes

IN: steel, ferro alloys, aggregate

OUT: steel, used cars, machinery, scrap, tallow

25 - Windsor, Ont.
4,604, 504 tonnes

IN: aggregate, sand, cement, grain, steel

OUT: salt, grain, petroleum

26 - Sarnia, Ont.

IN: grain, ore, petroleum products

OUT: petroleum prod-

27 - Goderich, Ont.
430,000 tonnes

IN: grain, salt

OUT: grain, salt

28 - Burns Harbour, Ind.
8,164, 663 tonnes

IN: steel, fertilizer, potash, salt, slabs, general cargo

OUT: coal, fertilizer, grain, steel

29 - Chicago, Ill.
894,832 tonnes

IN: steel, liquid bulk, stone, cement, sugar

OUT: steel, scrap, grain, liquid bulk

30 - Milwaukee, Wis.
2,654,876 tonnes

IN: steel, salt, coal, cement

OUT: grain, scrap, food aid, sand, project cargo

31 - Green Bay, Wis.
1,900,000 tonnes

IN: coal, limestone, cement, liquid asphalt, salt, pig iron, liquid bulk

OUT: tallow

32 - Sault Ste. Marie, On.

IN: iron ore, coal

OUT: steel products

33 - Thunder Bay, Ont.
8,200,674 tonnes

IN: petroleum, general cargos

OUT: grain, coal, potash, general cargos

34 - Duluth, Wis.
34,800,000 tonnes

IN: limestone, salt, cement

OUT: iron ore, iron concentrates, coal, grain

fig. 2.45 Great Lakes Port Statistics

MANUFACTURED FLOWS

fig. 2.46 Chicago Urban Center

fig. 2.47 Detroit Urban Center

fig. 2.48 Toronto Urban Center

PEOPLE

Population
33,000,000 (approximately one 10th of United States' population and one 4th of Canada's population. Over 80% of people live in 17 metropolitan areas.

Population Density 41 persons / km^2

Language
The languages of the region are English in the United States and Canada (except regions located in Quebec), French in the province of Quebec, and Languages of the First nations (majorities are Algonquian and Iroquoian).

Ethnicity
Multicultural, European Caucasian majority with large minority groups such as Black, Hispanic, and Asian

Land Use
Basin Land Use: Agriculture 36%. Residential 6%, Forest 54%, Other 4%
Shoreline Land Use: Residential 38%, Recreational 12%, Agricultural 20%, Commercial 18%, Other 12%

Urbanization (Suburbanization)
Six Metropolitan areas hold 67% of the Great Lakes population, Metropolitan Chicago, Toronto, and Detroit are within the top 12 urban agglomerations in North America all of which have sprawled over 100 km from their central cores consuming thousands of hectares of agricultural land some of which is highly fertile and non replaceable.

GOVERNMENT

Political Type
Canada - Democracy
United States - Democracy

Political Boundaries
Canada - Great Lakes border the Province of Ontario, United States - Great Lakes border States of New York, Pennsylvania, Ohio, Michigan, Illinois, Wisconsin, and Minnesota

ENERGY WATERSHEDS: SOUTHERN ONTARIO + CENTRAL ONTARIO

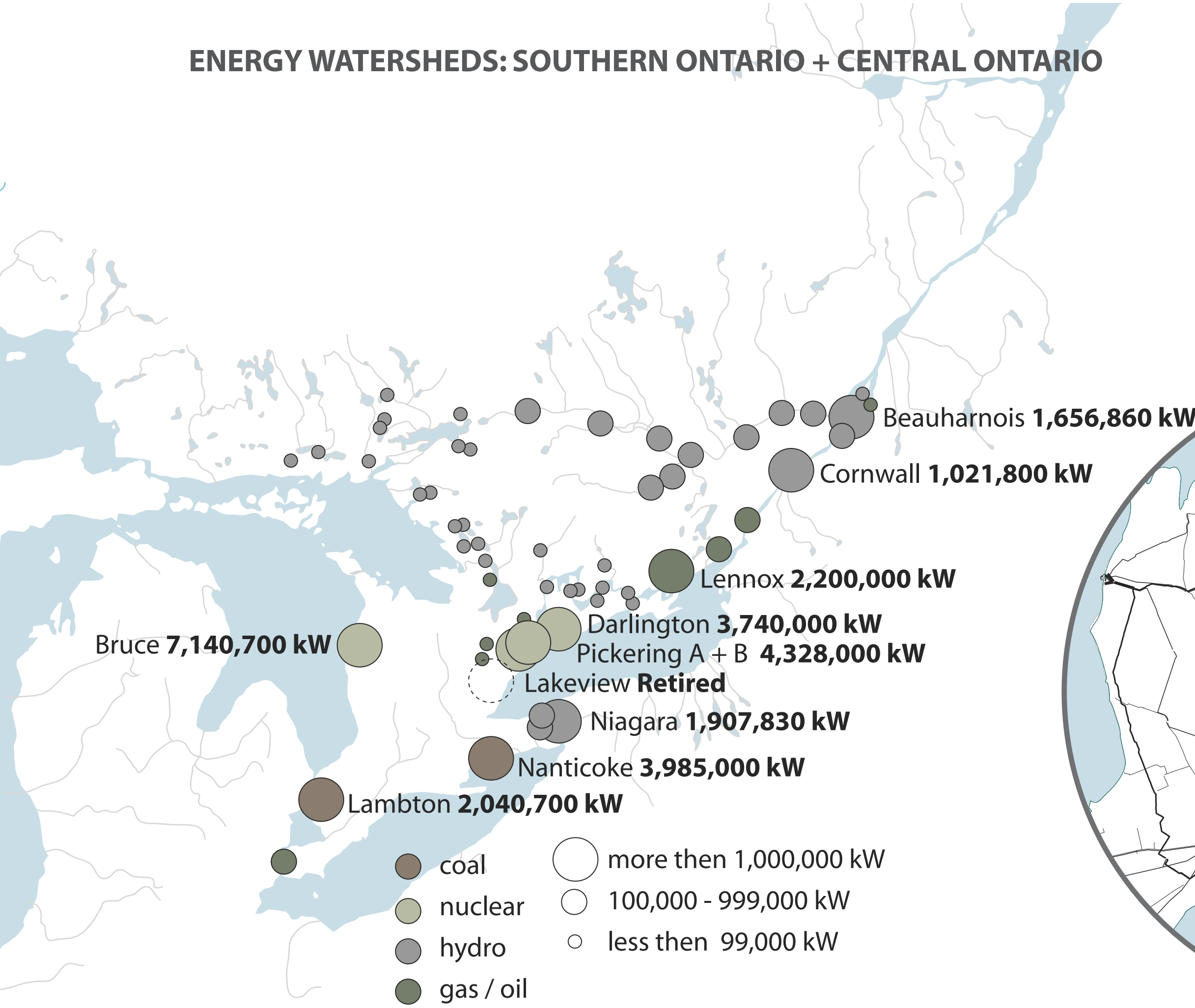


fig. 2.49 Southern Ontario Power Stations

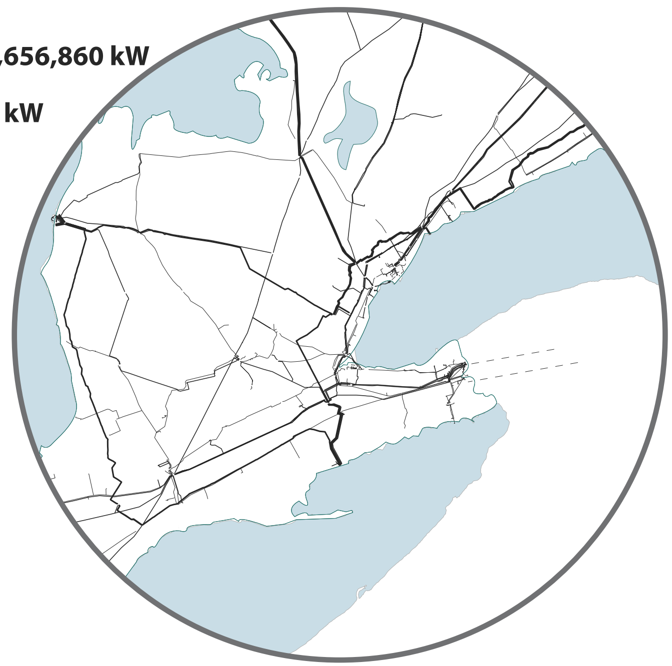


fig. 2.50 Transmission Lines into Hamilton

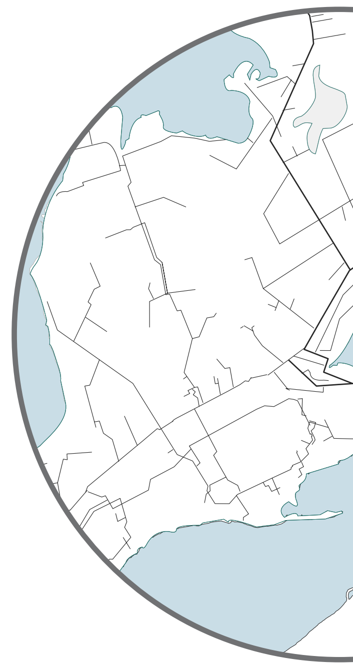


fig. 2.51 Gas Lines into Hamilton

MANUFACTURED FLOWS

fig. 2.52 Co-gen Electricity Generation in South Ontario

fig. 2.53 Nanticoke coal powered thermal power plant.

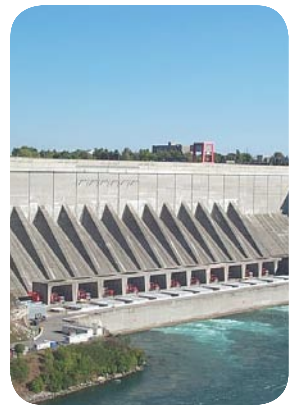


fig. 2.54 Niagara Falls hydroelectric power plant.

fig. 2.55 Glanbrook municipal landfill site at the head of the Red hill creek watershed.

ENERGY

Energy Use

Industry is the largest sector for energy use in the region which uses coal, electricity and raw materials. Municipal energy use is also intense coming primarily from the residential sectors.

Energy Generation

The two major municipal sources are located within 50 kms of downtown Hamilton. One is a hydroelectric plant at Niagara Falls and the second is coal powered thermal electric plant at Nanticoke. There is no major production facility located in the city aside from small cogen production from local industrial and municipal operations. U.S. Steel Canada generates approximately 4000 kW per annum from cogen processes. Mohawk College has a natural gas cogen system that generates 800 kW and Laidlaw Corporation uses an incinerator that produces 4300 kW. The Hamilton Community Energy partnership is a developing organization beginning to implement bottom-up solutions to energy needs. Some developments include small generators from biomass and district heating.

WASTE

The region currently uses a conventional sewer system that collects waste and distributes to Woodward Sewage Treatment Plant. Several land fills are located along the periphery of the region. These facilities use conventional methods of waste storage. Glanbrook landfill site is nearing capacity and a new site will need to be developed in the future.

REGIONAL SUBWATERSHEDS: TERRESTRIAL ECOSYSTEMS

fig. 2.56 *Grimsby Terrestrial Ecosystems*

- forest ecosystem
- wetland ecosystem
- other ecosystem
- water

ABIOTIC FLOWS

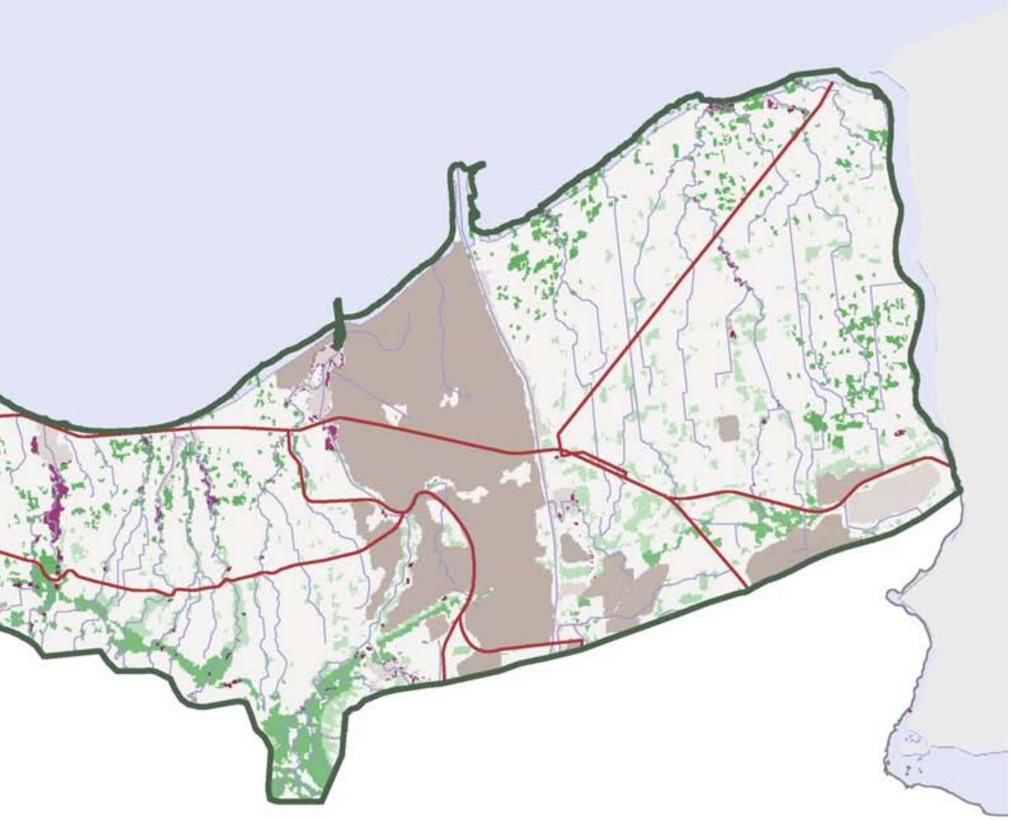


fig. 2.57 *Niagara Falls Ontario*

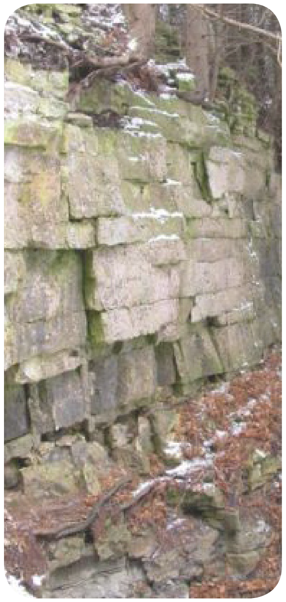


fig. 2.58 *Limestone sedimentary rock formation of the Niagara Escarpment*

GEOGRAPHY

Geographic Location

Located on the Southwest banks of Lake Ontario beginning just north of Hamilton Harbour and extending to the Niagara River bordering upstate New York.

Geographic Coordinates

Located between 79° W and 80° W longitude and at 42.1° N latitude

Area

83,865 hectares

GEOMORPHOLOGY

Physiography

This ecodistrict includes the southern reaches of the Niagara Escarpment along with the shallow till moraines along the southern boundary. The eastern boundary includes the lower slopes of the Niagara Escarpment and a portion of the Iroquois Plains. The escarpment of the till moraines and spillways are located on the western edge of the ecodistrict. The Norfolk sand plains reach the transition to the Flamborough Limestone plains. This is the very unique larger ecosystem region that the Hamilton Harbour watershed attributes its terrestrial ecological qualities.

Elevation

Low Ranges 0 - 100 m

High Ranges 100 - 200 m

CLIMATE + PRECIPITATION

The fruit belt has a temperate northern climate, precipitation occurs all year, snow occurs in winters, warm summers 20° to 25°, cold winters -10 to 0. The adjacency to Lake Ontario causes a lake effect that moderates seasonal temperatures absorbing heat and cooling the air in summer, then slowly radiating that heat in autumn.

Natural Resources

Limestone, gravel, water, sand, salt

NATURAL HAZARDS

Tornados (November 10th 2005), blizzards, freezing rain

REGIONAL SUBWATERSHEDS: TERRESTRIAL CONSERVATION

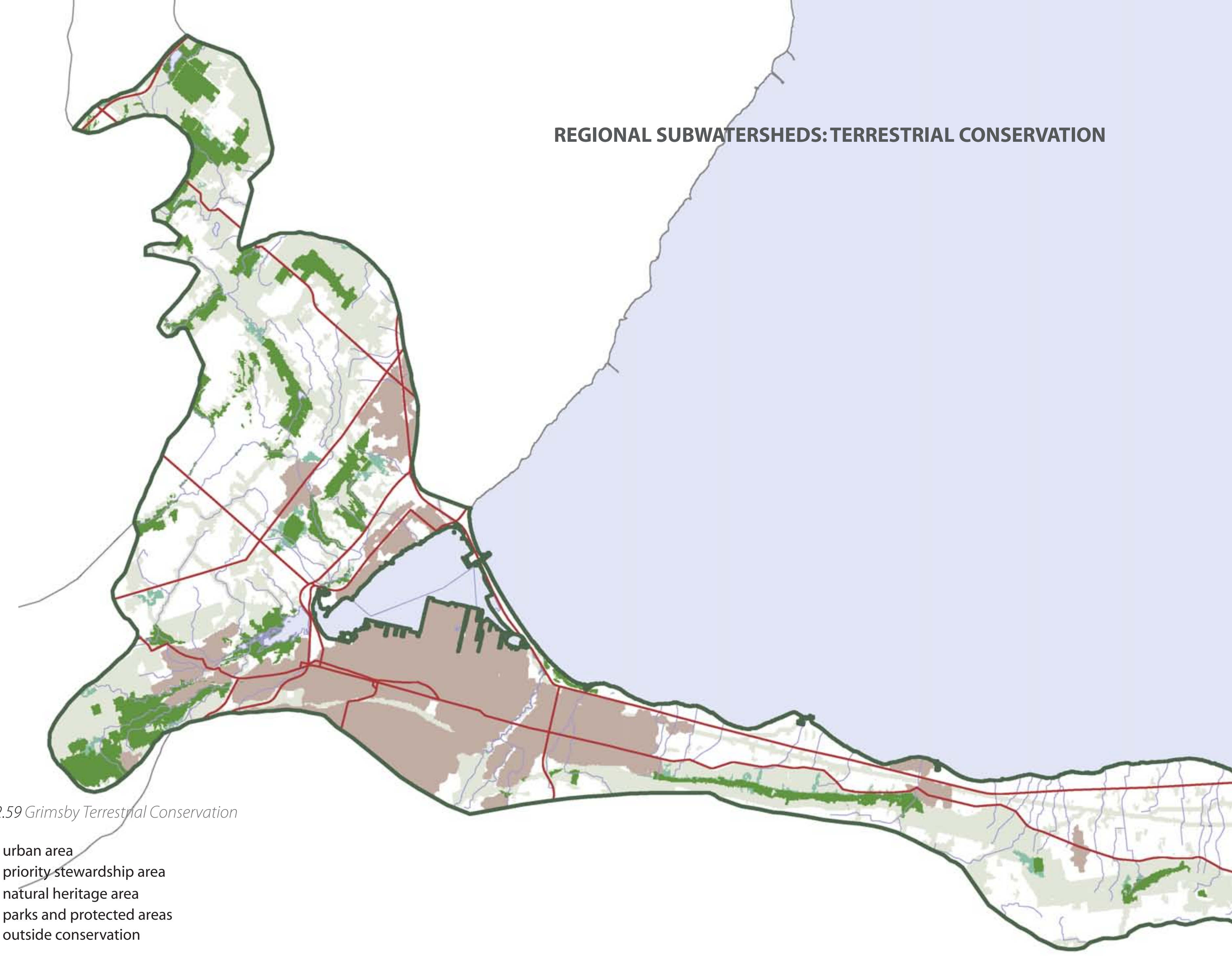


fig. 2.59 Grimsby Terrestrial Conservation

- urban area
- priority stewardship area
- natural heritage area
- parks and protected areas
- outside conservation

BIOTIC FLOWS

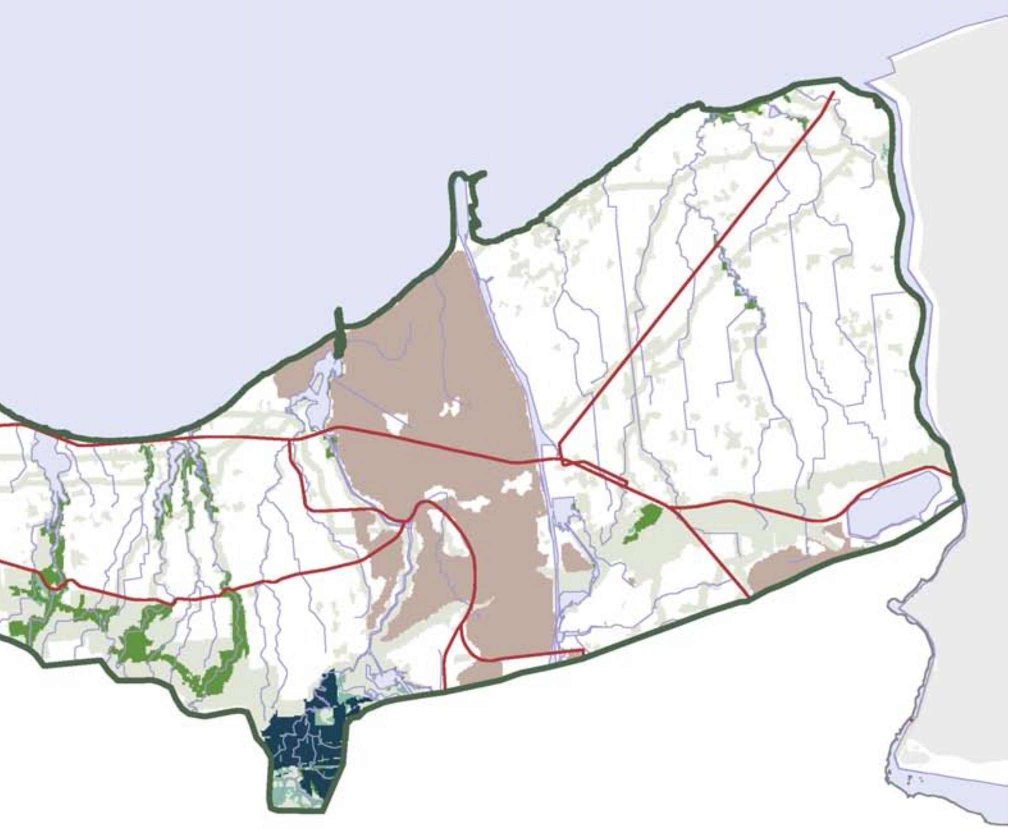


fig. 2.60 *Niagara escarpment forest complex.*

fig. 2.61 *Caspian Tern*

fig. 2.62 *Jefferson Salamander*

ECOREGIONS

In this region approximately 19% of the ecodistrict remains as natural cover, which is mostly forest. The Niagara Escarpment forest complex makes up 25% of the current natural cover. Sand plain forest complexes make up 15% of the district and till and moraine forest complexes are at 14%. The ecodistrict's forest complexes are predominantly deciduous species. The remaining 10% are wetlands, three quarters of which are swamps.

BIODIVERSITY

Species At Risk

The ecodistrict is home to 33 targeted conservation species, over half of which are plants. COSEWIC and OMNR have designated that 80% of these species are at risk, including the endangered Red Mulberry, American Chestnut, Jefferson Salamander, and Caspian Tern.

Rare Vegetative Species

Five out of the 24 significant vegetative communities located in this ecodistrict are considered to be globally rare, the limestone talus and tall grass prairie, 18 vegetative communities are considered to be provincially rare, and six are considered to be high-quality representative vegetation communities that are important to conservation.

ENVIRONMENT ISSUES

Soil Erosion

The wildlife and vegetative communities in this ecosystem are at serious risk due to soil erosion caused by heavy agricultural use. Orchards are grown in the area without ground cover and soil erosion is washing away soil nutrients. Water washes down the Niagara Escarpment across unprotected fields into Lake Ontario.

Urban Sprawl

Urban sprawl posses a serious threat to both agricultural uses and natural habitat. Important land is being consumed by permanent damage by suburban development in Stoney Creek, Grimsby, St. Catherines, and Niagara on the Lake.

POLITICAL SUBWATERSHEDS: GREENBELT + FRUIT BELT

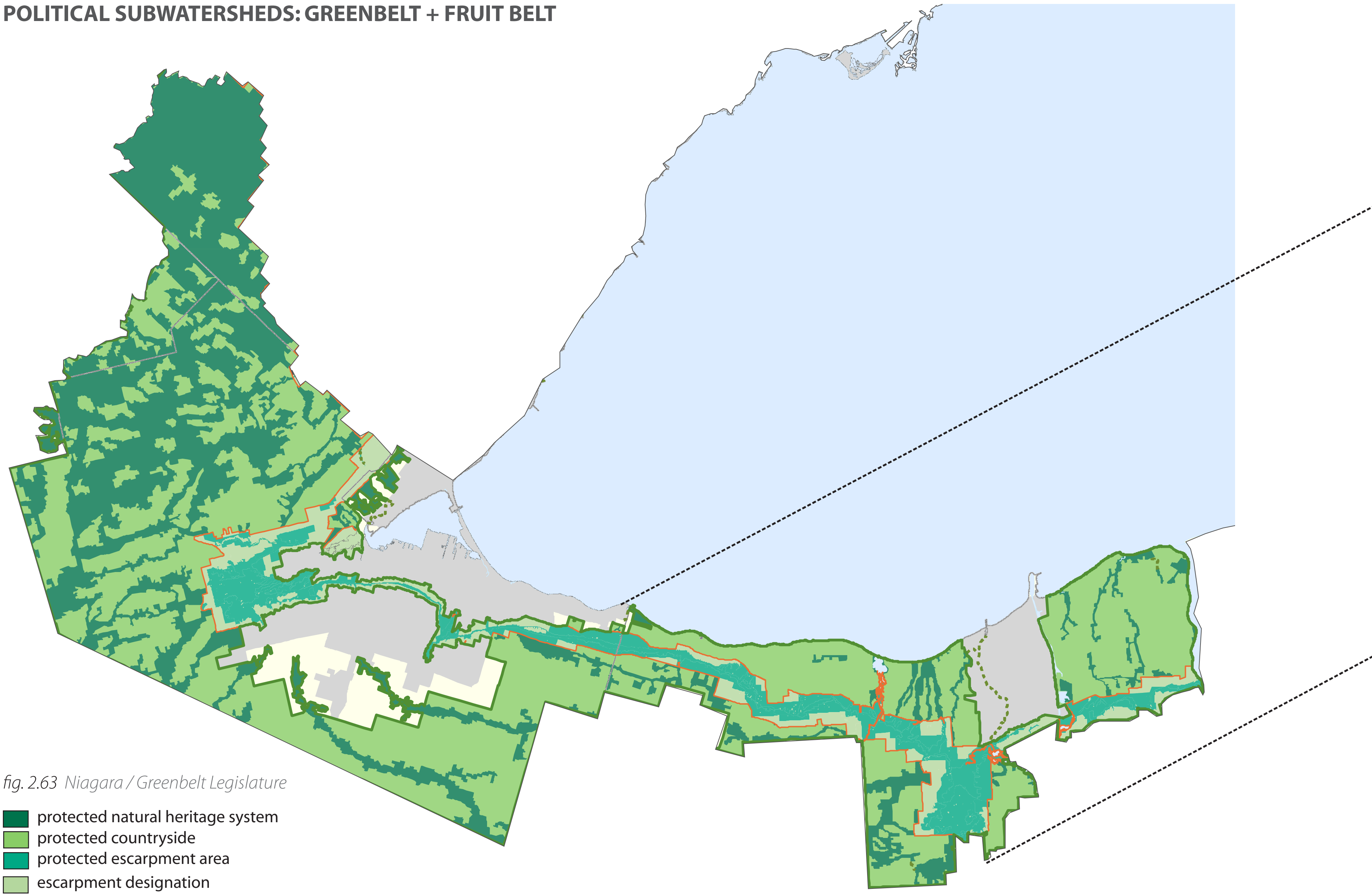


fig. 2.63 Niagara / Greenbelt Legislature

- protected natural heritage system
- protected countryside
- protected escarpment area
- escarpment designation

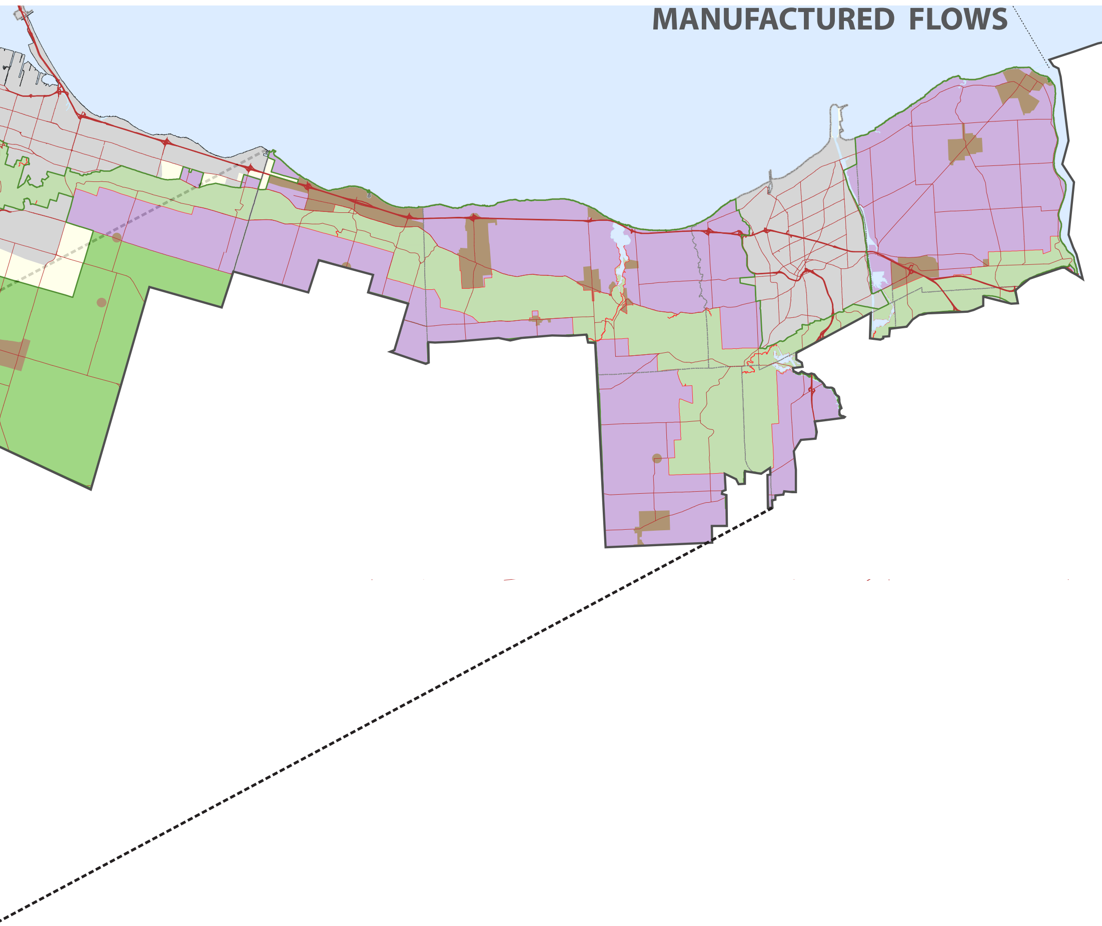


fig. 2.64 *Niagara Fruit Belt Land Use*

- tender fruit and grape land
- niagara escarpment
- agricultural use
- hamlet settlement
- urban land

fig. 2.65 *Large scale suburban development in the Niagara Fruit Belt*

fig. 2.66 *Grape vines in the Niagara Fruit Belt*

fig. 2.67 *Barton area fruit market*

Pollution

Air pollution is created by a large manufacturing base in Hamilton, Stoney Creek, St. Catharines, and Niagara. Heavy traffic on the QEW highway is another major producer of air pollution. High acidity from precipitation is leading to severe water and soil damage, another serious threat to the ecodistrict's abiotic and biotic systems.

Climate Change

Climate change is of great concern to this ecodistrict since its rare biotic conditions are susceptible to catastrophe or changed self-organization. The ecodistrict could lose its unique growing capabilities if precipitation, length of the growing season, or air humidity are altered by global warming.

PEOPLE

Population + Density

0.87 million (approximate 2001), 1038 persons/km^2

Land Ownership

90% private 10% public

LAND USE

In this ecodistrict 60% of land use has been converted to agriculture uses. Half of the agricultural land is developed agricultural with 40,524 hectors and another 9,066 as pasture or abandoned field. Settlement in urban centers, including Hamilton, Stoney Creek, and St. Catharines, constitutes 20% (16,500 hectares) of land use.

CONSERVATION

8% of the ecodistrict is conservation lands. The conservation authority accounts for half this land with 3005 hectares. Approximately 4,000 hectares are designated provincially significant life science areas, 83 hectares are within provincial parks. Seventy percent of all rare species and vegetative community occurrences are within identified conservation lands.

ELECTRICITY

Niagara Fall's Hydro Production is 4.4 MW annually

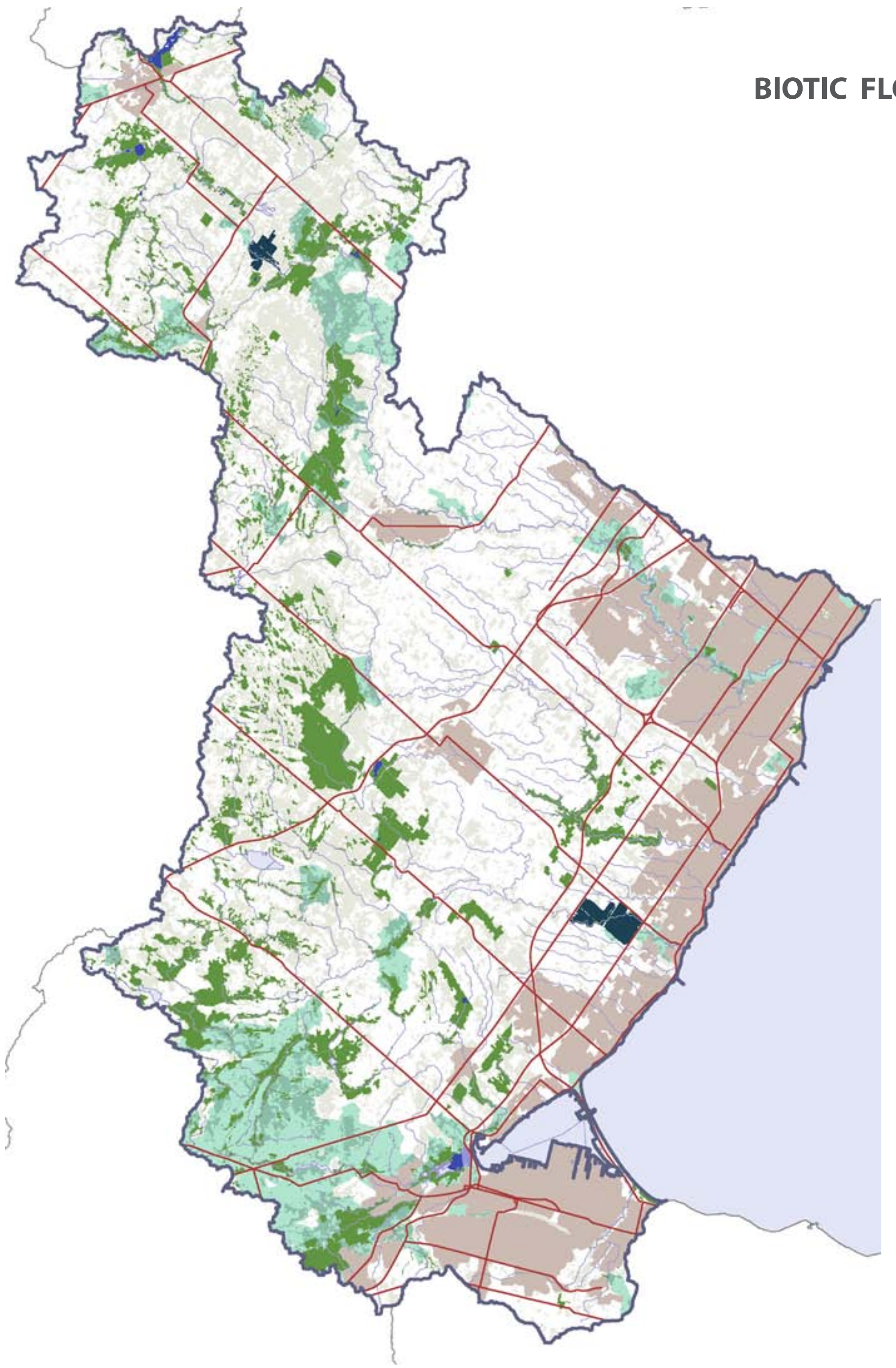
REGIONAL SUBWATERSHEDS: AQUATIC ECOSYSTEMS + AQUATIC CONSERVATION

fig. 2.68 *16 Mile Creek Watershed Aquatic Ecosystems*

- coastal ecosystem
- stream (light) ecosystem
- stream (moderate) ecosystem
- stream (intense) ecosystem
- wetland ecosystem

fig. 2.69 *16 Mile Creek Watershed Aquatic Conservation*

- urban area
- non-natural stewardship area
- natural stewardship area
- natural heritage area
- parks and protected areas
- natural cover
- protected water



BIOTIC FLOWS

fig. 2.70 Urbanization in Oakville along the mouth of 16 Mile Creek

fig. 2.71 Expressway water runoff and contamination

fig. 2.72 Bridging 16 Mile Creek

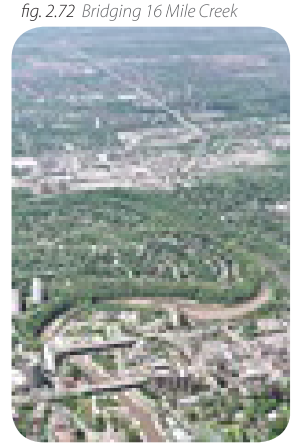


fig. 2.73 Urbanization within the watershed region

GEOGRAPHY

Geographic Location

This ecodistrict impacts the city on its western side and more particularly Hamilton Harbour at the head of Lake Ontario. This is the larger watershed framework that affects the streams and creeks that flow into Hamilton Harbour.

Area 230,222 hectares

WATERSHED

This watershed drains into the northwestern section of Lake Ontario. Costal areas cover approximately 9,617 hectares, 205,117 ha. are streams, 787 ha. are lakes, and 14,486 ha. are wetlands. The watershed contains coastline in Hamilton Harbour, Cootes Paradise, and Lake Ontario from Hamilton Beach to Port Credit.

BIODIVERSITY

There are eleven target species in the watershed considered important for biodiversity. The primary targets are Silver Shiner and Hill's Pondweed. The secondary targets include the Jefferson Salamander, Spiny Softshell, Black Tern, Redside Dace, Wood Turtle, Northern Map Turtle, Least Bittern, Prothonotary Warler, and Louisiana Waterthrush. Also there is only one known occurrence of Hill's Pondweed.

LAND USE

The dominant land use in this watershed is agriculture. Cropland covers the majority of agricultural land. There are small amounts of pasture and abandoned fields. On the Niagara Escarpment there is significant quarrying activity. Urban development is significant around Lake Ontario including Hamilton, Burlington, Oakville, Mississauga, Milton, Halton Hills, and Orangeville.

CONSERVATION

There are 24,645 ha. of protected conservation lands in the watershed constituting 11% of its total area. Approximately 173 ha. of these lands are located within provincial parks. Another one quarter are conservation authority lands. There are also 63 ha. of protected costal areas 11,927 ha. of protected streams, 379 ha. of protected lakes, and 12,252 ha. of protected wetlands.

URBAN SUBWATERSHEDS: HAMILTON MUNICIPALITY

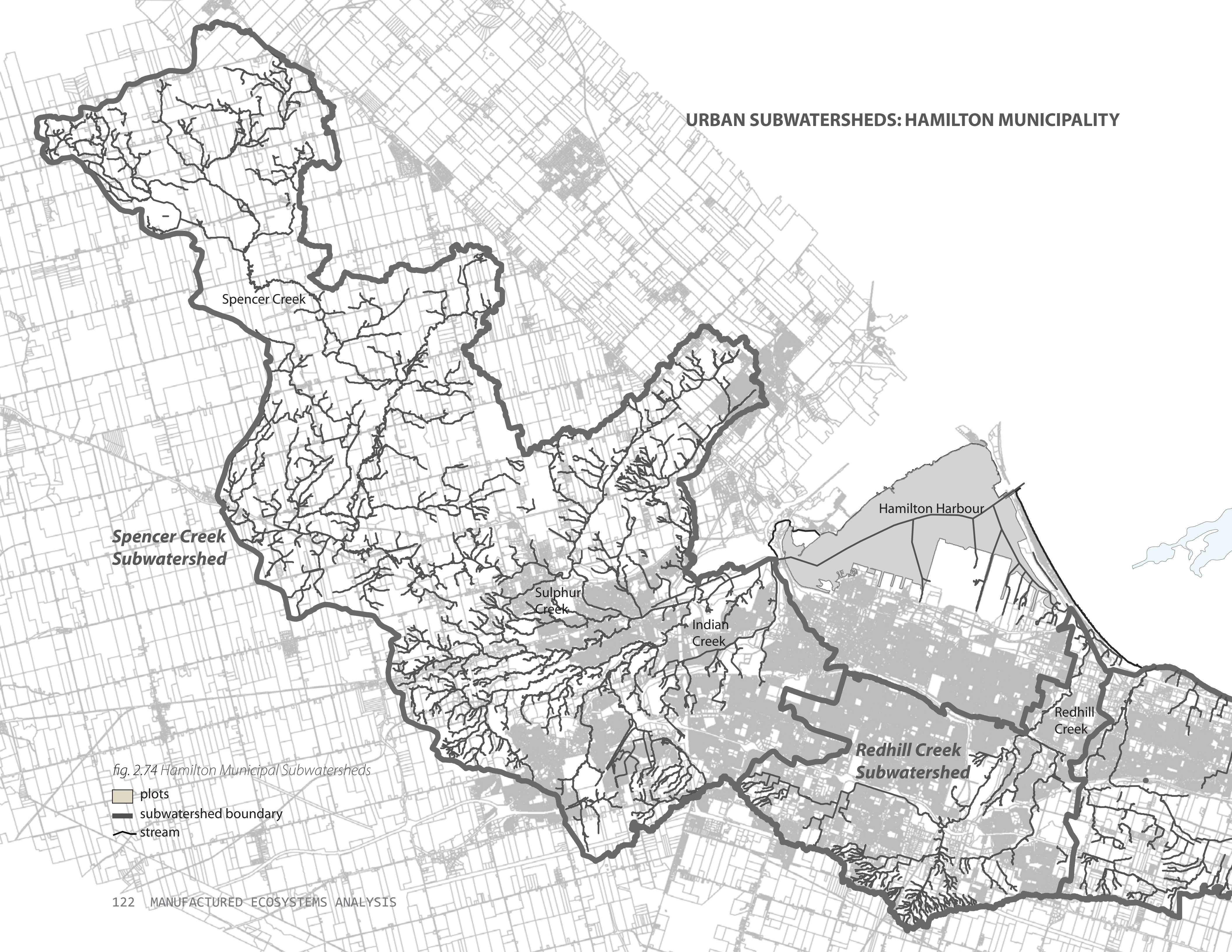


fig. 2.74 Hamilton Municipal Subwatersheds

ABIOTIC FLOWS

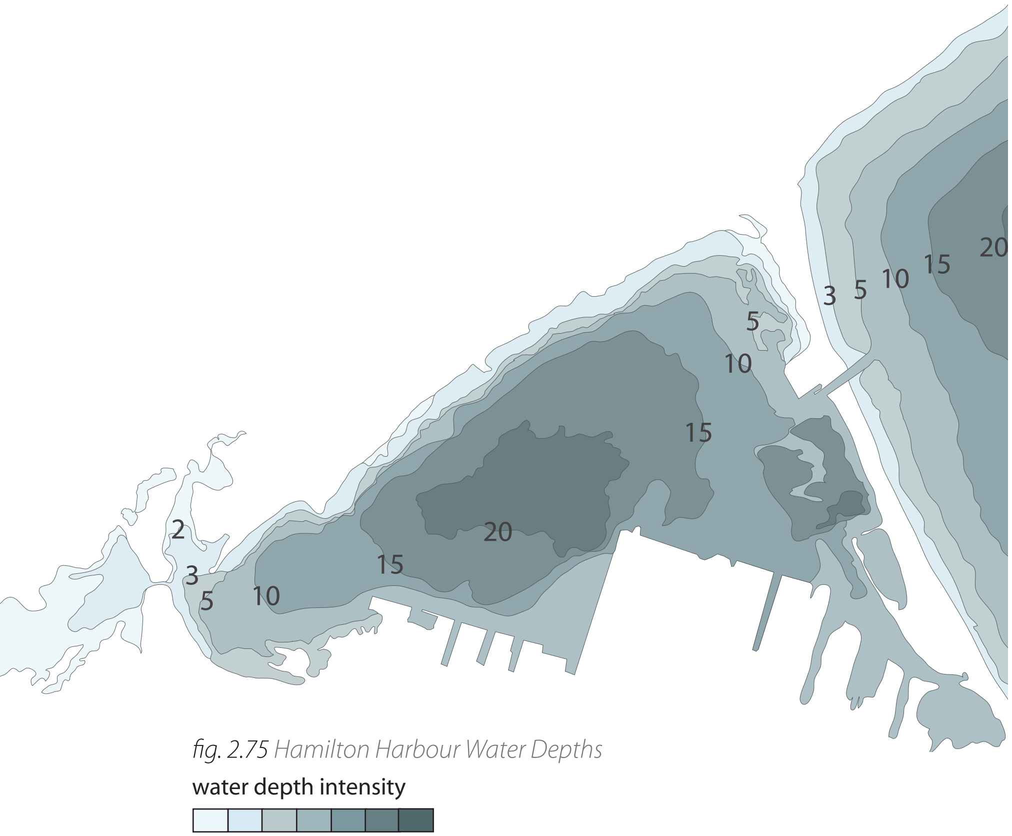


fig. 2.75 Hamilton Harbour Water Depths

water depth intensity

Stoney and Battlefield Creek Subwatershed

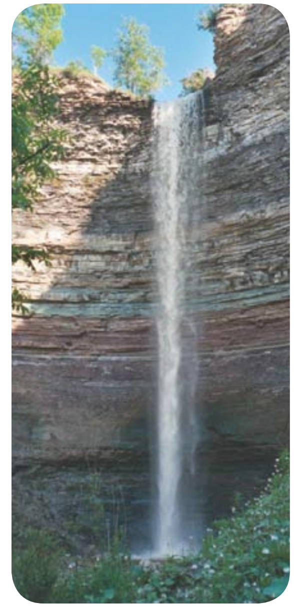


fig. 2.76 Devils Punch Bowl in Hamilton part of Red Hill Creek Watershed

fig. 2.77 Hamilton Beach sandbar separates Lake Ontario and Hamilton Harbour

GEOGRAPHY

Geographic Location

Hamilton Harbour is located at the head of Lake Ontario. The harbour is connected to Lake Ontario by a ship canal across a sandbar that forms its enclosure.

Geographic Coordinates

Located at 80.2° W longitudinal at 43.3° N latitude

GEOMORPHOLOGY

Topological Description

Major topographic features include the Niagara Escarpment, Dundas Valley, and Lake Ontario shoreline. The escarpment is generally flat with average grades of 1 to 2000 and elevations between 100 and 190 meters. Streams move across shallow gradients of clay and sand, through the Dundas Valley to Cootes Paradise below the escarpment and enter Hamilton Harbour.

WATERSHED

Geological Description

The geology of the area formed over the course of five chronological periods. During the Precambian Era to Miocene Epoch, the rock structure was established. During the Pliocene Epoch streams eroded the rocks as dominant geomorphic agents. During the Pleistocene Epoch erosion was caused by the deposition of various proglacial lakes. Post Pleistocene streams returned as dominant agents. Currently, erosion and deposition occurs in Lake Ontario. The soil types are clay, silt, and sand sediments from the last era of glacial deposit

Physical Description

The harbour is a body of water enclosed by two breach sandbars. The one on the west end separates the Harbour from Coote's Paradise and the one on the east end separates the Harbour from Lake Ontario. The Harbour is 8 km long (east to west) and 4.8 km wide, its area is 2150 hectares with an average depth of 13 meters. The watershed is approximately 500 sq. kilometers and includes a number of creeks namely, Spencer, Grindstone, Indian, Chedoke, Falcon, and Red Hill.

URBAN SUBWATERSHEDS: ABIOTIC ECOSYSTEMS

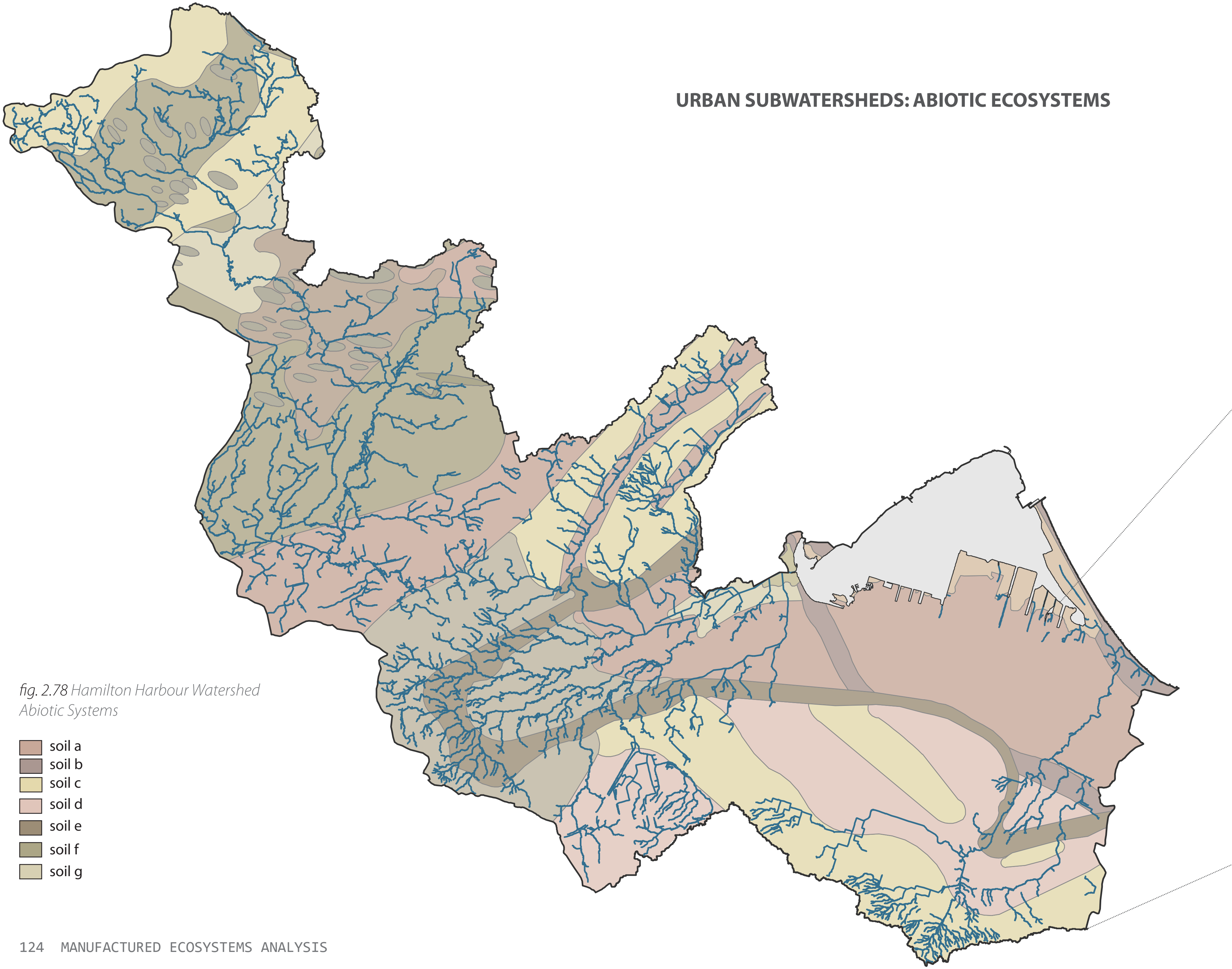


fig. 2.78 Hamilton Harbour Watershed Abiotic Systems

ABIOTIC FLOWS

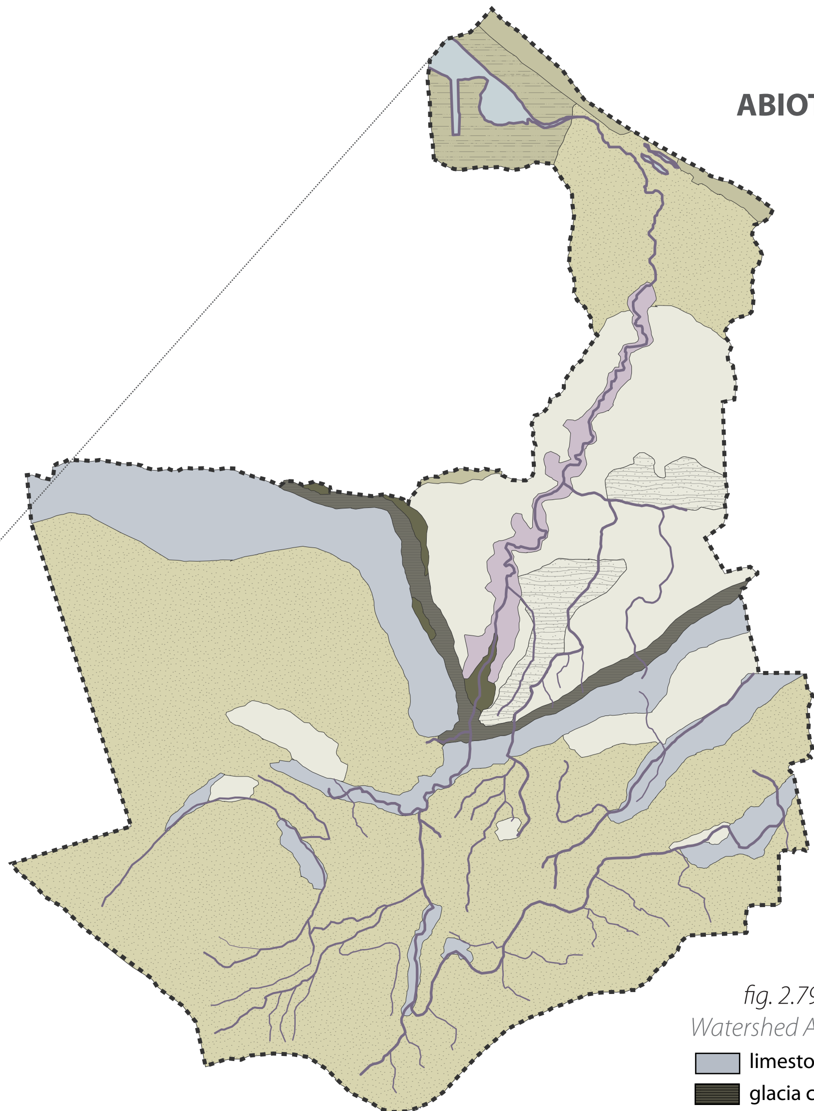


fig. 2.79 Red Hill Creek Watershed Abiotic Systems

- limestone
- glacia clay/sill
- hallum clay till
- glacia sand
- beach sand gravel
- aluvial stream deposits (gravel)
- alluvial stream deposits (clay)
- talus deposits
- mixed fill

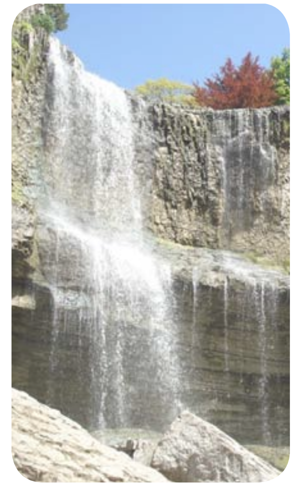


fig. 2.80 Webster's Falls on Spencer Creek

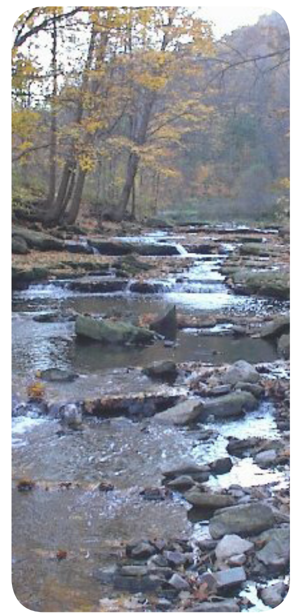


fig. 2.81 Red Hill Creek watershed before being modified for Construction of the Red Hill Creek Expressway

WATERSHED

Surficial Water Energetics

The harbour is drained into by dendritic streams and creeks consisting of headwaters above the Niagara Escarpment with a transition zone at the escarpment. The three major harbour inflow tributary systems are Grindstone, Spencer, and Red Hill. The main outflow system is the Burlington Shipping Canal.

Grindstone Creek Watershed: 88 km^2 or 18% and includes Falcon Creek, Indian Creek, Hager-Rambo Creek, West Aldershot Watershed, and Edgewater-Stillwater Creek Watershed

Spencer Creek Watershed: 197 km^2 or about 40% and includes Fletcher, West Spencer, Logie's, Westover, Flamborough Springs, Ancaster, Sulphur, Sydenham, Tiffany, and Borers Creeks.

Red Hill Creek Watershed: 62 km^2 or about 12% and includes Buttermilk, Hannon, and Davis Creeks .

Burlington Shipping Canal: Major water exchange with Lake Ontario.

Ground Water Energetics

The water quality is generally good with approximately 7% sulphur reported in wells. The major aquifers include the Guelph Dolomite Formations and the Lockport-Amabel Formations both form the surface bedrock above the Niagara Escarpment. Municipal Wellhead areas include Freelton, Carlisle, Lynden, and Greensville. Recharge areas of the watershed are predominantly above the escarpment and includes the Galt Moraine which serves as a headwater source of the Bronte, Spencer, and Farchild Creek systems. In the southern portion of the region recharge is received in eastern Ancaster and extends along the top of the escarpment. The major discharge areas are predominantly located below the escarpment. Along the escarpment discharge is focused in areas of re-entry valleys. General ground water flow is into Hamilton Harbour, however, some from the Red Hill Creek flows into Lake Ontario.

URBAN SUBWATERSHEDS: BIOTIC ECOSYSTEMS

fig. 2.82 Oak
"Traditionally, oak trees were the backbone of the Hamilton Harbour environment. The immense trees provide shade and nesting areas in the summer, and the acorns are a valuable food source for animals prior to the winter. Parasitic flowers attach themselves to all kinds of oaks. Deep roots made them resistant to the short, hot fires that swept through the savannah landscape. In the autumn oak leaves are colourful, changing to yellow, orange and reddish-purple. Common trees found in the area are the bur oak, red oak and white oak. Black oaks once populated the savannah areas of Hamilton, but today they are uncommon. All oaks are in high demand for furniture, wood flooring and wine barrels."

fig. 2.83 False Foxglove
"A plant that is now rare in Ontario, it once thrived in the bay area. Now, it is only found in Cootes Paradise and Grindstone Creek. It is a highly parasitic species that flowers from August to September. It's characterized by very lacy, fern-like leaves and fuzzy, sticky stems. The bushy plant, with many flowers, bonds to oak trees and draws energy from them. They declined rapidly in numbers mostly due to deforestation."

fig. 2.84 Fig Buttercup
"This invasive species is beginning to raise alarm. Also called lesser celandine, pilewort and figwort, it is an ephemeral plant that lives for only two months in the spring. It is an aggressive colonizer in low-lying wet soil and can out-compete native species like trilliums, trout lilies and violets. The fig buttercup has small yellow flowers that greatly contrast with the glossy green leaves. It is very difficult to identify and eliminate because the plant dies in April or early May and survives in underground tubers. In small areas it can be eliminated with thorough handdigging, while herbicides are used to control large areas."

fig. 2.85 Red Mulberry
"Ontario's largest remaining population of this endangered species is found on Royal Botanical Gardens property. Other pockets of this once-abundant tree exist in the eastern United States and Southern Ontario. In the fall, these trees are easiest to find because they are among the last to lose their lime-green leaves. The abundant and mildly sweet fruit attracts many birds and mammals. The trees were devastated by deforestation and cross-breeding with Asian white mulberry trees. The white version was introduced to Canada in a failed experiment to raise silkworms. It looks substantially different from the red mulberry but cross-pollinates very easily. As white and hybrid trees encroach on remaining populations, the pure red mulberry becomes increasingly threatened."

fig. 2.86 White Trillium
"It's the provincial flower of Ontario. It blooms from early to mid-May and grows from 15 to 50 cm high. It takes six years for a seed to grow into a plant and store enough energy to produce a flower. The three petaled flower is widespread across Ontario and is becoming increasingly popular in gardens. Also found in the harbour area is the red trillium, slightly smaller and pungent-smelling. Native Canadians used both red and white trilliums for medicine. They used a tea made from trillium roots to help with menstrual disorders and to induce childbirth. Many animals snack on trilliums, especially the whitetailed deer."

fig. 2.87 Purple Loosestrife and European Manna Grass
"These two plants have devastated much of the wetlands of southern Ontario. Purple loosestrife is the most talked-about invasive species in Ontario. It was introduced from Europe as a decorative plant and has the ability to choke all other life out in a swamp. No native insects feed on the purple flowers, so in an effort to curb their expansion the Ministry on Natural Resources introduced European beetles in the late 1990s. The gamble appears to have paid off. The harbour area is relatively free of purple loosestrife, but fellow invasive European manna grass has colonized nearly all of Cootes Paradise and much of the bay to the exclusion of all other species. The flowers and stems are useless to insects and animals — they don't know how to use them. Meanwhile, they have destroyed important populations of swamp milkweed and southern wild rice."

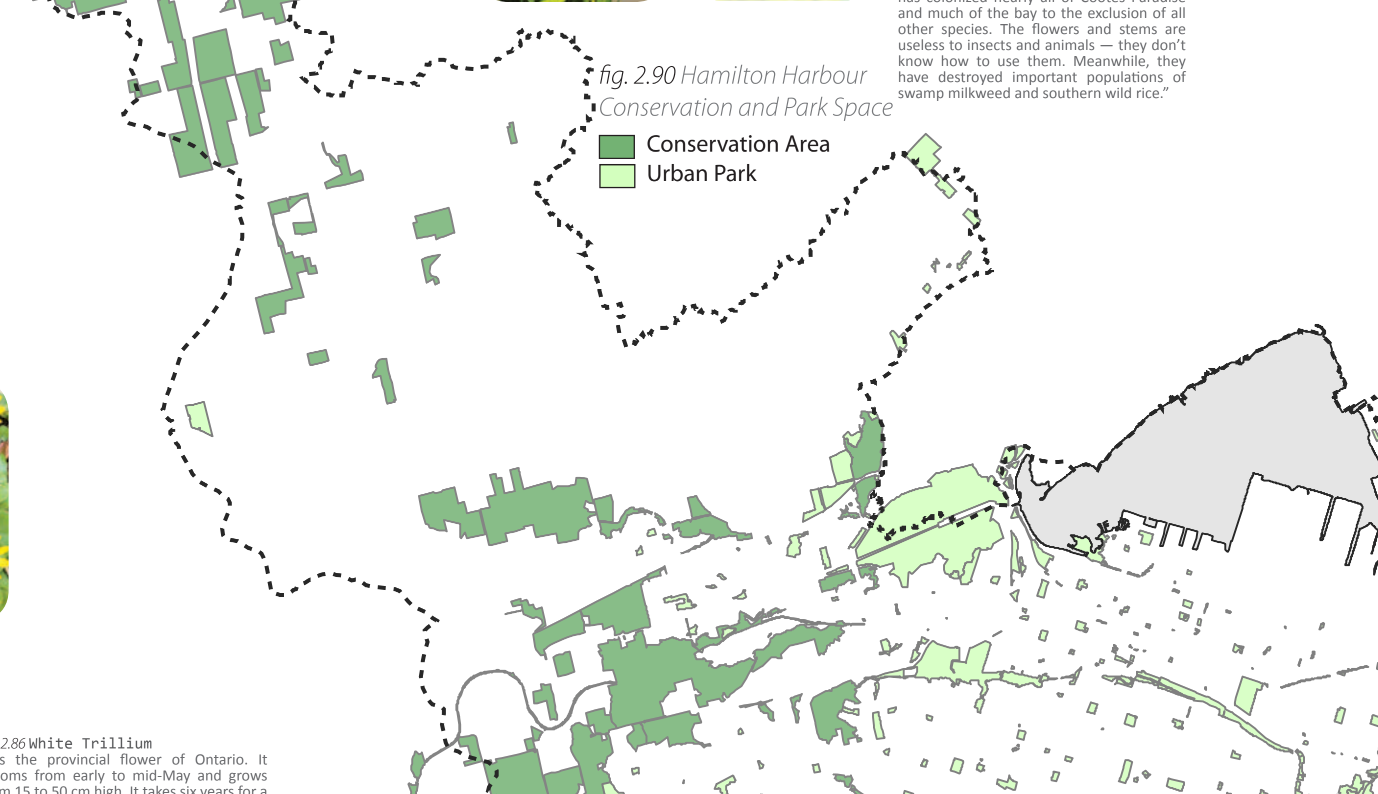


fig. 2.90 Hamilton Harbour Conservation and Park Space

fig. 2.88 New England Aster
"This late-blooming flower will usually appear from August to October. Growing in damp thickets and meadows throughout North America, it's often seen on roadside shoulders and ditches. It grows up to two metres high and can have up to 100 flowers. Each head is about 1 1/2 inches wide with 40 or more bright purple, petal-like ray flowers surrounding a yellow disk. Occasionally, the New England aster also produces a white flower (as shown). Roughly 18 other types of aster can be spotted in the fall, most with similar, but less dense flowers. They range in colour from pink to blue but most are white. Mice and deer eat the flowers and plant."

BIOTIC FLOWS

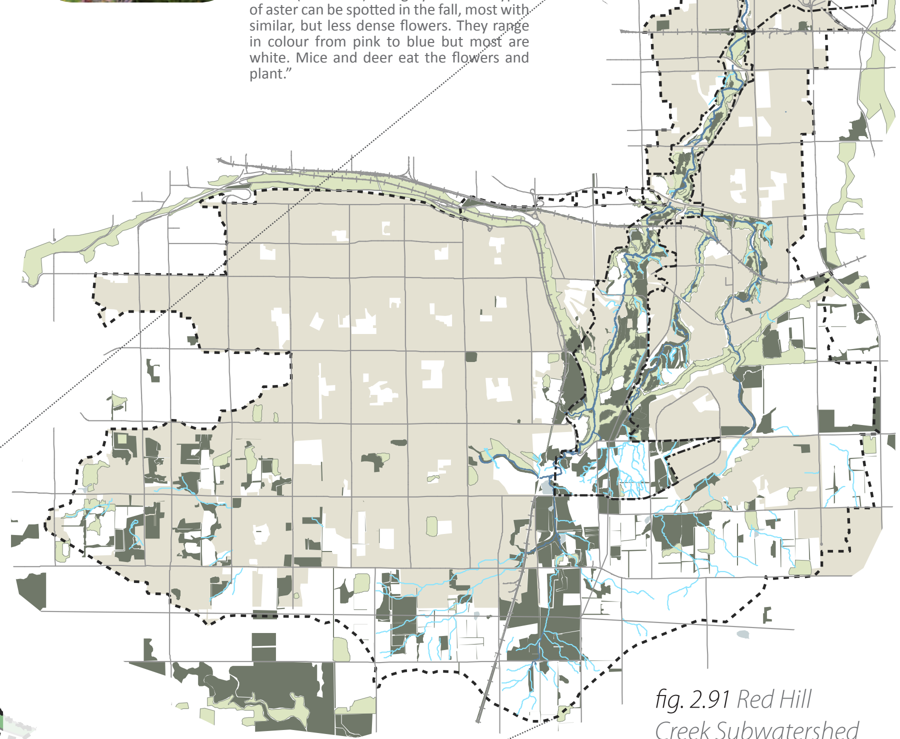


fig. 2.91 Red Hill Creek Subwatershed Conservation and Park Systems

Conservation Area
Urban Park

fig. 2.89 Eastern White Pine
"The provincial tree of Ontario and was once far more prominent in the harbour area. The broad coniferous trees grow to more than 30 metres tall (100 feet) and live for 200 to 350 years. They are particularly susceptible to deforestation because they don't produce seeds until they are 20 to 30 years old. In colonial times they were used for ship masts and some stands were declared property of the Royal Navy. The branches make important perching and nesting locations along the shoreline, while the seeds provide food for a variety of mammals and birds. The Eastern white pine was featured in many Tom Thompson paintings, including West Wind."

fig. 2.92 Flooding in the Red Hill Creek Watershed in Stoney Creek

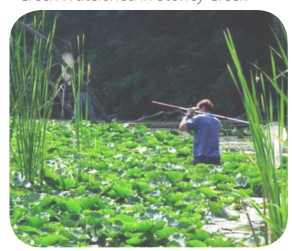


fig. 2.93 Intricate marshland ecosystem within the Royal Botanical Gardens

fig. 2.94 Peregrine Falcon in downtown Hamilton

CLIMATE

Continental hot and humid summers, cold, dry winters. The mean average temperature is 7° C, summer high is 27° C, winter low is -10° C. The prevailing wind comes from the west to southwest at and average speed of 12 km/hr. The annual precipitation is 780 mm per annum. There is a slight micro-climate to the Harbour because of the moderating influence of Lake Ontario and the sheltering effect of the Niagara Escarpment to the south.

NATURAL HAZARDS

Flooding in the low land regions of the watershed. Latest flood occurred December 1st 2006 due to flooding of the Red Hill Creek watershed.

ECOREGIONS

Hamilton Harbour is a component of the previously discussed Regions, the 16 Mile Creek Watershed as well as the Terrestrial Grimsby region. It shares the unique characteristics of these regions with regards to its biotic species of flora and fauna. Since the Hamilton Harbour watershed region is located within a transition zone between the Eastern Deciduous Forest and Great-Lakes - St. Lawrence Forest it contains a diverse range of forest species from both regions.

BIODIVERSITY

The Harbour is home to a wide range of fish species and its fresh water creeks serve as home to very importing spawning beds for species of Lake Ontario's cold water trout and salmon. The harbour is also home to over 11 common species of sunfish, perch, and bass. In addition, there are over 59 common species of birds, as well as 16 amphibian species. Predatory birds such as the Peregrine Falcon are also a revived species in the area. There are over 800 species of plant life in the area. There are 50 total species of mammals in the region as well. The Hamilton Harbour watershed also supports several fern species along the escarpment including species unique to more southern Carolinian Forests. Unique grassland alvars grow on soils over level limestone or dolostone rock found in the Flamborough Plains.

