Architecture for a Lifeboat World:
Examining the Scale Shift between Master Planning and the Pedestrian

by

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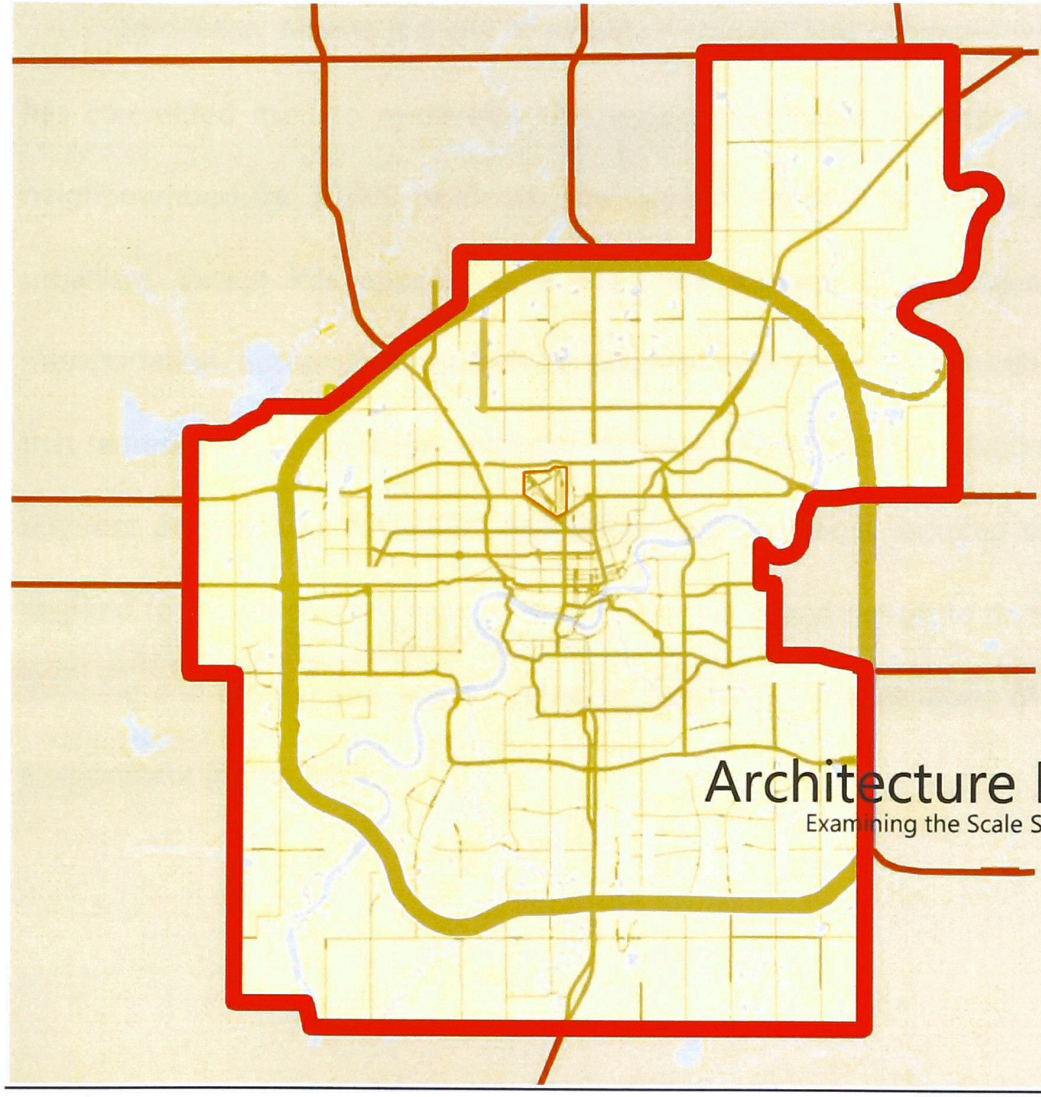
A thesis submitted to the Faculty of Graduate and Postdoctoral
Affairs in partial fulfillment of the requirements
for the degree of

Master

in

Architecture

Carleton University
Ottawa, Ontario



Architecture For a Life Boat World

Examining the Scale Shift Between Master Planning and the Pedestrian

Jay Brauneisen
Pre-defence Submission
April 5, 2012

Abstract

Edmonton, Alberta is a city of perpetual change. This continues with the quest for sustainability, as the City has committed itself to re-develop the lands of the municipal airport, which is intended to become a model neighbourhood for 30,000 residents. The current proposal calls for a pedestrian oriented, intensive mixed-use urbanism, except this appears as a site wide strategy of homogeneous zones with a reliance on public transportation. Sustainability cannot be achieved without pedestrianization. A new method of design is required that represents a combination of Master Planning and Architecture. Both examine the same central ideas, but from different perspectives. A circular, multidisciplinary process is required so that each discipline can influence and respond to the other. The proposal is, to use research and design to demonstrate the connection between master planning and architecture, and by doing so suggest a different mode of thinking that could lead to a pedestrian environment for the ECCA.

Acknowledgements

Special thanks to the Edmonton professionals, who supported me and sat down with me to answer my questions and curiosities when starting out on this process, including:

Croy Yee	Croy D. Yee Architect Ltd.
Frank Hilbich	Frank Hilbich Architect Inc.
Don Ried	City of Edmonton: Sustainable Development (Formerly known as the Planning Department)
Tom Lunsdun	Brookfield Developments
Nancy MacDonald	Stantec
Craig Fitch	City of Edmonton: Sustainable Development

To my editors who were extremely helpful in getting this paper ready:

Eleanor Hossie, Jennifer Hossie and Francess Brauneisen

Finally special thanks are also due to my advisor, **Kelly Crossman** for his steady support, my **classmates** who helped in times of frustration and my loving wife, **Hongyan Lu**, who waits patiently in Edmonton for my return.

Section 1

1.0 Introduction

The Canadian city of Edmonton, Alberta is a city in a constant state of change. Since the railway arrived in 1902 (Vanterpool, The Edmonton 2) and accelerated its development, the urban conditions have always been adapting. This continues today with the quest for sustainability, as the municipal government has committed itself to re-develop the lands of the municipal airport. Recently named The Edmonton City Center Airport (ECCA) this unassuming airfield, an important piece of aviation history, is now being phased out. The land is intended to be a model neighbourhood of sustainable development for 30,000 new residents. For this reason the City of Edmonton called an international competition to develop a master plan for this area, which was won by Perkins + Will, from Vancouver, Canada. The current proposal calls for a pedestrian oriented, mixed-use urbanism, one in which Edmontonians can easily adapt their lifestyles to be environmentally friendly. Yet this mixed-use approach appears to be a site wide strategy of predominately homogeneous zones and single use buildings, where all development is linked by mass transit. Therefore a dependence is created on this new infrastructure to move people between the residential areas and the commercial "town center". The seed of sustainability is not transit oriented development, the seed is designing for the pedestrian. Urban form has more impact than any mass transit system. New technology for renewable energy, energy efficient buildings and fuel efficient cars is not enough in a sprawling city. Therefore at the urban level sustainability cannot be achieved without the pedestrianization of the city. With this as a premise the difficult question remains of how a pedestrian oriented city is achieved, especially in Edmonton with the harsh climate conditions in winter. This thesis will examine the proposed master plan and the links between planning and architecture which can theoretically achieve a pedestrian oriented urbanism. The thesis proposal is to use research and design to demonstrate the connection between master planning and architecture, and by doing so suggest a different mode of thinking that could lead to a pedestrian environment for the ECCA.

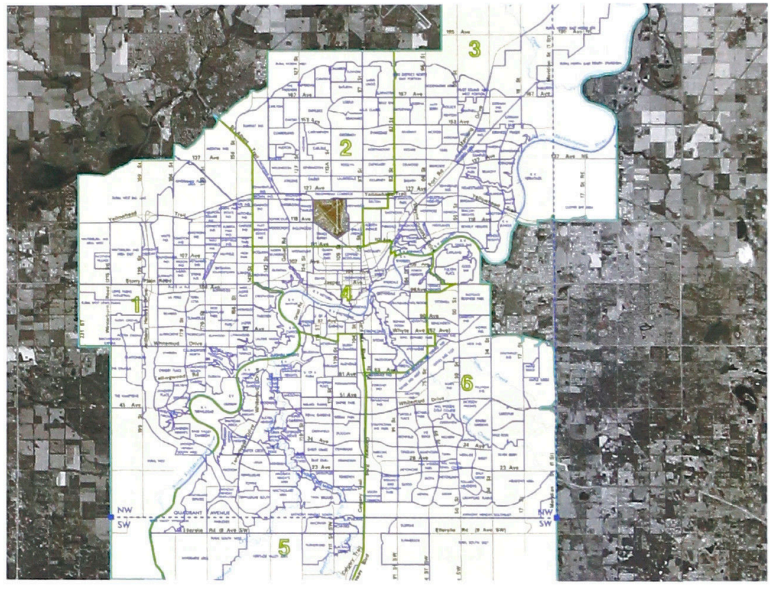


Figure 1.1: Map of Edmonton Neighbourhoods and city limits, showing the location of the ECCA relative to the city.

1.1 Importance of Edmonton

The city started as a fur trading post for the Hudson's Bay Company which opened up the west because it was well located on major water routes. It was a stepping off point from which explorers accessed both the Arctic and West Coast. With the arrival of the railway the city grew rapidly with an influx of immigrants from Eastern Canada and Europe. With increased labour, good rail transportation and improved farming techniques the agricultural base was established around 1910, taking full advantage of the rich soils (MacGregor, Edmonton 177).

Today Edmonton remains a major divisional point for the Canadian National Railway operations in the Prairies. The influence of the railroad on the city has waned but resource development in the area has not. Alberta is a resource rich province, most importantly with oil. Canada is considered to have the third largest oil reserves in the world within the Alberta oil-sands. ("Oil Reserves") Edmonton, in close proximity to the oil-sands, is an important center for that energy production.

For Canada, Edmonton is an important city economically. The City is a strong-hold of the middle class providing well paying and permanent jobs, in addition to affordable housing, when compared to Vancouver, Calgary and Toronto. Edmonton's median family income in 2009 was the third highest of all major cities in Canada but average income levels are not as polarized as in the above mentioned cities. Oil prices of $100 a barrel keep the economic underpinnings solid. The diverse regional economy contains a manufacturing sector for Alberta's oil sands in addition to a large government, educational, medical and financial presence. The region is also home to some of the busiest construction and engineering firms in the country (Lamphier E1).

The entire northern half of the province could be considered part of Edmonton's hinterlands, and the city is both a gathering point and funnel in which resources, goods and services flow north or south. With global warming this importance may simply increase.

1.2 Background of the ECCA Site

Edmonton City Center Airport (ECCA) has possessed two previous names, being called The Edmonton Municipal Airport, (EMA) and before that, Blatchford Field. The airport earned Edmonton its nickname of "Gateway to the North." due to the work of pioneer aviation characters such as Wop May. The first recorded flight was in 1909, but officially the airfield became the first licensed airport in Canada in 1929. Later the airport was a major stop-over on the Northwest Staging Route during World War II and hosted a wartime British Commonwealth Air Training school. In the 1950s the need for longer runways became apparent and the Edmonton International Airport was built south of Edmonton in Leduc. Its initial construction finished in 1963, and at that time the ECCA was scheduled to close. Unforeseen was the development of regional passenger service which kept the airport open until the 1990s ("Edmonton City Center (Blatchford Field) Airport"). During the 90's there were several political moves, by private developers and the City, to close the

airport despite strong public objection and disapproval by northern communities. The records of the Public Meetings held during early 1990's contain numerous third party reports detailing how the ECCA did not compete with the International Airport, citing they served different markets (Public Meeting 25, Vol 1-3). The process appeared politically dominated and the final decision was to close the airport. Despite continuing objections from some citizens the damage has been done and the ECCA is no longer viable. The final decision to approve the phased closure and redevelopment of the ECCA came July 8, 2009. The re-development of the land is expected to generate large amounts of revenue and be a show piece for the City of Edmonton.

1.3 Description of the Physical Site

The ECCA site is the approximate center of Edmonton, just northwest of the downtown and central business district. It encompasses approximately 217 hectares in area and is owned by the City of Edmonton. It is bordered on the north by the Yellowhead Trail (highway 16) that connects Vancouver and Winnipeg. Also bordering the northern edge is the Canadian National Railway main line and rail yards, including a Via Rail station at the north-west corner of the site. To the east and west are 121 St and 107 St respectively, which are major arterial roads leading to the Yellowhead Trail. Both are bordered by older suburban areas with predominately single family detached housing. The southern border is marked by Kingsway Ave which is a commercial corridor, where the second largest mall in the city, Kingsway Garden Mall is located. Two smaller industrial areas exist, one to the south west, and one on the north edge against the Yellowhead Trail. Major institutions include the Northern Alberta Institute of Technology (Technical College) on the south east corner and the R.C.M.P Headquarters building. Residential areas directly south of the ECCA quickly change from detached housing into apartment blocks as you move southerly towards the North Saskatchewan River Valley. The surrounding structures are generally low because they were limited in height to 3 or 4 stories as previously required for the landing aircraft.

Figure 1.2: Current satellite Photo of the ECCA

Section 2: Framing the Project

2.0 The ECCA Competition

Upon the decision to close the ECCA, the City also decided to host a competition for the preparation of a Master Plan for the site. The competition was done in two stages, the first stage was to generate a short list of five firms, who then prepared their initial plans for the second phase of the competition. The first round was open internationally to all firms in order to attract the best minds and ideas to the table. From thirty-three submissions the shortlisted group included BNIM, Foster & Partners, KCAP, Perkins+Will and Sweco International AB. These groups were required to prepare their visionary and innovative ideas that would achieve the sustainability goals laid out by the City of Edmonton (CoE). These goals were presented in the original competition brief, titled Edmonton City Center Airport Lands; Master Plan Principals. The remainder of this section was CoE's vision for the re-development of the ECCA as taken from that same report:

"The ECCA lands will be home to 30,000 Edmontonians living, working and learning in a sustainable community that uses 100% renewable energy, is carbon neutral, significantly reduces its ecological footprint, and empowers residents to pursue a range of sustainable lifestyle choices."

In the report the City made the point that sustainability requires people to accept new lifestyle choices and this must also be affordable for families, individuals and businesses. For this reason the development was also envisioned to be an inclusive family-oriented environment and offer "*superior urban lifestyle opportunities*" with a range of housing choices and amenities. The City's intention was to build with sensitivity to the aviation history of the site. It was to be a transit oriented, walk able and bicycle friendly, mixed-use community, meant to demonstrate what a future sustainable community could look like.

In the CoE report the definition of the sustainability goal is vague, the idea being adopted from the United Nations definition found in the U.N. report "Our Common Future":

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Three dimensions of societal development must cooperate for sustainable development: The social, economic, and ecological dimensions.

The CoE report states that Edmonton should be a world sustainability leader by 2020, hosting international visitors and promoting the ECCA development. The document also includes international precedents such as Vastra Hamnen in Malmo and Hammarby Sjostad, Stockholm, both in Sweden, as models to emulate. In more concrete terms the City would like to match and exceed the goals currently being pursued by the city of Malmo, which are quoted as:

- be climate neutral in 2020 and by 2030 the entire municipality will be run on 100% renewable energy, much of it produced locally;

- decrease energy consumption by at least 20% per person by 2020 (compared to the 2001-2005 average), and a further 30% by 2030;

- decrease greenhouse gas (GGH) emissions by at least 40%, calculated from 1990.

In a nutshell sustainability is measured against energy use and carbon dioxide emissions.

In regards to pedestrian development the CoE report mentions that the master plan *"must clearly demonstrate how this new community is to be compact, mixed use in character, pedestrian and transit-oriented, and capable of minimizing the impacts of the automobile and reliance on fossil fuel technology."* This leads into a paragraph about Edmonton as a winter city and the need for design considerations that improve winter liveability and quality, citing the following criteria:

- Encourage people to go outdoors;

- Address snow removal and storage, sunlight exposure, wind and darkness in the built environment;

- Aid in creating comfortable micro-climatic conditions in open spaces through landscaping and building placement; and

- Provide opportunities for year-round use of open spaces and infrastructure.

This thesis' research emphasizes how critical these points are for pedestrianization in the local climate, showing the CoE report did not miss its mark. A key point is creating micro-climate conditions through building placement, suggesting the connection between architecture and planning that will be discussed in later sections.

During the second stage and final stage of the competition the five master plan proposals were available for public consultation and a jury selected a final winner. The "preferred proponent" (Perkins+Will) was then invited to enter into negotiations with the CoE to formalize an agreement for the preparation of a more detailed version of their winning competition entry. The intention is that winning P+W Master Plan proposal will become the basis of the *Area Structure Plan* which will govern all future public investments and private developments on the ECCA lands (Edmonton City Center Airport Lands, App. E). Any specific Area Structure Plan is the second highest level of the hierarchical planning process, that the CoE uses for new development, after the Municipal Development Plan (The Planning and Development Handbook).

The City sees itself as the developer of the property and states it must put in place the "foundations" of such a development, setting a clear value system to determine whether a building proposal for the ECCA site measures up to expectations. The remainder of the original competition brief suggests an initial framework for such an evaluation system and the main Master Plan Principles discussed in the next section.

2.1 Examination of the Master Plan: Comparison of the Competition Brief and the Perkins+Will Master Plan.

This thesis argues that the key to establishing a sustainable city is through pedestrianization with development focused on the generation of a healthy pedestrian environment. This includes aspects of planning, architecture, urban design, landscape design and others which must be combined. A city may have many energy efficient buildings but if the urban form is sprawled, the benefit is reduced. Sprawling infrastructure such as highways and the associated cars used to connect those buildings wastes valuable energy. Delivery of utilities and access to public facilities is spread thin and unnecessarily duplicated. The costs quickly become unmanageable and city governments feel the effect with ballooning infrastructure budgets.

The document "*Edmonton City Center Airport Lands; Master Plan Principals*" as discussed in the last section, lays out a series of master plan concepts that were to provide the basis for developing strategies that connect with the sustainability goals. Divided into eight sections they cover topics as wide as planning and design, to technology, to history. Each competition entry was required to address these principals with their own unique solution. The following will examine how the winning Perkins+Will proposal interpreted these aspects in regards to pedestrianization. The proposal is weak because it does not address winter conditions; there is no indication of creating micro climates and only a token gesture towards wind protection for the streets. Most of the images presented display summer modes of thought related to the pedestrian, and Edmonton summers are short.

Section A: Planning and Design

The first CoE principle was to: "*connect new neighbourhoods with surrounding communities and incorporate pedestrian-oriented systems that promote healthy living within neighbourhoods situated within walking distance of local shops, parks, restaurants and schools.*"

In the P+W Master Plan the strategy is that all new development is positioned within a five minute walking radius (undefined distance) of a transit stop, be it LRT or Street Car system. The new primary street grid is matched to the existing street grid and there are pedestrian right of ways proposed, to link to adjacent neighbourhoods. These cross the existing arterial roads around the ECCA and it is questionable if a pedestrian crossing four to six lanes of high-speed traffic, to access a suburban neighbourhood, is practical for pedestrians or drivers.

The second CoE principle was to create public parks, and set aside areas for conservation and restorative ecological initiatives. By creating vegetated interconnected trails and bicycle paths linking the entire development, the response is precisely as the brief calls for, providing a large central park with a trail network. The P+W Master Plan proposes to keep approximately 50% of the entire site as open park space, the largest area of any proposal. "Green" or vegetated paths and walkways are shown throughout new neighbourhoods.

Section B: Ecological Footprint

One of the CoE principles in this section was about housing; mainly construction and maintenance and there was no response by P+W to these specific requests. Their Master Plan does not address housing issues at the level of detail requested by CoE. The P+W plan only shows general housing typologies, and location on the site. Although the competition entry was not to design every structure, the impact housing and building form will have on the pedestrian environment needed to be addressed in the P+W submission.

Transport and the impacts that arise from fuel consumption; car ownership; public transport; and maintenance of the transport networks was another CoE question. The response was transit oriented development; dense multifamily housing typologies; and mixed use development for proximity to services. There is no mention of traffic reduction measures or the possibility of "Car Free Condos" or leases. Reductions in traffic would enhance the pedestrian environment and could have been suggested without detailed building designs from P+W.

Section C: Infrastructure

Specifically the CoE asked for storm water management. The lake in the central park is primarily intended as a storm water storage pond, where water is pre-filtered by engineered wetlands and used for site irrigation. Secondly it is used for recreation and this ties into the pedestrian environment through the proposed "Green" pathways. It gives people an interesting place to stroll and enjoy the outdoors. There are even small "ravines" planned to branch out from this pond and stretch into the city, presumably with trails.

CoE also asked for efficient right-of-ways for vehicular circulation but with the addition of parking policies to discourage private use of cars and encourage transit use. The response is the alignment of the primary street grid to match the existing conditions outside the site, as mentioned above. This raises the question; if the road connections are too good, won't this encourage citizens to use cars? There may be an unspoken theory here used by P+W, that driving should be easy, but walking should be effortless. If walking is more convenient than driving P+W may assume people will simply walk, but this is left unsaid.

On-grade parking areas are not evident, even in the commercial zones, yet there is specifically no mention of policies to limit the use of personal vehicles, or limitation of on-site parking. It is also unknown how often underground parking garages are to be relied upon. A strategic lack of parking may be the deterrent against automobile use but this is unclear in the Master Plan.

Section D: Family Housing

CoE main's focus in this section was to promote mixed-use development and achieve an overall minimum (gross) density of 25 units per acre, equalling approximately 12,500 residential units. The Master Plan responded with mainly mixed

use residential and mixed use commercial buildings at different parts of the site, connected by an LRT and Street Car line. This positions the majority of new commercial development closer to the existing commercial facilities along Kingsway Ave. Therefore the majority of people in the new residential wings would be dependent on transit. The research in the next section suggests not developing a transit dependency when it's not necessary, as it is not sustainable in the long term. The Master Plan does allow for higher density of development at LRT stops and arterial road intersections. This is a good strategy because the concept is to create the critical mass necessary to sustain pedestrian-oriented street life. Yet it will probably still fail in a predominately residential neighbourhood.

Section E: Open Space

Many of the CoE principles in this section repeat the intentions of the central park and the interconnected path system which was provided in the P+W plan. What is lacking is any idea of how open space can enhance the day to day pedestrian life on the streets, not just in open parks. Wind protection is an issue but the proposed solution lacks vitality and this is a critical omission for a winter city such as Edmonton.

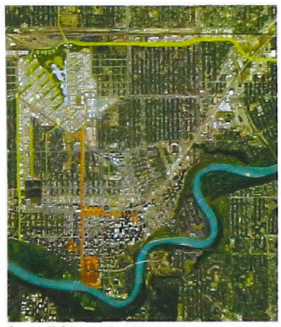
Open space is related to building form and how the buildings interact with the voids around them. The Master Plan has suggested a rough massing for individual buildings but there is no solid evidence to suggest why such forms were chosen. The reason could have been wind protection and creation of micro climates for the pedestrian street level. There is one diagram suggesting wind protection, but is flawed because it shows the winds coming from the northwest, which is not the right direction. The actual prevailing winds are from the west and south with only gusts coming from the northwest ("Canadian Climate Normals"). Small scale, relatively dense patters of buildings can reduce wind speeds, but only when facing directly into the wind (Kuismanen 20). With the P+W plan perhaps 60% or more of the street grid and buildings would be oriented at 45 degrees to both prevailing winds. This would create extra wind turbulence and may increase wind speeds depending on building heights. Therefore most streets on the site are actually exposed to, and not protected, from prevailing winds.

Summary:

At first glance these topics may not seem connected to pedestrianism but in reality they are. The relationships shown are evidence of the intricate and complex nature of a pedestrian city and should speak to how easily it can fail to be effective. This danger exists with the ECCA using the current P+W Master Plan. Edmonton culture is very reliant on cars; drivers don't like sharing the road with bicycles and visitors to the city quickly observe how pickup trucks, SUV's and large cars are very popular. It is not a city of compact sedans and cyclists like Vancouver. Edmonton is such a large geographical area that transit has not proliferated and is inefficient. If people can't walk for daily routines they will probably drive everywhere.

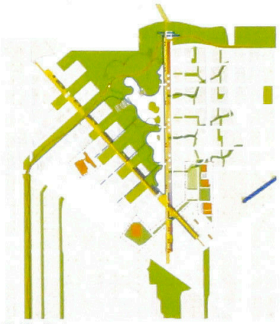
PLANNING AND DESIGN FRAMEWORK

Vision: Imagine a landmark park, a new jewel in the city's green network, woven into the neighbourhoods that embrace it; picture diverse neighbourhoods, known for their distinctive patterns, uses and networks; envision a town centre pulsing with the life of academic, health and retail communities; imagine learning the lessons of new energy systems that go beyond carbon neutral and encountering aviation history imprinted on the public spaces of this place - connecting the past to the present and a sustainable future for Edmonton.



Connecticity

Our plan embraces the unique opportunity of reconnecting the airport lands to the City of Edmonton's neighbourhoods and open spaces - envisioning a citywide beyond carbon neutral energy system and a world class public park.



Public Realm

- Existing Buildings
- Runways
- Promenade
- Green Spaces
- City Greenway
- Pavillions

Street Network

- Primary Street
- Secondary Street
- Neighbourhood Street

Land Use Plan

- Res-High
- Res-Med-Hi
- Res-Med-Hi
- Res-TH
- Mu-District
- Mu-Local
- Mu-Office
- Industrial
- Hospital
- NAIT
- School
- Amenity
- Gov't/Military
- Park
- Agriculture

connecticity

The idea of 'connecticity' builds on a concept identified by Edmontonians. At a recent forum, citizens were asked what aspect of community life was most important to them and the answer was: 'connectedness'. Our plan pursues the idea of connectedness at multiple levels, seeking to link future residents, existing neighbours and the larger Edmonton community to the unprecedented potential of the ECCA site in four distinct ways. These connections form our key strategies or '4 BIG IDEAS'.

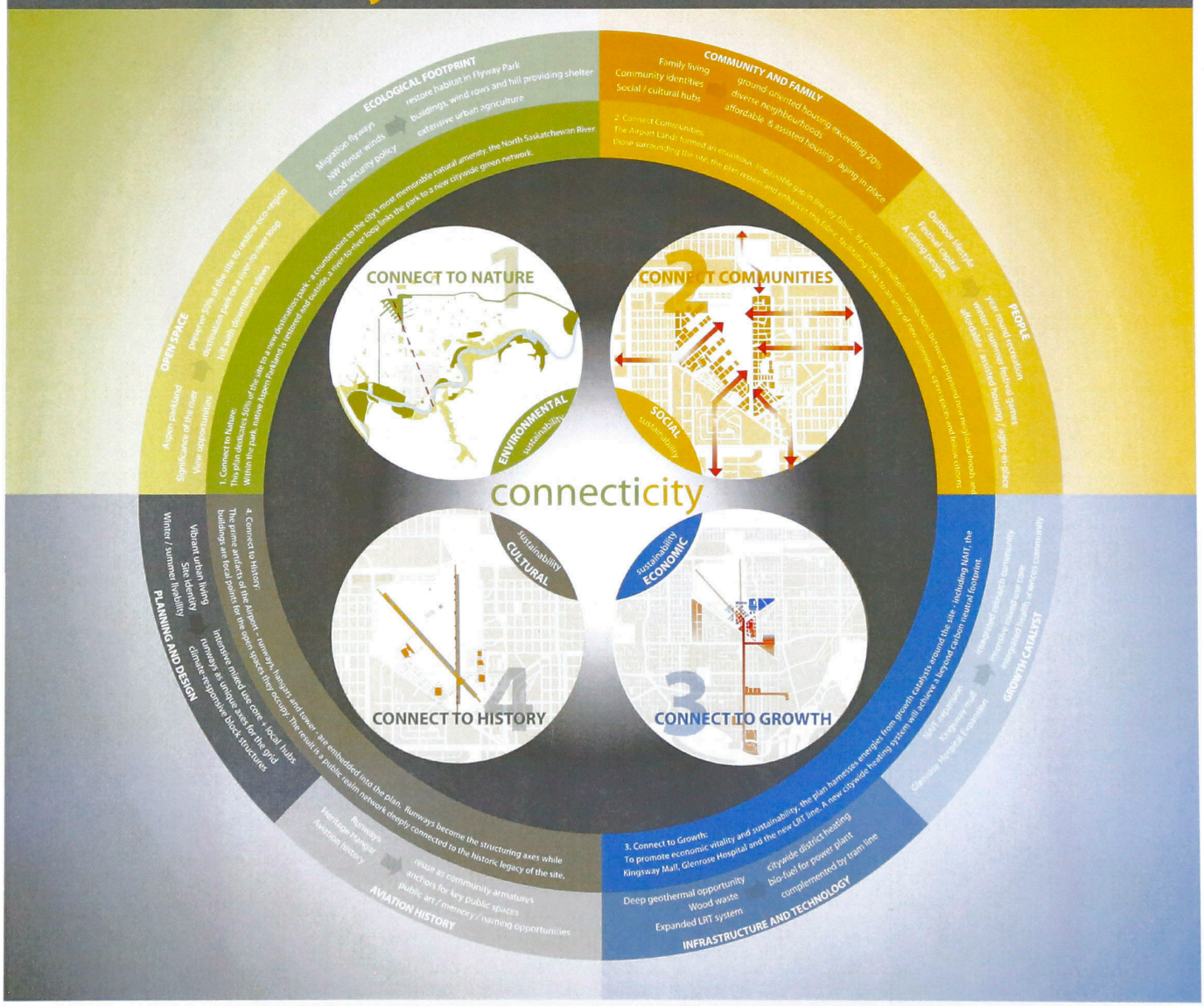


Figure 2.1 P+W Competition Panel #1 Planning and Design Framework

OPEN SPACE

connectcity

Edmonton's most dramatic natural feature is the North Saskatchewan River and the remarkable network of public parks along its broad banks. The Airport Lands opportunity is to create a major destination park in the north of the city as a counterpoint to the river, a breath-taking new open space restoring the native eco-environment and connecting to the river through found green corridors.

