Greening the City: Ecologically–Based Design Within an Urban Context

By

David Rodger Harrison

A Practicum

Submitted to the Faculty of Graduate Studies

in Partial Fulfillment of the Requirements

for the Degree of

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Department of Landscape Architecture

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ABSTRACT

This practicum provides an examination and practical application of the principles of ecology as they relate to the designed urban environment. Emphasis will be placed on ecologically-based designs which stress the use of a variety of indigenous plant species, ecosystem modelling, and environmentally responsive design. The resulting designs are inherently representive of the native landscape, show greater visual and species diversity, and can be essentially self-maintaining through natural processes and community evolution.

The first part of the study is a critical evaluation of national and international examples of ecologically-based landscape design. These include: housing projects, urban nature parks, infill planting, and corporate and residential landscaping.

The second section identifies some basic principles of ecology and examines how these are influenced by the built environment. Ecologically-based design strategies are explored which can provide a means for reconciling these urban and natural processes.

In the third part these strategies contribute to the redesign of the Bishop Grandin roadway extension between Pembina Highway and Waverley Street, providing a local demonstration of ecologically-based design principles as they could apply to a typical and representative Winnipeg site.

ACKNOWLEDGEMENTS

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INTRODUCTION

One of the fundamental ecological principles is ecological succession, the essence of which is described by Eugene P. Odum as follows:

> In a word, the "strategy" of succession as a short-term process is basically the same as the "strategy" of long-term evolutionary development of the biosphere- namely, increased control of, or homeostasis with, the physical environment in the sense of achieving maximum protection from its perturbations.[1]

Unfortunately, just as ecosystems gravitate towards control of their physical environment, so too does humanity gravitate towards controlling the same physical environment. Ian McHarg traces this tendency towards dominance of the natural world back to an Old Testament world view in which man is God's steward on Earth, and thus has responsibility for the management of all creation.[2] David Nicholson-Lord, in The Greening of the Cities, writes of this relationship:

> The major tradition of Christianity took its cue from God's instructions to man in the first book of Genesis, reaffirmed later in the eighth Psalm, to subdue the earth and assume 'dominion ... over every living thing'.[3]

However, this desire to master the natural world is likely not just an ideological matter, but is ultimately based on a fundamentally practical instinct for survival. Cordula Loidl-Reisch, in an article entitled "Growing

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1 Eugene P. Odum, "The Strategy of Ecosystem Development", Science, Vol. 164, No. 3877, (April 18, 1969), p. 164.
2 Ian L. McHarg, Design With Nature (Garden City: Doubleday & Company, 1971), pp. 68-74.
3 David Nicholson-Lord, The Greening of the Cities (London: Routledge and Kegan Paul, 1987), p. 43.

Wild- A Sign of Hope" describes man's insistence on controlling nature as simply an age-old reaction against 'wasting' a potential resource:

> ...an uncultivated piece of land initially probably gave most people cause for considerable criticism. An uncultivated state was not regarded benevolently by any means, because it meant the loss of a valuable piece of land which had been laboriously wrung from the wilderness: it was thus clear proof of human inability.[4]

Unfortunately, our gains are most often at the natural world's expense and nowhere is this more apparent than in the built, designed environment. In most urban settings, ecological processes are not taken into account during the planning process, except as factors to be to be suppressed and overcome. In simplest terms, ecological processes have been seen as hindrances to development and not potential opportunities. However, in the 1960's this began to change with the emergence of the movement known as ecologically-based landscape design. Throughout Europe, in particular Holland and Great Britain, this has become a well-established and influential approach, to the degree that it is regarded as a significant design movement, complete with detractors and admirers. In North America, on the other hand, it is regarded almost as a fringe movement, populated by an assortment of birdwatchers and back-to-the-earth types. However with the tremendous increase in public awareness and concern over the health of the natural environment it would appear that North Americans may be placing a higher value on urban natural systems.

In Winnipeg, natural landscapes are represented, on the one hand, by natural preserves such as Living Prairie Museum or Assiniboine Forest.