URBAN SUBWATERSHED: CULTURAL ECOSYSTEMS

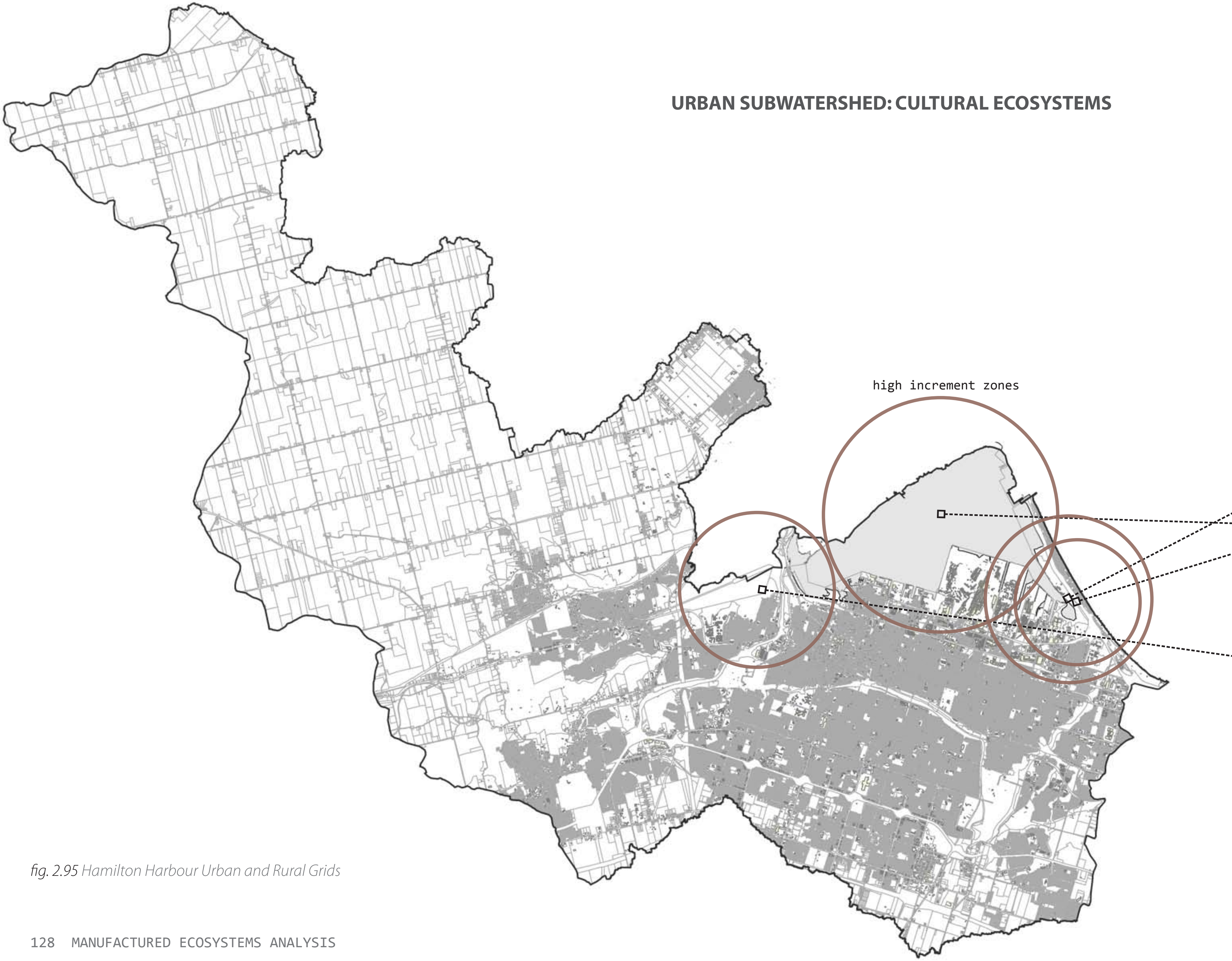


fig. 2.95 Hamilton Harbour Urban and Rural Grids

MANUFACTURED FLOWS

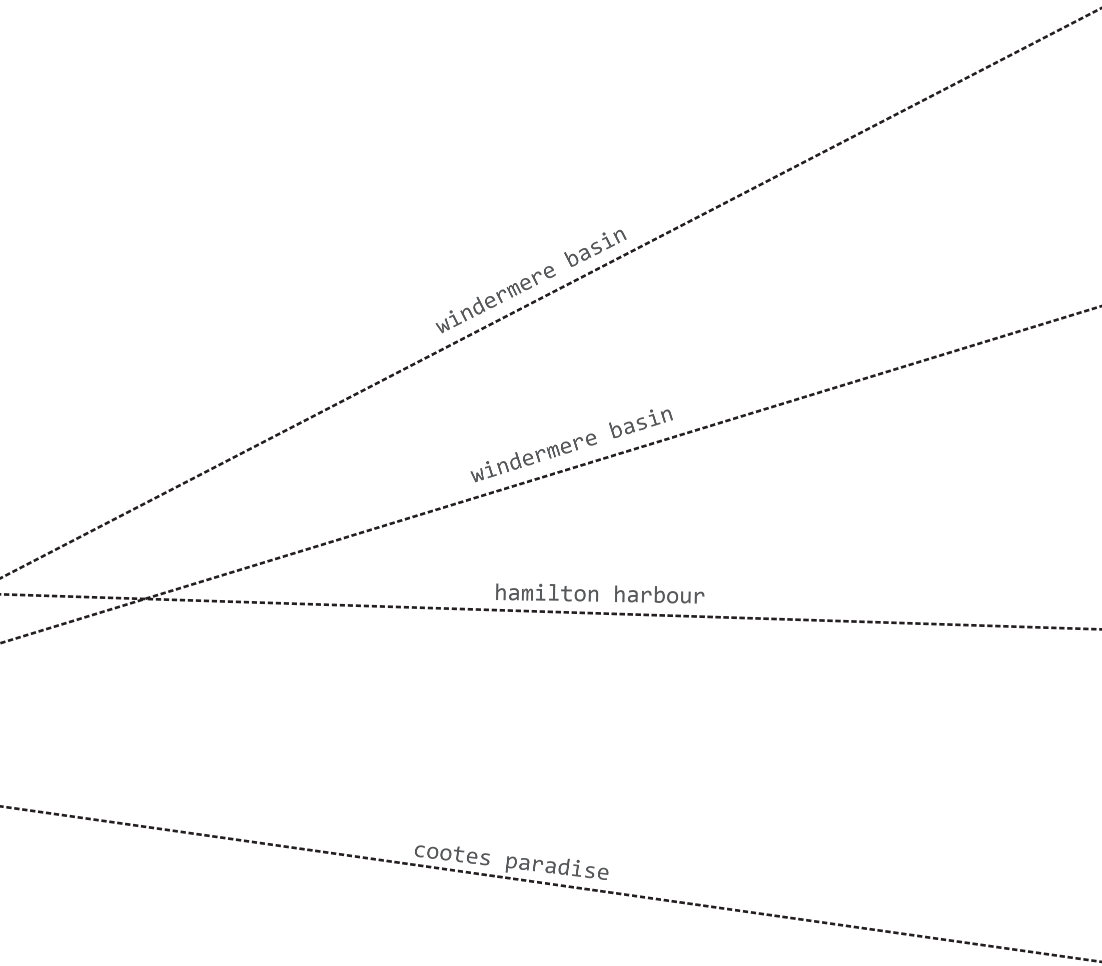



fig. 2.96 Cormorant on Hamilton Harbour


fig. 2.97 Common White Herring Gull


fig. 2.98 Common Carp over populate Hamilton Harbour


fig. 2.99 Purple Loosestrife as dominating Hamilton Harbour Aquatic Ecosystems

THREATS TO BIODIVERSITY

Problem Species

As a result of the combined cultural influences that are discussed in the next section of this document, several alien biotic species thrive in Hamilton Harbour and dominate the local ecological food chains due to their resilient capabilities over domestic species. These species thrive on the cultural conditions set up by the Harbour's artificially created ecosystem based on human interventions.

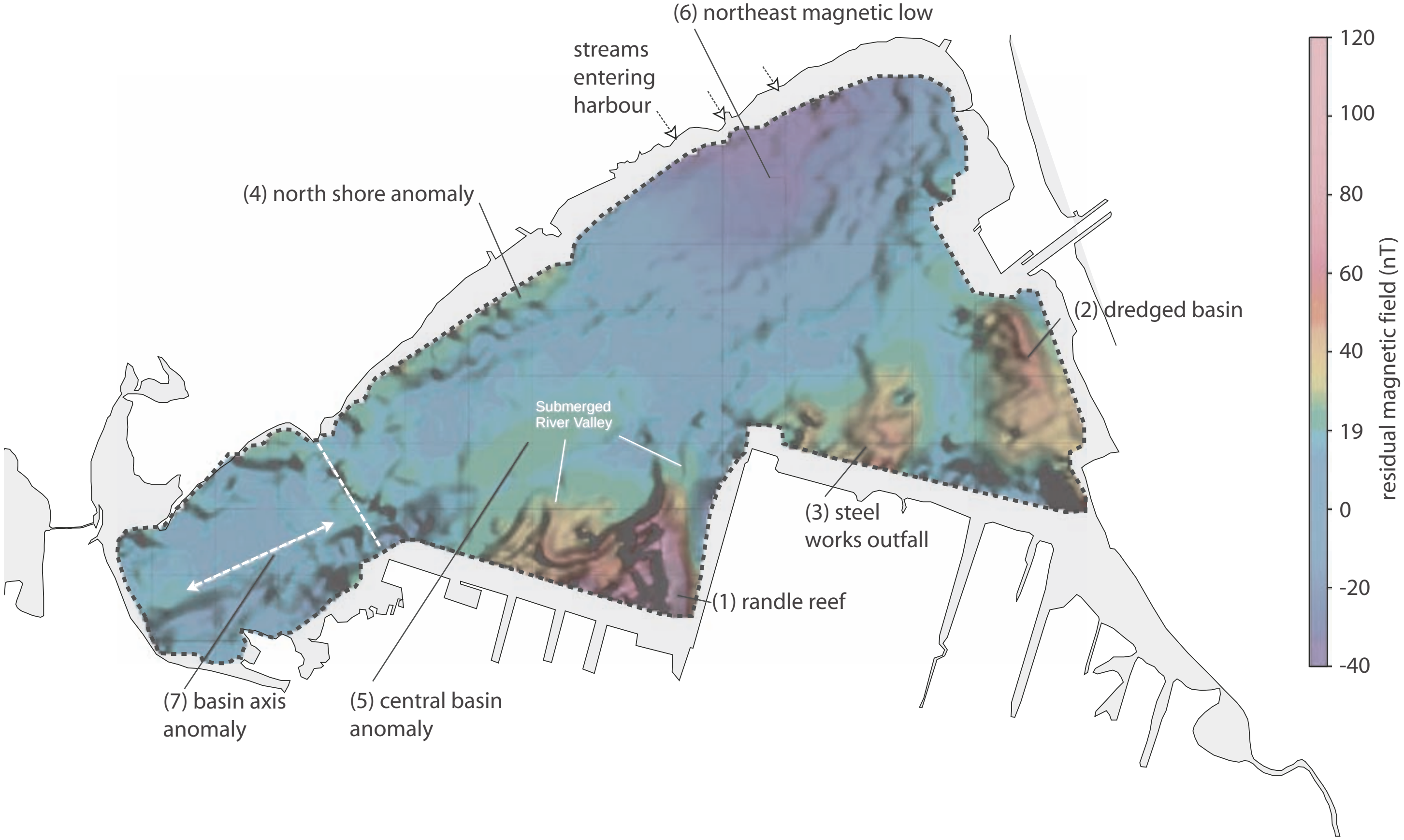
Cormorants: They compete with Black-crowned Night Herons for nesting habitat. They are destructive in their nesting habitat and destroy tree species. They feed largely on surface-water fish. Their acidic faeces destroys the trees they nest on and any vegetation below. Began as a visiting species to the Great Lakes in the 1880s.

Herring Gulls: Feed on a large amount of surface area fish. Over occupation and dominance over other bird species. High levels of bacteria in their faeces has been linked to instances of water contamination. They are highly resistant to pollution and feed on local garbage.

Common Carp: During feeding, they suck up mud from the bottom of the Harbour and then expel it. They select their food while it is suspended in the water. Through this process they directly uproot vegetation. Carp feeding, spawning and nesting behavior interferes with plant photosynthesis by muddying the water so that sunlight cannot penetrate. Species originate from Eastern Asia.

Purple Loosestrife: Severe impact on native vegetation, where it causes the wetland to dry out and no longer support many species that previously thrived. It is good at invading disturbed areas, such as construction sites, docks, and marinas. It may also invade and force out native plants in some undisturbed habitats to form dense, single-species stands. Causes reductions in waterfowl and aquatic mammal productivity because it does not provide suitable habitat for food, nesting, or shelter. Species originates from Eurasia.

EFFLUENT SUBWATERSHEDS: METALLIC FIELDS + RISK LEVELS



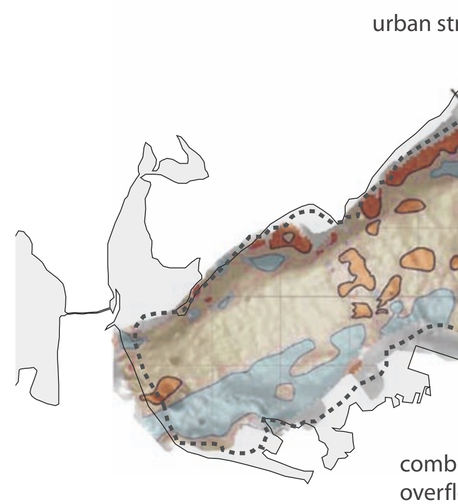


fig. 2.100 *Hamilton Harbour Watershed Metallic Particulate*

MANUFACTURED FLOWS

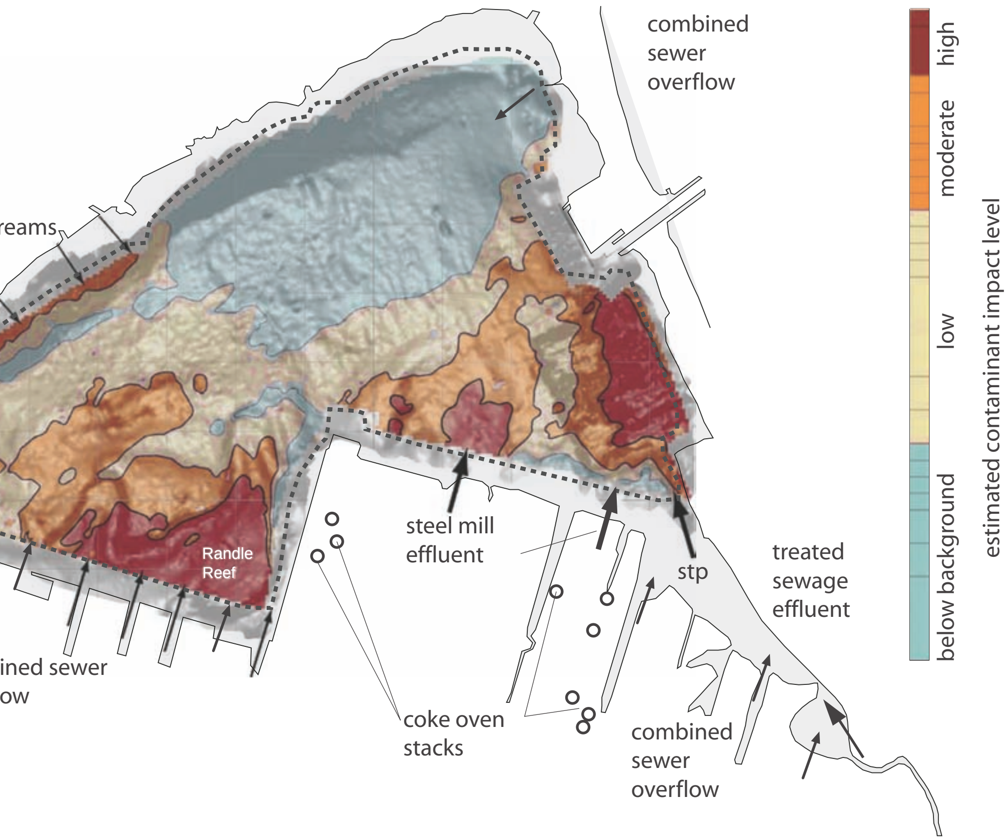


fig. 2.101 Hamilton Harbour Watershed Metallic Risk Levels

fig. 2.102 Cargo ship next to Stelco Pier Hamilton Harbour

fig. 2.103 Nautical transportation vessel in Hamilton Harbour

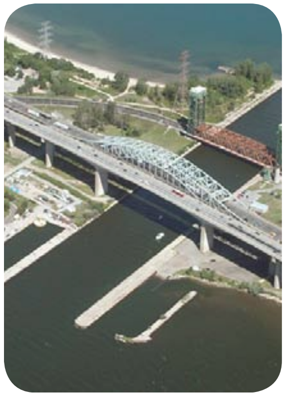


fig. 2.104 Burlington shipping canal

PEOPLE

Population

There are approximately 700,000 persons occupying the watershed area of Hamilton Harbour. Of this population 90% live in urban regions. Of this population 60% live in pre 1960s regions of Hamilton. Population density
438.9 persons/km².

LAND USE

Approximately 65% of lands are used towards agriculture including mixed farms (livestock, hay, grains, and corn and fruit and vegetable farms). The remaining land use is divided into 14% residential, 8% industrial, 8% public open space or conservation, 5% vacant, less then 1% commercial, government, and institutional, and less then 1% private open space and railway. There are a total of 21 natural conservation areas including the Royal Botanical Gardens and natural heritage park systems associated with the Niagara Escarpment. Development has consumed approximately 12% of the Grindstone Creek Watershed, 20% of the Spencer Creek Watershed, and 80% of the Red Hill Creek Watershed.

TRANSPORTATION

Major Highways include the 403, QEW, Lincoln Alexander Expressway, Red Hill Creek Expressway, Burlington Street Expressway, and Highways 2, 5, 6, and 8. Commercial and passenger railway systems are the Canadian National, Canadian Pacific, Ontario Southland, Via, and Go. International airport John C. Monroe is the largest Canadian cargo hub.

NATURAL RESOURCES

The main natural resources in the area are limestone and water, both are used in the steel industry.

ECONOMICS

Manufacturing accounts for approximately 56% of the region's employment. The region is the largest concentration of steel, iron, and primary manufacturing industries in Canada. Currently uses a linear 'Classical' approach to economic development primarily reliant on resource extraction (coal, iron ore, slag, limestone) from external regions.

EFFLUENT SUBWATERSHEDS: SUSPENDED + SETTLED

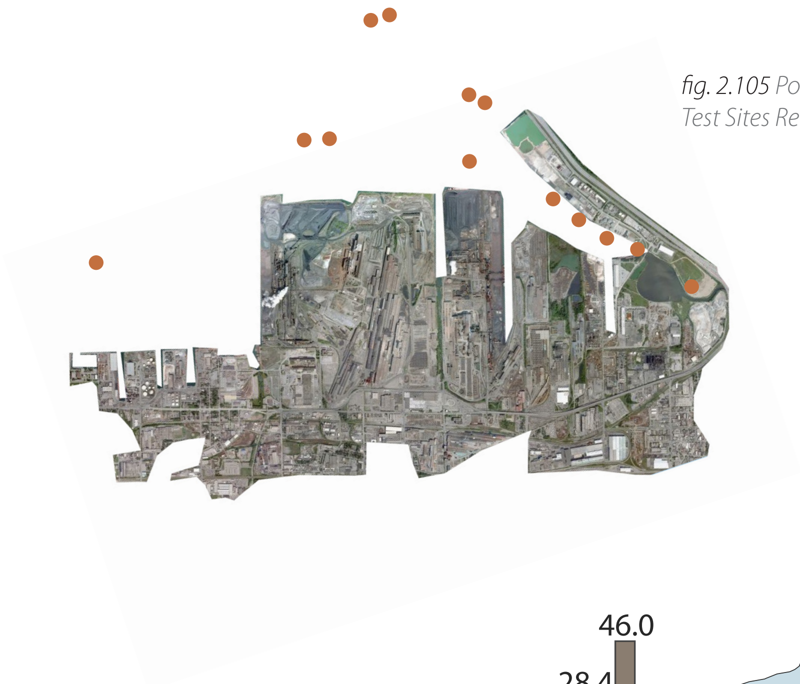
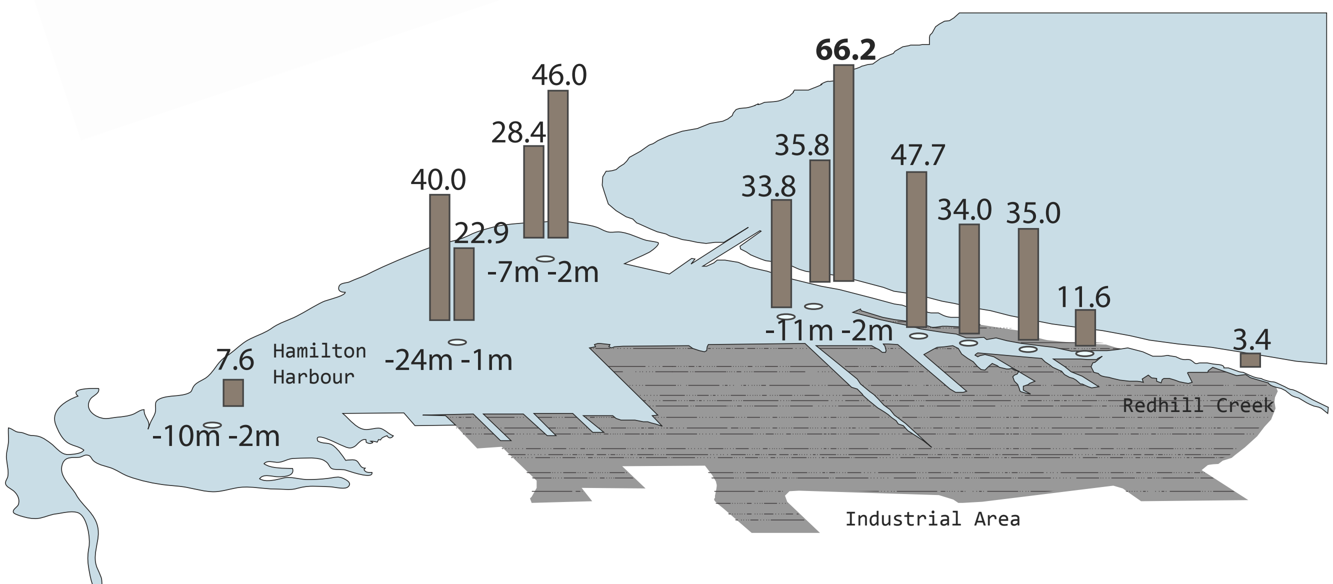


fig. 2.105 Port of Hamilton Aerial Test Sites Relative to Industry



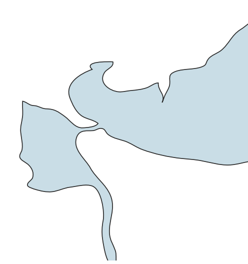


fig. 2.106 Hamilton Harbour Suspended Sediments
** quantities in total PAH (ug/g dry weight)*

MANUFACTURED FLOWS

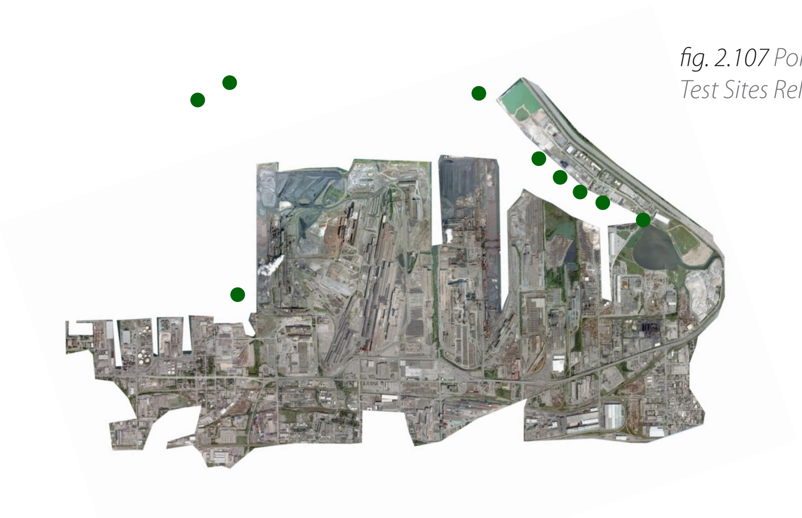


fig. 2.107 Port of Hamilton Aerial Test Sites Relative to Industry

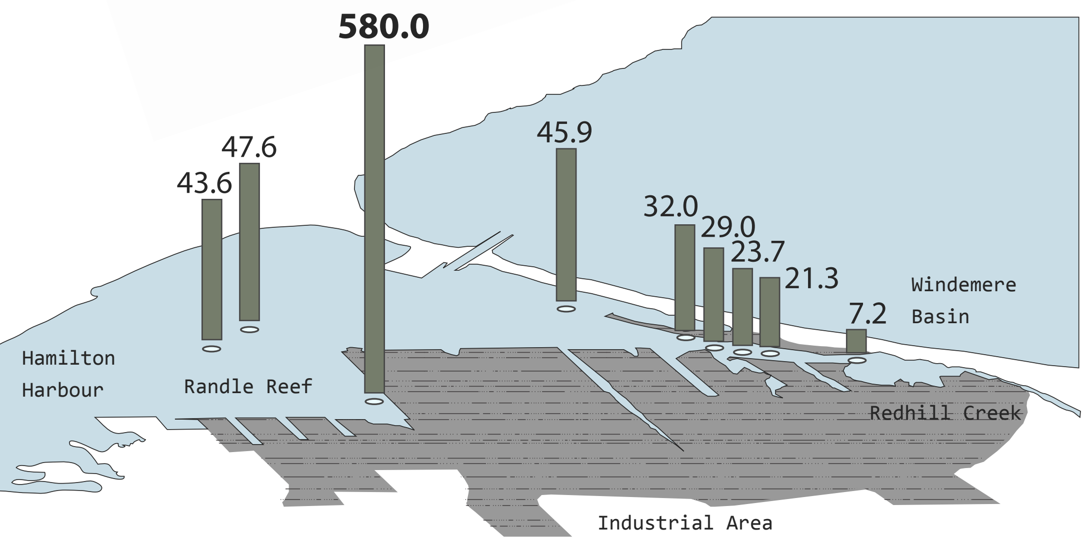


fig. 2.108 Hamilton Harbour Bottom Sediments
* quantities in total PAH (ug/g dry weight)

fig. 2.109 Randle Reef and Coke

fig. 2.110 Cootes Paradise aerial image

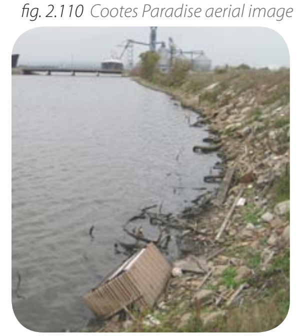


fig. 2.111 Windermere Basin at the mouth of the Red Hill Creek as contaminated by local industry

ENVIRONMENTAL ISSUES

There are several key issues that threaten abiotic and biotic systems within the Hamilton Harbour watershed. Most are associated with municipal waste water or industrial waste disposal, air pollution, and untreated urban and rural water runoff. There are several identified environmental problem areas that summarize the combination of these issues including, but not limited to, Randle Reef, Cootes Paradise, and Windermere Basin.

Randle Reef: Located west of U.S. Steel Canada pier it is considered to be one of the more complex and highly contaminated sediment sites throughout the Great Lakes. The sediments in the reef contain very high concentrations of polynuclear aromatic hydrocarbons (PAHs) in coal tar. It is known that the PAHs are re-circulating and moving up into the food chain, damaging future ecosystems.

Cootes Paradise: Located west of the harbour towards Dundas, was originally a shallow march that provided habitat for a dense array of species. Human overuse, pollution from water exchange with Hamilton Harbour, and alien species such as the carp caused an 85% loss in plant cover by 1985. Other stresses include overgrazing by Canada Geese, high nutrient levels, water turbidity, and sediment accumulation.

Windermere Basin: Located in the south east of Hamilton Harbour, the basin is the mouth of the Red Hill Creek. It has become a problem area due to runoff of Woodward Sewage Treatment plant as well as Landfill Sites located on Hamilton mountain. It is of importance due to its ecological influence on the Harbour. Continual contaminative discharge into the Harbour through the Basin will not allow full recovery of its natural ecosystems.

2.3 FILL + EFFLUENT TIMELINES

GLOBE PARK MUTATION During the mid 1800s onward Hamilton Harbour was subjected to intense infilling activity. This activity continues today with three ongoing fill projects in the works. Generally the filling continues for two reasons. First, there is no designed solution to prevent dredging to accommodate shipping depths. Second, there is still desire from the Hamilton Port Authority to develop more shipping wharfs. Historical technical reports confirm that this infilling activity buried contaminate without any understanding of future environmental implications. This cultural activity is perhaps an example of an inability to think about landscape in an innovative environmentally benign way. More recently, ecological process has reduced residual contamination and naturally has brought the site up to a healthy enough state to allow some human occupation. Since Globe Park is thought of as a hybrid remedial landscape process, a new spatial transformation is possible. Conceptually, the site's historic composition is essential to its design. The following mapping analysis develops a narrative for Globe Park in terms of temporal residual flows of effluent and soil. Through this process of flow, the composure of Globe Park becomes a spatial experience more interested in time and process than formality or optics. The layers of sediment and chemical nutrients within these deposits will be the ingredients used to seed the contemporary reclamation of the site.


HIGHWAY No. 20A
Aggregate + Slag
Pumping Station
Orchard
4337

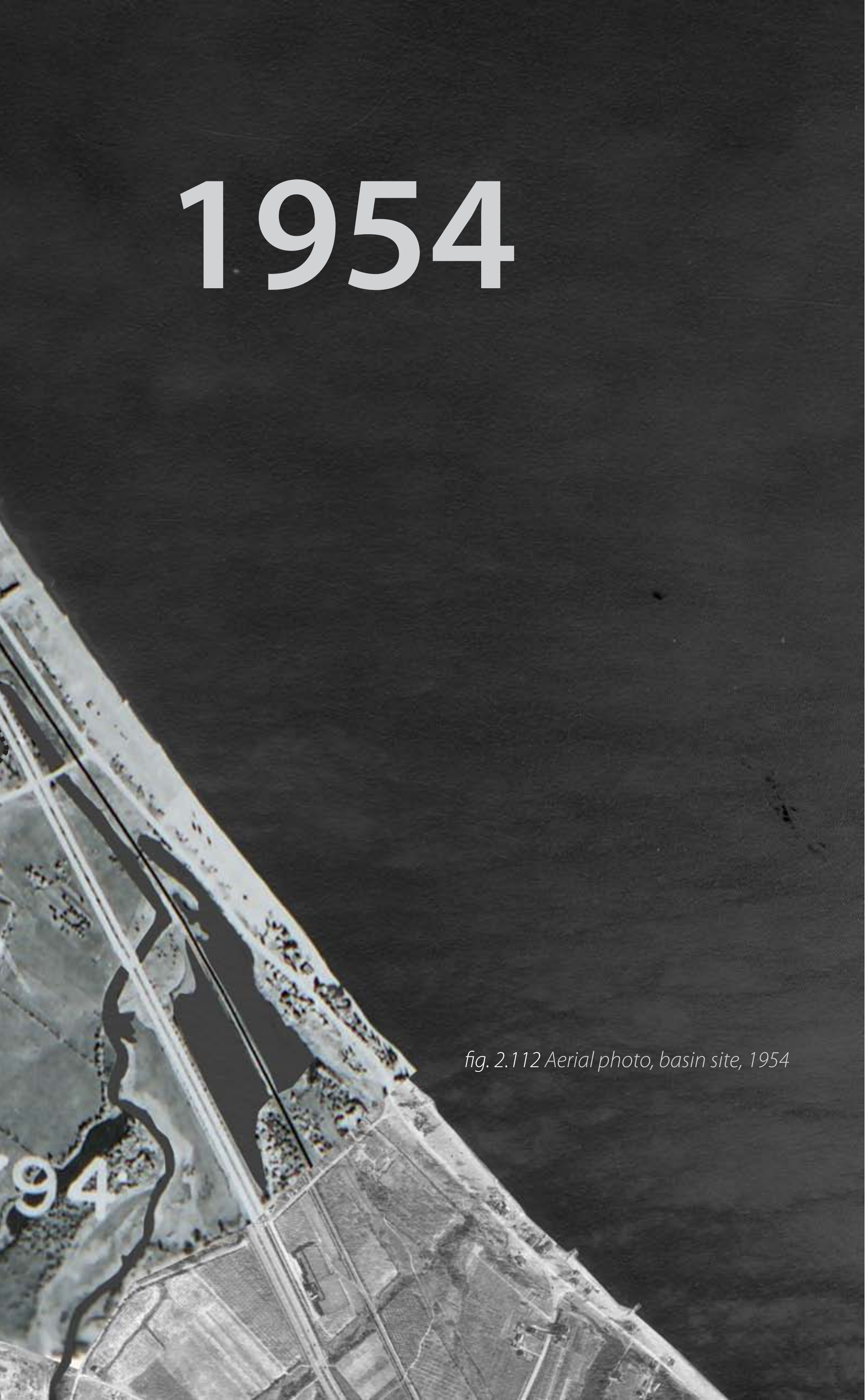


fig. 2.112 Aerial photo, basin site, 1954

Hamilton Harbour was discovered by French explorer Sieur de LaSalle in 1669. The sheltered bay was known as Lake Macassa to the Attiwandaronk Indians who lived on its shores. The name Macassa translates to "The Lake of Shining Waters". It was originally not accessible by ship from Lake Ontario since it was a separate lake. It carried a variety of names including Little Lake, Lake Geneva, Burlington Lake, Burlington Bay, and in 1917 was officially named Hamilton Harbour.[111]

In the 1800's Hamilton did not treat its sewage and relied on water closets.[112]

Fecal matter, in the early 1900s, could be seen floating in the eastern end of the bay.[113] In 1832 and again in 1854 cholera epidemics occurred as a result of people consuming contaminated water in the bay.[114]

In order to improve sanitary conditions, a pumping station was constructed in 1859 so that Hamilton's supply of drinking water would come from Lake Ontario rather than Burlington Bay[115]. In 1859, Hamilton's residents and factories began using the harbour as a sink for their residential and industrial wastes, while a new waterworks system took in water from Lake Ontario.[116]

City engineers, within decades of the water pump's construction, began infilling the inlets of the Harbour where sewer outlets had been located.[117] They covered the noxious wastes emitted from the sewer outlets. The reclaimed land was used to construct waterfront industrial districts.[118]

"Between 1900 and World War I, 100,000 people lived in Hamilton, with many of them finding employment in the city's 400 factories, the largest of which were located on the reclaimed land along the eastern waterfront. At that time fecal matter and industrial waste flowed from the sewers mostly untreated directly into the bay".[119]

An editorial from Hamilton, Ontario's, Herald newspaper, in 1919, proclaimed that, "No waterfront development is complete or adequately meets the requirements of a large industrial city if ample provision is not made for recreation purposes".[120] However, for Hamilton, developments to follow this proclamation went in the opposite direction.


Infill
1954 shoreline
Infill
Infill
Steel Wire
Carbon Black
Primary Sewage Treatment

1962

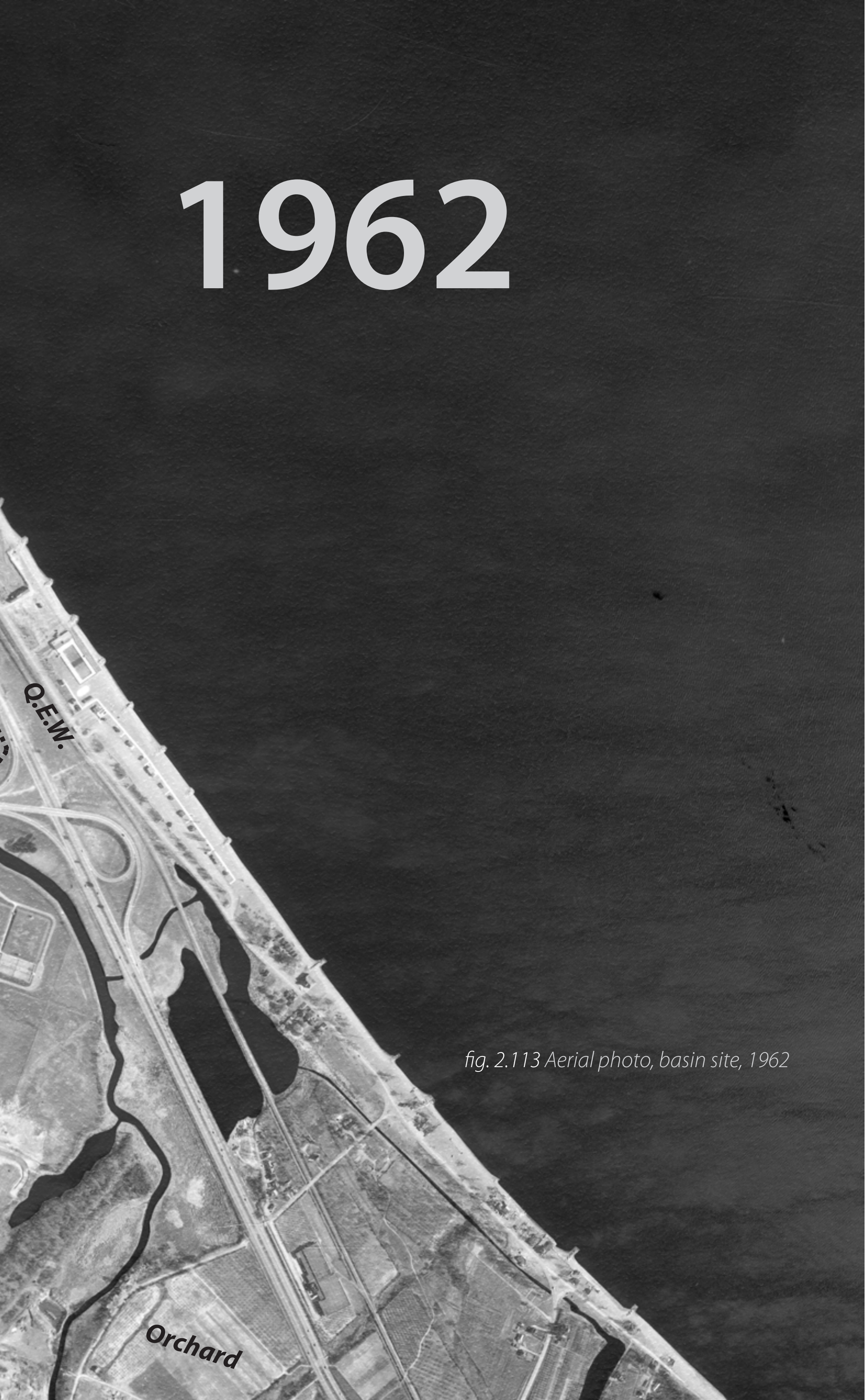


fig. 2.113 Aerial photo, basin site, 1962

In 1959, the Lax Brothers, a Hamilton scrap metal firm, acquired from the city's Harbour Commission the right to water lots on the north side of the Harbour, and then gradually acquired some of their adjacent shorelands.[121] The firm had acquired enough property to begin planning a 4050 acre industrial park by the mid 1960s.[122] In the plan they aimed to fill in the relatively shallow water lots to create more land.[123] This process of speculative infilling occurred along Hamilton's north waterfront and properties were sold to industrial developers.

Lining up their vision with the Harbour Commissioners postwar plans for the area, the Lax Brothers' proposed their industrial park and a private apartment complex on the west harbour front. During the early 1960s, they acquired more water lots and began buying up properties on the harbour speculatively converting the waterfront lots to piers before industrial construction began.[124] The process was repeated on the east harbour front lots as well by other speculators.


1954 shoreline
Pier 23
Pier 24
Scrap Warehouse
Scrap Metal
Warehousing
Hydro Transformer
Secondary Sewage Treatment

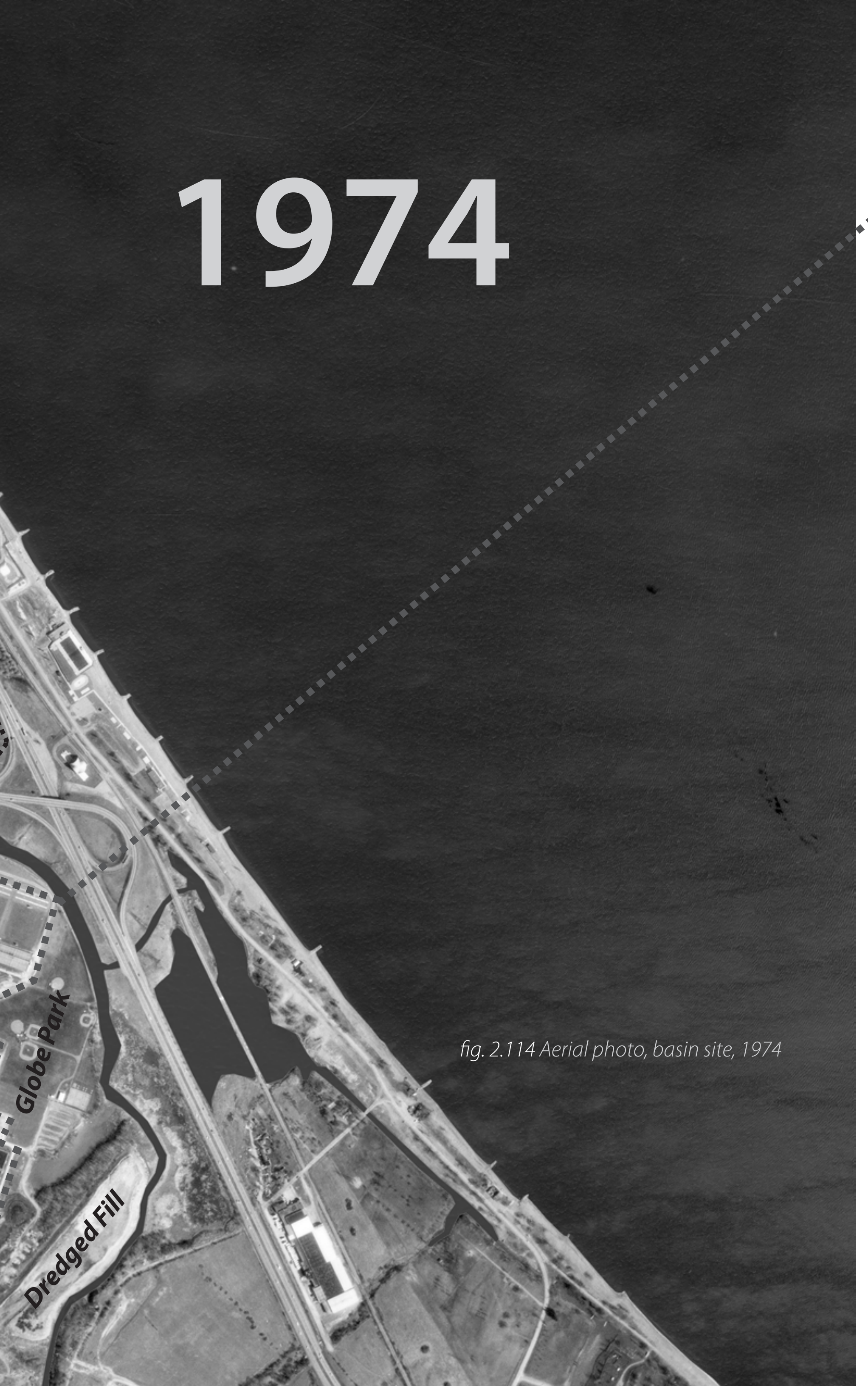


fig. 2.114 Aerial photo, basin site, 1974

Sewage was discharged untreated directly into Hamilton Harbour prior to 1963. The construction of a primary sewage treatment plant was completed in 1963 to treat municipal effluent.[125] In 1972 a secondary treatment facility was constructed to upgrade the original facility.[126]

By the late 1960s, the city's decision to transform a nearby brownfield site into a residential area altered the Lax Brother's Plans. In 1969, thousands of truckloads began being dumped creating a landfill area that modified the landscape that was once occupied by boathouses and boat makers until the 1960s.[127] In 1969, the Lax Brothers streamlined their proposal by dumping thousands of tons of soil into the harbour to create nearly 50 acres of new land.[128]

By the late 1960s, the political agencies and other groups joined local community activists widening the debate against the transformation of the harbour. Opposition over infilling emerged over the controversy over infilling of the west harbour and significant support propelled opposition groups.[129]

The secondary sewage treatment plant was expanded in capacity in 1977 to 273,000 m3/d.[130] It discharged 265,000 m3/d of effluent into Windermere Basin upon its completion.[131]


1954 shoreline

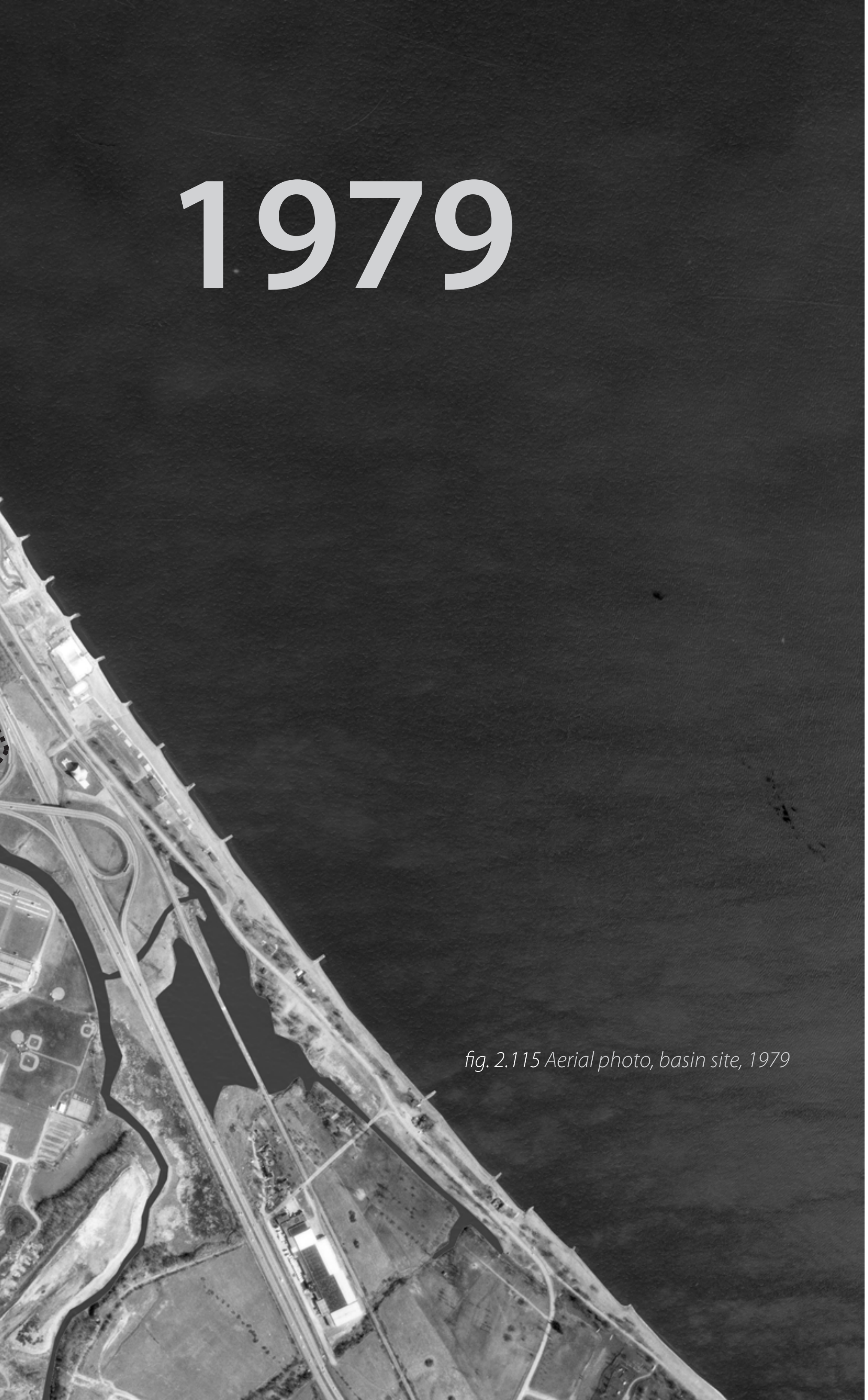


fig. 2.115 Aerial photo, basin site, 1979

Between 1958 and 1975 iron deposited on the beach from dustfall is reported to have increased, annual dustfall in 1958 is calculated at 36.78 kg Fe/Ha and by 1975 this amount increased to 97.09 kg Fe/Ha.[132]

From the steel foundries in 1977 the highest historic amount of waste effluent was diverted to Hamilton Waste Treatment Plant, 34500 kg/d of Iron, 1100 kg/d of Zinc, and 1090 kg/d were reported as discharges.[133]

Hamilton's city council acquired 50 acres of land filled in by the Lax Brothers in 1985, after over a decade of debate.[134] The land purchase forced them to stop infilling the lake and the city decided to use the land to build a public recreational park on the waterfront.[135]

Studies between 1972 and 1981 of benthic worms in Windermere Basin reveal that they are contaminated with chlorinated organics, a threat to predatory species.[136] Associated sediments levels in fish fillets declined steadily between 1972 and 1981; sedimentation in fish are higher due to biomagnifications.[137]


Infill
1954 shoreline
Road + Rail Bridge
Raised Burlington Street Expressway

1986

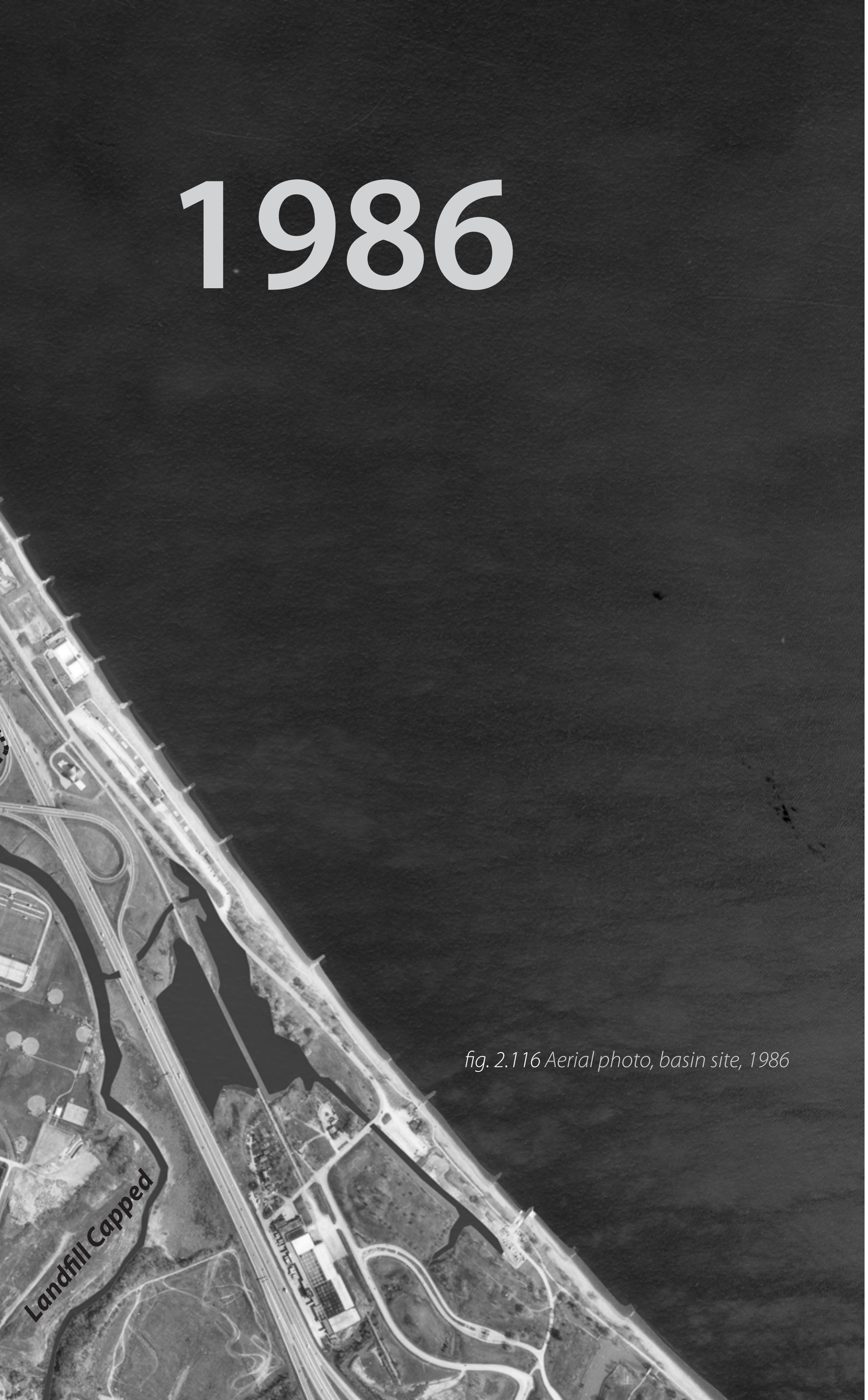


fig. 2.116 Aerial photo, basin site, 1986

The International Joint Venture listed Hamilton Harbour as an ‘area of concern’ on the Great Lakes in the 1980s due to some of the worst pollution being recorded in Windermere Basin with contaminated sediment coming from water runoff, city sewage, water treatment plants, combined sewer overflows, industrial waste discharges, and erosion from the Red Hill Creek watershed.[138]

In 1982 and 1984, Windermere Basin was reported to have had the highest concentration of lead, copper, nickel, and zinc when compared to other areas of high contamination in the harbour.[139] Windermere Basin placed second after the south shore of Randle Reef in studies conducted in 1982 because it revealed PAHs in four sediment samples.[140] Windermere Basin also had the highest recorded PCB and pesticide concentrations in sediment for the entire Harbour at this time.[141] Conditions were confirmed to be lethal to aquatic biota.

Net industrial loading into Hamilton Harbour from the Hamilton Waste Treatment Plant have decreased by 91.8% between 1964 and 1985 to the level of 5256 kg/d.[142] Cyanide loadings into the plant also decreased by 96.7% to about 65kg/d.[143]


Pier 25
1954 shoreline
Dredged Fill Cells
Dredged Fill Cells
Basin Dykes

1992

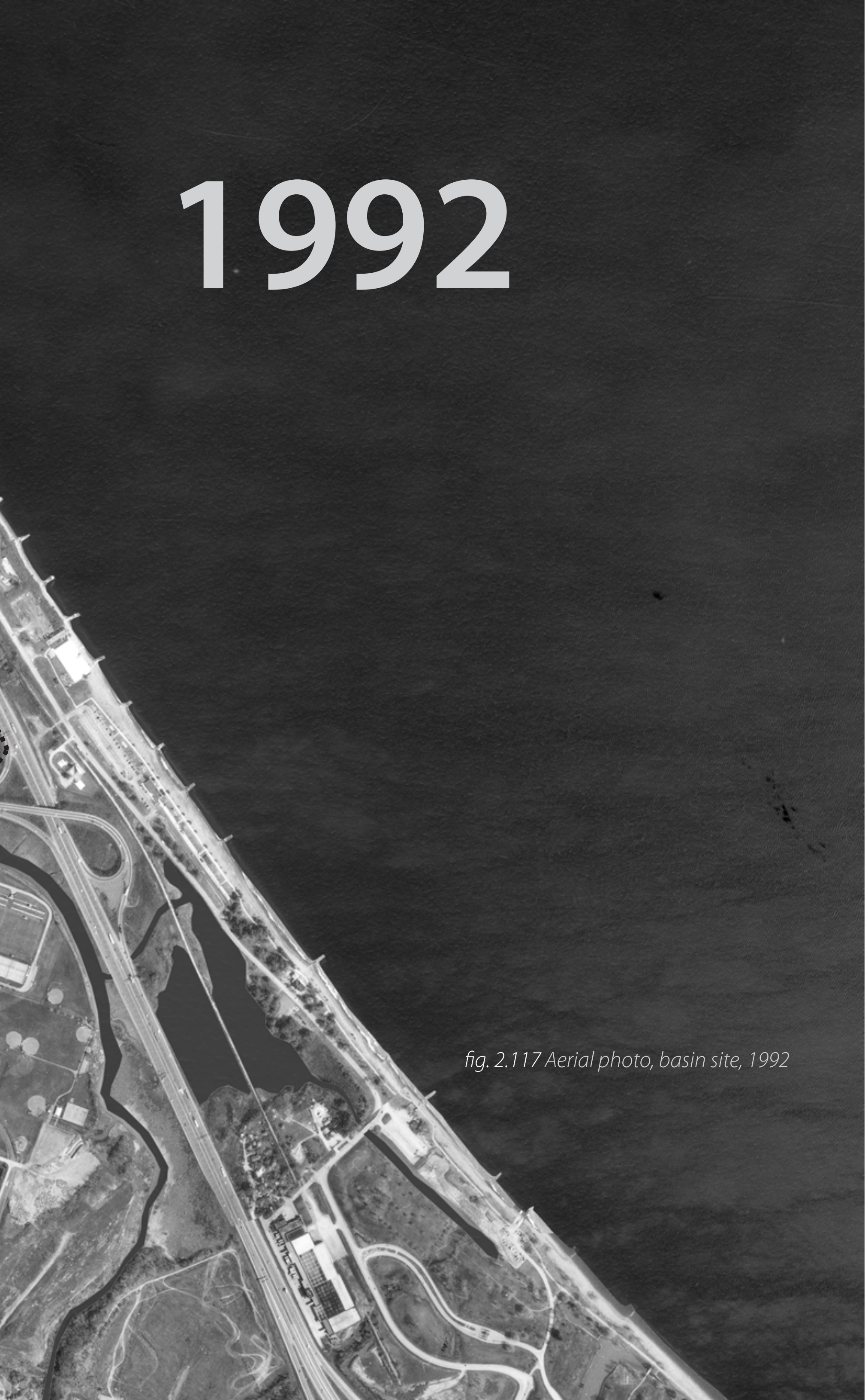


fig. 2.117 Aerial photo, basin site, 1992

By 1988 slag piles are only stored on the property of National Slag and may be an unmeasured source of metals into Windermere Basin.[144] Slag is limited to this site because of constant complaints from heavy dustfall on Beach Boulevard.

By 1988, waste treatment had reduced chemical inputs by more than 90% since 1960 but storm water separation in Hamilton Harbour is still deamed to be incomplete with discharges.[145] A stakeholders report by the Great Lakes Laboratory for Fisheries and Aquatic Sciences deems these conditions unacceptable.[146]

The basin was last dredged in 1990, resulting in the creation of a sediment trap which continues to operate today.[147] The sediment trap requires periodic maintenance to continue functioning effectively. As indicated by recent surveys, a total of 218,000 cubic meters of sediment has accumulated since the last dredging in 1990 and has surpassed 1989 levels.[148]

In 1988, it is reported that the plume of the Hamilton Harbour discharge has created elevated levels of ammonia, metals, and other constituents in the lake.[149] The report also reveals that copper levels exceeds water quality objectives in 26% of the samples within 6-7km of the canal, and sediment levels of metals were elevated.[150]

“In the 1990s, the Hamilton Harbour Commission (HHC) placed a soil cap over the dredged fill material at the site. The cover material consisted of surplus soils from City projects (e.g. excavated material from sewer and water main installations, road cuts) as well as surplus material from construction projects at other industrial properties in Hamilton. Analysis conducted on capping material samples indicate that concentrations of lead metals including lead, silver, zinc, mercury, cobalt, and nickel are above MOE standards”.[151]

Soil test using 14 bores identifies that the former basin bottom occurred at an elevation of 73 to 74 meters above sea level; the thickness of the cap varied from 1.4 to 4.0 meters.[152] In localized areas the cap fill is up to 10.8 meters thick.[153]


1954 shoreline
Filled Cells
Filled Cells

1999

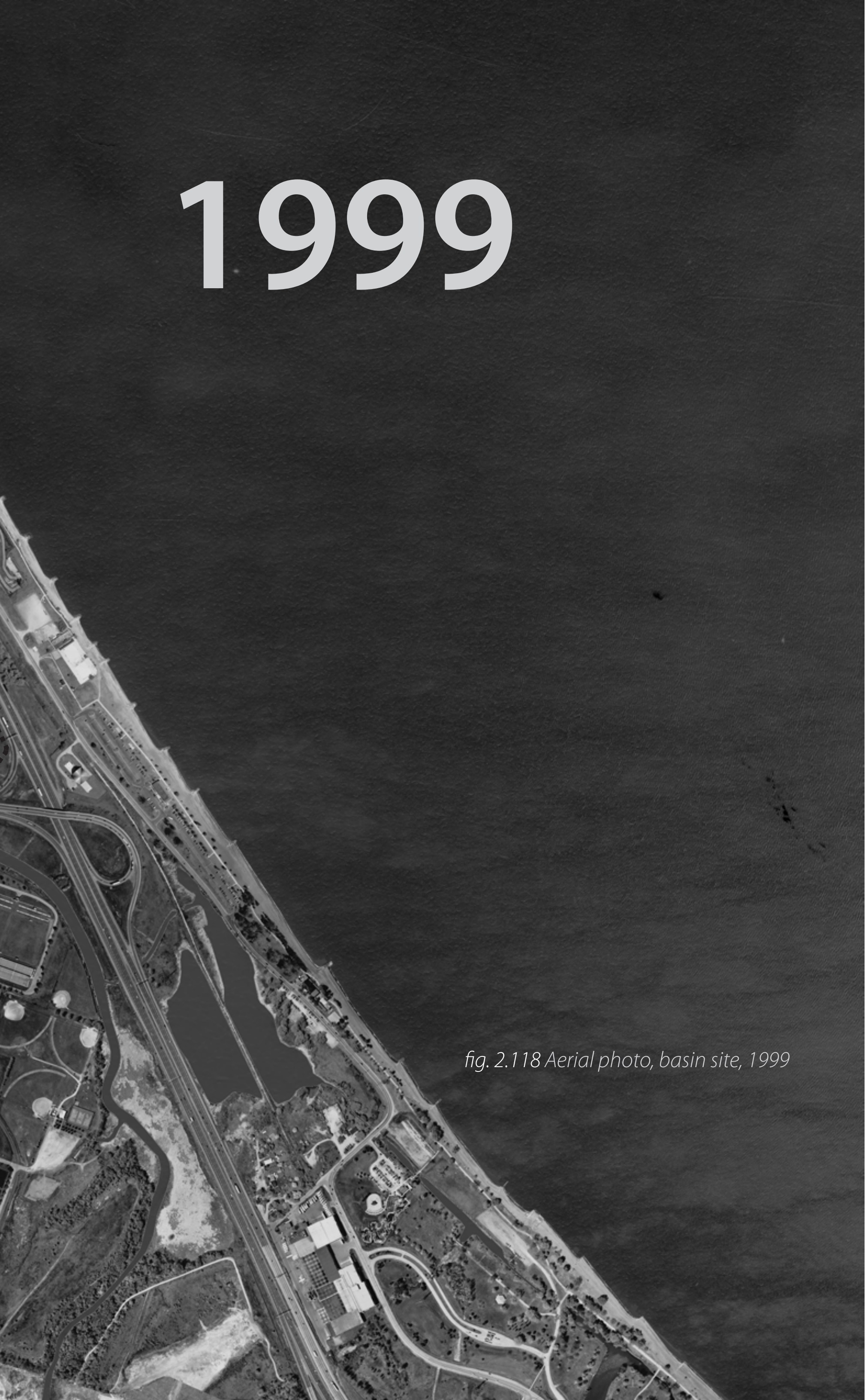


fig. 2.118 Aerial photo, basin site, 1999

In 1999, an environmental assessment conducted looked at the future constraints of the site to assess the best way to deal with its problematic water quality that was created by environmental disruption from dredging activity, and the isolation imposed on the site caused by surrounding industrial development.[154] Tests concluded that although samples exceeded the MOE and HHC values, the materials are deemed acceptable for use as cover.[155]

"In 2001 core sample leachate, 347 in total, indicate concentrations of boron and lindane in the neutral leach test exceeded the Provincial Quality Objectives in one or more sediment samples. Methane gas measurements ranged between 1.8% and 69.7% by volume indicating that gas concentration is associated with the decomposition of organic matter in site-sediment".[156]


1954 shoreline
Logistics Warehouse
Top Soil Fill
Diesel Fueling Station
Lab

2006

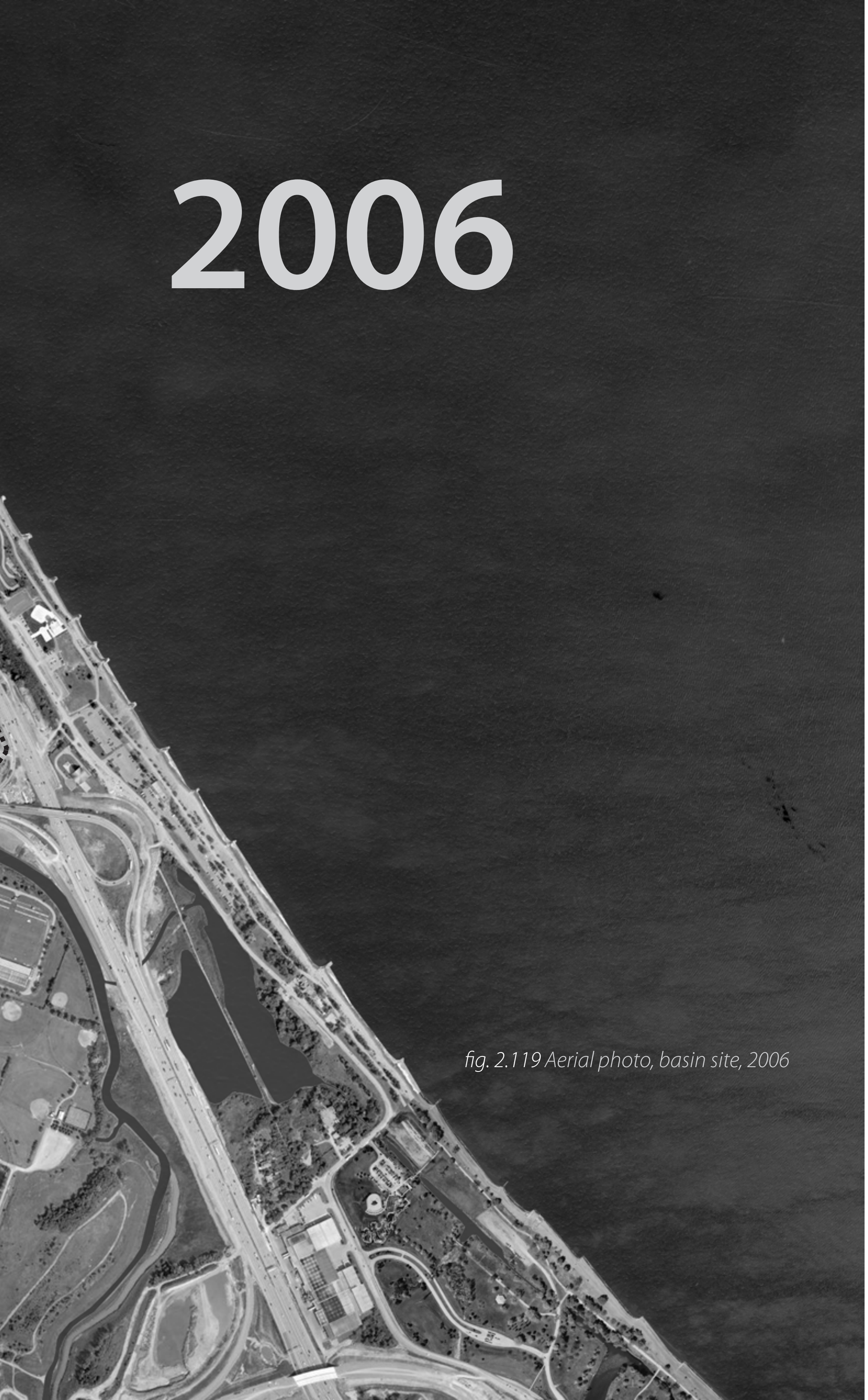


fig. 2.119 Aerial photo, basin site, 2006

In 2001 a steering committee was formed to present potential solutions for the environmental redevelopment of the site and to install permanent input to lead the process of renewal.

A 2006 consultant report indicates that the restoration process shows that Windermere Basin has been brought up to a healthy enough state to support aquatic plants.[157]

Greenhouse trials indicate that the sediment in the basin is suited for wetland plants. An ecological risk assessment concluded that current levels of contaminant are low and are not expected to result in direct mortality to aquatic organisms.[158]

The report also indicates that exposure to the environment from waterfowl and wildlife will not cause mortality or severe adverse health effects.[159] A wetland is feasible in the Windermere Basin area with proposed modifications of more frequent, less intrusive dredging activity.

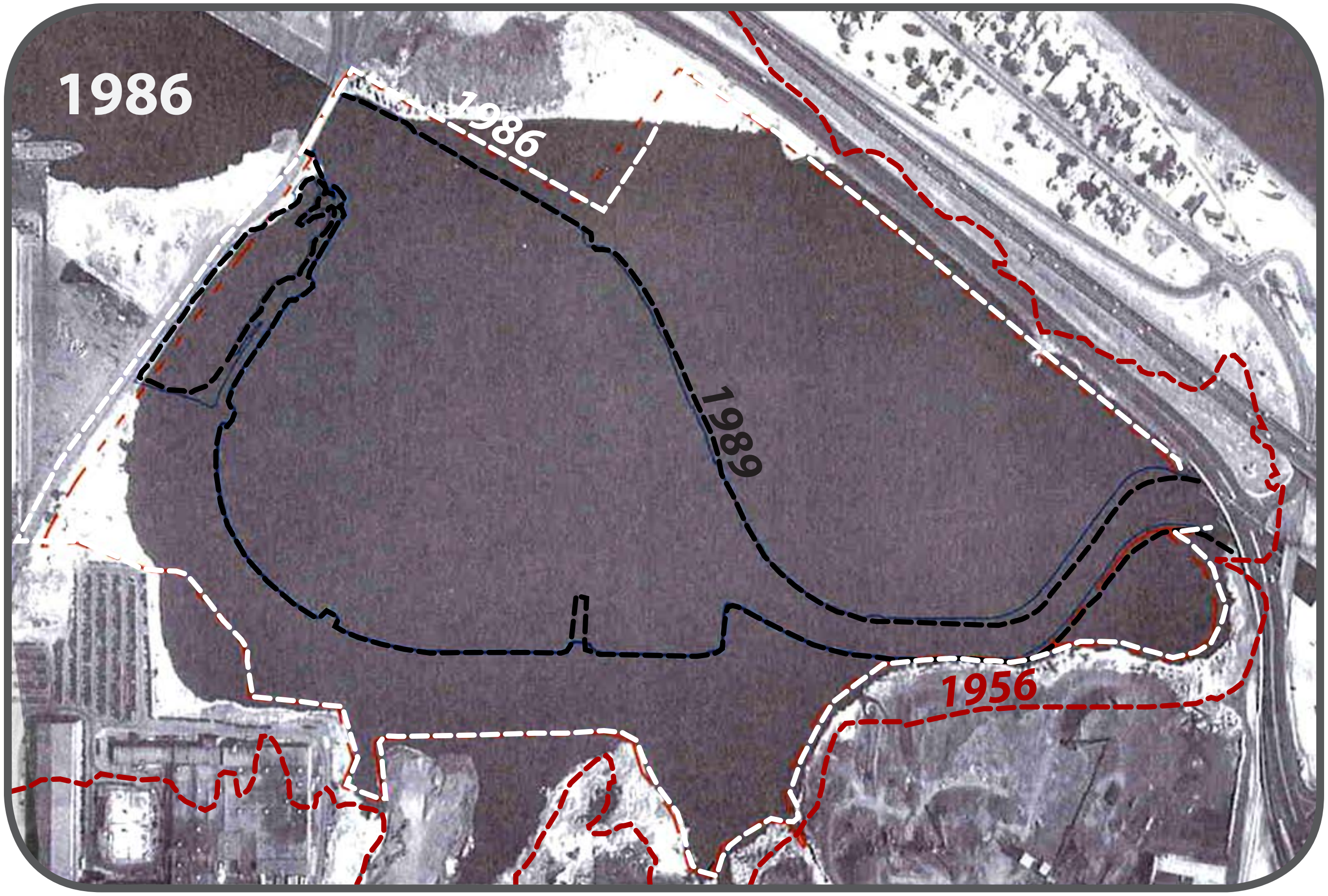
It is revealed to the public that it is estimated that dredging the overflowing sediment from the basin could cost eighteen to twenty two million dollars.[160] An alternative study is being drafted to develop a wetland ecosystem to treat this sediment.