River to River Loop

Open Space Programming

Flyway Park is the key destination for a new River-to-River loop system comprising new and existing greenways that will link the park into the City's primary public space network. Especially appealing to Edmonton's passionate year round cyclists, the new route will run from one river-park to another while the Flyway Park provides a welcome oasis along the way. Riding the Loop is expected to become an Edmonton ritual.

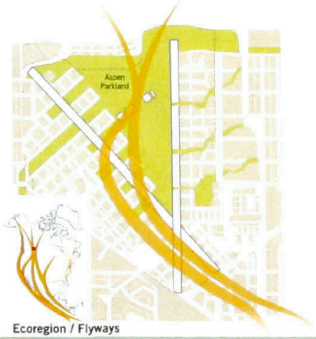
A blending of constructed and naturalized landscapes, the spirit of this destination park is that of a 'wild-patch' in the centre of the city. Here, visitors can lose themselves in a microcosm of the larger northern Alberta landscape as they experience elements of prairie, forest, wetland, bluff and ravine. Contained within the 'X' created by the intersecting runway axes, wild spaces are juxtaposed against the formality of the runways, along which smaller scaled, more formal parks, gardens and recreational spaces.

Figure 2.2 P+W Competition Panel #2 Open Space

ECOLOGICAL FOOTPRINT

connecticity

Edmonton is a northern city with severe winter and summer extremes. The ECCA opportunity is a holistic development-wide design response to these conditions to most effectively take advantage of benefits - sun and sky – while mitigating discomforts – cold and wind. Blocks and streets are designed to offer sheltered open space whether within the block or protecting pedestrian routes moving between and through them. These work in concert with landscape elements including wind rows and shaped topography.



Ecoregion / Flyways

Edmonton lies at the nexus of two mid-continental bird flyways. Restoring the site's natural avifauna habitat is a critical element in our plan. To encourage habitation, initiatives protecting bird colonies will be encouraged.

Ecology

- Aspen Praire / Meadow
- Aspen Forest
- Greenway / Ravines
- Wetland / Lake

Climate Responsive Design

- Protective Hill
- Wind Rows
- Built Form Providing Shelter
- Forest

Storm Water Management

- Ravine Catchment
- Lake
- Storm Water

1. Agrihood

Figure 2.3 P+W Competition Panel #3 Ecological Footprint

COMMUNITY / FAMILY

Edmonton is a city of great neighbourhoods, a strong sense of family and a custom of looking after the less privileged members of society. This concept creates unique new neighbourhoods with strong connections to surrounding neighbourhoods. Within each neighbourhood a high degree of family housing choices are included - from intensive urban mixed use to small rowhousing - each with its own garden plot. Public amenities are the focal points of these neighbourhoods, from the iconic buildings in the Town Centre, like the library, to the more integrated facilities woven into residential blocks.

Connecting Communities

Street grids and green corridors extend from existing neighbourhoods onto the site, linking to the destination park at the community heart. Public amenities and institutions are integrated within key community nodes.

Diverse Neighbourhoods

- Town Centre
- NAIT
- Kingsway Corridor
- Light Industry
- North Agri-hood
- South Agri-hood
- North Research Neighbourhood
- South Research Neighbourhood

Community Amenities

- Public Amenities
- Schools
- Community Centres
- Pavillions
- Community Parks
- Daycares

Housing Typologies

- Student Housing
- Assisted Living
- Family Housing
- Townhouses
- Social Housing
- Towers
- Mixed use

2. Downtown View from Hill

3. Northern Lights Winter Festival

4. Tobogganing at Hilltop

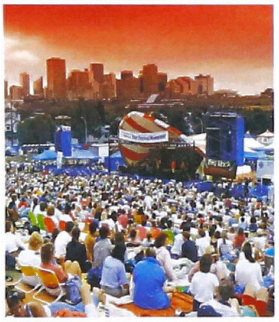
5. Bush Pilot Runway

Figure 2.4 P+W Competition Panel #4 Community / Family

PEOPLE

connecticity

Unique cities are vivid expressions of the people that inhabit them. The Edmontonian zeal for outdoor activities, commitment to citywide arts and cultural events and compassion for fellow citizens are key characteristics celebrated in this plan. A wide range of recreational and cultural opportunities will make this place a new destination for citizens to come together and enjoy each other's company. Equally, a comprehensive approach to social considerations will foster a new kind of community focused on the wellbeing of its members.



Festival City

Festivals are spectacular opportunities to celebrate and a reflection of the city's truly communal spirit. Memorable outdoor and public indoor spaces are conceived as supporting a wide variety of events in all seasons.

Winter Festival

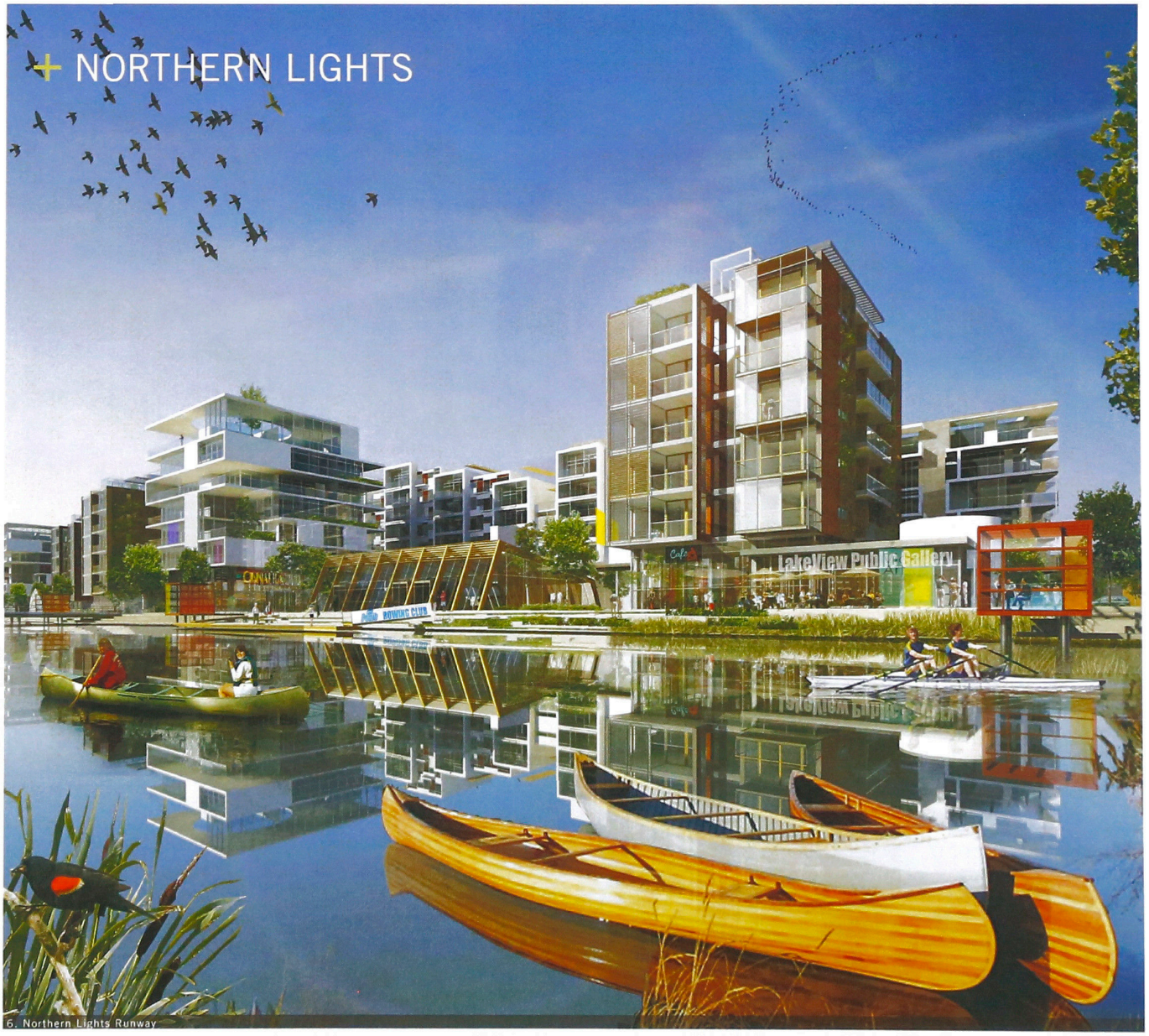
- Skater's Pond
- Northern Lights
- City Greenway
- Toboggan Hill
- Cross Country Race

Summer Festival

- Lake
- Oxbow Trail
- City Greenway
- Green Fingers
- Forest Agriculture
- Pavillions
- 1 km Rowing Course

Community Wellness

Edmonton's community-minded spirit, a hallmark of prairie life, feeds the idea of community wellness in an urban environment designed to promote physical and social well-being.



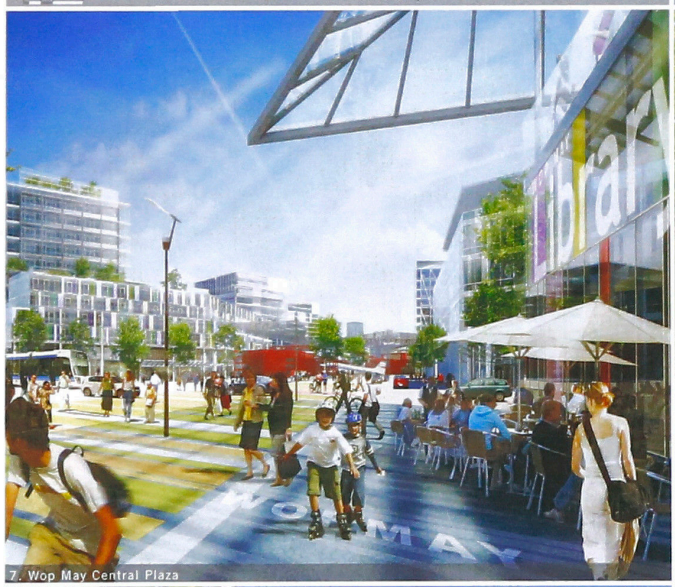
6. Northern Lights Runway

Figure 2.5 P+W Competition Panel #5 People

PLACEMAKING / GROWTH CATALYSTS

connecticity

The plan seeks to ensure economic vitality and sustainability by extending the energy from four vibrant growth catalysts into the site - NAIT's research and innovation, Kingsway Mall's commercial vitality, the busy life of the new rehabilitation hospital and the development spark of the new LRT line - these new components will create 10,000 jobs and animate the local employment market. A flexible Phasing Plan enables our scheme to respond to growth levels along the proposed LRT line.


7. Wop May Central Plaza


8. Hospital Green Connection

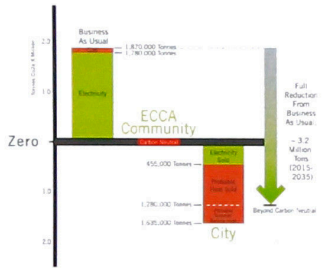

9. NAIT Front Door


10. Aviation History

Figure 2.6 P+W Competition Panel #6 Placemaking / Growth Catalysts

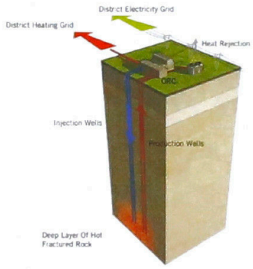
INFRASTRUCTURE - INNOVATIVE TECHNOLOGY

Engineering design for ECCA takes an innovative approach to infrastructure, delivering resilient carbon neutral energy as well as promoting water and waste reduction. Carbon emissions from the community will reduce by 3.2 million tonnes over 20 years. Energy produced with carbon neutral sources of biomass and deep geothermal create enough electricity to fully meet the needs of the development. Solar and wind technologies provide research and training opportunities. To provide all thermal needs of the site, waste heat from the carbon neutral electrical generation is captured and used. The surplus is sold to public buildings within the greater City of Edmonton resulting in beyond carbon neutral strategies.



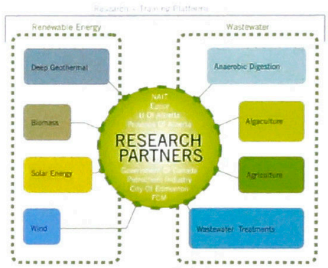
Carbon Emissions 2015 to 2035

- Business as usual would produce 1,870,000 tonnes of CO_2 emissions
- Electricity sold to the grid will save 455,000 tonnes of CO_2 emissions
- District heat sold will save 825,000 tonnes of CO_2 emissions



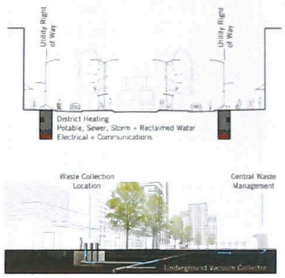
Deep Geothermal

- Ground Heat from ~5 km deep will provide heat energy
- Organic Rankine Cycle generator produces ~5 MWe of power
- Water is returned to deep ground for heating
- Well sleeves provided in shallow layers to protect groundwater



Research and Training Platforms

- Utility services on site will allow research into new approaches
- Training of people to develop the Green Economy
- Research Partners: NAIT, Epcor, U of A, industry and petrochemical, FCM, City of Edmonton, Alberta and Federal Governments



Waste Management

- Underground vacuum tubes collect garbage
- No garbage trucks driving around enhance site tranquility
- Central collection location
- Separate recyclables, organics, and waste collection

+ BEYOND CARBON NEUTRAL

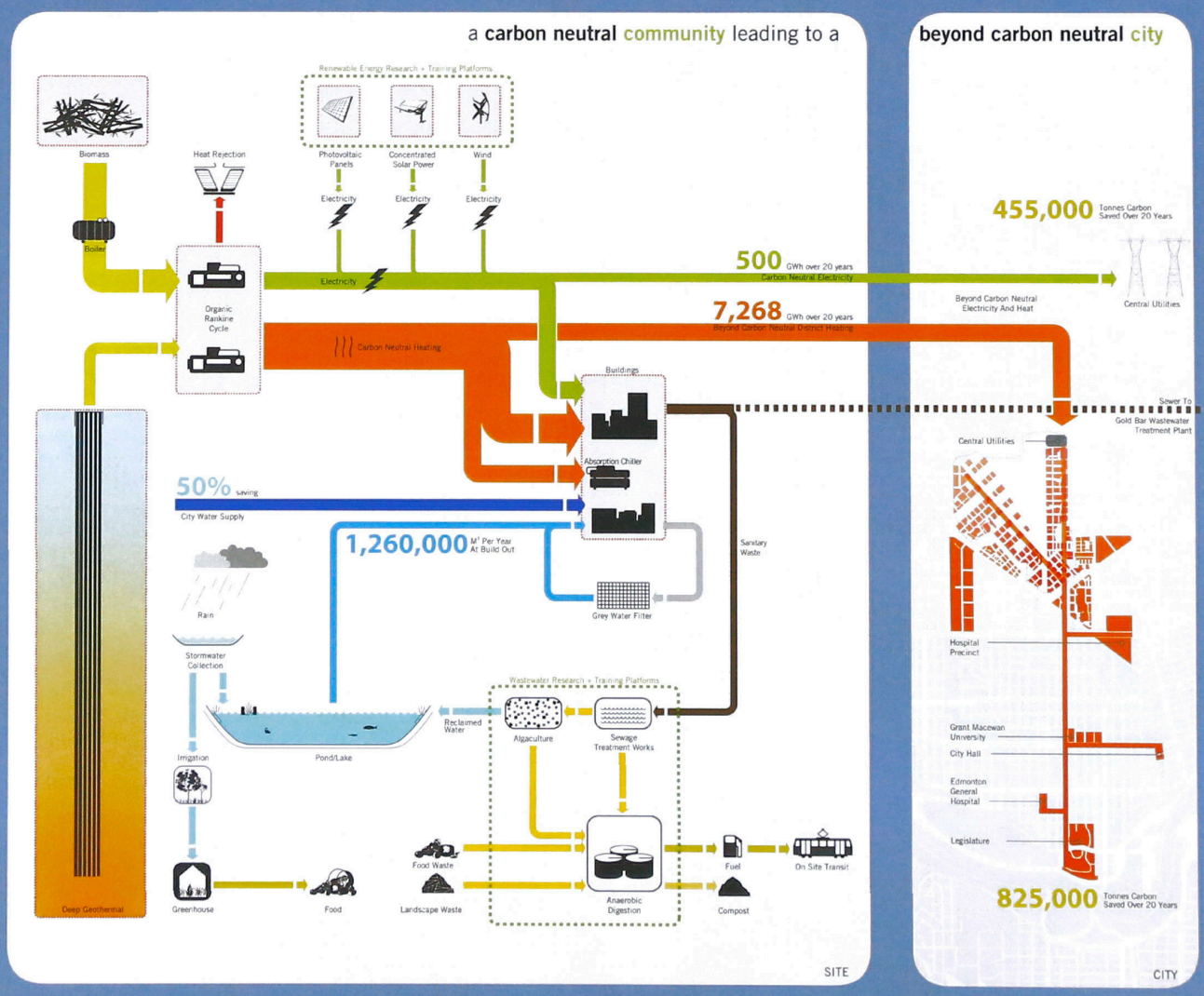
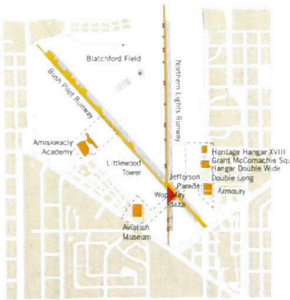


Figure 2.7 P+W Competition Panel #7 Infrastructure - Innovative Technology

AVIATION HISTORY

The cradle of Canadian aviation history and the first 'registered Air Harbour' in the Commonwealth, ECCA is a significant part of the Edmonton legacy. With dramatic runways intact as well as impressive hangars and tower, the plan embraces these elements of history, giving them new life as focal points for major public spaces. Expansion of the Aviation Museum and its collection of aircraft offers an exciting chance to showcase these artifacts within the public realm of the Town Centre. Public art and naming of streets and public places recall the exploits and characters of Edmonton's past including Wop May and Margaret Littlewood.



Re-use of Airport Runways

Opportunities for Public Art

- Historic Buildings
- Runways
- Civic and Community Armatures

- Deep Geothermal Art Object
- Pavillions
- Civic Places
- Renewable Energy Plants
- Community Places
- Runways

In addition to history, art initiatives responding to other specific aspects of the site help to deepen and diversify the arts program. These might include installations associated with the various civic buildings like the library or performing arts centre.

A new kind of community drawn from Edmonton's own unique aviation history. Like the Airport before it, this new place will open up a **whole new world** - a future that embraces the idea of resiliency, exploration and innovation.

11. Flyway Park

Figure 2.8 P+W Competition Panel #8 Aviation History

Section 3 Critical Theory

3.1 Critical Stance

The re-development of the Edmonton City Center Airport into a residential community is similar in scale to building a city from scratch. This development can either make or break Edmonton as a vibrant 21st century city.

Generating a pedestrian environment is the key ingredient to sustainability. The virtues of combining walking with the type of development needed to support pedestrian street life, lead us on a path to sustainable cities. This requires examination, analysis and planning at different scales to pedestrianize the city.

Before modernist planning, housing typologies shaped urban form (Finley and Stahl, Urban Housing Handbook). Now the planning process shapes urban form because of universal zones, inflexible street grids and planning for the car. Idealistically a new model to inform the planning process would not be linear, but circular. This would represent the push-pull between architecture and planning, moving back and forth from the macro to the micro scale to discover solutions. These solutions would include theories on pedestrian oriented design, density, multiple-use, and other sustainability strategies. In addition this development model needs to take into consideration the local climate and culture of the place.

The following is critical theory as it relates to the ECCA development and pedestrianization. It is divided into four main parts: pedestrian oriented design, density, mixed-use, and sustainability. Individually these four aspects are important but they also overlap in many regards and must be combined to have full effect.

3.2 Pedestrian Oriented Development

"Peak oil means peak car" in the words of Ken Greenberg. There is simply no more room for cars; we have saturated our cities with roads and street widening. If we want dense, active and competitive cities something has to give. There are also the health concerns and unimagined consequences such as baby boomers reaching an age where they can no longer drive safely and are stranded. Land use and density, which can also mean less reliance on public transit, are important places to start but are not a silver bullet by themselves (Greenberg, Walking 193). We must also nurture a pedestrian oriented city.

The theories of Jane Jacobs may be considered outdated but in light of the shift to re-urbanize city cores and the push for sustainability, her theories fit well. Mixed-use development and density are great but do not stand alone. They are the prime ingredients that must be organized into pedestrian friendly forms to be effective.

In her book "The Death and Life of Great American Cities" Jane Jacobs lists the main elements of successful pedestrian cities (Jacobs, The Death 143-221). To generate a street life a city must first have diversity. This requires four conditions to be present: First, a variety of uses on the street that bring out different people at different times of day and for different purposes (mixed-use design). Second, frequent streets and short city blocks to allow for non-regimented flow of human

traffic. Third, the district must consist of buildings of different age and function. Fourth, it must have a sufficiently dense concentration of people to support the various activities. The premise is that public life in a city is developed on the street, but this first requires the streets to be safe. The basic building blocks of cities are actually the sidewalks which maintain the safety of the inhabitants. This requires clear boundaries between public and private and no "non-spaces" that are difficult to monitor. It also means eyes on the street, accomplished by orientating buildings to face the sidewalk and the continuous use of the sidewalks to ensure the street is monitored around the clock. Neighbourhood parks should also be linked into this street system and self monitoring process. Large parks, such as Central Park in New York have secluded sections that cannot be monitored. Slums and areas of decay are created as the vacuums of abandoned areas are filled by less privileged or undesirable people.

Ken Greenberg in his new book Walking Home gives examples of dense cities that have no pedestrians and quotes Jonathan Barnett; "It's not how dense you make it but how you make it dense" (Greenburg 88). In practice the four principles of diversity are not enough to create public spaces. They are the bones but Greenberg found that Whyte's conclusions are still important for successful public space (Greenburg 45). These criteria are similar to what Team X found in their explorations. Team X were right when they challenged the C.I.A.M. modernist model of city building. These criteria: shade, sun, shelter, food, drink, public restrooms, a sense of security, interesting things to see and other people, bond the city fabric and allow us to loiter with creature comforts. This is evident with the rise in popularity of side walk cafes and street markets in North American cities. One must also not forget that store front windows also enrich the street (Greenburg 85).

Another consideration is the aging and elderly population who requires the city to be safe and convenient for continued independence. Inclusive planning for this demographic would include new housing options with no driving required, good accessibility to building entrances, public transit and removal of physical barriers such as awkward level changes in sidewalks (Greenburg 91).

Integration with Infrastructure

Any city's architecture is not pedestrian oriented without integration with infrastructure. This was alluded to in the examination of the P+W Master Plan and previous paragraphs regarding how buildings should address the street. Greenberg gives examples of many different projects detailing the relationship of the buildings to the street and the kinds of streets implemented. A concept used when talking about street design is sub-optimizing the parts to optimize the whole. Greenberg refers to Jane Jacob's book titled Systems of Survival. The concept is, a street may not be ideal for one particular use, such as traffic flow or pedestrian activity, but when all traits are combined, is appreciated as a whole. Examples are streets like Hanover and Salem in Boston's North End (Greenburg 149). Another seminal project was a Boulevard study by Allen Jacobs and Elizabeth MacDonald at Berkely, who then used this study to redesign Octavia Boulevard in San Francisco. Since then, the

study has been used as a reference by students and professionals (Greenburg 201).

The P+W Master Plan is pushing transit as the method of generating a pedestrian oriented lifestyle. Every residential unit is a five minute walk from a transit station, representing either a street-car or LRT stop. The street car is a local system used to access the regional LRT. Street car and LRT are an example of integration of infrastructure with the urban fabric. Theoretically higher density mixed-use areas reduce the need for transit. For example; why should everyone moving into the ECCA development be required to take transit for their grocery shopping? Especially at the LRT stops there should be an increased density, higher than the site average, which is the intention, but at this point it should also be the most intensive mixed-use. The P+W Master Plan should allow for more local commercial settings, such as grocery stores within walking distance, then the current Master Plan has allocated.

Connect to 'Nature' and 'Community'

The Perkins+Will Master Plan developed a concept of "connection to nature and community" through landscaped "green" recreational trails. Interestingly the idea of "green pathways" and bike trails has actually become the new paradigm for economic development. Cities are the principal generators of wealth in our economic system, but they must first attract investment. With the move to re-urbanize city cores, value is attributed to quality of life and place, as much or more than land, labour and capital costs (Greenburg 261). Quality of place is a deciding factor for location of global enterprise, so sustainable public support for the public realm becomes a strategy for attracting and supporting effective private sector investment (Greenburg 264). This may or may not have contributed to Perkins+Will thinking when so much green space was purposed for the site. Open space was explicitly asked for by the City and links between the large central park and smaller neighbourhood parks via green pathways is definitely a strategy that should be pursued. A critical response at the level of an individual city block would be integration of such pedestrian green paths with pedestrian streets and sidewalks. As mentioned above with the topic of open space, the individual buildings have a strong role to play.

The minimum of twenty percent ground oriented housing, as called for in the brief, can also be another method of integration with the street and building the public realm.

Localized Conditions; Seasonal Weather

In 1986 Edmonton hosted the Winter Cities Conference and examined the issues between pedestrianization and winter climates. They concluded elements of pedestrian discomfort in winter cities are cold, wet and distance combined with wind. Comfort requires only minimum warmth which can be accomplished by protecting exterior pedestrian areas from prevailing winds and providing periodic seating, pedestrian density and streetscape interest. Other suggestions from the conference were for public spaces to connect where possible, be oriented to key building entrances, and encourage dual use of indoor spaces by designing entrances to be large enough to

serve as waiting areas (Livable Winter Cities 26). As well, indoor/outdoor transition spaces should be recognized and treated as important winter activity zones. Important indoor spaces should be located along and connected to the public indoor circulation system. Pedestrian movement should be given priority when in conflict with vehicles. Indoor public areas should accommodate a wide variety of activities to encourage public uses similar to outdoor summer uses. Indoor space should also be readily accessible to outdoor public spaces where possible and should have direct access to sunlight. Edmonton, with its northern latitude, also requires pedestrian pathways to be well lit, especially at intersections and points of decision, because of longer periods of darkness.

The conference considered Edmonton's Skyway (enclosed and elevated pedestrian bridges) in the downtown as a good beginning for the integration of the downtown area. However, they found the system to be unreadable, but suggested improvement could be made by more intuitive connections between the indoor areas and exterior streets. "*Where possible the skyway system should be embellished with clear entrance and exit points and integrated with building design elements*". Providing views to the exterior was considered critical for orientation. (FN)

Ken Greenberg argues against the skyways that were also created in Calgary and St. Paul Minnesota, where he helped develop a new planning framework to reinvigorate the downtown. Though the skyway was convenient for weather protection in a northern climate but in the case of St. Paul it prevented the development of a lively street environment. Greenberg felt it was necessary to break the city's love affair with this system and there were efforts to limit its use in new areas and re-connect the existing sections to the street level. This was done with animated two story frontages, more stairs, escalators and elevators tying the two levels together (Greenburg 137). The same strategies can be applied in Edmonton with the new ECCA development.

Summer is relatively easy by comparison to winter as temperatures are much more tolerable. Wind is still an issue in the summer due to dust which can sting your eyes, as well as driving rain. Although in summer natural vegetation affords some protection. Landscaping, especially trees is important for air quality and shade. Edmonton has a tradition of planting elm trees along streets and has many large, beautiful elm tree stands, which provide shade and cooling in the summer and allow penetration by winter sunlight to the street when they lose their leaves.

3.3 Density

People from different parts of the world are accustomed to varying levels of density in their own cities and a definition may simply be a case of perspective. What Jacobs points out is that a minimum level of density is required to keep streets active and support the local economy. If density represents concentrations of people and activities, it must be acknowledged how important this concentration really is to the city. Proximity is obviously one positive for the pedestrian. Edmonton, like most

prairie cities, is traditionally not a dense city, so the importance of the densification of the ECCA lands as a concept should be explored.

In our interconnected world where people and capital seem to move fluidly, globalism still requires specific sites of production. All finance and digital software companies are rooted in some physical space. Nothing exists completely in cyber space. This creates a new geography of sometimes hyper-concentrated facilities to allow globalization to work (Sassen 55-72). This can result in highly dense cities.

An important concept when talking about density was Jane Jacobs's idea of "organized complexity" which introduced a more biological notion of the city (Greenburg 79). Traditionally the city has been a place of fusion, but the combination of immigration and increasing land values in the core often pushes these new arrivals to the near suburbs. Auto-oriented environments make informal exchange difficult, and the city as a place of fusion declines (Greenburg 81). One example would be the creation of better choices for young families, who are now compelled by economics to live in suburbs or smaller centers, (Greenburg 177) forcing families to adopt the use of automobiles into their daily routines.