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4 Cordula Loidl-Reisch, "Growing Wild- A Sign of Hope", Anthos 3, 89.

The citizens of Winnipeg are fortunate to have these parks which have resulted from a determined effort to preserve the few surviving remnants of the native Aspen parkland ecosystem. As well, Winnipeg's two rivers and numerous creeks still support varying amounts of river bottom forest, a resource which until very recently has been virtually ignored. Another overlooked resource is the remnant patches of native landscape which persevere on scattered pieces of undeveloped vacant land, which Michael Hough refers to as "the unofficial landscape" of a city. More recently, there have been some efforts at reintroducing indigenous plants to the city through projects such as Big Bluestem Nature Park, a designed naturalized environment using plants from the tall grass prairie.

In sharp contrast however, the majority of Winnipeg's planned open space is essentially identical in content and appearance to open spaces throughout North America. The late Robert Dorney, a pioneer in ecosystem redevelopment in Canada, once referred to these landscapes as"'genetic junkyard[s]' of living elements bearing little geographic and no ecological relationship to one another."[5] This is far removed from the scene which greeted early European visitors to the area. William Francis Butler, in The Great Lone Land: A Tale of Travel and Adventure in the Northwest of America, paints a reverent picture of the prairie landscape just outside of Winnipeg:

> Some French writer, speaking of these prairies, has said that the sense of this utter negation of life, this complete absence of history, has struck him with a loneliness oppresive and sometimes terrible in its intensity. Perhaps so; but ,for my part, the prairies had nothing

5 Robert S. Dorney, "The Mini-Ecosystem: A Natural Alternative to Urban Landscaping", Landscape Architecture Canada, Vol. 3, No. 4, (December 1977), p. 56.

terrible in their aspect, nothing oppressive in their loneliness. One saw here the world as it had taken shape and form from the hands of he Creator. Nor did the scene look less beautiful because nature alone tilled the earth, and the unaided sun brought forth the flowers.[6]