WINDERMERE BASIN MUTATION As a result of substantial lake filling, the basin was significantly changed from its native state first discovered by Europeans in 1669. The dredged sediment that creates Windermere Basin's existing form is a result of contaminated fill being put behind berms in cells and capped. The following mapping exercise traces the perimeter of the basin from 1956 to 2005 and speculates on its future recovery beyond 2010. Created through processes of dredging and filling in the late 1980s, the subject lands surrounding the open water of the basin were increased in area incrementally. This mutation will help influence the design of Windermere Basin as a remedial estuary within Globe Park. Potential fill types and depths will be interpreted from aerial photography. This will help in organizing new and existing perimeter lines necessary for the basin's reclamation.

fig. 2.120 Aerial photo, basin, 1956

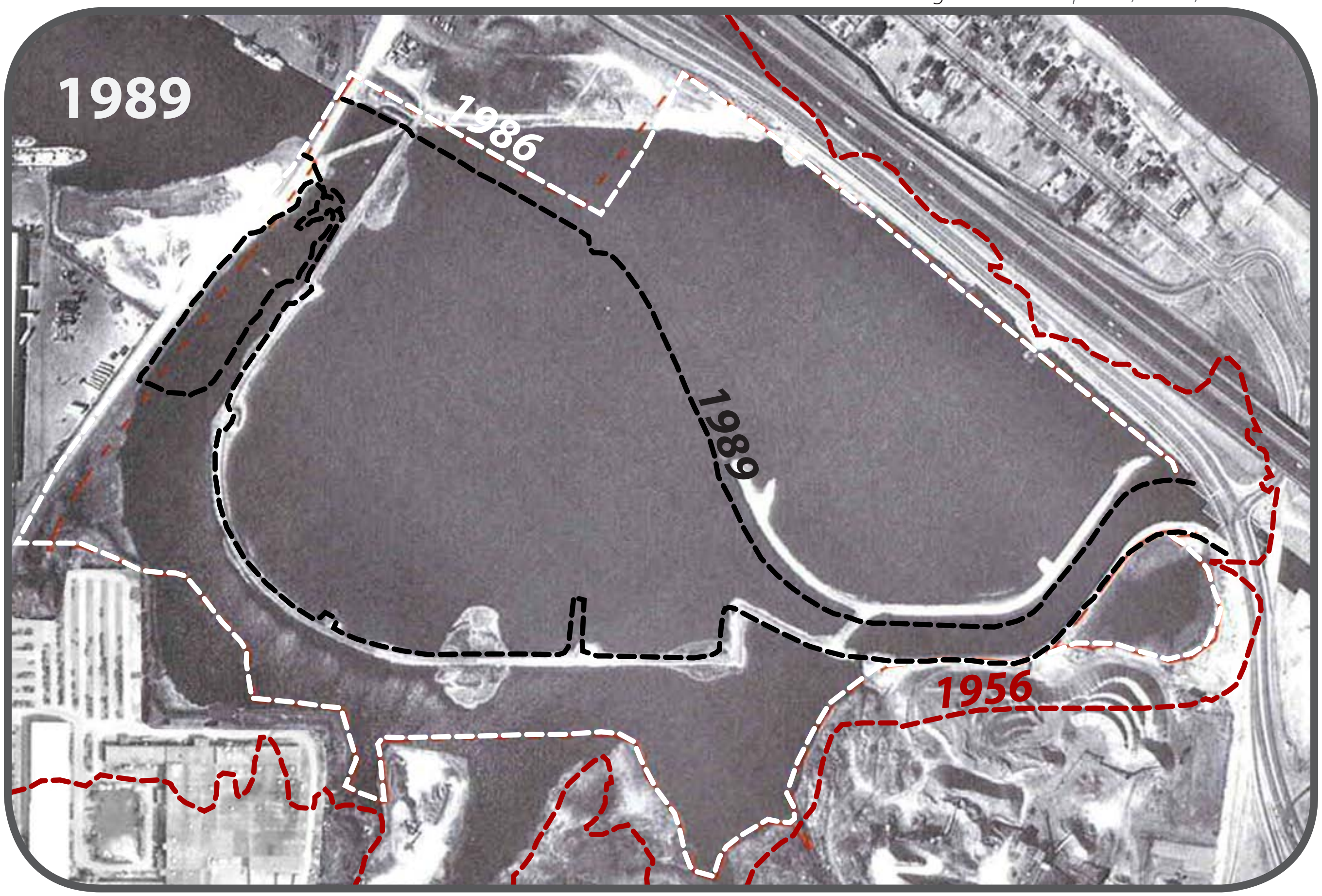
- aggregate storage occurs at the east end of the basin
- piles of aggregate and conveyors are first located on the former National Slag yard
- five large ground storage tanks are located to the west of the aggregate pile
- the first part of the basin is filled to construct a warehouse on the south shore

fig. 2.121 *Aerial photo, basin, 1986*



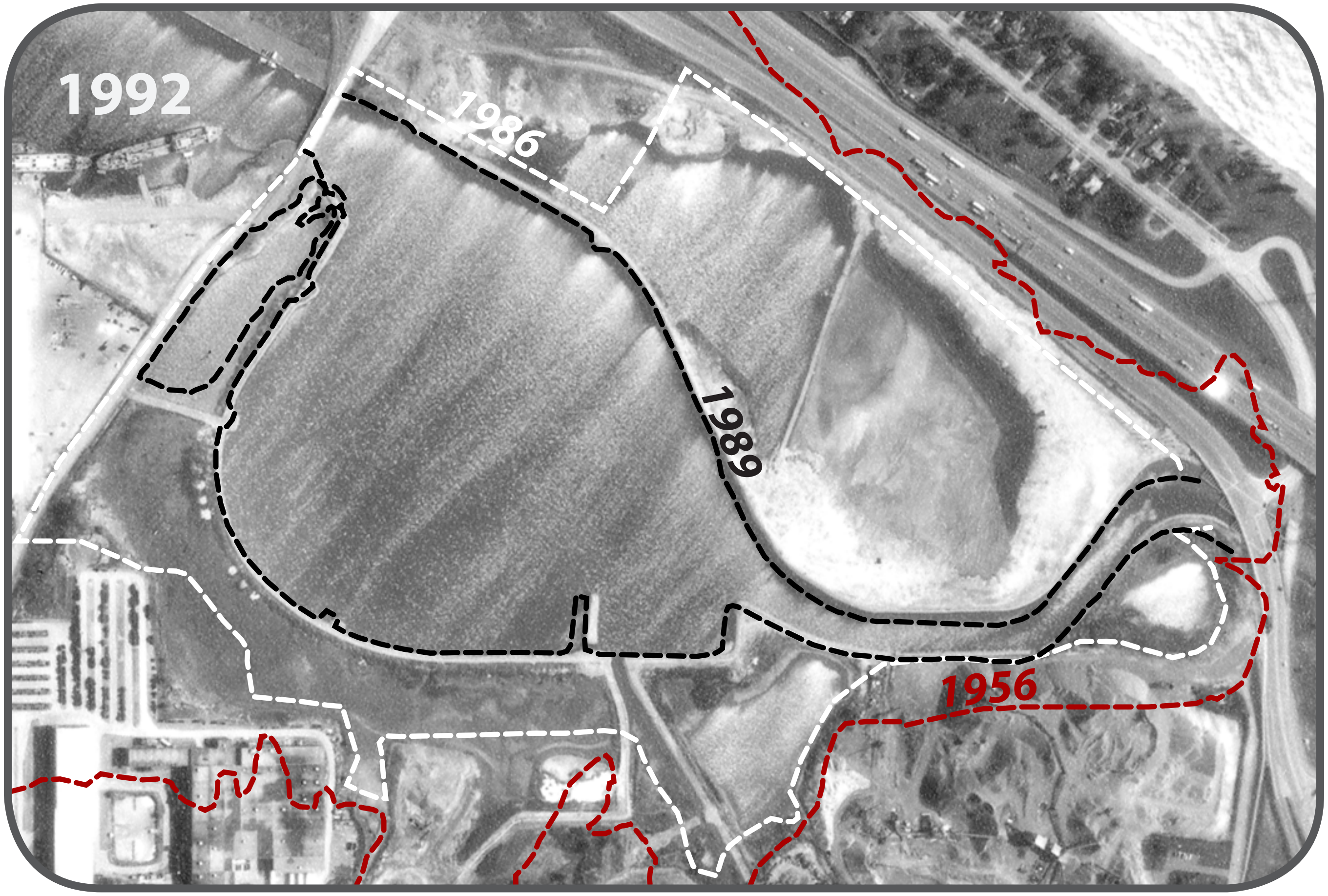
- significant in-filling has occurred on the southeast and east portions of the basin
- a retaining wall fill cell is constructed on the northeast corner
- a pier for large ships is created through infilling the northwest area of the basin
- the bridge located to the northwest entrance of the basin is constructed

fig. 2.122 Aerial photo, basin, 1989



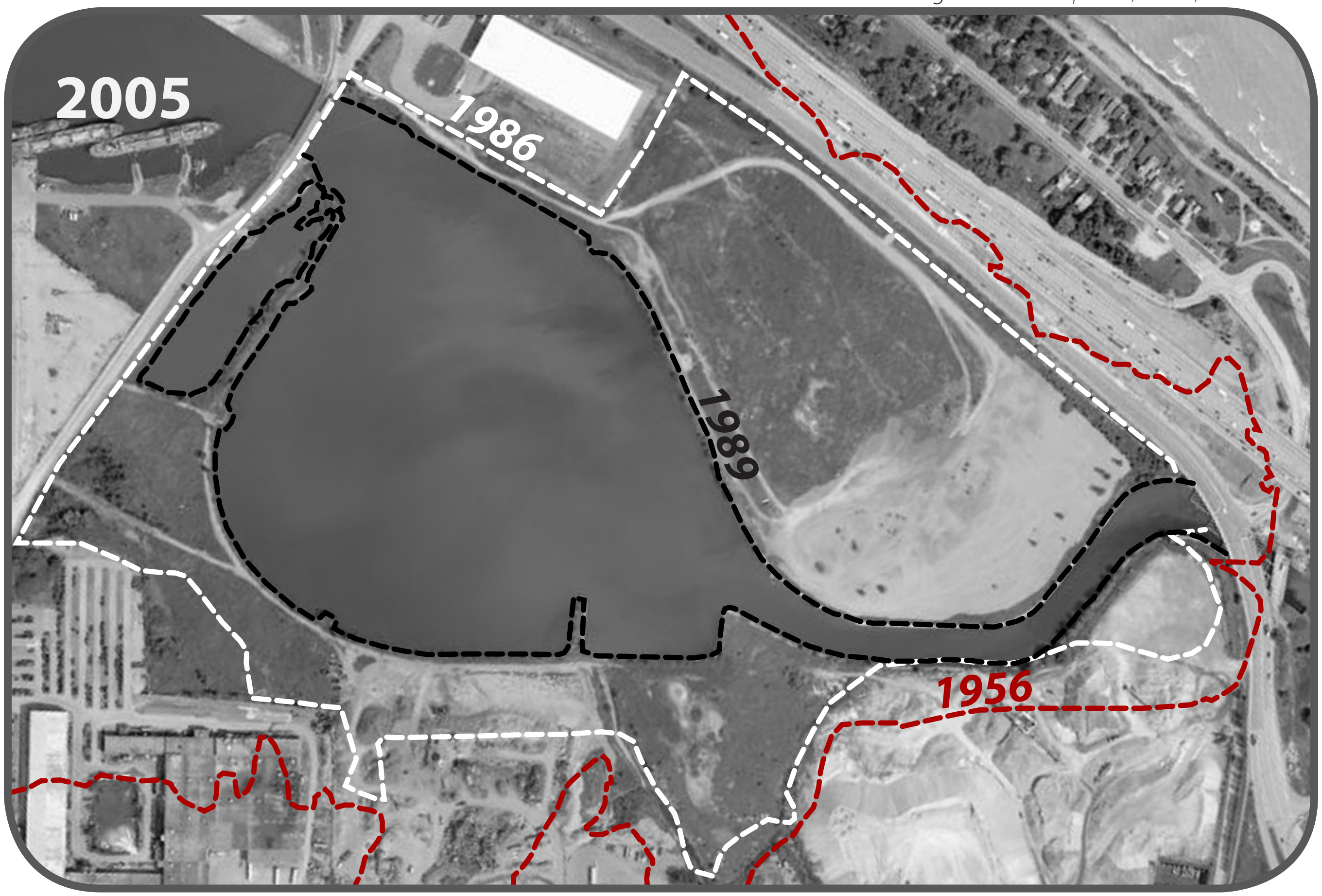
- dykes have been constructed creating a diversion channel from the Red Hill Creek's mouth to Hamilton Harbour
- a scrap yard and other industrial properties are observed near the south shore of the basin

fig. 2.123 *Aerial photo, basin, 1992*



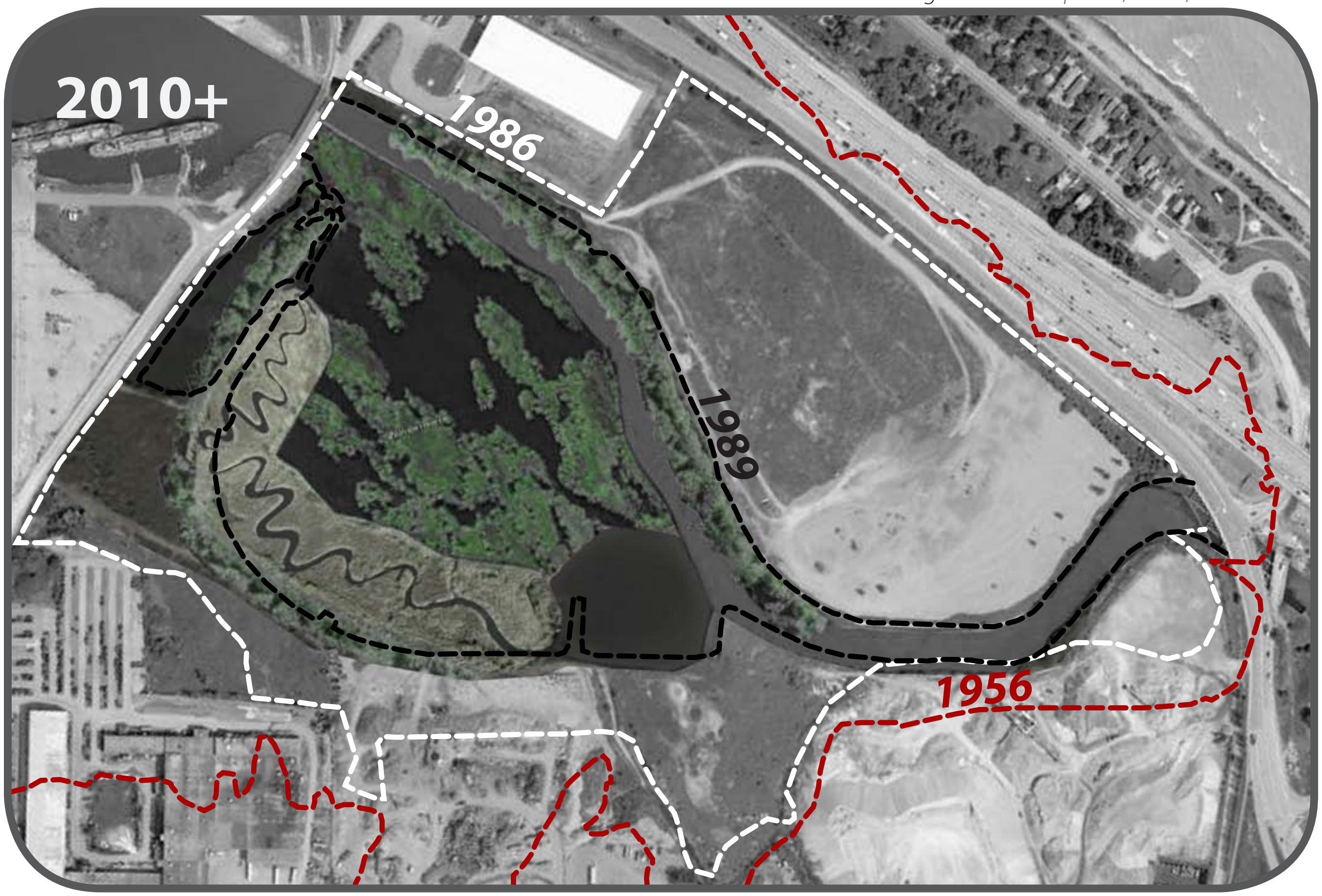
- approximately one third of the basin area have been filled including areas on the north and south of the dykes
- the south portion of the diversion channel is now part of the Red Hill Creek
- the Parkdale Combined Sewer Overflow (CSO) is now constructed on the south side of the basin
- a partially filled cell is located adjacent to Pier 24 access road

fig. 2.124 Aerial photo, basin, 2005



- a scrap yard is visible to the south of the site
- a warehouse is constructed on the northeast corner of the site
- the basin is in its most contemporary state

fig. 2.125 Aerial photo, basin, 2010



• proposed future wetland infill of the basin includes treatment wetland, shoreline plants, a main wetland area, settling basin, in-channel structures for sediment diversion, and a channel for the Red Hill Creek

03 HYBRID LANDSCAPE PRECEDENCE

fig. 3.1 Parc de la Villette
61 acres

fig. 3.2 Downsview Park
640 acres

fig. 3.3 Globe Park
576 acres

fig. 3.4 Fresh Kills
2200 acres

3.1 EVOLUTION OF CONTEMPORARY URBAN PARK

Contemporary design, through the medium of landscape, has confronted redefining the notion of urban park. A category of major park reconceptualization projects have attempted to examine urbanism with appreciation for the dynamics and temporality of complex systems. Learning from the operative and speculative techniques of these projects, a new territory for design intervention is accessible. The design hybridization of Globe Park [section 4] is influenced by prominent proposals for Park de la Villette in Paris, Downsview Park in Toronto, and Fresh Kills Park in New York. Globe Park can be understood as part of the evolutionary reconceptualization of contemporary urban parks.

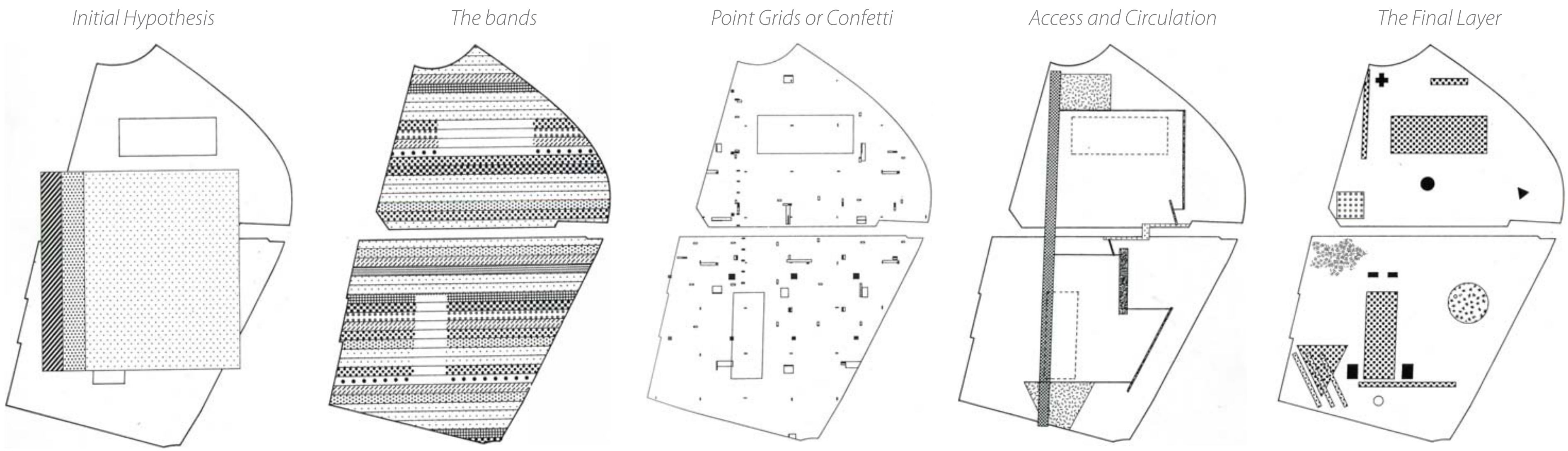
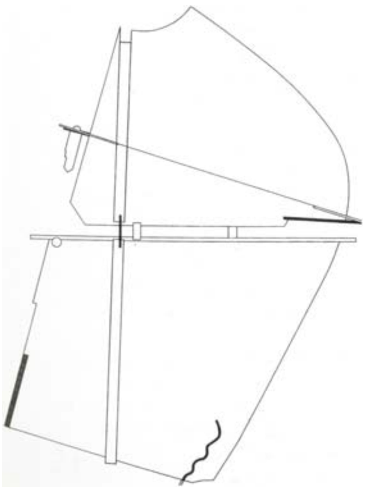


fig. 3.5 OMA's proposal for Parc de la Villette — The design was conceived through a series of layers. Each of these layers represent interactions within the park that respond to the whole. These layers would facilitate park program and public occupation of the space.

Connections and Elaborations



Demonstration

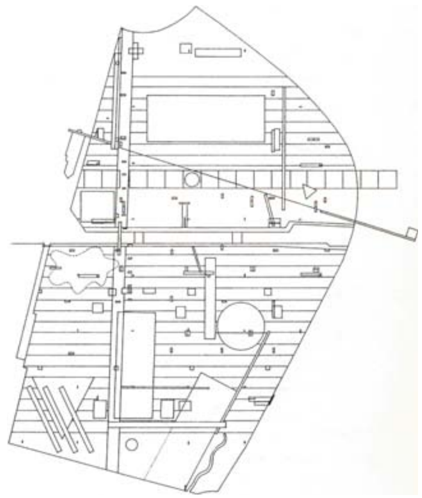
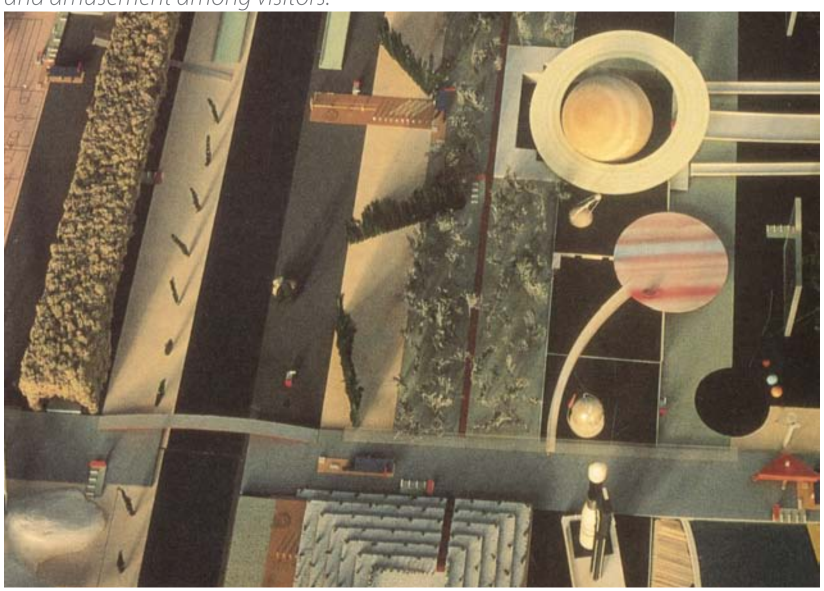


fig. 3.6 Original OMA model of Parc de la Villette — Large speculative attractors such as the spherical figure near the center of the space would stimulate activity and amusement among visitors.



PARK DE LA VILLETTE The Park De La Villette competition advanced the idea of urban park with two influential entries by OMA (Office of Metropolitan Architecture) and Bernard Tschumi. In the OMA entry, Koolhaas is critical of the conventional notion of park as a replica of nature that is typically served by sparse facilities to encourage delight. Koolhaas demanded that the program of the new park extend "like a dense forest of social instrument across the site".[161] The park's program was to undergo dynamic adjustment and change during its lifespan. The harder the park was to work the more adjustment and revision it was to facilitate. Therefore its "design" was a proposition of "method" that could combine "architectural specificity with programmatic indeterminacy".[162] The formal concept was to allow any shift, modification, replacement, or substitution to occur without altering the initial hypothesis, which frames the underlying principle of "programmatic indeterminacy".[163] Formally, a series of parallel bands were to accommodate the major program of OMA's design including the theme gardens, half the playground, and discovery gardens, which was to maximize the length of "borders" between different programmatic compounds. This gesture was to subdivide the site for maximum permeability to facilitate the "largest number of programmatic mutations".[164] Koolhaas was to use a standardized structuring system to organize these strips on the site to create fixed points for programmatic infrastructure. Within these systems small-scale elements such as kiosks, playgrounds, sales kiosks, refreshment bars, and picnic areas are distributed to treat and service the park. The park's circulation system ensures 'exploitation' and 'nourishment' using two approaches, the boulevard and the promenade. The boulevard intersects with the parks programmatic bands, while the promenade is demarcated as a plaza. The plaza would be created through the interaction of bands. The landscaping of the park was to be conceived as the sum of infrastructural interventions. The orchestration of these techniques was to organize a framework to absorb meanings, extensions, without compromising, redundancies, or contradictions that the park could generate.[165] OMA's Park de La Villette proposal opened the possibility of urban park as a self-organizing cultural construct. The park

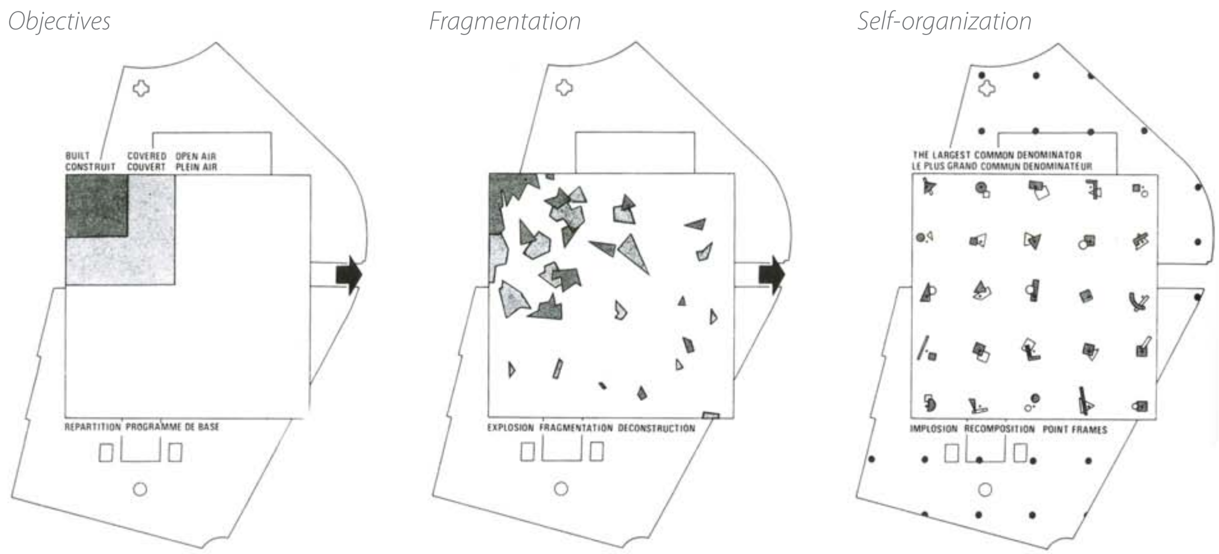


fig. 3.7 Bernard Tschumi's original proposal for Parc de la Villete — Generally, the Tschumi scheme can be interpreted as having three general strategies. First, objectives, in terms of program and spatial distribution. Second, fragmentation, dissects the existing space to open it up for new possibilities of spatiality. Third, self-organization, facilitates new networks that form out of fragmented propagations.

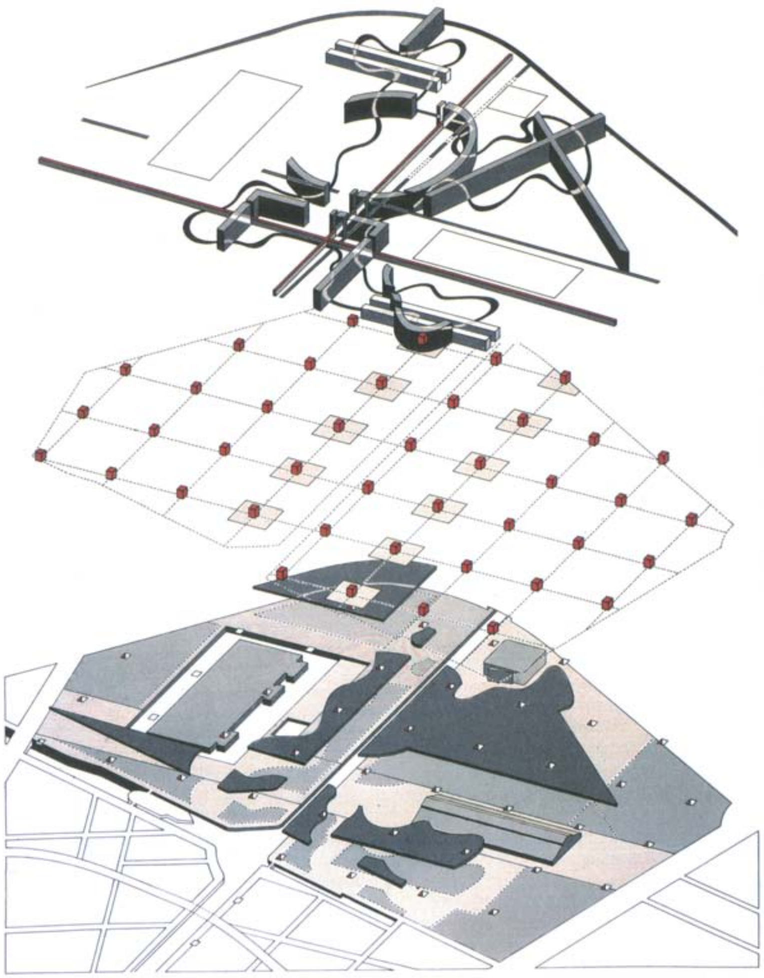


fig. 3.8 Diagram representing the layering propositions of Tschumi's Parc de la Villette — The initial hypothesis is linked to the formality of the grid and unplanned activities that happen within it.

was hypothesized on these organizing principles and was to avoid limiting future potentialities of the space. The OMA conception of an open park is consistent with theories of complex adaptation and systems ecology where cultural determinacy becomes the driver of occupational flow.

Bernard Tschumi notes that the program of the Parc de la Villette was very specific since it attempted to address everyone including the old, young, active, passive, working class, young elite, the rich, and the poor, which was an indication of the wide social political interests that governed at the time. Tschumi attempted to remain abstract while determining an organizational system for the space. His intension was to overcome preconceived concepts of homogeneity in the park by exploiting notions of density, heterogeneity, conflict, and contraction.[166] This was facilitated by creating a dynamic new city of activities rather than forms. Tschumi attempted to achieve this by rationally organizing a series of 'folies' throughout the site that were capable of accommodating a variety of activities, organized according to a Cartesian Grid. The 'folies' are twelve-by-twelve structures that were intended to be flexible to adapting to activities; they were painted red to become site attractors.[167] The repetition between the 'folies' sets up a relationship with the existing 19th century buildings on the site. Tschumi claims that the promenade of the park is the only random element in the park since "randomness, by definition, is vulnerable to change; it's very difficult to maintain in architecture since it can't be justified and goes against any sort of logic in terms of construction or cost".[168] The forms of the park are organized to allow random events to take place. The orchestration of the project exemplifies taking advantage of contradictions as an opportunity to overview all the interests of the project actors' conflicting interests. Tschumi's staging of the park sets up the designer as the mediating agent. This approach could become more dynamic if occupation, operation, production, employment, obsession, and fetishization are added to the layering of site possibilities. To expand on the principle of heterogeneity in staging of urban parks, adding friction could intensify potential

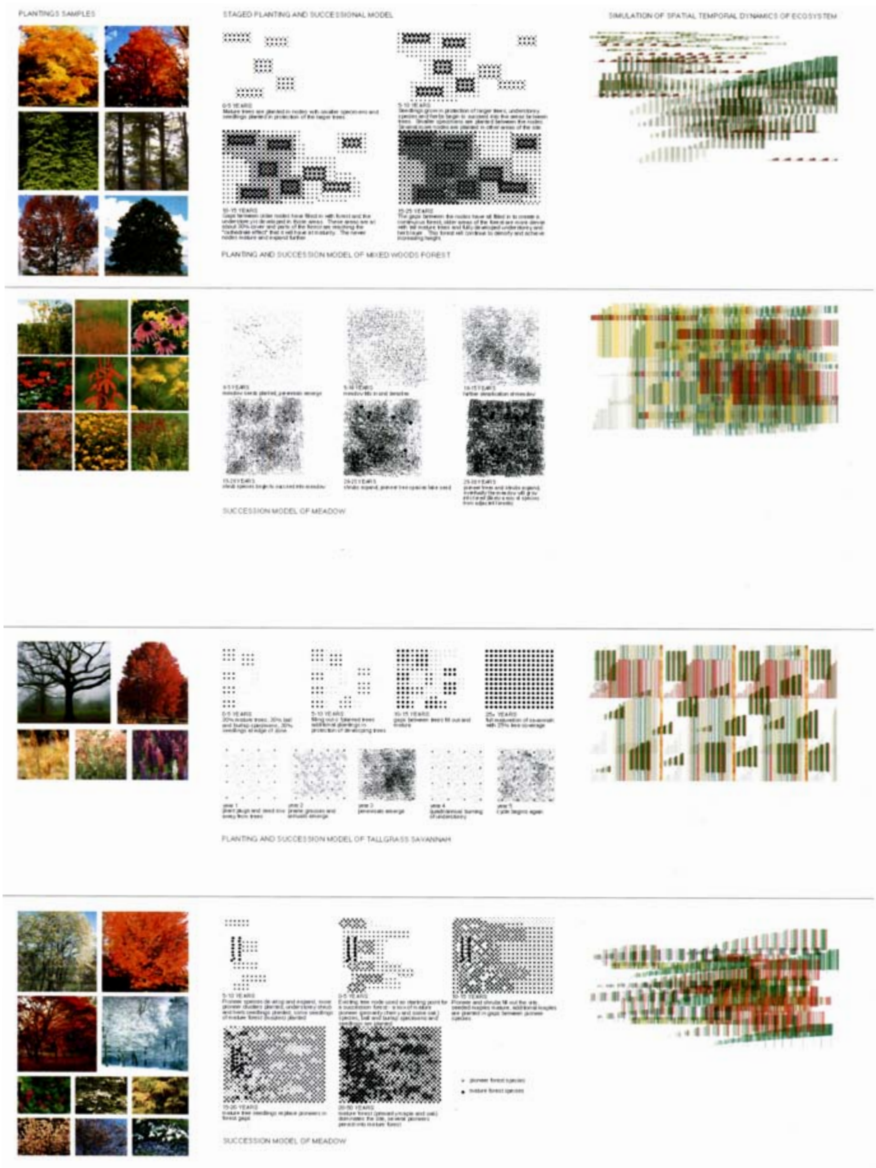


fig. 3.9 Succession of Downsview's Ecosystems — Tchumi's proposal for Downsview park ambitiously visualizes the succession of anticipated park ecosystems. Downsview represented deliberate consideration from design of ecology as a temporal spatial quality.

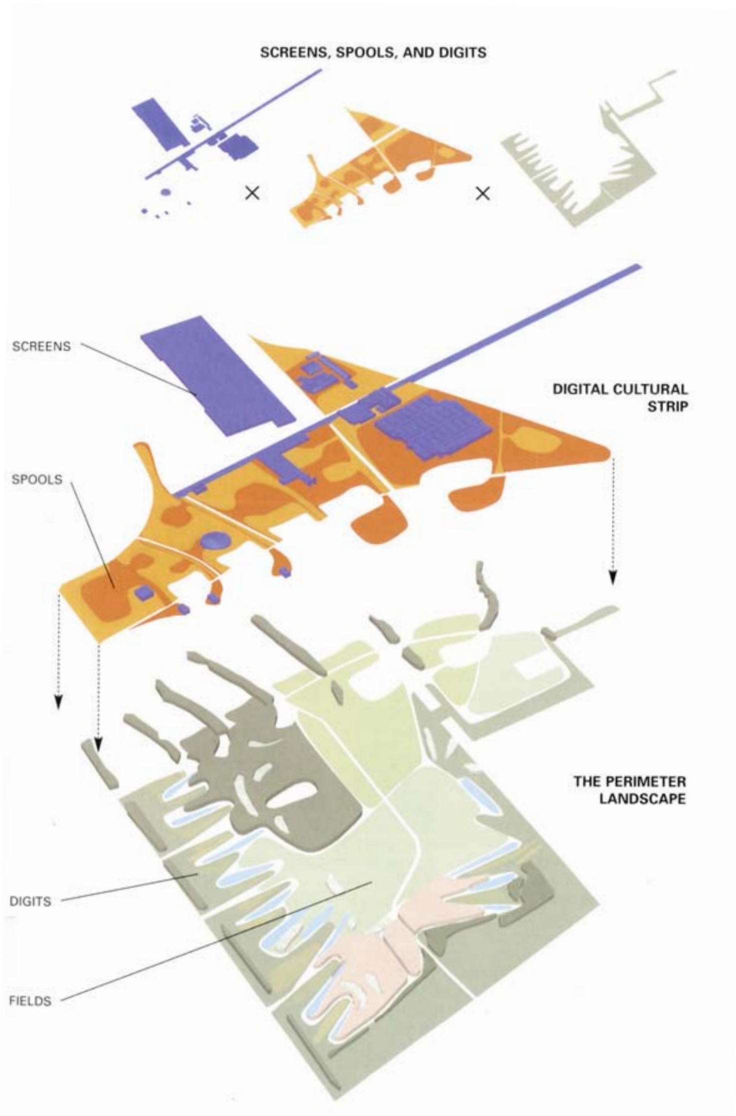


fig. 3.10 Layering of Tschumi's Downsview Park Proposal — Represents a series of conceptual surfaces where the activities of the park would play out. The lower layer is a notion of landscape where perhaps the ecological flows of the space are activated.

dynamism. Tschumi's approach facilitates self-organization by establishing networks of attractors as a physical form.

DOWNVIEW PARK The Downview Park competition called for accommodating changing future scenarios in the city of Toronto. The park was to facilitate recreational program as well as passive space for natural ecosystems and wildlife. James Corner's and Bernard Tshumi's entries become influential in staging design in section 4. The Corner entry emphasized that "specificity vs. open-endedness and human activities vs. natural systems may be the best resolved through the precise deployment of forms and pathways that will each support the emergence of self-organizing flows and behaviors in time".[169] With this conception, geometry and form become less important than site operation. A constructed framework of interacting systems was to be constructed within the first five years to draw energy, life, matter, and activity across the site.[170] The park was to be organized by two integrated systems 'circuits' and 'through-flows'. 'Circuits' were to accommodate activity programs and 'through-flows' were to accommodate hydrological and ecological process. The entry was the first time the science of ecology was considered as a primary agent in contemporary urban park design. Tschumi's design entry confronted two realities including the 'digital and the wild'. The large spatial approach began with strategy not form, site attractors include attempts to maximize seduction by maximizing perimeter. The park included an existing corporate business area. A strategy was devised to interface between natural and cultural artifacts. Major digital screens were to activate the park and seduce visitation. Time was to become the precursor to the park's self-organization.[171] These two competition entries anticipated blurring distinctions between cultural and ecological activity. The hypothesis could have larger implications for staging activities of Globe Park including potentiality for manufacturing and historical designation.

fig. 3.11 Large site plan of James Corner's Fresh Kills Park — The large park is organized through a series of conceptual operational ecological threads. These relate to the overall topography of the landscape.

fig. 3.12 *Representational spatial distribution of Fresh Kills — The reclaimed landscape will be a significant addition to the ecological composition of Staten Island.*

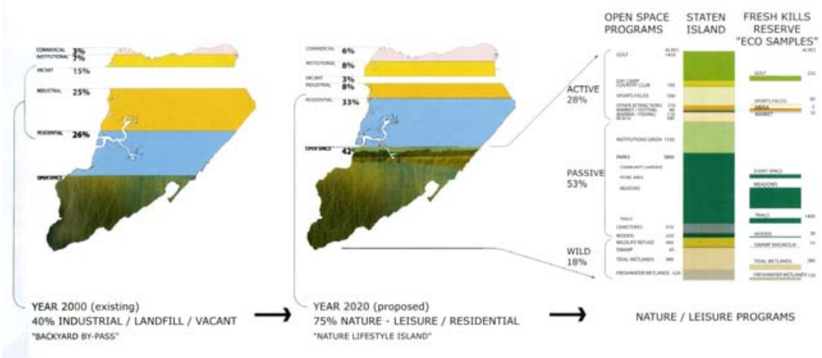


fig. 3.13 *Speculative view of Fresh Kill's reclamation*

FRESH KILLS The winning scheme for Fresh Kills, submitted by Field Operations, has expanded notions of contemporary urban park into the realm of complex adaptability by engaging cultural-natural symbiosis in its spatial conception. As a large-scale intervention, closure and reclaiming of Fresh Kills Landfill will shift Staten Island's landuse from forty percent industrial to a scenario where seventy-five percent landuse includes nature, recreation, and residential program. Forty percent of the later seventy-five percent will be open space, which is a suitable figure because Staten Island supports a percentage of plant species, including endangered species, larger than any comparable sized area in New York State.[172] The health of larger ecosystems is influenced by Staten Island's mix of northern and southern species. James Corner saw that with the closing of the Fresh Kills Landfill an unsustainable pattern could be reversed and Staten Island could facilitate expansive "natural sprawl".[173] Corner describes natural sprawl as spread of vegetation, birds, mammals, and amphibians; he sees that the impact of the project will recast the island from backyard bypass in a discerning metropolis to an area with networks of greenways, recreational open spaces, and restored habitat reserves.[174] The reclaimed park is to rebrand the island with a heart of nature-culture hybrids to serve as a destination and envy of surrounding urbanites. The land mass of Fresh Kills is visible from the moon and is considered one of the most complex land masses attempted to be manipulated. Its artificial topography was an opportunity for designing a new form of public-ecological landscape to be intensified more by time and process than by space and form. The park challenges the traditional concept of nature and culture as separate realms by creating a "synthetic, integrative nature that is simultaneously wild and cultivated".[175] New environments are continuously manufactured as the park produces and evolves. Future cultural engagement will intensify the symbiotic relationships between urban and natural ecosystems in the region. The project at an interdisciplinary level expands site regeneration intelligence as landscape architect William Young suggests:

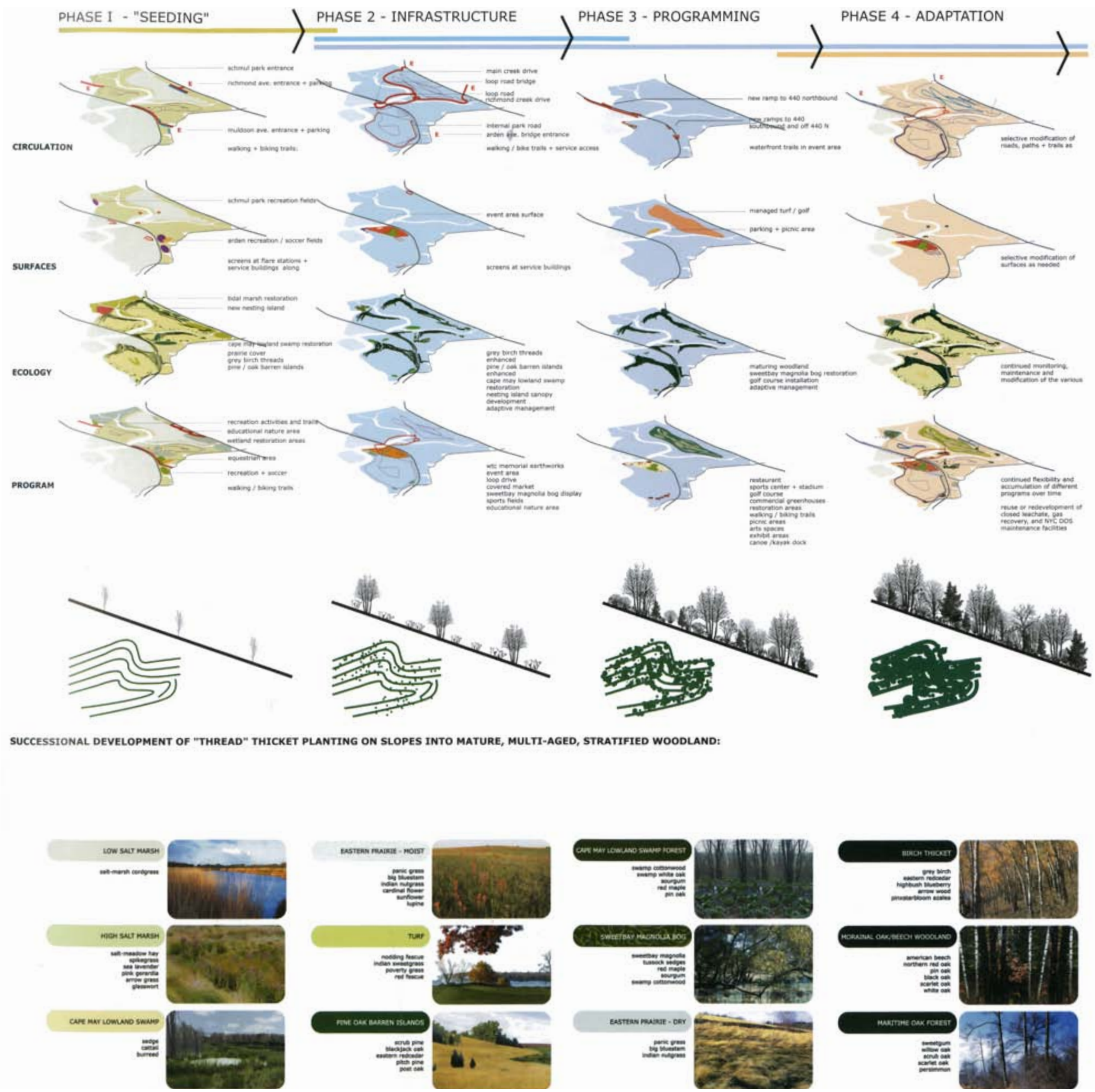


fig. 3.14 *Phasing and Successional Process of Fresh Kills — The succession and reclamation of landscape is responsive to the experience of the park*

> "Clearly in created wetlands, phytoremediation, brownfield redevelopment and now in landfill reclamation, the application of environmental engineering in combination with landscape design offers greater benefits than each discipline alone would produce, including reduction or elimination of contaminants, containment of contaminants, redevelopment, created habitats, increased open space, recreational opportunities and regenerative systems often providing treatment at lower cost than artificially engineered solutions".[176]

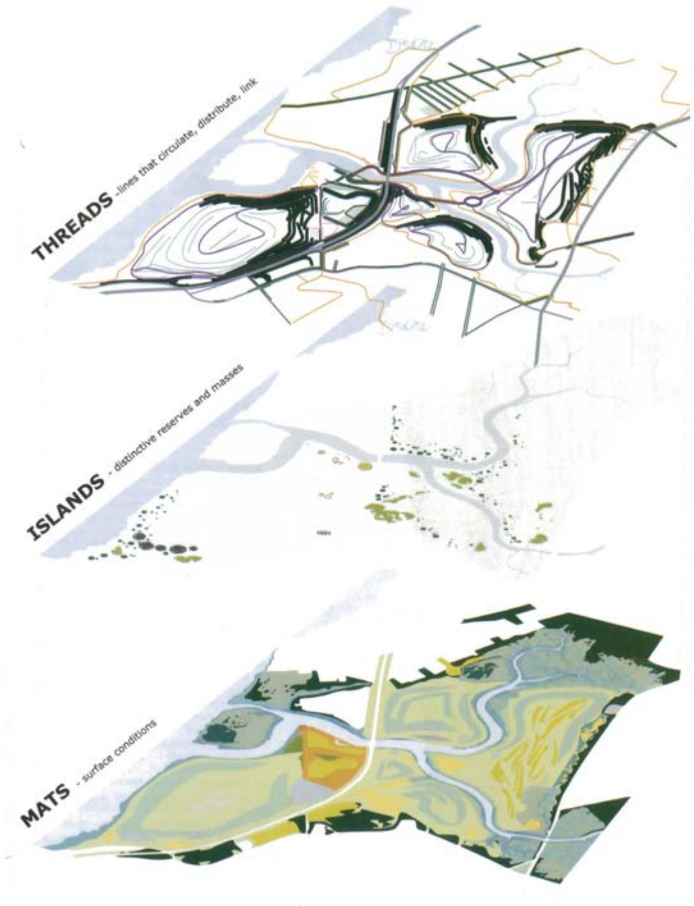


fig. 3.15 Complex layering of Fresh Kills — The successional layering of the park facilitates self-organizing cultural, recreation, and ecological symbiosis

Operationally, Fresh Kills engages activities that attract new cultural utilization through academic research, planting, and restoration. The process of reclaiming Fresh Kills illustrates the relationship between research and innovative practices. William Young, landscape architect, notes that the "Fresh Kills project comes close to the laboratory approach, in which pioneering remediation systems are carefully monitored so that data can be generated to support future uses of these strategies for landfill capping, stormwater management, and habitat development".[177] This is significant because uncharted territory is explored relying on skills and resources of researchers like local academic institutions to build a database for assessing predicted and unanticipated benefits.

fig. 3.16 Blue Lagoon, Iceland, Geothermal power plant with bathers enjoying geothermally-heated water, — Represents a healthy symbiotic relationship between industrial facility and human leisure.

3.2 OPERATIONAL ECO-INDUSTRIAL PARKS

Globe Park learns from the exchange systems embedded in contemporary eco-industrial parks and hybrid adaptable building types. It recognizes that from the perspective of material consumption, more can be facilitated by developing internal networks to treat and make use of materials from within its perimeter. To fulfill these objectives, Globe Park learns from Kalundborg, Denmark's industrial symbiosis in terms of its ability to create a real local network of material flows. Learning from these abilities, it can emulate these basic frameworks to encourage material reuse and adaptability. For Globe Park, it is necessary to think of potential adaptability and of material reuse because future occupations of the space may not be certain. If adaptability is considered, the design may be able to facilitate more future unintended uses. The more potential created by interior networks and by adaptability, the more intensified the experience of the space can become. Although there are differences between Kalundborg eco-industrial park and Globe Park's material uses, the basic social and ecological conditions are similar. With this in mind, Globe Park will build a symbiosis that propagates the maximum potential between cultural, ecological, and industrial operations. The following section discusses some of the primary motivators that enabled Kalundborg's self-organizing symbiosis.

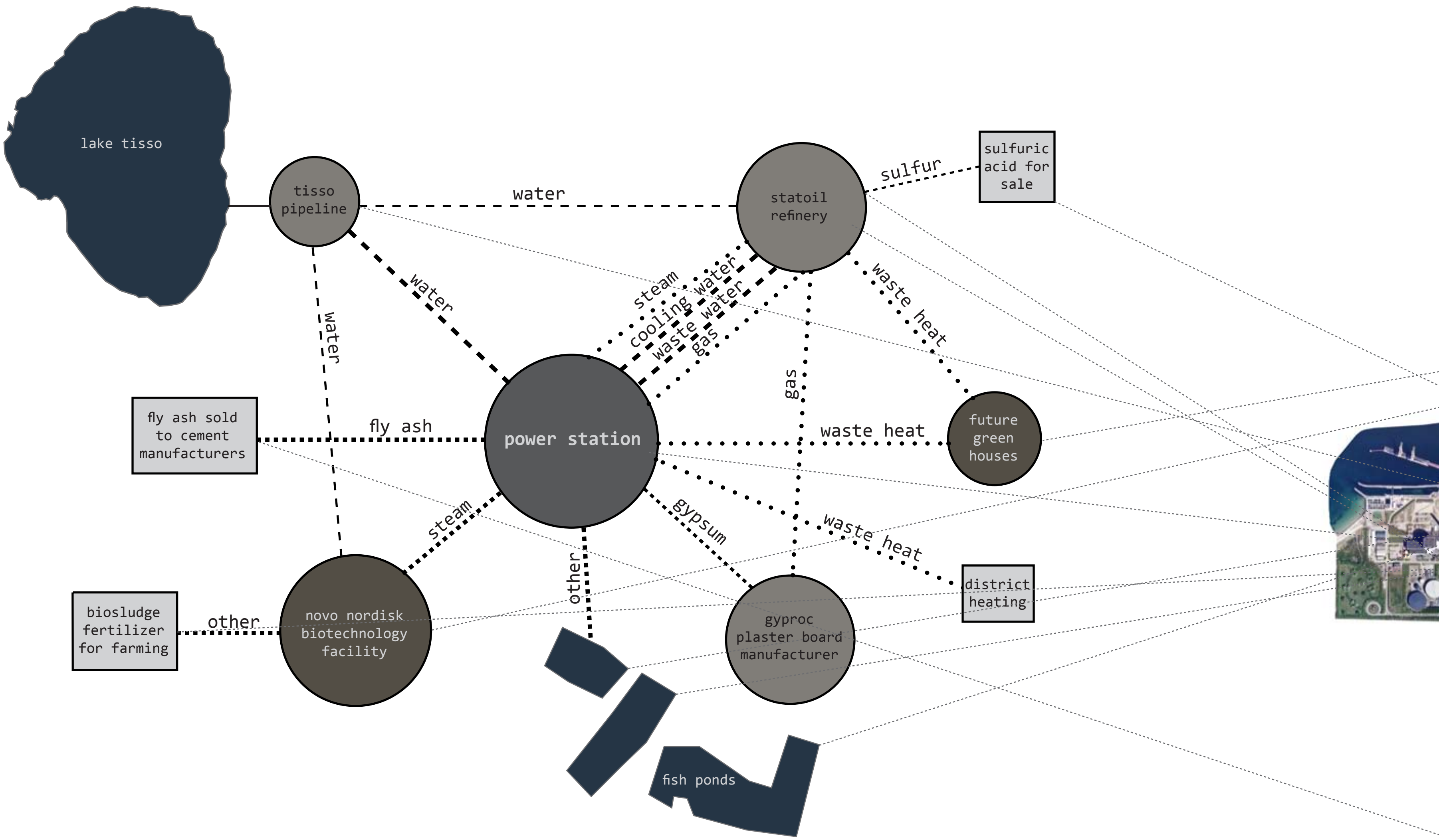


fig. 3.17 *Kalunborg, Denmark material exchange symbiosis*

fig. 3.18 Kalunborg, Denmark port aerial

KALUNDBORG, DENMARK One of the most internationally well-known examples of a local exchange network among industrial producers is the eco-industrial park in Kalundborg, Denmark.[178] The Kalundborg symbiosis has established nineteen different exchange activities based on water exchange, energy exchange, and exchange of solid waste.[179] Large companies with stable continuous waste streams and needs for inputs are at the center of this symbiosis.[180] The partnership between industry and public authorities can be viewed as a process for institutionalizing the industrial symbiosis concept. To overcome barriers, often created by poor communication or mental blocks in the system, reorganization through testing new ideas and establishing collaboration over branch and company borders is developed.[181]

Environmental impact is minimized by maximizing material exchange between economic actors. The social element in this coordination of activities is important.[182] The social cooperation of the system's actors will create the design linkages that benefit from locating and specifying industries according to a grand scheme.[183] The only downfall from a planning and design perspective is the limited information required to organize synergistic relationships among firms.[184] In the Kalundburg eco-industrial park, the success of these cooperative efforts were because local facility managers as a group had strong social ties with other actors from the same community often having established friendships and acquaintanceships. The strong commitment from local actors represents the benefit of self-organization and self-governance that contribute to the functioning and stability of the ecosystem as a whole.

fig. 3.19 *West8 operational section showing adaptation of Canada Malting Co. Silos into hybrid Biofiltration System and Interpretive Center/Nightclub*

fig. 3.20 *West8 rendering of Canada Malting Co. Silo hybrid*

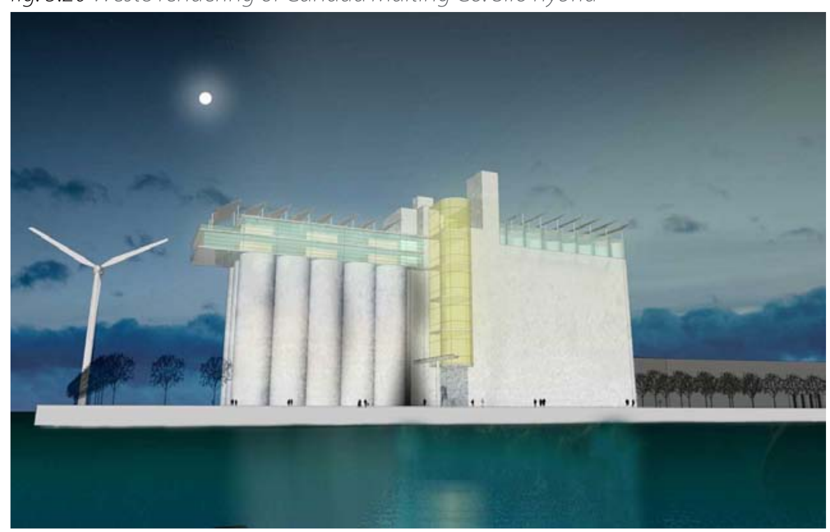


fig. 3.21 IGUS plastic manufacturing plant

HYBRID ADAPTATIONS The facilities of an eco-industrial park anticipate future use by encouraging design that maximizes spatial adaptability and minimizes need for remediation. Additionally, the facilities anticipate maximum integration with native ecosystems on the site, storm water control measures, and maximum material exchanges between associated facilities. The IGUS plastic manufacturing plant in Germany, by Nicholas Grimshaw, is a building that was designed as a plastic plant, which in the future could become anything from a retail food store to an office complex.[185] The design of eco-industrial facilities attempt to advance the protection of the environment and landscape through intentional design and not through remediation.[186]

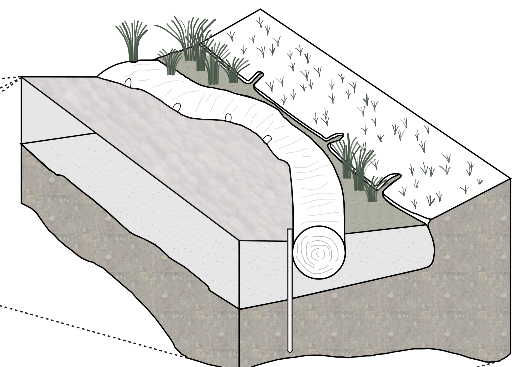
Jean Rogers in his essay entitled 'Industrial Evolution: prevention of remediation through design' published in *Manufactured Sites: Rethinking the Post Industrial Landscape* explains that designers have the unique opportunity at the beginning of a project to eliminate environmental impacts. His position is that with this designers face hard decisions every day, such as facility siting and reuse options, building envelope design, energy considerations, materials selection, integration with operations, and, most importantly, communicating the design vision to management.[187] He claims that because of incompetent design and management, industrial plants continue 'inadequate disposal of toxic waste products, water and soil contamination from discharges and leakages, and airborne contamination from plant emissions.[188] For designers "the greater question may be how, as we anticipate these occurrences, we can mediate them with systems that treat in place or contain toxins on-site for long-term treatment in a safe and sustainable manner".[189] Designing buildings to anticipate future use at an urban scale will require the networking of material exchange and treatment. These could be the central organizing principles of future eco-industrial urban land use.

3.3 LANDSCAPE RECLAMATION

The design of Globe Park takes into account major landscape reclamation features that improve water and soil quality within its boundaries. New site developments are now at a minimum required to address storm water management issues for both legal and practical reasons, however Globe Park intends to revolutionize these practices by integrating active reclamation practice with hybrid plant operations. Learning from the notable landscape reclamation of Bureau of Prison Medical Center, the design of Globe Park will incorporate similar bio-engineered water treatment systems to help reclaim its blighted ecosystems. One of Globe Park's primary objectives is to help substantially clean the water quality of Hamilton, Harbour. From the Fort Devens landscape reclamation project, it is necessary to see that biological means of improving water quality is a progressive way to integrate direct human intervention with environmental improvements. A potential outcome of a constructed ecological landscape, is a methodology to involve the community in reclaiming its urban environment. The following section will give a technical overview of the Fort Devens reclamation project, which helped influence the design of Globe Park's landscape reclamation and storm water management operations.

fig. 3.23 Aerial of central operations at Fort Devens Military base

fig. 3.22 Axonometric of constructed wetland bank supported by prevegetated coir mats



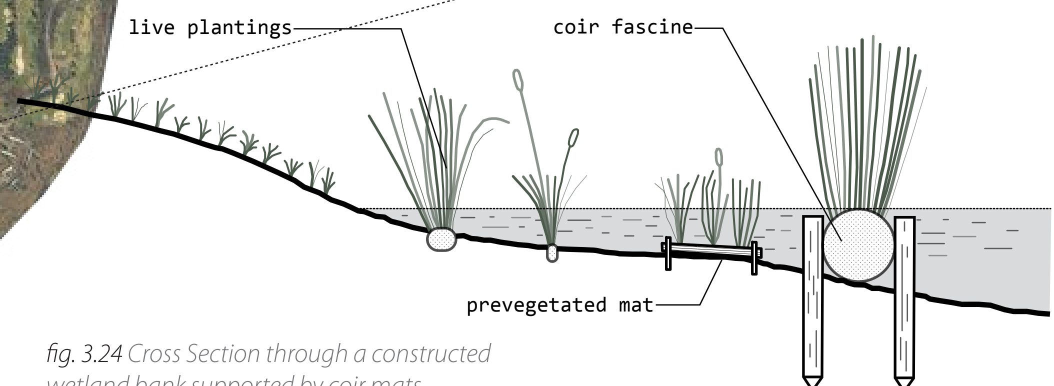


fig. 3.24 Cross Section through a constructed wetland bank supported by coir mats

BUREAU OF PRISONS MEDICAL CENTER Bureau of Prisons Medical Center is a decommissioned army base, in Devens, Massachusetts. The project used a bio-engineering pond and wetland system to combine discharge control and improve storm water quality.[190] Three interconnected, heavily vegetated basins were constructed along an existing steam course to stabilize soils, provide wildlife habitat, and to improve water quality.[191] The project used bio-engineered vegetated materials to regulate storm water flow for up to 100-year storm events.[192] The system was able to create an ecologically beneficial and esthetically pleasing system that controlled discharge and removed pollutants, although the alteration of the area was controversial from a public perspective.[193]

fig. 3.25 Devens Wetland Construction

The ecological system in Devens functions by allowing the stream to enter through a pre-existing culvert in a headwall. The stream collects run-off from a watershed of 21.7 hectares and a hillside spring enters the first basin.[194] The first basin prides primary treatment; its area is 0.05 hectares designed with a permanent wet pool that traps 50-70 percent of incoming sediment.[195] The stream flows from basin one into a second 0.10 hectare basin with a heavily vegetated wetland, which provides water quality improvement through biological treatment, filtration, and added sedimentation.[196] To maximize fine particle removal, hydrocarbon breakdown, and nutrient uptake, soils, fine grading, and plant materials were specified for the pond.[197] Baffles were built to increase the surface area for biological treatment and to reduce short-circuiting by directing flow, which in turn decreased the residence time.[198] The stream from the second basin discharges over a 0.5 meter artificially constructed cascade before entering the third basin, which is the largest of the basins at 0.3 hectares.[199] Mechanical aeration to increase dissolved oxygen is induced by the cascade, which also creates a visual feature that onlookers at an adjacent overlook may view.[200] A wildlife habitat island and wetland border is included in the third basin with native grasses, sedges, rushes, wildflowers, shrubs, and trees.[201] The third pond supports a diverse aquatic community with its size and depth; its native edge vegetation offers terrestrial wildlife habitat.[202] The three stage process represents a structure that could be adaptable to the Windermere Basin Site to help improve water quality by controlling sediment flow. Site runoffs may be deposited in containment ponds and managed for dredging before entering the basin.

The third basin in the Devens project provides important aesthetic and ecological functions and the first two basins substantially improve water quality. Further, the third basin dilutes and cools rainwater that has been pavement warmed and expands residence time for passive treatment of water chemical particulates.[203] Native trees, shrubs, and meadow grasses enhance the setting and maximize the inception and infiltration of stormwater, in contrast to turf, which yields high run-off and excess nutrients from synthetic fertilizers.[204] Bio-engineering treatments provide immediate and long-term stabilization of the watercourse's 600-meter bank within the designed flow conditions.[205] To protect the banks of the stream in areas of high velocity or steep banks, 0.3 meter diameter coir fiber rolls were used.[206] Vegetative plugs like sedges, rushes, and bulrushes were planted within the fiber rolls as well as flowering natives such as flag iris (Iris versicolor), cardinal flower (Lobelia cardinalis), and monkey flower (Mimulus rigins) to attract pollinators and improve aesthetics.[207] To provide robust vegetation quickly in lower stress areas, pre-vegetated coir mats were installed. Pallets of iris, sweet flag (Acorus calamus), and other species provide verdant cover on lower banks which is aesthetically pleasing.[208] The notion of a hybrid wetland area for the Windermere site is a similar feature that will integrate managed industrial uses with ecological habitat.

fig. 3.26 Devens Wetland two years after construction

The high meandering channel of the wetland, at basin two, in the Devens project used a combination of bio-engineering materials. Pre-vegetated coir mats using a mixture of sedges, iris, Canada manna-grass (Glyceria Canadensis), rice cutgrass (Leersia oryzoids) and blue-joint reed grass (Calamagrostis Canadensis) were used to develop the wetland since they are all tall clump or sod-forming species resistant to flow.[209] Three tight meanders created by bio-engineered baffles and plant mat extensions cover about two-thirds of basin two's width.[210] Soft-stem bulrush (Scirpus validus), a tall, flow resistant, and prolific native wetland plant was used on pre-vegetated mats where planting density varied, with open water pockets to maximize opportunities to create wildlife habitat.[211] Live brush layers were installed on a fiber roll tow for stabilization on the steepest parts of the berm in basin three, where high flow impact and water level fluctuation is the greatest.[212] The flow of water will also be a concern on the Windermere site, which could be managed using similar techniques to the Devens project.

The most water-loving species, like red osier dogwood (Cornus stolonifera) and buttonbush (Cephalanthus occidentalis), were placed just above water height, while drought-tolerant species, such as arrowwood viburnum (Viburnum dentatum), willows (Salix spp.) and elderberry (Sambucus canadensis), were used on the upper most rows.[213] Planned sequencing of erosion and sediment control ensured the project's success; seeding and mulching were used to minimize exposed soils.[214] Around the new basin and channel edges bio-engineered erosion controls were installed as they filled with water.[215] Herbivores such as geese are kept away using crisscrossed twine fencing.[216] Erosion control will be of particular interest on the Windermere basin site to avoid the exposure of buried materials that could pose a serious threat to site operations and potential habitat.

Bio-engineered treatment of water is a trend that shows promise in improving water quality and reclaiming ecological habitat. Using bio-engineered planting provides bank stabilization, erosion control, water quality improvement, wetland restoration, and habitat enhancement that uses living plants, and organic structural elements as basic modules.[217] Conventional barriers, like rock are held to a minimum, while sustainable native or naturalized plant communities are used as primary erosion controls.[218] Developing these processes will help in the creation of natural habitat *fig. 3.27 The banks of the mouth of Red Hill Creek and Windermere Basin use extensive rock supports — Learning from the Fort Devens Reclamation project there is opportunity to redevelop these banks with extensive reconstructed bio-engineered banks. Doing so will create habitat for plants and animals while improving water quality.*

that will have positive implications for natural systems at a regional level. On the Windermere Basin site, implementing these processes will encourage natural regeneration to reduce the need for chemical treatment at the municipal treatment plant. The design aspirations are to integrate natural site landscape with mechanical operations creating a hybrid presence for bio-engineered process.

Natural process facilitated by human intervention is able to reclaim large landscapes after abandonment from industrial occupation. Additionally, landscape reclamation can help improve the ecological quality of ecosystems. Designed biological systems can seed natural habitat that can resemble natural ecosystems after several years of succession. Tighter environmental standards require proposed site designs to have on-site detention and retention of storm water and site planning to incorporate liquid waste products.[219] Conventional treatments such as rock-lined detention basins with chain link fences are now obsolete. Contemporary water management features natural ecosystems that promote public access and wildlife habitat.[220] Biologically designed wetlands can be effective for flood storage, erosion control, and filtration of pollution in a natural manner.[221] Emerging biological treatment methods include the use of artificial reefs and structures to support aquatic plants and introduce oxygen and aeration into their ecosystems; these techniques are derived from both ecological science and environmental engineering.[222] Long-term management plans are effective in introducing aquatic life that utilizes the natural food chain and contributes to continued water quality improvements over extended periods of time.[223]

05 DESIGN HYBRIDIZATION

fig. 3.28 *Aerial of the head of Lake Ontario towards Hamilton and the Golden Horseshoe*

4.1 REGIONAL OPERATIONS

Globe Park is intended to be a regional destination within Ontario's Greater Golden Horseshoe Area. The park is located near the geographic center of this area. The Golden Horseshoe is a highly industrialized area within the Great Lakes region with a population of over 8.1 million people. The two main tourist destinations are central Toronto and Niagara Falls, Globe Park will be located in the middle of these two attractions. This regional operations analysis investigates Globe Park's position within the Greater Toronto Area and Hamilton manufacturing network; its position within Hamilton park, conservation and trail networks; and its position within Hamilton's Historic Bayfront Industrial Lands. These analyses will project the cultural, ecological, and industrial implications for Globe Park.

fig. 4.1 Aerial of Greater Golden Horseshoe Region

Greater Golden Horseshoe Area

The Greater Golden Horseshoe Area is home to 8.1 million people with an area of 31,561.57 km². There are two urban metros within the region with over half a million people including Hamilton and Toronto. The region is projected to grow to 11.5 million people by 2030. Globe Park will be developed near the geographic center of this area.

Greater Hamilton Urban Area

The Greater Hamilton Urban Area is home to 647,634 people and is located near the center of the Golden Horseshoe Area. The region has an urban area of 227.70 km². Included within this urban area are the cities of Hamilton and Burlington, and the town of Grimsby. Globe Park will maximize impact on this urban area as a regional incubator.

GLOBE PARK REGIONAL HOLARCHY

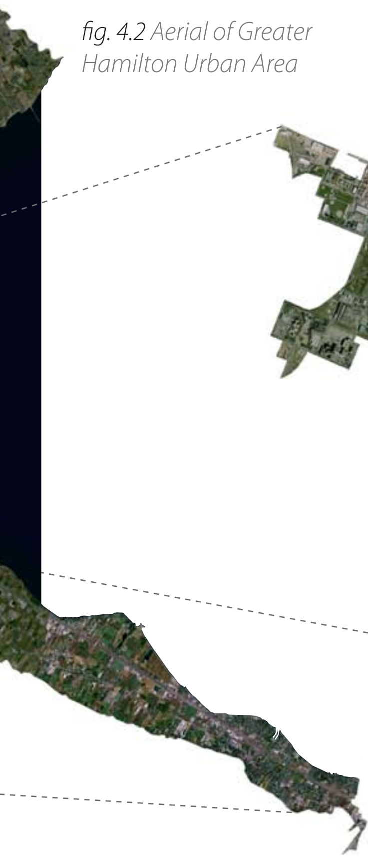


fig. 4.2 Aerial of Greater Hamilton Urban Area

fig. 4.3 Aerial of Port of Hamilton Bayfront Industrial Area

fig. 4.4 Aerial of Globe Park Study Area

Port Of Hamilton Bayfront Industrial Area

The Port of Hamilton Bayfront Industrial Area is a historic manufacturing community located on the south side of the City of Hamilton waterfront. It was one of the first historic port areas developed in the Greater Golden Horseshoe Region. The 3400 acre area manufactures 60 percent of the steel in Canada, which constitutes 7.2% of Canadian GDP. Globe Park will hybridize an area of this space into an integrated cultural, ecological, and industrial hybrid public-private amenity.