"How do we intervene in multifaceted "organic" systems in a way that accommodates the will and desires of multiple parties? Especially when those parties may not voice opinions until change is upon them? Humility in dictating outcomes means city design should aim to create conditions that allow for flexibility and change (the next move) to happen naturally. The most important contribution of design is making different activities and land uses overlap" (Greenburg 85). This requires density and this same overlapping is also critical for the pedestrian.

Density is also important for land management and protection against urban sprawl. Greenberg creates a good summary of city shaping forces in the past and points to today's city shaping forces (Greenburg 174). Today the big ones are once again consolidating forces, but operating to different and accelerated pressures (Greenburg 175). Rising energy costs are one factor. Jeff Rubin claims transportation costs will outpace labour costs and local manufacturing will re-emerge. Adjusting for this and the demands made for sustainability will assist in growing new "green sectors". This growth will require providing spaces and relationships for them to prosper, including connections to where people live and work (Greenburg 176). If these connections are pedestrian oriented they require no constant input of energy to maintain, unlike that needed to keep the cars and highway systems in working order.

Despite decentralization to the suburbs the city core has remained important because if it declines regionally the city declines in the global context. The premise is that city image is important for economic prosperity and this is why central business districts continue to be populated with corporate office towers. To maintain a city's image and economic vitality new immigration to a city can't all go to the suburbs. In the argument made by Robert Fishman, a new balance between the city core and the suburb must and will be achieved in the 21st century. The urban fabric must react to both infill density in certain parts and suburban growth in others, while planned or encouraged

shrinkage happens in other sections. An extremely important aspect of the re-urbanization process will be a public housing policy, necessary to protect against the potential of rapid gentrification (Fishman 75-89).

With the re-urbanization of our cities, "*This regional solidarity reflects a growing understanding that while there may be affluent areas on the urban fringe, suburbs cannot prosper without the intensity and one of a kind attractions that come only with a healthy core*" (Greenburg 233).

Density as Related to Housing

For city cores to be healthy they need to offer a healthy balance of housing options. The emphasis should be housing at different income levels to accommodate low income groups. David Hulchanski examined the economic situation in Toronto and discovered the city is splitting itself into three distinct parts based on income (Greenburg 177). In other cities such as Vancouver it can be argued that new developments in the Yaletown and False Creek areas, which were intended as new community building, in reality represent gentrification of their neighbourhoods (Walks and Maaranen, The Timing) . In addition this encourages suburban sprawl by pushing people to Surrey or farther out to find affordable housing.

In Edmonton the ECCA is a "infill" project on a grand scale, building new neighbourhoods up from nothing. It is close enough to the downtown that it should strengthen the Central Business District and encourage infill strategies to be developed for the surrounding mature neighbourhoods. As Fishman and Greenberg point out there is a danger of gentrification if market forces are allowed to dominate. A stated goal by CoE was affordable housing and the advantage the Municipal Government has is ownership of the land. Removing land costs from the equation and adding revenue generated from other parcels of the ECCA being sold off, should be extremely liberating to a public housing policy.

"*There are many tenure options such as rental, condominiums, co-ops, and different units in high, mid and low rise structures which are the cornerstone of social sustainability*" (Greenburg 210).

"*Greater density paradoxically goes hand in hand with the preservation of nature, giving urban dwellers easier access to the natural world than is the case for their suburban counterparts*" (Greenburg 212). This is reflected in P+W's Plan, with walk able access to the large park space proposed. Paolo Soleri also spoke of this in his book Arcology: City in the Image of Man where he introduced his seminal concept of archcology in 1970, a word he coined, meaning a combination of architecture existing within the ecology of the planet. He was also a proponent of density. His theory was based on observations in nature, noting when living beings evolve to become more complex they also reduce in size, this reduction being essential for their survival. He extended this analogy to the city.

At the level of the city block or building the successful application of density is evident in how active the pedestrian street scape is. Harsh winters in Edmonton pose a challenge.

"Pedestrian systems and spaces should be well integrated and frequently connected, to optimize choice and year round use of both. Land use controls must encourage adequate building density to have continuous activity along indoor circulation routes" (Livable Winter Cities 33) Winter can also be socially isolating especially for the elderly, because of mobility issues. The compact nature of density also facilitates movement for this demographic(Livable Winter Cities 11-13).

3.4 Mixed-Use

In North America the modernist dream of an efficient city appealed to architects and developers alike because of its conceptual simplicity and commercial potential. North American developers picked up on Frank Lloyd Wright's, Broad Acre City concept and sold diluted versions of it as suburbs. These communities developed in an environment lacking the social equality of Europe which views housing as a human right, not a commodity. This one track thinking by developers also resulted in single purpose centers for government, cultural facilities, recreation and entertainment. Greenberg's argument outlines how modernism broke the city into pieces for supposed efficiency. To compound this, in the United States General Motors, Firestone, and Standard Oil attacked cities by purchasing and dismantling the urban street car networks, promoting automobiles and expansion of the interstate highway system (Greenburg 28). Mixed-use development is not only about building occupancy types (residential, commercial etc) but also allowing the city to be flexible and adaptable without large scale and wasteful demolition. As stated previously, density and mixed-use are building blocks of pedestrian urbanism which planners moved away from when modernist planning methodologies were adopted.

This modernist breakdown of the city appears in the P+W Master plan despite the claim of "intensive mixed use." This term is undefined and seems to mean mixed commercial or residential areas. Complete land controls are still being developed by the City. Although the overall plan may contain residential, commercial, industrial and other uses, at present these are predominately grouped together into their own "neighbourhoods" resembling the modernist principals of segregation. Therefore the "intensive mixed use" strategy applies generally to the site as a whole. Instead each neighbourhood should contain a residential component mixed into commercial and potentially industrial uses as Jane Jacobs talks about in her four points on diversity. Her writings also suggest major social and cultural facilities should be placed apart, as nodes of different neighbourhoods to facilitate cross movement of people (Jacobs, The Death). The ECCA plan congregates such facilities with a commercial area in a "Town center" at the southern most point of the site, with residential units filling two wings moving away from it. Residential occupancy should be placed on every part of the site because it makes up 90% of the urban fabric (Finley and Stahl). Without it an area quickly turns into a 'mixed' commercial or industrial zone which has to be accessed by some sort of mechanized transportation. Even when an area is dominated by residential, the residential units must be mixed, either as a combination of single and multi-family housing or a variety of multi-family

housing units. Greenberg talks extensively about this when discussing the re-vitalization schemes he has worked on in various cities around the world.

With the renewed interest in mixed use developments a common mistake in the planning process is "building community" as a focus of design. Community forming as a method of planning is exclusionary. Not all people can or chose to belong to every social group. The idea of community assumes everyone in that group has something in common. Community from this point of view is automatically excluding certain individuals or demographics (Fincher and Iveson 129-146) .

Despite this, the new planning mantra has become creating diversity through the people who inhabit the city. This can be defined as the combination of different demographics and minorities. The standing theory is this intermingling stimulates creativity. Susan Fainstein suggests we should not plan specifically to generate this diversity because it will not be seen as authentic. Instead we should aim for the "just" city in which everyone has equal opportunity to participate.

"*The new urbanist approach of intermixing a variety of building types and levels of affordability, along with its support for transport-oriented development, is not the panacea that some of its supporters assume. If, however, it becomes the template for in-fill development (rather than the formula to justify destruction of public housing), it can provide a physical framework for a city that offers a higher quality of life to residents and visitors. Developing an appropriate physical setting for a heterogeneous urbanity, however, can go only so far in the generation of a just city. Most crucial is a political consciousness that supports progressive moves at national and local levels toward respectfulness of others and greater equality*" (Fainstein 115-128)

Despite Feinstein's critical stance towards mixed use development, Ken Greenberg demonstrates how, with the right political will, it can be used as a building block in a framework for many infill situations. One such example is Regent Park in Toronto. The advantage of a mixed use program is it provides adaptability and flexibility over time, to allow for change without disrupting the underlying economic engine of the city. The exception being that different forms of change have different time frames. Residential and employment have slower rhythms than retail but also more inertia. Long term planning requires you get the foundation right. Examples are width of streets; depth of blocks; floor to ceiling height and available space for ground floors. With these you set the basic constraints and opportunities (Greenburg 183). Spaces that are more generous are more adaptable, ones not built to minimum standards and dimensions are essential to a building's longevity (Greenburg 183). Warehouse districts and old neighbourhoods score well for absorbing change because of this. A current problem Greenberg notes, is that unlike old warehouse districts, big box stores are too tailored for their original purpose to be adaptable (Greenburg 184).

One must deliberately build flexibility into cities and buildings so neighbourhoods have the ability to evolve. Examples of this flexibility are residential units which can be divided or combined, or housing stock taken out of the market and formed into Co-ops to protect low income residents (Greenburg 184).

Especially prudent with the aging demographic in Canada are different housing options for "aging in place" for members of the community. This is the danger of developments with identical units and similar layouts targeted to young families, because as they age it creates problems with schools (Greenburg 185). Edmonton is having this exact problem today with construction of new schools in the suburbs coupled with low student enrolment and unnecessary school closures in the core.

The ECCA re-development has no old neighbourhoods to build upon. Even the majority of the industrial buildings which are not considered to have any historical aviation value are to be torn down. This is despite several being valuable examples of Modernist architecture in Edmonton from the 1960's (Crowston, Capital Modern). Since the intention is to build a mixed use community from scratch, the groundwork laid by the first developments will be critical.

The government needs to allow for different directions at the same time, which is where the development industry often fails. Market housing tends to specialize and doesn't build housing to meet the needs of all demographics at once (Greenburg 185).

The current Edmonton Municipal Government has demonstrated a political will to use a mixed-use development approach. P+W have interpreted this approach as an overall site strategy but as Jacobs, Fainstein and Greenberg suggest it is one of the basic components of city building. It must permeate down the planning hierarchy to the level of the building, for when combined with concepts of pedestrian design and densification the overall impact has social, economic and environmental sustainability implications.

Therefore any design should not be meant for a specific community type or attempt to generate an artificial ethnic diversity. Instead the strategy should be to design for equal opportunity, represented by various housing types that fit different demographics and income levels.

3.5 Sustainable Design

Pedestrian oriented design, concepts for density and mixed use strategies are so tightly connected that together they represent huge implications for sustainability. The most critical aspect they address is creating a pedestrian urbanism which is the base of sustainable cities. The more compact nature of this urban space has its own virtues including a defence against city sprawl. This reduces competition for land around the city which can then be used for agriculture and natural preserves, evidence that the concept of sustainability is more important on the urban level than that of the individual buildings. This is the fundamental problem with systems such as LEED (Leadership in Energy and Environmental Design; U.S. Green Building Council) which put too much emphasis on stand-alone buildings and overlook the fact that context matters. "*The greatest reductions in carbon output could be realized by lower impact lifestyles made possible in city neighbourhoods and urban districts*" (Greenburg 187) This has been acknowledged by the Green Building Council and to

rectify this LEED-ND (Neighbourhood Design) was introduced in 2009.

Greenberg claims buildings account for almost half of all carbon dioxide emissions and this is easier to reduce if the urban form is not spread out. "*By virtue of sheer proximity and numbers, living in mid-rise and high-rise buildings that share walls, floors and ceilings with neighbours, we consume less energy; we heat less and cool less*" (Greenburg 186-187). Downtown living is smaller because people have so many convenient places to meet and congregate outside the home, which contributes to a lower carbon footprint with no special effort (Greenburg 187).

In David Owen's book Green Metropolis he talks about how people use less energy per capita in New York, being a fraction of the national average. Undoubtedly high density development helps (Greenburg 187). Urban development also assists in sharing locally generated energy in city districts, such as geothermal and co-generation (Greenburg 187). Deep geothermal among other technologies has been proposed for the ECCA re-development as a way of going beyond carbon neutral, powering and heating the new development and surrounding parts of the city.

Pedestrian oriented development, density and mixed use reduce an inhabitant's carbon foot print and their economic costs. In the context of the city, reductions come from shorter travel distances and less construction of supportive infrastructure such as roads and utility services. Initial upfront costs are paid for by developers (who charge the buyer) but they are not responsible for maintaining it. These costs fall to the City of Edmonton and are the most difficult to carry. If not for older neighbourhoods providing relatively more tax revenue compared to dollar spent on infrastructure, the city could literally not afford the new development in suburban areas. (Ried) This means that the economic and environmental sustainability issues are inseparable. The economics of the situation are also related to social concerns such as affordable housing. Thus, the question of sustainability is a three pronged issue - economy, environment and society. Sustainability is really about sustaining human life. The adaptation and evolution of our cities is therefore critical in facing the emerging 21st century challenges of climate change (see Appendix 1) and a shrinking economy.

3.6 Conclusions

When developing a master plan one needs to look at both the big picture and also the level of the individual block or buildings. Pedestrian environments have needs we no longer plan for and the sustainability goals may require new typologies adapted to local conditions such as climate and culture. In new construction this may only be discovered after the fact, when an effective idea for a prototype building does not fit into the arbitrary grid established at an earlier time. Wind conditions, angles of sunlight and building height all influence the position, orientation and spacing of the street grid and built environment. Instead of duplicating ideas from a different time and place, we can learn from others but the ideal of an International Style or all encompassing technological solution must be rejected. The only constant would be the pedestrian environment and this would be accomplished differently in different places.

With top down hierarchical planning one gets locked into early choices related to urban form and no one can foresee everything. The P+W proposed master plan simply assumes sustainability will be achieved because of transit, increased density with the addition of new energy production technology. People will then simply be pedestrians instead of car owners. This is without looking at the relationships between planning and architecture, the macro and micro scales. A second phase of planning would start designing from the bottom up, examining individual city blocks and comparing them to the master plan to see where they meet, then re-evaluating and adapting the master plan.

As the P+W Master Plan exists now, it is questionable whether the sustainability goals will be met. It will require more attention to the pedestrian environment, different flexible frameworks replacing zoning bylaws and perhaps even changing the orientation of the primary street grid and position of future utilities. The high costs of construction and traditional inflexible zoning bylaws constrict possibilities after the initial phases of development. The urban form will require some architectural experimentation and innovation. There is danger in relying on typical developer typologies inserted into any master plan, no matter how progressive it appears. For these reasons when new development guidelines in the form of by-laws are created, they must be carefully considered.

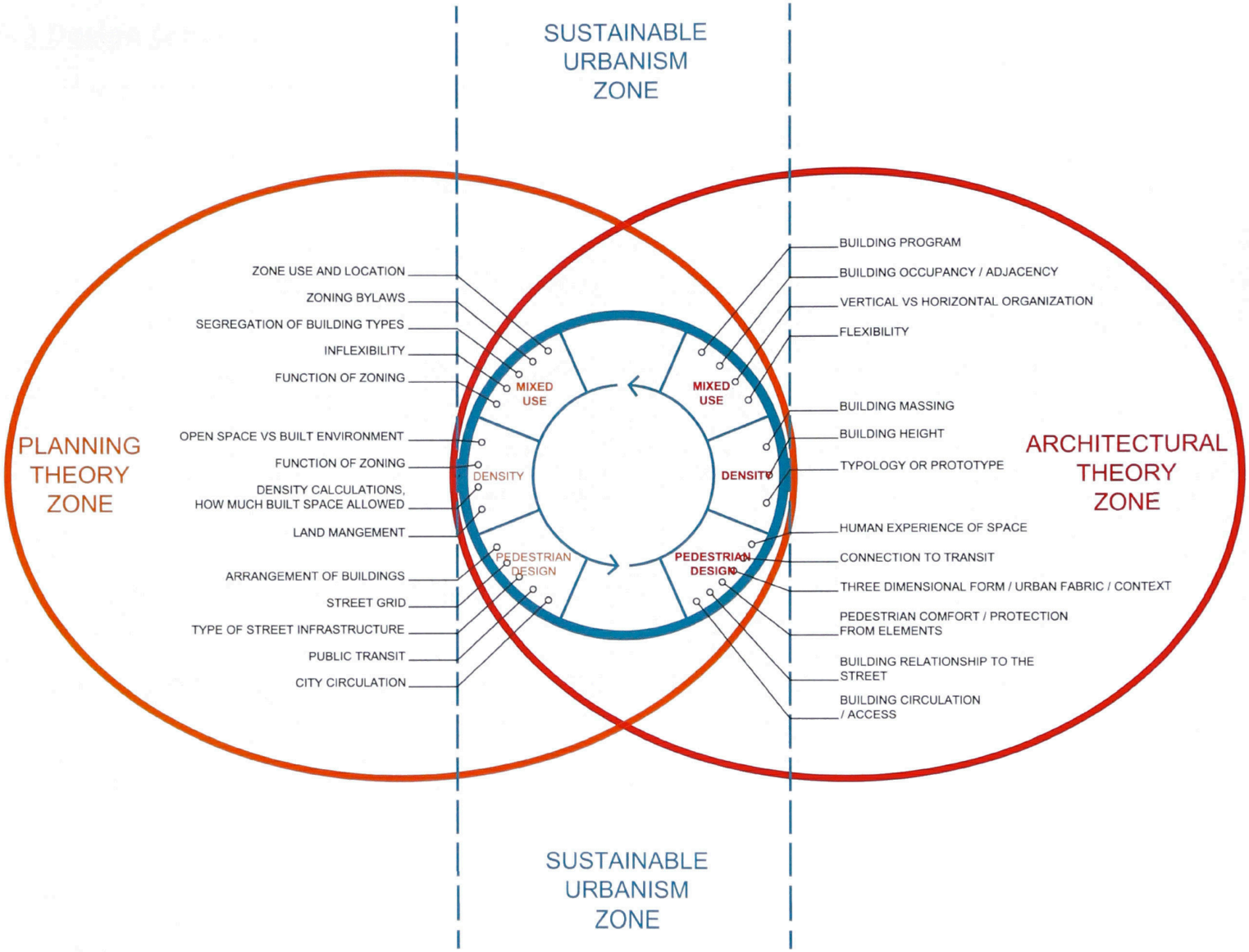


Figure 3.1: Graphic representation of how planning and architectural theory combine to form sustainable urbanism.

4.0 Design Guidelines

The purpose of this section is to identify ideas and methods that directly relate to the critical theory in the previous section, establishing concepts that can be applied to generate a pedestrian urbanism. These concepts will form the basis of design guidelines, which could potentially be codified into by-laws. For the purposes of this thesis, such guidelines will provide a framework in which to design a prototype building that addresses the pedestrian environment for the ECCA.

This investigation will be at the block level, in order to examine the shifts from macro (masterplan) to micro (sidewalks) scales, the push-pull that exists between planning and architecture. The block level allows enough space to examine a microcosm of the entire pedestrian system and the buildings that would result from the critical theory as listed in section three.

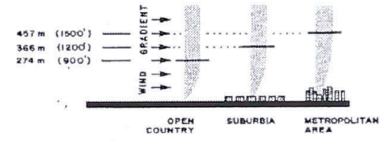
We know from the master plan that the ECCA will be built at a higher density and in a different manner then the rest of Edmonton. The stated goal is pedestrianization but we know from the critical theory that mixed-use and density are not enough on their own. Therefore formal massing is not the seed for a design concept. To ensure use by pedestrians a framework for design needs to start with pedestrian comfort.

4.1 Pedestrian Oriented Development

Wind

In a cold desert environment such as Edmonton where winter is considered to last from October until April, it is important that the buildings provide shelter from the wind. When exterior pedestrian areas are protected from strong winds, cold is more tolerable.

- Buildings should therefore act as hedge rows would for wind protection of public areas.



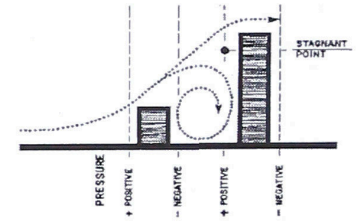


Figure 4.1: Left: Wind Gradient Over Cities, showing increased velocities at greater heights.
Figure 4.2: Right: The Wise Effect, the problems with buildings of different heights.

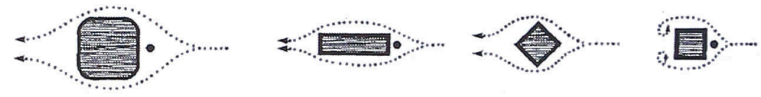


Figure 4.3: Plan View: airflow around different building shapes, round corners and oblong shapes reduce wind resistance and turbulence. The dot represents the stagnation point.

- Aerodynamic principals can be applied to the buildings. Aerodynamic forms reduce the creation of different pressure zones which can increase wind speeds or increase turbulence.

Figure 4.4: Wind Resistance Profiles

WIND COMFORT CHART

EFFECT CAUSED BY THE WIND: ON LAND	EFFECT CAUSED BY THE WIND: ON SEA	SPEED km/h	SUMMARY OF WIND EFFECTS ON PEOPLE, BASED ON BEAUFORT SCALE: BEAUFORT NO.	AIR MOVEMENT	GENERAL EFFECT ON PEOPLE	TENTATIVE COMFORT CRITERIA FOR WINDINESS TEMP. 10°C+: HILL SLOPES DEMANDING THE SAME MUSCULAR POWER %	∠	AREAS / ACTIVITY: SIDEWALKS – WALKING	PARKS SKATING-RINKS – STROLLING SKATING	PARKS PLAZAS – STANDING SITTING SHORT-EXPOSURE	OUTDOOR-RESTAURANTS BANDSHELLS STADIA – STANDING SITTING LONG EXPOSURE
Still smoke rises vertically	surface mirror-like	0 - 2	0	Calm	Not noticeable	-	-	-	-	-	-
Smoke drifts but vanes remain still	Only ripples form	3 - 5	1	Light Air	Not noticeable	-	-	-	-	-	-
Wind felt on face, leaves rustle, vane moves	Small, short wavelets, distinct but not breaking	6 - 11	2	Light breeze	Wind felt on face	-	-	○	○	○	○
Leaves and small twigs move constantly, streamer or pennant extended	Large wavelets beginning to break, glassy foam, perhaps scattered white horses	12 - 19	3	Gentle breeze	Wind extends, light play; hair is disturbed, clothing flaps	-	-	○	○	○	◔
Raises dust and loose paper, moves twigs and thin branches	Small longer waves fairly frequent white horses.	20 - 29	4	Moderate breeze	Raises dust, dry soil and loose paper, hair disarranged	-	-	○	○	◔	◕
Small trees in leaf begin to sway	Moderate waves, distinctly elongated, many white horses, perhaps isolated spray	30 - 39	5	Fresh breeze	Force of wind felt on body; drifting snow becomes airborne; limit of agreeable wind on land.	5%	3°	○	◔	◕	◕
Large branches move, telegraph wires whistle, umbrellas hard to control	Large waves begin with extensive white foam crests breaking; spray probable	40 - 50	6	Strong wind	Umbrellas used with difficulty; hair blown straight; difficult to walk steadily; wind noise unpleasant; windborne snow above head height (blizzard).	10%	6°	◔	◕	◕	◕
Whole trees move; offers some resistance to walkers	Sea heaps up, lines of white foam begin to be blown downward	51 - 61	7	Near gale	Inconvenience felt when walking	14%	8°	◕	◕	◕	●
Breaks twigs off trees, impedes progress	Moderately high waves with crests of considerable length; foam blown in well-marked streaks, spray blown from crests	62 - 74	8	Gale stormy wind	Generally impedes progress; great difficulty with balance in gusts	20%	11°	●	●	●	●
Blows off roof tiles and chimney pots	High waves, rolling sea, dense streaks of foam; spray may already reduce visibility	75 - 87	9	Strong (storm) gale	People blown over by gusts.	33%	18°	●	●	●	●
Trees uprooted, much structural damage	Heavy rolling sea, white with great foam patches and dense streaks, very high waves with overhanging crests; much spray reduces visibility	88 - 101	10	Heavy storm or whole gale	DEATH ZONE						
Widespread damage	Extraordinarily high waves, spray impedes visibility	102 - 116	11	Hurricanelike storm							
Widespread damage	Air full of foam and spray, sea entirely white	117 - 132	12	Hurricane							

SOURCES:

- Penwarden, A.D. and Wise, A.F.E., 1975: wind environment around buildings, Chapter 5 - Comfort and Safety Conditions, Dept. of Environment, B.R.E., HMSO, London, pp. 40-42.
- Davenport, A.G., 1972: An Approach to Human Comfort Criteria for Environmental Wind Conditions; Paper No. 8. - Conf. Teaching the Teachers on Building Climatology, Stockholm, 1971. Statens Institut for Byggnads Forskning, Stockholm.
- Page, J.K., 1976: Application of Building Climatology to the Problems of Housing and Building for Human Settlements, Technical Note No. 150, WMO No. 441, World Meteorological Organization, Geneva, Switzerland

LEGEND

Relative comfort scale	Symbol	Acceptable if occurs not more than once
Perceptible	○	—
Tolerable	◔	A week
Unpleasant	◕	A month
Dangerous	●	A year

NOTE

At lower temperature, relative comfort level might be expected to be reduced by one Beaufort number for every 20°C reduction in temperature.

Figure 4.5: Wind Comfort Chart. What happens with increasing wind speed.

The Swiss RE Tower in London provides an example which lessened wind resistance. This reduced the overall wind turbulence and improved conditions around the building at the pedestrian level. This approach also reduces heat loss inside the building to prevailing winds (Dahl, Climate 92).

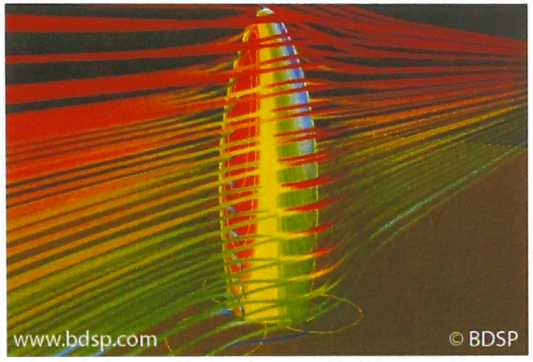


Figure 4.6: Swiss RE Tower Wind Resistance Diagram

Another example is the City Hall in Marseilles, which is designed based on two seasonal winds. The building's aerodynamic principle is that wind shears off the building profile.

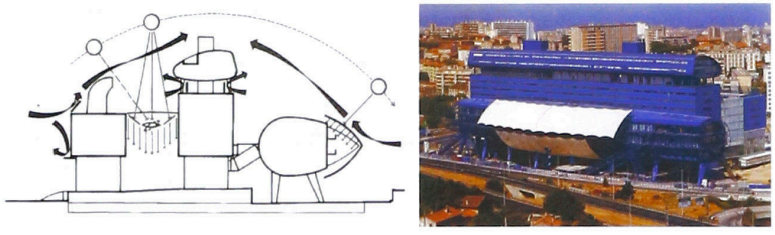


Figure 4.7: The City Hall in Marseilles Diagram and Photo

- Landscaping should make use of trees that provide wind breaks as well as greenery.

Shelter

Major pedestrian routes not only require wind protection but other forms of shelter to be comfortable. For example protection from winter snow or summer sun and rain. This comes directly from the findings of Team X discussed above. This shelter can take the form of an arcade which keeps precipitation off the walkway and prevents snow and ice build-up.

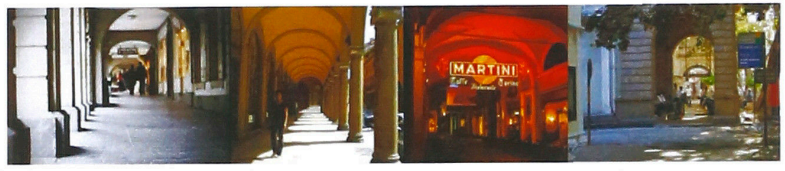


Figure 4.8: Examples of Arcades from Europe and Mumbai (far right).

Seating

Public seating must be provided, at periodic intervals along the pedestrian route.

Figure 4.9: Examples of various kinds of public seating. It is important to have a variety of seating types, for different numbers of people, including moveable chairs and tables.

People and Cars

Pedestrians are to be given priority when in conflict with vehicles, for example at cross walks. Despite this, elevated enclosed walk ways should only be used when there is no other practical alternative. Permitted uses should only include: over arterial roads at intersections with major pedestrian routes, access /connections to an LRT station, over roads between public buildings or access between public roof top parks. These "skywalks" should never be intended to replace the street level circulation system in favour of their own internalized circulation system (Greenberg 138).

Figure 4.10: Examples of the Skyway System in Edmonton's Central Business District. These are typical of the glass enclosed pedestrian bridges linking interior spaces which lack clear and obvious access points from the street.

When skywalks are used the following conditions apply: access must be clearly visible from the street with a two story facade with views to exterior, include handicap access and integrate where possible with building entrances. In addition they should provide an interior area large enough to facilitate a heated waiting area (Livable Winter Cities 30-34).

Green Pathways

- Sidewalk and pedestrian street circulation systems must integrate with the Green pathway system proposed by the master plan.
- Walkway surfaces must be continuous, and devoid of barriers such as curbs and height changes allowing accessibility for the elderly and wheeled transportation such as wheel chairs bicycles, or Segways.
- Extend the building landscaping to integrate with Green pathway landscaping for visual interest, wind breaks and interesting environments.

Day lighting and Artificial Lighting

- Sidewalks are to have the maximum sunlight exposure possible. Where possible building massing should be oriented or shaped to allow sidewalks and pedestrian streets maximum sun exposure.