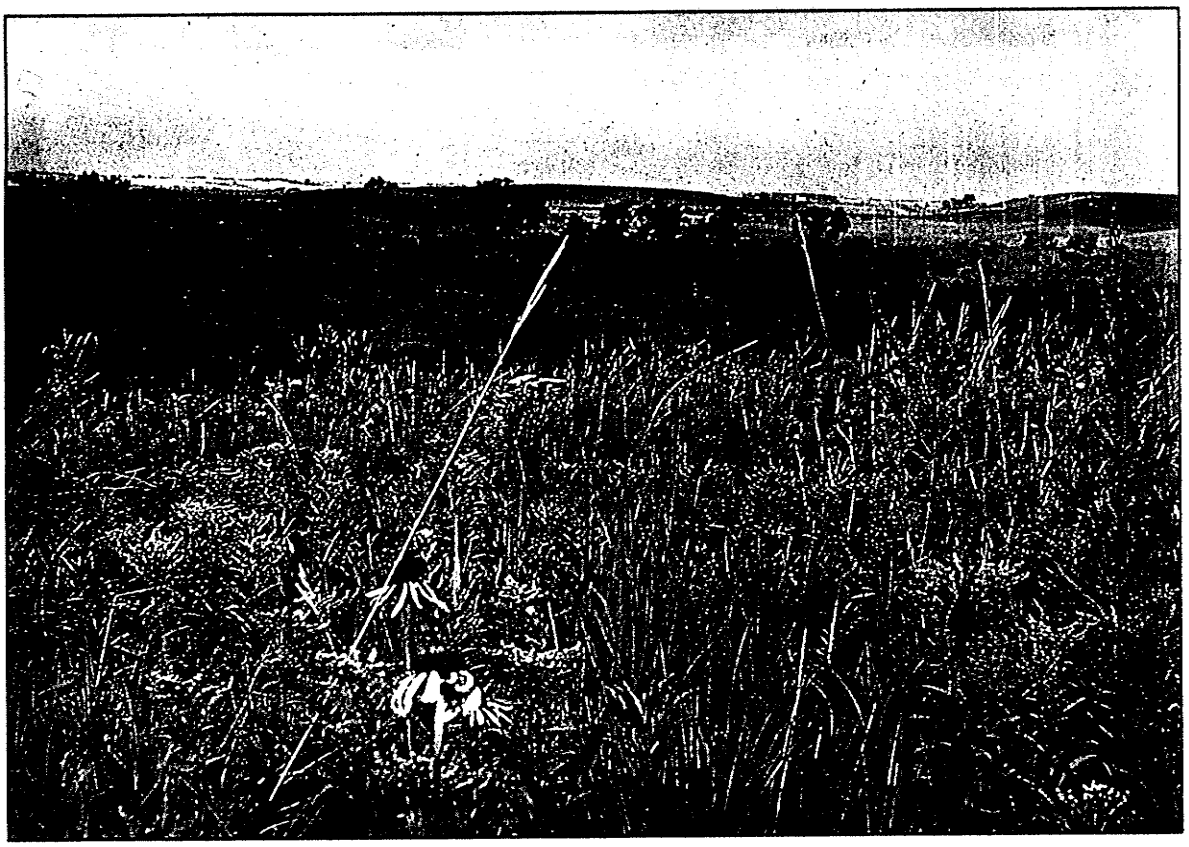

FIGURE 1: AN EXAMPLE OF TALL GRASS PRAIRIE.[7]

Although only a fraction of its original size and extent, the native prairie landscape still exists in small pockets and strips. Originally, in the vicinity of present-day Winnipeg three categories of vegetation types would

6 William Francis Butler, The Great Lone Land: A Tale of Travel and Adventure in the Northwest of America (London: Burns and Oates, 1915), p.200.
7 - from Prairie Grasslands Guidebook: A Management Manual (Winnipeg: Manitoba Natural Resources,1990), p. 3.

largely be predominant. These are Grasslands, Aspen parkland, and River bottom forest.

The grassland is represented by the Tallgrass prairie of the American midwest which reaches its northern limit in the Red River lowlands [8] (Figure 1). The existence of this northern area of Tallgrass prairie can be attributed largely due to the heavy clay soils and poor drainage of the Lake Agassiz basin. This increase in the supply of available moisture is sufficient to allow for the growth of such dominant tall grasses as Big Bluestem (*Andropogon gerardi*) and Little Bluestem (*A. scoparius)*, the two species which comprise 75% of the vegetative cover of the tallgrass prairie.[9] Some characteristic features of the tallgrass prairie species that make them particularly well-adapted include: tall, hollow, flexible stems (up to 2.5 metres tall in the case of *A.scoparius*), a few long, narrow leaves, and a deep and fibrous root system that often reaches 3 metres in depth (Figure 2). This interwoven root system knits soil and vegetation together to form what Braithwaite refers to as "a sheet anchor"[10], protecting the ground layer from erosion and moisture loss. As well, the impenetrability of this prairie sod, together with the dense vegetative cover, is very effective in discouraging invading species.The growth of most prairie plants tends to be most rapid in the early season when water is easily available. During the dry hot prairie summer the plants tend to be almost dormant. Most of the species are long lived perennials which reproduce vegetatively from

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8 -unless otherwise cited, most of the subsequent information on tallgrass prairie comes from Shay, C.T., "The History of Manitoba's Vegetation" in Natural Heritage of Manitoba: Legacy of the Ice Age, James T. Teller, ed.(Winnipeg: Manitoba Museum of Man and Nature,1984). pp. 93-125. ....

9 Max Brathwaite, The Western Plains (Toronto: Natural History of Canada Ltd., 1970), p.23.

10 Ibid., p.70.

underground rhizomes. This provides a distinct advantage for regeneration in the aftermath of the commonplace prairie fires and the trampling by Buffalo.