Globe Park

The Globe Hybrid Park is made up of 576 acres of underutilized public utility and industrial land. The form of its existing landscape is a result of operational processes related to urban mining, sewage treatment, port dredging, and landfill capping. These operations will feed future reformatting of this space as an integrated urban park, eco-industrial center, and landscape reclamation project.

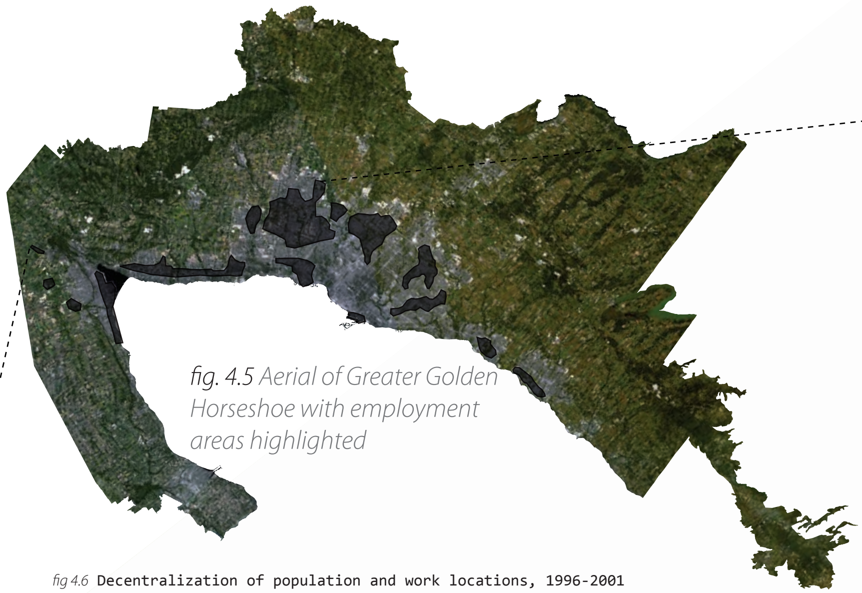


fig. 4.5 Aerial of Greater Golden Horseshoe with employment areas highlighted

fig 4.6 Decentralization of population and work locations, 1996-2001

	Average distance from place of work to city centre, 2001	% change, 1996-2001	Average distance of residences from city centre, 2001	% change, 1996-2001
Hamilton	8.2	5.4	8.9	1.8
Toronto	17.3	4.7	20.4	2.9

fig 4.7 ~~GTAH~~ Major Employment Areas

#	Employment
1 - Toronto CBD	418,000
2 - Airport-West	352,900
3 - Vaughan	141,700
4 - Markham	115,900
5 - 427-Gardiner	62,100
6 - Hamilton Port Area	57,000
7 - Don Mills	47,300
8 - Hamilton CBD	32,000
9 - 401 - 404	19,100
10 - 401- Allan Road	20,400

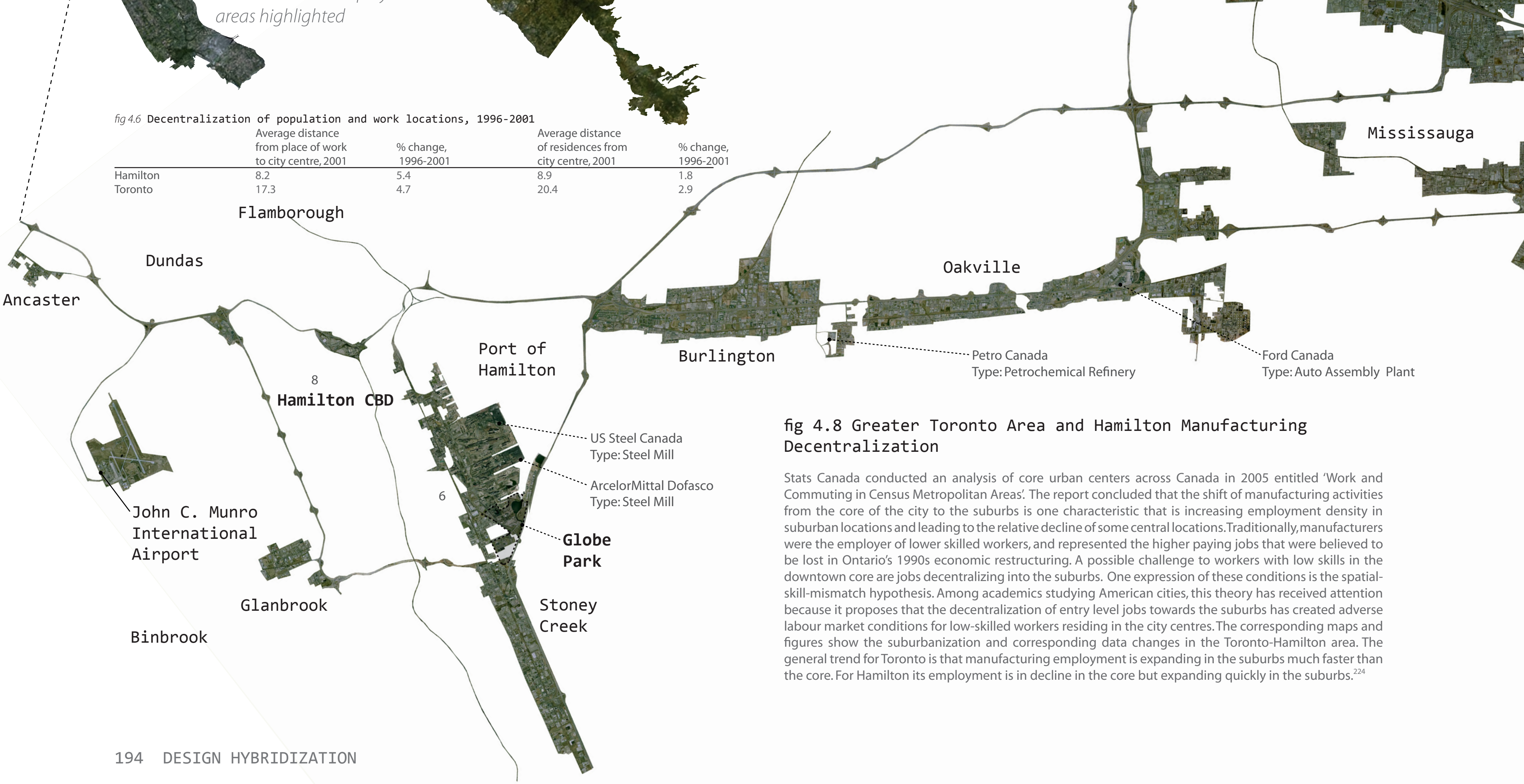


fig 4.8 Greater Toronto Area and Hamilton Manufacturing Decentralization

Stats Canada conducted an analysis of core urban centers across Canada in 2005 entitled 'Work and Commuting in Census Metropolitan Areas'. The report concluded that the shift of manufacturing activities from the core of the city to the suburbs is one characteristic that is increasing employment density in suburban locations and leading to the relative decline of some central locations. Traditionally, manufacturers were the employer of lower skilled workers, and represented the higher paying jobs that were believed to be lost in Ontario's 1990s economic restructuring. A possible challenge to workers with low skills in the downtown core are jobs decentralizing into the suburbs. One expression of these conditions is the spatial-skill-mismatch hypothesis. Among academics studying American cities, this theory has received attention because it proposes that the decentralization of entry level jobs towards the suburbs has created adverse labour market conditions for low-skilled workers residing in the city centres. The corresponding maps and figures show the suburbanization and corresponding data changes in the Toronto-Hamilton area. The general trend for Toronto is that manufacturing employment is expanding in the suburbs much faster than the core. For Hamilton its employment is in decline in the core but expanding quickly in the suburbs.[224]

GREATER TORONTO AREA AND HAMILTON MANUFACTURING NETWORK

fig 4.10 Change in manufacturing employment by distance from city centre, 1996-2001

	0 to 5 km 1996	2001	Difference in jobs	5km+ 1996	2001	Difference in jobs	Average distance 1996	2001
Hamilton	31.7	27.9	-2,300	68.3	72.1	1,900	8.8	9.4
Toronto	8.0	5.2	-9,400	92.0	94.8	43,700	20.3	22.1

fig 4.11 Number and percentage distribution of CMA workers by distance of job from city centre, 2001

	0 to 5 km	5 to 10 km	10 to 15 km	15 to 20 km	20 to 25 km	25 km	+ Employment
Hamilton	37.4	27.7	19.9	12.2	1.3	1.5	275,200
Toronto	23.1	10.2	11.8	13.2	15.6	26.2	2,461,700

fig 4.12 Change in employment by distance from city centre, 1996-2001

	0 to 5 km 1996	2001	Difference in jobs	5km+ 1996	2001	Difference in jobs	Average distance 1996	2001
Hamilton	40.0	37.4	-2,300	60.0	62.6	14,700	7.7	8.2
Toronto	23.0	23.1	72,700	77.0	77.0	237,200	16.5	17.2

fig 4.13 Commuting distance for work by CMA

	Number of commuters	Less than 5 km (%)	5 to 14.9 km (%)	15 to 24.9 km (%)	25 km + (%)	Median distance (km)
Hamilton	278,395	33.0	35.9	12.4	18.8	8.2
Toronto	2,046,610	28.9	40.1	18.0	13.0	9.2

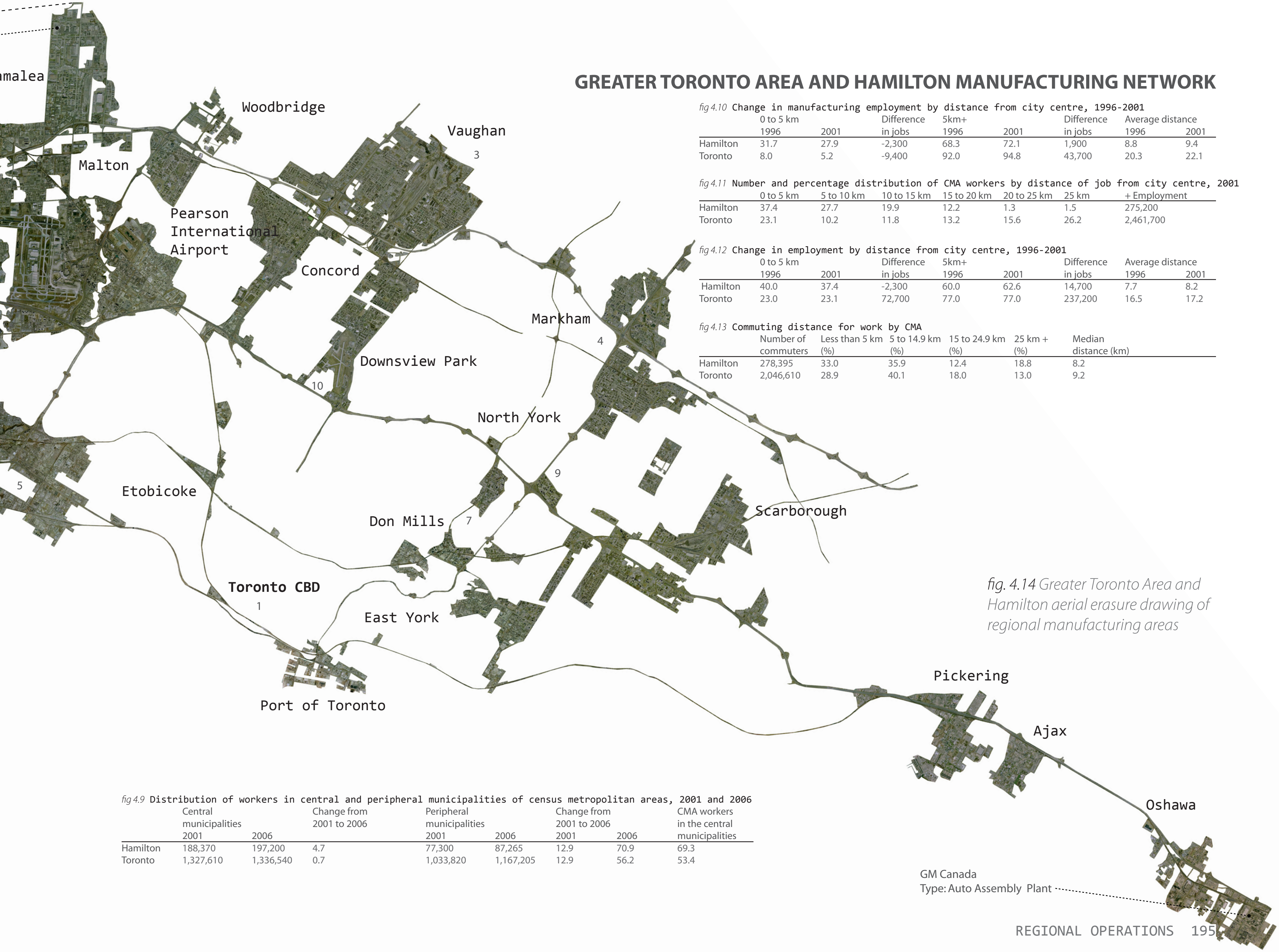
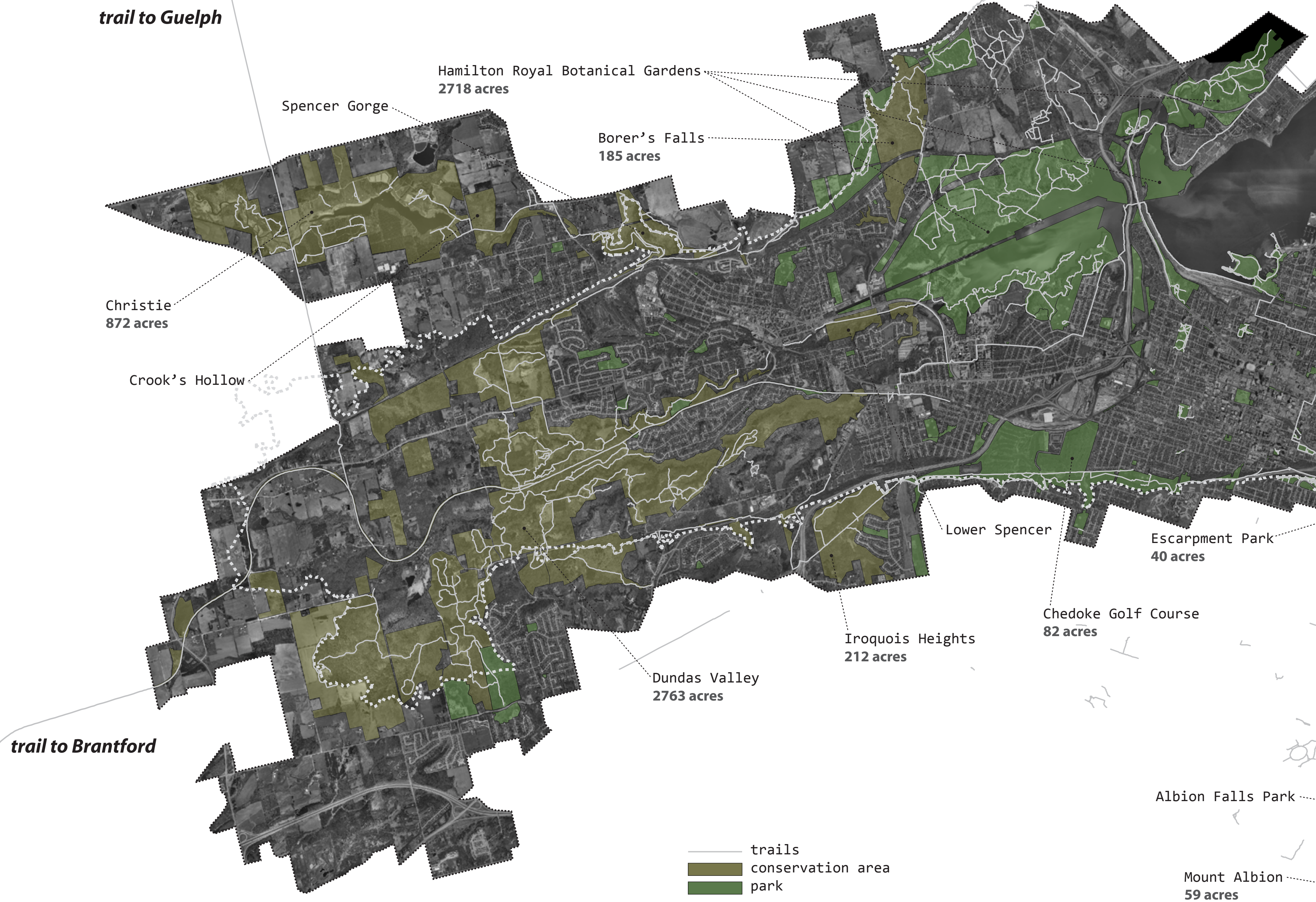


fig. 4.14 Greater Toronto Area and Hamilton aerial erasure drawing of regional manufacturing areas

fig 4.9 Distribution of workers in central and peripheral municipalities of census metropolitan areas, 2001 and 2006

	Central municipalities 2001	2006	Change from 2001 to 2006	Peripheral municipalities 2001	2006	Change from 2001 to 2006: 2001	2006	CMA workers in the central municipalities
Hamilton	188,370	197,200	4.7	77,300	87,265	12.9	70.9	69.3
Toronto	1,327,610	1,336,540	0.7	1,033,820	1,167,205	12.9	56.2	53.4


trail to Guelph
Hamilton Royal Botanical Gardens
2718 acres
Spencer Gorge
Borer's Falls
185 acres
Christie
872 acres
Crook's Hollow
Lower Spencer
Escarpment Park
40 acres
Chedoke Golf Course
82 acres
Iroquois Heights
212 acres
Dundas Valley
2763 acres
trail to Brantford
Albion Falls Park
Mount Albion
59 acres
trails
conservation area
park

GREATER HAMILTON INTEGRATED PARK, CONSERVATION, AND TRAIL NETWORK

Globe Park is located at the north east terminus of the Red Hill Creek Valley park system. As revealed by the MEM conducted in section 2.2 The area is approximately 1600 acres that is conserved natural area and parkland. There are over 600 plant species representing 22% of the native flora of Ontario. Within the valley there are over 25 mammal species including fox, coyote, deer, mink and southern flying squirrel. The Red Hill Creek Valley provides a migration corridor for at least 177 species of birds. There is nesting habitat for over 75 bird species. Within the creek is habitat for approximately 24 species of fish. Approximately half the valley is part of the Niagara Escarpment World Biosphere Reserve. In 2007 a new divided four lane Parkway was opened though the valley. The internal paths of Globe Park will be designed to interface with the region's larger network of trails.

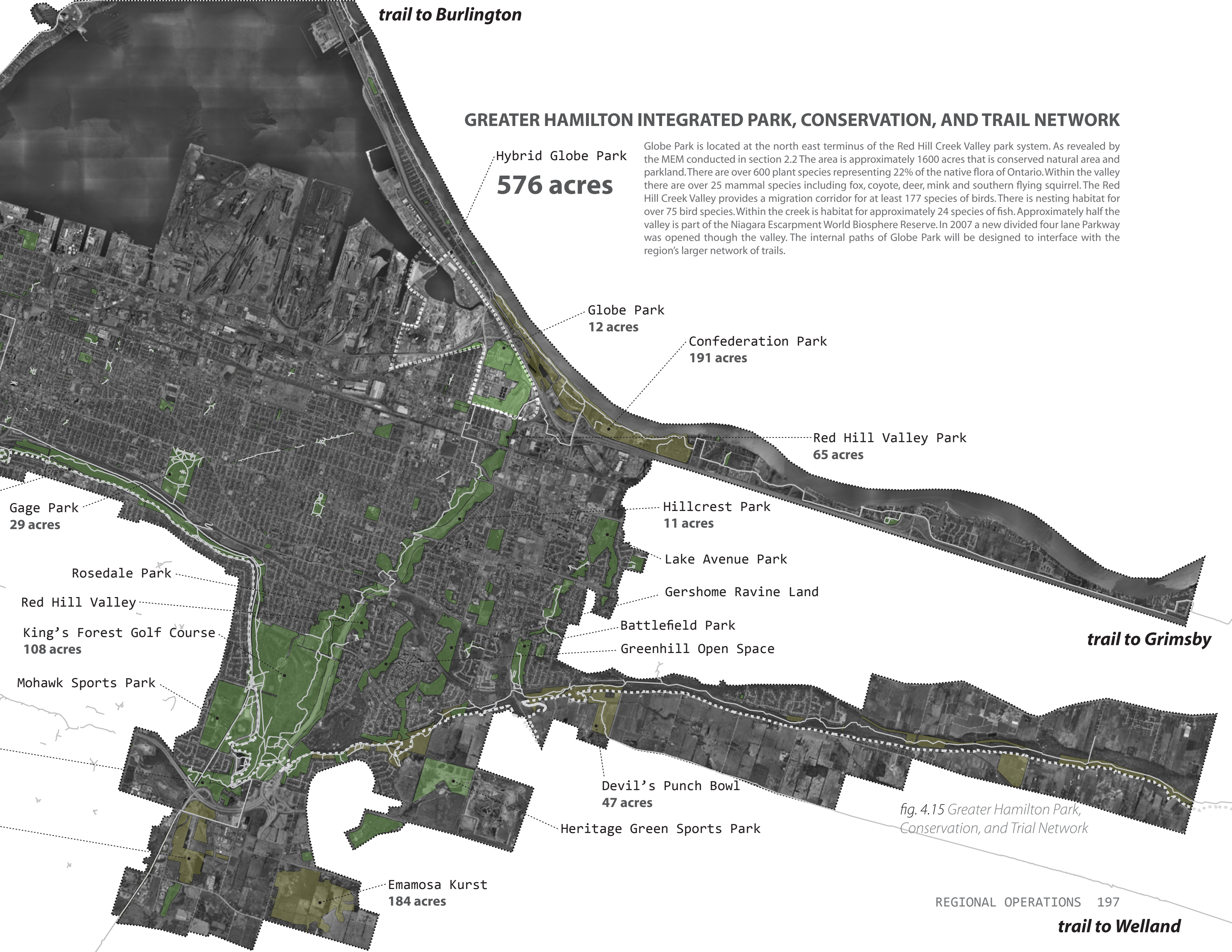


fig. 4.15 Greater Hamilton Park, Conservation, and Trial Network

HAMILTON WATERFRONT LAND USE ANALYSIS

The landuse that characterizes the majority of Hamilton's Bayfront Industrial Area is made up of heavy industry related to steel manufacturing. An area of 70 acres of 3713 acres can be described as vacant and unoccupied. A large unknown amount of the total 3713 acres is likely historically contaminated or underutilized. Globe Park is located in an area generally designated as open space, public facility, or underutilized industry.

Pier 27
- Future wharf
Confined Disposal Facility for Dredged Sediment

Pier 17
- US Steel Canada

Pier 18
- ArcelorMittal Dofasco

Pier 12
- Cargo types handled at this pier include general, liquid and dry bulk cargo such as steel coil, sheet, pipe & bars, ferro & silico manganese and containers. Ro-Ro terminal (cargo can "Roll-on and Roll-off")

Pier 11
- Cargo handling for dry and liquid bulk.

Pier 10
- general cargo such as 40-foot containers & steel coil
- active as an overseas terminal
- Mission to Seafarers
- Four covered buildings with 15,864 m² (170,760 sq ft) of enclosed storage space intermodal access for both rail and road

Pier 9
- Hamilton Navy Barracks
- HMCS Haida

Pier 8
- Ship Storage
- Canada Marine Discovery Center

Pier 7
- Royal Hamilton Yacht Club

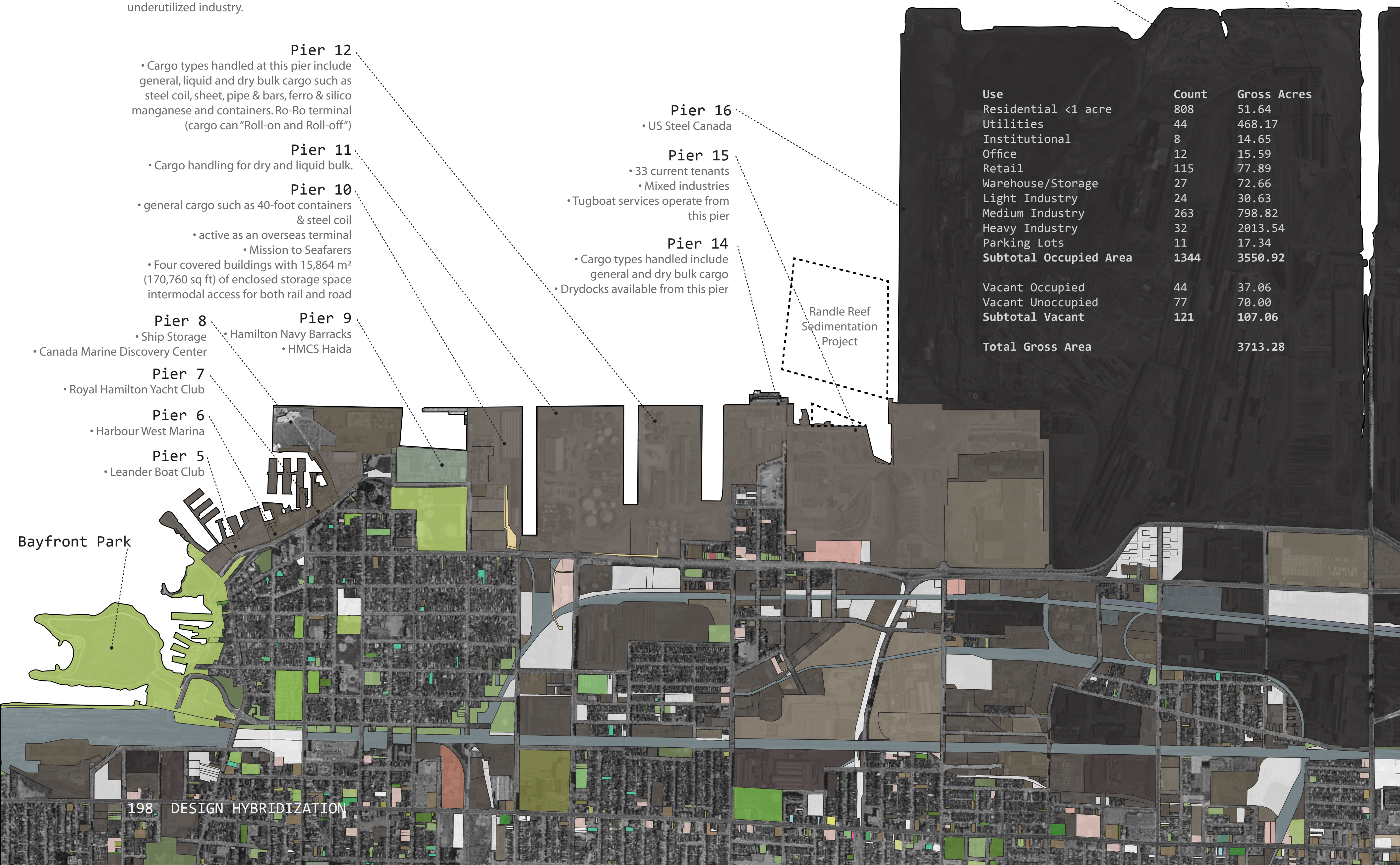
Pier 6
- Harbour West Marina

Pier 5
- Leander Boat Club

Pier 16
- US Steel Canada

Pier 15
- 33 current tenants
- Mixed industries
- Tugboat services operate from this pier

Pier 14
- Cargo types handled include general and dry bulk cargo
- Drydocks available from this pier



Use	Count	Gross Acres
Residential <1 acre	808	51.64
Utilities	44	468.17
Institutional	8	14.65
Office	12	15.59
Retail	115	77.89
Warehouse/Storage	27	72.66
Light Industry	24	30.63
Medium Industry	263	798.82
Heavy Industry	32	2013.54
Parking Lots	11	17.34
Subtotal Occupied Area	**1344**	**3550.92**
Vacant Occupied	44	37.06
Vacant Unoccupied	77	70.00
Subtotal Vacant	**121**	**107.06**
Total Gross Area		**3713.28**

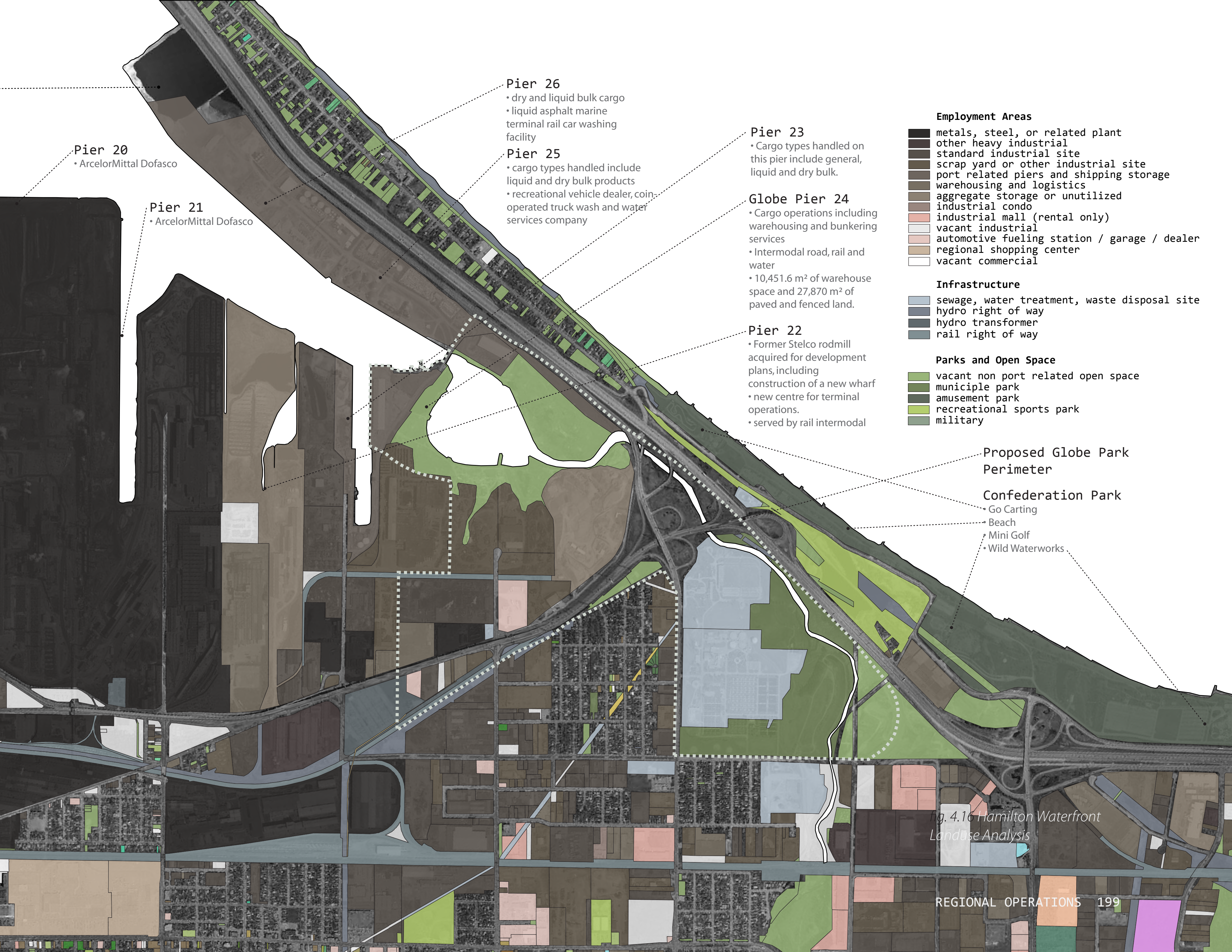


Fig. 4.16 Hamilton Waterfront Landuse Analysis

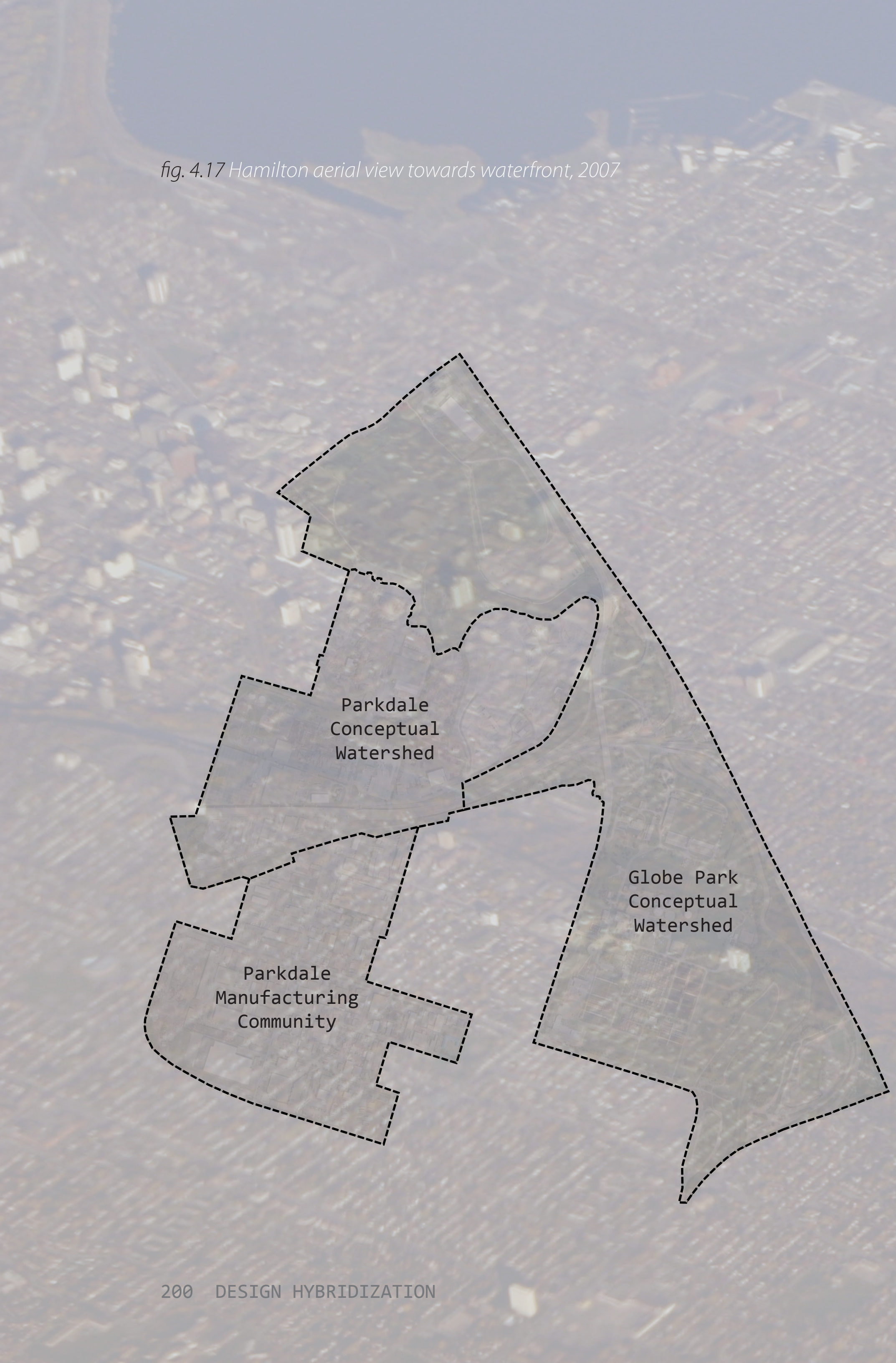


fig. 4.17 Hamilton aerial view towards waterfront, 2007

fig. 4.18 Globe Park conceptual watersheds — The study area of Globe Park is conceptualized as having three major areas that effect water flows within its perimeter. These are not watersheds in the pure ecological sense, instead they are conflated relating to a conceptual idea of watershed. These spaces are categorized based on shared commonalities between land uses. For the purpose of this analysis they are categorized as Globe Park Conceptual Watershed, Parkdale Conceptual Watershed, and Parkdale Manufacturing Community. As collective units, their operations need to be analyzed to project methods for improving ecological conditions within their common boundaries.

Globe Park Conceptual Watershed — characterized by large public open spaces that surround municipal facilities and water systems

Parkdale Conceptual Watershed — characterized by a group of heavy industrial operations that directly affect adjacent water systems

Park Manufacturing Community — characterized by light and medium industrial uses that have fringe impacts on Globe Park Conceptual Watershed and Parkdale Conceptual Watershed

4.2 PRE-PARK OPERATIONS

Globe Park is compiled by a number of sites that range in operation from public utility to underutilized industrial space. This pre-park operations analysis will investigate the layered conditions of the sites. The investigation looks for their future potential in terms of contamination, excavation, and adaptation. Various layers of surface information are revealed including material types, flows, uses, and vegetation. These qualities will inform the design of Globe Park in terms of their operative use in constructing or financing the project.

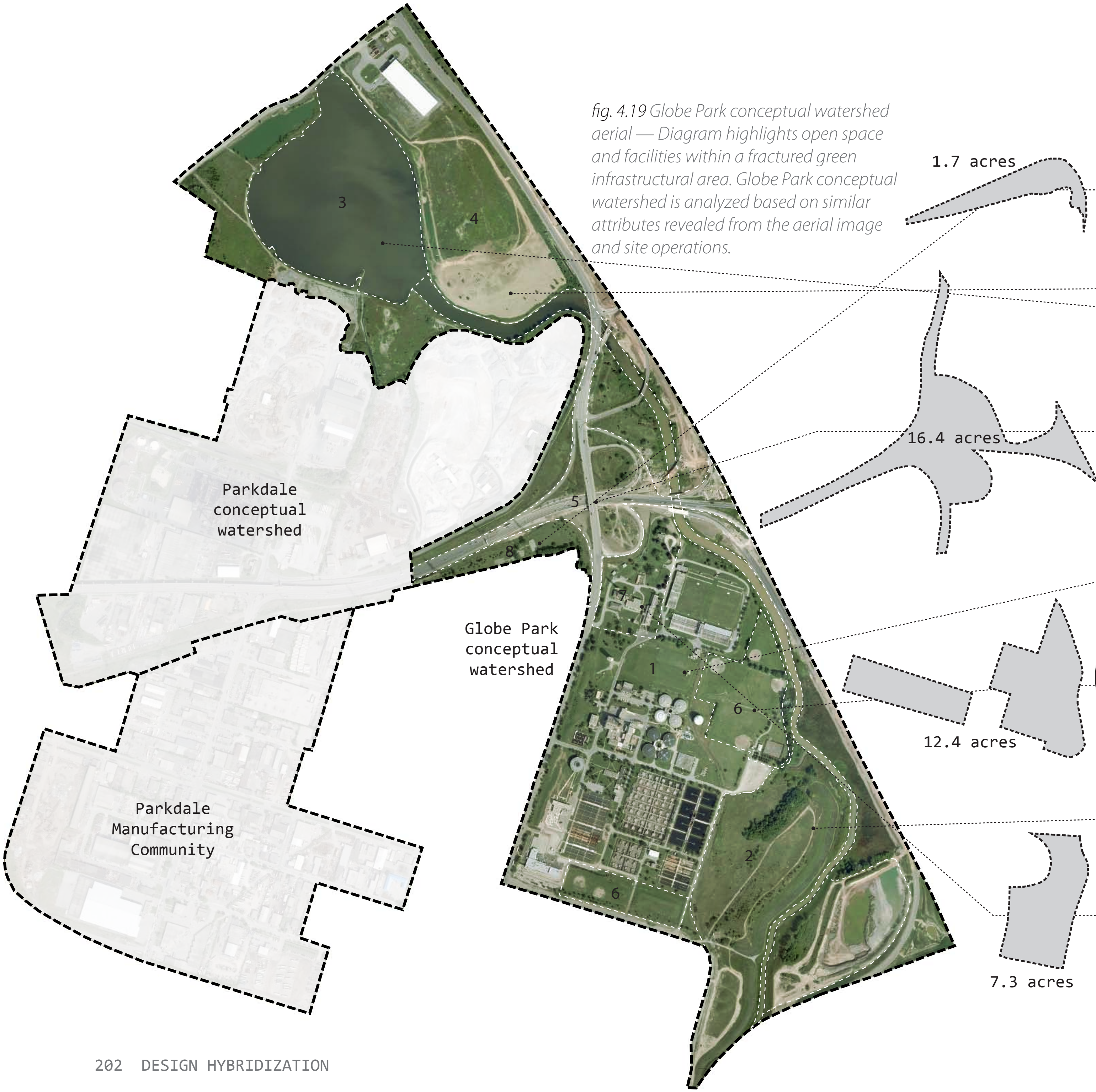


fig. 4.19 Globe Park conceptual watershed aerial — Diagram highlights open space and facilities within a fractured green infrastructural area. Globe Park conceptual watershed is analyzed based on similar attributes revealed from the aerial image and site operations.

Leaside Park

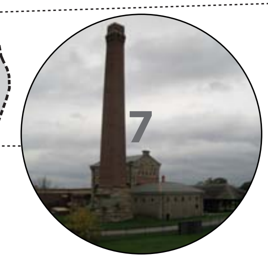
A modest strip of turf grass located to the south of the raised Burlington Street Expressway. The patch creates a small separation between industrial port operations, expressway noise, and a residential neighborhood.

Burlington Street + Woodward Avenue Interchange

An interchange that replaced Woodward Avenue's turning circle in the 60s where truck jackknifing was frequent; the interchange links three major four lane divided highways.

Globe Park

A recreational park area constructed as part of phase 2 of Hamilton's sewage treatment plant's expansion. It was intended to be a statement that public recreation and industrial waste treatment could coexist



Steam + Technology Museum

A municipal museum that highlights Hamilton's industrial history and alludes to innovations that propelled its expansion. Adjacent to the site is Hamilton's original pumping station which brought clean water from Lake Ontario. By the early 1850s Hamilton Harbour's drinking water was too polluted to drink and was associated to outbreaks of cholera.

GLOBE PARK'S EXISTING PUBLIC OPEN SPACE AND FACILITIES

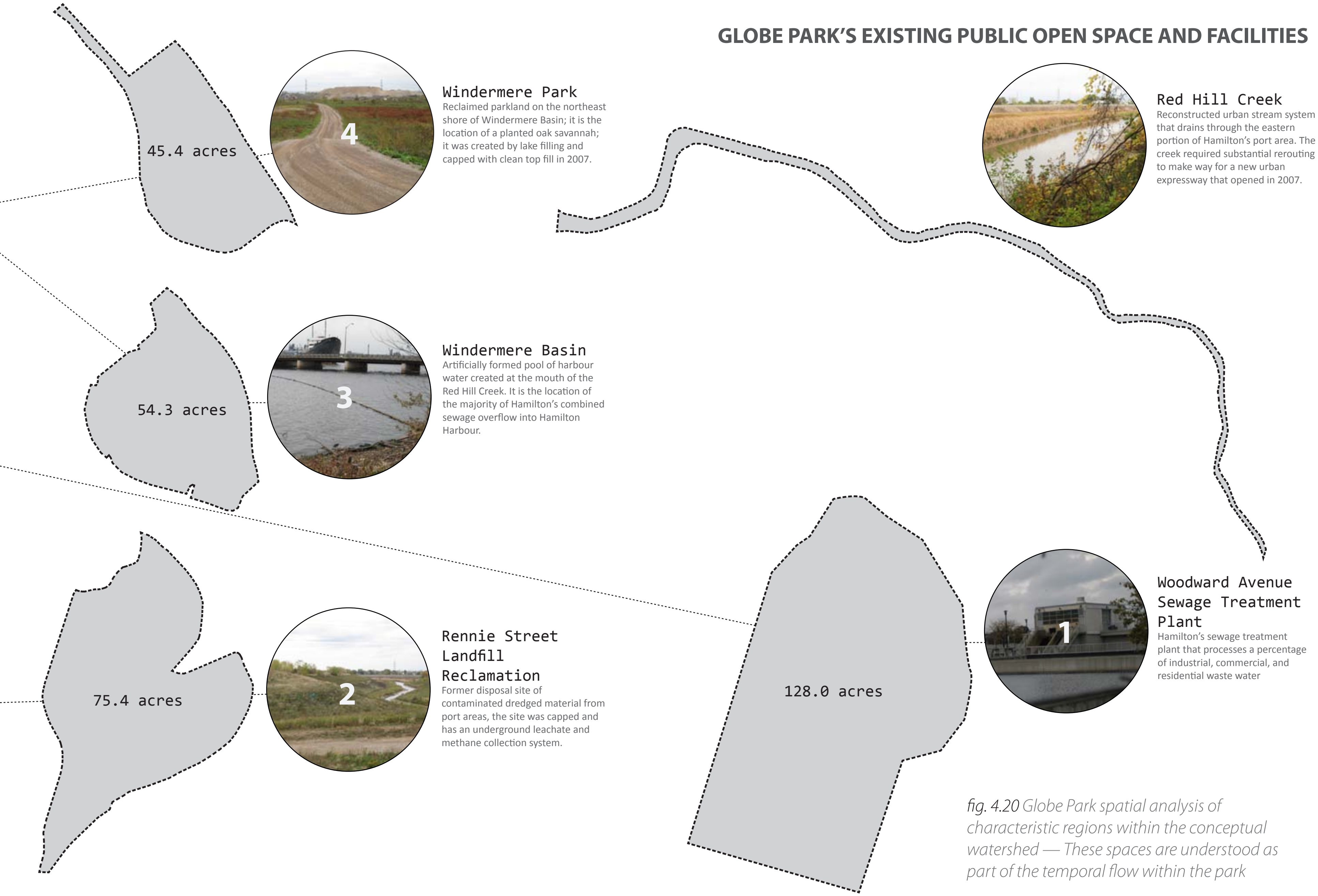


fig. 4.20 Globe Park spatial analysis of characteristic regions within the conceptual watershed — These spaces are understood as part of the temporal flow within the park

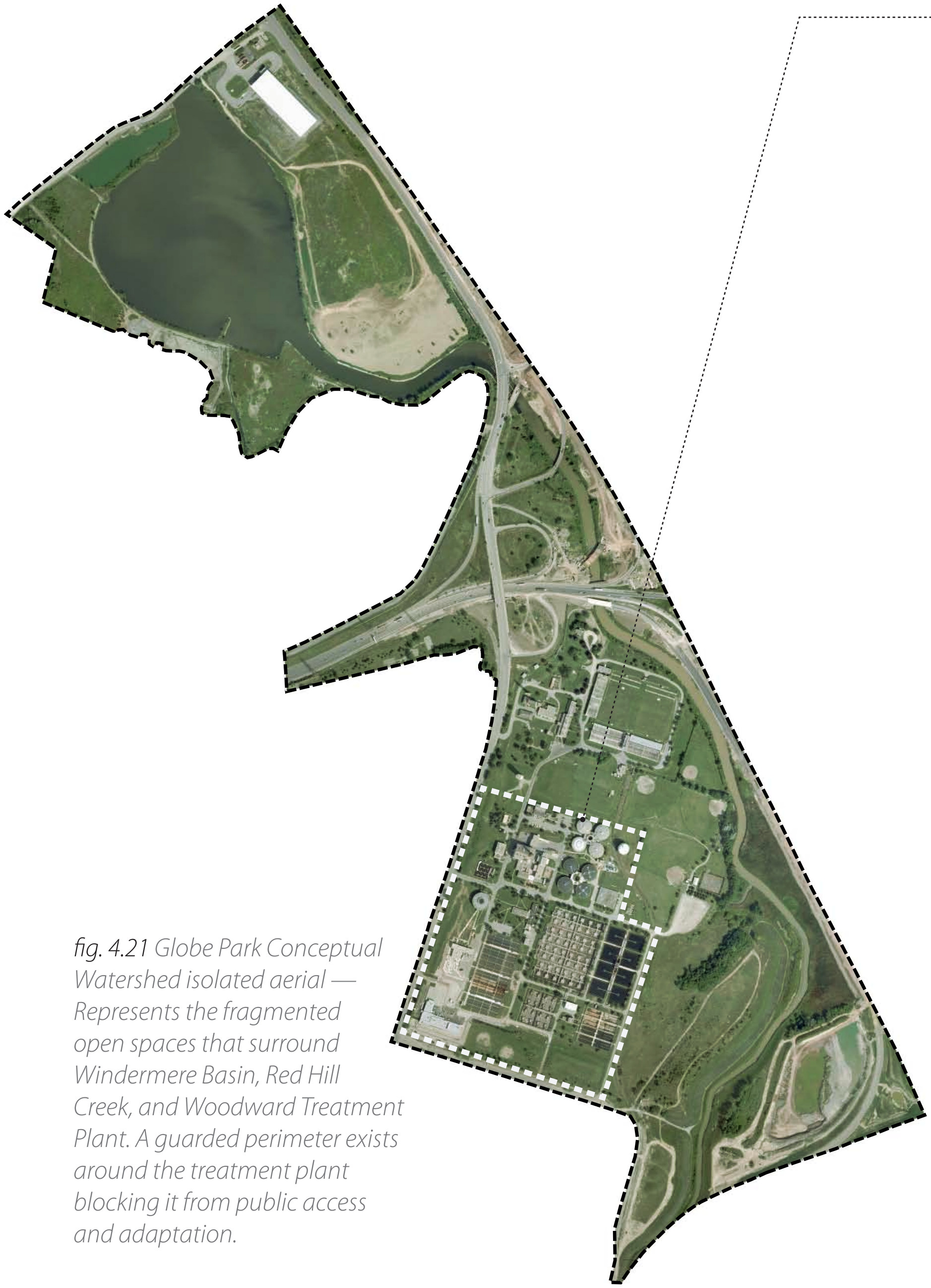


fig. 4.21 Globe Park Conceptual Watershed isolated aerial — Represents the fragmented open spaces that surround Windermere Basin, Red Hill Creek, and Woodward Treatment Plant. A guarded perimeter exists around the treatment plant blocking it from public access and adaptation.

WOODWARD AVENUE SEWAGE TREATMENT PLANT

SCALE: One of the largest and most complex sewer systems on the Great Lakes.

TYPE: Over 30% of the system is a combined sewer system. Wastewater and storm water are transported to the treatment plant in a single pipe.

Storm water can overwhelm the system and result in untreated discharges to the environment, combined sewer overflows are extremely diluted in comparison to raw sewage and all bypasses from 2005 onwards receive preliminary (removal of stones, grit, sticks) and/or primary (removal of solids) treatment prior to being discharged.

OPERATIONS: The combined sewer system is designed and approved to overflow at various points in the sewer system, or bypass the plant to prevent flooding and to protect the integrity of the treatment facilities.

Seven combined sewer overflow storage tanks have been built with two more scheduled to begin construction this year. On average, these facilities prevented 2.9 billion liters of combined sewer overflow from being discharged untreated to Lake Ontario, and only allowed approximately 1 – 3 % of all the combined wet weather flows to be discharged untreated. An upgrade of the system to the Tertiary level to reduce the loading to the Hamilton Harbour and Lake Ontario is still needed.

EXPANSION: Hamilton is projecting a 10-year infrastructure investment of over $1.5 billion. Of which, $500 million addresses aging water and sewer pipes and $1.1 billion addresses future growth, wet weather, improving the quality of effluent entering Hamilton Harbour and upgrades to the wastewater treatment plants. Over the next 5 to 10 years capital will be invested to meet the final Hamilton Harbour Remedial Action Plan targets as set out in reports filed with the International Joint Commission on Great Lakes.

fig. 4.22 Woodward Avenue Sewage Treatment Plant description

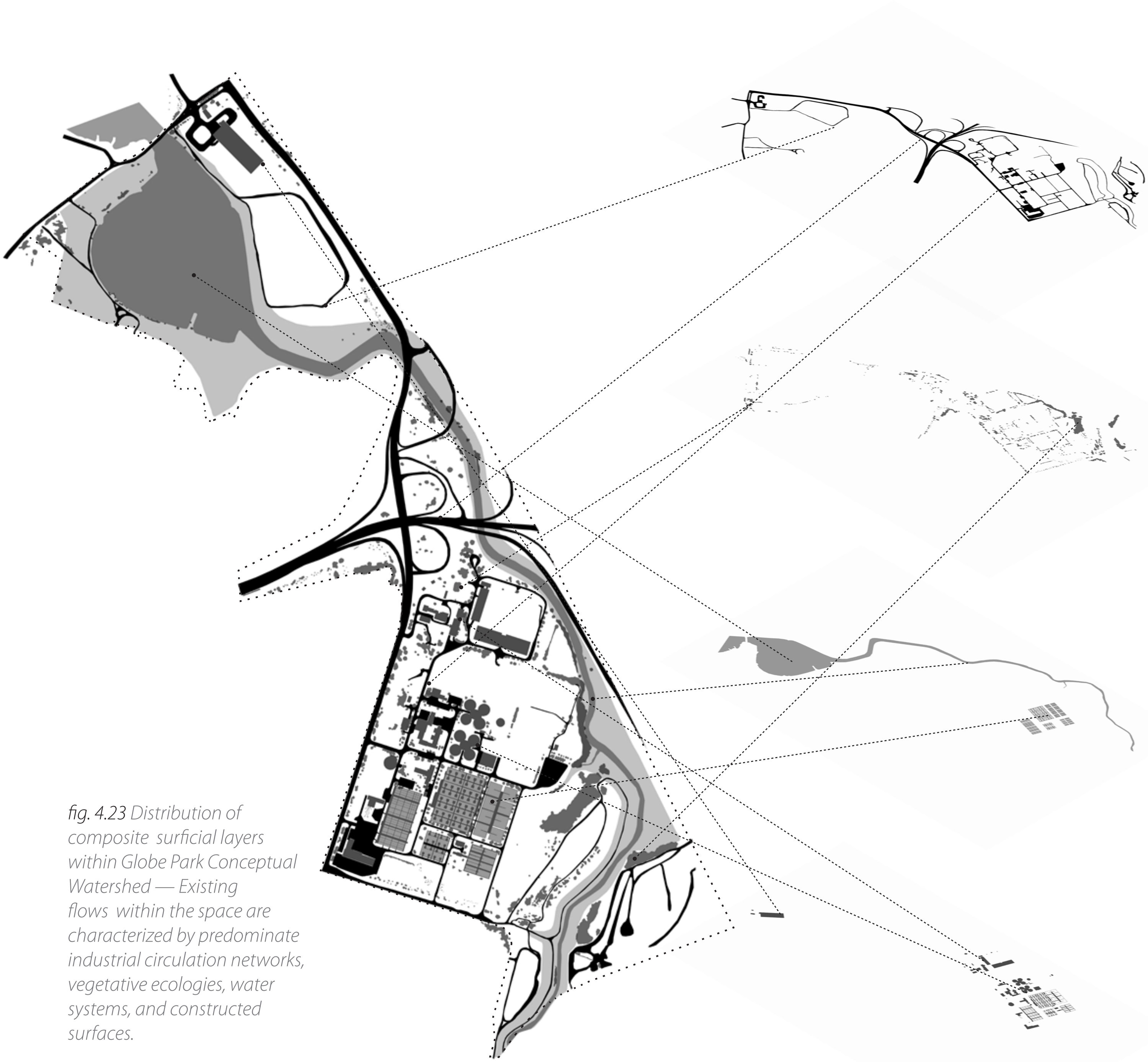


fig. 4.23 Distribution of composite surficial layers within Globe Park Conceptual Watershed — Existing flows within the space are characterized by predominate industrial circulation networks, vegetative ecologies, water systems, and constructed surfaces.

`circulation surface`

Globe Park is dominated by circulatory routes that provide site access to the Woodward Avenue Sewage Treatment Plant. Self-organizing dirt or gravel roads provide access to reclamation sites. Recreational use of circulatory routes is currently discouraged.

`vegetative surface`

Globe Park's vegetative surfaces include species that are both planted and emergent. Predominant surfaces include turf grass, broad leaf threads, grasslands, and wetlands.

`water surfaces`

All water surfaces within Globe Park are constructed. There are three different water surfaces within Globe Park including Red Hill Creek, Windermere Basin, and the Woodward Avenue Sewage Treatment Plant's cleaning pools.

`constructed surfaces`

There are four basic building types found within Globe Park. These include the treatment facilities, office and administration space, labs + warehouse hybrids, and museums.

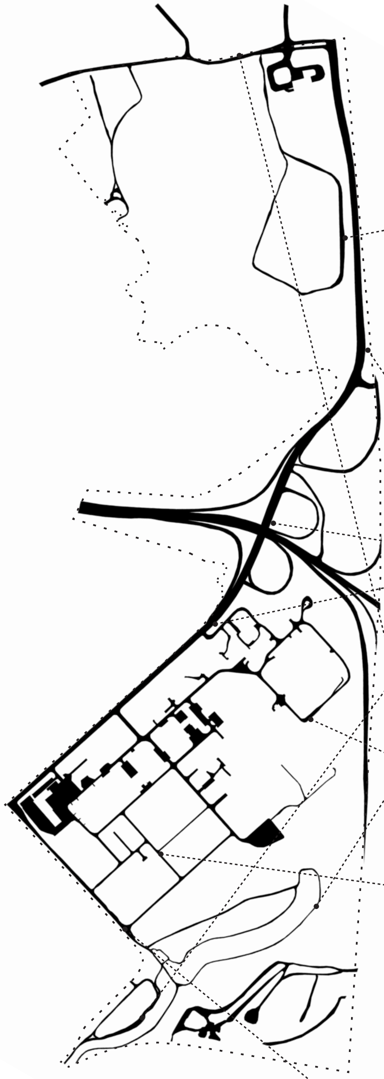
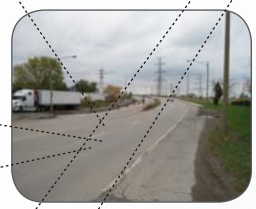


fig. 4.24 Circulation surface — a representation of constructed surfaces used for circulation

gravel + dirt pathways
operations: recreational pathways for pedestrians and bikers, access route for birders, ecologists, and planters
flows: gravel sediment travelling off of pathway and mixing with vegetation



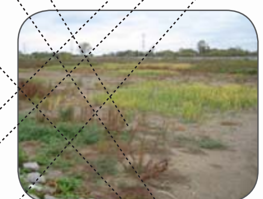
asphalt arterial roads and highways
operations: bitumen and aggregate based semi permeable surface for vehicle travel and parking,
flow: freeze thaw creates pot holes, regular maintenance, salt, break dust, petro effluent, carbon emissions, heat islands, general access to the public, no sidewalks for pedestrians

asphalt secondary roads
operations: bitumen and aggregate based semipermeable surface for secondary vehicle travel, provides access to woodward avenue sewage treatment plant internal facilities
flows: underutilized service roads, used to access facilities for maintenance and monitoring, restricted public access

asphalt road with curb side parking
operations: bitumen and aggregate based semipermeable surface for secondary vehicle travel, access for park visitors, widened areas for vehicle parking
flows: underutilized flow of vehicle parking, effluent discharges onto poorly maintained surfaces

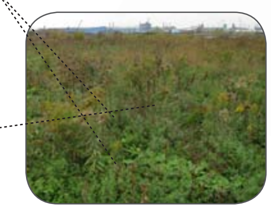
fig. 4.25 Vegetative surface — a representation of prominent planted or self-organizing vegetative surfaces

turf grass
site species: Kentucky Blue Grass, Ryegrass
operations: controls rain water flow, erosion control
flow: typically requires fertilizer, petro runoff during mowing, invasive, monoculture



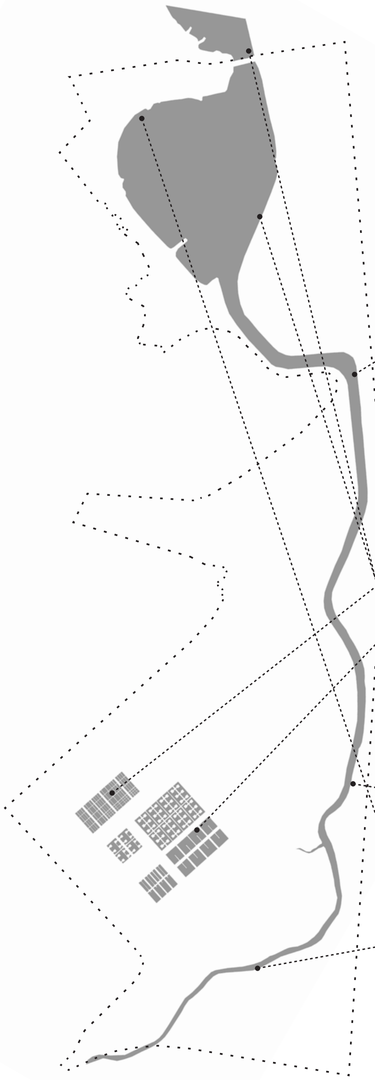
planted wetlands
species: planted bull rushes, reeds, cat tails
operations: control and collection of rain water flow, has the ability to stabilize water sediment
flows: pooling water on site adjacent to Windermere Basin, habitat for insects and animals

planted grasslands
site species: sedges, perennial grasses, fescue
operations: control surficial rain water flow, absorption of dust, improves soil quality, food source and habitat for insects and animals
flows: invasive species have the ability to overtake this territory based on nutrient levels in soil



planted broad leaf threads
site species: oak, maple, elm
operations: roots control underground rainwater flow, dust control in summer, metallic contaminate uptake in some occasions
flow: limited dust control during winter, leaf loss fertilizes undergrowth

fig. 4.26 *Water surfaces — a representation of prominent artificial or naturally adapted water systems*



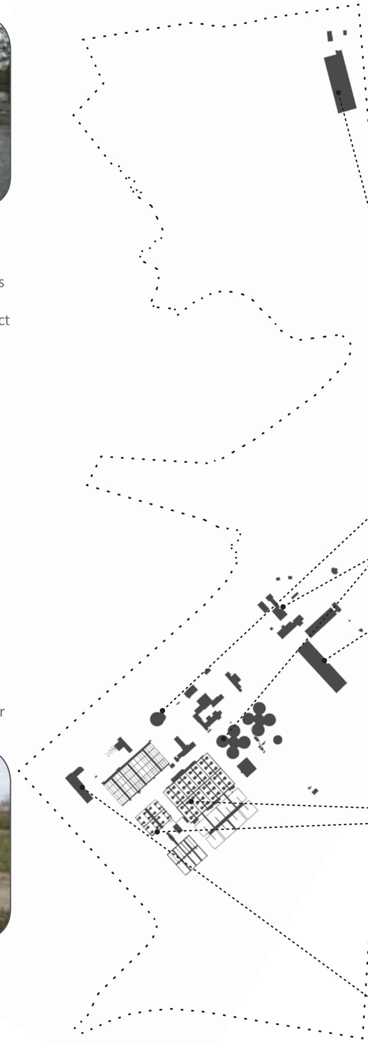
concrete creek head walls and culverts
operations: directs head of Red Hill Creek under Woodward Ave., debris and sediment buildup are heavy,
flows: concrete has heat island affect on redirected creek water

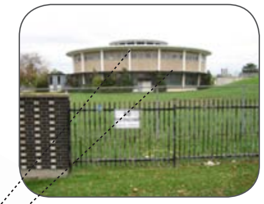
concrete sewage treatment pools
operations: pooling of contaminated waste water from the city and industry, artificial treatment procedures
flows: municipal sewage, chemical mixing and complex water treatment procedures

rerouted red hill creek watercourse
operations: reconstructed creek course using coir mats and native grass species, coir mats are anchored to soil surfaces maintaining plant roots
flows: collects water from the Red Hill Creek watershed, natural vegetation reduces soil erosion, improves water quality in rain water run off

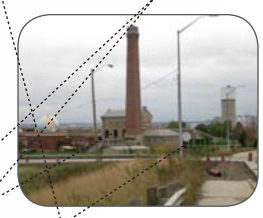
rock lined basin edge
operations: erosion control of basin edge, stabilizes bank
flows: traps debris along edge, heat island effect on basin water, prevents vegetation from growing at the edge of basin, lost opportunity to create habitat for insects and animals

fig. 4.27 *Built-up surfaces — a representation of the largest built facilities located within the Globe Park conceptual watershed*



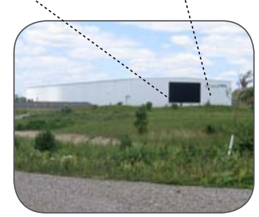


woodward ave. sewage treatment plant lab facilities
operations: administration of plant operations, information collection
flows: large trucks, passenger vehicles, researchers, information technologists, management, city staff, politicians



steam and technology museum
operations: public museum showcasing Hamilton's industrial history
flows: museum visitors, staff, patrons, maintenance

woodward ave. concrete sewage treatment pools 2
operations: concrete cell assemplies divide water, pooling of contaminated waste water from the city and industry, artificial treatment procedures
flows: heat island effects, chemical mixing, complex water treatment procedures



LEED certified warehousing and research labs
operations: single story warehouses, Steelcare: mechanical logistics of steel rolls, information collection, lab research of sewage treatment processes, Woodward Lab: research related to treatment processes
flows: large trucks, passenger vehicles, researchers, information technologists, management

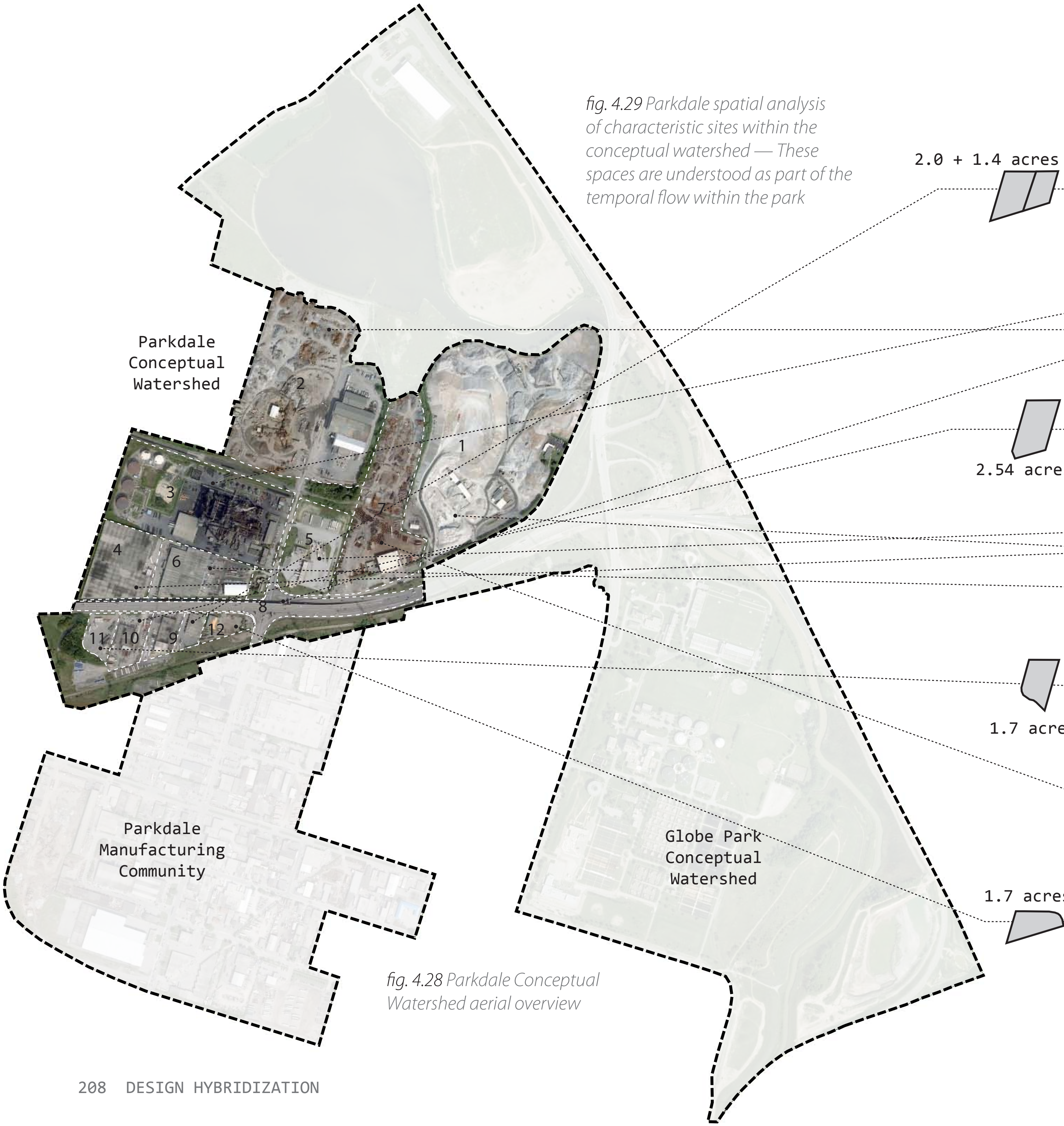
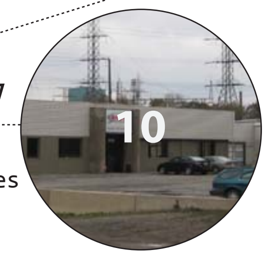


fig. 4.28 Parkdale Conceptual Watershed aerial overview

fig. 4.29 Parkdale spatial analysis of characteristic sites within the conceptual watershed — These spaces are understood as part of the temporal flow within the park

CFF Stainless Steel

use: administration offices and warehouses for stainless steel
speculation: Low grade building type constructed in the mid 60s preservation is not desirable materials such as brick could be recovered for landscape fill.

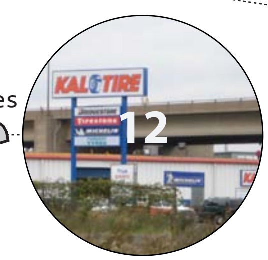


RIM Logistics

use: transportation logistics service
speculation: structure may be readapted to park operations, left as is, or reused as material for site facilities.

Pioneer Fueling Station

use: filling station for propane, gasoline, and diesel
speculation: underground fuel storage is linked in many occasions to tank leaks and site spills. Site design will need to consider excavating these tanks and their associated contaminates.



Kal Tire

use: large truck tire retail
speculation: Generic temporary structure is not worth preserving as part of park operations. Metals that compose structure may be reused in site facilities or recycled as scrap.

GLOBE PARK'S EXISTING INDUSTRIAL FACILITIES

5.0 acres

Burlington Street + Parkdale Interchange
use: elevated municipal highway
speculation: Site controls to minimize noise and effluent runoff will need consideration in close proximity to this road.

7.4 acres

Petropass Canada
use: prepaid diesel filling station
speculation: underground fuel storage is linked in many occasions to instances of tank leaks and site spills. Site design will need to consider excavating tanks and associated contaminates. Potential location of clean fuel filling station (electric or hydrogen).

7.1 acres

Samuel Manutech
use: steel trucking logistical warehouse
speculation: Single storey warehouse constructed in 70s may be adapted to remedial operations or reused in park facilities.

6.44 acres

American Iron
use: scrap metal yard
speculation: high likelihood of metallic minerals imbedded in soil site. Site will be adapted to phytoremediation biomass fields and integrated with Poscor Site 2

7.5 acres

Fluke Transportation
use: trucking logistics warehousing + distribution
speculation: Single storey warehouse constructed in 70s may be adapted to remedial operations or reused in park facilities.

21.6 acres

Columbia Chemicals
use: carbon black manufacturer
speculation: Associated ground contamination of this type of facility is linked to poly-aromatic hydrocarbons (PAH) interlaced in soil. Site will require excavation of contaminate and soil washing. Future adaption includes a combined carbon and biofuel plant after an operational overhaul.

40.4 acres

Poscor Metals
use: scrap metal yard
speculation: high likelihood of metallic minerals imbedded in soil. Site will be adapted to phytoremediation biomass fields. Existing structure on site will be adapted as seeding factory and parking area.