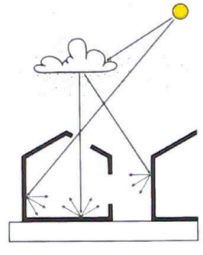


Figure 4.11: The three types of daylight: sunlight, skylight and reflected light

- Where sidewalks and pedestrian streets are protected by means of arcades, rain or wind screens, the structures must contain a minimum of 50% transparency or translucency to allow for natural day lighting. Natural vegetation such as

trees providing a vertical wind break would be an exception.

Figure 4.12: Examples of translucent arcades from Vancouver (left) and New Zealand (right).

- All pedestrian pathways are to be lit with artificial lighting. Critical intersections and direction changes should be double the minimum lighting level for clear orientation (Livable Winter Cities 37).
- Artificial lighting for pedestrian routes should strive to be localized. Lighting fixtures should be down-lighting to avoid unnecessary light pollution.

Integration with Infrastructure

Streets Types and Design

- Incorporate multiple, short streets, motorized (with cars) or pedestrian creating divisions of small blocks to facilitate pedestrian flexibility and mingling. These blocks should also be defined by architectural design as well the street grid and wind orientation.

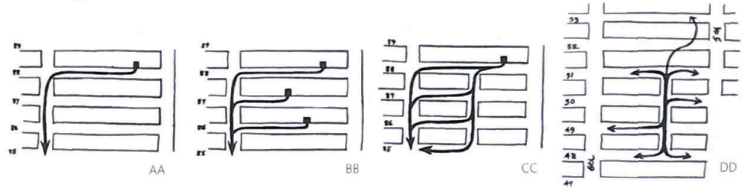


Figure 4.13: Jane Jacobs own diagram illustrating in New York, how short, small blocks facilitate movement of people. In image AA and BB the observation is, when multiple possibilities are not possible, a person will define and repeatedly use a single route and never interact with other parts of their own neighbourhood, unlike the blocks in diagrams CC and DD.

- For mega block forms provide multiple and frequent pedestrian access routes and building entrances to break up the scale of the building.

- Sidewalks and bicycle lanes on motorized streets are to connect with pedestrian streets.

- Pedestrian streets are to penetrate the buildings at strategic locations where necessary. Necessity is deemed by block layout or determination of the shortest path between points of interest. This is to minimize distances to compensate for winter cold.

- Motorized Streets are to have sidewalks on both sides.
- Sidewalks are to be a minimum width of 1.8 m or 6ft.
- Pedestrian Streets are to be 4 to 6 m in width.
- Motorized streets must be wide enough to accommodate bicycle lanes. Curbs along bicycle lanes, with a height different to the top of side walk, are to be sloped at a maximum 30 degree angle. This will facilitate quick movement by cyclists on and off the bicycle lanes at any point. Cyclists become pedestrians more fluidly than people in cars and encouragement of this will facilitate bicycle use.

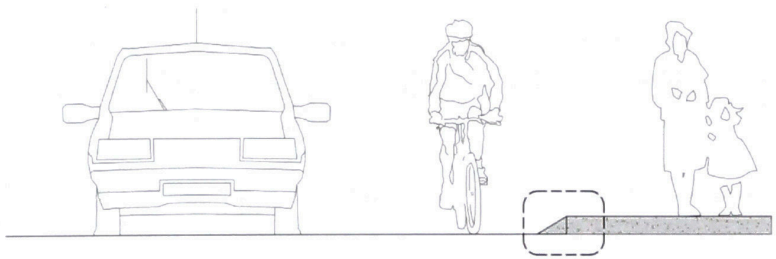


Figure 4.14: Road, Bicycle land and sidewalk section with curb detail.

- Pedestrian Streets must also incorporate bicycle lanes.
- Provide left hand turn bicycle lanes at major intersections if automobile left hand turn lanes are to be provided.

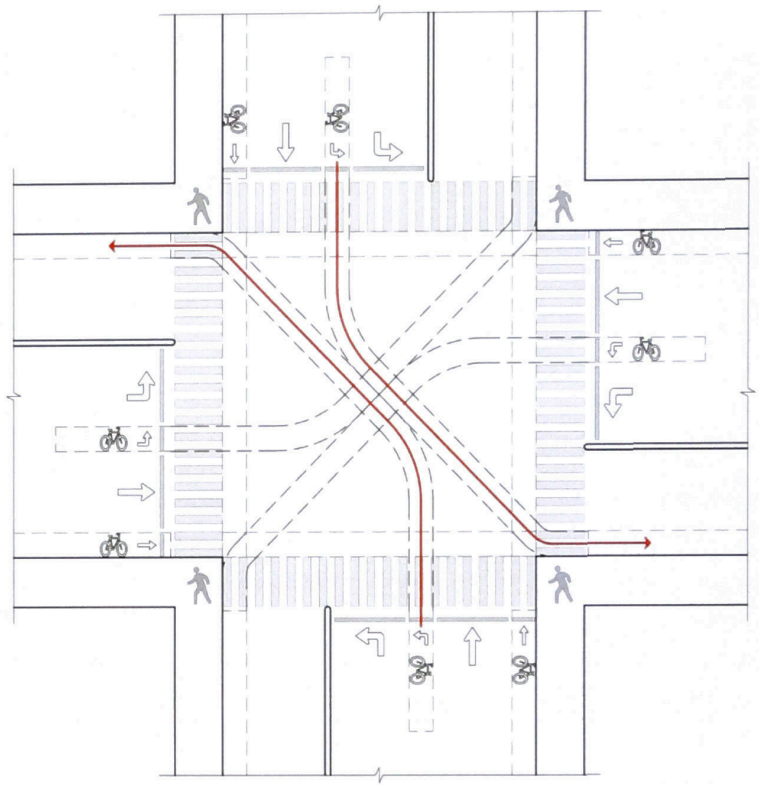


Figure 4.15: Example of possible four way stop with left hand turn bicycle lane.

- Bicycle lock/hitch posts to be placed at regular intervals along motorized and pedestrian streets.

Figure 4.16: Example of various bicycle hitch posts.

Building Response to the Street

Buildings must address the street, such that all building occupancy has a public face towards the street in the form of a view outwards or inwards. At grade this would typically be a window, either store front windows for commercial establishments, glazed building entrances and lobbies or reception areas. Above grade residential or office occupancy must also face the street. No occupancy is allowed to be screened from view. This is to facilitate eyes on the street, a passive community surveillance that will contribute to sidewalk safety (Jacobs, The Death).

Building Occupancies of a public nature, should integrate exterior mingle spaces where possible. Examples would include patios for restaurants and cafes or small plazas in front of larger commercial establishments. This would be in addition to, and combined with, the sidewalk area. Such spaces do not have to be large but allow small groups of people to stop and mingle without completely blocking sidewalks.

- Lingering spaces should not create alcoves that are difficult to monitor by public surveillance or create blind spots that present security issues where individuals may try to conceal themselves for unlawful purposes.

- Ground level residential occupancy must have a "transition space" at the front entrance such as an enlarged stoop, porch or portico, a space that can be customized and allow people to linger for social interaction and observation.

- Private versus public space for lingering on the street should be marked by level changes. Public zones would be at grade continuous with the sidewalk but private or semi private spaces such as porches and patios for residential units should be slightly elevated. Patios for restaurants could also be elevated or separated by a small fence or planter.

4.2 Density

The concept of density is multifaceted and has different requirements. It must make different uses and activities overlap, therefore different occupancies must be located close to each other positioned horizontally or vertically. This will shorten distances between activities of daily life and facilitate walking. To achieve this, any building must have a total site coverage minimum of 40%. After that there is the opportunity to use the building massing to protect pedestrian areas and exterior amenity space from prevailing winds. Buildings should also be allowed to extend over the street to take advantage of "unconventional space" and again act as wind barriers.

Building Massing

Closely connected to density is building massing. This is not just a formal exercise in architectural expression as the building massing will directly affect the pedestrian environment,

alluded to above in *Building Response to the Street*. The two main elements are *building height* and *building floor plate*.

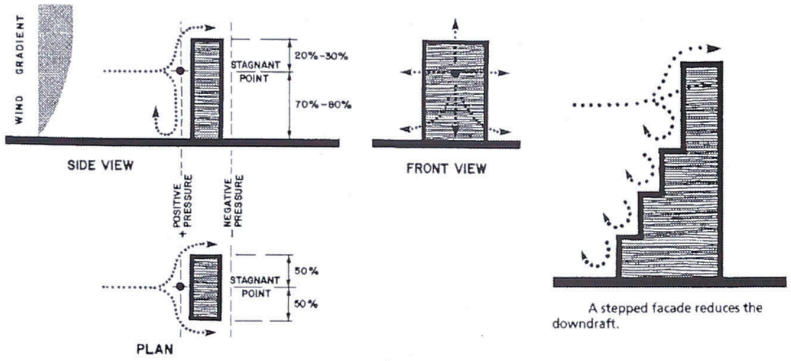


Figure 4.17: Wind against buildings. Flat building facades produce down drafts originating about 2/3 up the height of the building. The dots represent the stagnation point. Only about 1/3 of the wind will pass directly over the roof.

Figure 4.18: (Right) Illustration demonstrating how a stepped facade can break up down drafts.

Building height is extremely important in how it affects the wind at the pedestrian level. High-rise buildings (20 stories and higher) dramatically increase wind speeds and turbulence at the pedestrian, potentially to the point where a street is abandoned due to wind. Research in Britain conducted by the Building Research Establishment (BRE) measured wind speed at the base of high-rise buildings compared to low-rise and noted increased occasions of winds being accelerated. Where speeds of 5 m/s were exceeded only 5% of the time at low-rise buildings, this same speed at high-rise buildings was exceeded over 20% of the time. Speeds of 5m/s would be an annoyance but when 20m/s is achieved, wind can become dangerous (Roaf, Crichton and Nicol, Adapting 248). Prevailing average wind speed in Edmonton ranges from 3 to 3.8 m/s (11-13.7 km/h) with gusts up to 20 m/s (74km/h) as a maximum hourly speed and maximum gusts recorded of 32.5 m/s (117km/h) during wind storms (Canadian Climate Normals). This is without any increased speed from the effects of buildings.

Criteria for Building Height

- An individual building should nestle into or beneath the city "canopy" to escape wind storms and not shade other buildings. This means there should be a maximum threshold any building cannot pass.

- Firefighting access; according to the New York City Fire Department a firefighter can access with full equipment and be effective up to 10 stories without an elevator. Fire Rescue ladder trucks will typically also reach this height, being in the range of 22-30 meters.

- One must consider optimal height for evacuation of a building that requires no more then 15-30 minutes.

- Natural ventilation can be achieved in buildings of approximately 15 stories.

- What is a manageable distance to carry bags, groceries, equipment or even buckets of water up stairs in an

emergency during a blackout with no reserve power? This is perhaps 3-6 stories.

A compromise between the different factors may be considered to be 6-8 stories in height (Roaf, Crichton and Nicol, 257-258).

Edmonton does not have the mentality or culture to build and occupy high-rise towers (above 12 stories as defined by the Toronto Tower Renewal Project) of a residential nature. Residential and Commercial towers do exist but are located in the downtown core, or in proximity to it, along the North Saskatchewan River Valley. Typically these buildings today represent a luxury housing market. Affordable condos or apartment blocks are in suburban areas and are typically 3 or 4 story walk-ups.

- For the purposes of the ECCA such a trend should continue with a maximum height restriction of 8 stories or 30 meters.

To prevent inefficient land use, there should also be a minimum height requirement, set at 3 stories for commodity housing, as well as a minimum of 2 stories for major public institutions. This would include schools and libraries if it is deemed necessary for these structures to be autonomous.

- Building floor plate refers to the area of the building that will touch the ground. As stated in 3.4.2, it should be required to be a minimum of 40% site coverage. Density is important for land use and sustainability as mentioned in the critical theory.

The question is then, what basic building form should this massing take, to achieve density if height is to be restricted. Traditionally the tower has been hailed as the vehicle for densification, but considering the coming years with increasing energy costs and projected shortages, combined with the economic and social costs we should now consider the high rise tower a failed typology (Roaf, Crichton and Nicol 237). In a paper written at Cambridge University examining building form of cities, the results showed that "land use performance improves with increasing circumference, i.e. courtyards perform better than pavilions" (Ratti, Raydan, and Steemers 49-59). Pavilions being the stand alone buildings such as the high-rise towers we are accustomed to seeing in downtown cores. The article also explains how this archetypal urban form also increases access to daylight while allowing equivalent density at one third the height of a "pavilion" type building (Ratti, Raydan, and Steemers 49-59).

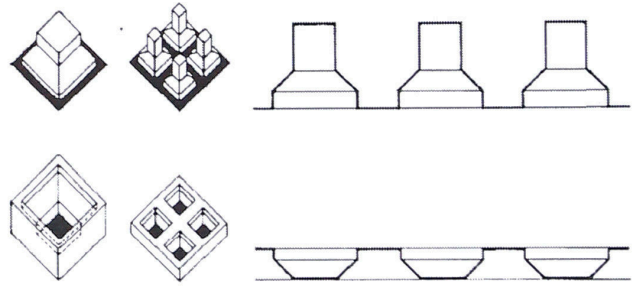


Figure 4.19: (Top) Pavilion urban form versus (Bottom) Courtyard urban form. From Left to right: Axonometric drawing of a single unit, four units combined, and section through pavilion or courtyard city.

The paper studies the effects primarily with arid climates where courtyards are the appropriate typology. Edmonton is similar to an arid desert, simply a cold one. The paper hints that "large courtyards are environmentally adequate in cold climates, where under certain geometrical conditions they can act as sun concentrators and retain their sheltering effect against cold winds" (Ratti, Raydan, and Steemers 49-59).

A historical precedent may be the mega blocks of Copenhagen which represented a turning point in 19th century tradition and 20th century modernity because they blurred the lines between urban design and architecture. The block delineated the public realm of the street to the inner courtyard but then offered the residents a communal park on the interior (Finely and Stahl 208).

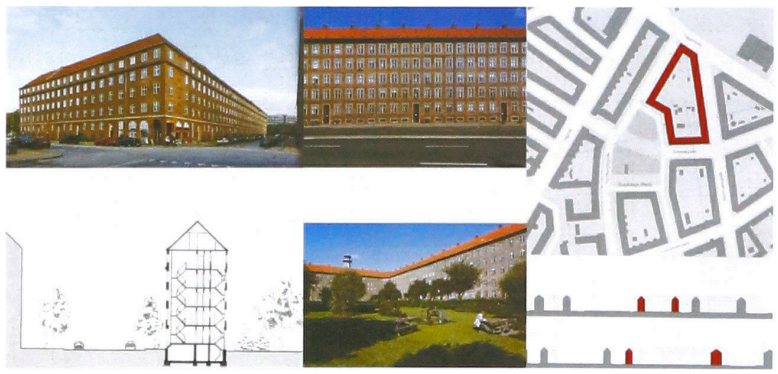


Figure 4.20: Copenhagen Megablock, photos, plan and section. Dwelling units in this building have access to both facades as well as 2 sets of stairs, the public one off the street and "private" or service stair facing the courtyard's interior.

Such a building, if pushed with a multi-use program, may prove to be a successful approach to pedestrianize a dense multipurpose development such as the ECCA. There is no universal answer, as design is always judgement call, but in this case such a methodology can be the basis for a design approach.

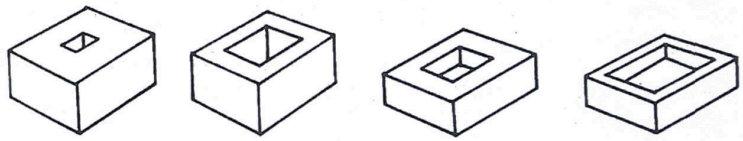


Figure 4.21: This diagram shows how courtyard massing will gradually change according to latitude. Courtyard massing from arid hot climates (left) to cold northern climates (right) The more open block in cold climates allows sun penetration for warmth, opposite to the strategy used for hot desert climates.

4.3 Mixed-Use

The basic criteria for mixed-use buildings would be as follows:

- The prototype is not allowed to be single use occupancy.
- Program must contain multiple use occupancy, meaning a mix of residential with some other form of commerce or place of work.
- Residential units must be of various types and sizes to accommodate different demographics and income brackets, and 20% of residential units must be ground oriented housing.

- Ground oriented housing must have private outdoor amenity area at grade. Play area provided for children will make this housing more attractive to young families.

- Housing units above grade must also provide amenity space in the form of balconies or roof top patios.

- Floor areas and ceiling heights must be beyond standard minimum requirements by a margin of 10-30% to allow for future adaptation of existing interior spaces.

- When extra floor areas falls into the 10% margin the structure must compensate allowing for walls to be removed without compromising structural integrity.

- Occupancy can be stacked vertically based on required access to the public. Striations would be based on the public versus private nature of the space. For example commercial should be at street level with office functions above and residential above that.

- Priority for access to sunlight as follows: Residential, Public buildings / Meeting places, Office Space, Industrial then Commercial Space.

4.4 Sustainable Design

Passive Low Energy Architecture

LEED has some significant weak points, which suggest to some it is failing the architectural community and the public. The Edmonton Municipal Government has decided that all new City buildings must meet LEED Silver. Sustainability is a noble goal but an interesting case study that highlights some of the problems with LEED was the San Francisco Federal building. The design incorporated approaches for passive low-energy architecture (PLEA), but failed to achieve any LEED certification. In reality the building uses 33% of the power a standard office building would (67% savings) but was given no points for this achievement. The two reasons for this were: first, the environmental control system was so innovative LEED criteria could not assess it; second, it did not rely on mechanical systems which denied it a possible 10 points for LEED certification (Roaf, Crichton and Nicol 233). Research has also been done to show that LEED silver does not actually achieve real gains for energy efficiency of a building because it relies on mechanical systems efficiency, not passive systems. One can achieve Gold or even Platinum with no PLEA, simply by tinkering with mechanical and electrical systems (Roaf, Crichton and Nicol 232).

The thesis design guidelines thus far have proposed a low to mid rise, high density courtyard typology as an advantageous urban form. These forms also have opportunities for PLEA, some of which in turn would enhance the pedestrian environment. The goal is pedestrianization of the city but this is

also about architecture, so the basic issues around PLEA in the design and construction of a prototype must be addressed.

Building Height

As mentioned above building height directly affects wind speeds. This can either subject the sidewalks to increased wind or protect them. Low rise buildings protecting pedestrian areas are also more socially connected with the sidewalk than high-rise buildings, increasing street safety (Roaf, Crichton and Nicol 249). The height also has direct influence on the amount of energy used to heat or cool the building because increased wind pressure increases air penetration and this affects the heating and cooling loads (Roaf, Crichton and Nicol 248). In addition low rise buildings experience less thermal stratification, meaning less heat rises from lower to upper floors, thus costing less to cool higher floors during summer (Roaf, Crichton and Nicol 251). Low rise buildings have the potential to eliminate the typical dependence on mechanical systems for the survival of their occupants, where high-rise, air conditioned buildings with no operable windows do not.

Natural Ventilation

A traditional courtyard typology in arid climates has many tricks for cooling by natural ventilation. In a dry continental climate such as Edmonton the simple addition of adding operable windows can ventilate the building in summer months, especially if units occupy the entire width of the building with access to both facades for cross ventilation. Edmonton summers are dry and day time heat dissipates quickly at night. Evening air can quickly become quite cool, even from a starting point of 30 degrees Celsius, so that no air conditioning systems are necessary. At most, mechanical ventilation would be enough.

Figure 4.22: Principals for Natural Ventilation:
a. By means of pressure difference across the building - and through windows.
b. By thermal lift, through chimneys and ducts (b.1), through glass facades (b.2) and through-going, vertical spaces and atriums (b.3) the 'chimney effect' is utilised as the underpressure that is created by the rising heated air. (Solar assisted ventilation is based on the thermal life principle).
c. By means of wind catchers and wind towers, which work at both overpressure and underpressure.
d. By Means of hybrid ventilation, where natural ventilation can be improved by being connected to mechanical systems. This is often called 'mixed-mode' ventilation (wind, solar, thermal, and mechanical used together).

Wind traps could also be used to ventilate spaces and corridors and perhaps add pressurization to supply fresh air to residential units. This removes complicated and expensive duct work that is often impossible to clean after it's installed and eliminates the growth of moulds and other toxins that get trapped in closed loop air conditioning systems. Even during winter, wind traps could still be used, but with the addition of a heat exchanger to minimize heat loss.

Figure 4.23: Modern Wind Catchers. On the BedZed sustainable development building in Sutton, London (2002), wind towers ensure both air intake and air exhaust in one single fitting on the building's roof. They are adjustable according to wind direction. Architect: Bill Dunster.

Double glass facades or variations of this system are also worth exploring as a means of natural ventilation and optimizing solar gain for heating purposes.

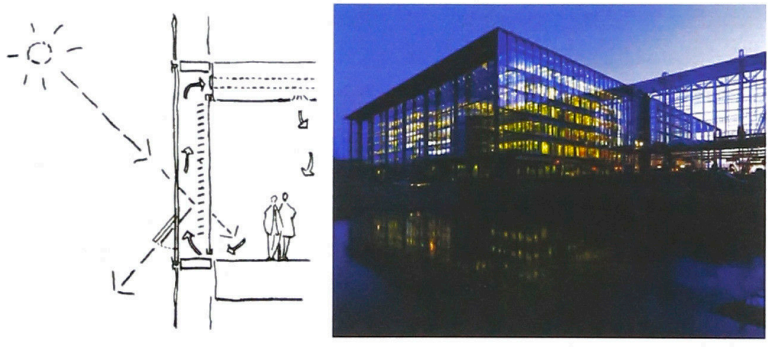


Figure 4.24: Danish Broadcasting Corporation. Facade completed with naturally ventilated double glass facade based on thermal lift. The outermost glass layer is suspended from the roof edge. Architect: Dissing+Weitling architecture.

Solar Gain

Sunlight is a local energy source that must be used, both for the building and pedestrian zones. Maximum sunlight possible for the pedestrian is good, but maximum sunlight penetration into the building is not. Day lighting is important and easily accomplished with a narrower floor plate of a courtyard typology. Ideally, the building should be no more than 12 meters deep, as any more than that and it becomes difficult to day-light (Roaf, Crichton and Nicol 246).

The other consideration is how much glazing is used. A basic rule should be a building facade can never contain 100% glass. The problem is too much thermal gain that must then be rejected. Heavy construction with good thermal mass (concrete for example) takes longer to heat and could afford 50% glazing. If a building is light weight construction it should only be 20% glazing if south facing and not shaded. Even with interior blinds drawn there is still a heat gain (Roaf, Crichton and Nicol 217). Southern and western exposed facades must always have sun protection from the long hours of summer light but allow penetration in the winter. Light shelves are one key strategy, or a combination of awnings and overhangs or the development of an external screen or blind, possibly with movable parts. When choosing a system, the designer must still be careful to maintain a visual connection with the street.

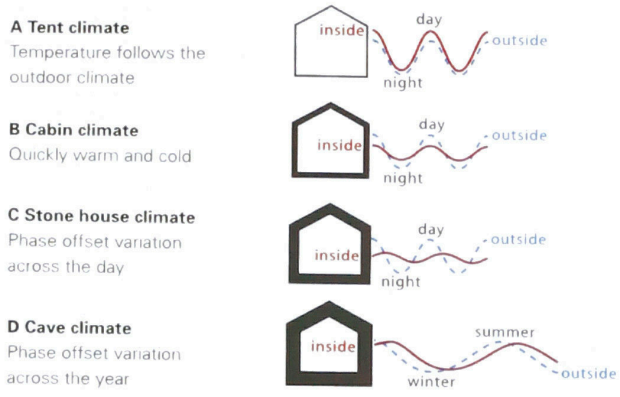


Figure 4.25: The effect of thermal mass to a building's heating and cooling cycle, inside versus outside environments.

Southern walls can also become solar walls, which warm outside air that can be used for ventilation during winter. (solarwall.com) Glare is another factor to consider. Materials chosen for any facade must not reflect too much heat/light into neighbouring buildings, defeating their own systems and strategies. Reflected light from shiny materials must not affect the vision of pedestrians or drivers. This would be especially true in courtyards.

Solar gain in courtyards with wind protection should create small micro-climates inside the city, which would be more suited to pedestrian movement and outdoor activity, especially in the winter. If the external streets are too cold and windy, pedestrians should be able to move from courtyard to courtyard comfortably to cover the distance they need to travel.

Technology and Construction

All of these PLEA approaches when combined would already produce a building that consumes less energy, than one of typical construction today, and lower its CO2 emissions significantly. The ECCA would also generate the heating energy required to meet its needs with the proposed deep geothermal power plant. This facility would produce some electricity, but mostly heat, essentially free and CO2 neutral. This is an alternative to current heating fuels in Alberta, which is predominantly natural gas. Assuming deep geothermal works, the intention is to heat every building on the ECCA with a district heating system.

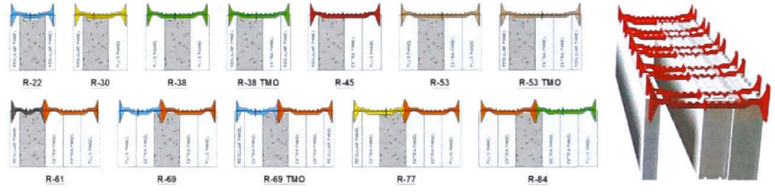


Figure 4.26: Quad-lock Insulated Concrete Form (ICF) system is a modular and adaptable construction system. Special Styrofoam is used as a concrete formwork and then left in place as insulation after the concrete is poured. The thickness of the foam and depth of the concrete cavity can be adjusted depending on the insulation and structural requirements. It can also be used to build curved forms.

If one adds more thermal mass to the building, such as concrete floor slabs, this offers another opportunity. Radiant floor heating could be installed for efficient heating, but these systems can also be reversed for cooling. For example, Edmonton Transit Service's new southern bus garage, intended to use their radiant floor system in reverse, to dump waste heat into the city snow dump during the summer months. When such strategies

are combined with a super insulated well sealed building, energy efficiency can be achieved.

The main premise is that once PLEA is applied, reliance on new expensive "green" technology or mechanical systems and their complexity can drop significantly. Mechanical Systems that already are considered efficient under LEED have significantly less load to carry in a PLEA building. It is then possible to build these mechanical systems with even smaller capacities than previously, which increases efficiency. Money saved on construction, heating and cooling costs and extra costs associate with greater building height can instead be invested into the architectural design, PLEA features and the street environment, increasing the properties desirability and market value. Concrete as a material is energy intensive but has an extremely long life span. This should be considered worth the investment, especially if the architectural spaces provided are adaptable to changing types of occupancy. At this point the building becomes worth the investment, its sustainability coming from low energy consumption, affordable maintenance and no requirement for demolition to meet changing needs.

Section 5: Design Proposal Development

5.1 Site Selection:

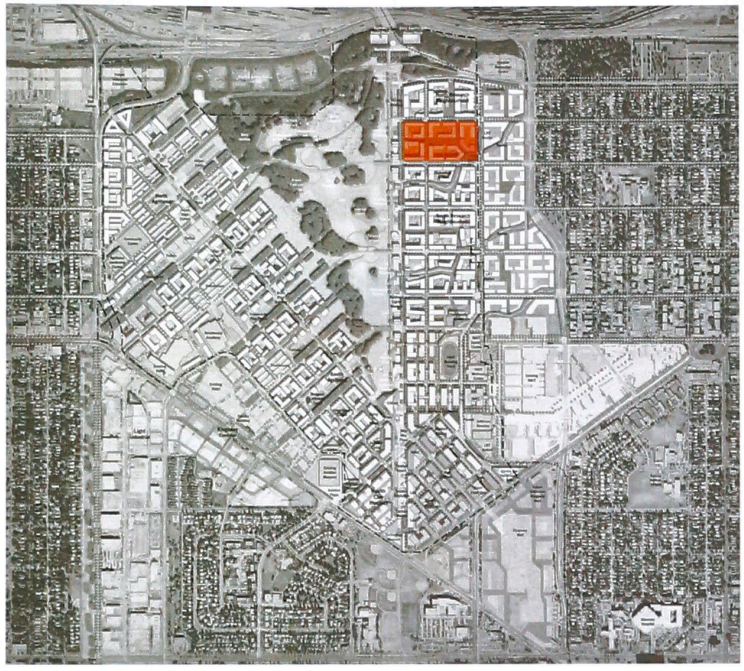


Figure 5.1 Site Location in the P+W Master Plan

Reasons for selection

- The Site is in proximity to the proposed LRT line and station which offers the possibility to integrate the prototype with the LRT station. This represents architectural integration with infrastructure, as well as interaction with the street that passes through the site.
- The blocks in this area are super blocks, which would not be pedestrian friendly. The prototype can demonstrate how these blocks can be broken down and made pedestrian friendly, accommodating vehicle traffic without allowing it to dominate the streets. (Design Guidelines; Street Types and Design / figure 4.13)
- The site warrants higher than average density because of its location next to a proposed LRT stop and major arterial roads running through the ECCA. Increased density at such a location is one of the master plan principles. (Section D: Family Housing)
- Master plan called for local retail at this location. With one end of the site against a major pedestrian route/boardwalk and the other against an LRT station, this suggests a greater opportunity for retail and mixed-use program, than proposed in the P+W Plan.
- Good location to propose urban dwelling units meant for families because of the adjacent proposed elementary school.
- Selected a large site that allows for critical mass of a mixed use program and the development of a building massing that can shield pedestrian areas from winds. This orientation also works better for wind protection and access to sunlight then the western half of the site (See 2.1 Section E Open Space). The site is also large enough to enable an "urban courtyard" approach.