FIGURE 2: CROSS-SECTION SHOWING ROOT SYSTEMS OF SOME TYPICAL TALL GRASS PRAIRIE PLANTS.[11]

11 -from David R. Krapp, "The Prairie Annual", Landscape Architecture, (October 1975), pp. 414-5.

In addition to the Tallgrasses, other grasses which may be present in this association include Canada Wild Rye (*Elymus canadensis*), Northern Wheat Grass (*Agropyron dasystachyum*), June Grass (*Koeleria cristata)* and Needle Grass (*Stipa spartea*). Forbs which may occur include Willow Aster (*Aster praealtus)*, Canada Anemone (*Anemone canadensis*), Prairie-lily (*Lilium philadelphicum* var. *andium)*, and Canada Goldenrod (*Solidago canadensis*).Within the geographic area occupied by the Tallgrass Prairie other grassland communities may occur according to the amount of moisture present. Wet sites support a sloughgrass community dominated by Prairie Cord Grass (*Spartina pectinate*), with smaller numbers of Switchgrass (*Panicum virgatum*), Canada Wild Rye (*Elymus canadensis*), Alkali Cord Grass (*Spartina gracilis*) and Northern Reed Grass (*Calamagrostis inexpansa* var. *brevior*). Typical forbs include Canada Goldenrod and Baltic Rush (*Juncus balticus* var. *littoralis)*. Dry sites support upland communities of Porcupine-grass (*Stipa spartea)*, Western Wheat Grass (*Agropyron smithii*), Side-oats Grama (*Boutelous curtipendula)* and June Grass. Forbs include Leadplant (*Amorpha canescens*), Prairie Lily, Silverleaf Psoralea (*Psoralea argophylla)* and Missouri Goldenrod (*Solidago missouriensis*).

The floodplain or river-bottom forests were areas to which both the native peoples and the early European settlers were first attracted(Figure 3). The thick stands of deciduous trees provided much needed protection from the elements as well as a ready supply of fuel and building materials. These forests are composed of broad-leaved species such as American Elm (*Ulmus americana*), Manitoba Maple (*Acer negundo)*, Cottonwood (*Populus deltoides*), Basswood (*Tilia americana*) and Green Ash (*Fraxinus pennsylvanica)*. Shrub and herb layers are sparse in the river-bottom forest

owing largely to the high water levels and ice scouring associated with the spring thaw. However there may be present Ostrich Fern (*Pteretis pensylvanica)*, Virginia Creeper (*Parthenocissus* sp.), Wood Nettle (*Laportea canadensis*), Red Osier Dogwood (*Cornus stolonifera*) and, in low areas, dense thickets of Sandbar Willow (*Salix interior*).

FIGURE 3: TYPICAL RIVER BOTTOM FOREST COMMUNITY.[12]

12 -from Shay, p. 123.

Surrounding the area occupied in Manitoba by Tall Grass Prairie is the belt of vegetation known as the Aspen Parkland (Figure 4). This is an area of transition between the southern grasslands and the northern boreal forest. As such it is not a continuous forested landscape but consists instead of treed bluffs of varying sizes set within grassland. These bluffs would generally occur in localized areas of higher levels of soil moisture. Typically this includes such conditions as northeast exposures of ravines and valleys, sandy soils, areas of snow buildup and prairie depressions that collect runoff. The edge between the forest and the grassland is constantly in flux, with the forest often advancing upon the grassland by means of suckering shoots. As might be expected, the dominant tree is the Trembling Aspen (*Populus tremuloides*), sometimes occurring in nearly pure stands. Other trees which may also be present include Paper Birch (*Betula papyrifera*) and Balsam Poplar (*Populus balsamifera).* In drier locations the Bur Oak (*Quercus macrocarpa*) may be found and, in areas of high ground it may even be dominant. The shrub and herb layers in the Aspen parkland are thick and well-defined. The dominant shrub is Hazelnut (*Cornus americana),* also found are Red Osier Dogwood and Highbush Cranberry (*Viburnum opulus*). Towards the forest edge Rose (*Rosa* sp.), Choke Cherry (*Prunus virginiana*), Pin Cherry (*Prunus pensylvanica)* and Saskatoon (*Amelanchier alnifolia*) are found in dense stands. The herb stratum consists of upper and lower strata. The upper stratum would contain, among others, Wild Sarsparilla (*Aralia nudicaulis*), Red Baneberry (*Actaea rubra),* Lindley's Aster (*Aster ciliolatus*) and Sweet-scented Bedstraw (*Galium triflorum*), while the lower stratum would be composed of Bunchberry (*Cornus canadensis*), Woodland Strawberry (*Fragaria vesca* var. *americana),* False Lily-of-the-valley (*Maianthemum canadense* var.