41.6 acres

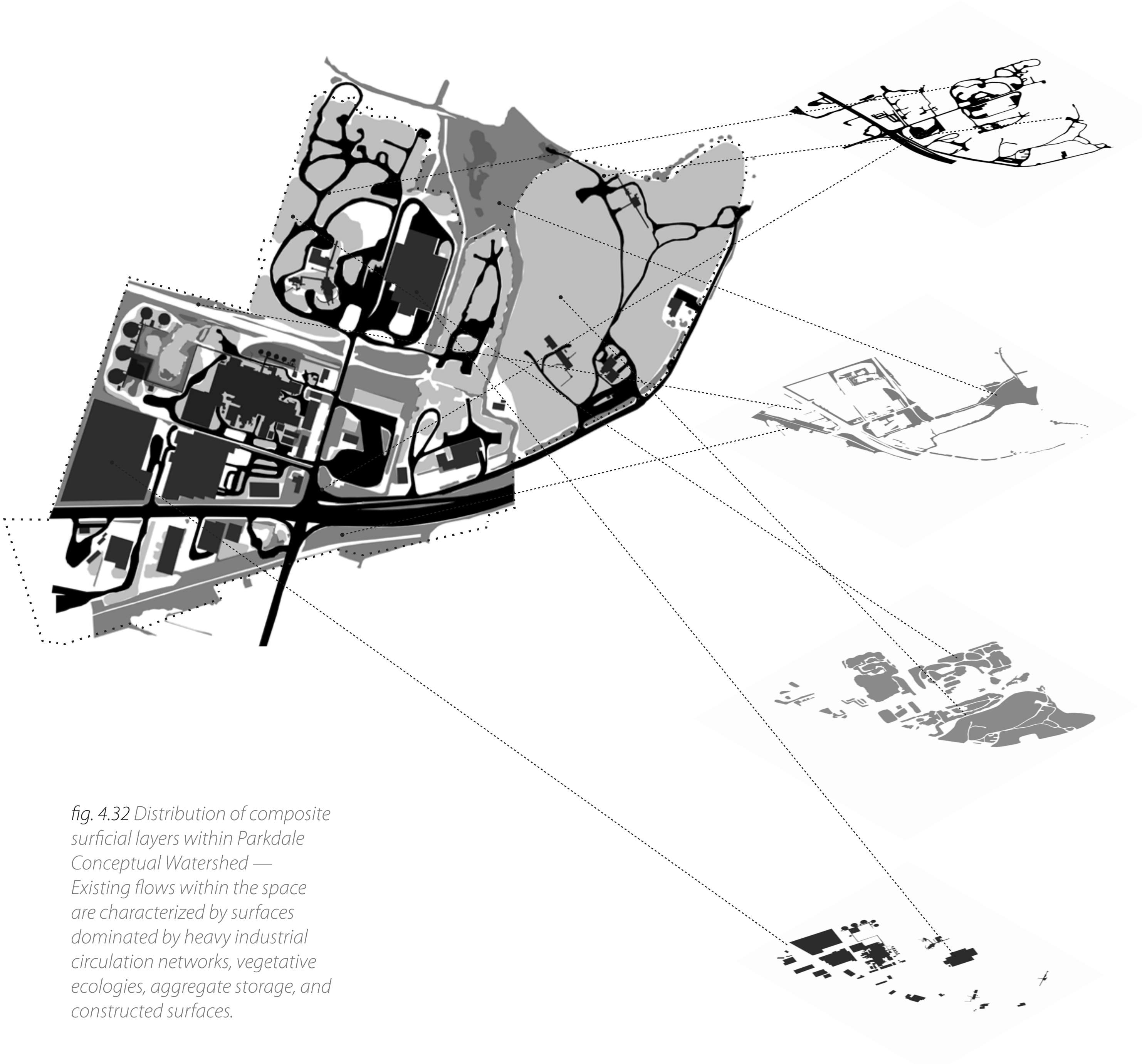
Lafarge
use: limestone slag + aggregate manufacturer
speculation: Aggregate sorting is needed within globe park to separate contaminated and large debris from soil. The aggregate site has the equipment necessary to complete this and will be adapted as a sorting lab accordingly.

HISTORIC LANDUSE

fig. 4.30 Parkdale Conceptual Watershed aerial — This area was originally occupied by residences pre 1940. The slag facility located on Windermere Road is now over 58 years old. It was the original industrial occupant of the conceptual watershed.

Directory Information	Street #	Year	
Residential Listings	38000	1940/1950	**Windermere Rd.**
Listed as “Windermere Cut-off”	--	1960	
I Waxman & Sons			
National Slag	--		
Petrofina Canada Ltd.	1575139	1970	
Waxman & Sons (scrap dealers)			
National Slag			
71/75 Waxman & Sons (scap dealers)	71/75	1980	
139 National Slag Ltd.			
Barlin Construction			
Red-D-Mix Concrete			
I W & Sons Ferrous Limited	75139	1990/2000	
National Slag. Ltd.			
Brenden Trucking, MCQ Handling	75139	2003/2004	
Hamilton Slag			
Trimac Transport Ltd.			
Lafarge Canada Inc.			
Petro Canada	15	2005	
Parkdale Not Listed	--	1940/1950	**Parkdale Ave.**
No listing north of Burlington Street	--	1960	
City of Hamilton Sewage Division	755	1970-1990	
Columbian Carbon (Can) Ltd.	755	1970	
Columbia Chemical Canada	755	1980-2003	
Poscor Mill Services Corp.	779	2005	

fig. 4.31 Parkdale Conceptual Watershed historical land use chart, 1940 - 2005



circulation surfaces

The existing site of Globe park is predominantly circulated using five road types including: gravel roads, concrete highways, dirt paths, gravel roads, and gravel pathways.

vegetative surfaces

Globe Park has five predominant vegetative types including turf grass, planted coniferous, planted grasslands, planted deciduous, and emergent grasslands. All vegetation has been created or altered as a result of direct human intervention.

aggregate surfaces

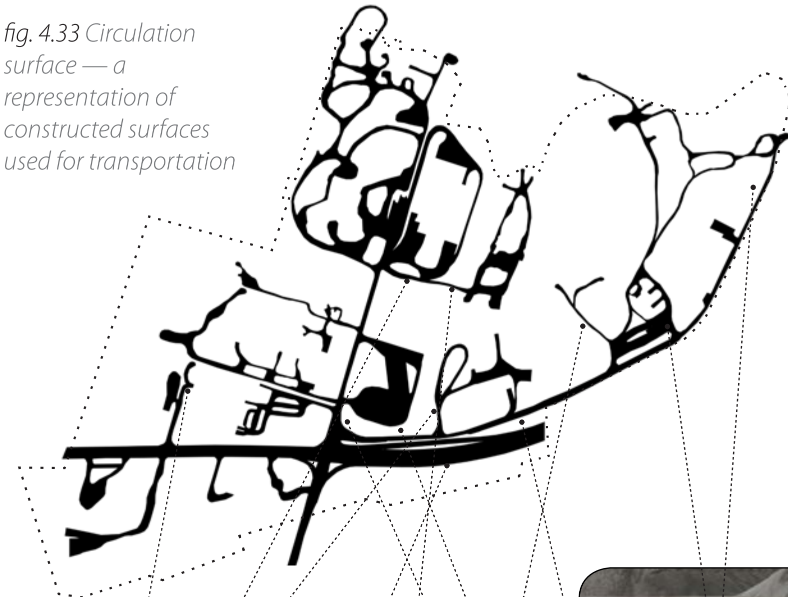
Globe Park is an intense site for the disposal of metallic and non-metallic minerals. The following are the most common stock piled materials: shredded metals, metal rolls, scrap metals, limestone slag and aggregate, and complex carbon compounds.

constructed surfaces

The existing site has five predominant assembly types including: single story warehouses, large equipment, multistory offices, industrial complexes, and bulk liquid containers.

fig. 4.32 Distribution of composite surficial layers within Parkdale Conceptual Watershed — Existing flows within the space are characterized by surfaces dominated by heavy industrial circulation networks, vegetative ecologies, aggregate storage, and constructed surfaces.

fig. 4.33 Circulation surface — a representation of constructed surfaces used for transportation



gravel road
operations: permeable surface for vehicle travel and parking
flow: sediment runoff of gravel and lime, absorption of vehicle effluents, dust falloff, low traction for vehicles

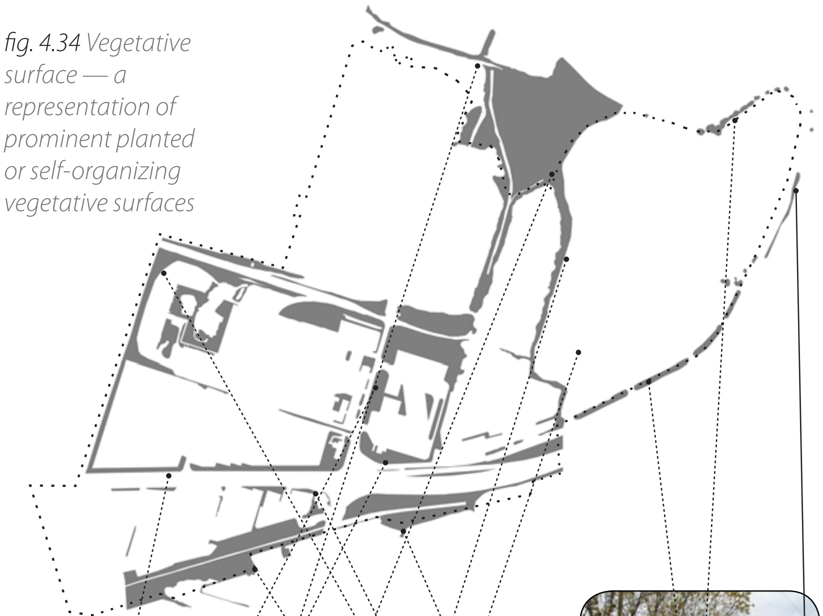
gravel pathway
operations: permeable surface for pedestrians and cyclists
flow: sediment runoff of gravel, gravel displaced into adjacent vegetation, low traction for cyclists

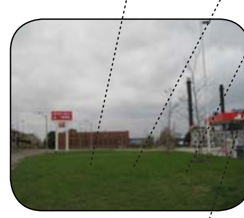
concrete highway
operations: non permeable surface for transportation trucks and passenger vehicles
flow: salt, break dust, petro effluent, carbon emissions

dirt pathways
operations: permeable surface for large equipment to access aggregate
flow: constantly changing area and route, dust outflow, water sedimentation, erosion, flexible surface

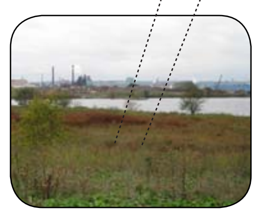
asphalt road
operations: bitumen and aggregate based semi permeable surface for vehicle travel and parking
flow: freeze thaw creates pot holes, regular maintenance, salt, break dust, petro effluent, carbon emissions, heat islands

fig. 4.34 Vegetative surface — a representation of prominent planted or self-organizing vegetative surfaces

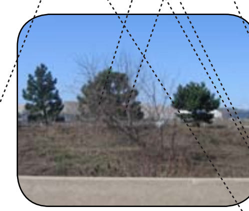




turf grass
site species: Kentucky Blue Grass, Ryegrass
operations: controls rain water flow, erosion control
flow: typically requires fertilizer, petro runoff during mowing, invasive, monoculture



planted grasslands
site species: perennial grasses, fescue
operations: control surficial rain water flow, absorption of dust, improves soil quality, food source and habitat for insects and animals



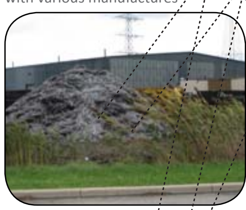
coniferous plantings
site species: spruce, pine
operations: roots control underground rainwater flow, dust control in summer and winter
flow: acidic needles impair undergrowth, soil erosion where undergrowth is limited

deciduous plantings
site species: poplar, willow
operations: roots control underground rainwater flow, dust control in summer, metallic contaminate uptake
flow: limited dust control during winter, leaf loss fertilizes undergrowth

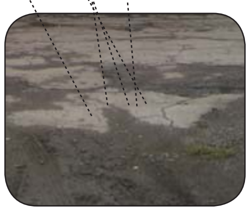
emergent grasslands
site species: burdock, crab grasses, thistle, fleabane, ragweed
operations: cover vacant lots
flow: invasive

fig. 4.35 Aggregate surfaces — a representation of prominent heavily manufactured industrial surfaces

shredded metals
operations: piles created by shredding mechanical equipment and vehicles, the material includes metal and various plastic, fabric, and composite material
flows: material is piled on site after shredding, it is sorted using magnetic equipment and exchanged with various manufactures



metal rolls
operations: used to store imported and exported metal rolls, rolls are stacked on site to reduce surface area
flows: oxidation causes iron to runoff and mix with soil



asphalt capping
operations: used to cap past contamination of historic ground contamination, maintains surface for vehicle and machine transportation
flows: under the surface contamination is expected to be leaching into underground water and soil flows

scrap metals
operations: on site retention of recovered or recycled metals, copper, steel, aluminum,
flows: materials are disposed of in large heaps, associated effluents runoffs have high traces of metal particulates, materials are moving using large machines

aggregate piles
operations: on site retention of limestone aggregate used in associated concrete, slag, and aggregate manufacture
flows: aggregate piles are serviced by a flow of large dump trucks and loader machines

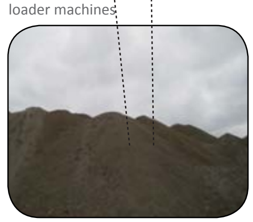
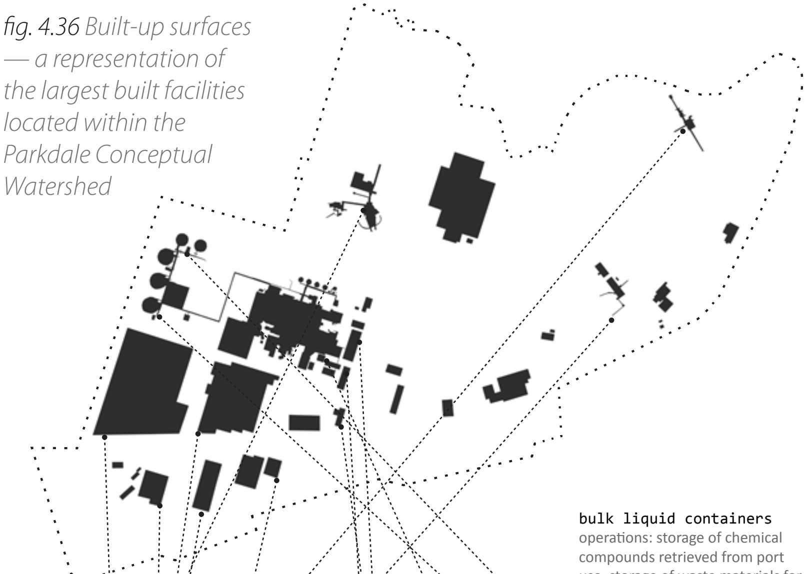


fig. 4.36 Built-up surfaces — a representation of the largest built facilities located within the Parkdale Conceptual Watershed

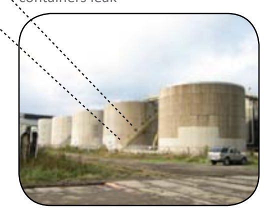


single story warehouse
operations: material collection and sorting for imported and exported manufactured goods, one story in height, disposal of goods for protection form the elements
flows: retrieval of goods from trucks, turning surface for large trucks, interior surface for fork lifts or similar equipment

large installed equipment
operations: grinding recovered recyclables and mined material such as metal, limestone, vehicles
flows: large disposal piles discharge effluent into the surrounding environment including heavy metals and excessive aggregate

multistory office/warehouse
operations: tertiary work for associated industrial facilities, information collection on material flows and finances, two or more stories in height
flows: office personnel and middle management

bulk liquid containers
operations: storage of chemical compounds retrieved from port use, storage of waste materials for disposal
flows: chemical contamination near intake points, contamination where containers leak



industrial complex
operations: manufacture of chemical compounds used in various industrial production systems, carbon black, steel, coke, slag
flows: intake of primary compounds, intense mixing processes, carbon and noxious emissions fallout, soil contamination and run off near facilities

SPECULATIVE REMEDIAL OPERATIONS

The current state of contamination for the heavy manufacturing area to the south of Windermere Basin is largely unknown. The following speculates upon existing site uses that are typically linked to certain types of contaminate. The chart on the adjacent page suggests typical methods for treating these soil types. During the early stages of park development the most appropriate remedial processes will be linked to discovered contaminates. A team of experts will analyze major contamination conditions. When more information is uncovered remedial activity will generally organize according to the staging process developed in the following sections.

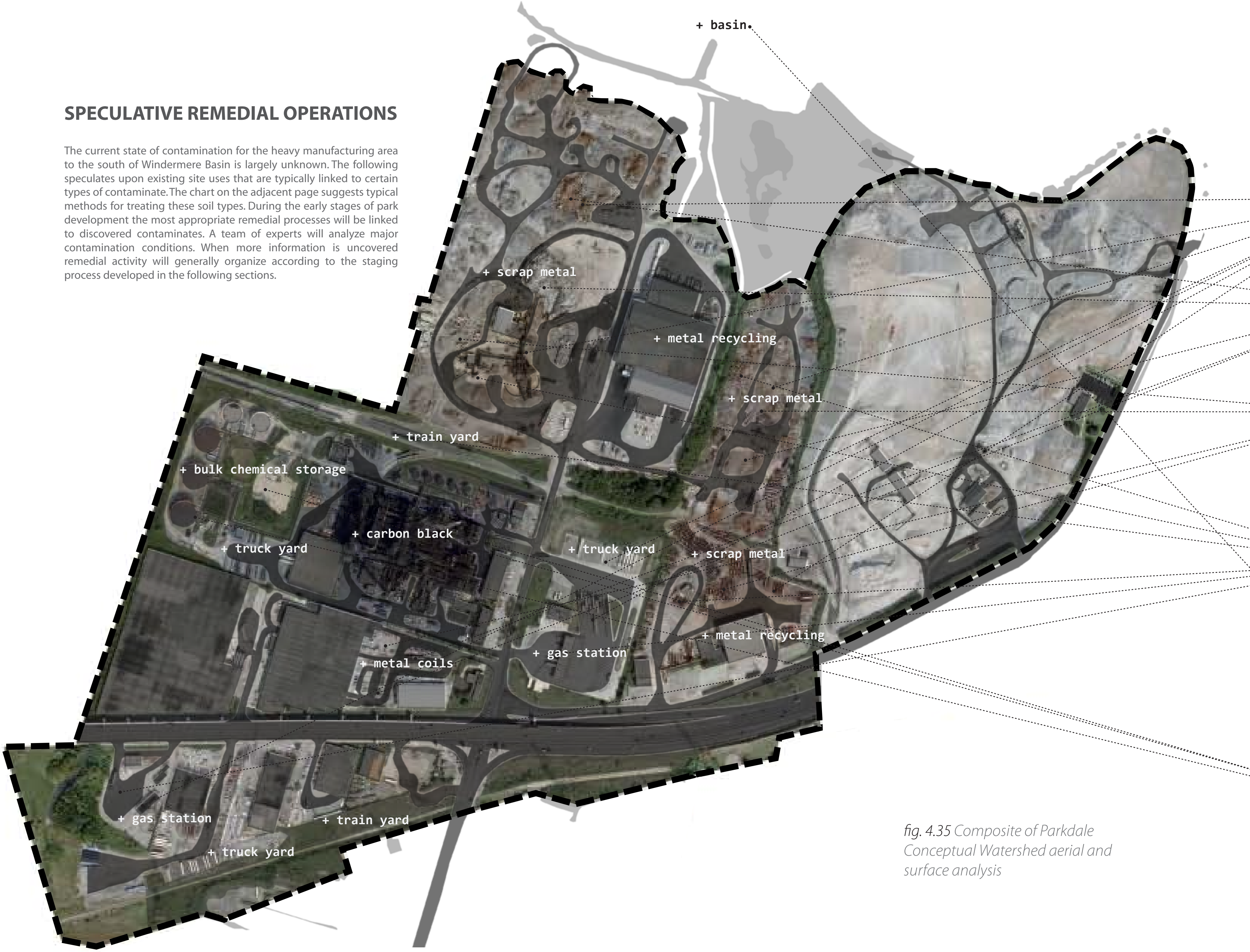


fig. 4.35 *Composite of Parkdale Conceptual Watershed aerial and surface analysis*

PRIMARY REMEDIAL TECHNOLOGIES BY CONTAMINANT AND APPLICATION

CONTAMINANT	IN-SITU TECHNOLOGIES	EX-SITU TECHNOLOGIES
Petroleum Hydrocarbons Found in: gas stations, military bases, scrap yards, construction, truck/train yards, energy extraction operations/ drilling sites, abandoned manufacturing sites, etc.	natural attenuation surface capping/ encapsulation biodegradation bioventing soil vapour extraction	evacuation and landfill disposal solid phase biological treatment slurry phase biological treatment soil washing low temperature thermal desorption
Heavy Metals Found in: mine sties, metals processing and manufacture industries, scrap yards, etc.	solidification/ stabilization bioremediation phytoremediation soil vapour extraction air sparging thermal treatment	evacuation and landfill disposal low temperature thermal desorption soil washing
Non-Halogenated Volatiles and Semi-Volatiles Found in: gas stations, military bases, scrap yards, truck/train yards, dry cleaners, construction sites, energy extraction operations/drilling sites, etc.	natural attenuation surface capping/ encapsulation biodegradation bioventing	evacuation and landfill disposal incineration soil washing solid phase biological treatment slurry phase biological treatment chemical extraction low temperature thermal desorption high temperature thermal desorption
Halogenated Volatiles and Semi-Volatiles Found in: gas stations, military bases, scrap yards, truck/train yards, construction sites, dry cleaners, energy extraction operations/ drilling sites, etc.	surface capping soil vapour extraction	evacuation and landfill disposal soil washing dehalogenation chemical extraction low temperature thermal desorption high temperature thermal desorption
Pesticides Found in: agriculture, forestry, pesticide storage facilities, etc.	surface capping/ encapsulation	evacuation and landfill disposal incineration dehalogenation chemical extraction high temperature thermal desorption
Inorganics Found in: Pulp and paper mills, agriculture, snow dumps, manufacturing, construction, scrap yards, chemicals processing, etc.	surface capping/ encapsulation solidification/stabilization phytoremediation	evacuation and landfill disposal vitrification soil washing chemical reduction/ oxidation

fig. 4.36 Technical list of potential remedial techniques deployed in the staging of Globe Park — A best practice methodology will be established as historic contaminates are uncovered. These activities will be self-organizing and established by professionals managing these operations. As the park, evolves design will adjust to consider new organization and potential outcomes of this activity.

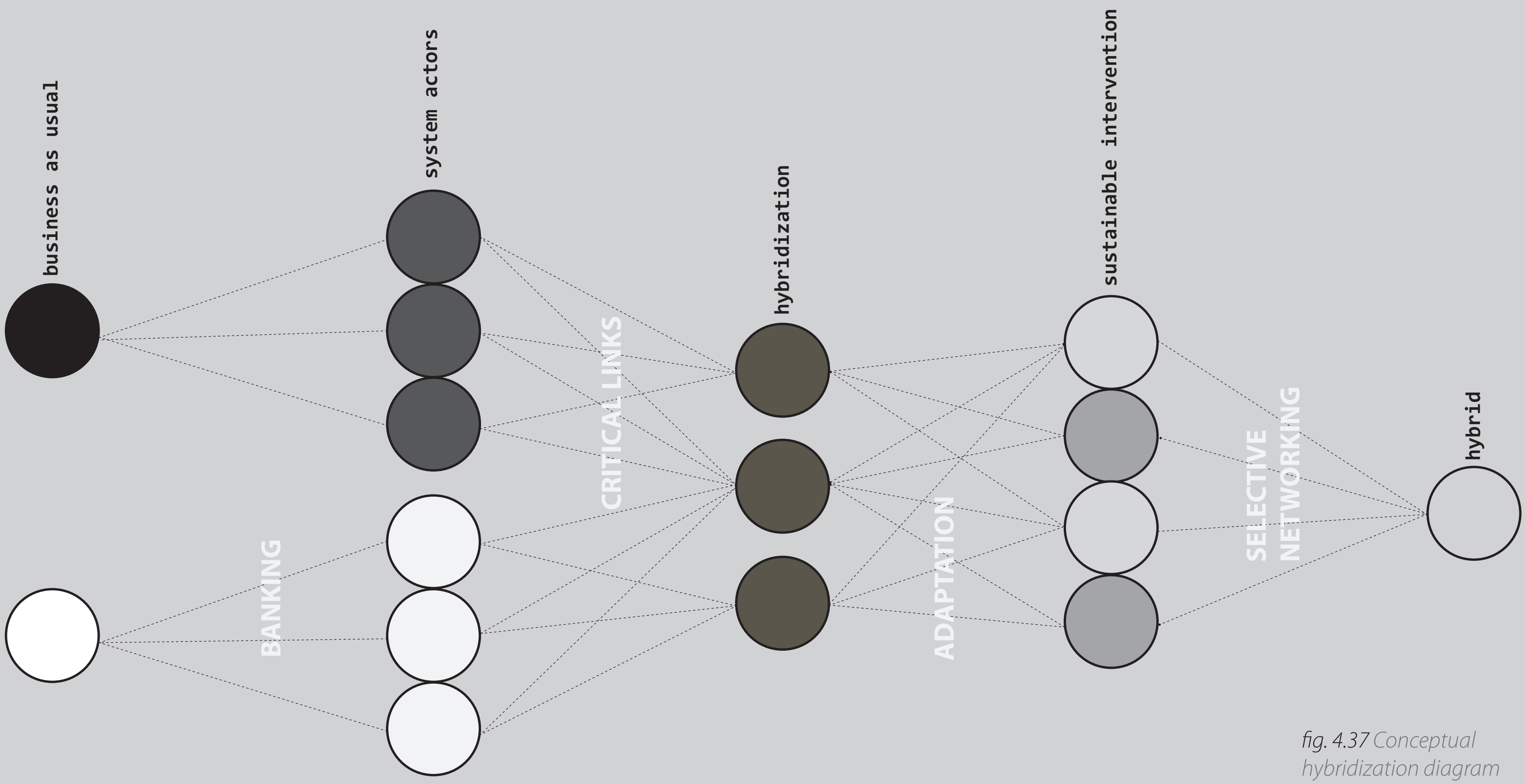


fig. 4.37 Conceptual hybridization diagram

4.3 PARK HYBRIDIZATION PROCESS

Globe Park is influenced by theoretical frameworks that originate from complex systems ecology and industrial ecology. This framework sees the park as an iterative ecological process that facilitates flows of cultural, ecological, and industrial process. The physical manifestation of this process is what creates the experience of the park. Globe Park is not limited by preprogrammed phasing, instead it is a staging process that facilitates several key attractors. These attractors will evolve over time following technical doctrines determined by internal consensus. Globe Park is a temporal process, as the park works harder, so do its performative processes. The more involvement from regional flows of visitation, the more intense the spatial deployment and urgency for self-manufacture Globe Park exerts. The following are terms of reference to describe the hybridization process:

adaptation — the direct consequence of hybridization and a form of spatial intake

banking — describes the analysis and collection of key properties within the perimeter

business as usual — describes the current spatial state that propagates mediocrity

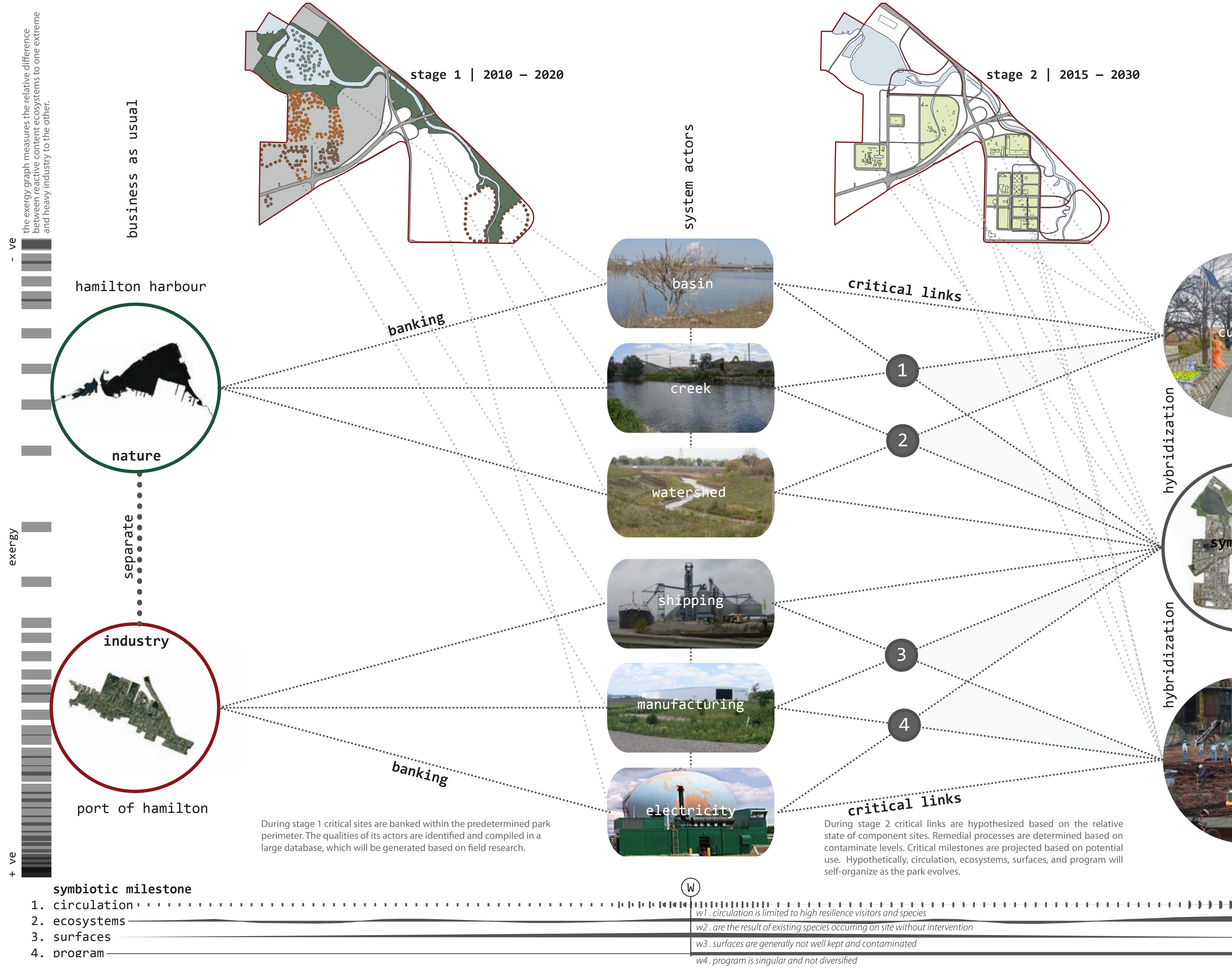
critical links — the critical innovations in technology or organization that will facilitate hybridization

hybrid — the collective self-organization or desirable state of the park as determined by consensus

hybridization — the process of change as a result of critical links as the space reorders itself

selective networking — the internal organizations that facilitate self-organization

sustainable intervention — the interventions that attempt directing the park's temporal processes in one direction or another



During stage 1 critical sites are banked within the predetermined park perimeter. The qualities of its actors are identified and compiled in a large database, which will be generated based on field research.

During stage 2 critical links are hypothesized based on the relative state of component sites. Remedial processes are determined based on contaminate levels. Critical milestones are projected based on potential use. Hypothetically, circulation, ecosystems, surfaces, and program will self-organize as the park evolves.

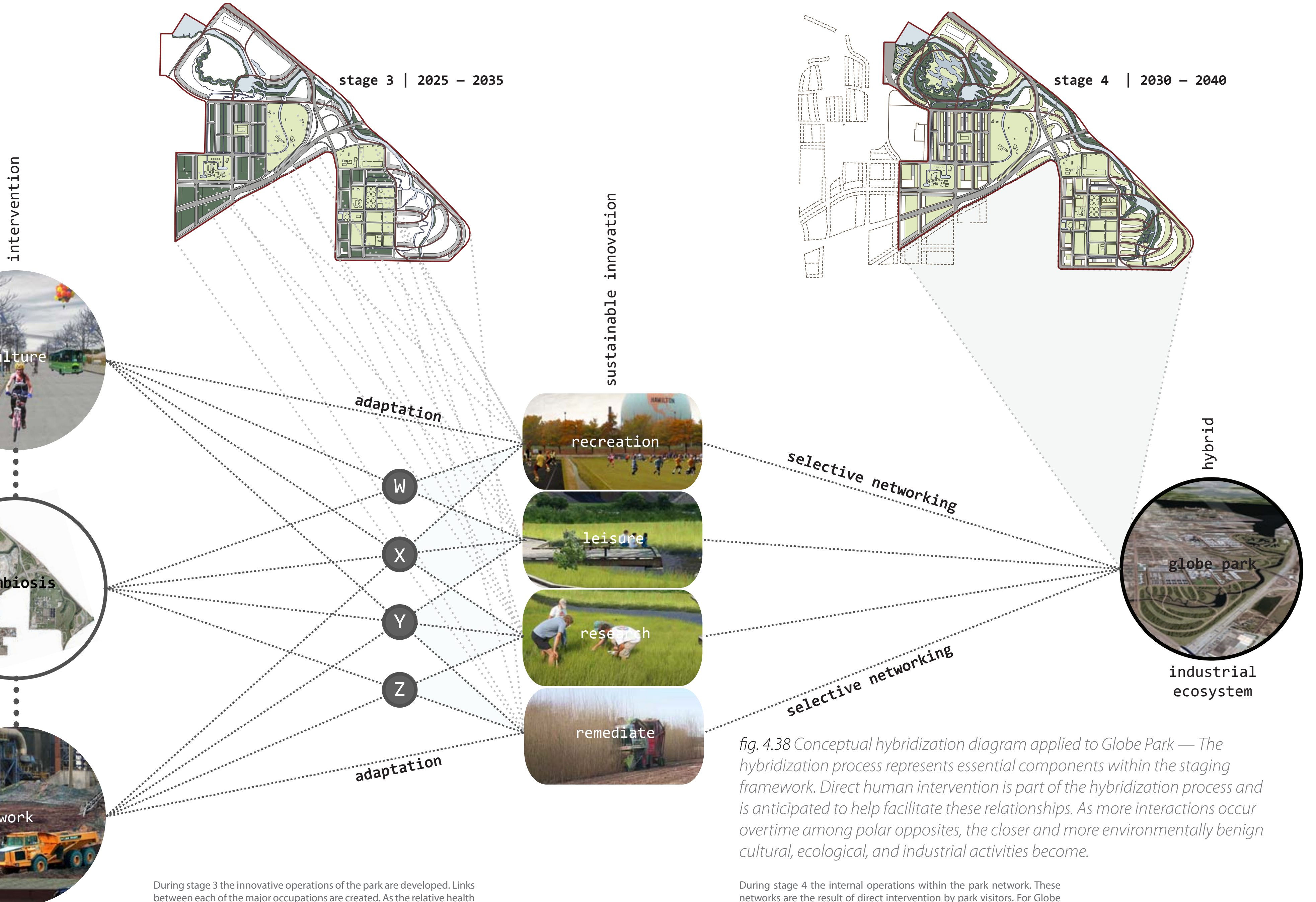


fig. 4.38 *Conceptual hybridization diagram applied to Globe Park — The hybridization process represents essential components within the staging framework. Direct human intervention is part of the hybridization process and is anticipated to help facilitate these relationships. As more interactions occur overtime among polar opposites, the closer and more environmentally benign cultural, ecological, and industrial activities become.*

During stage 3 the innovative operations of the park are developed. Links between each of the major occupations are created. As the relative health of each site improves the symbiotic links between cultural, ecological, and industrial activity grow. The more diversified the links become the more accommodating Globe Park becomes.

During stage 4 the internal operations within the park network. These networks are the result of direct intervention by park visitors. For Globe Park, visitors are as much actors in its ecological succession as plants and animals. Speculatively, as the health of the park and its operations grow, so does its attractiveness. Subdivided plots spawn into new uses.

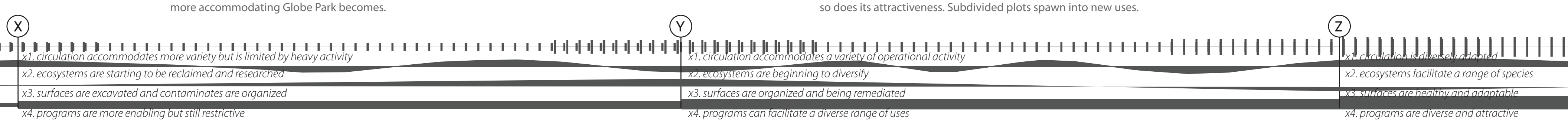
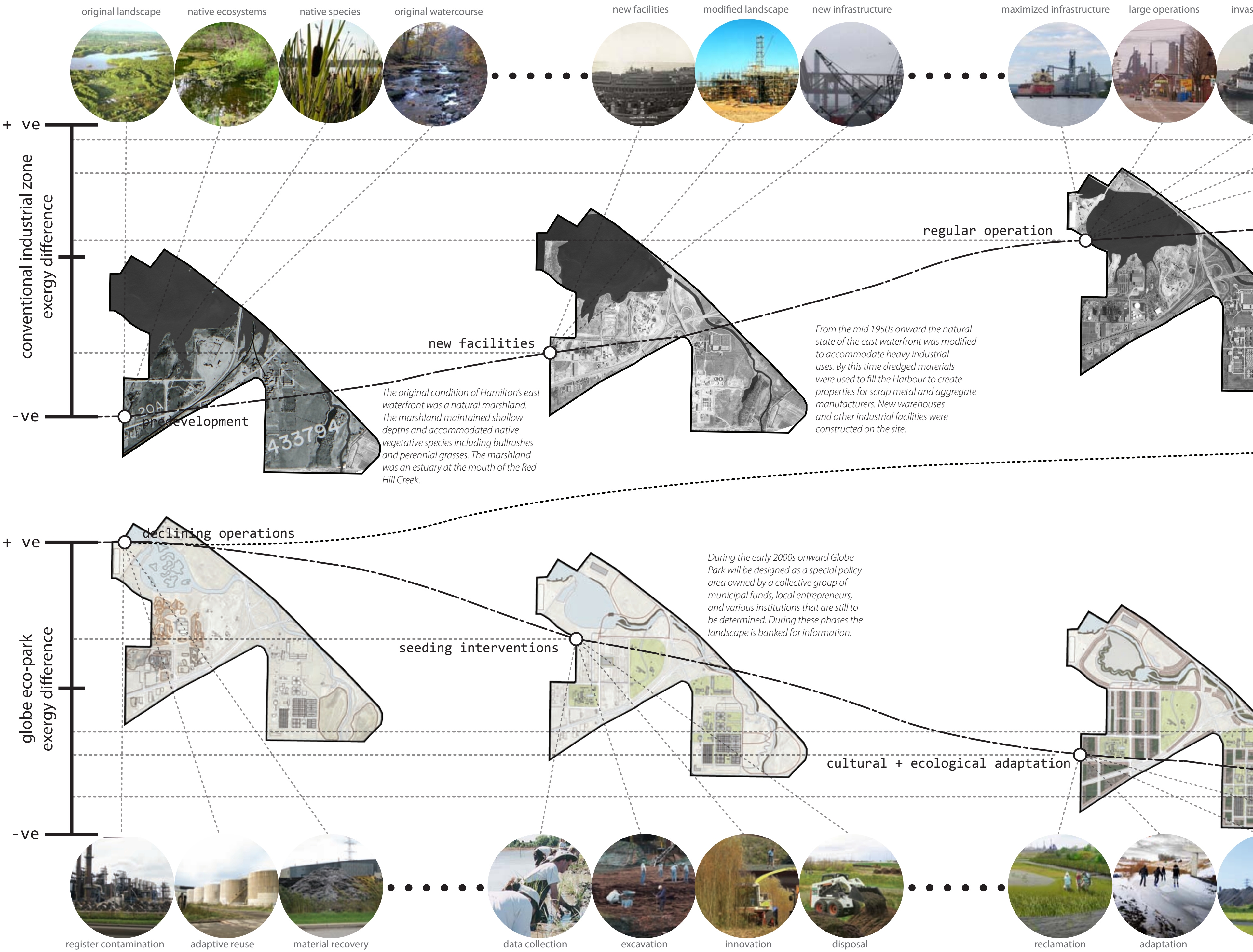


fig. 4.39 Aerial of Globe Park, 1954

fig. 4.40 *Aerial of Globe Park, 2005*

4.4 PARK SUCCESSION

Globe Park is an urban space that will change over time as a result of external local, regional, provincial, national, and international influences. The park is at a precipice in terms of what potentialities will evolve from its hybridization. As a heavy industrial site, its survival can be described as bleak considering the twilight condition of the industries located within its perimeter. The park can hybridize these conditions into a new spatial framework. For this to begin, direct intervention is necessary to improve its relative health. The diagram on the following page describes the condition of Globe Park as part of a successional timeline. The diagram depicts physical attributes during each of these generalized conditions. There are an indeterminate number of choices regarding the site's future health. Globe Park intends to polarize its degraded environmental state into an opportunity. On the following page Globe Park is revealed as part of a temporal timeline illustrating it as a successional proposition.



original landscape
native ecosystems
native species
original watercourse
new facilities
modified landscape
new infrastructure
maximized infrastructure
large operations
+ ve
-ve
conventional industrial zone
exergy difference
predevelopment
new facilities
regular operation
The original condition of Hamilton's east waterfront was a natural marshland. The marshland maintained shallow depths and accommodated native vegetative species including bullrushes and perennial grasses. The marshland was an estuary at the mouth of the Red Hill Creek.
From the mid 1950s onward the natural state of the east waterfront was modified to accommodate heavy industrial uses. By this time dredged materials were used to fill the Harbour to create properties for scrap metal and aggregate manufacturers. New warehouses and other industrial facilities were constructed on the site.
+ ve
-ve
globe eco-park
exergy difference
declining operations
seeding interventions
cultural + ecological adaptation
During the early 2000s onward Globe Park will be designed as a special policy area owned by a collective group of municipal funds, local entrepreneurs, and various institutions that are still to be determined. During these phases the landscape is banked for information.
register contamination
adaptive reuse
material recovery
data collection
excavation
innovation
disposal
reclamation
adaptation

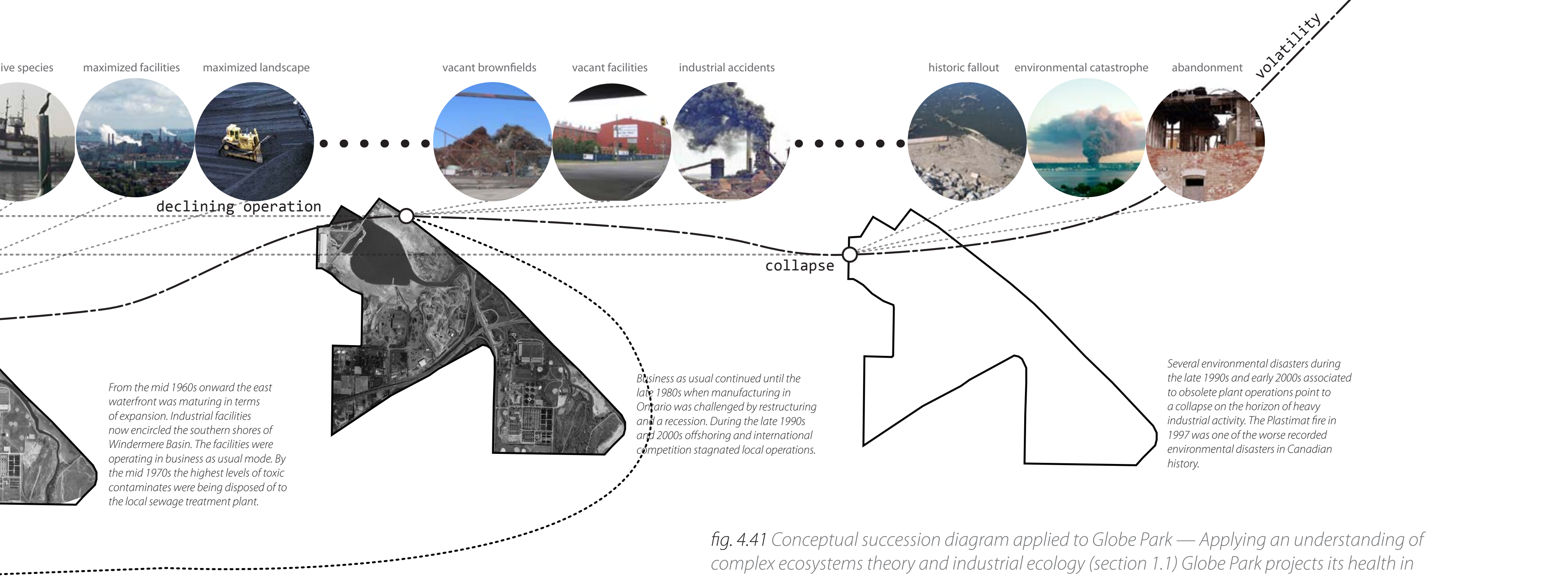


fig. 4.41 Conceptual succession diagram applied to Globe Park — Applying an understanding of complex ecosystems theory and industrial ecology (section 1.1) Globe Park projects its health in relation to exergy differential. As differences between reactive industrial content and ecosystems are moderated, the healthier the space grows. As nutrient loads output from industry, become higher quality, they will be absorbed by immediately surrounding ecosystems. Speculatively, this symbiosis will require unique management to ensure the relationship remains stable and nourishing. It is intended that ecosystems benefit from hybrid industrial loads.

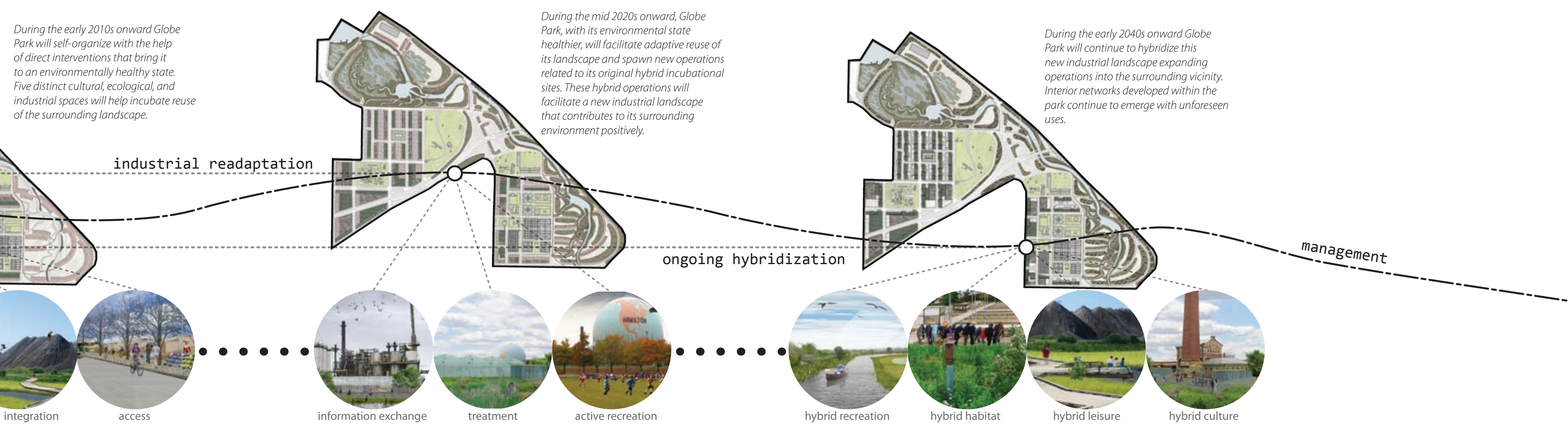
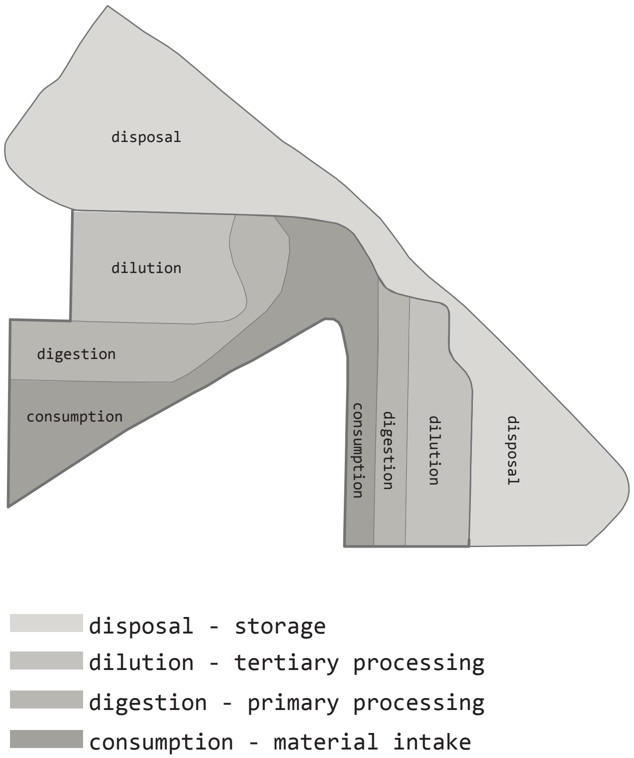
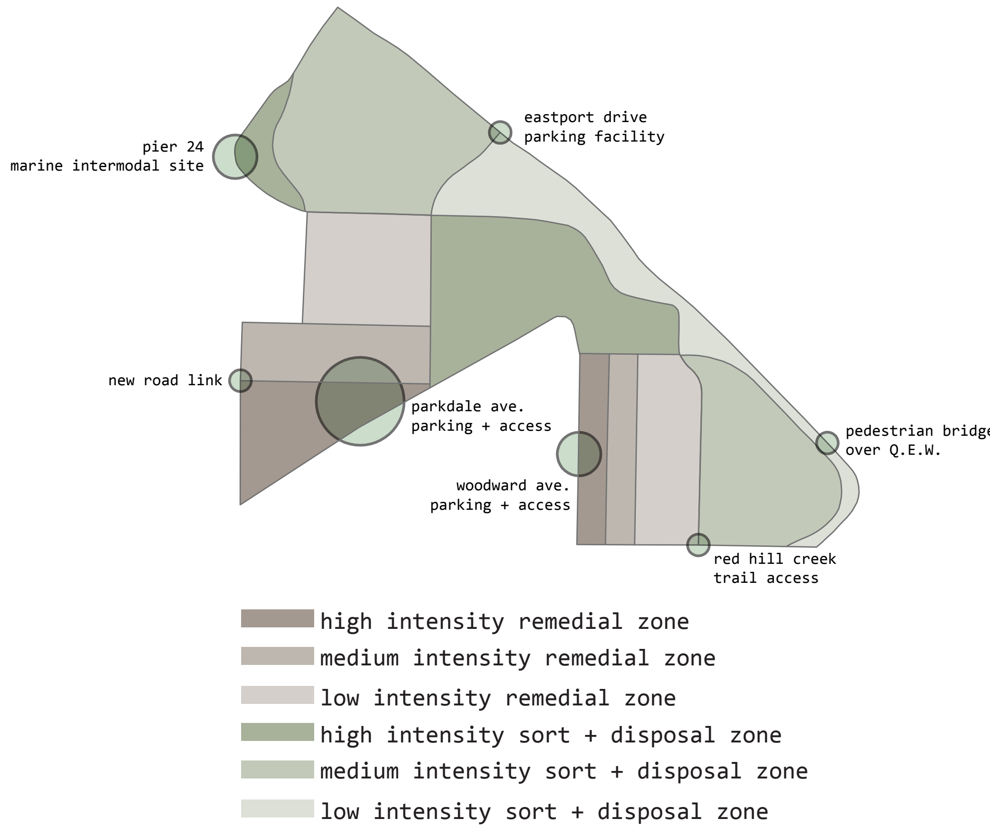


fig. 4.42 *Aerial view of Globe Park, 2007*

4.5 PARK LAYERS + STAGING

Globe Park will be created by a temporal process that is staged in layers. The term stages represents direct human intervention in the park. These stages occur over time to facilitate the space's occupational intensification. Each stage is a milestone for the park because it represents new ways that the community can interface with the space. The experience of the park will change not only relative to environmental or seasonal doctrines but also relative to economic or industrial doctrines. By facilitating these conventionally separate processes, Globe Park generates the most intensity. This speculative section anticipates necessary organizational strategies based on prior analysis, hybridization, and successional anticipations.





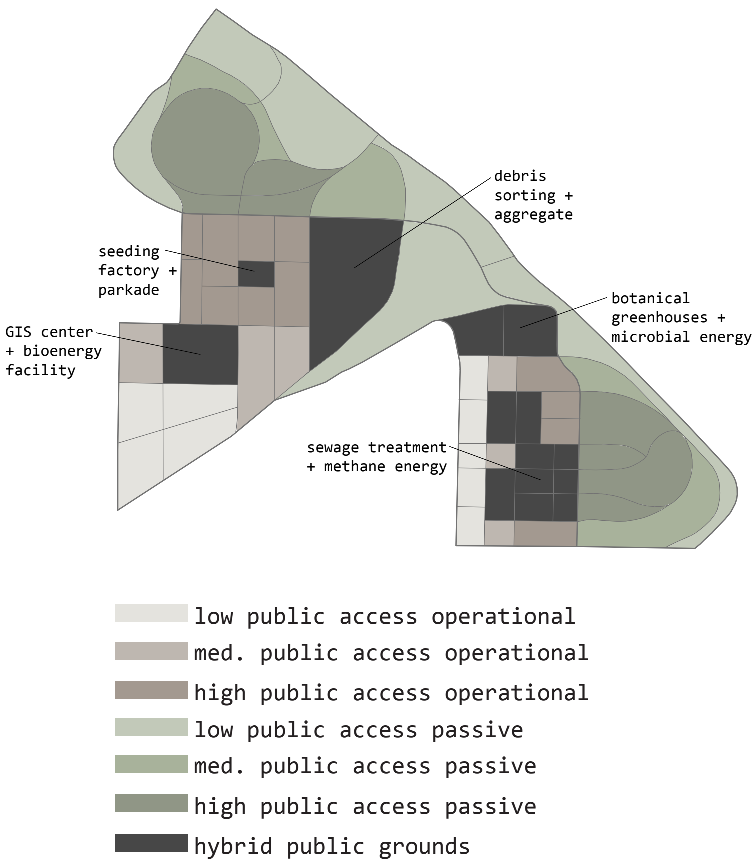
operational banding

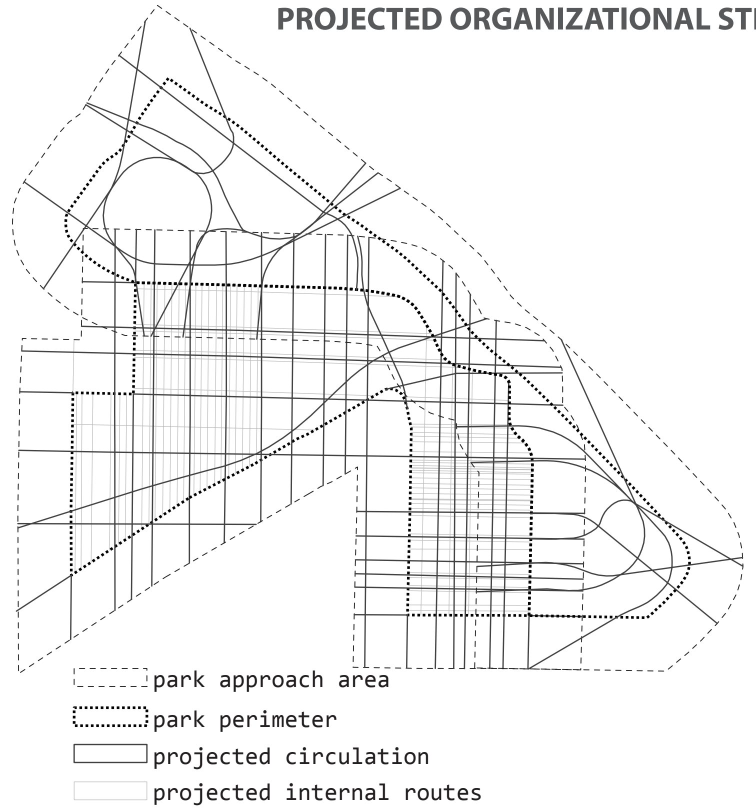
The general strategy for material intake into the park will use a four layer system. The layers will be consumption, digestion, dilution, and disposal. The consumption layer is closest to major road and rail infrastructure. Materials required to construct the site will be imported through the consumption layer. Uncontaminated debris will move directly to storage. Contaminated debris will receive primary or tertiary treatment based on its condition. The treated debris will be transferred to the disposal band or resold as a material based on demand.

zones + access points

Globe Park will be accessed through a perimeter with seven key points. The primary access point will be through Parkdale Avenue. An internal organization will remediate, sort, and dispose of ingested material based on its quality and potential for reuse. The areas represented by shades of grey are the ideal locations for remedial activity. They are furthest from significant site ecosystems including Windermere Basin, Red Hill Creek, and Hamilton Harbour. The areas represented by shades of green represent ideal sort and storage regions. These areas will only accept clean fill because of proximity to significant ecosystems.

PROJECTED ORGANIZATIONAL STRATEGIES





cellular gradients

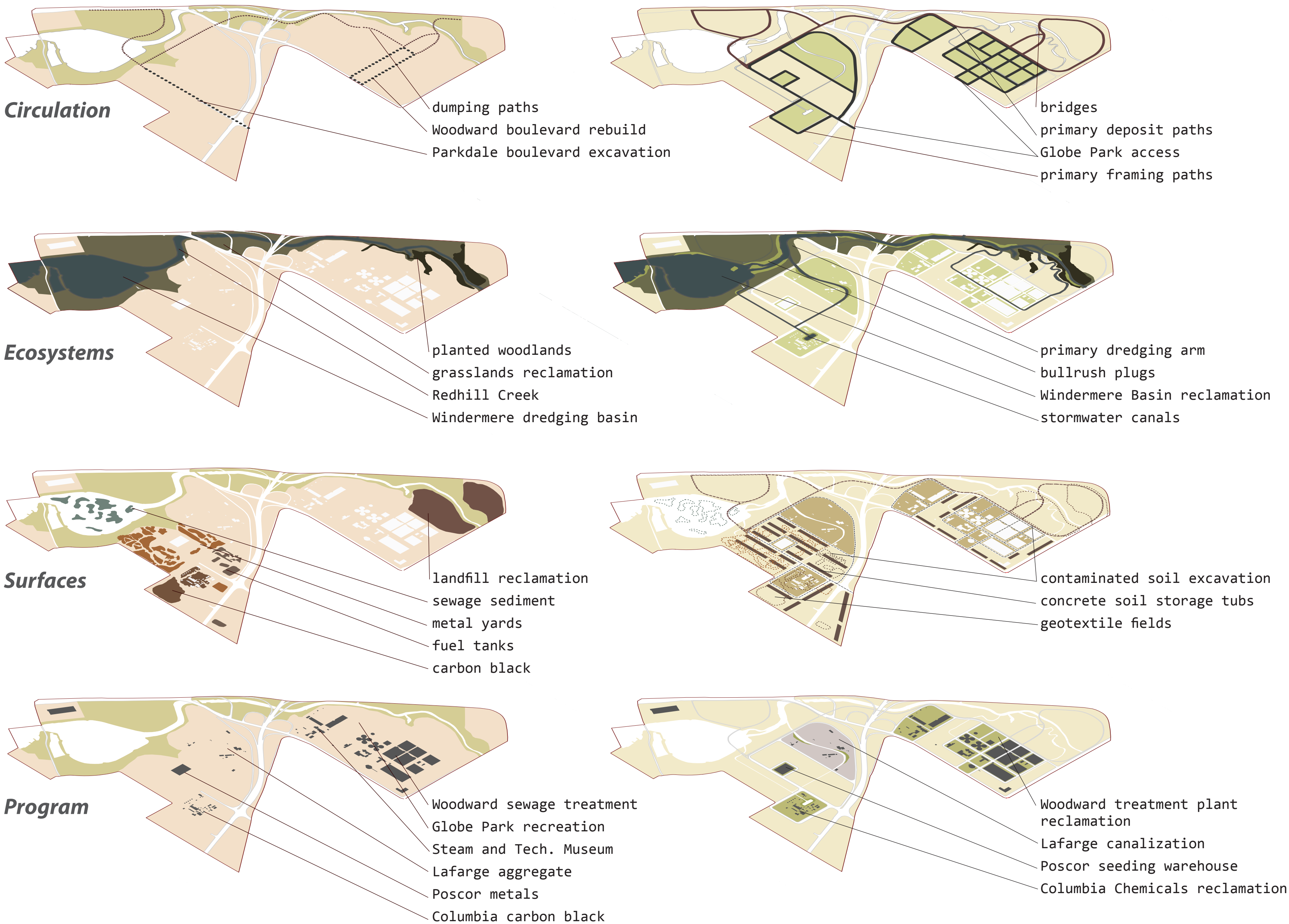
Internal spaces will be graded for desirable public access. In areas where remediation process are intense public access will be less desirable. In areas where the landscape is predominantly used for soil storage, public access will be facilitated. The five key hybrid public grounds are where public access will be most intense. These spaces will be the first to be excavated and remediated. Their remediation and organization will incubate the initial hybridization processes of Globe Park. Materials from outside of the park with moderate contaminate levels and will be imported as a service.

grid projections

A grid system will be generally projected onto the park. The grid will facilitate larger integration with the city as spaces become more accessible. There will be a hierarchy of four predominant grid types including a designated approach area, park perimeter, projected circulation paths, and internal routes. The designated approach area controls access and views into the park. The perimeter controls the park's policy areas. The project circulation allows general access, while internal routes control more intricate site flows.

STAGE 1 | banking
2010 — 2020

STAGE 2 | innovation
2015 — 2030



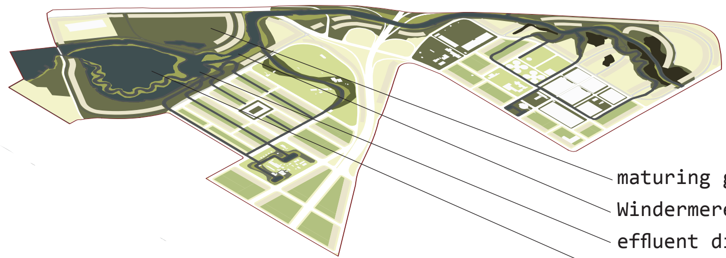
STAGE 3 | adaptation

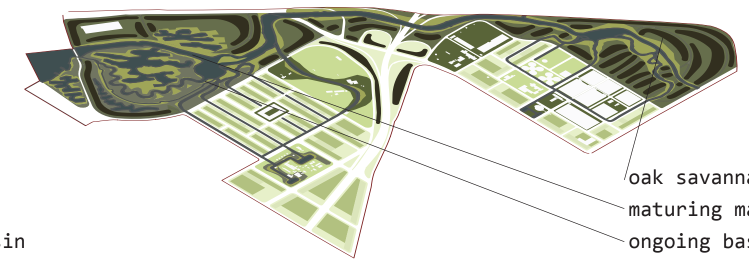
2025 — 2035

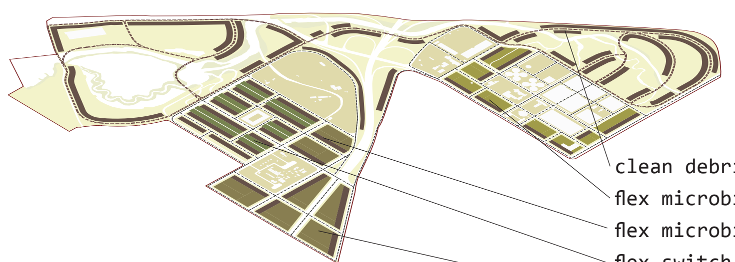
STAGE 4 | selective networking

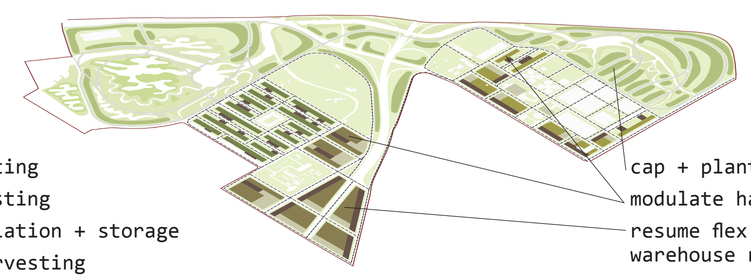
2030 — 2040

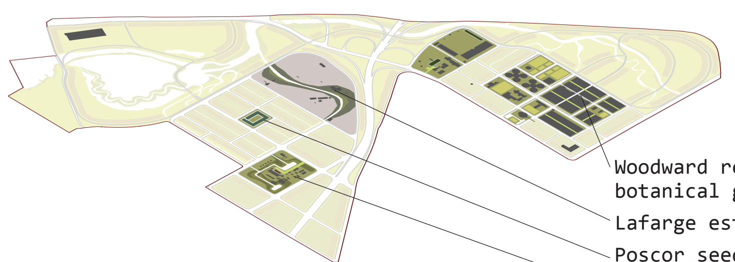
ongoing propagation

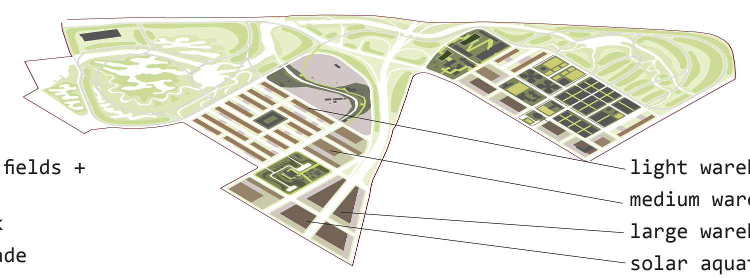


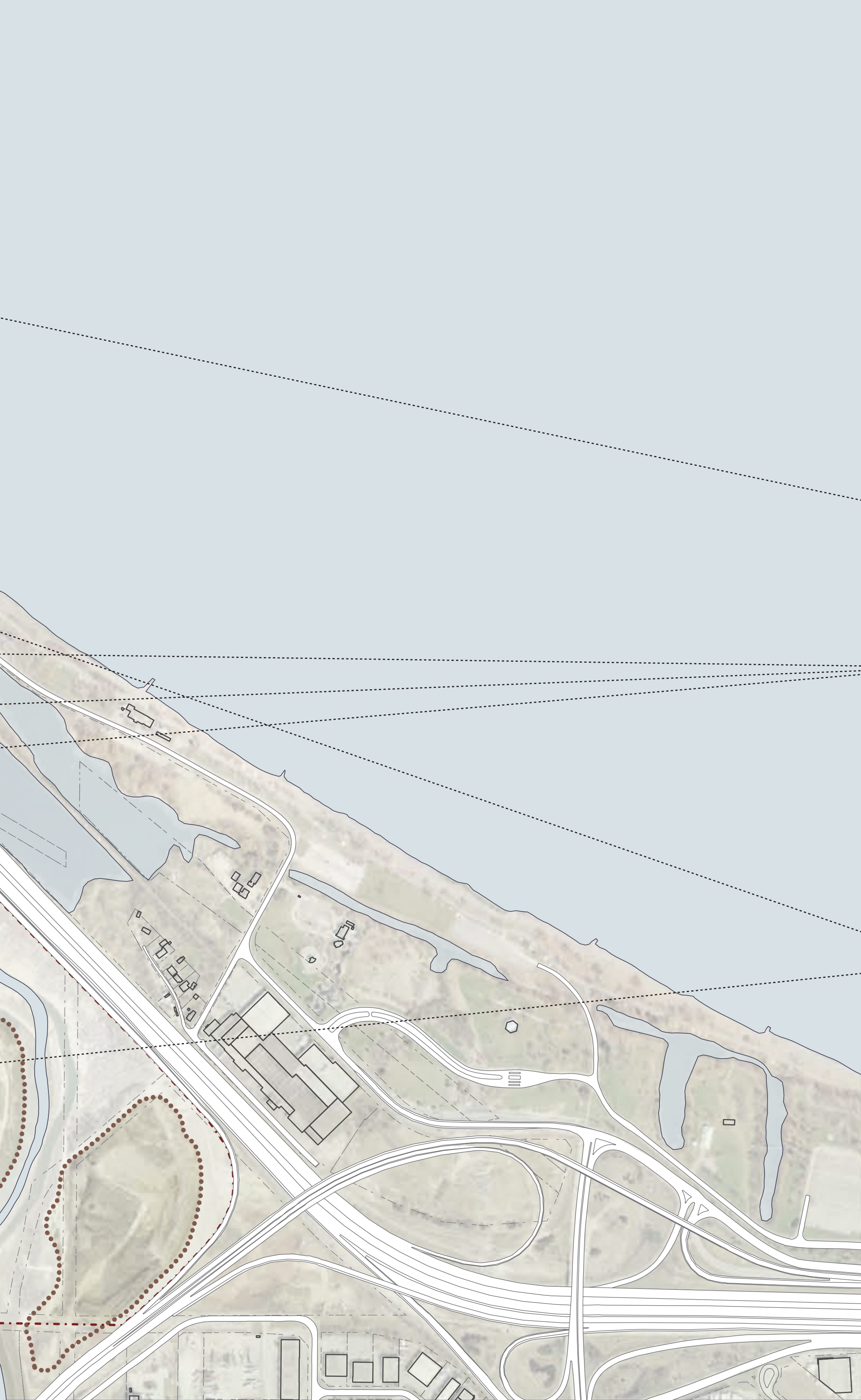












2010 — 2020

STAGE 1 | BANKING

ANTICIPATED INTERVENTIONS:

- Globe Park partners to negotiate with land owners within the park boundary
- Non-complacent owners to be removed and offered new grounds elsewhere
- An information database including historic contamination is constructed
- Contaminated soil and water areas are identified
- Ground water flow patterns are identified
- Arrangements are made with facility managers to collect detailed information
- Existing species and habitat are identified on site

Circulation

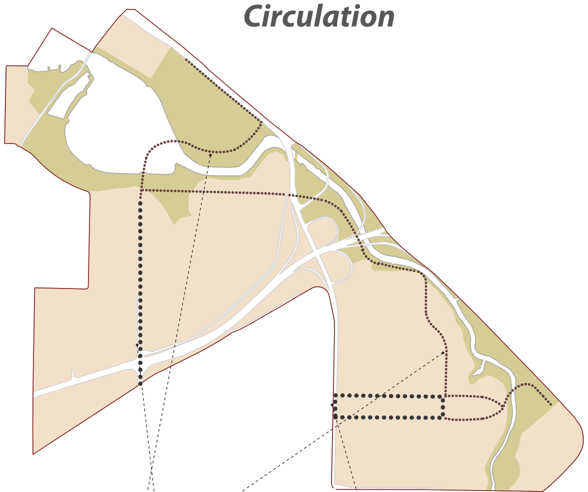


fig. 4.43 Stage 1 Circulation Sample Matrix

dumping paths

The paths setup key access ground to the north area of the site. Infrastructure will be constructed to transfer remediated material from excavated sites to debris dumping areas where designated.

Woodward Boulevard rebuild

The two central roads that access Woodward Avenue Sewage Treatment Plant will be reconstructed to facilitate public access into the space. Design measures will be taken to integrate recreation with operational process.

Parkdale Boulevard excavation

The boulevard is the main organizational spine of the park. It will be excavated, it is currently inhabited by several scrap metal yards. The contaminated soils will transferred to holding areas while the street is finalized.