5.2 Program

The following program represents the major occupancy types, (residential, commercial ect.) with possible minor occupancy types that would be given permission to inhabit the prototype building. These allowable uses are taken from the Edmonton Zoning Bylaws as they stand currently, and edited for what seemed appropriate to the aims of the project, building design and proximity to other major occupancies. For example some industrial and commercial uses were excluded, such as construction yards. The intention is not to explicitly determine every minor occupancy in each space of the building and design accordingly. The main intention is to identify possibilities and then design to demonstrate how various major and minor occupancies can be organized and interact.

Residential:

- Town homes
- Multi-family Housing - apartments of various sizes.

Temporary Residential:

- Hotel

Commercial:

Permitted Uses:

- Grocery Store
- General Retail Stores
- Local Retail (Convenience Stores or Boutiques)
- Commercial Gym
- Bowling Alley / Pool hall
- Restaurant(s) / Bar / Pub / Night Club
- Specialty Food Services (Examples coffee, donut, bagel or sandwich shops, ice cream parlours, and dessert shops.)
- Day Care
- Business Support Services
- Commercial Schools (Examples hairdressing, dancing or music schools.)
- Custom Manufacturing Establishments (Examples jewelry, toys, musical instrument manufacturing, gunsmiths, sculpture studios)
- Equipment Rentals
- Household Repair Services
- Professional, Financial and Office Support Services
- Veterinary Services
- Montessori School

Office Space:

- Commercial Leased Office Space
- Professional Services
- Lab / Research Space

Institutional:

- Community Center
- Tourist / Information Kiosk
- Branch Library

Light Industrial:

Permitted Uses:

- Broadcasting and Motion Picture Studios
- Large Scale Print Shops
- Small scale manufacturing or assembling of semi-finished or finished goods, products or equipment. (ie Millwork shop)

Special Industrial Uses for the Research District.

a. The manufacture or assembly of products using innovative or advanced technology where substantial value is created or added to the product through the process of its manufacture or assembly;

b. research and development uses in which innovative or advanced technologies are employed.

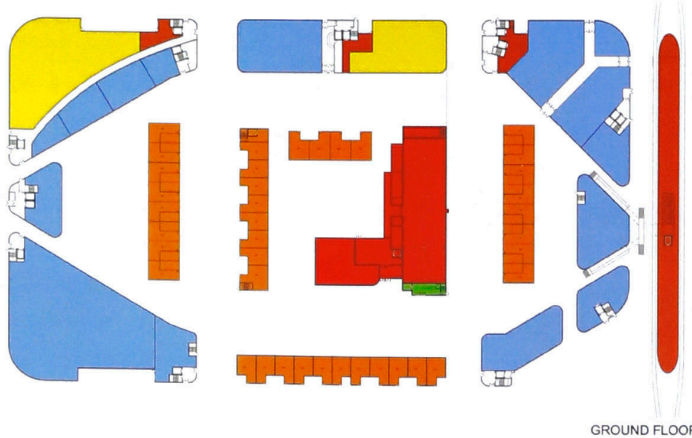
Exterior Public Spaces:

- Community park / green space with play area
- Green Walkways /pedestrian paths
- Games Kiosk / public games (Shuffle board etc.)

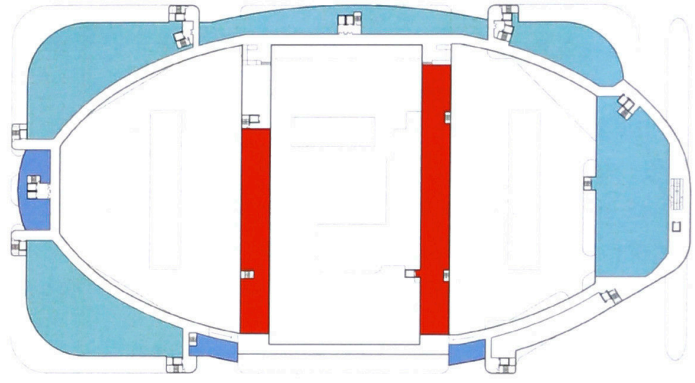
Infrastructure:

- LRT Station / connection.
- Bus stops
- Loading Docks + Vehicle loading/unloading areas
- Non-accessory Parking (Parking for non-residents)

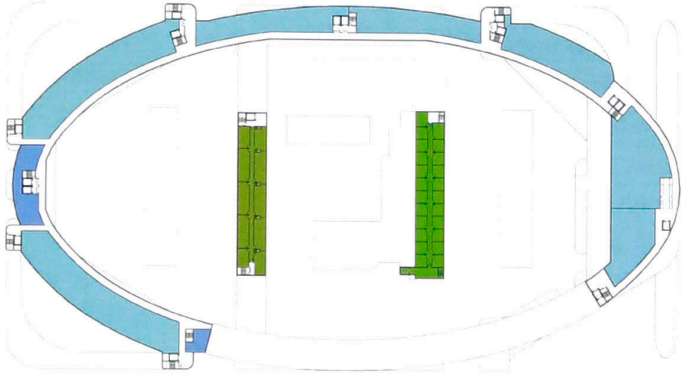
Amenity Space: Interior courtyards are to be a combination of private, semi-public and public amenity spaces. Private spaces would be patios at ground level, separated by slight grade changes or planters that exit into the semi-public zones, which would be designated outdoor green space for residents only. These would be separated by a security fence to the formally public green areas of the interior courtyards. Amenity areas for units above grade would either be private balconies, roof terraces or green roofs for the sole use of nearby residents.



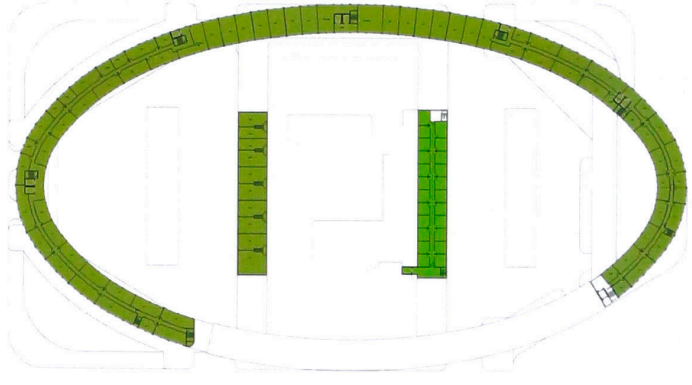
GROUND FLOOR



SECOND FLOOR



THIRD FLOOR



FOURTH FLOOR

OCCUPANCY TYPES

- COMMERCIAL / RETAIL
- OFFICE
- LIGHT INDUSTRIAL
- INSTITUTIONAL
- INFRASTRUCTURE
- HOTEL
- RESIDENTIAL APARTMENT UNITS
- TOWN HOUSE RESIDENTIAL UNITS

NOTE:
Above Fourth Floor all occupancy is Residential Apartment Units.

Figure 5.2

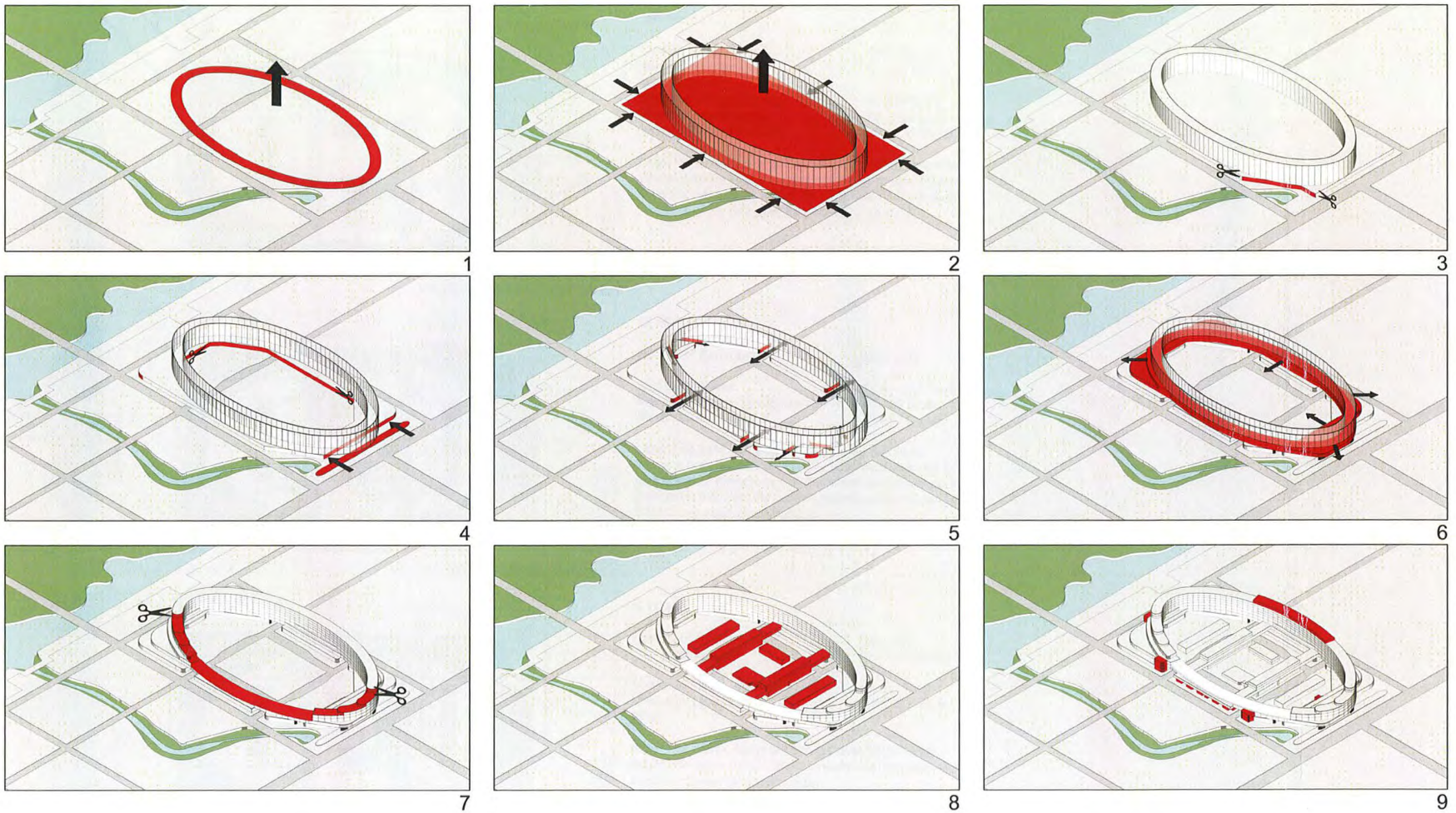
BUILDING PROGRAM

5.3 Design Prototype: Objectives and Rationale

Once a site was selected (See 5.1) the generation of a building design flowed from the design guidelines. One proposed change to the Perkins+Will Master Plan is to move the LRT line to the west side of 109 St NW. This is to preserve the buildings along the east side of that street where some are of historical significance to the architectural history of Edmonton, being examples of the Edmonton Modernist Movement. Most are also large, infrastructure buildings such as the ETS Westwood Bus Storage Garage. This area is presumably City owned but falls outside the official limits of the ECCA lands and it is in doubt as to when it would be cleared for re-development. For the ECCA re-development, the construction of the LRT line is critical for pedestrianization in the P+W Master Plan. Therefore, it makes no logical sense to position it on lands where there is uncertainty regarding the clearance of that land to allow for it. This wasteful demolition destroys facilities that provide local jobs, or removes buildings that can be re-purposed. It also adds cost to an LRT line that is already priced at $200 million per kilometre to extend from the downtown core to the N.A.I.T. Campus.

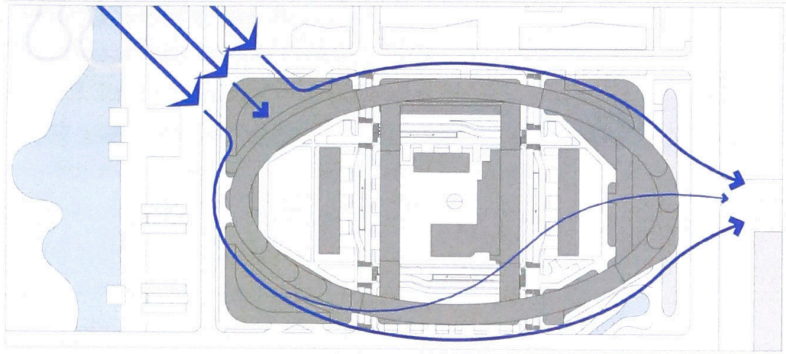
The prototype's form grew directly from the idea of interaction with wind. The challenge was to develop a form that shielded pedestrian areas from winds but was also aerodynamic enough to produce as little wind turbulence as possible, and the ellipse experiment was directly inspired by Figure 4.4. Another consideration with wind was building height, and a low to mid-rise form is the most suitable for windy conditions. (See 4.1 Building height) To achieve density in a low or mid-rise form, a courtyard design became the vehicle used to achieve this. (See 4.2 Criteria for Building Height). The courtyard typology not only has the opportunity for wind protection of the interior, but also creates particularly favorable micro climate for pedestrian activity, when the interior of the block is exposed to direct sun light. A courtyard also maximizes the perimeter of the building (compared to a tower) which allows more access to natural light for the building's occupants. (See 4.1 Build Height) This is advantageous especially for residential units.

Environment Canada research shows the prevailing wind directions for the site come from the south and west, with the worst of the winter gusts coming from the northwest. The ellipse form also fits the orientation of the site chosen, facing into the prevailing winds in order to deflect them. (See Section E Open Space) The site defined the size and outside edge of the ellipse while the interior edge was simply a twelve meter offset from the initial line, done for the purposes of day lighting the interior. (See 4.4 Solar Gain). Unfortunately an ellipse shaped courtyard on the site is very wasteful in terms of ground coverage, for both the corners and center are vacant, limiting building area for program on the ground floor. To expand the ground floor and increase site coverage to a minimum of 40% (See 4.2) a six meter set back was created and this became the outside edge of the building's ground floor. This set-back distance is typical of Edmonton Zoning bylaws today and seemed an appropriate amount of space for a large sidewalk with landscaping or a pedestrian street. (See 4.1 Street Types and Design) This stepping of the building massing also accomplishes two other factors. First; stepping the building's floors protects the pedestrian areas along the exterior face, from down drafts created by the wind. (See 4.2 Building



BUILDING FORM DIAGRAM

Figure 5.3

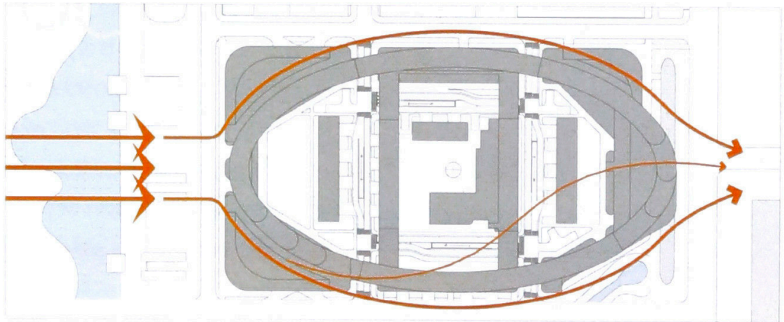


NORTH WEST GUSTING WINDS

NW Wind

Months of Occurance:	Oct - March
Avg Wind Speed:	0 km/h (Not a prevailing wind)
Maximum Hourly Speed:	64 - 74 km/h
Maximum Gust Speed:	93 - 114 km/h
Most Extreme Wind Chill:	-55.5° C in 1964

Note: While not a prevailing wind it is the most common direction in the year for maximum hourly speed. Often from the artic during winter, this is a cold northern wind which must be deflected for pedestrian comfort.

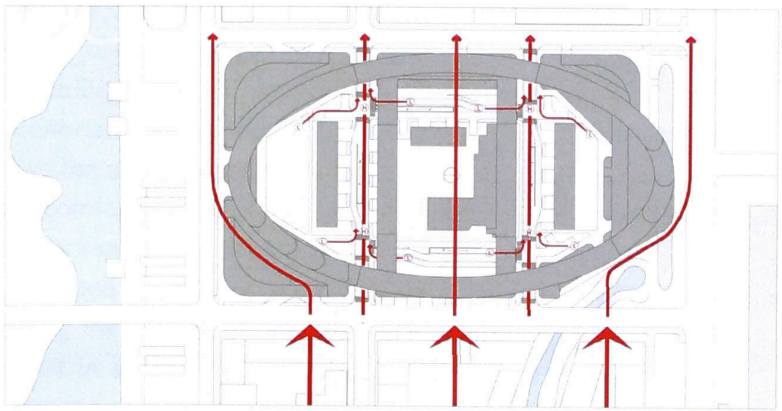


WEST PREVAILING WINDS

W Wind

Months of Occurance:	May - Oct
Avg Wind Speed:	12.4 - 13.7 km/h
Maximum Hourly Speed (km/h):	64 - 69 km/h
Maximum Gust Speed:	91 - 117 km/h

Note: This wind can be used to cool the building's western facades during summer which are exposed to long hours of sunlight in the afternoons and evenings. In Edmonton this typically causes internal temperatures to sour in any west facing building.



SOUTH PREVAILING WINDS

S Wind

Months of Occurance:	Nov - Apr
Avg Wind Speed:	11.1 -13.6 km/h
Maximum Hourly Speed:	63 - 72 km/h
Maximum Gust Speed: (SW)	108 - 117 km/h

Note: The design takes advantage of southern winds passing through the prototype to generate high and low pressure zones for air circulation.

National Climate Data and Information Achive
Edmonton City Center Airport Weather Station
Ranges Taken between
January to December 1971 - 2000

ADAPTATION TO PREVAILING WINDS

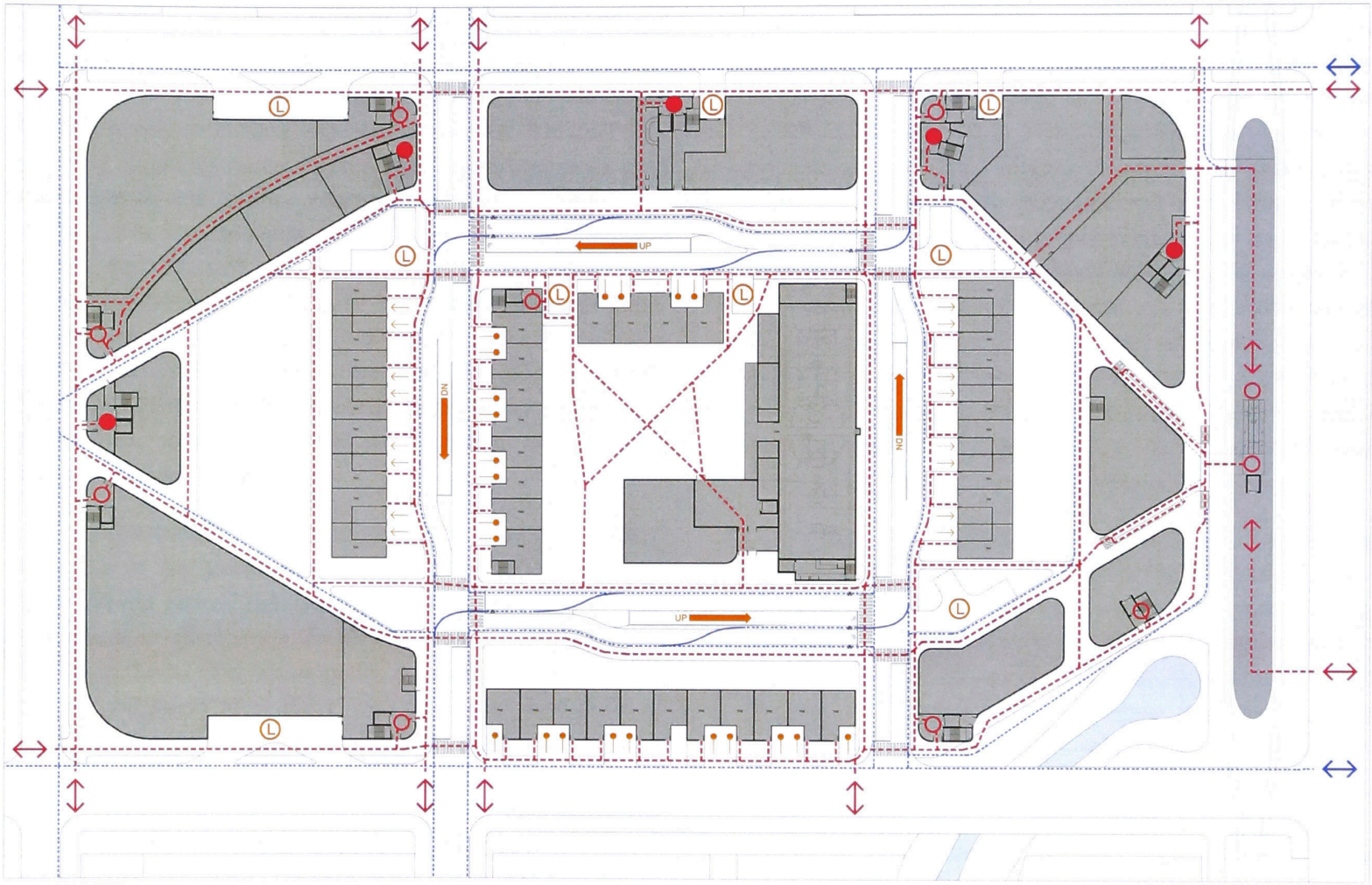
Figure 5.4

Massing) Second; architecturally this breaks up the massing and brings portions of the building lower to street level so that the overall structure is not overpowering. Corners were also rounded which reduces wind turbulence but also directly helps the pedestrian environment by improving sight lines, reducing the number of blind corners and increasing safety. For day-lighting, lower floor plates that are more than twelve meters deep can still have natural light because stepping the floors back as they rise allows opportunities for skylights.

One typical problem that occurs with any northern courtyard design is that the high walls required for wind protection come into direct conflict with sun access. The design reaction: is to lower the building on the south and east sides, to allow direct sun into the courtyard while keeping the walls high on the north and west to deflect the worst of the winds. In order to create protection from the southern prevailing wind and avoid the "Wise Effect" (Figure 4.2), the southern section is 12 meters high with a roof shaped like the spoiler of a car. The intended function is to push the wind upwards such that the bulk of it travels over the roof of the northern section, creating a lee for the courtyard. The building massing is also stepped on the interior at strategic locations to break up any downdrafts created. With the added protection of pedestrian arcades the area should be comfortable. This approach for wind protection and sun access would not have worked for a smaller courtyard because of Edmonton's northern position. Even with the current design during the months of January and December, half the courtyard is still in shade. For extreme winter weather there is also an interior public "winter garden" on the second floor, overlooking the courtyard, which connects all the sections of the building.

Since the goal was pedestrianization of the city, the architecture is designed to make pedestrian movement as seamless as possible, removing obstacles or providing a means to negotiate them. Paths are wide and obvious with clear sight lines and 90 degree turns are avoided as much as possible. Where this is impossible the corner of the building is rounded. Cross walks are provided across streets and bicycle lanes for cyclists, so that the organization of the circulation is clear. People, bicycles and cars are all mixed together but in clear view of each other and given their own space to avoid as many conflicts as possible.

To address automobile traffic, the decision was made to allow access by car, despite the project being focused on the pedestrian. The prime example is the ground oriented housing, which are townhouse units with private parking space for a single car. There are also loading docks and loading zones to allow for commercial delivery trucks and personal moving vans without interrupting traffic or pedestrians. What is not provided is street parking, which did not appear to be a priority in the Perkins+Will Master Plan and this was carried over into the prototype design. Despite this observation, street parking could be added in small amounts. Access for underground parking is provided and this would accommodate both visitor and resident parking requirements. The working principle was: driving should be easy, but walking should be effortless. Cars today are a fact of life but the assumption is when people find walking more convenient, they will do so.



LEGEND

- Pedestrian Route
- Connection to Area Pedestrian Routes
- Public Vertical Circulation
- Resident Vertical Circulation
- Attached Garage
- Carport
- Vehicle Loading Dock / Zone
- Vehicle Ramp to Under Ground Parking
- Bicycle Path
- LRT Tracks

NOTES:

1) Ground floor commercial is to have a double facade with access from two sides.

CIRCULATION ROUTES

Figure 5.5

The organization of the interior courtyard is based on different factors. The first was vehicle access as discussed above. The second was providing ground oriented housing with townhouse units to appeal to families with young children. The third was providing structures necessary to reduce winds that might swirl around inside the interior courtyard because it is so large. Smaller scale low buildings should accomplish this and the massing was adjusted to minimize shading. The fourth was adding neighbourhood park space This not only provides green amenity space but will help with air quality and trees will also break up winds at the pedestrian level. The addition of the Community Center and Branch Library to the center courtyard as opposed to more housing, was done because of the public nature of the central space.

Organizing the building's program into layers was based on access to the public, sunlight and a separation of public versus private space. The result is public places of assembly (commercial or office space) are limited to the first three stories. The rest of the building above that is residential. The intention is to keep the street level active with horizontal movement of people rather then vertical. Vertical access for the general public versus resident access is isolated, for security and orientation. Generally public access is positioned to the exterior of the building and can be lit up at night for clarity. Where an elevator core is shared between the general public and building residents, vestibules are used on residential floors as security points.

The decision to add hotel rooms, (temporary housing) to the design contributes another aspect to the mixed-use program. Instead of guests being isolated in a hotel that provides all amenities internally, the proposed hotel, positioned on top of the community center, could share meeting rooms and exercise facilities with it. This analogy is shared throughout the whole prototype as there would be no "common area" specifically for the hotel guests. They would instead use the public facilities, such as the library, local restaurants and cafes. The hotel could provide accommodation for visiting relatives. For larger functions such as weddings hotel guests and residents alike could rent the Community Center. This ties into the idea of a smaller foot print for guests and residents alike because of proximity, where the public realm is "urban living" as it becomes an extension of their personal living space. Temporary and permanent housing can then be smaller than their suburban counterparts because of amenities offered at their doorstep. (See 3.5)

The design of the residential units was meant to give flexibility and affordability through the choice of seven different, basic unit types with different floor areas. Even units of the same type differ in size depending on the configuration in plan. The initial ellipse also became the basis for residential unit design. This was done by dividing the ellipse into 100 points and connecting these points with straight lines. This gives the appearance of an ellipse but it is actually facetted into 100 different segments. On the outside face each facet is approximately 6.9 meters (22.6 ft) and the area of each compartment is 80 sqm or 860 sgft. This became the basic residential unit building block. Unit areas then change depending on type and adjusting for elevator cores and stepped floor plates.