interius), Pink Wintergreen (*Pyrola asarifolia)*, Dewberry (*Rubus pubescens)* and Star-flowered Solomon's Seal (*Smilacina stellata).*

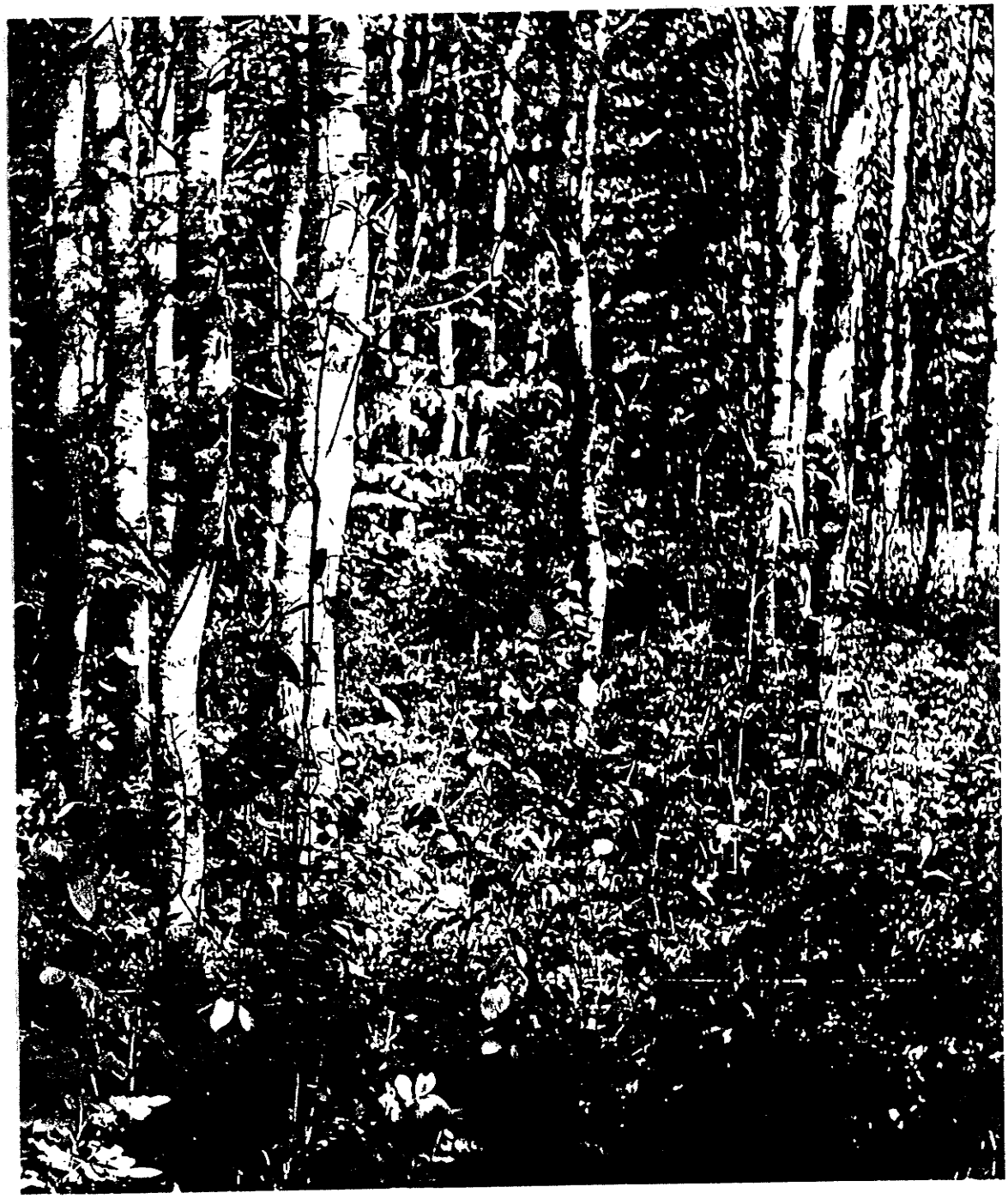

FIGURE 4: TYPICAL ASPEN PARKLAND COMMUNITY[13]

13 Ibid., p. 111.

In addition to these three terrestrial communities, the many depressions and potholes throughout the prairie support aquatic communities. These bodies of water, commonly known as sloughs, may persist throughout the year or may dry up rather quickly.The characteristic vegetation includes an edge community of Trembling Aspen giving way to a dense outer ring of Willows (*Salix* sp.) extending inwards beyond the high water mark. Further in would be Cattail (*Typha latifolia*), Bullrushes (*Scirpus* sp.), and Reed Grass (*Phragmites communis).* In the areas of open water, Pondweed (*Potamogeton pectinatus*), White Water Crowfoot (*Ranunculus subrigidus*) and Bladderwort (*Utricularia macrorhiza*), would be found. Seasonal sloughs which are dry before summer's end would be occupied by Sedges (*Carex* sp.) and Whitetop (*Scholochloa festucacea*).

The settlers who arrived on the prairies were confronted by the conspicuous absence of the large expanses of natural forests that they would be accustomed to seeing in their homelands, whether that be Europe or Eastern Canada. In "The Ideal and the Real: The Image of the Canadian West in the Settlement Period", R.D. Francis writes:

> Whether from Britain or France, they came from heavily forested areas of the world where successful agiculture was associated with abundant vegetation, trees and a moist climate. They came upon the grasslands, devoid of trees and lush vegetation, and could only conclude, based on their own experience, that the land was ill-suited for development.[14]

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14 R. Douglas Francis, "The Ideal and the Real: The Image of the Canadian West in the Settlement Period" in Rupert's Land: A Cultural Tapestry, Richard C. Davis, ed. (Waterloo: Wilfred Laurier University Press, 1988), p.255.

Often, the complex prairie ecosystem was mistakenly perceived by most of the new arrivals to be a barren desert.(Figure 5).