Ecosystems

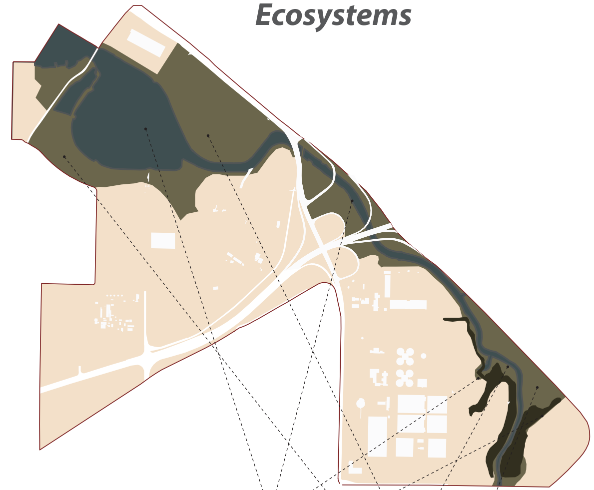
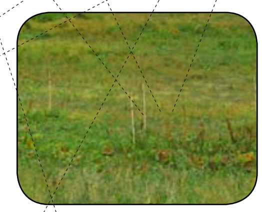


fig. 4.44 Stage 1 Ecosystems Sample Matrix

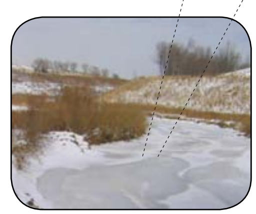
planted woodlands

A planted broad leaf forest grows adjacent to the Rennie Street Landfill reclamation project.



grasslands reclamation

A grasslands reclamation project began in the valley of the Red Hill Creek and on the grounds of Windermere Basin.



Redhill Creek Reconstruction

The Red Hill Creek was recently rerouted in 2007 as part of a major urban expressway project. Native grasslands were planted as part of the reclamation process. This space will be adapted as a passive recreational area and habitat preserve.

Windermere Basin dredging

The basin will be reclaimed as a site for a constructed wetland. The wetland will be integrated with future park operations. The basin will require dredging of contaminated sediments in study areas showing critical levels.

Surfaces

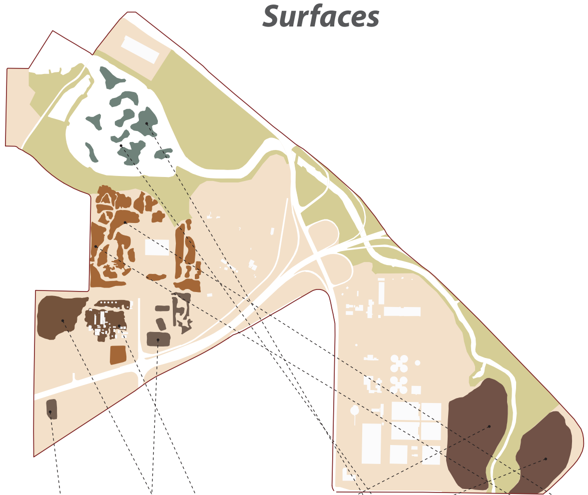
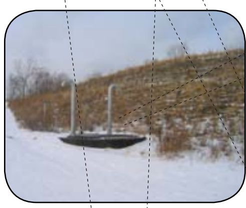


fig. 4.45 Stage 1 Surface Sample Matrix



landfill reclamation

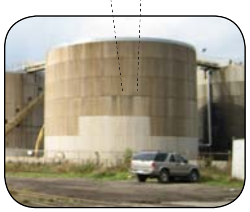
The former Rennie Street Landfill site will be a site for new debris dumping. An underground leachate system and gas collection infrastructure is already in place. It is originally a landfill for contaminated harbour sediment.

sewage sediment

Outflow from the Woodward Avenue Sewage treatment plant has collected within Windermere Basin. This sediment will be recovered to fertilize remedial processes within Globe Park.

metal yards

Scrap metal yards have been prevalent on the southern areas of Windermere Basin for over fifty years. These sites will be excavated. Soils with high metallic content will be stock piled for remediation. Bioremediation techniques are anticipated depending on contaminate levels.



fuel tanks

Elevated liquid storage tanks are prone to leak or run off of stored chemicals. Soil conditions around their vicinity will require study for contaminate. Contaminated soil will be excavated and stock piled with associated contaminates.

carbon black

Near carbon black facilities PAHs are highly suspect. The vicinity of chemical facilities will need scientific study to determine contamination levels.

Program

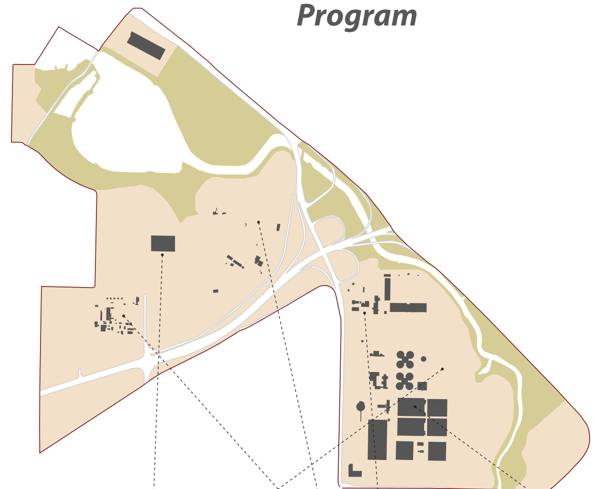
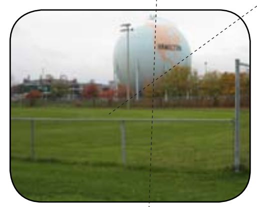
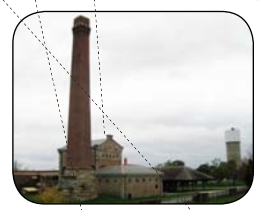


fig. 4.46 Stage 1 Program Sample Matrix



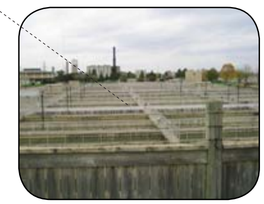
Globe Park recreation

Municipal active recreational area that will be adapted to the operations of Globe Park.



Steam and Tech. Museum

Municipal museum that will be adapted to the operations of Globe Park.

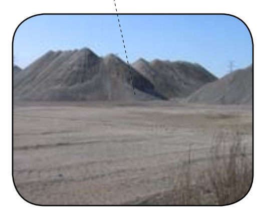


Woodward sewage treatment

Municipal facility that will be adapted to the operations of Globe Park.

Poscor metals

Scrap metal sites will be acquired through negotiations. This will make them entities within Globe Park.

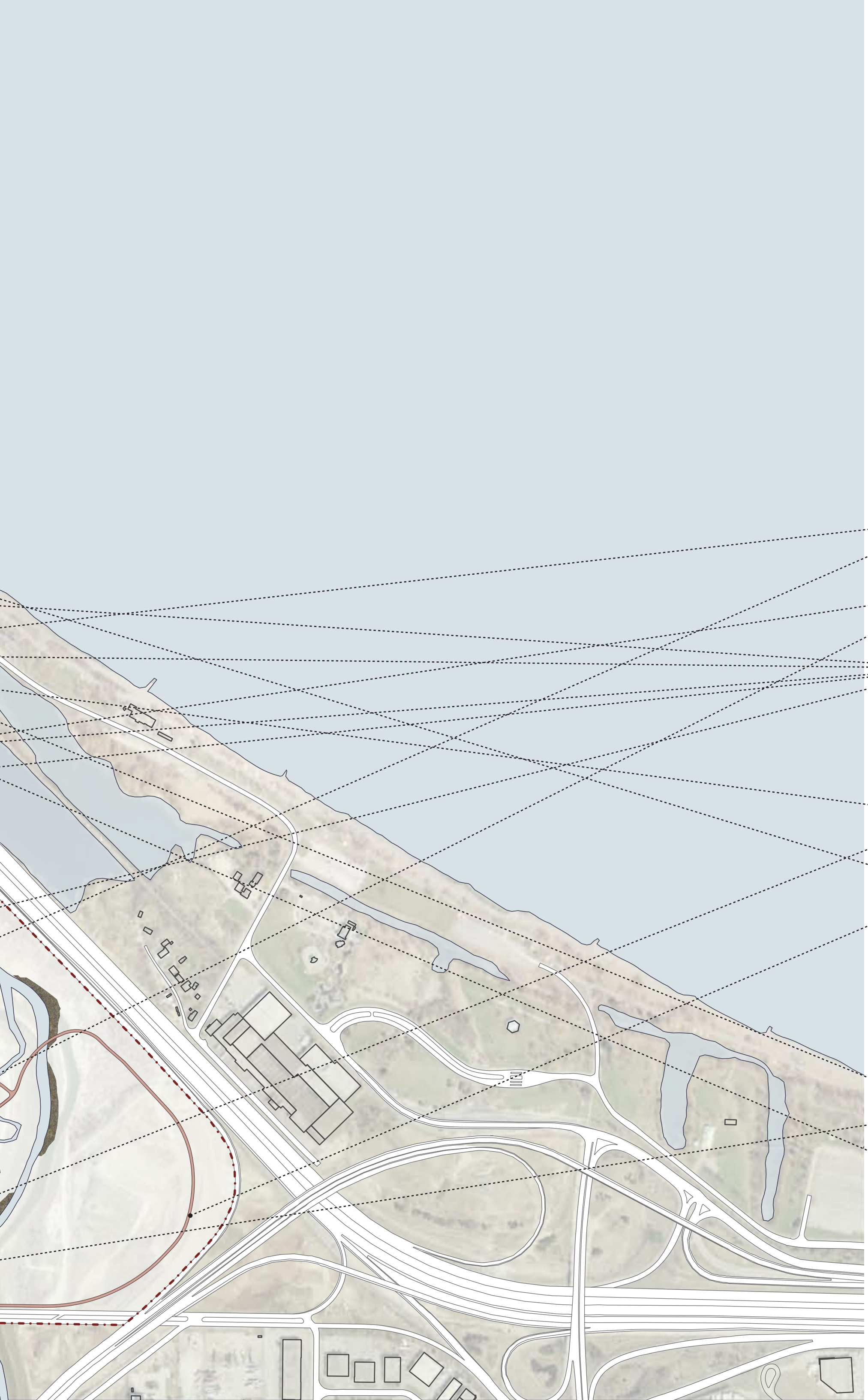


Lafarge aggregate

Negotiations with carbon black manufacture will acquire the site as an entity within Globe Park.

Columbian Chemicals carbon black

Negotiations with carbon black manufacture will acquire this site as an entity within Globe Park.



2015 — 2030

STAGE 2 | INNOVATION

ANTICIPATED INTERVENTIONS:

- Construct central boulevards with bus routes and street parking
- Temporary research labs retrofitted as required
- Excavate known contaminates from five incubator sites
- Fence excavation sites
- Construct geotextile soil fields and begin soil disposal
- Construct future disposal paths
- Construct underground servicing infrastructure
- Construct bus and parking terminals
- Begin Red Hill Creek bank stabilization
- Construct water flow velocity control islands and dredging channel

Circulation

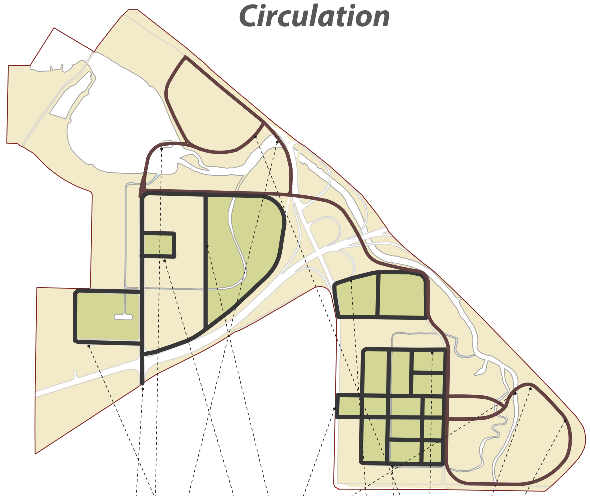
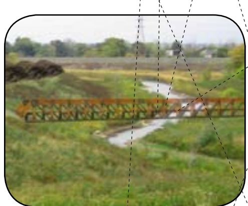
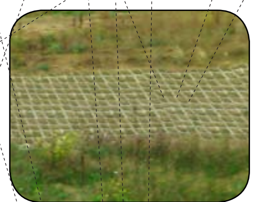


fig. 4.47 Stage 2 Circulation Sample Matrix



bridges
Bridges are constructed to accommodate debris dumping locations on the east side of Red Hill Creek. The bridges will be designed to accommodate the loads of dump trucks, bobcats, and levelers.



primary deposit paths
Deposit paths are to be a turf stone material with a geotextile underlayment. The paths will be permeable to vegetation and accommodating to dumping machines.

Globe Park access
Along the main boulevards special transit will bring visitors from the city. Recreational visitors will access the park through links to regional trail networks.

primary framing paths
A primary network of integrated roads and paths will facilitate all uses including pedestrians, machines, vehicles, and bikes.

Ecosystems

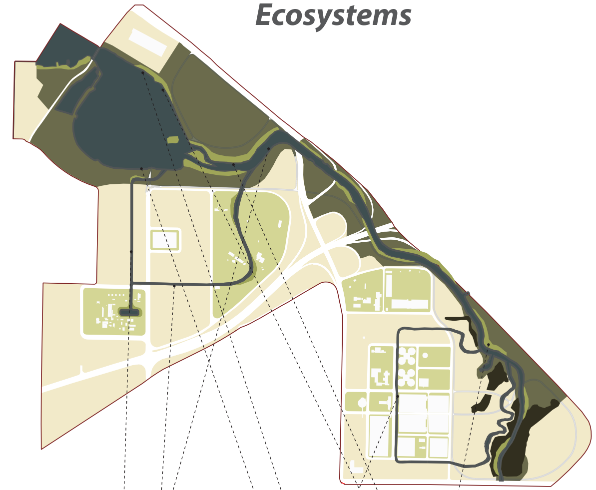
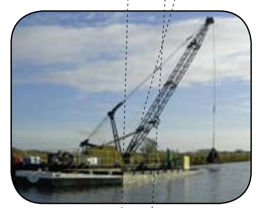
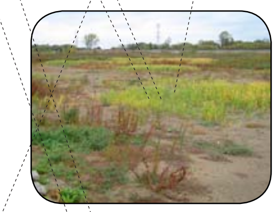


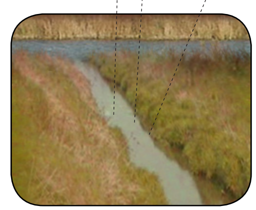
fig. 4.48 Stage 2 Ecosystems Sample Matrix



primary dredging arm
A supported dredging arm will be created south of Windermere Basin. The basin will be dredged on frequent occasion so that sediment does not unbalance nutrient levels in the basin.



bullrush plugs
Bullrushes and Wetland grass will be planted adjacent to Windermere Basin and the Red Hill Creek. Coir mats will be used in areas where bank stabilization is required.



storm water canals
Canals will be excavated in key areas to accommodate storm water flows on the site. Three primary canals will be established through: the aggregate site, the scrap metals site, and the sewage treatment plant site.

Windermere Basin reclamation
Coir mat bank stabilization will be constructed to control erosion in designated areas.

Surfaces

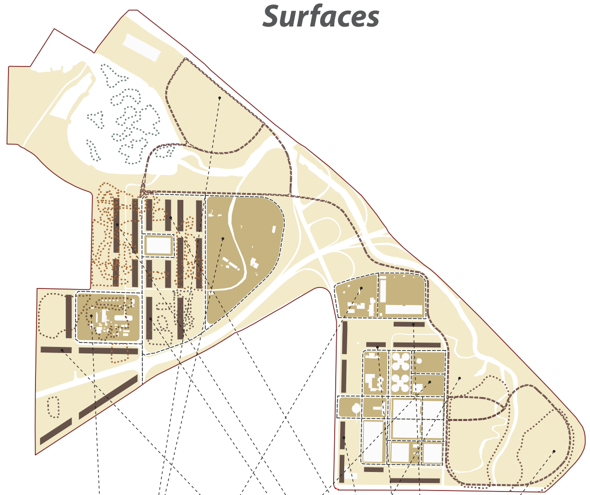
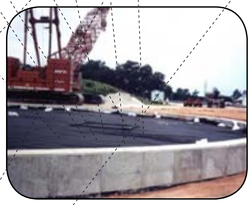


fig. 4.49 Stage 2 Surface Sample Matrix

contaminated soil excavation

Soil in five key locations will be excavated based on contamination levels. The contaminate will be sorted and divided based on the type.



concrete soil storage tubs

Concrete soil contaminate tubs will be constructed on large plots. These plots will facilitate future remedial activity and are flexible to a variety of types. The dimensions are determined based on anticipated remedial equipment and buildings.

geotextile fields

Geotextile will be used to demarcate debris dumping regions. These will protect effluent runoff into surrounding ecological systems. The geotextile will facilitate dumping procedures and berm formation.

Program

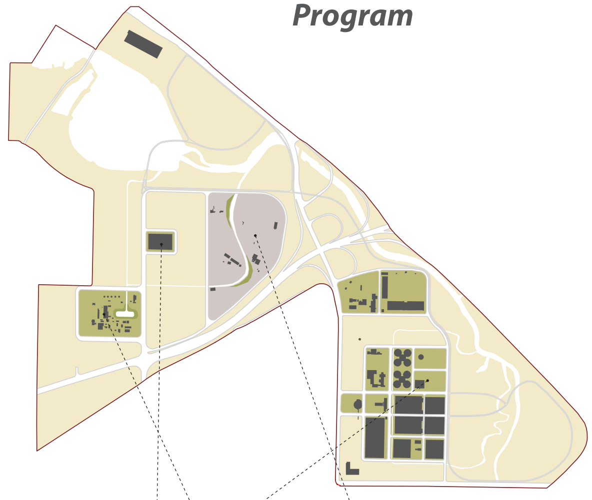
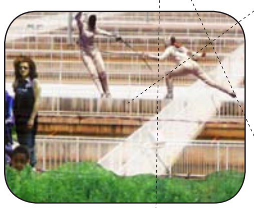


fig. 4.50 Stage 2 Program Sample Matrix

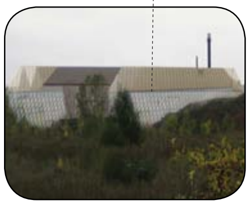


Woodward Treatment Plant reclamation

The treatment plant will be reclaimed and adapted with pathways that provide public areas. Recreational activities may carry on in some designated areas.

Lafarge channelization

The aggregate site is to accept a new water channel that will help control surface ground water flows.

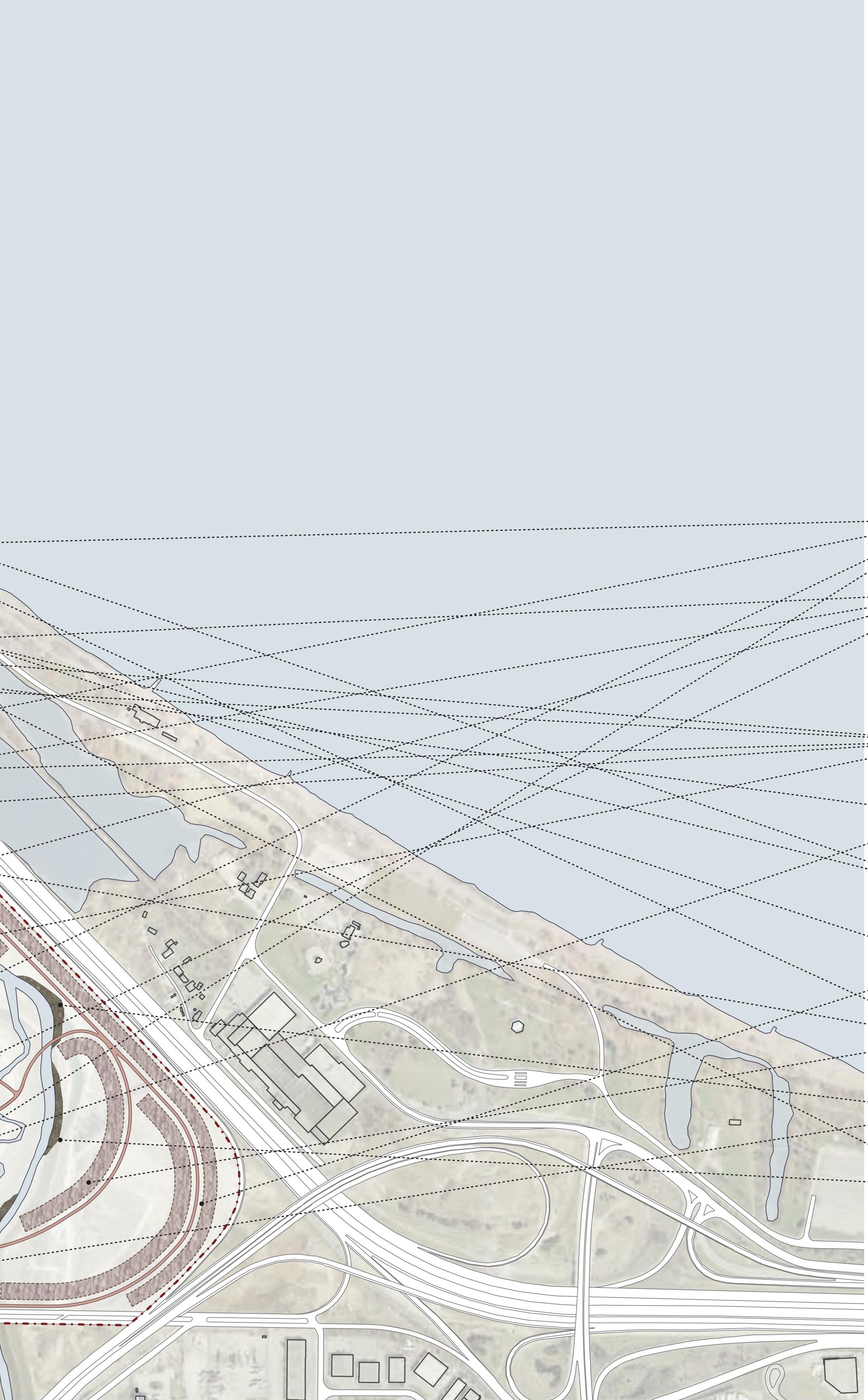


Poscor seeding warehouse

The former scrap metal storage warehouse will be reclaimed, remediated, and adapted to seeding operations. The seedlings will be transplanted to provide plants for remedial activities and bioenergy crop harvesting on adjacent plots.

Columbia Chemicals reclamation

The former carbon black facility will be given a complete overhaul reusing bulk containers, structure, and piping to accommodate a clean bioenergy plant. The plant will recover energy and district heat from remedial plants.



2025 — 2035

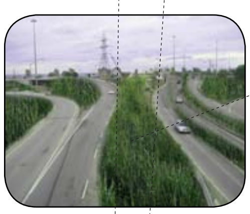
STAGE 3 | ADAPTATION

ANTICIPATED INTERVENTIONS:

- Remedial operations begin within designated geotextile fields
- Concrete soil storage areas are constructed
- Contaminated soil from the five incubator sites are disposed of in soil storage areas
- Landscape Reclamation begins on incubator sites
- Stormwater channels are constructed through interior sites
- Dredging pond and creek channelization begins in Windermere Basin
- Excess soil deposit paths are completed
- Remediated debris dumping begins in designated areas adjacent to dumping paths
- Red Hill Creek bank stabilization program resumes
- Wetland plugs are planted on the banks of Red Hill Creek and Windermere Basin

Circulation

fig. 4.50 Stage 3 Circulation Sample Matrix



new QEW access ramp

A new ramp will be completed to access Globe Park on the South East side. The ramp will connect to the Red Hill Creek Parkway. An operational entry corridor will be created to treat effluent runoff from the ramps.

secondary deposit paths

A secondary support network of deposit paths will be created to facilitate dumping in more areas of the park. Deposit areas will be designated to form large berms and organize a new passive recreational area.

secondary framing paths

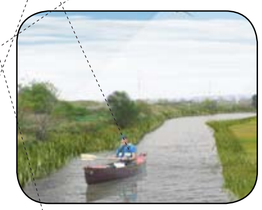
A network of secondary paths are created to access more territory within Globe Park. These paths will be shared by visitors as well as equipment operators for remedial sites. The paths will be adaptable to future needs based on park requirements.

Ecosystems

fig. 4.51 Stage 3 Ecosystems Sample Matrix

maturing grasslands

The planted grasslands of stage one are maturing and fostering a larger number of plants and wildlife species.

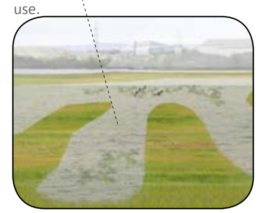


Windermere canal

The canal will channel the water from the Red Hill Creek into Hamilton Harbour. The water will mix with other nutrient discharges to dilute it before entering the Harbour. Windermere canal is constructed to facilitate recreational use.

effluent dilution basin

A network of effluent dilution basins will be developed along the park's channels. These basins will include plant species able to stabilize nutrient levels in collected site wastewaters .



settling marsh

Development using dredged material from the basin has began to create a settling marsh for effluents carrying high quality nutrients from the sewage treatment plant and solar aquatic labs.

Surfaces

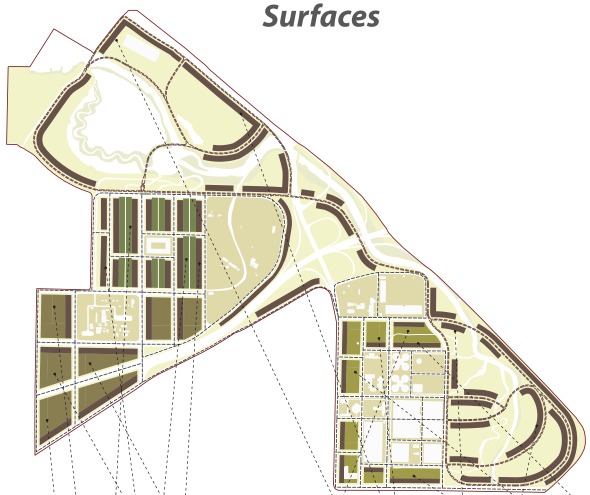
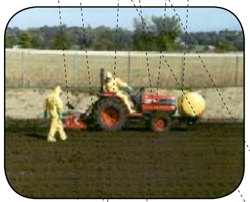
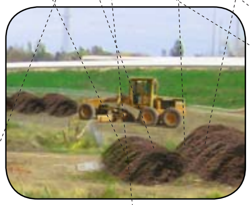


fig. 4.52 Stage 3 Surface Sample Matrix



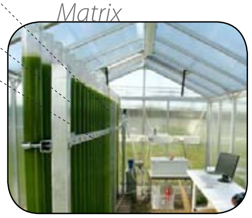
flex microbial remediation + storage

As debris is excavated and imported into Globe park it will be distributed to micobial remediation fields. The remediated soils, depending on quality, will be sold or stored.



clean debris depositing

Debris that has undergone testing and remediation will be deposited in the south west areas of the park. The deposits will create large berms as more material is ingested.



flex microbial harvesting

Waste waters from the treatment plant with high nutrient loads will be distributed where possible to fields that generate fuels from algae. Biodiesel, Natural Gas, and Hydrogen are all possible from particular algae species.

flex switchgrass harvesting

Switchgrass roots have properties that improve soil quality where there is a high percentage of metallic content. Switchgrass is a significant source of biomass that can be converted into heat, electricity or fuel. Flexible switchgrass fields will be planted based on soil supply.

flex willow harvesting

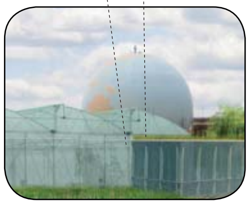
Willow roots have properties that improve soil quality where there is a high percentage of metallic content. Willow is a significant source of biomass that can be converted into heat, electricity or fuel. Flexible switchgrass fields will be planted based on soil supply.

Program

fig. 4.53 Stage 3 Program Sample Matrix

Lafarge estuary park

The aggregate site with stormwater channel will be adapted to have a wetland estuary and berms through the center of the site. These interventions will control water flow and improve its quality on the site before entering Windermere Basin.



Woodward recreation fields + botanical gardens

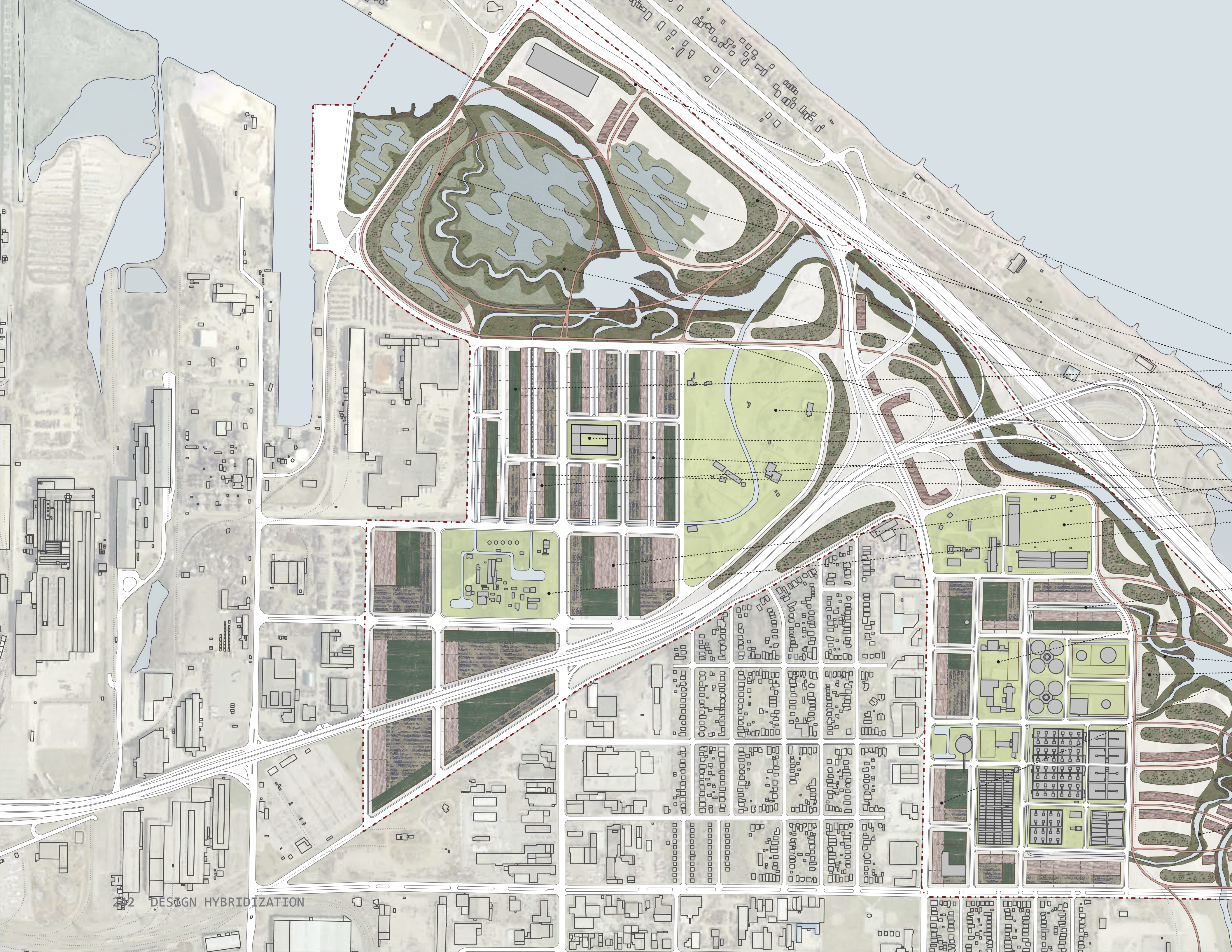
A botanical green house will be implanted to control odor, air flow, and treat some grey waters. This will retrofit the existing Steam & Tech. Museum making it a hybrid visitor center and productive greenhouse.

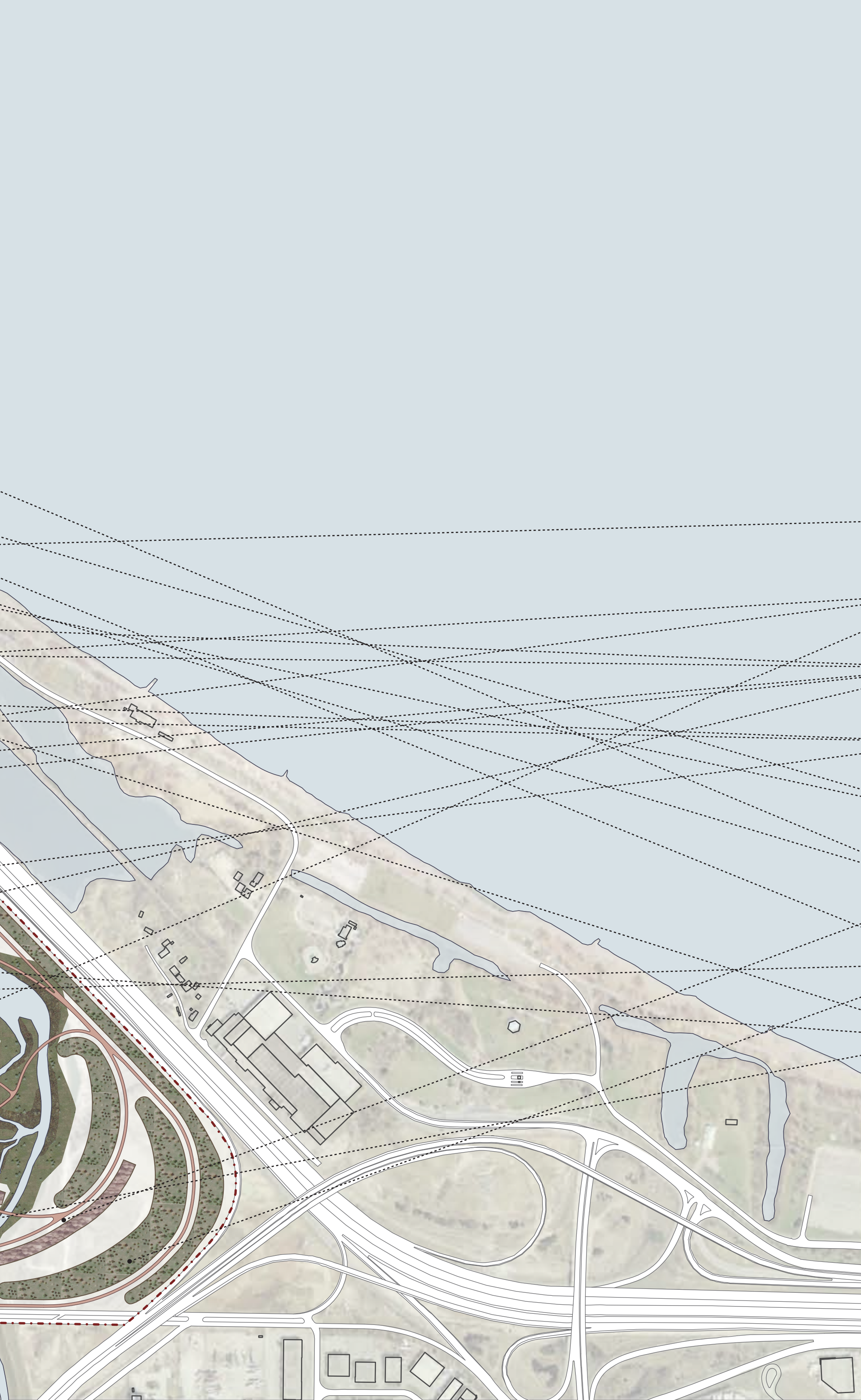
Poscor seeding parkade

The flex remedial harvesting area will require a lab to incubate seeds, seedlings, and algae for faster growth. Rhizofiltration will be used to filter contaminated waters from Globe Park and the harbour. These labs will be integrated with a multilevel parkade.

Columbia chemicals data park

A GIS collection lab and visitor area will be integrated with the overhauled biofuel plant. This is the arrival area for the park that registers contamination levels and information inputs and outputs for the entire park area.





2030 — 2040

STAGE 4 | SELECTIVE NETWORKING

ANTICIPATED INTERVENTIONS:

- Remedial fields are subdivided and new development may be facilitated
- Preconstructed concrete soil storage areas are adapted as building foundations
- Reclaimed landscape of incubators facilitate new employment + public visitation
- Stormwater channels are expanded between subdivided sites
- Dredging pond and creek channelization is maturing and self-organizing
- Soil deposit paths are expanded and further adapted for passive recreation
- Designed dumping areas near capacity receive topsoil and savannah planting
- Red Hill Creek bank stabilization program expands along storm water channels
- Wetland plugs with remedial qualities are planted to accept grey water outflow

Circulation

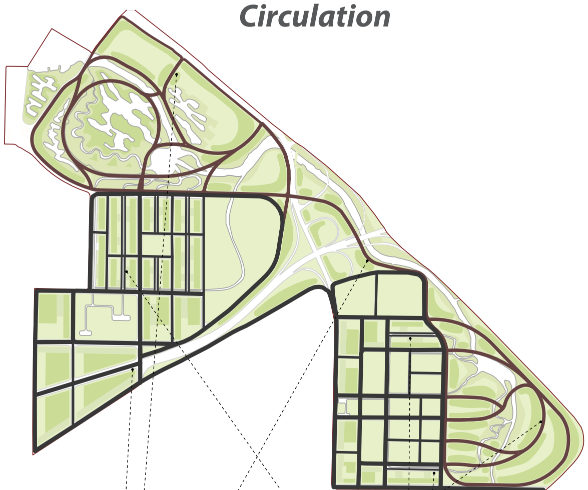
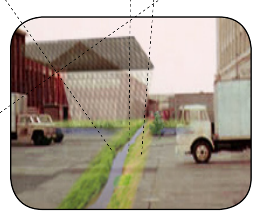


fig. 4.54 Stage 4 Circulation Sample Matrix

deposit path adaptation

Former paths used primarily for debris dumping are now adapted for recreational uses and site access for planting activities.



site access alleys

A network of alleys are adapted to loading areas of small warehouse sites. The alleys are flexible to new uses including material transfers. The sites are preconfigured to accommodate a number of truck types.

Burlington Street ramp improvements

As the import and export uses of Globe Park intensify, the Burlington Street access ramp will need to be upgraded to accommodate more visitors.

Ecosystems

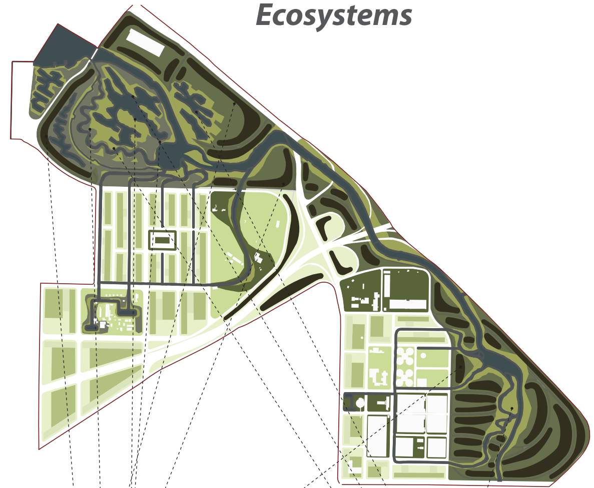
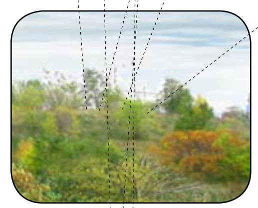
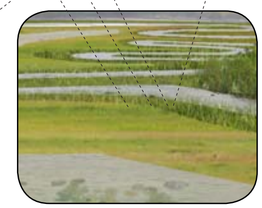


fig. 4.55 Stage 4 Ecosystems Sample Matrix



oak savannah threads

Many of the disposal berms on the northeast of the site are near capacity and will be stabilized with geotextile. A layer of topsoil will be added where broad leaf species and native grasses will be planted.



maturing marshland

Nutrient loads are beginning to stabilize as Globe Park's operations are expanding. The marshland is maturing holding a wider range of rare biological species. Contaminate levels are benign.

ongoing basin management

As the basin wetland matures it is managed through academic studies to review the overall impact of the process on plant and animal species. The processes of Globe Park are used to influence other projects with comparable objectives.

2030 — 2040

Surfaces

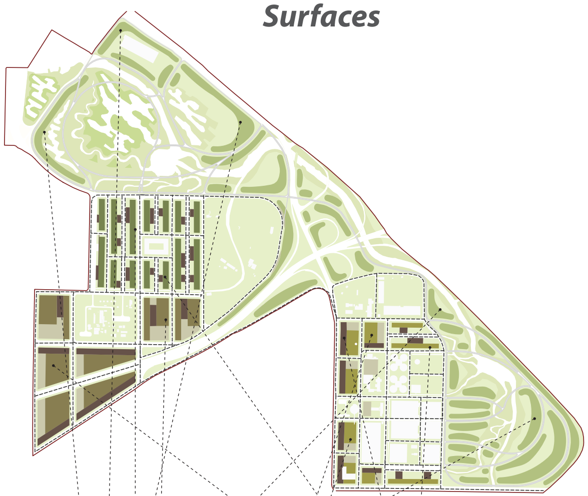


fig. 4.56 Stage 4 Surface Sample Matrix

cap + plant debris deposits

The planting project of debris berms is expanded through the north east areas of Globe Park. A diverse range of broad leaf species will be planted. The threads will improve rain water by improving flows on site.

modulate harvesting lots

The flex harvest lots can be subdivided to accommodate more intense lot uses such as warehousing. Standard configurations are proposed and these areas could be reclaimed for private sector uses.

resume flex harvesting on warehouse roofs

As plots are subdivided within Globe Park, continuation of remedial processes and biomass harvesting will be encouraged on facility roofs.

Program

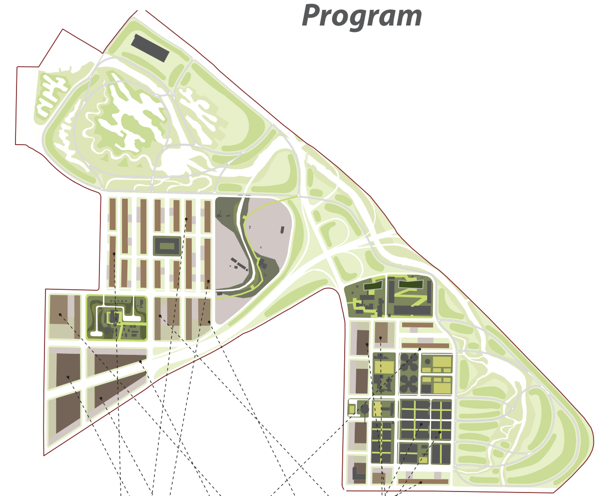
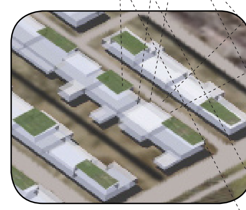
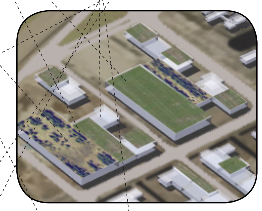


fig. 4.57 Stage 4 Program Sample Matrix



light warehousing adaptation

Small plots on the north and east portions of the park may be adapted incrementally for mixed warehouse and lab uses that facilitate public access. Flex harvesting will be encouraged on roof tops.



medium warehousing adaptation

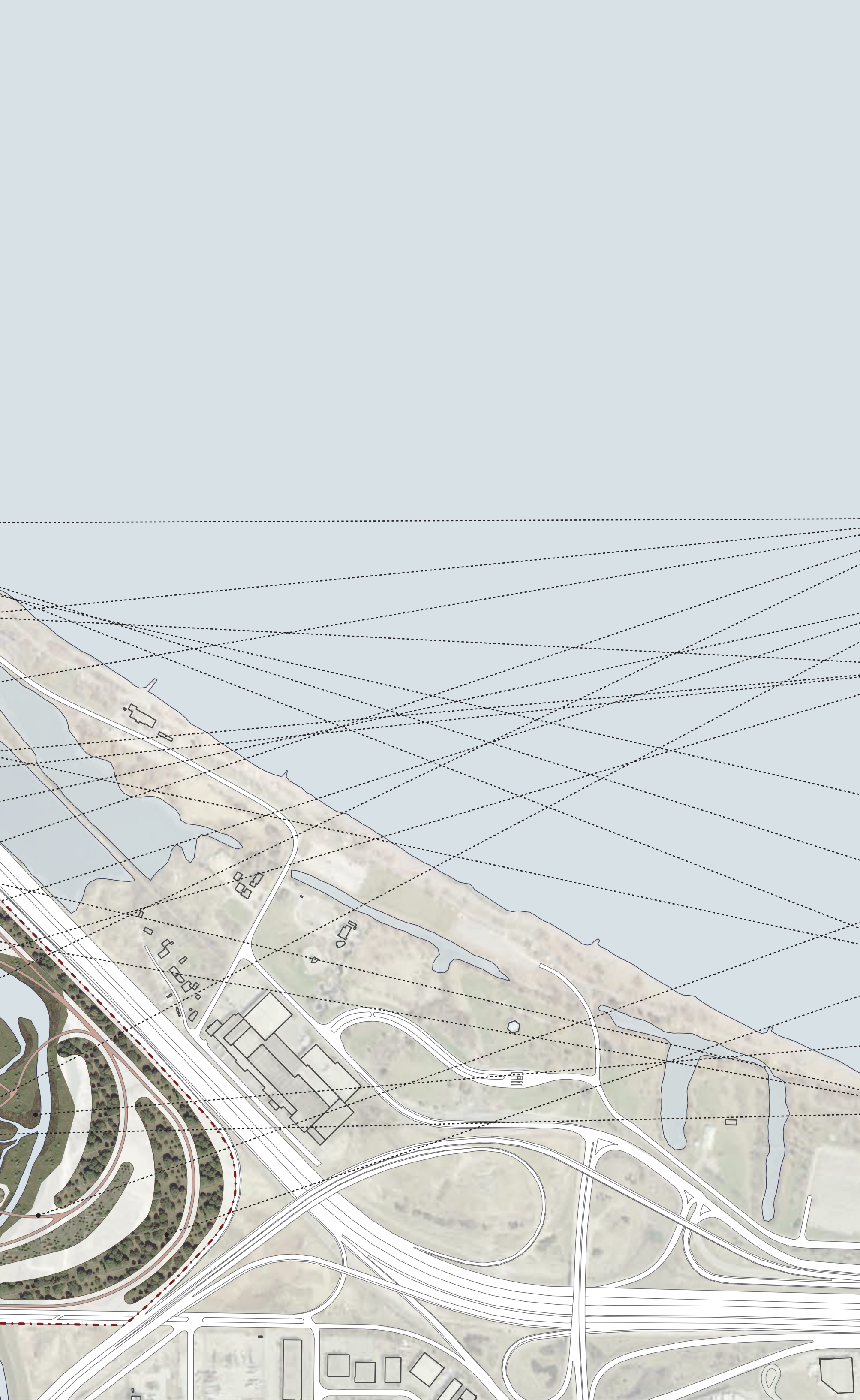
Medium plots within the north and east interim band of the park may be adapted incrementally for mixed warehouse uses that facilitate public access. Flex harvesting will be encouraged on roof tops.

solar aquatics adapted to building forms

Sites may be adapted for solar aquatic or micro algae uses. Incentives will be created to encourage new facilities to accommodate a percentage of these technologies depending on plausibility.

large warehousing adaptation

Large plots within the north and east primary band of the park may be adapted incrementally for heavy mixed warehouse and office uses that facilitate public access. Flex harvesting will be encouraged on roof tops.



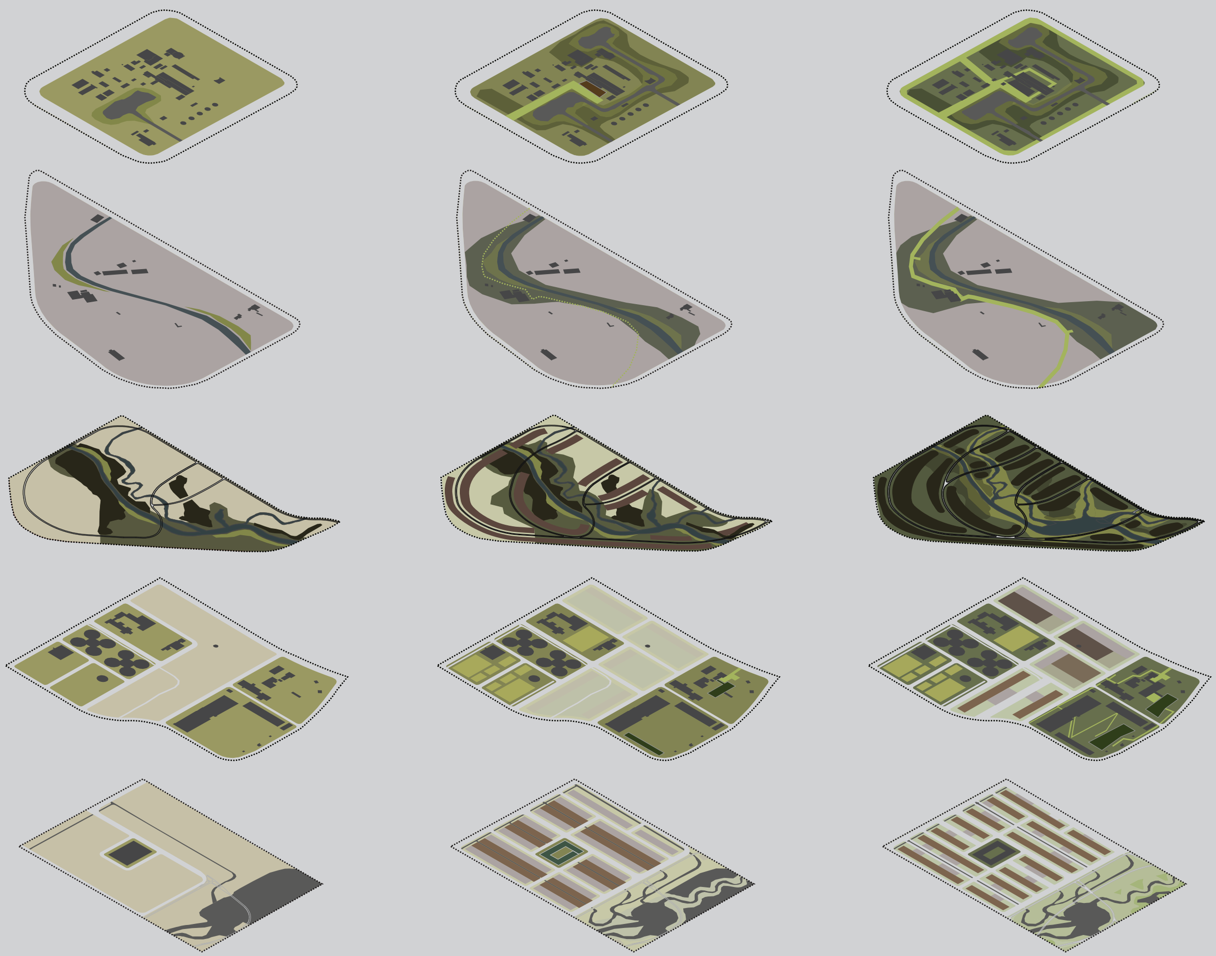
2040 +

ONWARD PROPAGATION

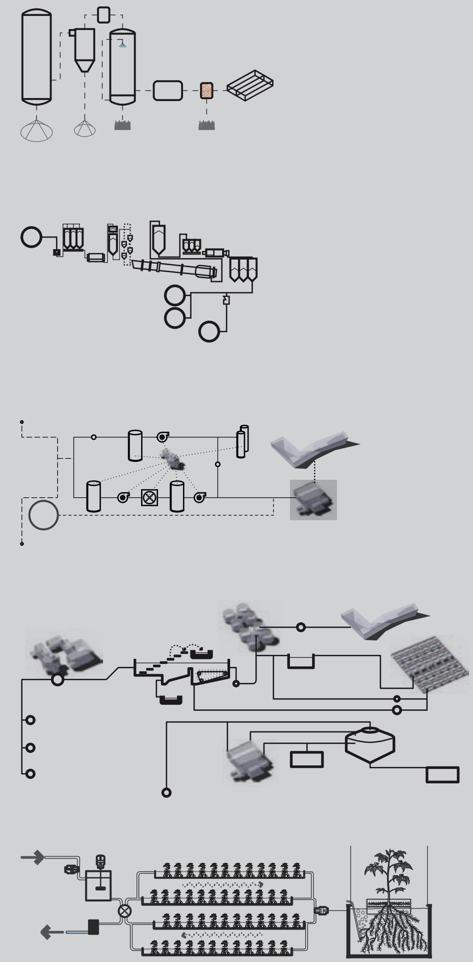
ANTICIPATED INTERVENTIONS:

- Infill of remedial fields is adapting and self-organizing to facilitate future trends
- Large roof areas carry on harvesting + remedial operations
- Incubators have a regional draw for visitors and researchers
- Solar aquatic labs are integrated with new buildings and site stormwater management
- Ongoing management continues with creek and basin estuary
- Soil deposit paths are adapted predominantly for passive recreation
- Planted savannah berms are maturing and may require some management
- Planted wetland areas are evolving successionally
- Globe park is a temporal process that seeks associated landscapes on adjacent sites

STAGES



OPERATIONS



NAME

HYBRID BIOMASS ENERGY & DISTRICT HEATING FACILITY + GIS INFORMATION COLLECTION CENTER + VISITOR CENTER + RECLAIMED GRASSLAND ECOSYSTEM + FISH PONDS + STORMWATER MANAGEMENT AREA

HYBRID AGGREGATE INTAKE SORTING CENTER + CEMENT MANUFACTURING PLANT + FISH PONDS + WETLAND ESTUARY + RECLAIMED GRASSLAND + EXTREME BIKING ZONE + BOARDWALK PROMENADE

HYBRID CLEAN FILL DUMPING AREAS + FORESTED BERMS + RECONSTRUCTED WATER COURSE + PLANTED MARSHLANDS + RECLAIMED GRASSLANDS + PASSIVE RECREATIONAL AREA

HYBRID SEWAGE TREATMENT PLANT + SOLAR AQUATIC WATER TREATMENT + ACTIVE RECREATIONAL AREA + RECLAIMED GRASS LAND + EDUCATIONAL FIELD TRIP CENTER + STEAM & TECHNOLOGY MUSEUM + BOTANICAL GREENHOUSE

HYBRID METALS REMEDIATION FIELDS + BIOMASS HARVESTING FIELDS + RHIZOFILTRATION SEEDING FACTORY + MULTILEVEL PARKADE + PARK BOULEVARD + TEMPORARY FRUIT MARKET

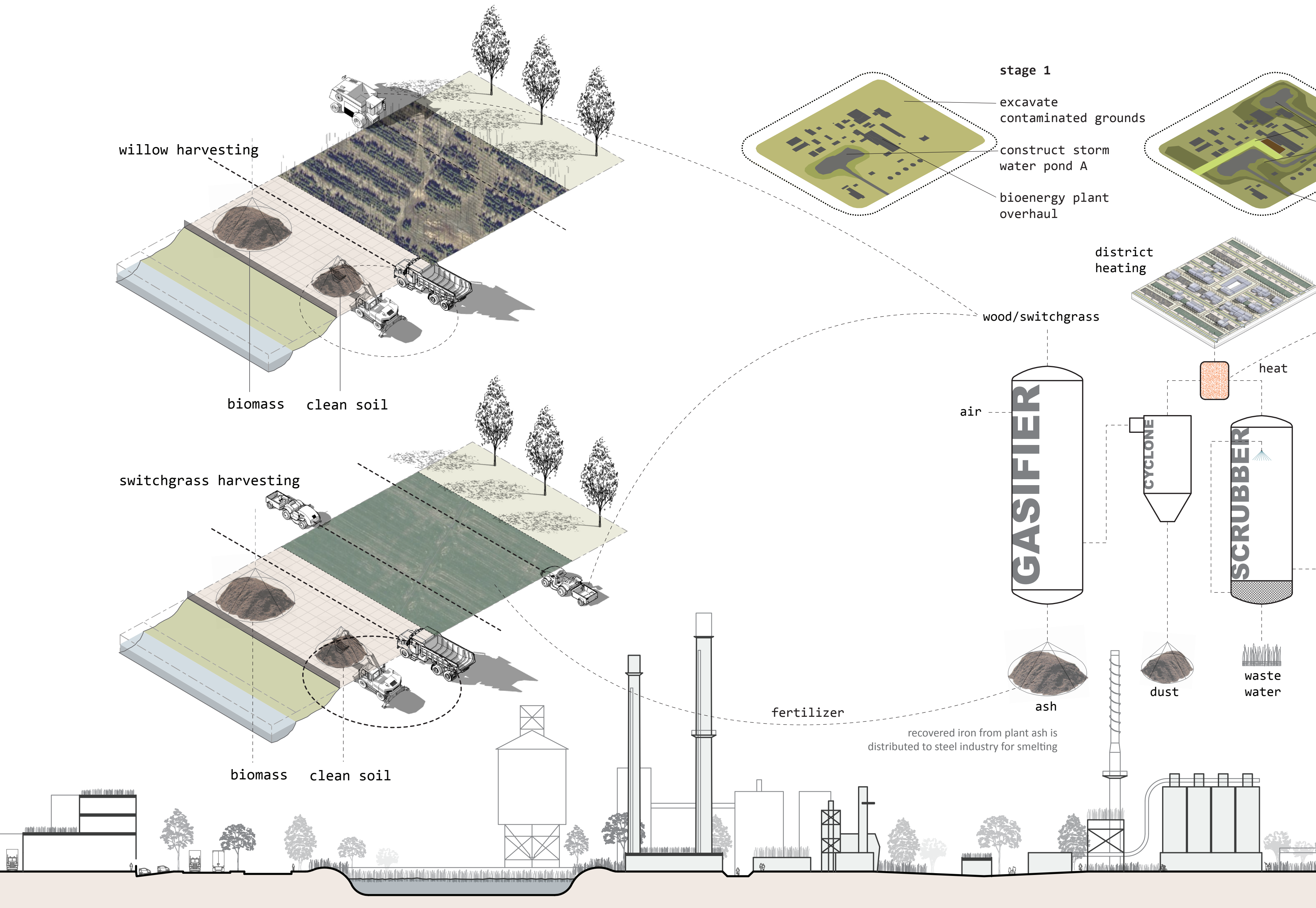
4.6 HYBRID CULTURAL, ECOLOGICAL, & INDUSTRIAL SPACES

Globe Park will have five distinct incubation areas that hybridize cultural, ecological, and industrial space. These sites will combine an operational industrial facility with ecological reclamation practices that will help treat the effluents that they create. These facilities provide basic services such as energy, wastewater treatment, material storage, building material, and heat to Globe Park. Excess materials, heat, and energy will be provided to the surrounding community as a service. The hybrid facilities are based on known technologies that are available. Combining their use creates a hybrid situation that is easier to maintain and operates symbiotically within the surrounding environment.

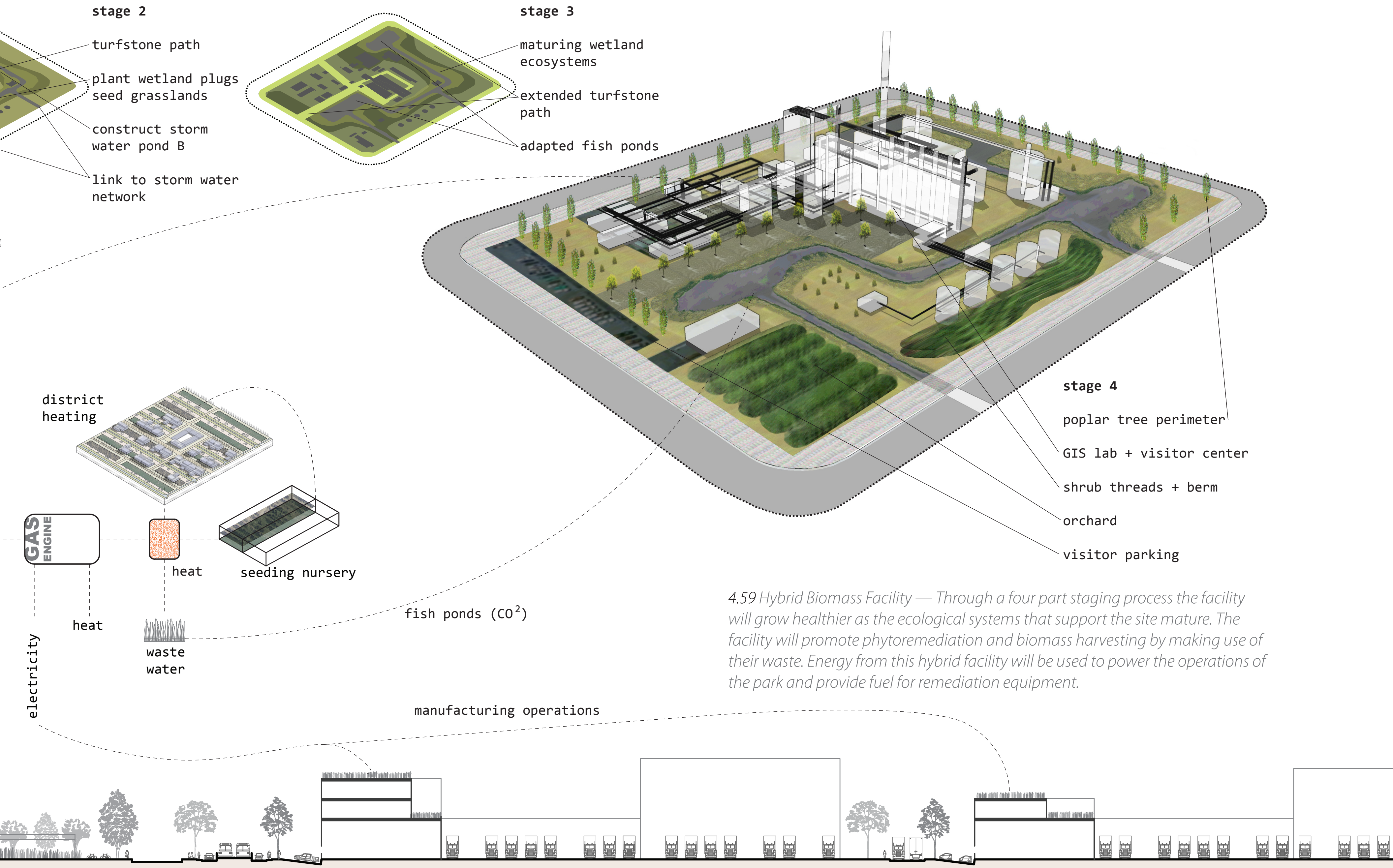
fig. 4.58 Carbon black facility at Columbia Chemicals site

HYBRID BIOMASS ENERGY & DISTRICT HEATING FACILITY + GIS INFORMATION COLLECTION CENTER + VISITOR CENTER + RECLAIMED GRASSLAND ECOSYSTEM + FISH PONDS + STORMWATER MANAGEMENT AREA

A hybrid space will be created on the site of the banked Columbian Chemicals carbon black industrial site. Initially contaminates will be excavated from the site and held in cells for remediation. The site will become a regional destination for harvested biomass crops particularly switchgrass and willow. The plant's operations will start with harvested remedial crops grown within Globe Park. A wider range of crops will be accepted based on compatibility and embodied energy characteristics. The following diagram represents the staging of the site's reclamation and anticipated operations of the plant. The plant will provide district heating for Globe Park and if possible to the surrounding community. Cogen will convert this thermal energy into electricity. The prototype biomass facility represents the future direction clean energy can take in facilitating ongoing remedial operations and public access.



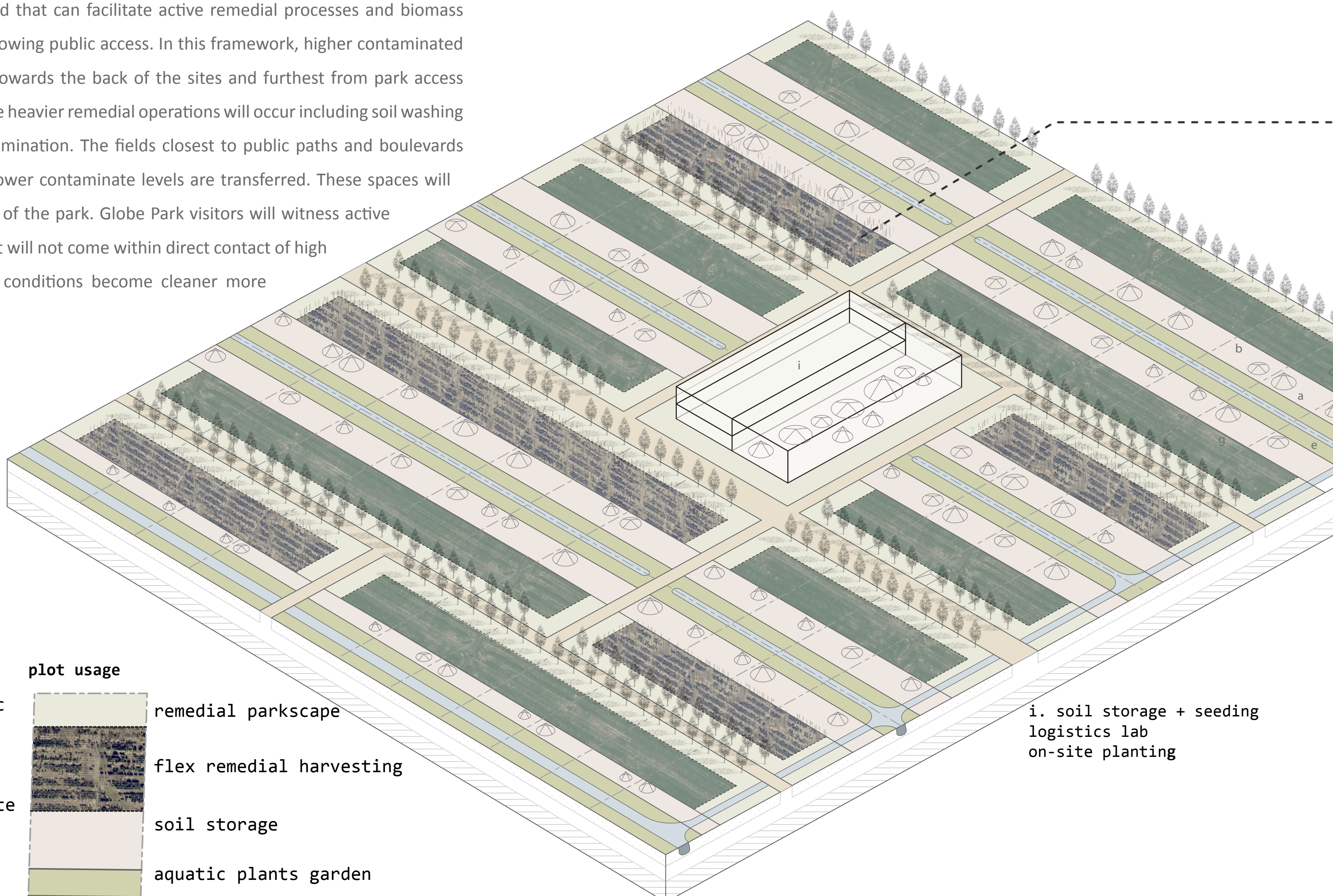
willow harvesting
biomass
clean soil
switchgrass harvesting
biomass
clean soil
stage 1
excavate contaminated grounds
construct storm water pond A
bioenergy plant overhaul
district heating
wood/switchgrass
heat
air
GASIFIER
CYCLONE
SCRUBBER
ash
dust
waste water
fertilizer
recovered iron from plant ash is distributed to steel industry for smelting



4.59 Hybrid Biomass Facility — Through a four part staging process the facility will grow healthier as the ecological systems that support the site mature. The facility will promote phytoremediation and biomass harvesting by making use of their waste. Energy from this hybrid facility will be used to power the operations of the park and provide fuel for remediation equipment.

HYBRID REMEDIAL + BIOMASS FIELDS

A framework is created that can facilitate active remedial processes and biomass crop harvests while allowing public access. In this framework, higher contaminated soil types are stored towards the back of the sites and furthest from park access pathways. This is where heavier remedial operations will occur including soil washing and microbial decontamination. The fields closest to public paths and boulevards are where soils with lower contaminate levels are transferred. These spaces will add to the experience of the park. Globe Park visitors will witness active remedial processes but will not come within direct contact of high contaminates. As soil conditions become cleaner more visitors will visit.



plot access

public
32%

private
68%

plot usage

remedial parkscape

flex remedial harvesting

soil storage

aquatic plants garden

storm water channel

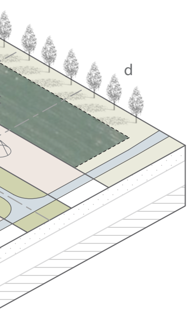


fig. 4.60 *Image of specialized high efficiency combine Harvesting willow crops*

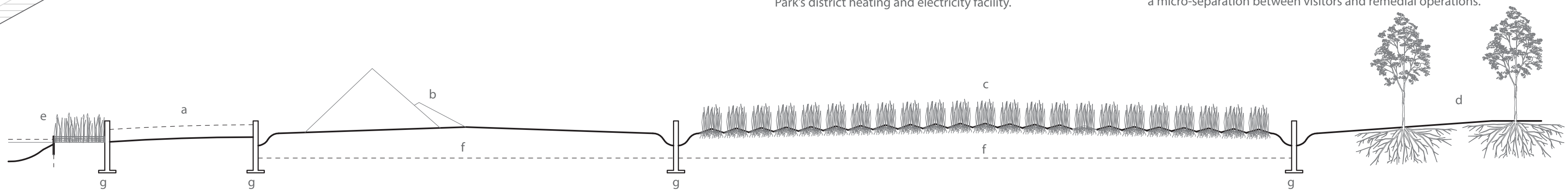
fig. 4.61 *Aerial of willow biomass crop harvesting in Denmark*

a. back of house easement
lane way with underground services including water to access sites

b. soil sorting area
soil washing and microbial soil treatment activities take place here intaking soils from excavated sites

c. switchgrass biomass harvesting
Phytoremediation takes place to improve soil quality. Maturing crops are harvested and transferred to Globe Park's district heating and electricity facility.

d. poplars and berms
Poplars will be planted to the edge of the sites facing public roads. Poplar roots have qualities that uptake metals from soil. They will be used to create a micro-separation between visitors and remedial operations.



e. remedial channel
Special wetland plug are planted to control surface rainwater flows. Waters with higher amounts of sediment that runoff will be reduced and ingested by plants to improve water quality.

f. geotextile underlayment
Special underground underlayments will be designed to allow the sites to be permeable. These geotextile fabrics will block contaminates trapped in soil and ground water from permeating through.

g. concrete remedial foundations
Specialized concrete foundations will be constructed to separate remedial operations. These will prevent mixing between different soil qualities. The foundations will be adaptable to future construction including warehousing and multistory buildings.

h. willow harvesting
Phytoremediation takes place to improve soil quality. Maturing crops will be manufactured into compressed heating pellets and used at Park's district heating and electricity facility.