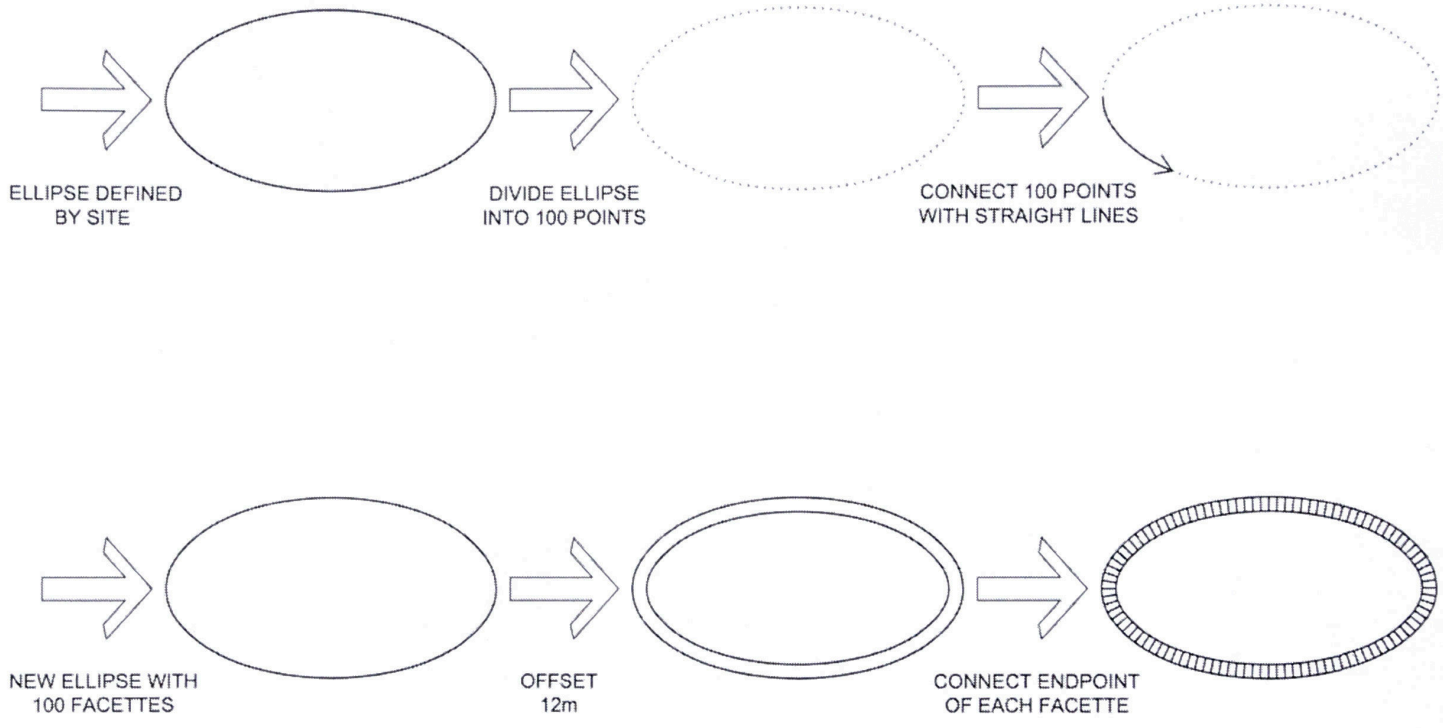
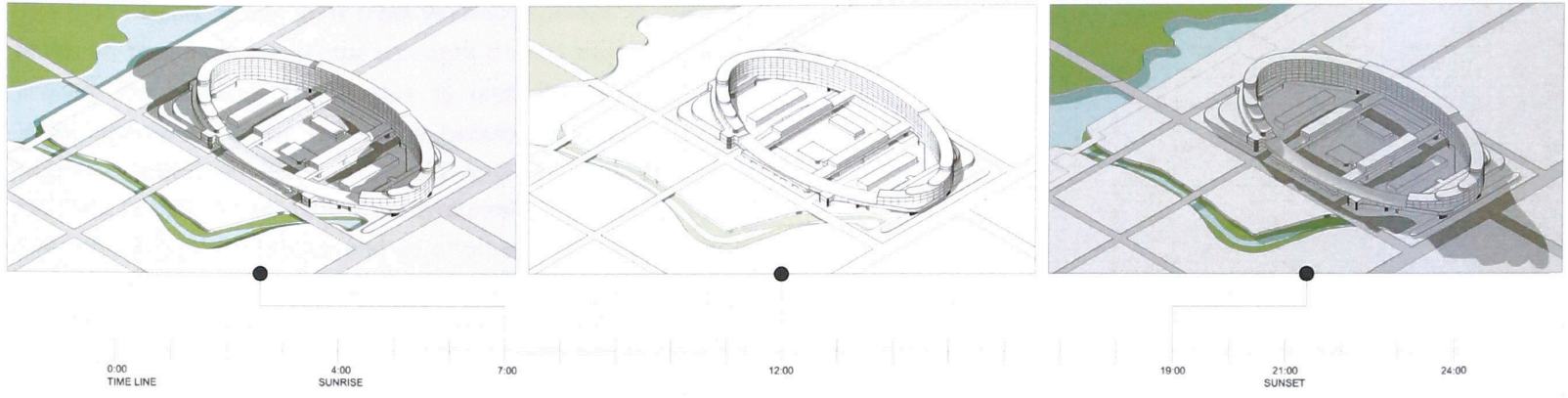


Figure 5.6

This facetted ellipse also helps gain access to sunlight for units that would have otherwise been facing north in a square building. There are no 90 degree corners to shade other parts of the wall on the exterior facade and single sided units are placed just far enough away from due north to catch direct eastern or western sunlight.

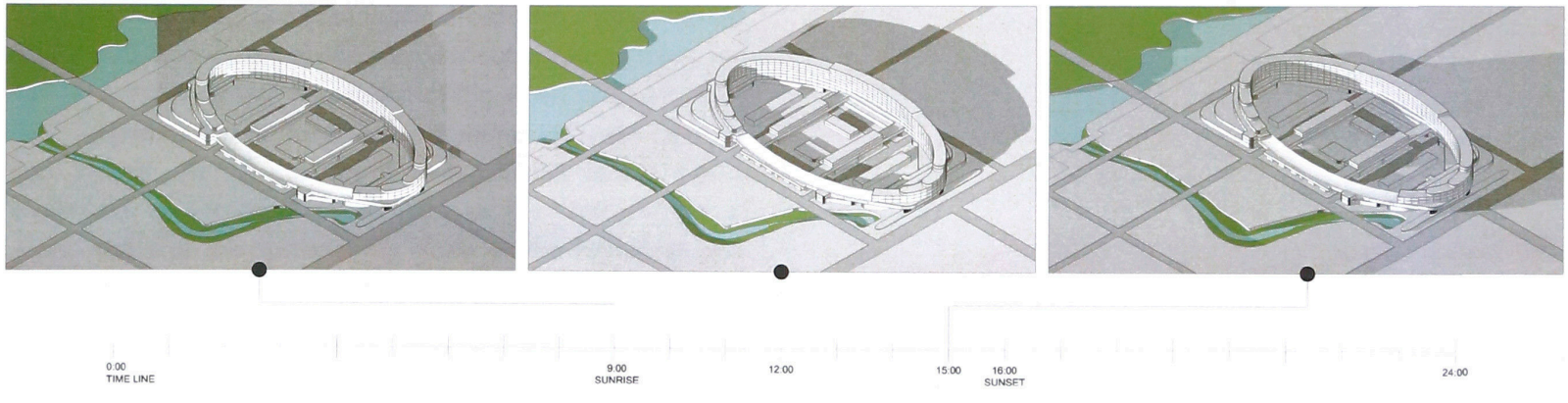
Residential units are designed to have windows on two facades as often as possible. This is true of every unit that faces north, such that any unit with only a single exterior face is facing any direction except due north. Unfortunately it is impossible for every unit to have two facades with cross ventilation, without repeating the same design through the whole complex. This would mean a unit in the style of Le Corbusier's Unite D'habitation or having an excessive and wasteful amount of stairs. (See Figure 4.20) This would eliminate choice and flexibility and would target a specific demographic and class, which was not the intention of the project. (See 3.4)



SUMMER SOLSTICE JUNE 20

Longitude = 113° 28.2' West, Latitude = 53° 33' North Time zone is MST, -7 UTC

Hours of Illumination: Sunrise to Sunset; 17.05 Civil Twilight : 1.77



WINTER SOLSTICE DECEMBER 20

Longitude = 113° 28.2' West, Latitude = 53° 33' North Time zone is MST, -7 UTC

Hours of Illumination: Sunrise to Sunset; 7.46 Civil Twilight : 1.44

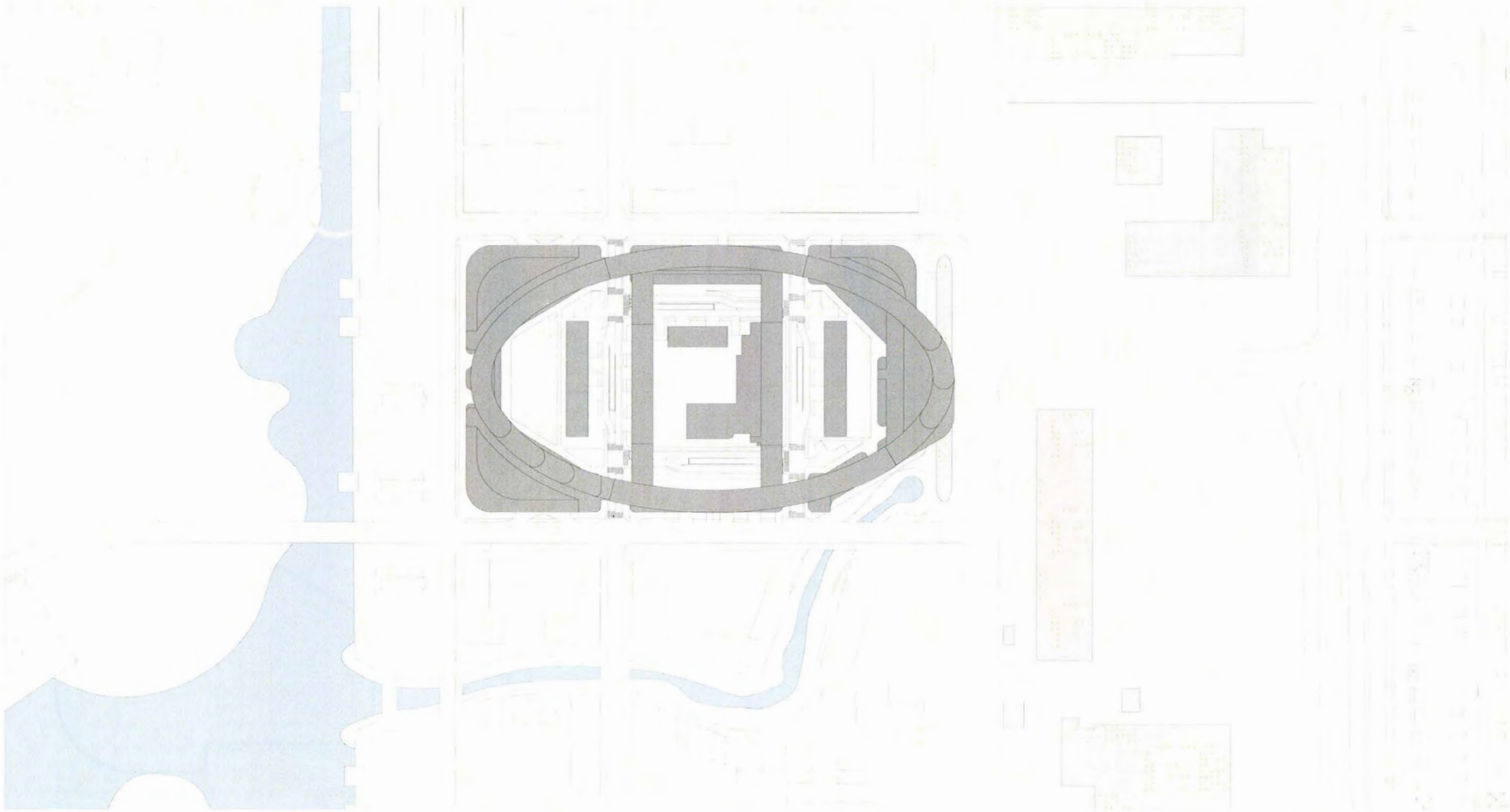
SUN AND SHADOW STUDY

Figure 5.7

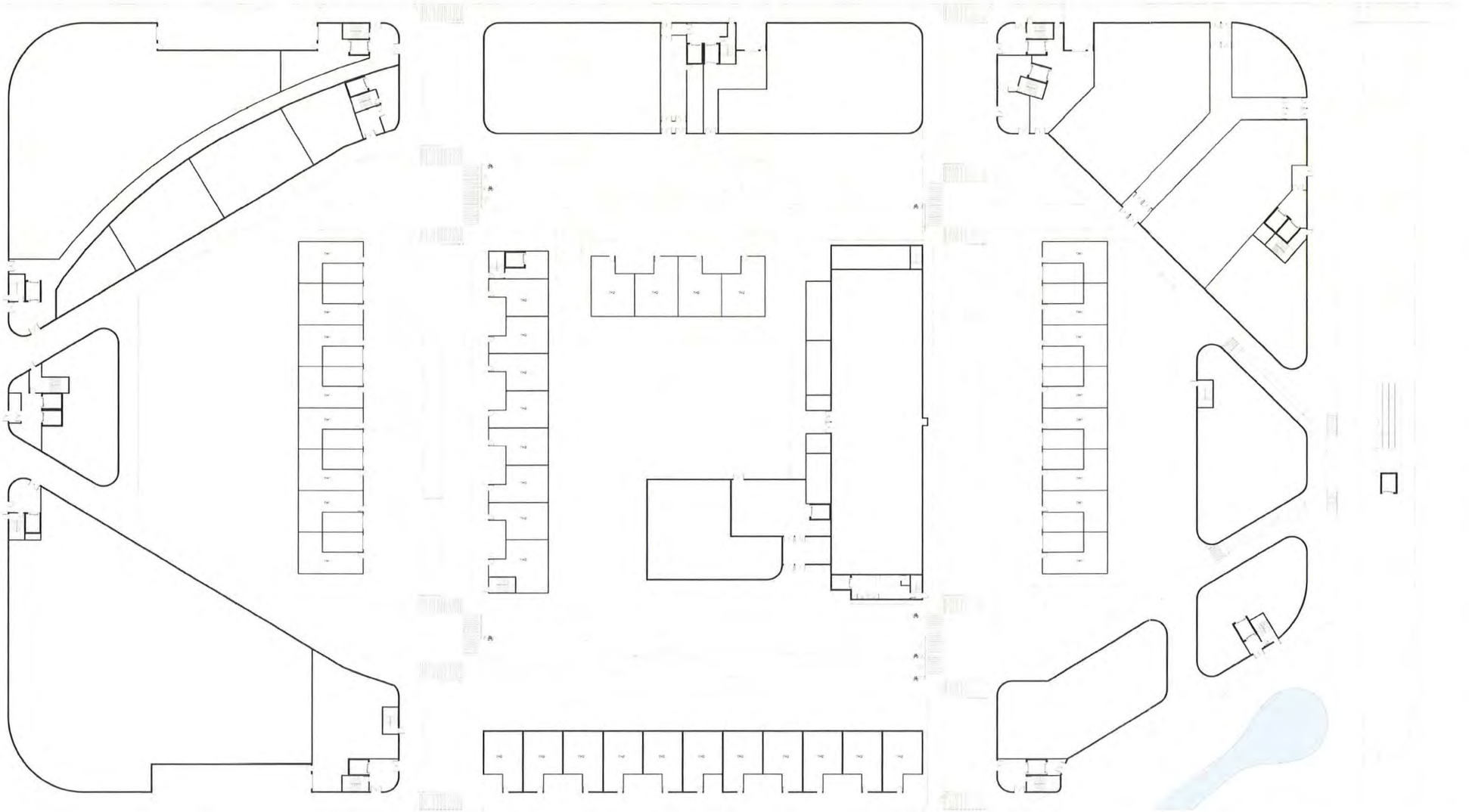
The plan reveals certain units cross the main corridor at different levels so that most residential corridors do not run all the way around the building. This is due to unit design but is also advantageous as it will encourage people to circulate at the public / pedestrian levels. To avoid long dark corridors and facilitate pedestrian access there are multiple entry points to the five main residential blocks, and an effort was made to bring in natural daylight where possible. This is either through windows at the elevator vestibules, or skylight opportunities as the floor plates step back.

The intention of this prototype design is to offer a flexible alternative to the podium-tower examples of Vancouver and Toronto. This is meant to demonstrate the application of density and mixed-use design in a mid-rise form, tailored for the pedestrian. On its own this prototype is not a new typology, but re-thinks the limits and application of the urban courtyard form. The intention is not to become a dominant new form of architecture. On the contrary it is a response to the theory presented in Section 3 in addition to the local climate of Edmonton and the sustainability goals of the Edmonton City Center Airport Re-development.