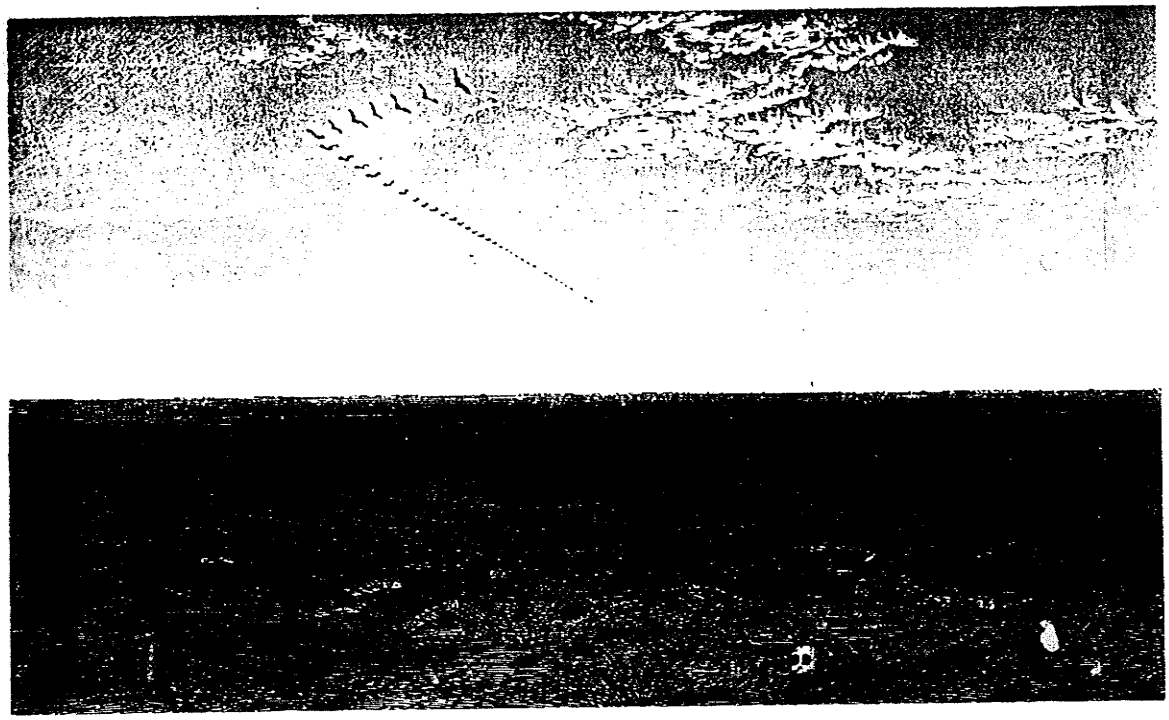

FIGURE 5: "THE PRAIRIES LOOKING WEST NEAR RED RIVER SETTLEMENT, SEPTEMBER-OCTOBER 1858." [15]

For many new arrivals, the addition of trees and planting to the landscape of their adopted home was one of the first things to be done. W.H. Alderman, in his book Development of Horticulture on the Northern Great Plains, writes of this desire:

> Above all, perhaps, was the need of trees to make the new homes more attractive and livable. There was need of trees to break the

15 -from Henry Youle Hind, Narrative of the Canadian Red River Exploring Expedition of 1857 (Edmonton: M.G. Hurtig Ltd., 1972), p. 136.

appalling monotony of the seemingly endless expanse of open and often bleak prairie.[16]

In cities such as Winnipeg, this impetus for beautification through planting soon became institutionalized by municipal governments. The major growth period of Winnipeg, occurring around the turn of the twentieth century, coincided with the rise of the City Beautiful movement. According to Alan Artibise, the founders of the city felt that it was burdened by "...a great handicap, namely that 'except for the two rivers running through the city there were few natural advantages wherewith to court the visitor's eye.'"[17] The establishment of the Winnipeg Parks Board in 1893 was an attempt to counter these arguments through the establishment of "small urban parks, ornamental squares, or small 'breathing spaces' throughout the city".[18] The Parks Board's success was such that by 1910 the city had developed 500 acres (202 hectares) of suburban parks (Assiniboine and Kildonan Parks) and twenty-six smaller parks and squares.[19] A program of boulevard planting was initiated by the city in 1896, and by 1908 the city could boast of 138 kilometres of boulevard, lined by 20,000 trees[20] (Figure 6). Through these efforts Winnipeg soon became known as "the city of

16 W.H. Alderman, Development of Horticulture on the Northern Great Plains (St. Paul, Minnesota: The Great Plains Region American Society for Horticultural Science, 1962), p.135.
17 Alan Artibise, Winnipeg: A Social History of Urban Growth, 1874-1914 (Montreal: McGill-Queens University Press, 1975), p. 268.
18 Edwinna Von Baeyer, Rhetoric and Roses: A History of Canadian Gardening, 1900-1930 (Markham: Fitzhenry and Whiteside, 1984), p. 86.
19 Margaret A. Meek, History of the City Beautiful Movement in Canada, 1890-1930 (Unpublished M.A. Thesis, University of British Columbia, 1979), p. 143.
20 Von Baeyer, p. 74.