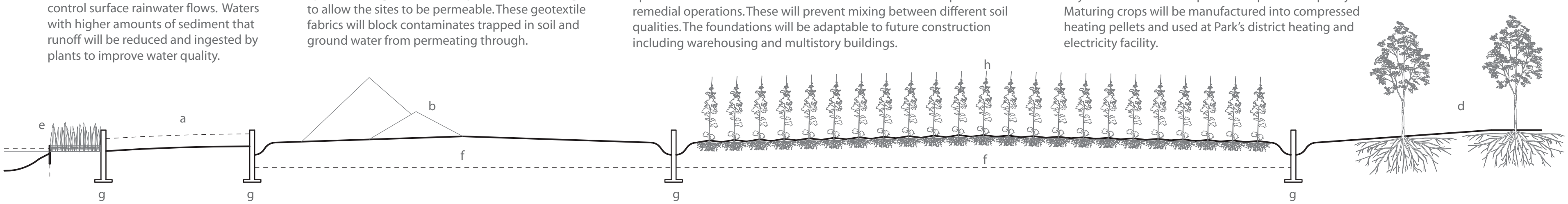


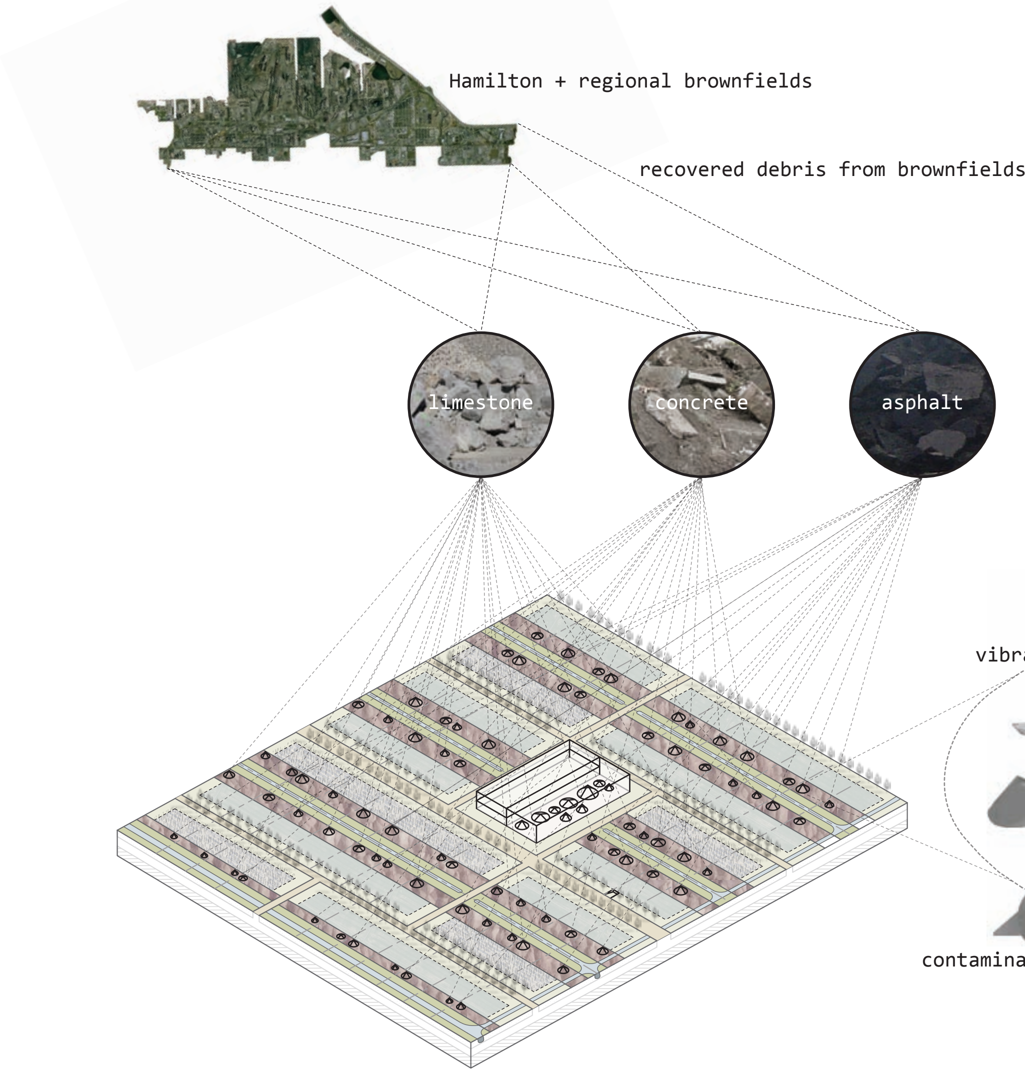
fig. 4.62 Stage 1 excavation and remediation of hybrid biomass facility showing moderate adaptation of paths

fig. 4.63 Stage 3 adaptation of hybrid biomass facility and associated grounds

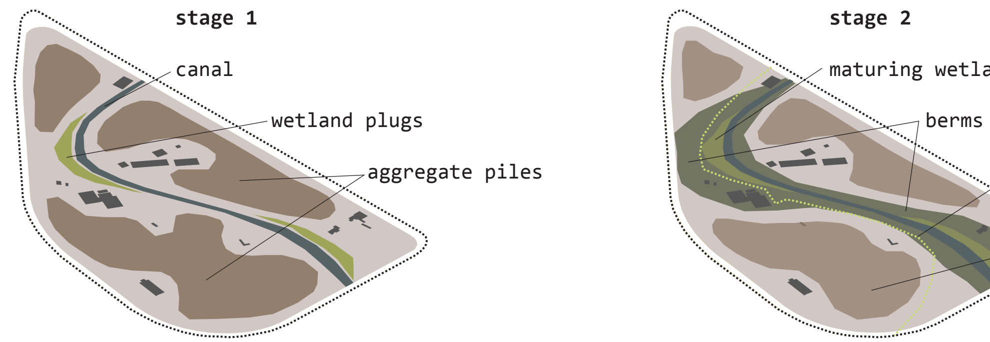
fig. 4.64 Aggregate piles on Lafarge site

HYBRID AGGREGATE INTAKE SORTING CENTER + CEMENT MANUFACTURING PLANT + FISH PONDS + WETLAND ESTUARY + RECLAIMED GRASSLAND + EXTREME BIKING ZONE + BOARDWALK PROMENADE

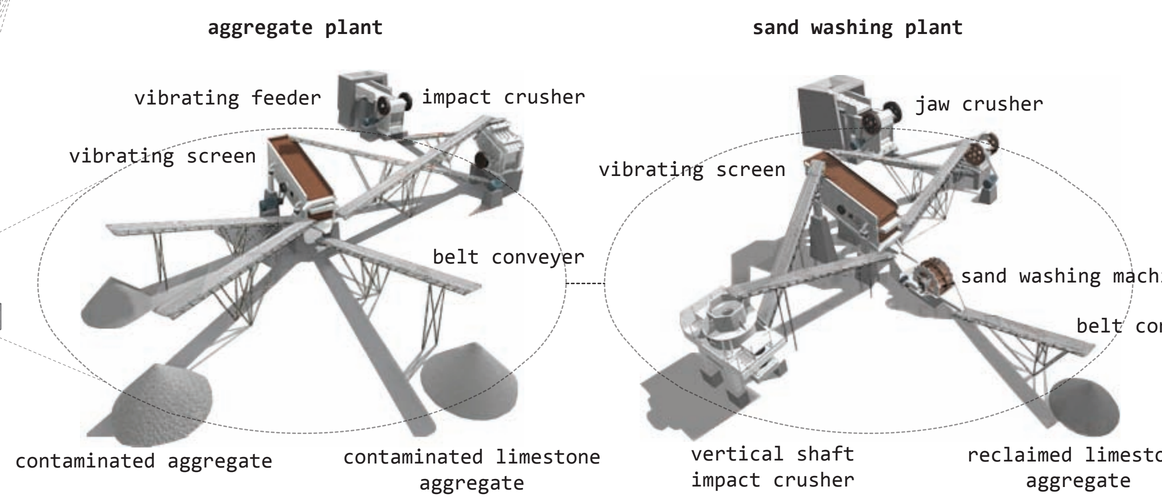
This hybrid area will combine the spatial operations of an aggregate and cement facility with space for visitation, recreation, and space to allow ecosystems to remediate potential fallout from the facility. Primarily the facility will find alternative use for construction debris within Globe Park and the city. The process will be temporal and will end once all recoverable debris in Globe Park is gone and there is no longer any need to process this material from the region. Once this time is reached, the site will remain a conserved open space with primarily recreational and ecological uses. During the facility's operational time frame, aggregate areas not in use will be adapted for extreme recreational activity (ie. stunt biking). When these areas of piled aggregate are needed by the facility, industrial use will resume. When industrial operations resume, the extreme recreational activities will move elsewhere within the park.



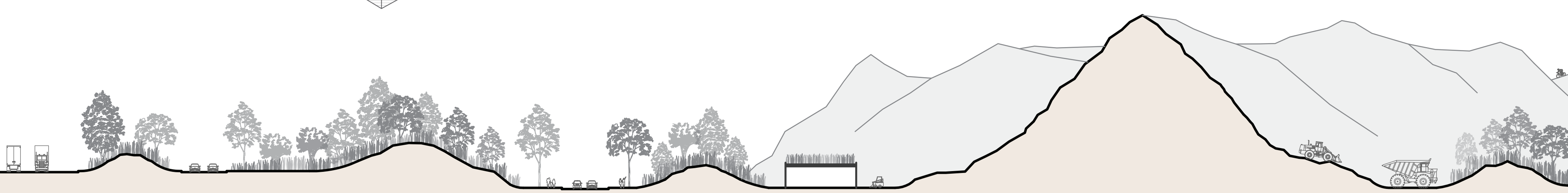
Hamilton + regional brownfields
recovered debris from brownfields
limestone
concrete
asphalt



stage 1
canal
wetland plugs
aggregate piles
stage 2
berms



aggregate plant
vibrating feeder
impact crusher
vibrating screen
belt conveyer
contaminated aggregate
contaminated limestone aggregate
sand washing plant
jaw crusher
vibrating screen
vertical shaft impact crusher
aggregate



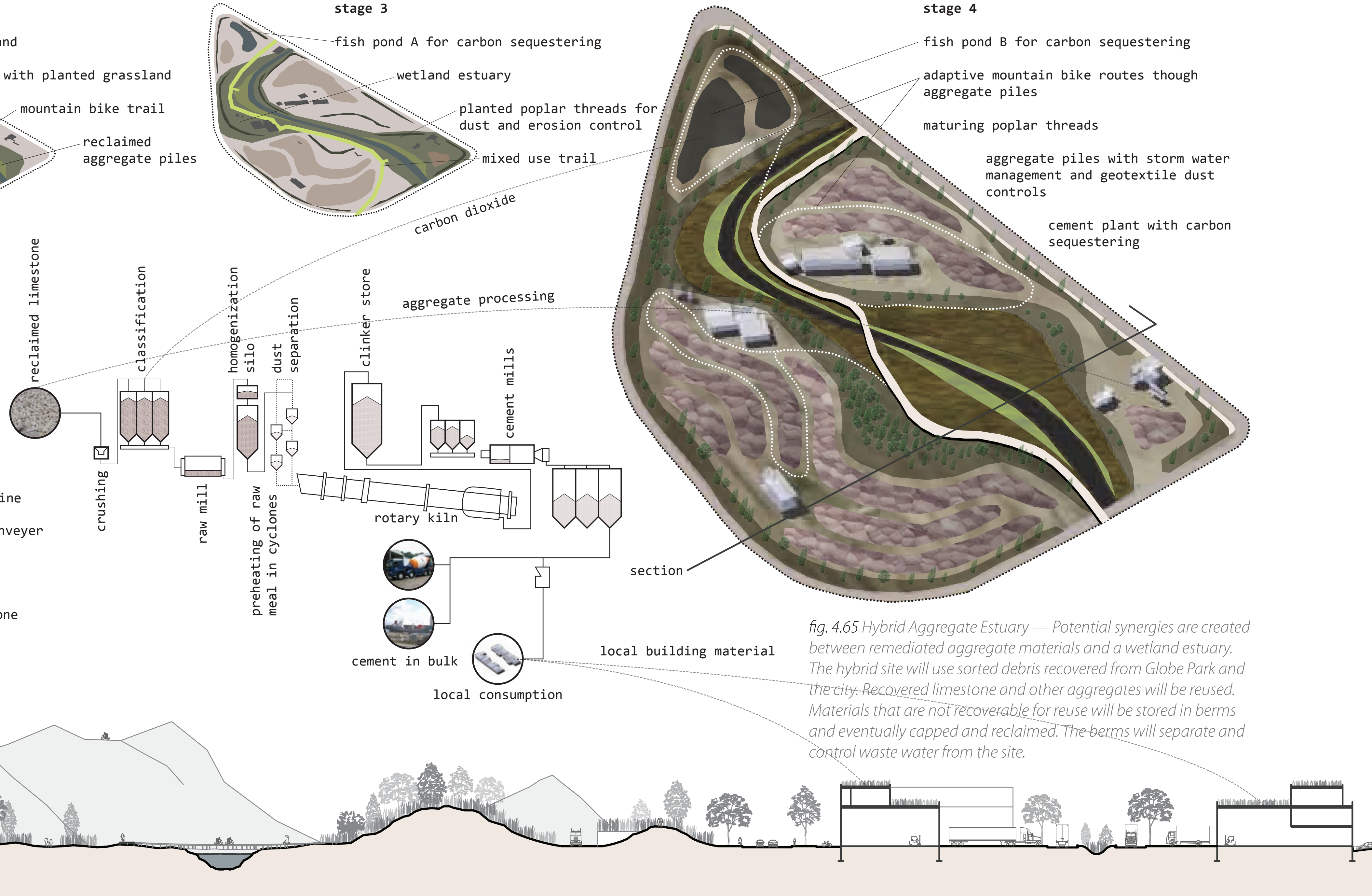


fig. 4.65 Hybrid Aggregate Estuary — Potential synergies are created between remediated aggregate materials and a wetland estuary. The hybrid site will use sorted debris recovered from Globe Park and the city. Recovered limestone and other aggregates will be reused. Materials that are not recoverable for reuse will be stored in berms and eventually capped and reclaimed. The berms will separate and control waste water from the site.

fig. 4.66 *Aggregate piles on Lafarge site during stage 3 adaptation — Landscape berms will separate waste water from the aggregate site. The sorting operations are a temporal process. When Globe Park's berms are at capacity the Lafarge aggregate site will be reclaimed.*

fig. 4.67 Red Hill Creek one kilometer from Windermere Basin

HYBRID CLEAN FILL DUMPING AREAS + FORESTED BERMS + RECONSTRUCTED WATER COURSE + PLANTED MARSHLANDS + RECLAIMED GRASSLANDS + PASSIVE RECREATIONAL AREA

This space fulfills the role of active dumping grounds within the park. Initially it is where all unwanted nonreusable fill is disposed. The fill will need to be environmentally benign. As described in the operational diagram on the following page, the dumping areas form large berms overtime. To facilitate dumping into this region of the park a network of concrete turfstone paths will be constructed. In addition to this, a network of bridges will be constructed to cross Red Hill Creek in an ecologically sound way. As the berms are filled and less fill is available for disposal, these areas will be capped with clean topsoil and planted with grasses and broad leaf trees. These reclaimed berms will be self-organizing after this initial intervention. Speculatively, the new planting will help erosion and ground water flow. This will help improve water quality of Red Hill Creek’s reconstructed water course. A methane collection system already exists as part of the former Rennie Street landfill reclamation project. This system will continue to operate as new fill is added to the site. Methane collected from the fill will be transferred to the methane storage globe at the treatment plant. This will add to Globe Park’s energy production capacity.

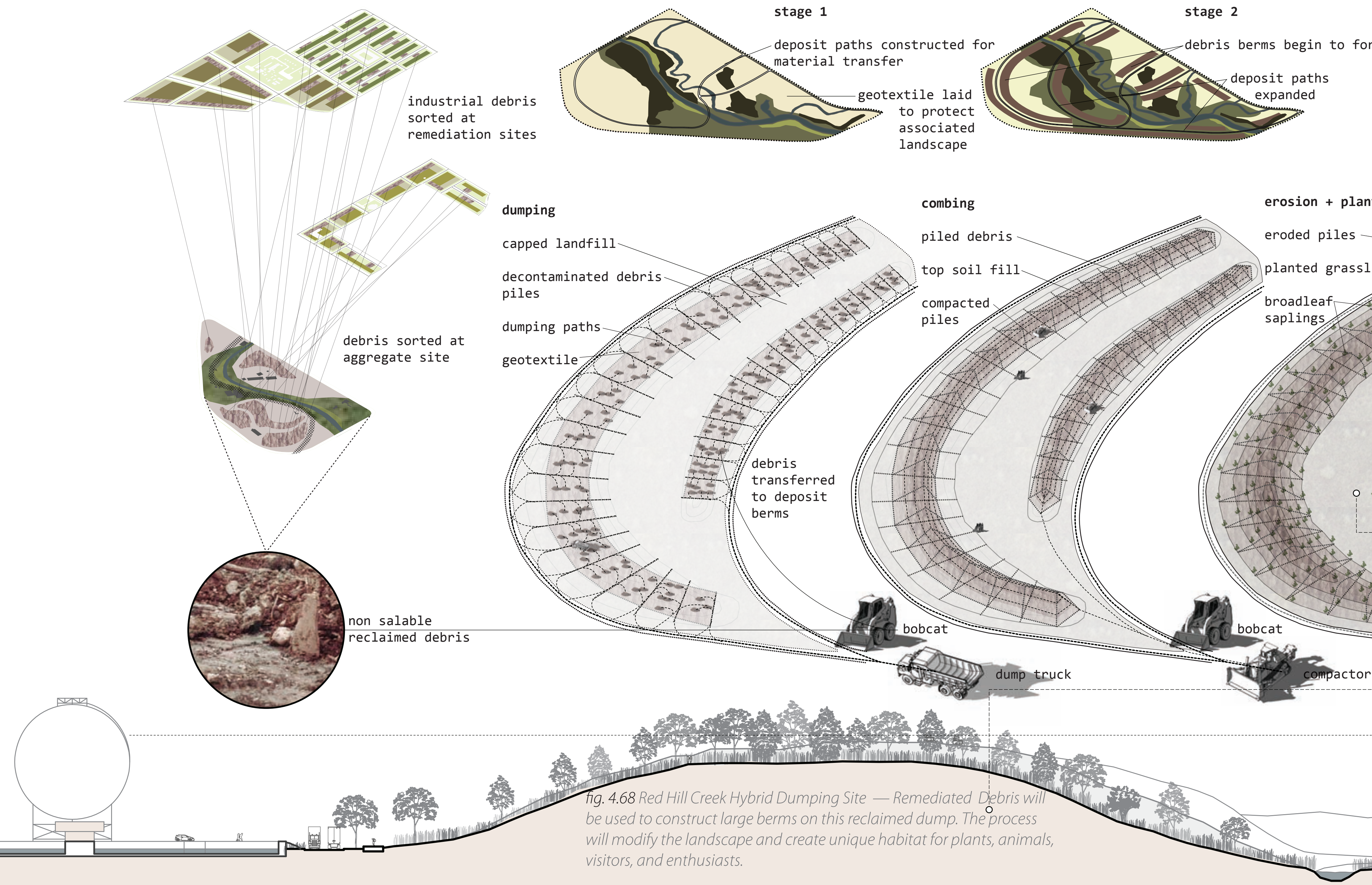


fig. 4.68 Red Hill Creek Hybrid Dumping Site — Remediated Debris will be used to construct large berms on this reclaimed dump. The process will modify the landscape and create unique habitat for plants, animals, visitors, and enthusiasts.

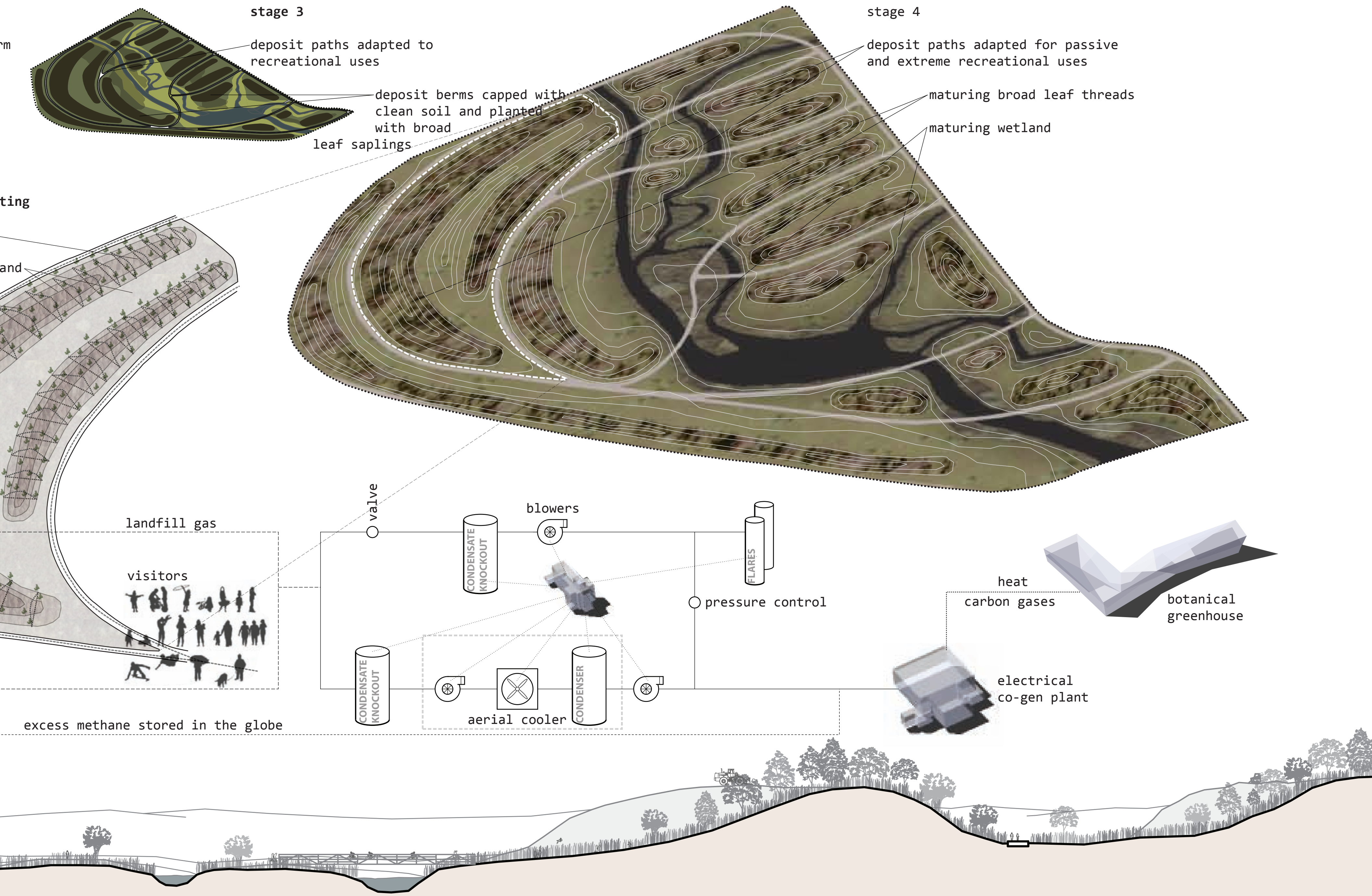
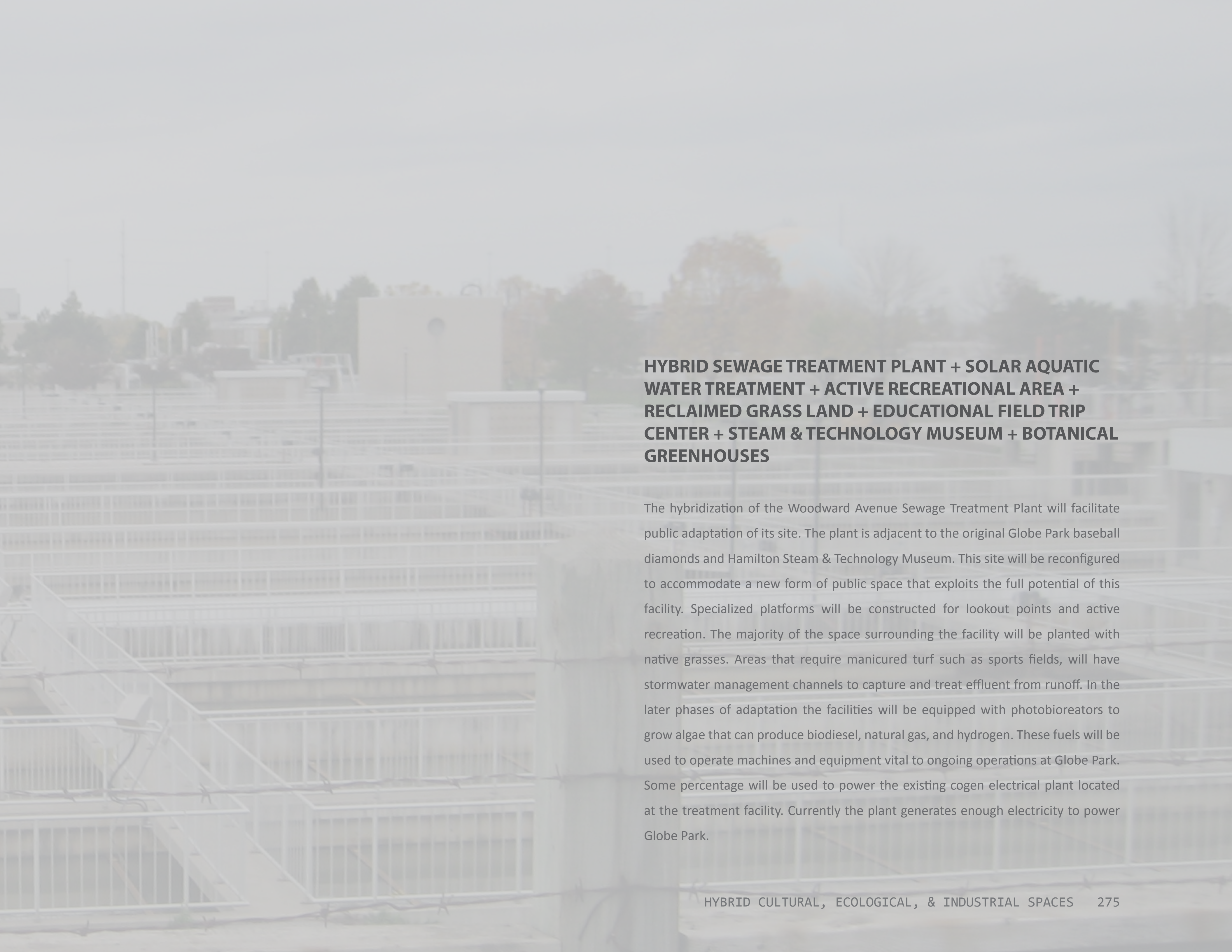

stage 3
deposit paths adapted to recreational uses
deposit berms capped with clean soil and planted with broad leaf saplings
stage 4
deposit paths adapted for passive and extreme recreational uses
maturing broad leaf threads
maturing wetland
landfill gas
valve
blowers
CONDENSATE KNOCKOUT
FLARES
pressure control
heat
carbon gases
botanical greenhouse
visitors
aerial cooler
CONDENSER
electrical co-gen plant
excess methane stored in the globe

fig. 4.69 Red Hill Creek reconstruction during stage 2 — During this time, clean dumping processes have started and primary dumping paths and bridges have been constructed. Some temporary occupations of the site are facilitated.


bobcat
753

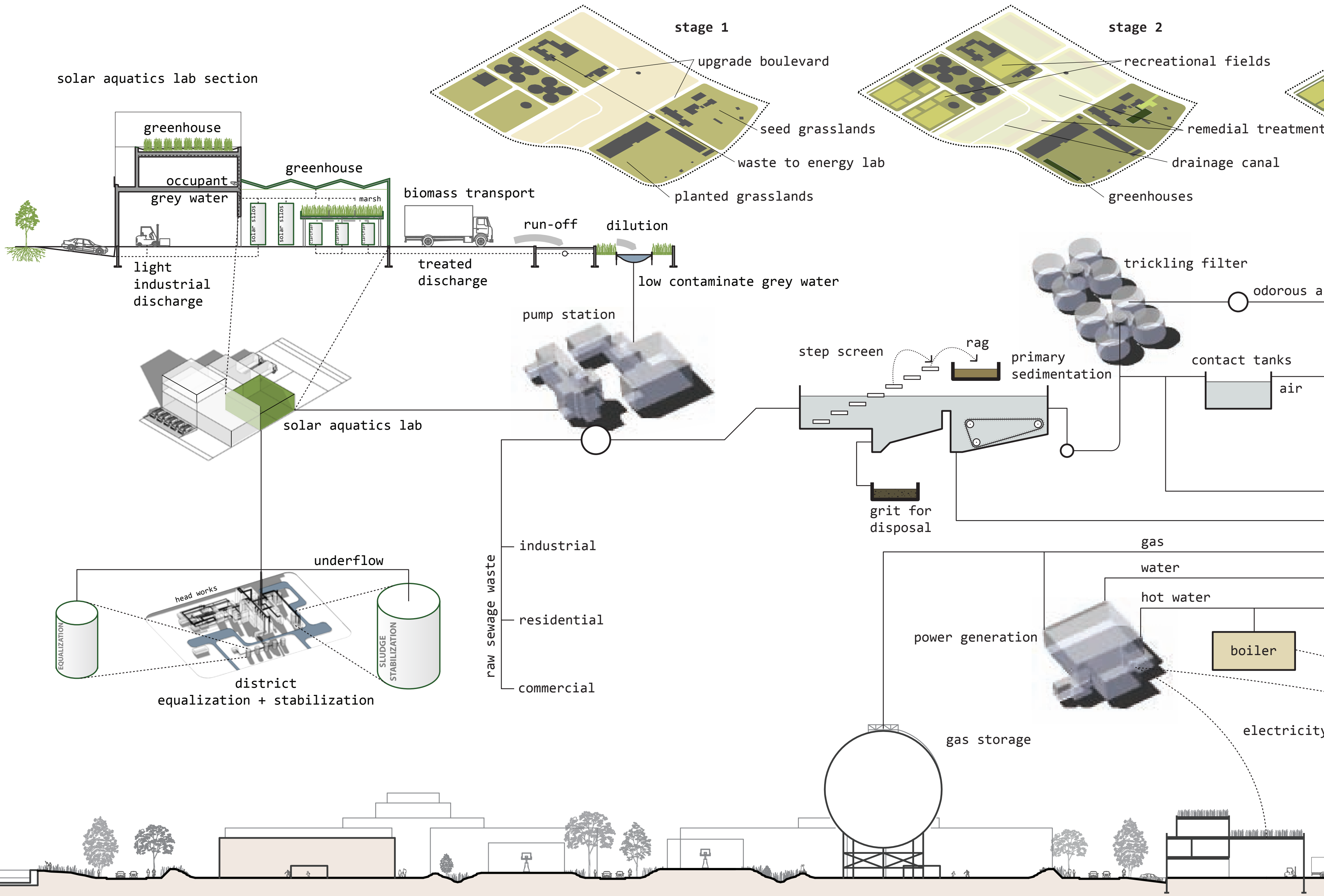
fig. 4.70 Red Hill Creek reconstruction during stage 3. During this time some of the dumping berms have been capped with clean top soil. These capped berms will be adapted to both passive and recreational uses.

fig. 4.71 Woodward Avenue Sewage Treatment pools



HYBRID SEWAGE TREATMENT PLANT + SOLAR AQUATIC WATER TREATMENT + ACTIVE RECREATIONAL AREA + RECLAIMED GRASS LAND + EDUCATIONAL FIELD TRIP CENTER + STEAM & TECHNOLOGY MUSEUM + BOTANICAL GREENHOUSES

The hybridization of the Woodward Avenue Sewage Treatment Plant will facilitate public adaptation of its site. The plant is adjacent to the original Globe Park baseball diamonds and Hamilton Steam & Technology Museum. This site will be reconfigured to accommodate a new form of public space that exploits the full potential of this facility. Specialized platforms will be constructed for lookout points and active recreation. The majority of the space surrounding the facility will be planted with native grasses. Areas that require manicured turf such as sports fields, will have stormwater management channels to capture and treat effluent from runoff. In the later phases of adaptation the facilities will be equipped with photobioreators to grow algae that can produce biodiesel, natural gas, and hydrogen. These fuels will be used to operate machines and equipment vital to ongoing operations at Globe Park. Some percentage will be used to power the existing cogen electrical plant located at the treatment facility. Currently the plant generates enough electricity to power Globe Park.


stage 1
upgrade boulevard
seed grasslands
waste to energy lab
planted grasslands
stage 2
recreational fields
remedial treatment
drainage canal
greenhouses
solar aquatics lab section
greenhouse
occupant
grey water
greenhouse
marsh
solar silos
solar silos
biomass transport
run-off
dilution
light
industrial
discharge
treated
discharge
low contaminate grey water
trickling filter
odorous a
pump station
step screen
rag
primary
sedimentation
contact tanks
air
solar aquatics lab
grit for
disposal
industrial
raw sewage waste
residential
commercial
underflow
head works
EQUALIZATION
SLUDGE STABILIZATION
district
equalization + stabilization
gas
water
hot water
power generation
boiler
electricity
gas storage

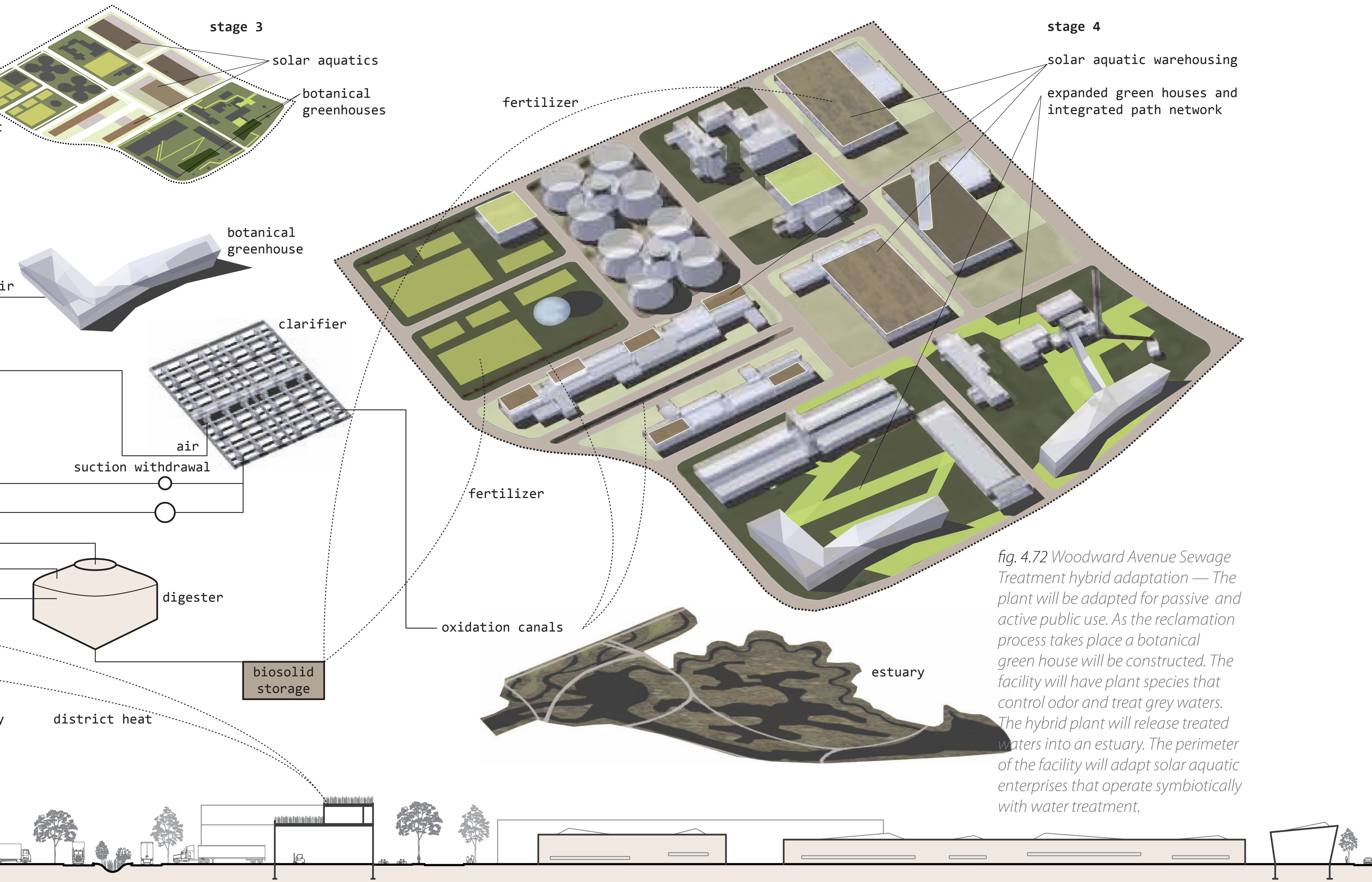


fig. 4.72 *Woodward Avenue Sewage Treatment hybrid adaptation — The plant will be adapted for passive and active public use. As the reclamation process takes place a botanical green house will be constructed. The facility will have plant species that control odor and treat grey waters. The hybrid plant will release treated waters into an estuary. The perimeter of the facility will adapt solar aquatic enterprises that operate symbiotically with water treatment.*

fig. 4.73 Woodward Sewage Treatment Plant during stage 2 — During this time grassland reclamation has begun, new paths are created and partly adapted, and more access is facilitated for active recreation. Park visitation is promoted for educational purposes. Speculatively, recovered gases from sewage process can be used to fill balloons. Visitors could be offered aerial views of the park from these balloons.

fig. 4.74 Woodward Avenue Sewage Treatment during stage 3 adaptation — With smells of the treatment plant diverted to a botanical greenhouse, and other treatment processes, the surrounding environment can facilitate active recreation


HAMILTON

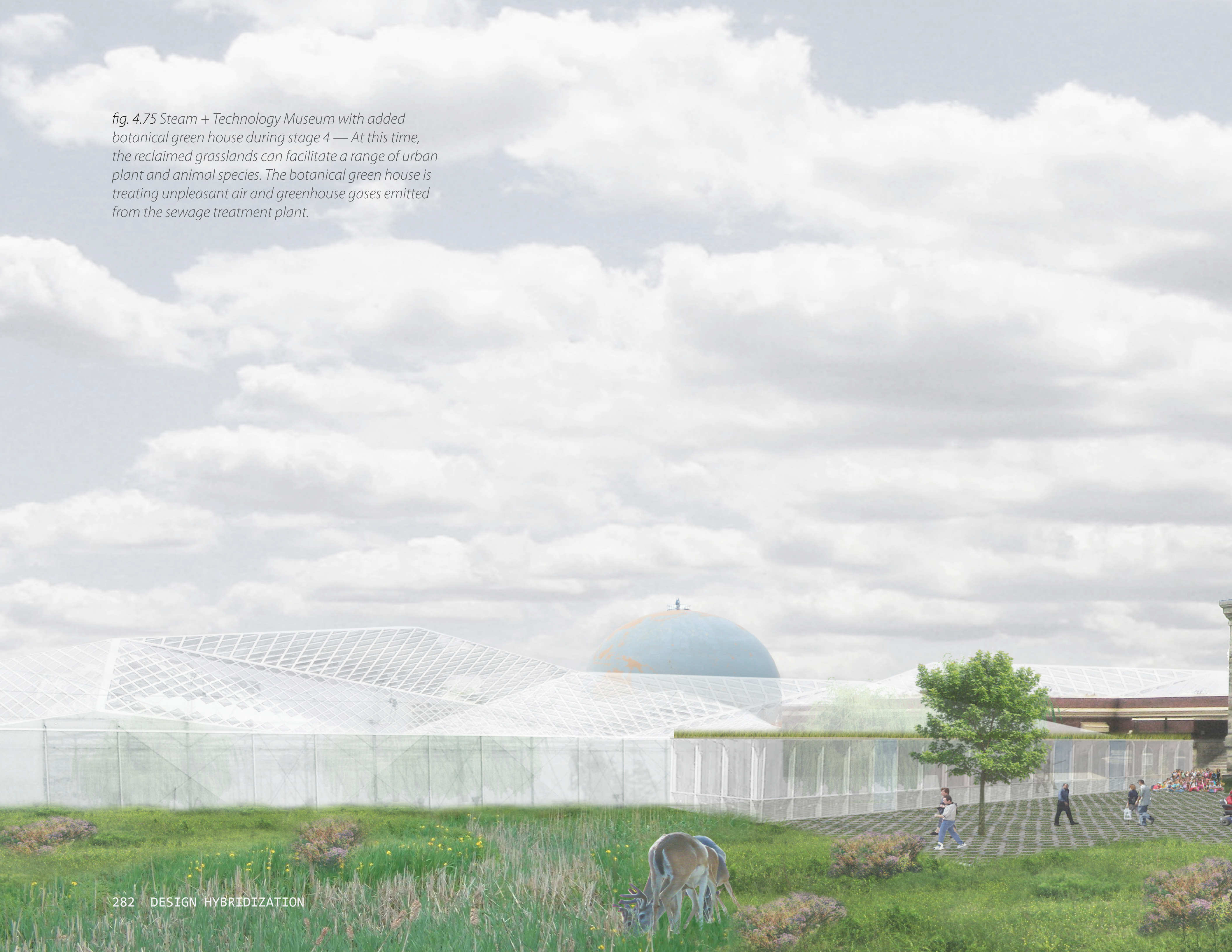


fig. 4.75 Steam + Technology Museum with added botanical green house during stage 4 — At this time, the reclaimed grasslands can facilitate a range of urban plant and animal species. The botanical green house is treating unpleasant air and greenhouse gases emitted from the sewage treatment plant.

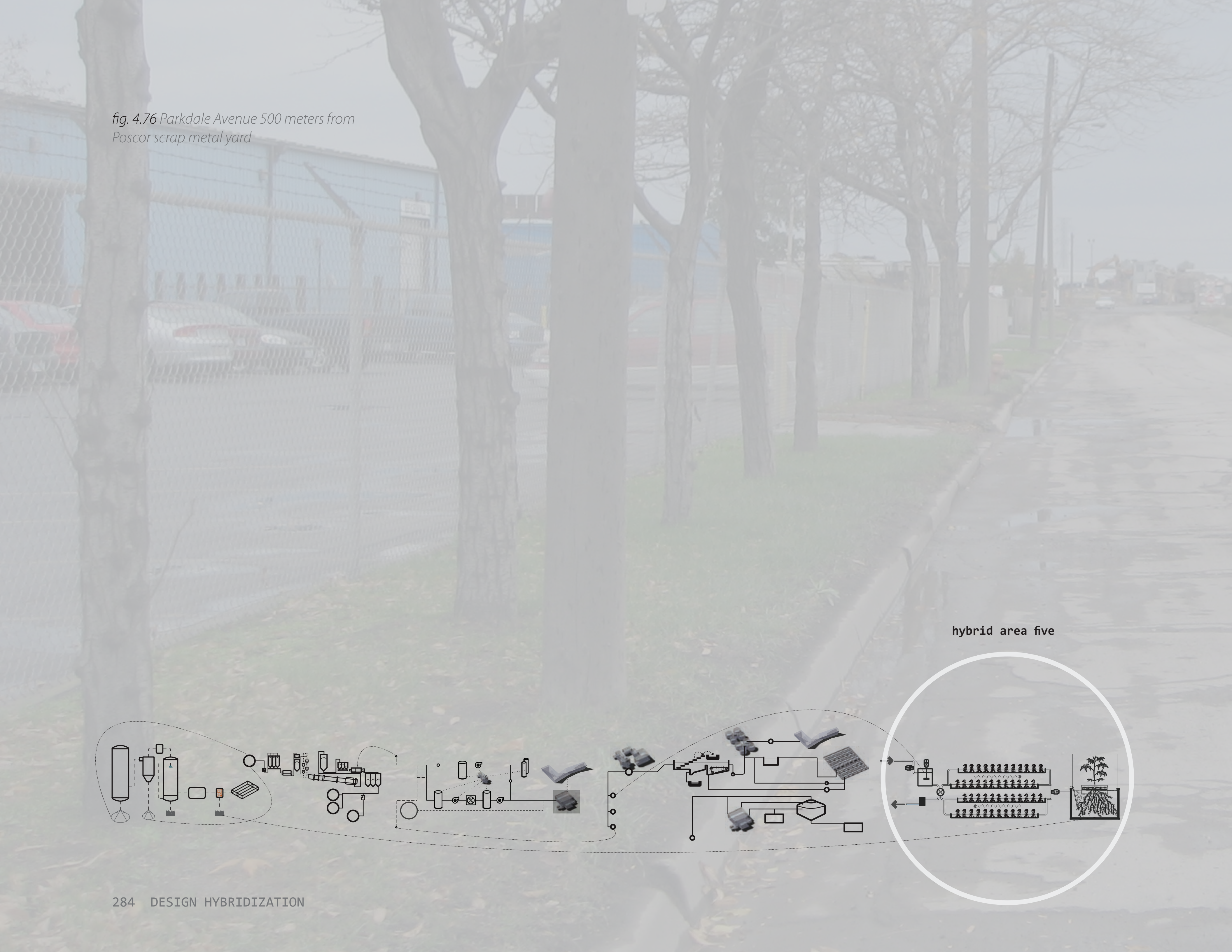
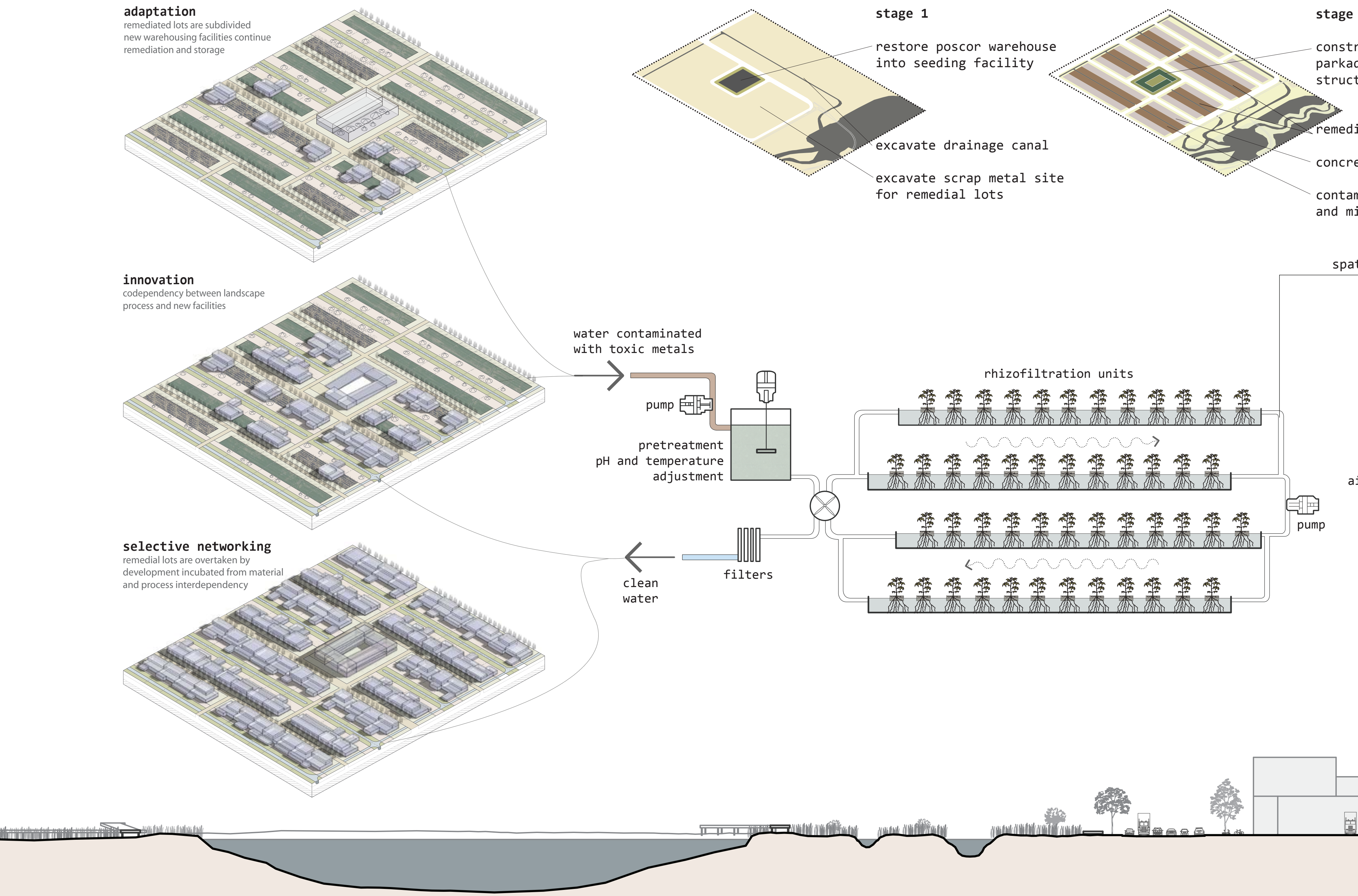
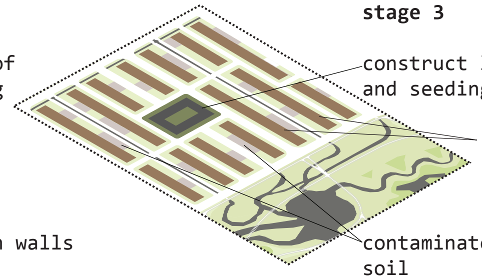


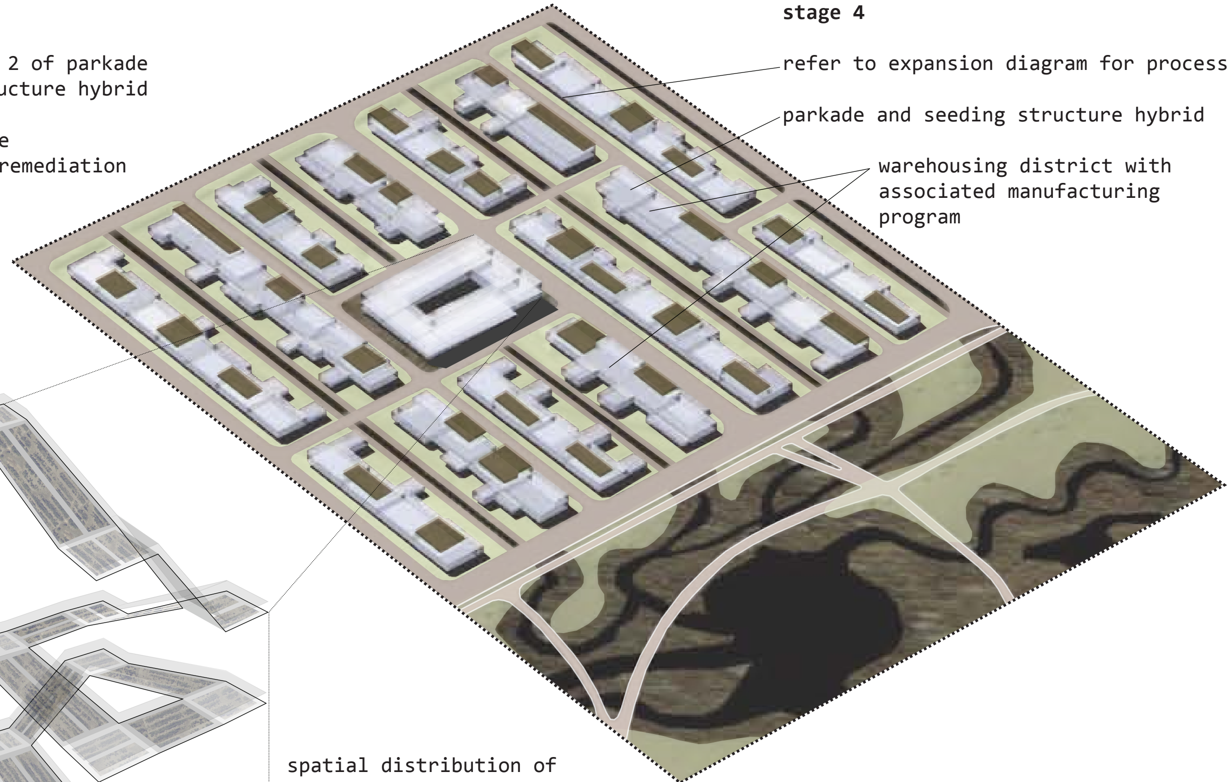
fig. 4.76 Parkdale Avenue 500 meters from Poscor scrap metal yard

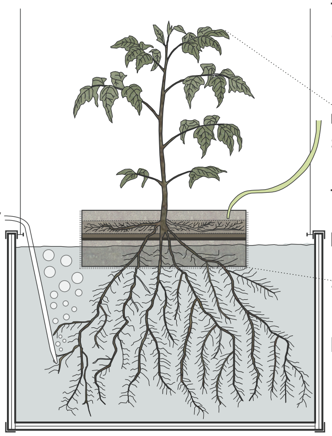
HYBRID METALS REMEDIATION FIELDS + BIOMASS HARVESTING FIELDS + RHIZOFILTRATION SEEDING FACTORY + MULTILEVEL PARKADE + PARK BOULEVARD + TEMPORARY MARKET

This former scrap metal area will be remediated to recover trace amounts of metals deposited in soils. From the plant species, energy will be acquired from harvested crops. These crops will initially be seeded in a retrofitted lab located in the former Poscor metals warehouse. This lab will clone seeds and incubate plants hydroponically using a process called rhizofiltration. Rhizofiltration will channel waters with high concentrations of metals received from the site and the harbour for decontamination. Over time this facility will expand into a combined parkade and seeding lab hybrid. When parking is combined with the rhizofiltration lab, metallic effluent from vehicles will be channeled through the system. Once the plant species mature they will be transplanted at the adjacent phytoremediation fields. Growing the plants first in the lab will speed up the process and improve their initial resiliency to soil contaminates. The seeding lab parkade hybrid and associated remedial fields will be connected by a grid of paths. These paths can accommodate both public visitation and material transfers within the area.


adaptation
remediated lots are subdivided
new warehousing facilities continue
remediation and storage
innovation
codependency between landscape
process and new facilities
selective networking
remedial lots are overtaken by
development incubated from material
and process interdependency
stage 1
restore poscor warehouse
into seeding facility
excavate drainage canal
excavate scrap metal site
for remedial lots
stage
water contaminated
with toxic metals
pump
pretreatment
pH and temperature
adjustment
rhizofiltration units
pump
filters
clean
water







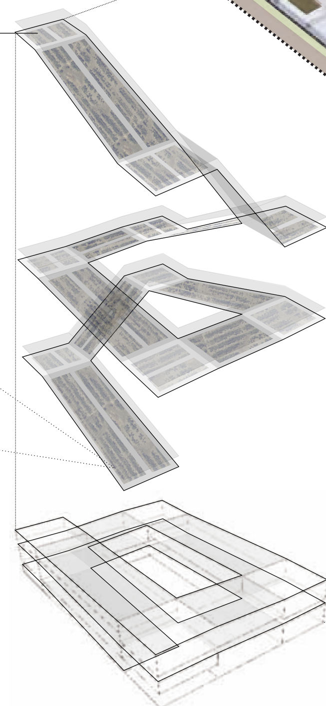
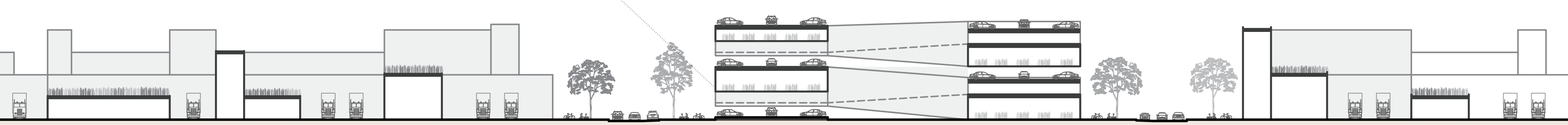
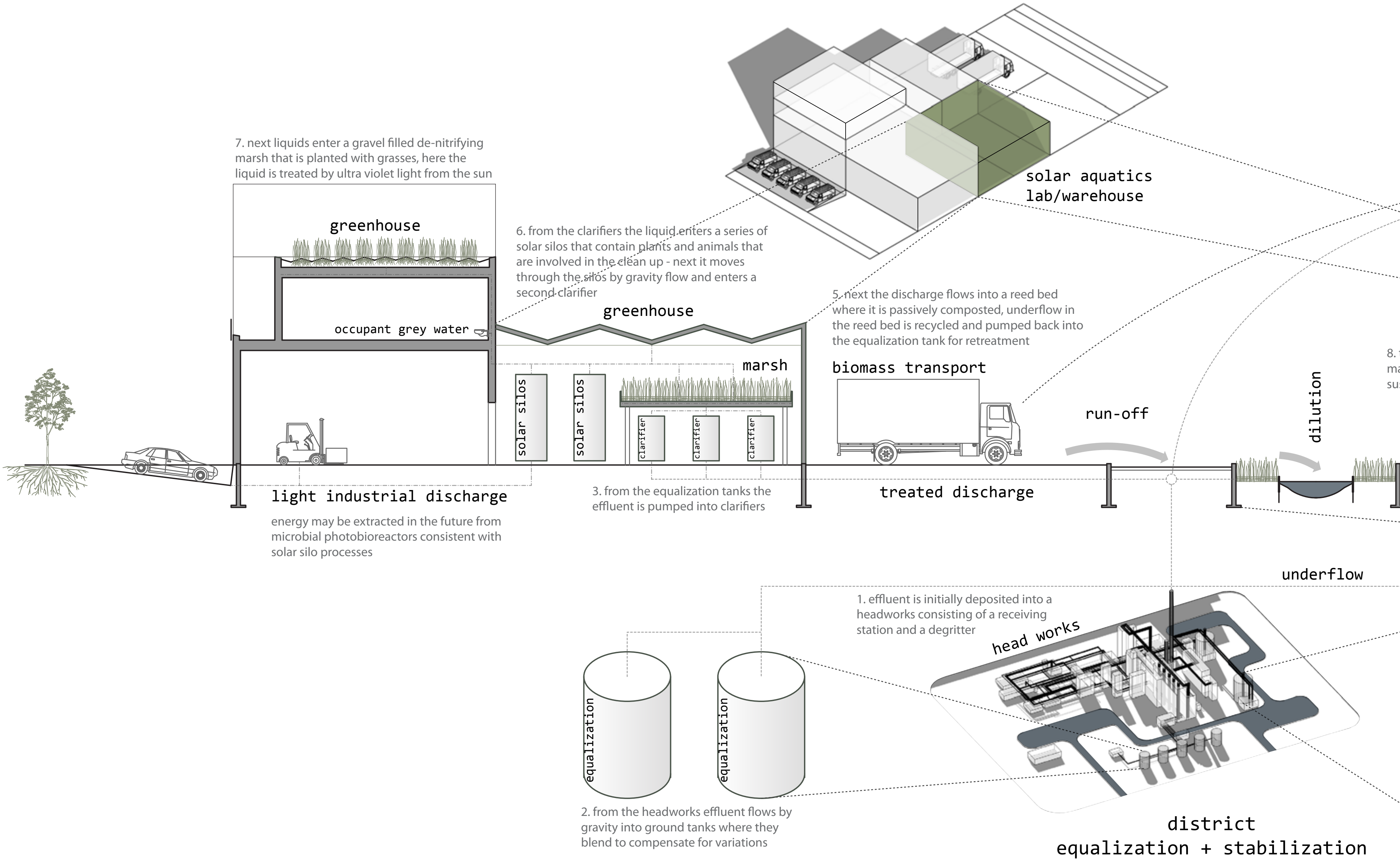


fig. 4.77 Hybrid Seeding Lab and Parkade — The seeding lab will be the coordination center of remedial activities on former scrap metal sites. The lab will filter contaminated grey water through a rhizofiltration system. The system will incubate seedlings which will be planted at adjacent biomass fields within Globe Park. The plants will accumulate toxins within the soil. When harvested these metallic particulates can be recovered and redistributed. The plants biomass will be converted into electricity and fuel to feed park operations.




solar aquatics
lab/warehouse
7. next liquids enter a gravel filled de-nitrifying marsh that is planted with grasses, here the liquid is treated by ultra violet light from the sun
greenhouse
6. from the clarifiers the liquid enters a series of solar silos that contain plants and animals that are involved in the clean up - next it moves through the silos by gravity flow and enters a second clarifier
5. next the discharge flows into a reed bed where it is passively composted, underflow in the reed bed is recycled and pumped back into the equalization tank for retreatment
greenhouse
occupant grey water
marsh
biomass transport
solar silos
solar silos
clarifier
clarifier
clarifier
run-off
dilution
light industrial discharge
energy may be extracted in the future from microbial photobioreactors consistent with solar silo processes
3. from the equalization tanks the effluent is pumped into clarifiers
treated discharge
underflow
1. effluent is initially deposited into a headworks consisting of a receiving station and a degritter
head works
equalization
equalization
2. from the headworks effluent flows by gravity into ground tanks where they blend to compensate for variations
district
equalization + stabilization

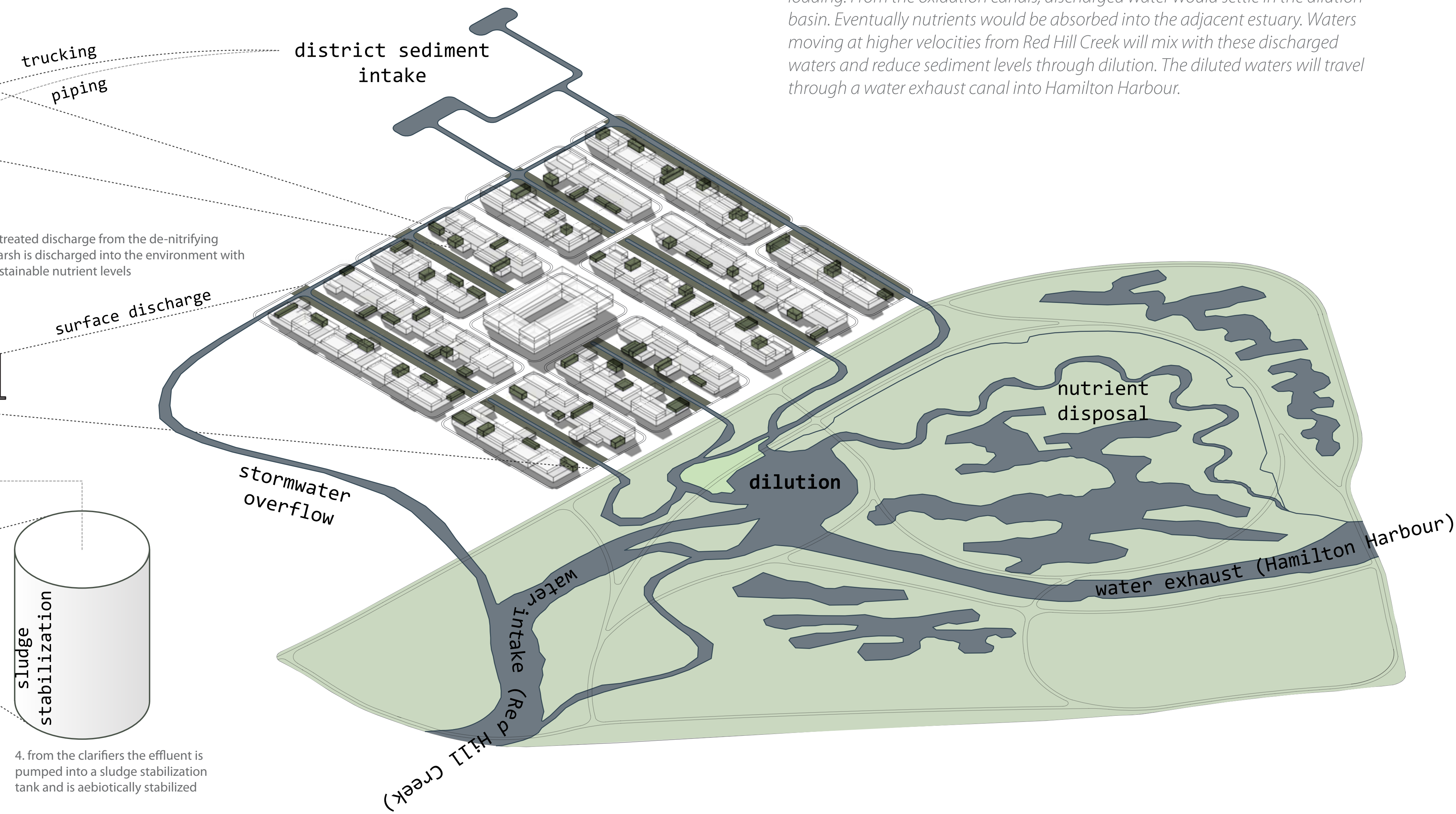
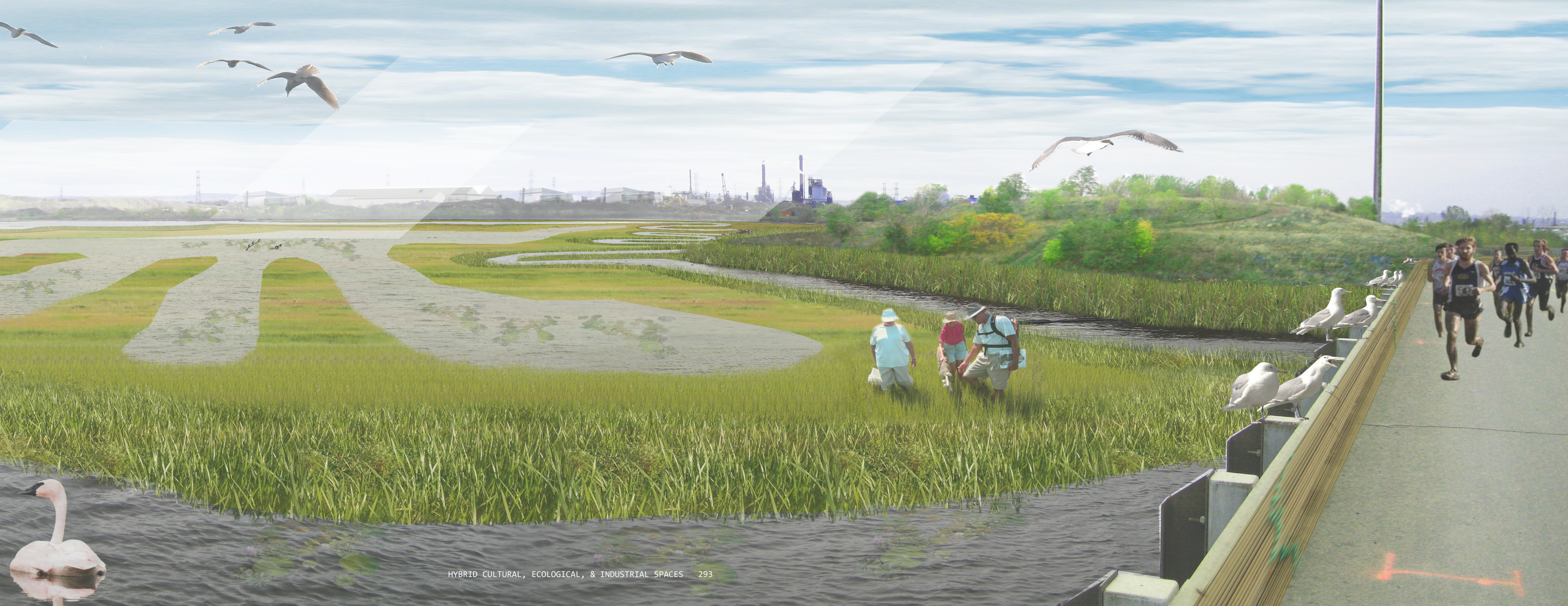


fig. 4.77 *Hybrid Solar Aquatic Labs and Estuary — Speculatively, as the operations within Globe Park become more environmentally benign, solar aquatic methods of treating grey water may be used by new facilities. The water used in these systems would be discharged in a network of canals for oxidation and nutrient loading. From the oxidation canals, discharged water would settle in the dilution basin. Eventually nutrients would be absorbed into the adjacent estuary. Waters moving at higher velocities from Red Hill Creek will mix with these discharged waters and reduce sediment levels through dilution. The diluted waters will travel through a water exhaust canal into Hamilton Harbour.*

fig. 4.78 *Globe Park's metal remedial fields during stage 2 — At this time Parkdale Boulevard is able to support a range of recreational activities while soil sorting and remediation occur in the background. Grassland berms distance the boulevard from remedial activity.*

fig. 4.79 Windermere Basin during stage 4 is channelized with a settling pool and wetland area — Ongoing management takes place within this tertiary water treatment area to ensure light recreation activities can be maintained and plant and animal habitat is healthy.



4.7 NETWORK DIAGRAM

The network diagram depicts the whole interaction among Globe Park's site operations. Materials are exchanged within a selective self-organized network. Overtime the materials excavated within the park are cleaned and put to new use. The outcome is a by-product of process. As much as possible is created from within. The outcome is a holistic network of exchanges between temporal hybrid spaces. This succession is experienced overtime as the networking leads to the health of the space. Material resourcefulness evolves out of these exchange networks. Cultural, ecological, and industrial interactions become more intense as this evolution occurs. Speculatively, a new and unforeseen speciality emerges within. When this occurs, Globe Park manifests itself as an entirely new way of experiencing the internal operations of a city. This network diagram represents a framework. As the park evolves information will become more concentrated and adjust to newly developed information. More design specifics can be filled in as experts reveal technical methodologies. These adjustments will affect how the space evolves and its future adaptability.

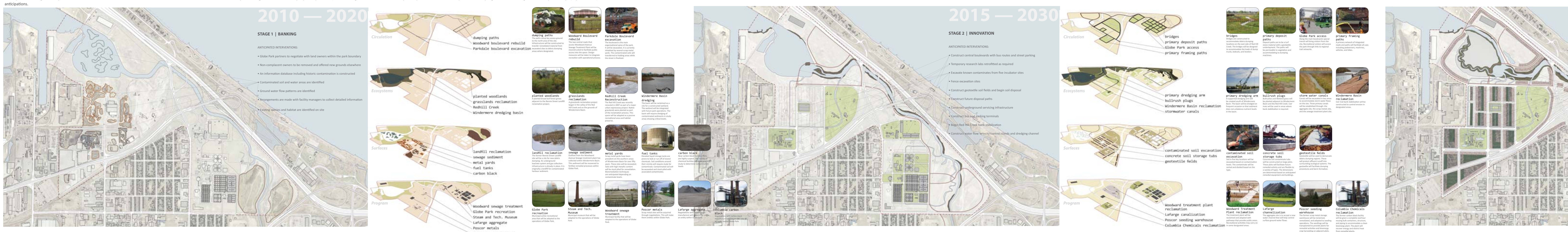
PARK SUCCESSION

Globe Park is an urban space that will change over time as a result of external local, regional, provincial, national, and international influences. The park is at a precipice in terms of what potentialities will evolve from its hybridization. As a heavy industrial site, its survival can be described as bleak considering the twilight condition of the industries located within its perimeter. The park can hybridize these conditions into a new spatial framework. For this to begin, direct intervention is necessary to improve its relative health. The diagram on the following page describes the condition of Globe Park as part of a successional timeline. The diagram depicts physical attributes during each of these generalized conditions. There are an indeterminate number of choices regarding the site's future health. Globe Park intends to polarize its degraded environmental state into an opportunity. This diagram of Globe Park is revealed as part of a temporal timeline illustrating it as a successional proposition.

Conceptual succession diagram applied to Globe Park — Applying an understanding of complex ecosystems theory and industrial ecology Globe Park projects its health in relation to exergy differential. As differences between reactive industrial content and ecosystems are moderated, the healthier the space grows. As nutrient loads output from industry, become higher quality, they will be absorbed by immediately surrounding ecosystems. Speculatively, this symbiosis will require unique management to ensure the relationship remains stable and flourishing. It is intended that ecosystems benefit from hybrid industrial loads.

PARK LAYERS + STAGING

Globe Park will be created by a temporal process that is staged in layers. The term stages represents direct human intervention in the park. These stages occur over time to facilitate the space's occupational intensification. Each stage is a milestone for the park because it represents new ways that the community can interface with the space. The experience of the park will change not only relative to environmental or seasonal doctrines but also relative to economic or industrial doctrines. By facilitating these conventionally separate processes, Globe Park generates the most intensity. This speculative section anticipates necessary organizational strategies based on prior analysis, hybridization, and successional anticipations.