5.4 Graphic and Presentation Material

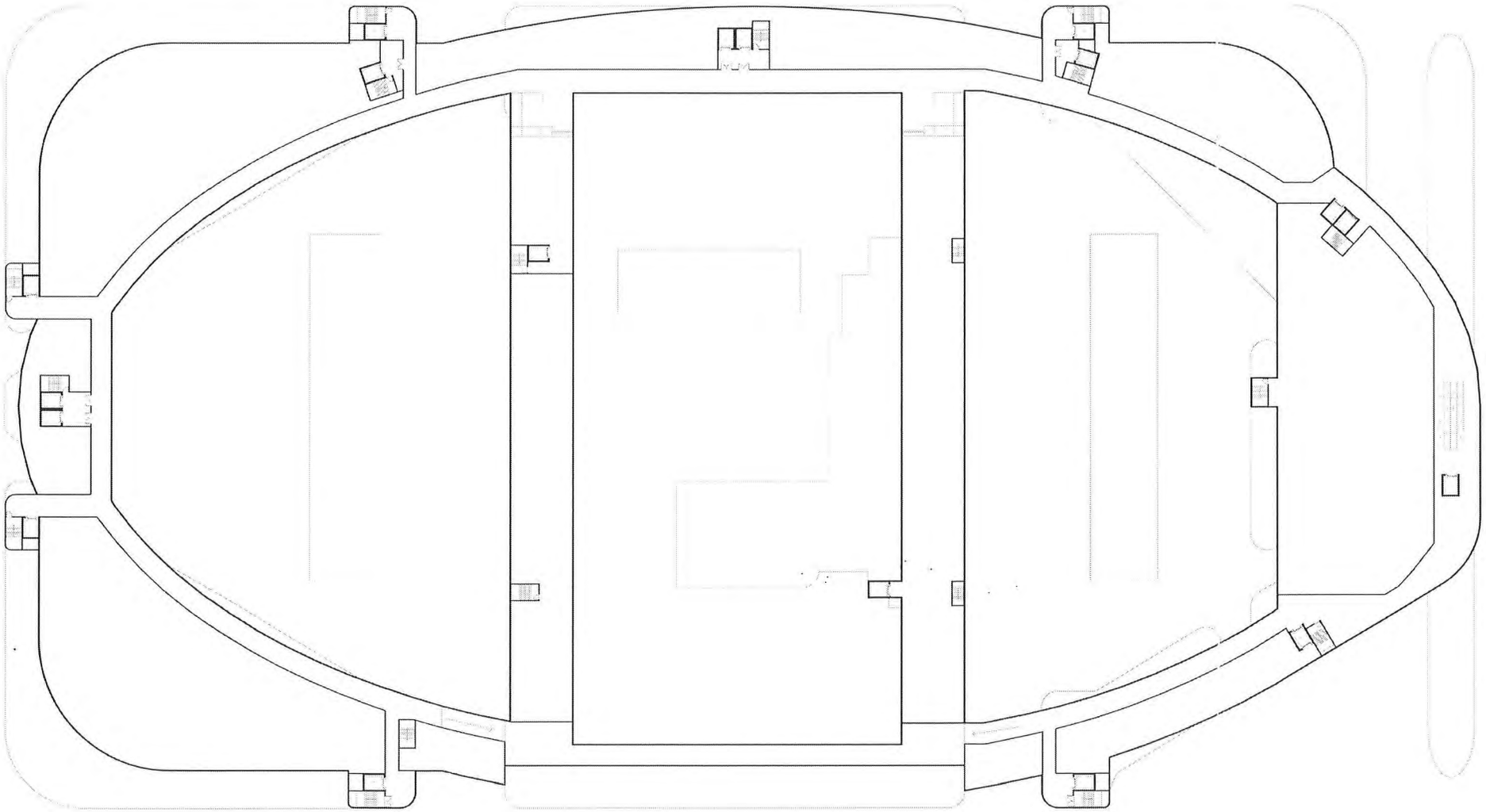


SITE PLAN



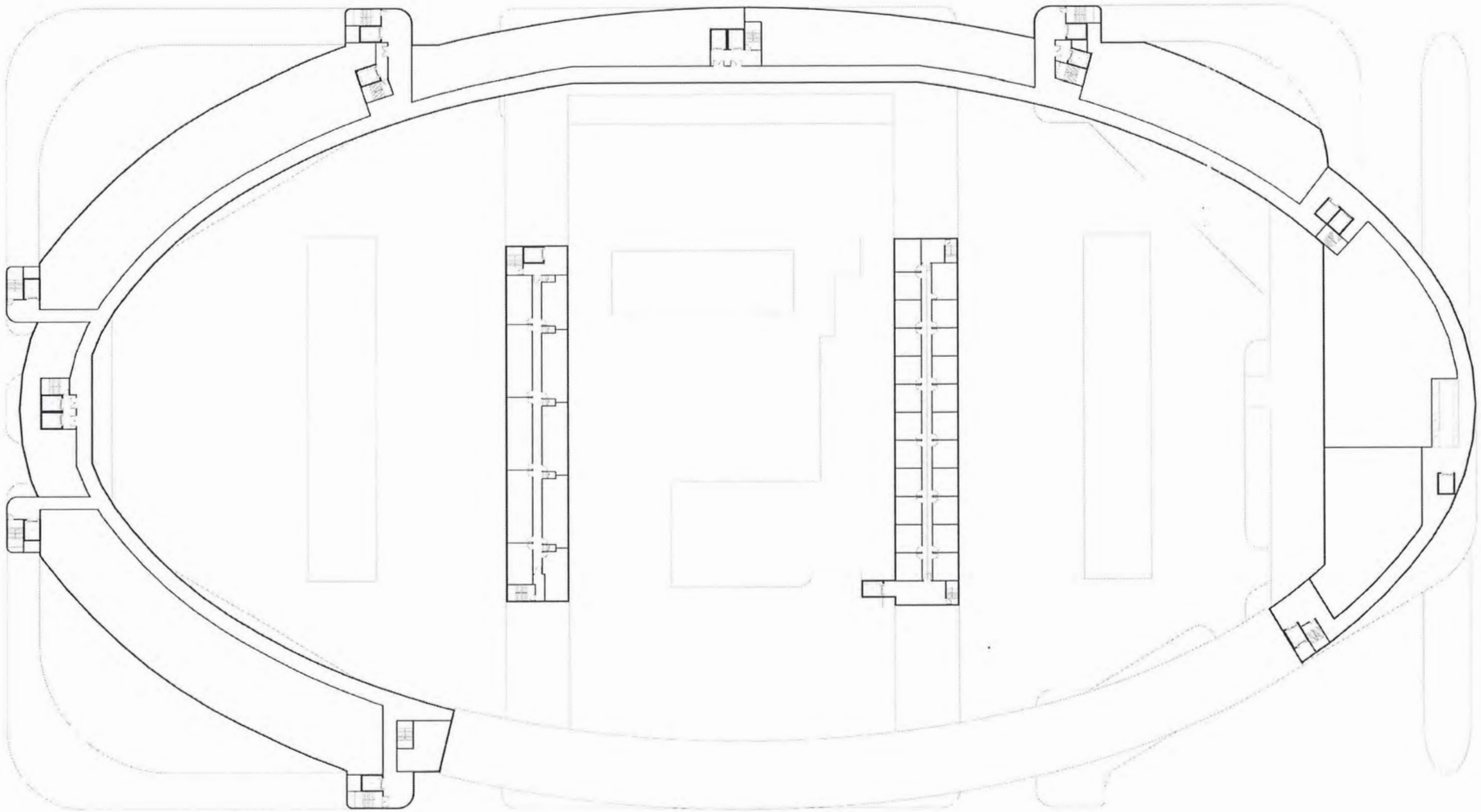
GROUND FLOOR PLAN

Figure 5.9



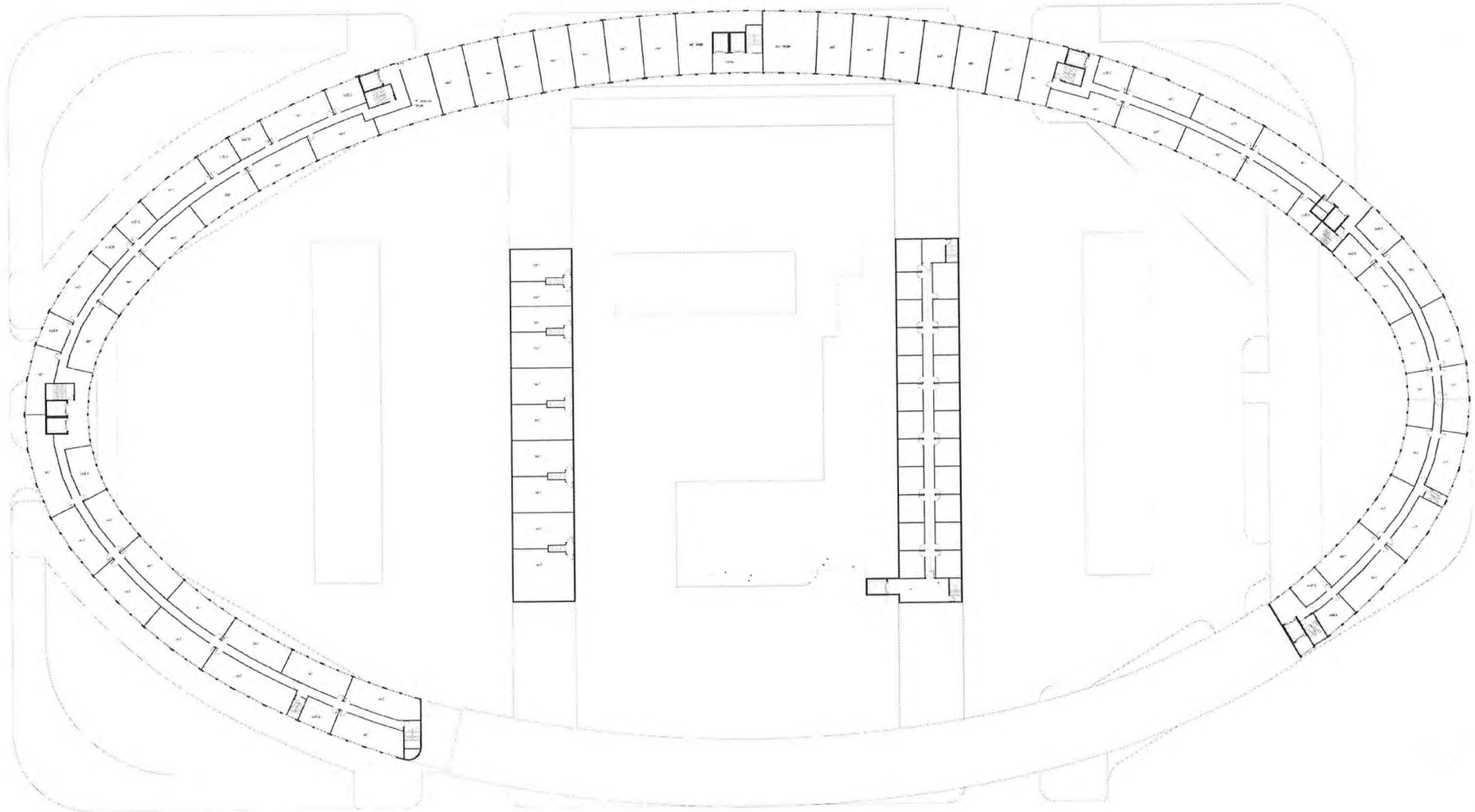
SECOND FLOOR PLAN

Figure 5.10



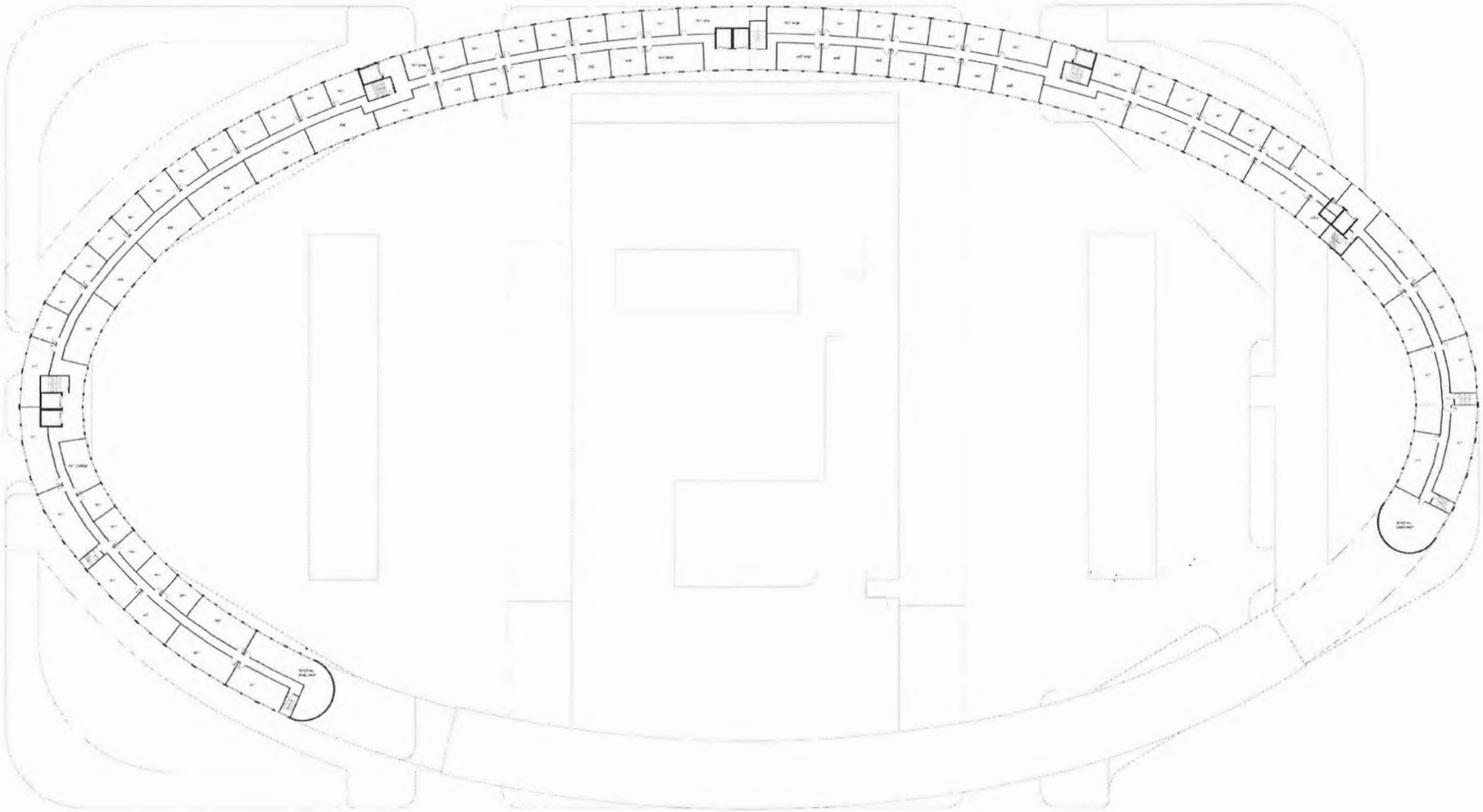
THIRD FLOOR PLAN

Figure 5.11



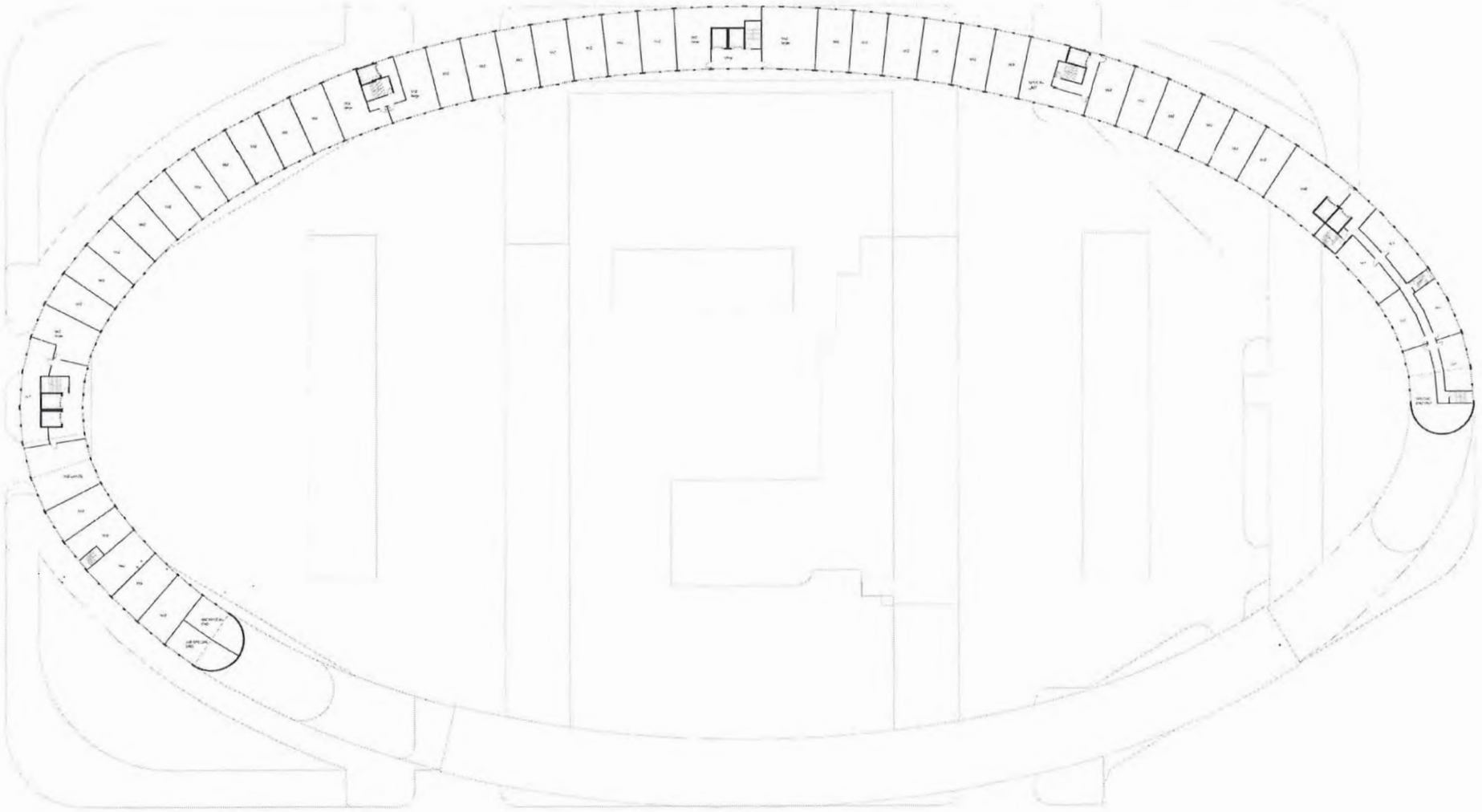
FOURTH FLOOR PLAN

Figure 5.12



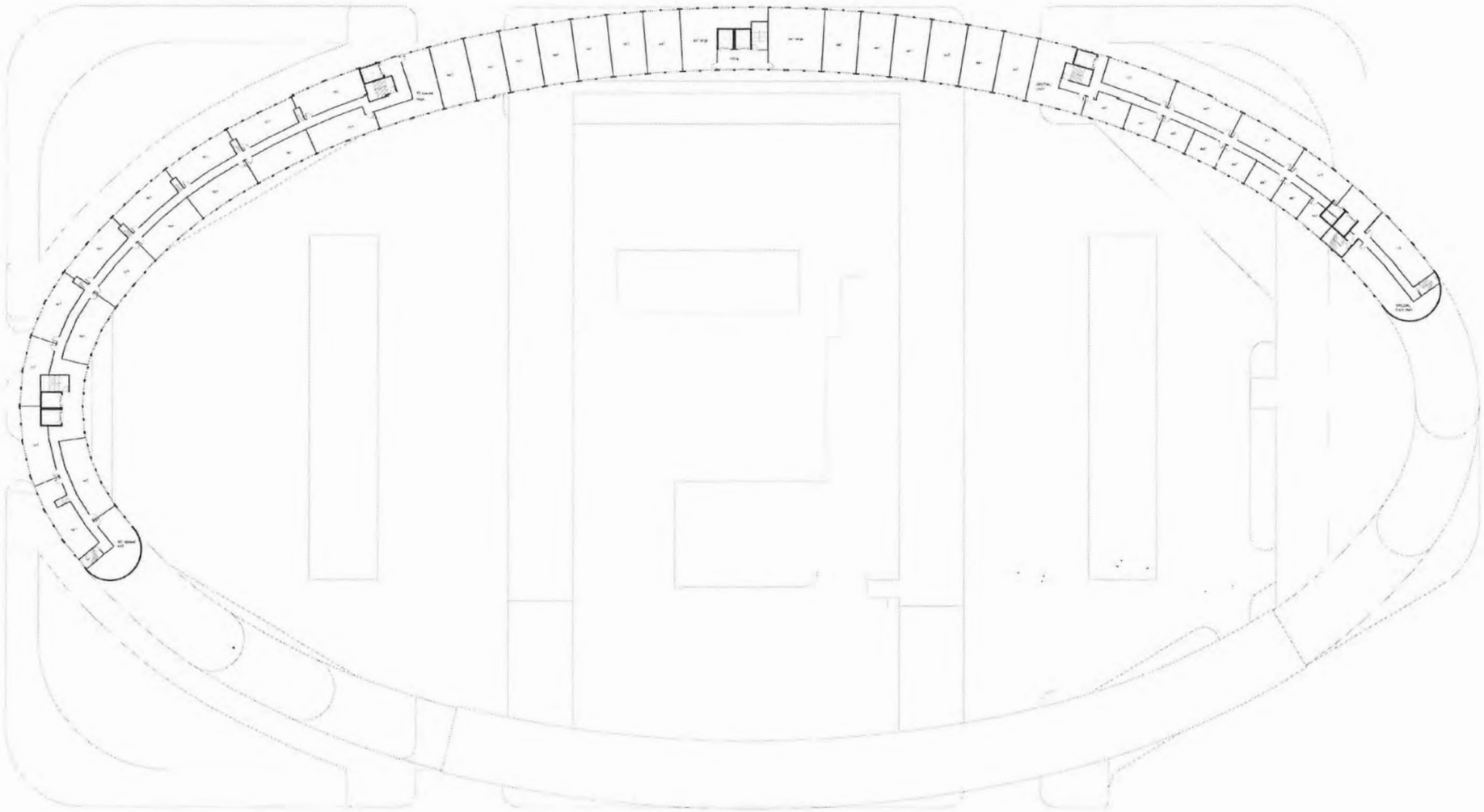
FIFTH FLOOR PLAN

Figure 5.13



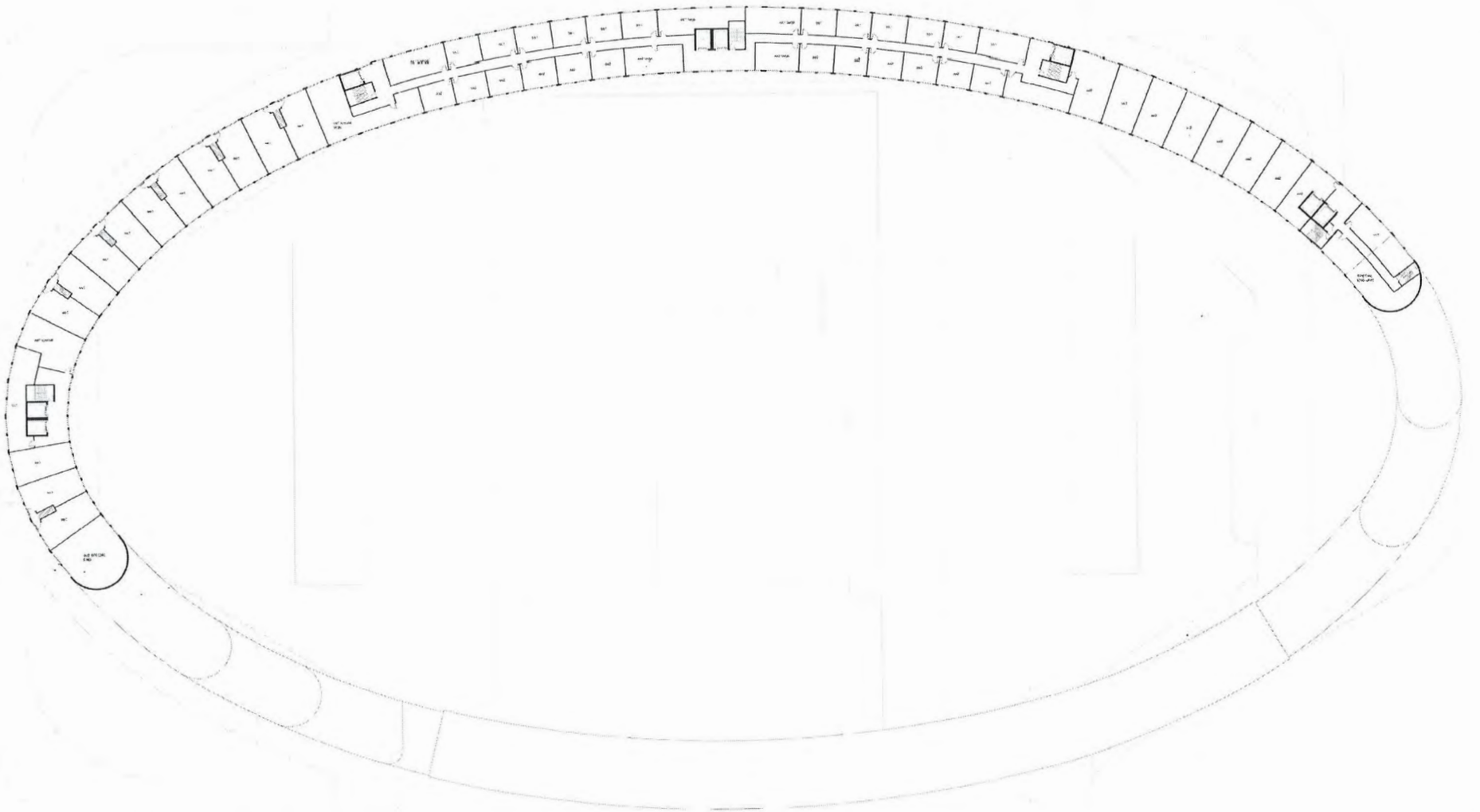
SIXTH FLOOR PLAN

Figure 5.14



SEVENTH FLOOR PLAN

Figure 5.15



EIGHTH FLOOR PLAN

Figure 5.16

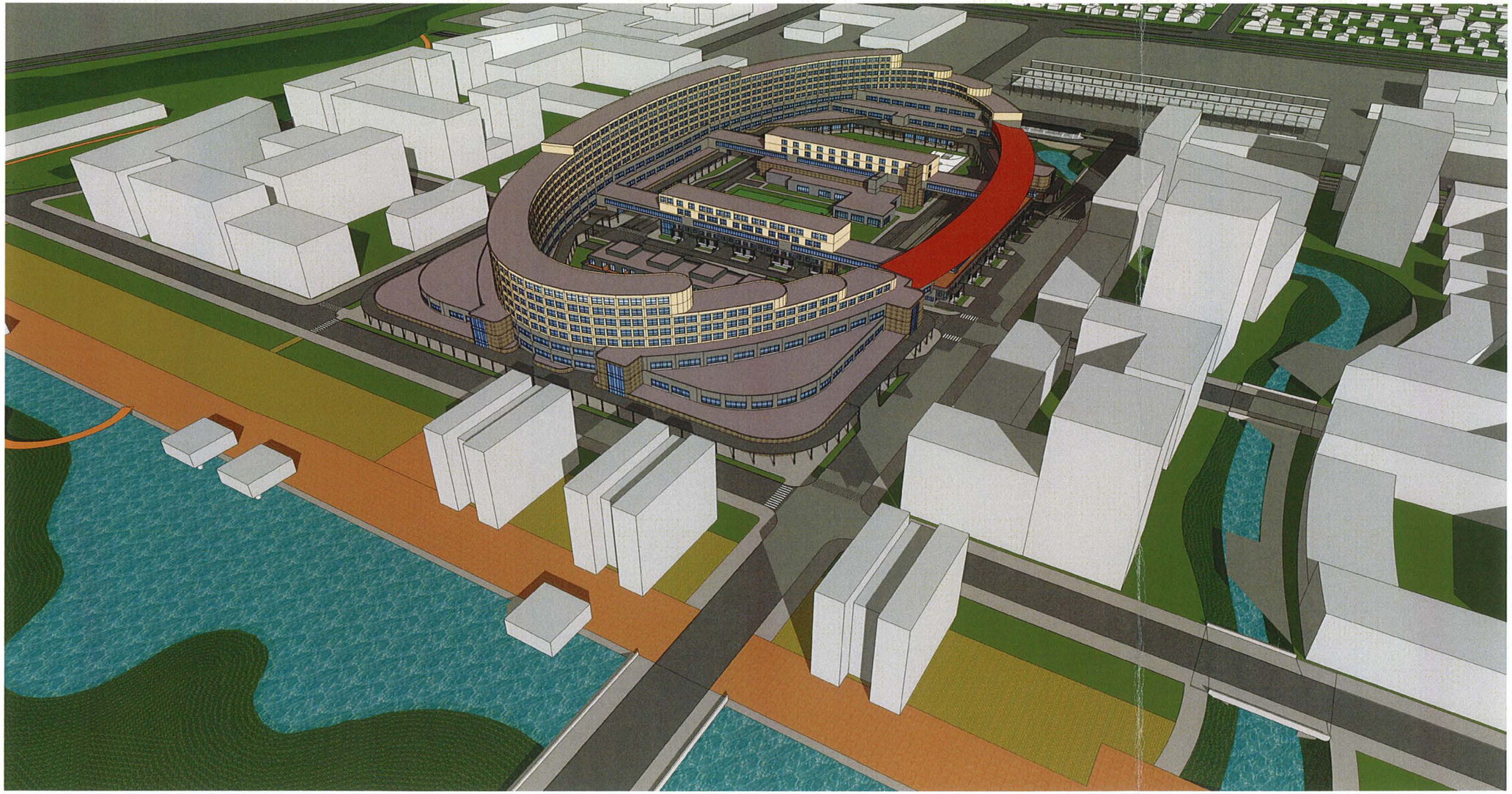


Figure 5.17 Building View from the south west.

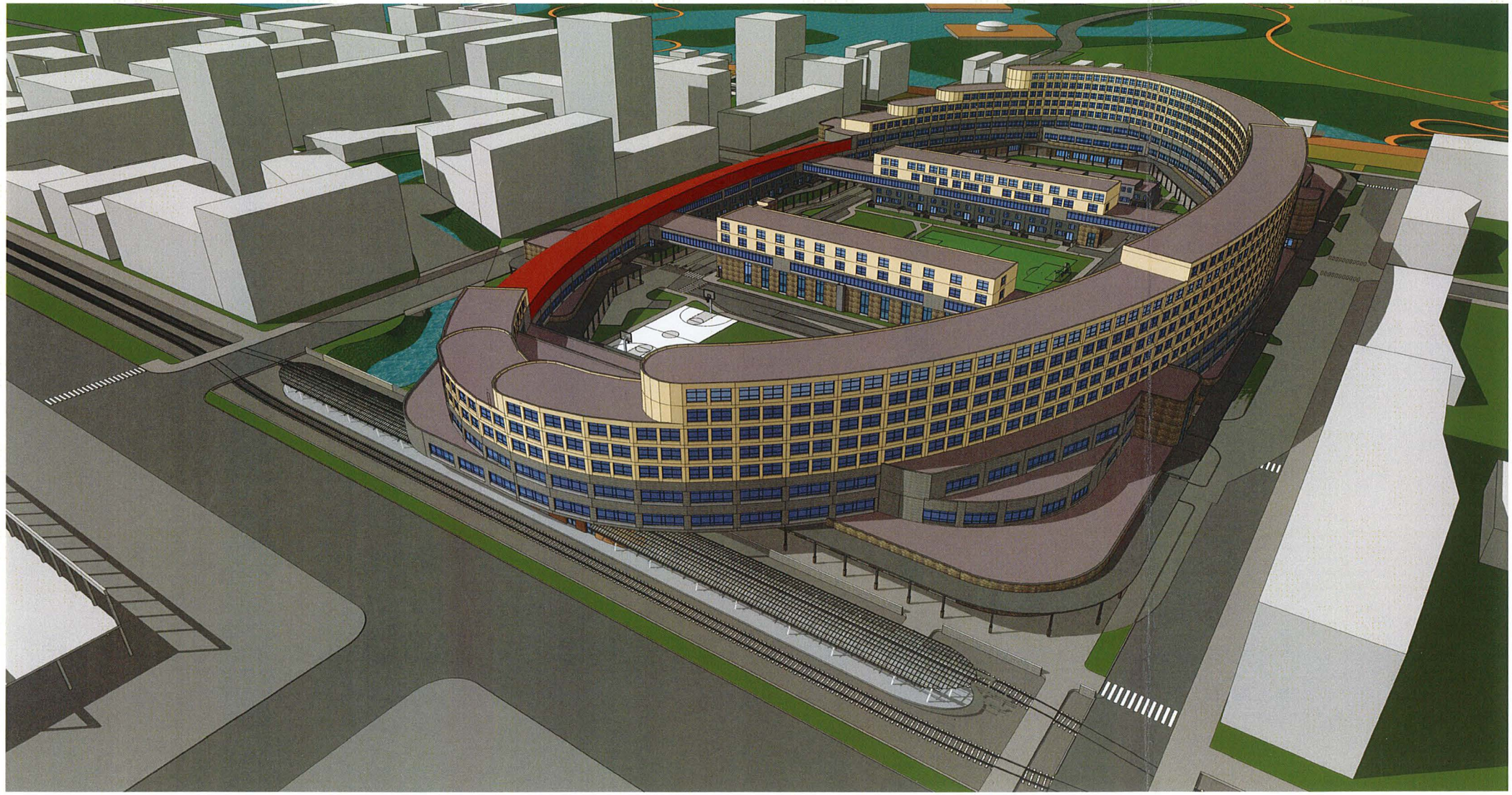


Figure 5.18 Building view from the north east.

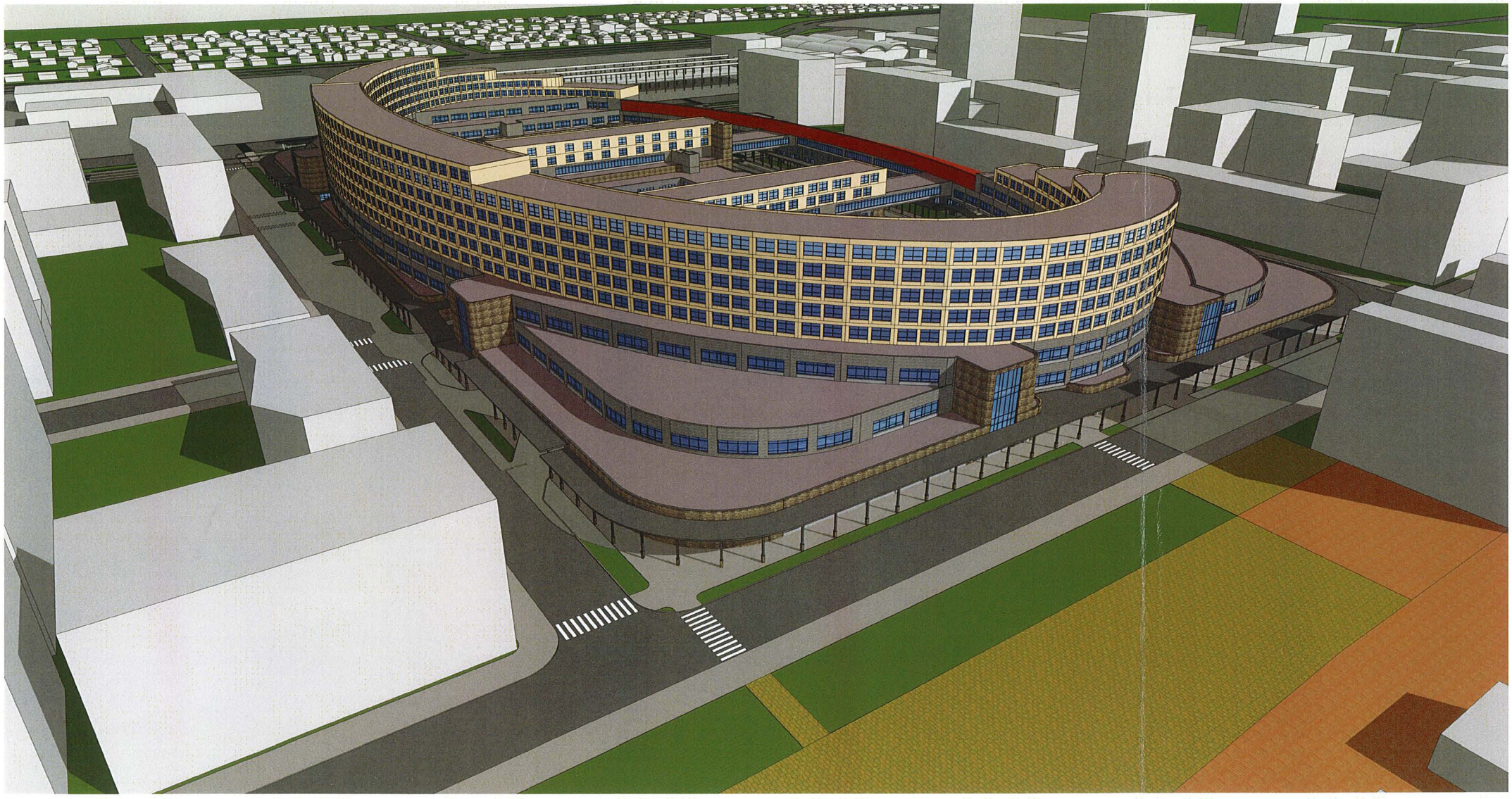


Figure 5.19 Building view from the north west.

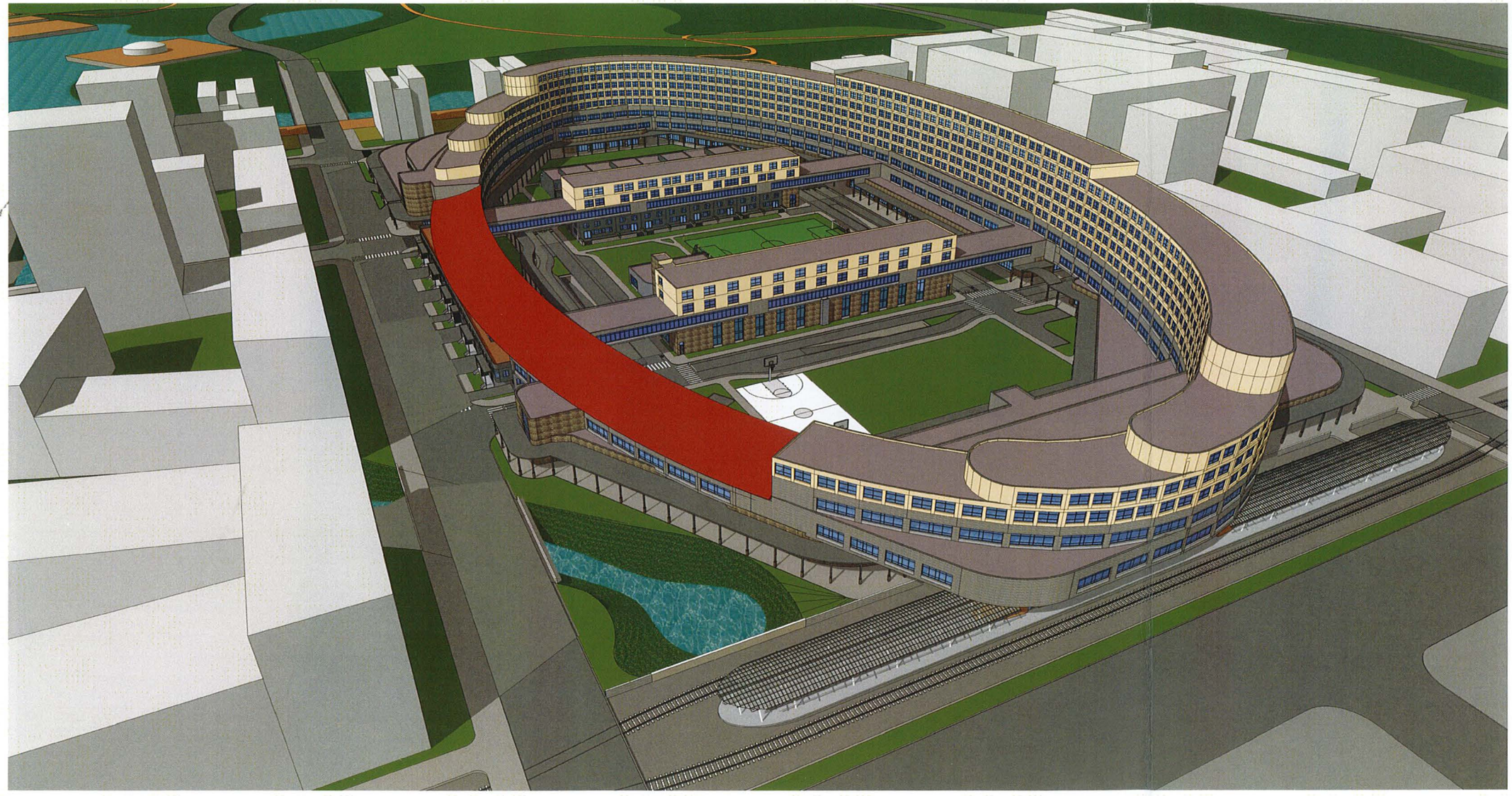


Figure 5.20 Building view from the south east.

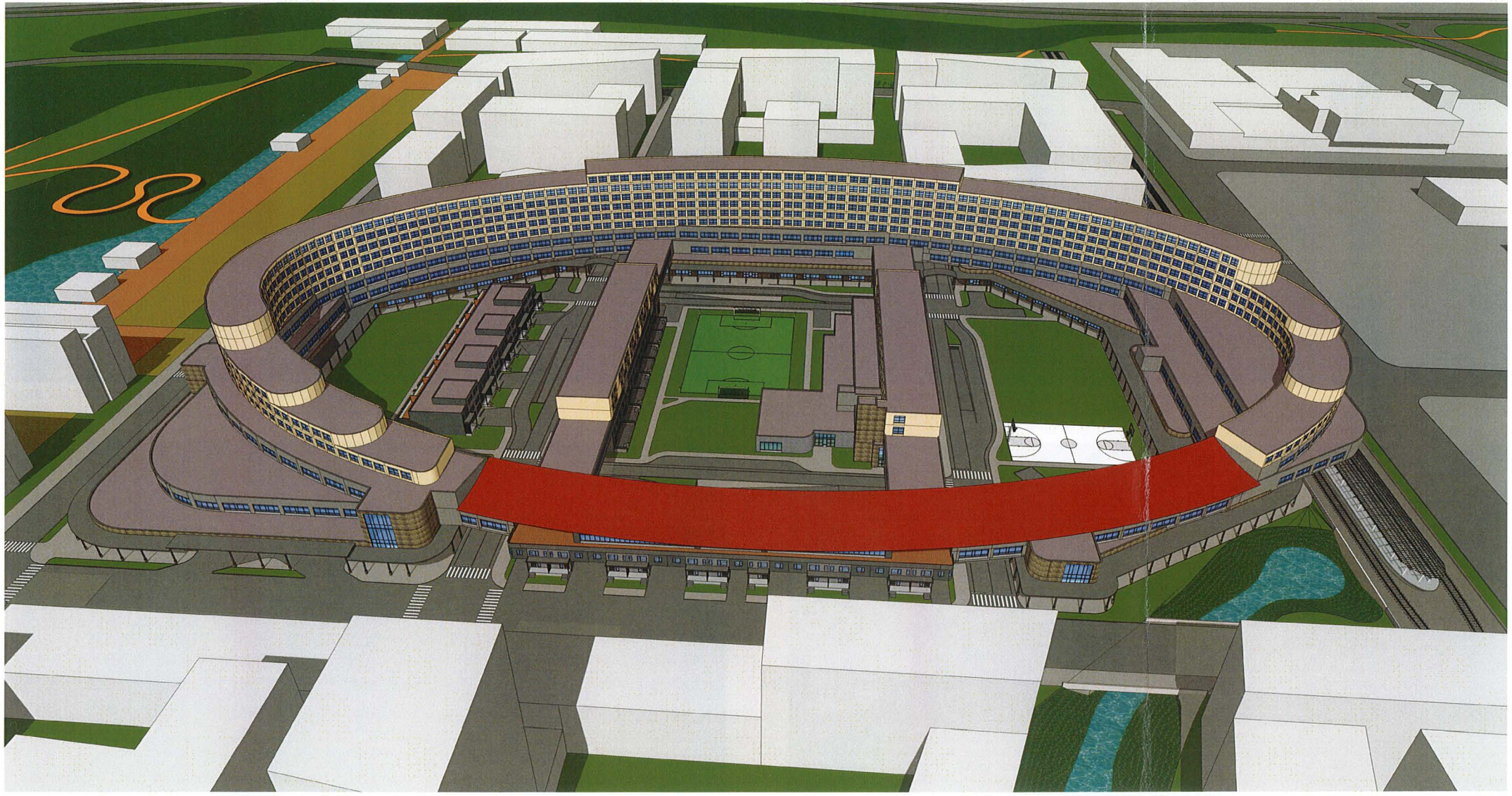


Figure 5.21 Building view from the south.