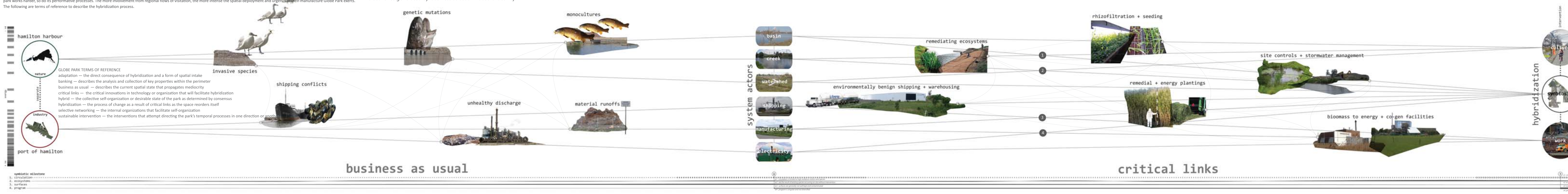


PARK HYBRIDIZATION PROCESS

Globe Park is influenced by theoretical frameworks that originate from complex systems ecology and industrial ecology. This framework sees the park as an iterative ecological process that facilitates flows of cultural, ecological, and industrial process. The physical manifestation of this process is what creates the experience of the park. Globe Park is not limited by preprogrammed phasing, instead it is a staging process that facilitates several key attractors. These attractors will evolve over time following technical doctrines determined by internal consensus. Globe Park is a temporal process, as the park works harder, so do its performative processes. The more involvement from regional flows of visitation, the more intense the spatial deployment and urgency for self-manufacture Globe Park exerts. The following are terms of reference to describe the hybridization process.

During stage 1 critical sites are banked within the predetermined park perimeter. The qualities of its actors are identified and compiled in a large database, which will be generated based on field research. The diagrams below speculate on anticipated discoveries generated by 'business as usual' industrial activity.

During stage 2 critical links are hypothesized based on the relative state of component sites. Remedial processes are determined based on contaminate levels. Critical milestones are projected based on potential use. Hypothetically, circulation, ecosystems, surfaces, and program will self-organize as the park evolves. Diagrams below speculate on links between new site operations.



HYBRID CULTURAL, ECOLOGICAL, & INDUSTRIAL SPACES

Globe Park will have five distinct incubation areas that hybridize cultural, ecological, and industrial space. These sites will combine an operational industrial facility with ecological reclamation practices that will help treat the effluents that they create. These facilities provide basic services such as energy, wastewater treatment, material storage, building material, and heat to Globe Park. Excess materials, heat, and energy will be provided to the surrounding community as a service. The hybrid facilities are based on known technologies that are available. Combining their use creates a hybrid situation that is easier to maintain and operates symbiotically within the surrounding environment.

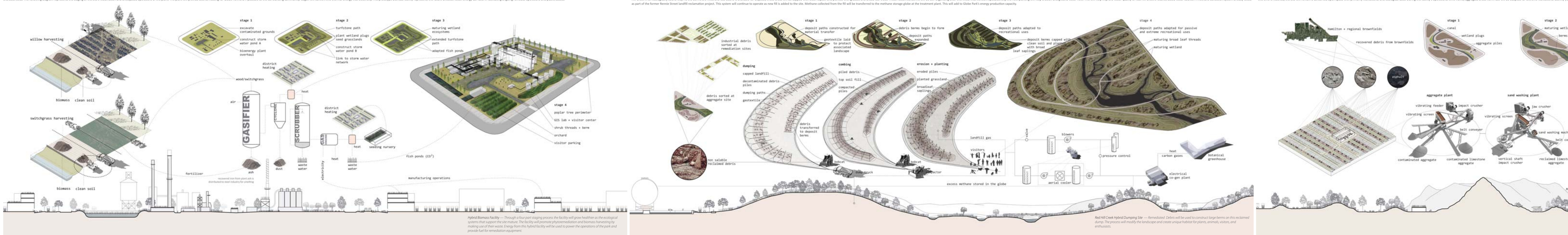
HYBRID BIOMASS ENERGY & DISTRICT HEATING FACILITY + GIS INFORMATION COLLECTION CENTER + VISITOR CENTER + RECLAIMED GRASSLAND ECOSYSTEM + FISH PONDS + STORMWATER MANAGEMENT AREA

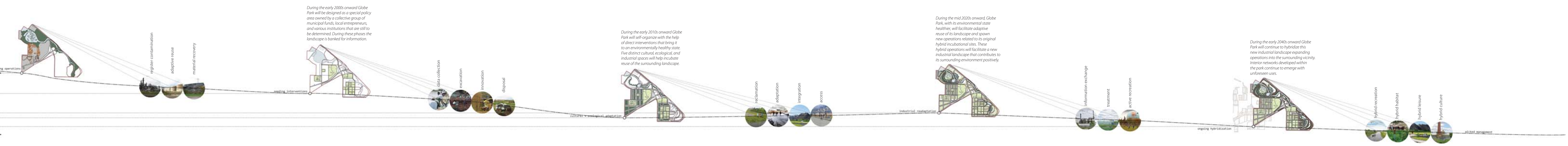
A hybrid space will be created on the site of the banked Columbian Chemicals carbon black industrial site. Initially contaminates will be excavated from the site and held in cells for remediation. The site will become a regional destination for harvested biomass crops particularly switchgrass and willow. The plant's operations will start with harvested remedial crops grown within Globe Park. A wider range of crops will be accepted based on compatibility and embodied energy characteristics. The following diagram represents the staging of the site's reclamation and anticipated operations of the plant. The plant will provide district heating for Globe Park and if possible to the surrounding community. Cogen will convert this thermal energy into electricity. The prototype biomass facility represents the future direction clean energy can take in facilitating ongoing remedial operations and public access.

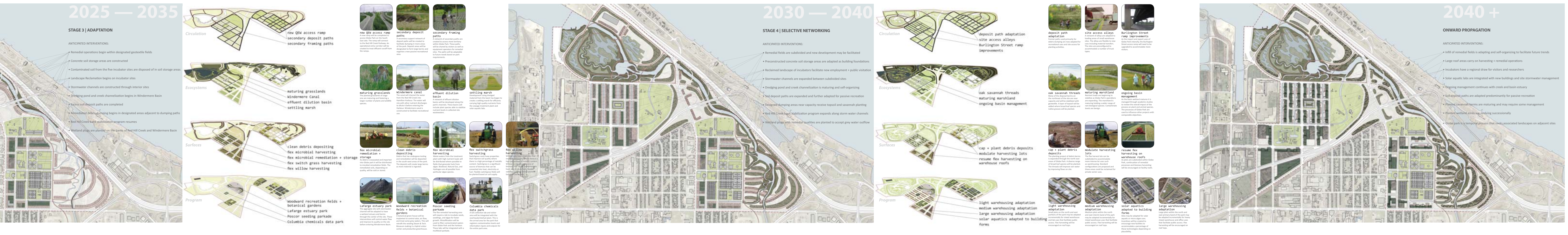
HYBRID CLEAN FILL DUMPING AREAS + FORESTED BERMS + RECONSTRUCTED WATER COURSE + PLANTED MARSHLANDS + RECLAIMED GRASSLANDS + PASSIVE RECREATIONAL AREA

This space fulfills the role of active dumping grounds within the park. Initially it is where all unwanted nonreusable fill is disposed. The fill will need to be environmentally benign. As described in the operational diagram on the following page, the dumping areas form large berms overtime. To facilitate dumping into this region of the park a network of concrete turfstone paths will be constructed. In addition to this, a network of bridges will be constructed to cross Red Hill Creek in an ecologically sound way. As the berms are filled and less debris is available for disposal, these areas will be capped with clean topsoil and planted with grasses and broad leaf trees. These reclaimed berms will be self-organizing after this initial intervention. Speculatively, the new planting will help erosion and ground water flow. This will help improve water quality of Red Hill Creek's reconstructed water course. A methane collection system already exists as part of the former Rennie Street landfill reclamation project. This system will continue to operate as new fill is added to the site. Methane collected from the fill will be transferred to the methane storage globe at the treatment plant. This will add to Globe Park's energy production capacity.

HYBRID AGGREGATE INTAKE SORTING CENTER + CEMENT MANUFACTURING PLANT + FISH PONDS + WETLAND ESTUARY + RECLAIMED GRASSLAND + EXTREME RE

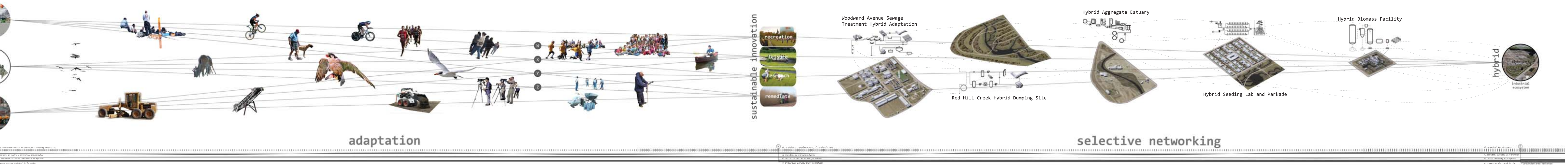






During stage 3 the innovative operations of the park are developed. Links between each of the major occupations are created. As the relative health of each site improves the symbiotic links between cultural, ecological, and industrial activity grow. The more diversified the links become the more accommodating Globe Park becomes. The diagram below speculates on park occupation as its health improves.

During stage 4 the internal operations within the park generate material networks. These networks are the result of direct intervention by park visitors. For Globe Park, visitors are as much actors in its ecological succession as plants and animals. Speculatively, as the health of the park and its operations grow, so does its attractiveness. Subdivided plots spawn into new uses. The diagrams below reveal potential selective networks between improved landscape operations.



4.8 BIRD'S EYE VIEWS

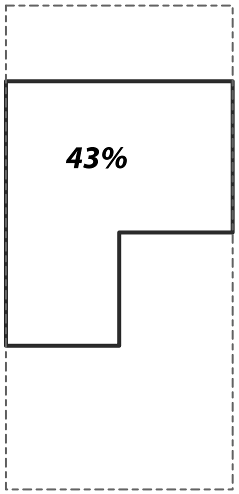
This section depicts Globe Park from the air in its speculative form. It represents the impact that the process will have on the surrounding urban environment. As an urban system it has the capacity to contribute positively to its surrounding environment. The ultimate outcome of Globe Park's hybridization is a summation of process. What is represented in these aerial views is a projection of the park's ultimate outcome. Each of the three views situate the design speculation in its larger urban environment. The first view reveals Globe Park's adjacency to the Hamilton beachfront where a major recreational trail connects community destinations including several restaurants, go carting, a pool, and an aquatic amusement park. The second image projects Globe Park's adjacency to the Niagara Escarpment, Downtown Hamilton, and the Dundas Valley in the far distance. The third image foregrounds Globe Park in the context of Hamilton's bayfront industrial area. It takes a sizable chunk of this waterfront landscape and polarizes it. The outcome is a healthier symbiotic relationship between urban and ecological systems. At a macro level, Globe Park is considered part of these urban systems and is intended to intensify their potential at the scale of the city.

fig. 4.80 Globe Park in the context of the Hamilton beachfront where a major recreational trail connects community destinations including several restaurants, go carting, a pool, and an aquatic amusement park.

fig. 4.81 Globe Park is projected into the perspective of the Niagara Escarpment, Downtown Hamilton, and the Dundas Valley in the far distance.

fig. 4.82 Globe Park is foregrounded into the context of the bayfront industrial area, Red Hill Creek Valley, and Downtown Hamilton

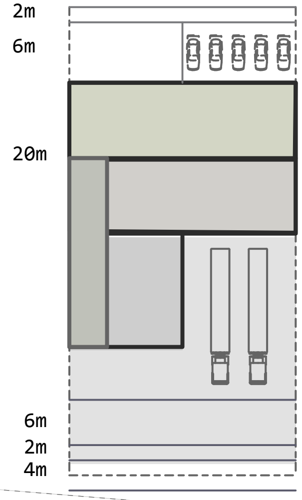
a0 APPENDIX

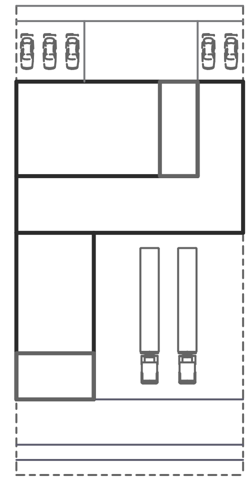


indeterminate spatial adaptations

total lot usage

43% building
57% landscaping

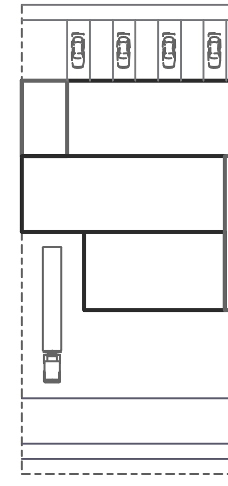


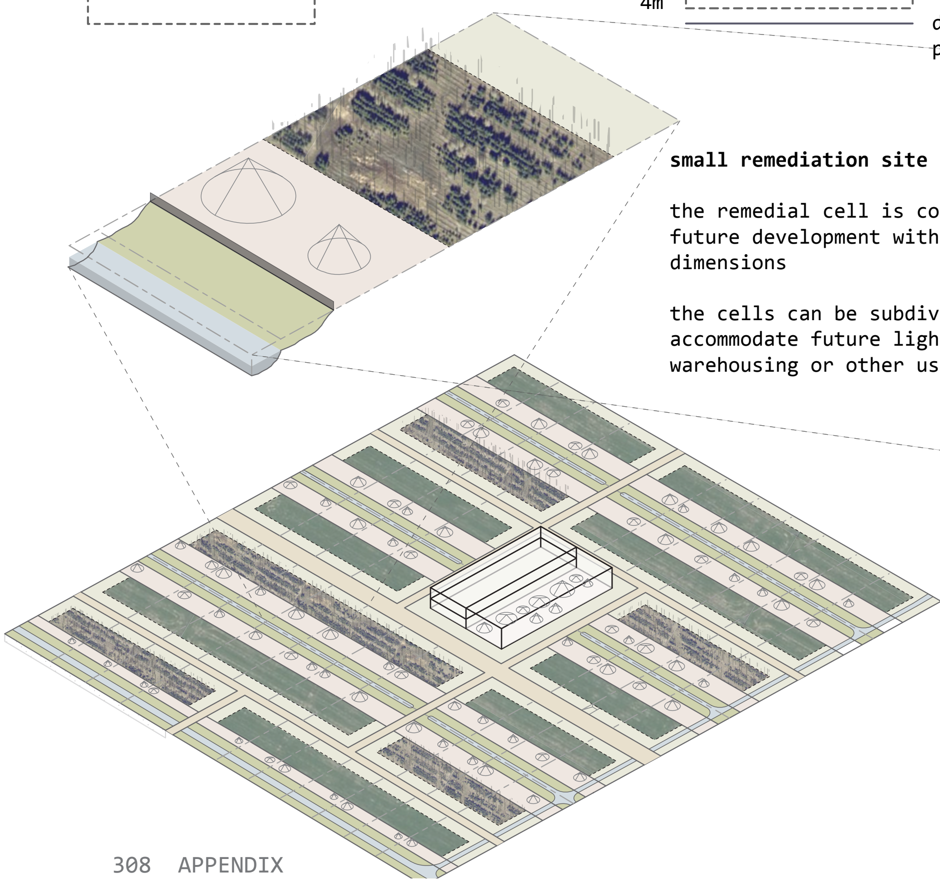


block variation 1

2 full size trucks

3-2 delivery/passenger vehicles

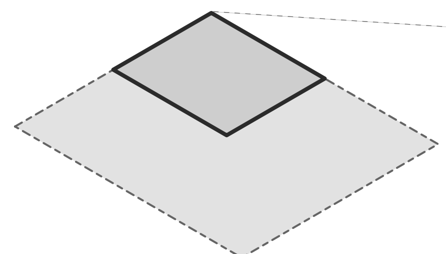




small remediation site adaptability

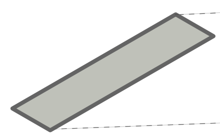
the remedial cell is configured for future development with pre-conceived dimensions

the cells can be subdivided to accommodate future light hybrid warehousing or other uses



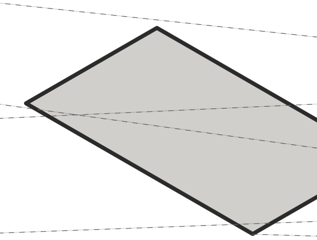
loading + warehousing yard

25% warehouse/office space
75% eco-paving
depth of structure is 22m max to preserve lane way



solar aquatic green house

15% of total building required size area may be subdivided

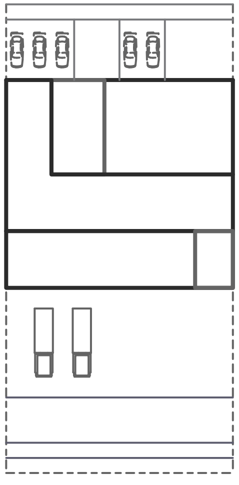


a1 SPECULATIVE ADAPTATION OF GLOBE PARK

block variation 2

1 full size truck

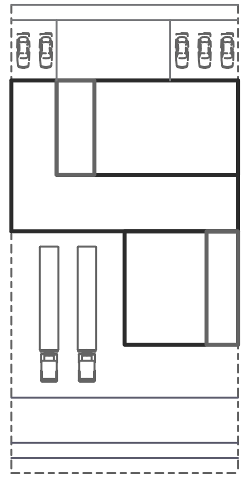
4 delivery/passenger vehicles



block variation 3

2 mid size trucks

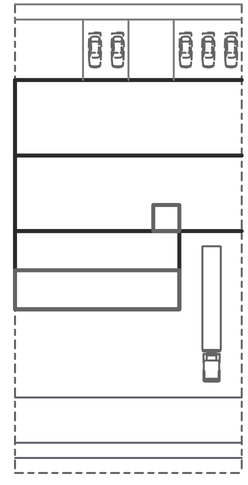
3-2 delivery/passenger vehicles



block variation 4

2 full size trucks

3-2 delivery/passenger vehicles

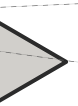


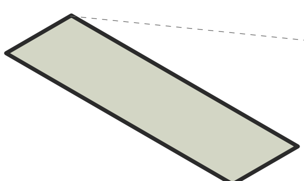
block variation 5

1 full size truck

3-2 delivery/passenger vehicles

fig. a1.1 Speculative adaptation of small remedial plot — Given the circumstances surrounding Globe Park a likely adaptation of its remedial plots will be medium to light warehouses with combined offices or labs. The dimensions of the plots are preconfigured to accept this use. Loading access can adapt to remedial access alleys. Foundations and services will already be in place, left over from remedial plots .



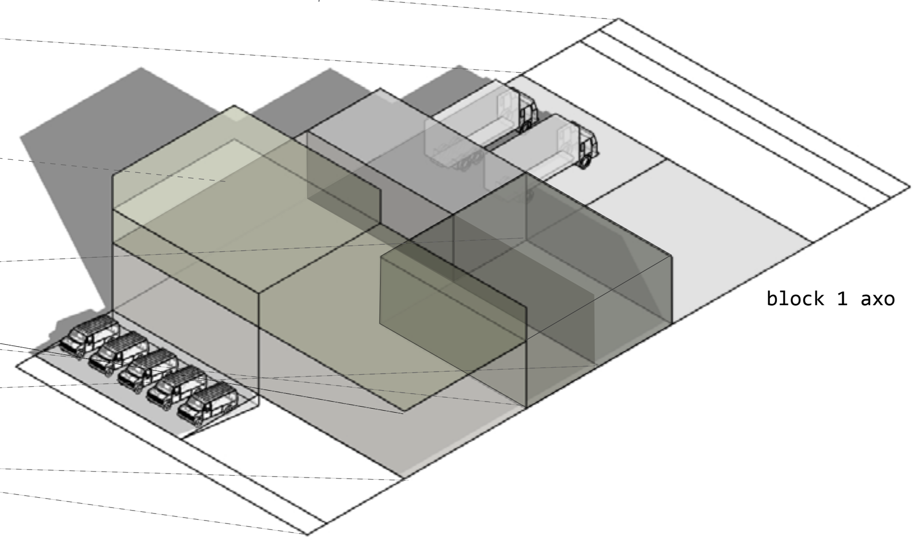


second story + office/light warehousing

50% of warehouse base with 95% of mass built to street facing edge of warehouse
8m max height maintain light access to remedial crops

first story light warehousing/manufacturing

10m setback from street edge
20m depth
10m height
joinable to adjacent warehouse space

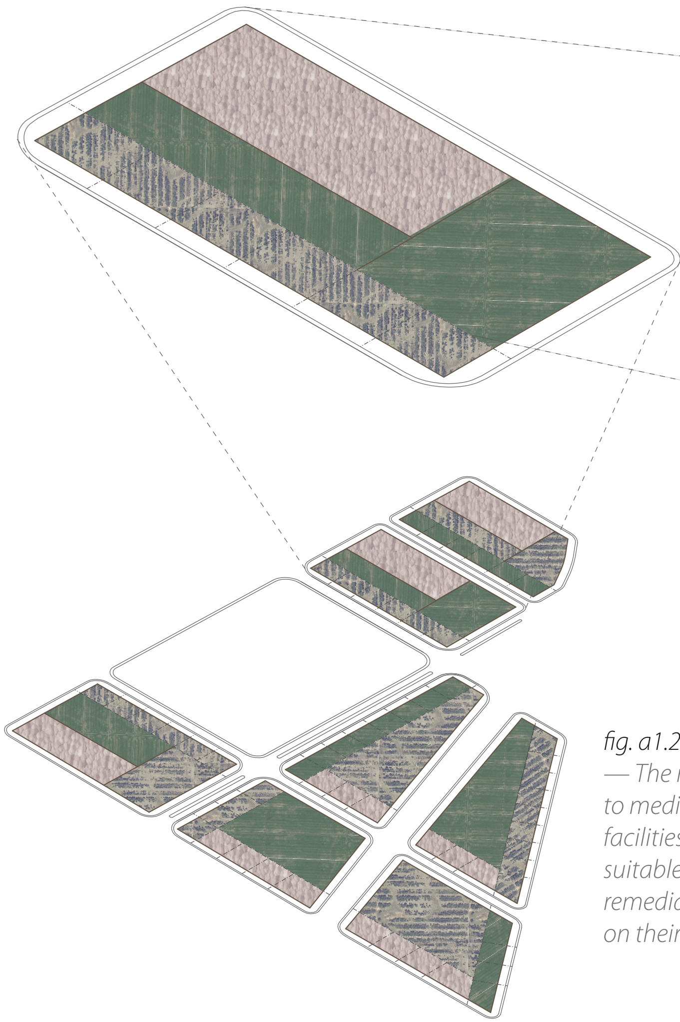


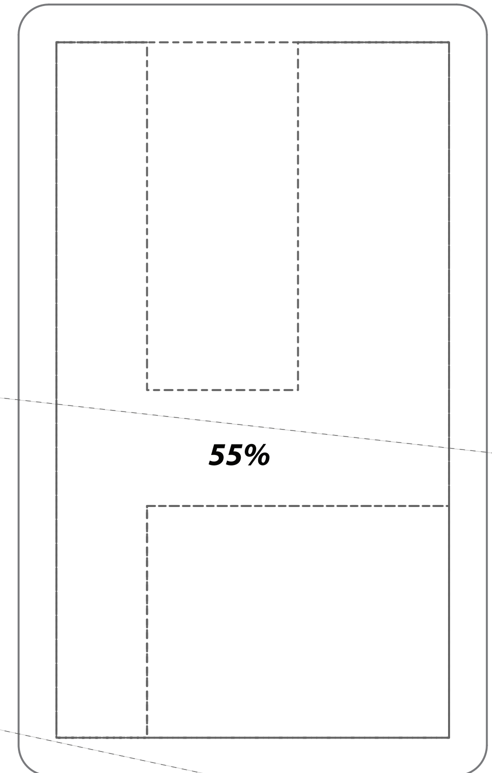
large remediation site adaptability

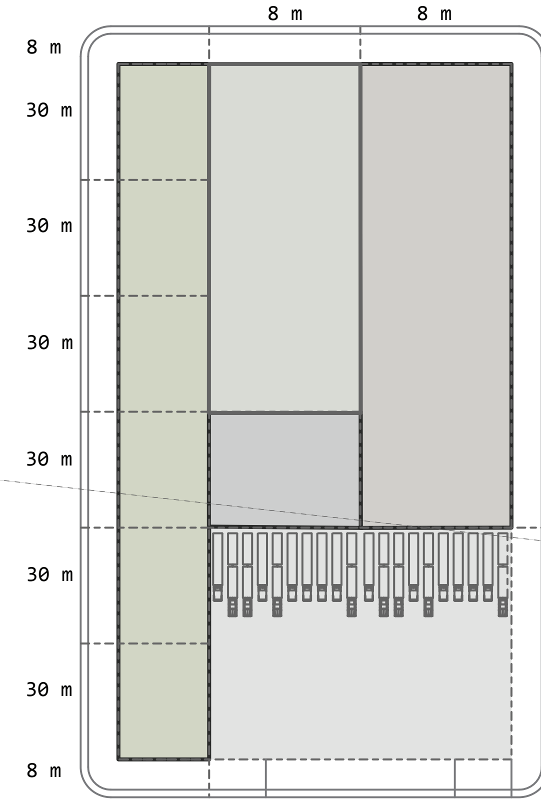
the remedial cell is configured for future development with pre-conceived dimensions for truck turning radii

pedestrians are accommodated as a result of pre-formated park organization

the cell can adapt for future hybrid warehousing or other needs



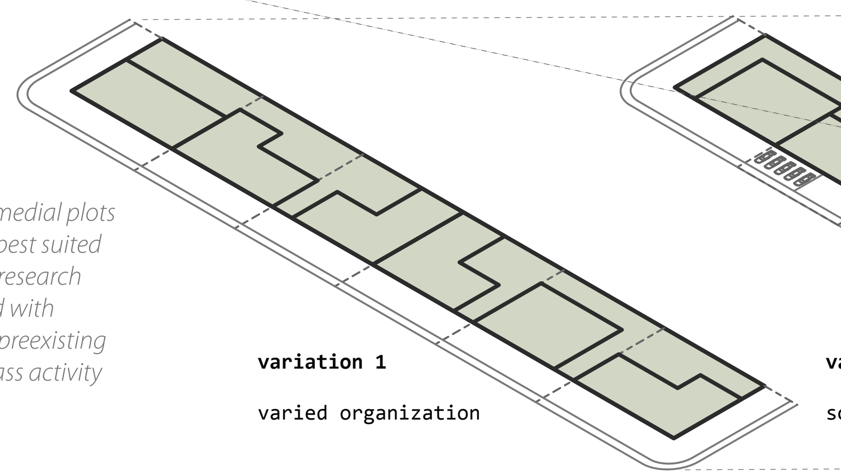




total lot usage

43% allowance for building
57% allowance for landscaping
8 m setback

fig. a1.2 Speculative adaptation of medium-large remedial plots — The medium and larger remedial plots would be best suited to medium or large warehousing and could include research facilities or multistory offices. The plots are prefigured with suitable concrete foundations already in place from preexisting remedial structures. Plots may retain remedial biomass activity on their roofs.



a1 SPECULATIVE ADAPTATION OF GLOBE PARK

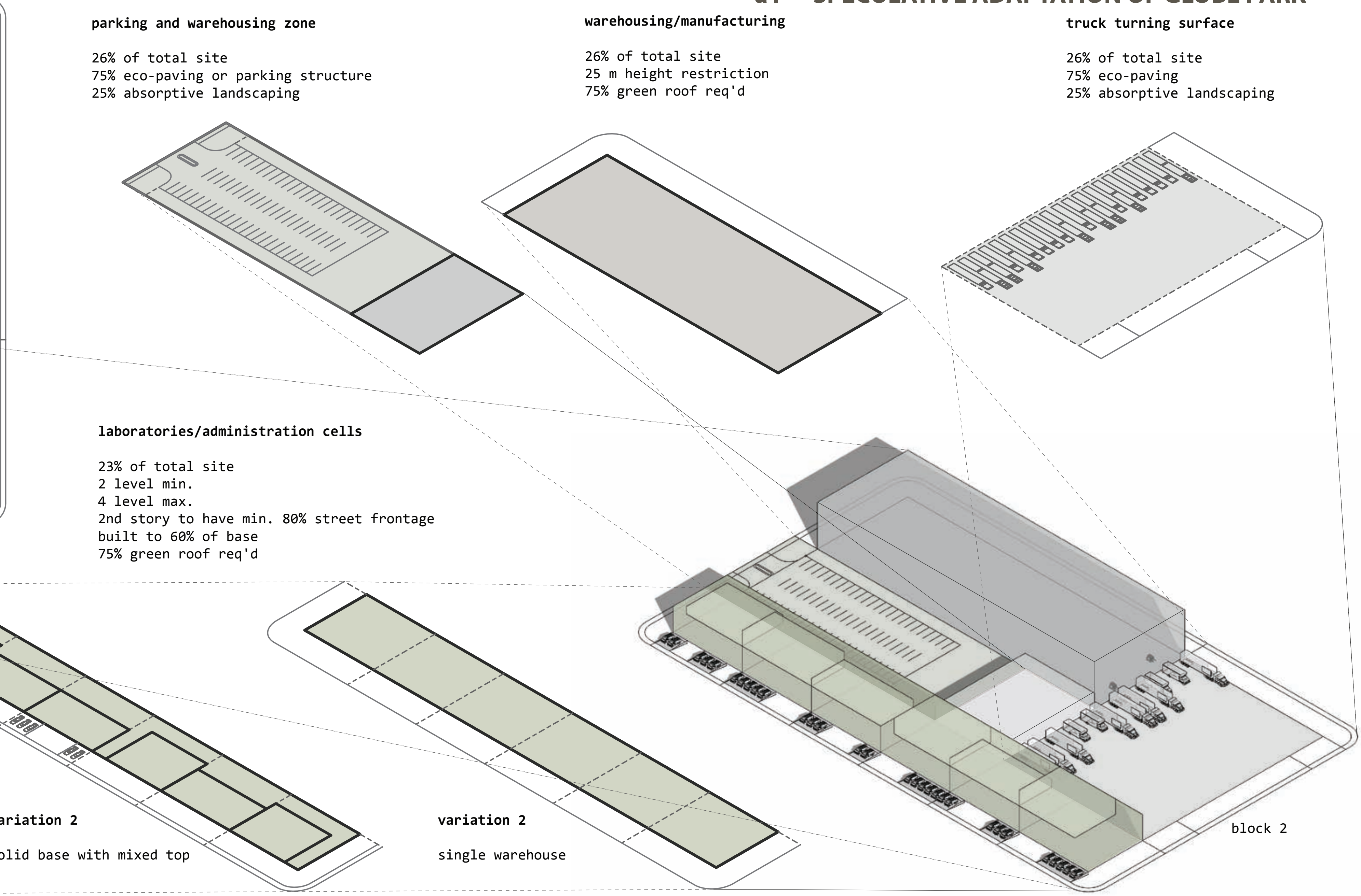


fig. a1.3 Pedestrian networks — Paths originally developed to carry debris and remediated soil will be adapted as a self-organizing network of pedestrian routes.

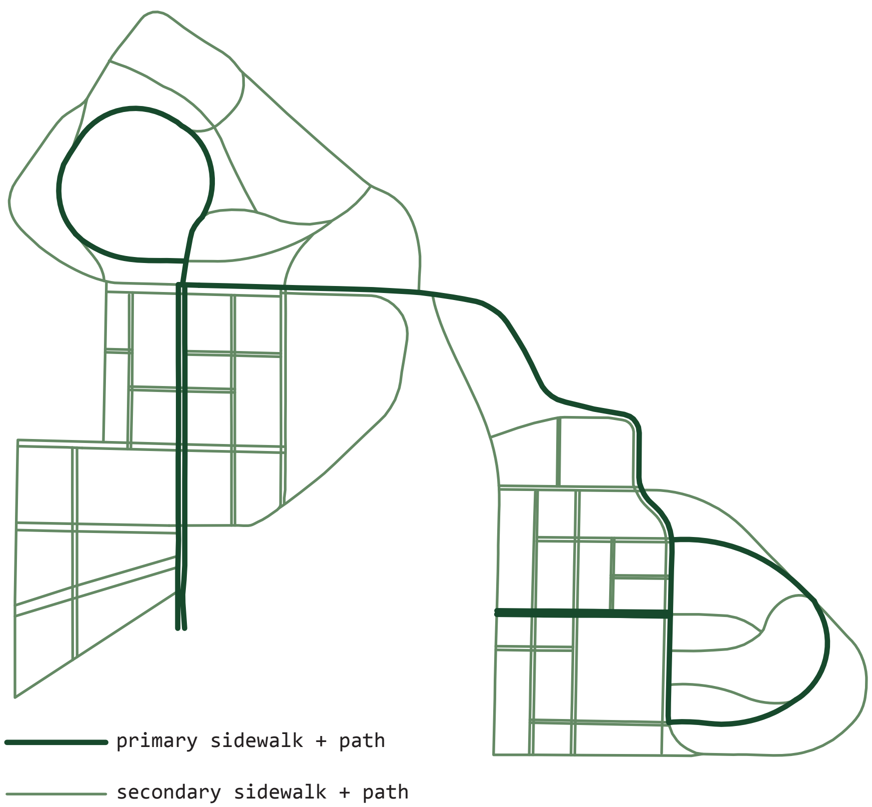
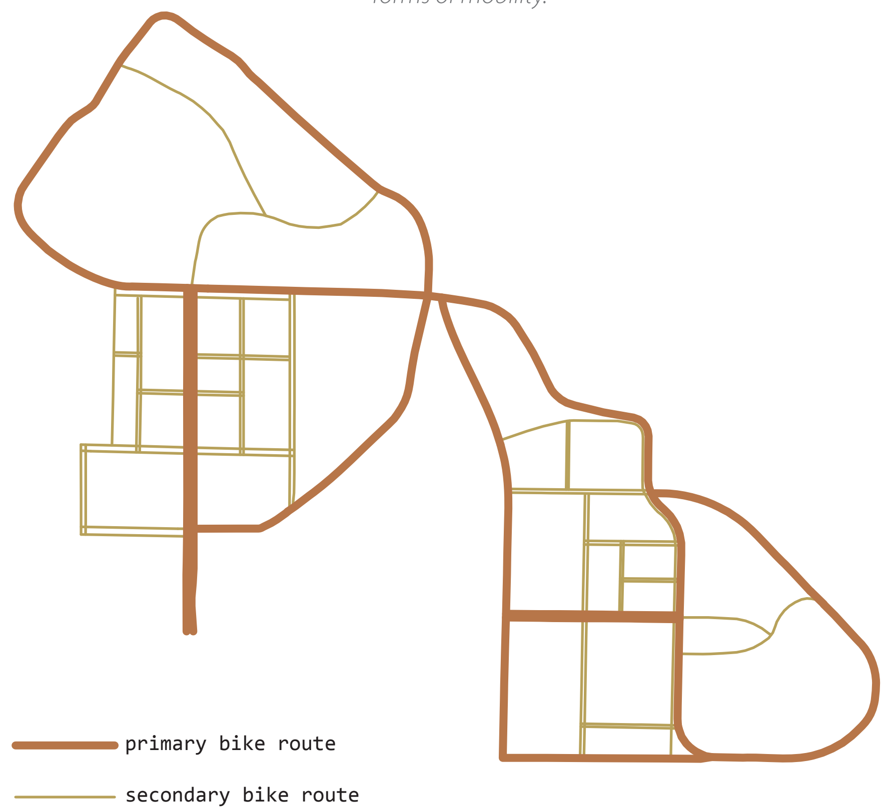
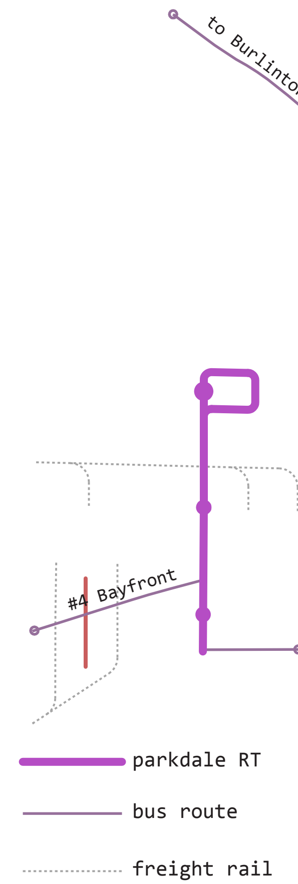


fig. a1.4 Bicycle networks — The paths will be adapted to carry cyclists. Internal designation will likely organize high speed routes towards the perimeter. Cyclists will be integrated with other forms of mobility.





a1 SPECULATIVE ADAPTATION OF GLOBE PARK

fig. a1.4 *Rail + transit networks — Interior paths will adapt for transit use within the park. As use expands, transit upgrading will take place. A designated bayfront industrial heritage line is recommended.*

fig. a1.5 *Trucking networks — As the park is adapted to new manufacturing uses, new routes for trucks will be integrated with other modes of mobility.*

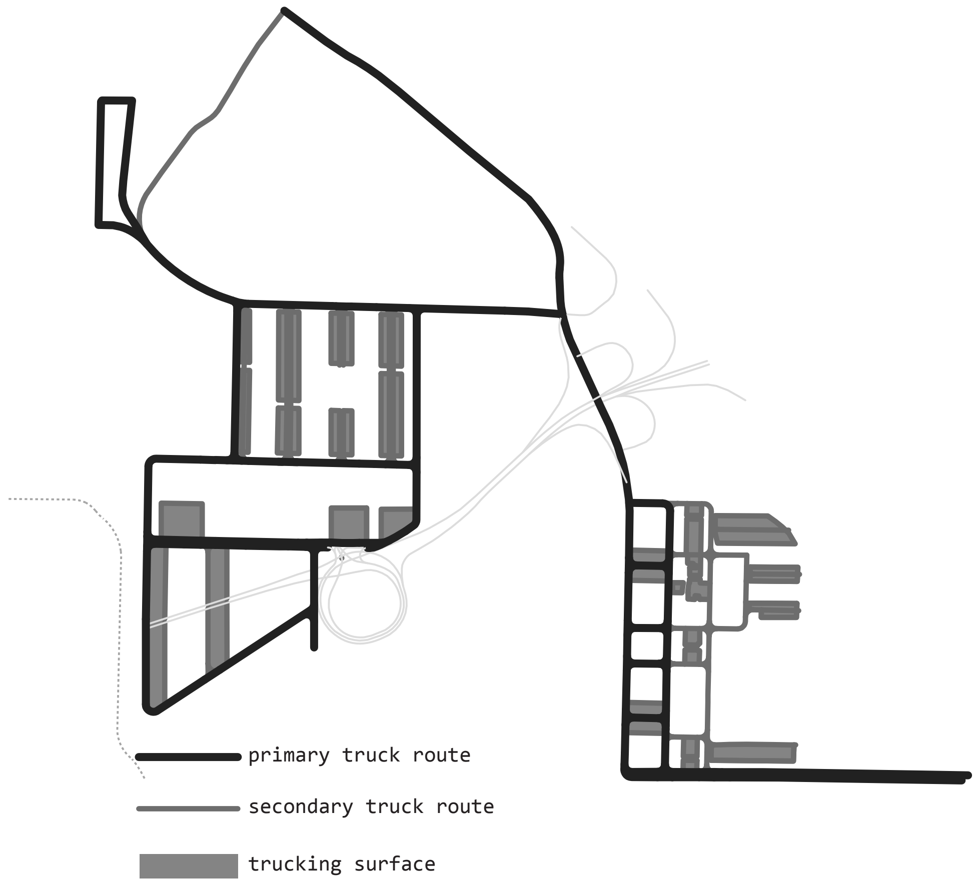


fig. a1.5 *Passenger vehicle networks — No direct planning will take place for passenger parking. It will be self-organizing and may be facilitated by street parking or designated lot areas. The seeding hybrid parkade will hold a percentage of vehicles*

a2 LIST OF REMEDIAL TECHNOLOGIES

fig. a2.1 *Typical in-situ technologies*

NATURAL ATTENUATION

The processes that act on a contaminant in the natural environment to reduce contaminant concentrations. These processes may include dilution, volatilization, biodegradation, adsorption, and chemical reactions.

IN-SITU BIODEGRADATION

Involves stimulating naturally occurring microbes to convert contaminants into less toxic compounds such as carbon dioxide and water. Nutrients and oxygen are added to enhance the biodegradation.

BIOVENTING

A form of biodegradation in which oxygen in the form of air is delivered to contaminated unsaturated soil through a system of extraction and injection wells.

SOIL VAPOUR EXTRACTION

A process of inducing air flow through unsaturated soil to remove volatilized contaminants. The air flow is induced by applying a vacuum to the soil through a network of extraction wells.

SOLIDIFICATION/STABILIZATION

Contaminants are physically or chemically bound to the medium to produce a non-leachate material. Commonly used binding agents include cement, lime, organic polymers, and silicates.

SURFACE CAPPING (Encapsulation)

Utilizes an impermeable ground cover to isolate the contaminants from the surface and redirect surface water percolation away from the contaminated soil. Surface caps are typically made of synthetic membranes, soil-bentonite mixtures, asphalt, steel or concrete.

PHYTO-EXTRACTION

A relatively new technique that exploits the property of some plants to absorb large amounts of heavy metals for storage in their roots and shoots.

fig. a2.2 Typical ex-situ technologies

SOLID PHASE BIOLOGICAL TREATMENT

A broad range of ex-situ biodegradation technologies such as biotreatment cells, soil piles, composting, and prepared treatment beds. Excavated soil is put into aboveground enclosures or spreading it over treatment beds that may include leachate and aeration systems. The careful control of moisture, heat, nutrients, oxygen and pH can enhance biodegradation.

SLURRY PHASE BIOLOGICAL TREATMENT

Consists of a series of large tanks or bioreactor vessels in which water, nutrients, and other additives are mixed with excavated soil or sludges to produce an aqueous slurry. The biodegradation process is carefully controlled in the bioreactor vessel with nutrients, oxygen and pH.

SOIL WASHING

Soil washing remediates excavated soil by separating contaminants sorbed onto soil particles with an aqueous solution that may contain a basic leaching agent, surfactant, chelating agent, or pH adjustment.

DEHALOGENATION

Excavated contaminated soils are heated and mixed with an alkaline polyethylene glycolate (APEG) reagent to render the halogenated compounds non-toxic through the replacement of halogen molecules (e.g. chlorine) by polyethylene glycol molecules.

CHEMICAL EXTRACTION

Chemical extraction processes use solvents to dissolve contaminants from excavated waste materials. The solvents are separated from waste materials and treated to remove any dissolved contaminants. Treated solvents are then recycled through the process.

CHEMICAL REDUCTION/OXIDATION

Reducing/oxidizing agents are used to chemically convert toxic contaminants in excavated waste materials to less toxic compounds that are more stable, less mobile, and/or inert.

LOW TEMPERATURE THERMAL DESORPTION

Low temperature thermal desorption is a process where excavated waste materials are heated from 95^{o}C to 315^{o}C to volatilize water and organic contaminants.

HIGH TEMPERATURE THERMAL DESORPTION

High temperature thermal desorption is a process where excavated waste materials are heated from 315^{o}C to 540^{o}C to volatilize water and organic contaminants.

INCINERATION

Incineration is a process where excavated waste materials are heated from 870^{o}C to 1200^{o}C to volatilize and combust organic contaminants in the presence of oxygen.

EXCAVATION AND DISPOSAL

Contaminated material is excavated and transported to a licensed waste disposal facility or landfill. Contaminated material may require pre-treatment prior to disposal.

VITRIFICATION

Vitrification is a process where excavated contaminated soils and sludges are melted at high temperatures to form a vitreous slag with very low leaching characteristics. Non-volatile inorganics are encapsulated in the slag, rendering them immobile.

fig. a3.1 Image of a community phytoremediation garden

a3 BIOLOGICAL SYSTEMS OVERVIEW

BIO-SOIL TREATMENTS A growing body of knowledge has emerged with implementable means to treat toxic sites through short-term to long-term processes that successfully remediate contaminated soil. These treatment methods can be integrated with site design and may have influence on the future site use. Traditional methods of dealing with the clean-up of industrial sites were to dig up existing contamination and haul it to a hazardous waste dump or entomb it in place with an asphalt or concrete cap.[225] There are now methods to treat soil contaminate onsite without requiring extraction and transportation. These trends show promise, as they are implementable as a long strategy to remediate the contaminated soils adjacent to the proposed Windermere Basin site. These processes hold potential to reclaim the sites in a more benign way. Biological systems used in water treatment, soil treatment, and energy production can be organized to work in symbiosis. The two fundamental biological soil remediation methods are phyto and microbial. Phytoremediation uses plant roots and microbial remediation uses microorganisms.

fig. a3.2 Image of switchgrass — proven metal accumulation capabilities

PHYTOREMEDIATION — A naturally occurring process that remediates contaminates in soil using plant species. More specifically, it is a process that includes either vitalization of contaminates and enhancement of the biodegradation process in root zone (rhizosphere), or direct uptake of soil contaminates by plants and the resulting biodegradation and accumulation.[226] The natural process of plant evapotranspiration has also been proven to reduce the infiltration of surface water, which means that species planted for phytoremediation may also act as natural barriers or caps.[227] Phytoremediation is not adaptable to all remediation applications, since it is a long-term process with treatment times within the order of several years.[228] The process needs to be implemented where contaminants are present, at depths within twenty feet of the surface, located less than a few feet below the water table.[229] Several possible interactions may take place when a plant encounters contaminates: the contaminate may be toxic and kill the plant, the plant may ignore the contaminate entirely, the plant may transform the contaminates into useful nutrients, or the plant may take the contaminate into the roots or shoot and deposit them.[230] There are three photomechanisms for the target contaminates remediated through phytoremediation which are accumulation, degradation, and hydraulic control.[231]

Accumulation is the first type of photomechanism. Here the plant takes heavy metals into its tissue and stores the contaminates in its roots.[232] For example, poplar trees are able to take in metals from contaminated soil and store them in the space between their root cells. Intracellular contaminant concentrations can exceed the expected toxic levels for the plant.[233] Some plants have proven to translocate accumulated metals from the roots to their leaf and shoots.[234] These plants are known as hyperaccumulators and may concentrate several parts per hundred contaminates to dry plant weight.[235] Indian Mustard plant is one species that can accumulate significant metal contaminates and can be grown in numerous climatic locations.[236] To mobilize a higher concentration of metal into a plant, chemical amendments can be added to the soil.[237]

When a brownfield site is first treated, it often resembles a gravel parking lot more than a garden in its texture, structure, and composition. The first phase in phytoremediation is to till the site and add amendments to the soil. The crop is then planted either in broadcast or in rows and as the plants mature more amendments are added to the soil to increase metal transport into the plants. After maturation, the plants are harvested.[238] Post harvest, the crops are air dried and sampled for metal content.[239] If metal content accumulated in the plant is high enough the harvested stock can be smeltered for metal recovery.[240] A higher concentration than some conventionally mined ores has been recovered in greenhouse conditions where metal content has reached above two percent of the plant's dry mass (Manufactured Sites – Rock 55).

Degradation, the second type of photomechanism occurs in two parts of the plant, in the root zone or rhizosphere, or in the plant tissue directly. Microbial populations have been reported higher in the soil of the root zone than in the adjacent unplanted soil as a result of plant symbiosis.[241] The growth-limiting factors of oxygen, nutrients and water are in the plant roots.[242] There is a passive aeration as roots penetrate the soil to loosen it causing active aeration from releasing oxygen as part of normal plant respiration.[243] By drawing water into the surface root zone, plants enhance microbial communities.[244] The soil's ability to retain water is increased by dropping leaves and sloughing roots that add organic matter to the soil.[245] In soils where creosote, a coal tar distillate, is the primary toxin in the soil, ryegrass may be used with soil amendments (seeded and irrigated to optimum levels) to remediate.[246]

Hydraulic Control, the third type of plant photomechanism is the influence plants have on contaminant movement, particularly in ground water.[247] Up to 350 gallons of water per day have been shown to be drawn by poplar trees, cottonwood, and willows.[248] The usage of water of even a two-year-old tree can be up to three *fig. a3.3* Image of Poplars — proven hydraulic control capabilities

to five gallons per day.[249] This can prevent the spread of contaminated groundwater since the water consumption can lower the level of contaminated aquifers.[250] Normal tree transpiration acts to volatize toxins by taking up contaminated water.[251] Plants also work to control dust and erosion on contaminated sites by creating vegetative caps.[252] One specific species, the cottonwood treed, is proven to have features that make it effective in remediating ground water and soil through the 'release of root exudates and enzymes that stimulate microbial activity in the rhizosphere and enhance biochemical transformation of contaminates'.[253] The treed effectively metabolizes or mineralizes contaminates within the vegetative tissue, water enters this tissue through root uptake in the aquifer.[254]

A case study where phytoremediation was used effectively in context is the case of a former gasoline transfer station in Odgen, Utah, where projected clean-up costs of the site would have been over one million dollars using traditional techniques.[255] Phytoremediation was encouraged as a lower cost means to remove, degrade, and stabilize environmental contaminates.[256] The planting plan was implemented in reference to contaminated areas and grasses, trees (poplar and juniper), and alfalfa were used to contain and treat the soils in situ (in situ refers to in place and ex situ refers to above ground).[257] The trees trapped soil particles and removed water from the underlying aquifers intercepting contaminated water before it flowed off site.[258] The cost of remediation was twenty percent of the estimated traditional remediation approach.[259] One of the fundamental items required for successful remediation is pertinent site data since contaminants located on the site must be understood before deploying the process.[260] This is so that the most effective plants are used to correlate to the correct treatment and the site's soil, light, and water conditions.[261]

Holistically, habitat creation on the site needs to be seen as part of larger climatic, landform, vegetative, and water conditions, which are essential to understanding the correct habitats for the site.[262] Understanding the site's contamination within

fig. a3.4 *Application of microbial substance in the field*

the context of the larger ecosystem is critical to the success of the approach. Some bird or large mammal habitat may take into account hundreds of acres and may work against the plant system if they are herbivores. Environmental conservation areas, forests, and water systems may all have an effect on the process since they have influential relationships to the fragmented site. To benefit the phytoremediation some universities or other research institutions may benefit through collaborating on experimental site processes and effectively monitor the performance of the plants.[263]

MICROBIAL REMEDIATION — an established remedial technology that operates through stimulating mico-organisms to break down organic compounds into more benign compounds.[264] These micro-organisms are often naturally present in soil and groundwater systems and used effectively in soil bioremediation.[265] The process may be used in situ or ex situ.[266] Bioremediation offers less potential advantages in the design process proposed here for the renewal of Windermere Basin site because of the long-term aspirations for biological integration with future energy technology.

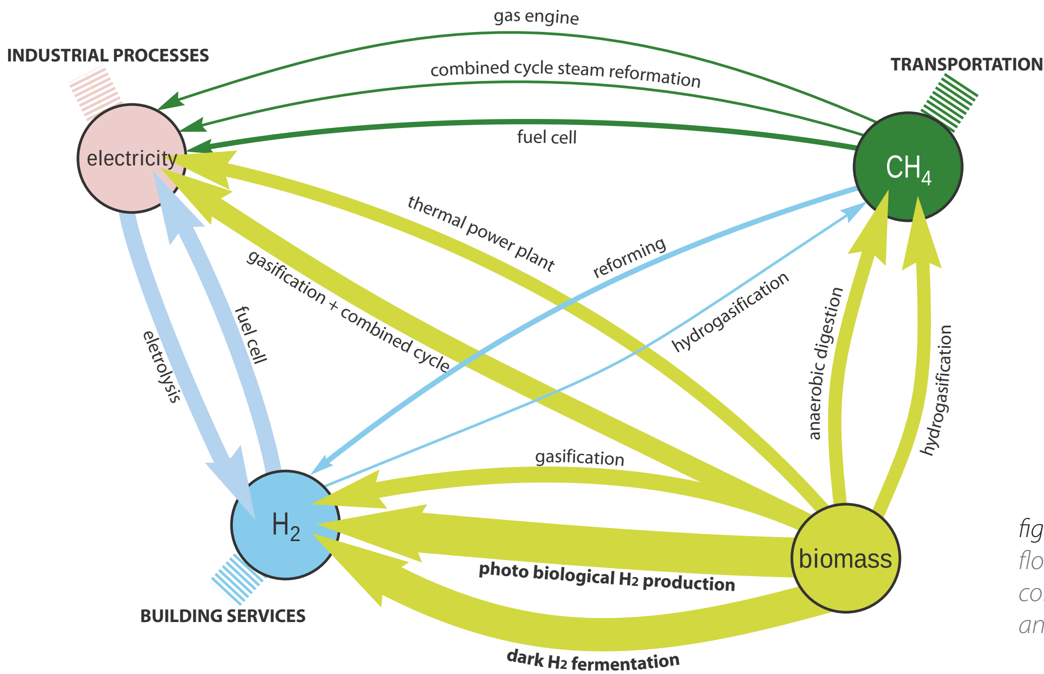


fig. a3.5 Biomass to secondary carriers flow chart — diagram represents conceptual flow of biomass between fuel and electricity

fig. a3.6 UASB reactor at Cerestar, Sas van Gent, The Netherlands, Biomethane

fig. a3.7 Vagron plant (Groningen) for separation and digestion of the organic fraction of MSW

fig. a3.8 *Biogas plant for manure digestion Praktijkcentrum Sterksel, The Netherlands*

BIO-MASS ENERGY There is a shift towards implementing more sustainable biologically produced fuels in response to depleting supplies of fossil fuel. Carbon-containing fossil sources such as oil, coal, and natural gas account for most contemporary energy consumption. Fossil fuels have been formed by millions of years from plant biomass.[267] In current global energy production, approximately 85 percent comes from fossil fuel sources, while the remaining 15 percent comes from a mix of 7 percent nuclear, and 8 percent renewable sources, which is primarily through wood as fuel or hydro.[268] Public concern derived from global warming and diminished affordable access to petro-fuels is pushing investigation and new investment into biological energy. The environmental advantage of biologically based energy is in its ability to offset carbon emissions through crop production or in significantly reduced emission quantities. Per year, the surface of the planet receives over 3.8 million exajoules of solar energy, while global energy use is currently near 400 exajoules, just 0.01 percent of total energy supply with an anticipated growth to 850 – 1100 exajoules in 2050.[269] In the short term, a full transition to renewable energy is not feasible, since it is currently not competitive with the established fossil-based energy production and infrastructure.[270] According to recent Shell speculations, the use of renewables on a global scale could reach 30 percent or 280-335 exajoules by 2050.[271] Of this percentage energy will come from ‘green’ sources such as hydropower, wind turbines, photovoltaics (PV), and combustion and gasification of biomass in the form of gaseous and liquid fuels.[272]

Renewable energy sources available through photovoltaic cells, wind, and chemical energy in biomass is ultimately based on the supply of solar energy.[273] The feedstock of renewable energy production is worthwhile with the considerable amount of wet biomass and residues available.[274] Speculatively, biotechnical process will be integrated with current energy use systems with the production of renewable gaseous and liquid biofuels including hydrogen, methane, bio-ethanol, and ABE (Acetone-Butanol-Ethanol).[275] Public demand will have the most substantial influence on the *fig. a3.9* *Conceptual flows of material between anaerobic fermentation and industrial operations*

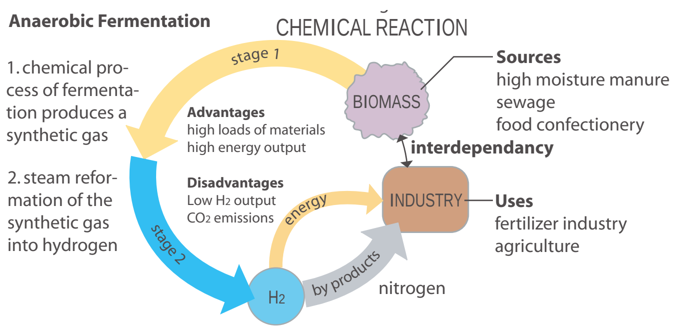
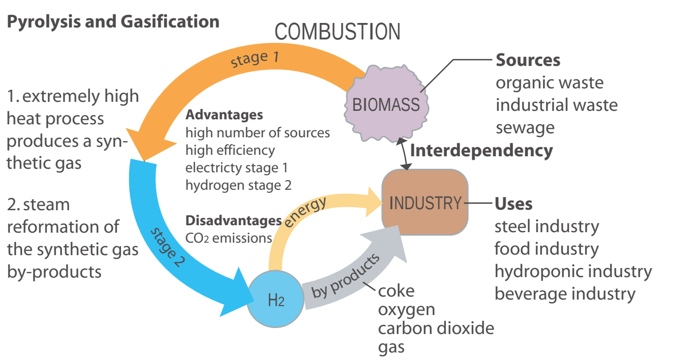


fig. a3.10 *Speculative spatiality could evolve outside the perimeter of Globe Park linked to these processes*

fig. a3.11 *Conceptual flows of material between pyrolysis and industrial operations*



emergence of specific carriers, although technology is also an important driver. The most critical driver in the transition to sustainable energy sources is the adaptability of the technology as usable occupations in the context of society. The key driver in this will require that the full implications of the system shift can be accounted for both economically and ecologically, otherwise there will be no societal benefit.

Anaerobic digestion — An established technology already employed in the treatment of human waste and wastewaters that produces a biogas: a mixture of methan (55-75% volume) and carbon dioxide (25-45% volume).[276] The biogas is usable in heating, upgrading to natural gas quality, or co-generation of electricity and heat.[277] Anaerobic digestion of wastewater and residues, including sewage sludge, manure, and the organic fraction of municipal waste, to create methane is already applied globally.[278] A process in which micro-organisms grow by metabolizing organic material in an oxygen-free environment to produce methane is the anaerobic microbial process.[279] Anaerobic digestion is typically a four phase process. The first phase, hydrolysis, converts non-soluble biopolymers to soluble organic compounds.[280] The second phase, acidogenisis, converts soluble compounds to volatile fatty acids and carbon dioxide.[281] The third phase, acetongenesis converts the volatile fatty acids to acetate and hydrogen.[282] The fourth phase, converts the acetate and carbon dioxide and hydrogen to methane gas.[283] It is vital that biological conversions are sufficiently coupled during the process to prevent intermediate compound to accumulate for stable digestion to proceed.[284]

MICROBIAL HYDROGEN — Bio hydrogen is a hydrogen formation process in which hydrogen is uncoupled and unconsumed in a reaction, so that it is available as a fuel in the final product. Many of these processes are still in the research and development phase in order to enable commercialization of the technology.[285] Several processes are being developed globally, including biomass fermentation and a photobiological process, that produce hydrogen biologically from sunlight.[286]

Efficient, sustainable hydrogen catalysts based on research into the catalytic site of natural hydrogen production enzymes (hydrogenases) are a related field.[287] Research into the structure of hydrogenases has revealed that the active sites of these enzymes consist of inorganic elements including nickel, iron, and sulfur.[288] The discovery of this knowledge could mean that synthetic biological catalysts could replace precious metal based catalysts that are used for hydrogen interconversion and electricity production from fuel cells.[289] Anaerobic digestion and bio-hydrogen processes produce carbon dioxide neutral, gaseous biofuels and residues, which are evidence that they are emerging sustainable technologies.[290]

The conversion efficiency of Biohydrogen is higher for hydrogen than bio-methane when factoring in the first step of converting biomass into hydrogen or methane.[291] The advantage that “green” bio-methane has is that it can be applied in existing natural gas infrastructure, while demand for hydrogen could not arise for twenty years or longer.[292] The production of bio-methane and bio-hydrogen are closely related processes in most cases because of the interaction of microbial hydrogen and methane metabolism on both the physiological and process level where various species of micro-organisms cooperate.[293] Speculatively, a transition trajectory employing existing gas infrastructure and the technological field of bio-methane production can evolve into a future adaptation to bio-hydrogen supply.[294]

Dark Hydrogen Fermentations — Biohydrogen may also be a naturally occurring element in biological systems in which it is part of a larger complex ecosystem. It is possible, if the correct condition is created, that micro-biological species become extremely effective producers of the energy carrying element. Hydrogen is scientifically proven to be produced during microbial breakdown of organic compounds in anoxic or anaerobic environments.[295] Dark hydrogen fermentation is the process that occurs when ‘organic compounds are the sole carbon and energy source providing metabolic energy’.[296] The building blocks for growth are when bacteria grow on origin *fig. a3.12* *Conceptual flows of material between bio-fermentation and industrial operations*

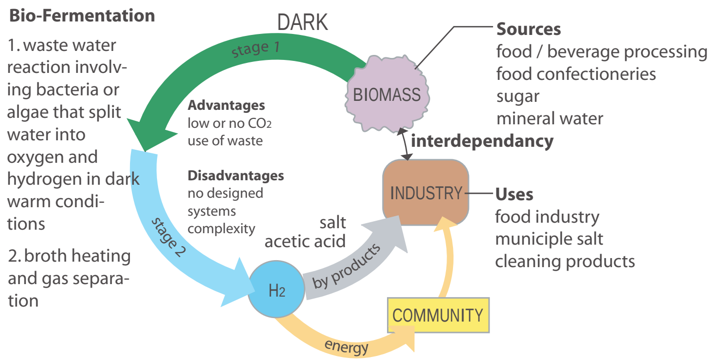
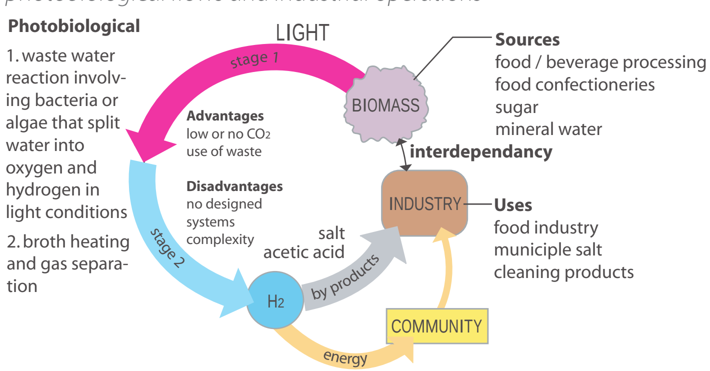


fig. a3.13 *Speculative spatiality could evolve outside the perimeter of Globe Park linked to microbial processes*

fig. a3.14 *Conceptual flows of material between photobiological flows and industrial operations*



substrates and are degraded to provide metabolic energy (heterotrophic growth).[297] To be exposed for the maintaining of electrical neutrality the oxidation generates electrons.[298] Other compounds are required to act as electron acceptors in anaerobic environments or anoxic environments.[299]

A specific environment, when the aim is to produce hydrogen from organic matter, is required to be created where hydrogen producing organisms flourish while others perish.[300] The conversion of carbohydrates to hydrogen and organic acids, from a thermodynamic perspective, is the preferred methodology for the process since it yields the highest amount of hydrogen per substrate mole.[301] Carbon dioxide is one of the byproducts of the production of Biohydrogen from biomass; it is arguable that since this carbon is derived from biomass there is no net emission and the result is carbon dioxide neutral.[302] Feedstocks proven to produce notable yields of biohydrogen include biowastes like: potato-processing residues, organic fraction of municipal solid wastes, paper sludge, as well as high energy crops such as Miscanthus and Sweet Sorghum.[303] In countries like Japan, dark hydrogen fermentation made yields possible from bean manufacturing waste, rice bran, apple, and potato peels, psalm oil mill effluent, and tofu waste water.[304]

Photobiological Hydrogen Production — Photoautotrophic or photoheterotrophic organisms can perform photobiological production of hydrogen.[305] In a photoautotrophic hydrogen production process sunlight is used by microalgae and cyanobacteria to metabolise carbon dioxide into high energy organic compounds with water as additional substrate.[306] Using light as the energy source under anaerobic conditions, microalgae can produce hydrogen through water photolysis, where the catalyst is a hydrogenase enzyme, which is extremely sensitive to oxygen, a by-product of photosynthesis.[307] In a photoheterotrophic hydrogen production process the ability of nitrogen fixation by photoheterotrophic bacteria or cyanobacteria is catalyzed by the nitrogen enzyme.[308] In the absence of nitrogen the nitrogenase enzyme greatly catalyses the evolution of hydrogen.[309] The nitrogenase enzyme is inhabited by ammonium ions and is also highly sensitive to oxygen.[310]

The capacity to absorb light energy and store it as chemical energy through chemical bond formation is an ability that photoautotrophic organisms such as microalgae and cyanobacteria, and photoheterotrophic bacteria comprise.[311] Relatively cheap hydrogen can be produced from generally available sources namely water and sunlight with no carbon dioxide produced making the photoautotrophic process universally attractive.[312] The fact that hydrogen producing enzymes (hydrogenases) are strongly inhibited by oxygen is one of the greatest problems in the photoautotrophic production of hydrogen, since it is simultaneously produced.[313] No direct biophotolysis process has advanced beyond laboratory testing to date due to this setback.[314]

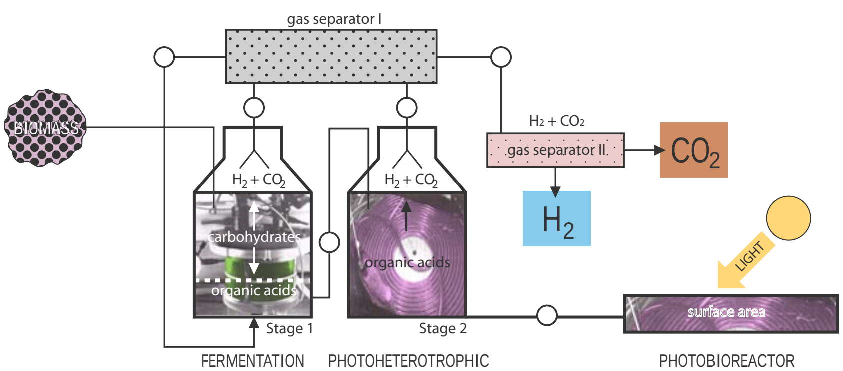
Another hydrogen production process is possible when the green alga chlamydomonas reinhardtii is alternated from a ‘phase of photosynthetic O2 evolution and carbon accumulation to a phase of H2 production and consumption of metabolites’, which is enforced by sulfur deprivation.[315] In this process the transforming of waste into an accessible substrate has to be taken into account since it would affect the efficiency of growing energy-crops; it would be more bioenergetically favorable to produce hydrogen from organic substrates than water.[316]

To evaluate the production of the photo biological hydrogen production process three variables are often used. The first is the efficiency at which hydrogen is produced from light energy, which is termed photochemical efficiency.[317] The second variable is the yield of the hydrogen production.[318] The final variable is the yield coefficient of hydrogen produced relative to the carbon source consumed.[319] Each of these variables vary based on the properties that influence the process. For example, the maximum yield calculated in Amsterdam for the month of June was 0.78 tonnes of hydrogen per hectare per day or 11.1 gigajoules of hydrogen per hectare per day.[320]

If the average sunlight intensity was assumed as 75% of the maximum value over the year, a 1000 hectare photobioreactor could yield an amount of 21,300 tonnes or 3 pentajoules of hydrogen in a year.[321] Comparatively, if the same 1000-hectare system were located in Seville in southern Spain, assuming the same average light intensity of 75% of July irradiance, the production would equate to 4.6 petajoules per year.[322]

A prerequisite for a reactor for photobiological hydrogen production is that it must be an enclosed system, since hydrogen gas must be collected.[323] A monoculture of species must be maintained for an extended period of time.[324] A high surface to volume ratio is another prerequisite for a photobioreactor, and the productivity is limited by light access.[325] To create an efficient biological process for hydrogen production, light needs to be dilute and distributed as much as possible over the reactor volume, and mix the culture at a high rate to ensure cells are exposed for a short time period.[326]

fig. a3.15 *Two stage photobioreactor operational flow diagram and speculative spatiality of its adaptation*



There are mainly two types of photobiological reactors that have been studied, flat panel reactors and tubular reactors. The flat panel reactors consist of a transparent rectangular box that is only one to five centimeters in depth. Within the box, a gas is introduced through a perforated tube at the bottom.[327] To create an appropriate degree of turbulence in the reactor, three to four liters of air per liter of volume per minute must be provided.[328] Direct sunlight illuminates the panels from one side as they are being placed vertically or inclined toward the sun.[329] The tubular reactors consist of long transparent tubes ranging in diameter from ten to one hundred meters, where culture liquid is pumped through the tubes with mechanical or air-lift pumps.[330] The various tested positions of the tubes include: "in a horizontal plane as straight tubes with a small or large number of U-bends; vertical, coiled as a cylinder or a cone; in a vertical plane, positioned in a fence like structure using U-bends or connected by manifolds; horizontal or inclined, parallel tubes connected by manifolds; in addition, horizontal tubes can be placed on different reflective surfaces with a certain distance between the tubes".[331]

BIO-ENERGY INFRASTRUCTURE The gradual introduction of fuels with increasingly lower carbon content per unit of energy is resulting in the continuous decarbonisation of global fuel in the transition process from wood to coal to oil natural gas.[332] The transition process from wood to coal to oil to natural gas as primary fuel sources corresponds to a gradual increase of the ratio of hydrogen to carbon within the twentieth century.[333] The current economic lifespan of energy infrastructure is approximately fifty years, meaning that the infrastructure being built today will be operational until 2057.[334]

Varying forms of fuel cells can operate on methane and hydrogen fuel with the main difference between the fuels being that methane, in the form of natural gas, is a primary energy carrier while hydrogen is an intermediate produced from primary sources.[335] As an energy carrier in today's energy system, hydrogen does not have significance since limited hydrogen infrastructure exists for industrial applications and its infrastructure would not be comparable to natural gas infrastructure.[336] The supply of hydrogen would need to incorporate production facilities and the infrastructure for transport, distribution, and storage simultaneously from production to end-use.[337]

High investments and subsidization would be required to make this feasible.[338] Using hydrogen as a fuel for PEM (Proton Exchange Membrane) fuel cells, the highest small scale conversion efficiency from gas to electricity is achievable.[339] At the level of individual buildings or districts the advantages offered by hydrogen as an energy carrier can be exploited through its final conversion in PEM fuel cells or CHP systems. The low temperature heat produced in the latter of these technologies would be useful for water or space heating required for buildings or facilities.[340] Potentially, hydrogen distribution networks could be of a much smaller scale than *fig. a3.16 Large scale photobioreactor in Arizona Desert proposed by Solix Biofuels as a method to grow biodiesel from algae*

the infrastructure required for natural gas.[341] The scale of hydrogen produced as well as the area to be covered would determine the optimum size of the operation processes.[342]

Compared to hydrogen, electricity has one major drawback for renewable sources of solar and wind power, since they are intermittently available making the electricity they produce difficult to store.[343] Electrolysis is the most basic method to convert electricity into chemical energy. Electrolysis produces hydrogen, which means that hydrogen could be used to store renewable energy when supply exceeds demand.[344]

If renewable energy sources emerge as prominent sources, hydrogen will have an important role as a clean carbon dioxide neutral energy source for decentralized electricity generation in a stationary fuel cell system.[345] Highly efficient electricity generation is feasible at all system scales, this is the advantage of fuel cell technology in contrast to other technologies that show a substantial drop in efficiency with smaller scales.[346] The adaptability of the technology to a varying degree of scales, makes feasible the application of fuel cells in vehicles and in centralized electricity production for industry, public distribution at urban levels, and for individual homes.[347] As global environmental concerns rise and regulations tighten, it is likely that hydrogen would preferably be produced from renewable sources such as the electrolysis of water with renewable electricity, through biomass gasification, or photobiological hydrogen production.[348] Hydrogen would be an effective, clean carrier of energy for storage and transport with large-scale implementation of renewable energy.[349] Additionally, hydropower or other renewable sources can be converted through electrolysis into hydrogen for storage and transport in liquid or gaseous form to end-users, where high efficiency fuel cells convert it to electricity.[350]

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