Figure 5.22 View of the exterior western facade from the Board Walk.

Figure 5.24 View of Townhouse Street. (Front of Townhouses from Figure 5.23)

Figure 5.23 Interior view from the Western Courtyard from the pedestrian arcade.

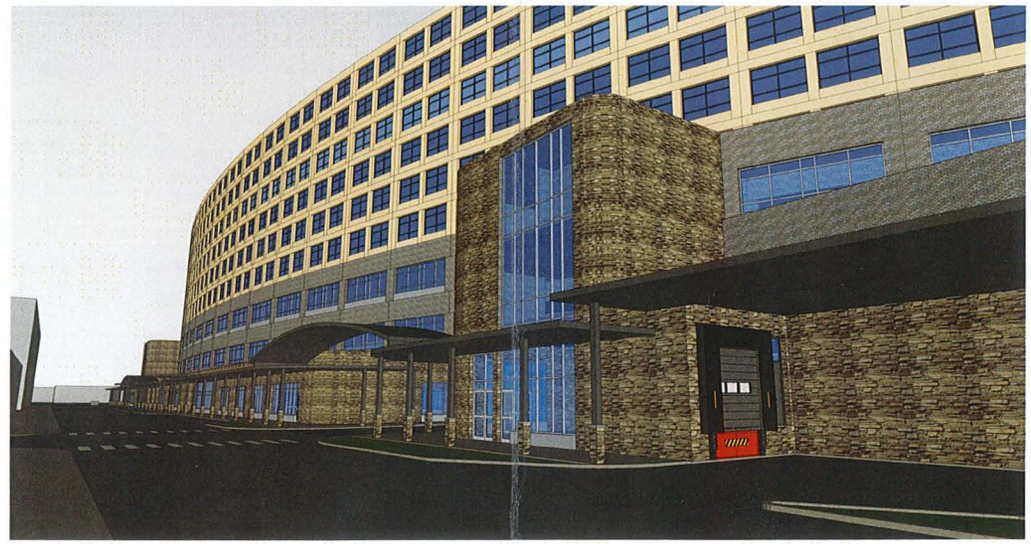


Figure 5.25 View of the exterior northern facade from street level.

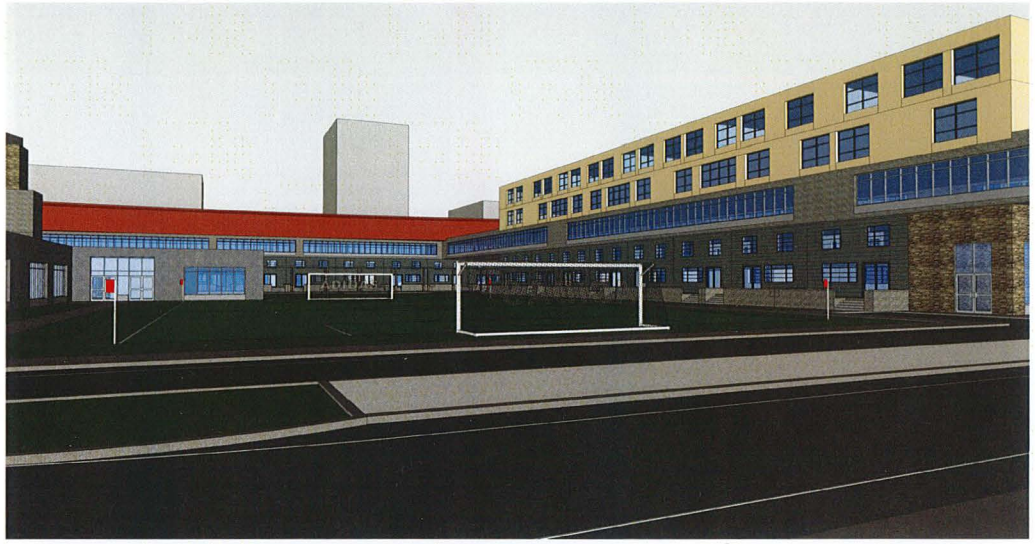


Figure 5.26 Interior view of small Soccer Field looking south.

Figure 5.28 Interior street level view of the Community Center with Hotel access and suites above.

Figure 5.27 Interior view of small soccer field looking north.

Figure 5.29 Interior view of eastern recreational courtyard with basketball court. (Townhouses removed)

Figure 5.30 View of exterior southern facade from street level facing east.

Figure 5.31 View of exterior southern facade from street level facing west.

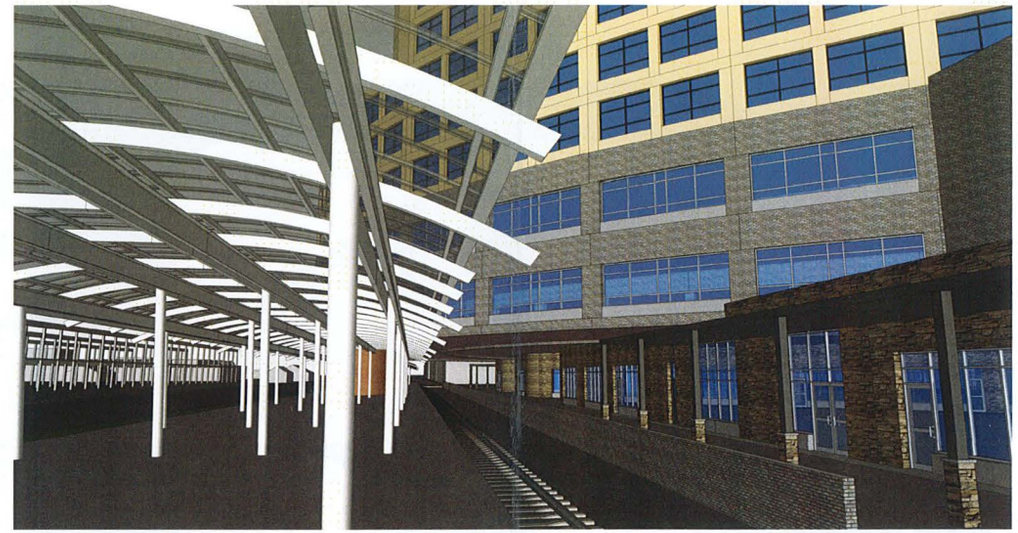


Figure 5.32 View from LRT platform facing south.

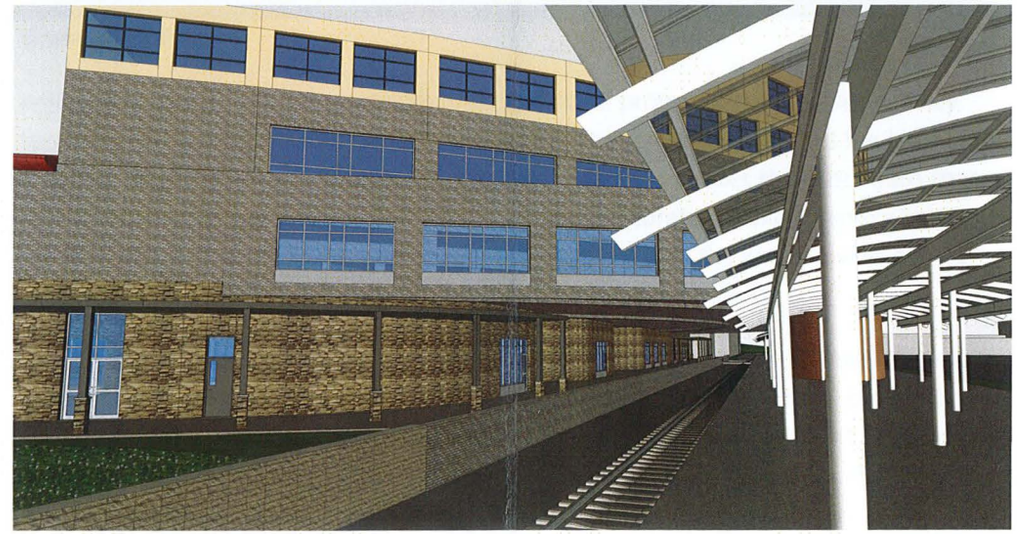
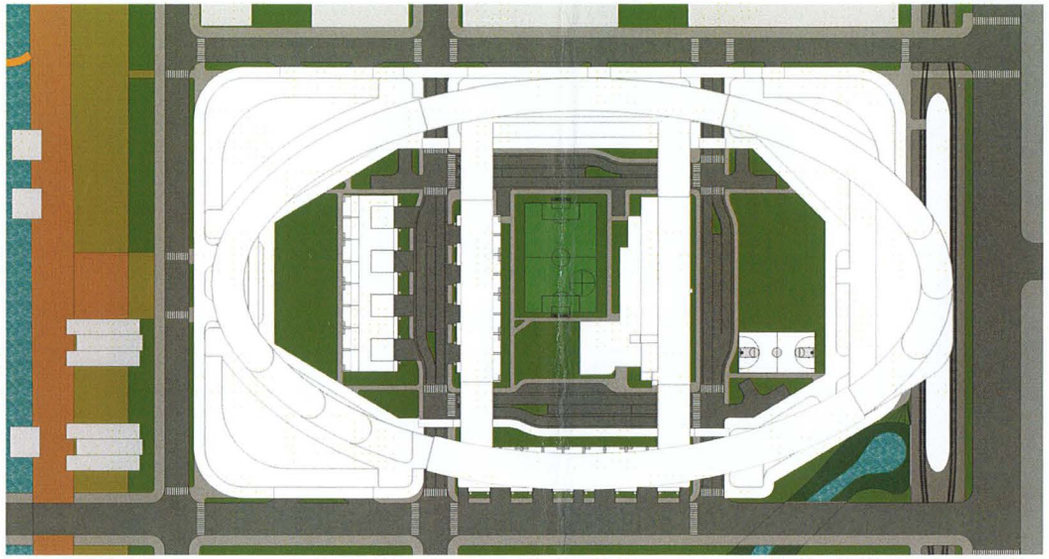


Figure 5.33 View from LRT platform facing north.

Appendix 1 Direct Comparison

Perkins+Will Plan



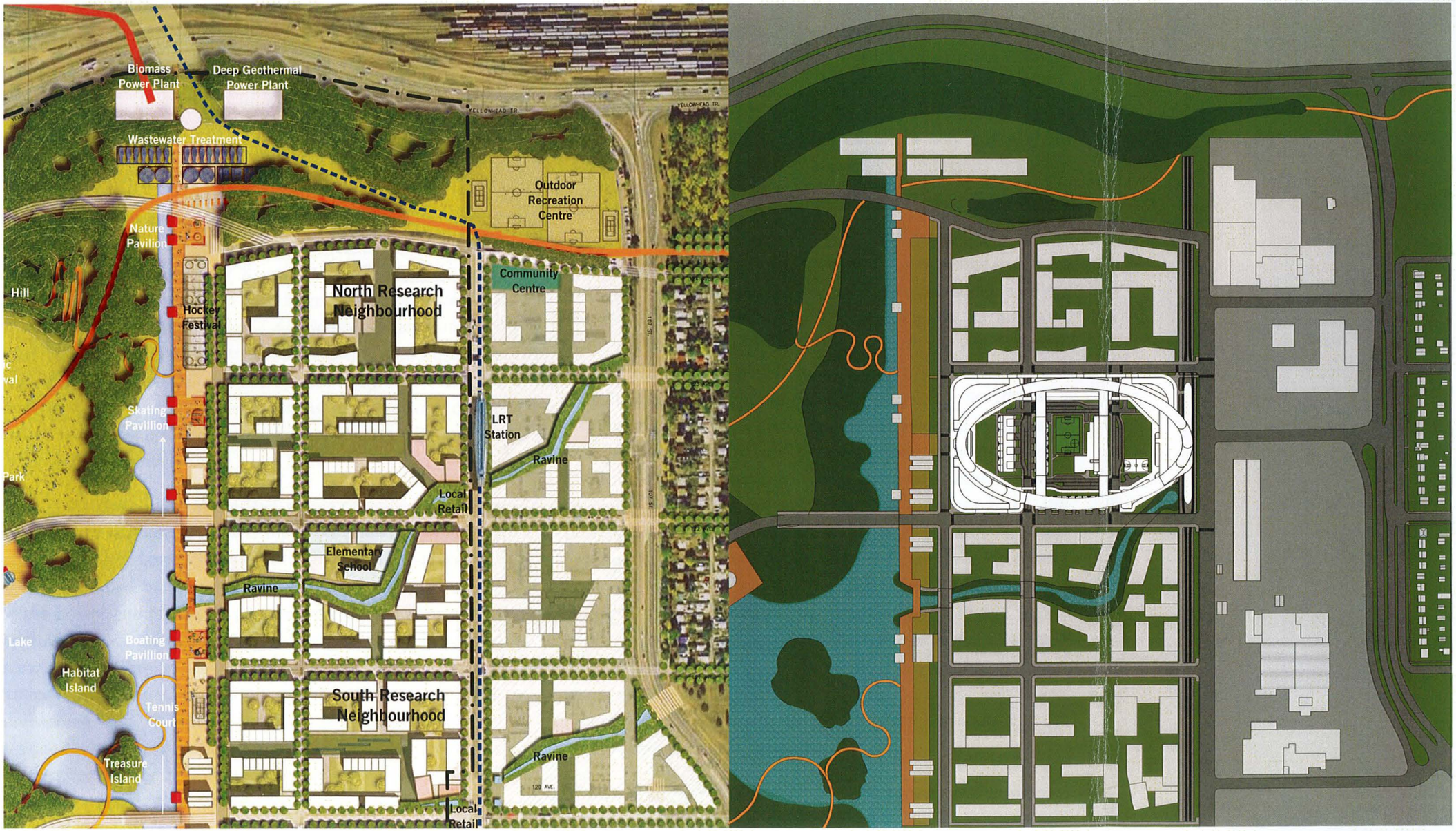
Brauneisen Plan

This appendix provides graphic material for a direct comparison of the Perkins+Will Plan to the one proposed. The first set of images is taken at the block level and the following page shows a larger section of the ECCA plan and context.

The differences in architectural form are obvious but please note the organizational differences this makes at the pedestrian level. Important to note is the changed location of the LRT line to the opposite side of the street. In the Brauneisen Plan the LRT line has been moved to avoid existing buildings and integrates the station directly into the architecture.

Movement through the block is also changed with the addition of a motorized street and pedestrian walkways which are integrated into the building. The courtyard in the Brauneisen Plan is intended to shield the entire block from winds and create an enjoyable public space. The pedestrian has additional protection from arcades in key locations and is exposed to commercial opportunities spread thought out the base of the building. The Perkins+Will plan isolates the local retail and divides their courtyard spaces into small, more private zones. The Brauneisen plan celebrates public assembly because the site bridges the LRT Station and the recreational areas to the west providing direct access to the boardwalk and festival areas.

In the overall site plan the existing buildings are preserved to maintain valuable infrastructure and buildings of historical significance. These structures could continue current use or be re-purposed in the future. This also removes the short term conflicts that would be created by LRT construction and service interruptions of the WestWood Transit Garage, Epcor operations or other CoE maintenance buildings.


Biomass Power Plant
Deep Geothermal Power Plant
Wastewater Treatment
Outdoor Recreation Centre
Nature Pavilion
Hill
Hockey Festival
North Research Neighbourhood
Community Centre
Skating Pavillion
LRT Station
Ravine
Park
Local Retail
Elementary School
Ravine
Lake
Boating Pavillion
Habitat Island
Tennis Court
South Research Neighbourhood
Treasure Island
Ravine
Local Retail

Appendix 2 Global Heating From the Global Perspective: The Theories of Lovelock

Global heating is changing our world. Our planet may be changing faster then we can adapt in regards to climate change.

What is global heating and how will it impact our planet? James Lovelock, an independent climatologist, has been researching this topic for over 30 years. In The Vanishing Face of Gaia, he presents an argument that claims the ultimate effect will be devastating climate change and eventual desertification of much of the planet. He disagrees with scientists who expect the climate to stabilize at 2 degrees warmer than at present. He predicts famine and mass migration as many regions of the globe will become uninhabitable in the not so distant future if we continue our current practices.

Climate models of the 1960's were problematic because they failed to take into account many of the phenomena that are happening today. Lovelock bases his theory on the measurement of heat absorbed by the earth and the tremendous role played by the oceans and forests. As polar ice melts, the oceans absorb heat that would have been reflected off the snow and ice. As the oceans grow warmer, algae growth decreases. This in turn reduces the amount of carbon dioxide removed from the atmosphere and effectively removes a cooling mechanism designed by nature. A similar result occurs when natural forests are removed to modify land use. This is compounded by human activity to produce essentials required to sustain human existence in ever increasing populations. The loss of land-based ecosystems, the desertification of land and ocean surfaces, and the loss of polar ice act together in a snow ball effect likely to commit the Earth to irreversible heating. Lovelock refers to this as a "positive feedback loop". The danger now, is that our activities compounded with those of nature only increase the global warming trend such that any action by humanity would be unable to reduce global heating.

The earth has been through a "hot house" state before. Approximately 56 million years ago an unexplained surge of carbon flooded the atmosphere and set temperatures soaring. The research as presented by Robert Kunzig in an article in National Geographic, points out that the earth was warmer at the time of this sudden geologic release then it is today, but there are still parallels with current circumstances (Kunzig 90-109). As a result of this era, there exists abundant geological evidence of what happens when the atmosphere is saturated with an excess of carbon dioxide. Scientists call it the Paleocene-Eocene Thermal Maximum or PETM. According to Philip Gingerich of the University of Michigan, PETM is the model for today's global heating. "It's the idea of triggering something that runs away from you and takes a hundred thousand years to re-equilibrate." (Kunzig 90-109) In this case the sea level was 220 feet higher than it is today and water during the summer at the north pole reached 23 degrees Celsius. It caused droughts, floods, insect plagues and an acceleration of evolution, as well some extinctions. It took the Earth 150,000 years to re-absorb the excess carbon from the atmosphere.

In addition to warming the atmosphere, carbon dioxide seeped into the oceans and acidified the water. The evidence lays

in core samples showing the disappearance of White Plankton shells from the sea floor. Fossils give us evidence of the abundant insect life with ravenous appetites. Skeletal remains of horses show they adapted by temporarily shrinking to the extent of once having shin bones the size of chicken drumsticks. The similarity exists in the amount of CO2 in the atmosphere at that time and the rate at which we are adding it today. The chain of events, says Yale Geochemist Mark Pagani, "eliminates any doubt that CO2 is driving climate." The prognosis is that if humans burn all their stores of fossil fuels the result will be comparable. This may seem to be in the distant future but as Matt Huber, from Purdue University says, "If we continue down this road, there really is no uncertainty. We're headed for the Eocene. And we know what that's like" (Kunzig 90-109).

Despite the release during the Eocene being natural this should not reassure us because no one knows its origin. Of concern is the fact that the carbon release from industrial processes is faster than the release engendered by any geological event. This is Lovelock's warning. He is suggesting we have initiated the positive feedback loop which will add carbon to the atmosphere beyond our own emissions. It's similar to an avalanche, where conditions build towards the event, even as the snow seems stable and peaceful until the right trigger, then chaos, where nothing can stop it.

Despite previous climate states being "natural", the earth has never before supported seven billion people. Even to lower our carbon emissions [industrial pollution] by 60% would not be enough. Exhalations by humans, their pets and livestock are responsible for roughly 23% of all carbon emissions. Add the fossil fuel burnt in the total activity of growing, gathering, selling and serving food and you account for half of humanity's total carbon emissions (Lovelock 47).

This represents only a direct part of humanity's contribution to the earth's positive feedback loop. "It is not the carbon footprint alone that harms the Earth; the people's footprint is larger and more deadly" (Lovelock 48). We increase the feedback loop with every new forest cut, even if that land is to be repurposed for agriculture. It does not serve its purpose for atmospheric regulation as it once did. This also doesn't address habitats (forests) and ecosystems (coral reefs) which appear intact but are actually damaged by pollution and over harvesting of economic species, overfishing being a prime example.

"*It is wrong to think that nothing can happen rapidly in climate change. Aerosols in the atmosphere, snow and ice albedo, ecosystem response and human response can all cause perceptible climate change within months*" (Lovelock 40).

"*Harm comes from prolonged and unremitting drought. According to the forecasts from the reports of the IPCC* (U.N. Intergovernmental Panel on Climate Change) *Working Group II 2007, many parts of the world will experience such a lack of water by 2030. Saharan conditions will extend into southern Europe, as they are experienced in Australia and Africa. Heavy rain will fall but when it is hotter than the mid 20's Celsius it does little good. Increasing heat and forest ecosystem destruction to provide farmland will continue and hasten the conversion of rainforest to scrub and desert*" (Lovelock 54).

"Of course we should do our best to cut back on damaging land use such as forest clearance anywhere and the farming of bio-fuels and cautiously prepare to reduce emissions. Until we know for certain how to cure global heating, our greatest efforts should go into adaptation, to preparing those parts of the Earth least likely to be affected by adverse climate change as the safe havens for a civilized humanity" (Lovelock 44).

It is impossible to predict precisely what devastating change will happen. This is a condensed summary of the global heating argument as seen by James Lovelock but he is not alone in his thinking. James Hansen, a scientist with NASA, has also voiced concern, specifically with our CO2 emissions and their consequences (Lovelock 32). There are other more moderate voices such as Peter Cox of the University of Exeter, UK but he still states "we must accept that changes are inevitable and start to adapt now" (Vince 28-33)

The areas expected to maintain a habitable climate are arctic and the north and south temperate regions. Canada is among these land masses, while some of the regions projected to be the hardest hit from drought are already overcrowded nations like China, India and parts of Africa. Canada will become part of a "lifeboat world" that will continue to sustain agriculture and human habitation.

"We cannot separate ourselves from our environment. When considering food and energy supplies we have to keep in mind that the immediate needs of human consumers is only part of the problem. We need to sustain the infrastructure of cities, the housing, health and other services, including schools, waste disposal and transport. At the same time we must leave enough natural ecosystems on land and in the oceans for planetary self-regulation" (Lovelock 50).

Sustainability and the Urban Region

In light of this argument by Lovelock, land management is a key issue. Such management is also key to the same issues that have captured the public's attention regarding urban sprawl. Around Edmonton, as in many cities across Canada, the city suburbs are expanding into prime agricultural land. This is an obvious example of poor land management, demonstrating where the architectural and planning community has to take a more progressive role in offering alternatives. As a Nation, a method must be found to balance land use for human needs and that of the planet while at the same time anticipating a population explosion from climate refugees fleeing drought in their own countries.

Sustainability really means sustaining human life, not an abstract notion of environmental stewardship. From the global perspective the Edmonton City Center Airport re-development should mean much more than a political consideration of city image or increased tax revenues. Edmonton is not a densely built city and as such the ECCA re-development should be considered in light of the larger picture. This is the opportunity the re-development project offers.

Urban Containment Boundaries

We have learned that through our collective actions in cities, we have the inherent capacity to rest more lightly on the planet. Sustainability is not about one or two new activities and new a fuel source. It's about the way that all these elements fuse; how the benefits of each build on the others (Greenberg 73).

"The best way to combat the degradation of other, irreplaceable environments that are suffering from the encroachment of human settlement is to increase the density of urban populations" (Greenberg 73).

The shift to return to the city core has been so dramatic it is showing up in census reports and noted by demographers. A report written in the U.S. named "Rise of Downtown Living" by Brookings Institution and the Fannie Mae Foundation (1998) highlights this trend. It also notes a decline in single family homes and shows people factor costs of transportation into their housing choices (Greenberg 72). It is both financial and environmental sustainability that is pushing the pro city offensive to its tipping point (Greenberg 73).

Robert Fishman in his article "The Fifth Migration" stated a balance is required between the city core and the fringe. Suburban construction and dwelling are not going to evaporate over night despite showing signs of decline. In Edmonton this is especially true, where there still seems to exist a frontier spirit to stake out one's own territory. It assumes the traditional prairie notion that open land is endless (Rochon 44-46). This is a fallacy in the context of global climate change argued by Lovelock. For those self interested parties who continue to view land as inexhaustible, limits must be set.

The tool for this would be the implementation of Urban Containment Boundaries. This would represent a new strategy for growth in Edmonton on based finite horizontal limits, which would bind both the City and surrounding municipalities. The Greater Vancouver Region is taking this approach to protect its agricultural, recreational and ecological lands ("Metro Vancouver"). Their geographical location trapped between mountains and ocean makes this approach seem obvious. In a global perspective the containment of Edmonton is just as important.

In the immediate future, to stop Edmonton's horizontal growth at the current city limits shouldn't be a challenge. These borders were established when the City of Edmonton last annexed additional land on January 1, 1982. To further annex land requires permission of the Provincial Government and consent by the smaller municipalities. Such a process historically has absorbed smaller municipalities and as a result the current municipal neighbours tend to feel bullied by the City of Edmonton ("Annexations of Edmonton") Even within the current boundaries suburban growth is still expanding. Instead of annexing additional land and potentially causing political turmoil for all involved, the different municipalities should adopt a co-operative urban containment strategy.

Without urban containment boundaries, the ECCA re-development could still be successful if judged on its own terms. For the city to become a truly sustainable place of dwelling, it

must do so in a city wide framework. How can the city densify as a whole if sprawl continues around the edges? Limiting horizontal growth may even generate a crisis situation in some opinions, but out of crisis, innovation is born.

"*Crisis or sense of urgency can be the crucible that enables change that would otherwise be impossible*" (Greenberg 213).

"*In many cases cities have put people in harm's way by ignoring the imperatives of nature, and the dilemma this creates is most clearly revealed in crisis*" (Greenberg 213).

The original reason for mass settlement in the Edmonton region was agriculture, and these areas should be protected as Vancouver is doing. The province of British Columbia also has the Agricultural Land Reserve protecting soils from development (Agricultural Land Commission Act). The soils surrounding Edmonton are defined as class 1 and 2 soils, the best grade in Canada ("Soil Survey Edmonton Sheet 83-H"). With the move to re-urbanize also comes an interest in local food. Presumably this will interest people in protecting their agricultural lands from unabated sprawl (Greenberg 247). The change we are witnessing is the growing capacity for dense cities and their hinterlands to become partial sources of their own food, partly a result of transportation costs becoming too high (Greenberg 189). In Edmonton local examples already exist, such as the Slow Food Movement and Operation Fruit Rescue Edmonton, an organization of volunteers that locate and harvest urban fruit trees and collectively pool the fruit ("About Us").

Edmonton is also in a unique situation where the Capital Region Board ("Land Use Mandate") has dictated, that all neighbourhoods must have a minimum level of density. The problem originated during the last boom of 2006, when multi-family housing was becoming popular mainly due to housing costs of individual homes. To compensate the markets planned various multi-family housing developments for the suburbs. Since the market declined and interest rates remain low it is now impossible for those same development companies to build and sell any multi-family housing (Lundsdun). Areas zoned for multi-family are vacant and now proposals are being presented to the city asking for re-zoning applications to return the same land to single family detached housing. Edmonton has 23 existing suburbs that are under developed and remain so because of market forces. Multi-family housing does not become viable until the price of a single detached home is equal to or greater than $400,000 Canadian (Ried).

Urban containment boundaries may limit future land acquisition by the City and subsequently raise land and housing prices, but if this spurs the development of multifamily housing the city will benefit. Demand will almost certainly rise in the wake of climate refugees and limited expansion. This is a win win situation for the City, home owners and developers. As long as the City and Federal Government have a public housing policy, they can theoretically house the majority of citizens. The CoE also has a unique opportunity with the ECCA because land costs are not a factor. This makes affordable housing projects much more feasible. This was one of the goals of the False Creek Development in Vancouver but it proved to have the opposite effect (Walks, Alan and Marranen). Suburbs have served certain demographics and lifestyles well, and for the immediate future are not obsolete, but are also not a holistic solution. The ECCA

development with denser housing for various demographics can begin to fill the void. A policy of Urban Containment boundaries would provide a powerful tool and stimulus for positive urban development and change, where Edmonton could ultimately move toward a point where the entire city could be considered sustainable, not simply from an ecological standpoint but also a social and economic one, maintaining human life.

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