trees"[21] and, according to Artibise, "comments congratulating the Parks Board for making 'a garden out of a desert' were frequently heard".[22]

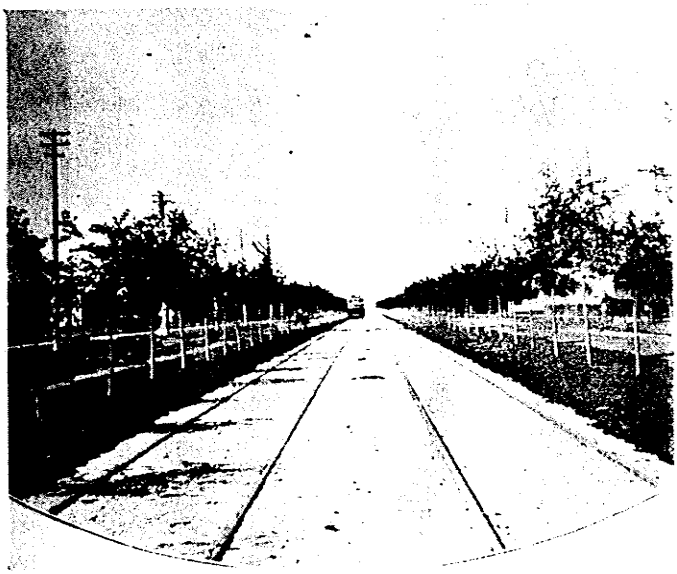

FIGURE 6: "BROADWAY, LOOKING WEST FROM MAIN, 1923."[23]

The initial burst of civic pride and enthusiasm which accompanied the City Beautiful movement died out in the 1920's. However the movement did leave behind the ideals of tree-lined streets and manicured parks which every citizen today holds sacred. Over the years Winnipeg's parks and boulevards have retained their appeal, perhaps to the extent that we have become blind to the qualities which the native landscape has to

21 Artibise, p.268.
22 Ibid., pp. 268-9.
23 -from Winnipeg One Hundred: Winnipeg Free Press One Hundred Year History of Winnipeg (Winnipeg: Winnipeg Free Press, 1973), p. 40.

destroyed. In 1918,Winnipeg's Superintendent of Parks, George Champion, made remarks to this effect in an article:

> For example, in 1918 there were 5800 acres [2346 hectares] of native vegetation on vacant lots in Winnipeg, but even then it was being cleared at a rapid rate.[24]

This systematic neglect of the indigenous flora disturbed Champion, who expressed concern at the waste of this resource:

> I am becoming more and more concerned with every added years experience in Manitoba that we have neglected to use our native shrubs and, worse than that, have in many cases willfully destroyed them.[25]

It is interesting to see Champion expressing this progressive insight over 70 years ago but, unfortunately, little attention seems to have been paid.

Winnipeg's subsequent parks development to the present day has followed a hierarchical model of Neighbourhood parks, Community Parks and Regional Parks. At the local level, the neighbourhood park is intended to be a flexible space that will meet the recreational needs of the immediate area. The community park provides more specific recreational and social services to a larger area, while the regional park is a multiple-use amenity designed to be available to the entire city. That the majority of these spaces are designed exclusively for recreational uses is typical of most mid-sized North American cities of this era. Since the turn of the century the movement of people from rural to urban settings has facilitated the belief that nature is something existing beyond the city. The private automobile

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24 George Champion, "Winnipeg's Interest in Vacant Lot and Backyard Gardening", The Manitoba Horticulturalist, Vol. 5, No. 5, (May 1918), p. 37.
25 George Champion, "The City Beautiful", The Manitoba Horticulturalist, Vol. 5, Nos. 9-10 (Sept., Oct., 1917), p. 78.

has ensured most citizens have relatively easy access to this resource, with the result that very little thought has been given to natural resources which may happen to have survived within cities. Public open spaces have traditionally been grassed fields which are the domain of recreational sporting events, with edges decorated in a hybrid conglomeration of the English Romantic and French Baroque landscape styles. Today, however, we cannot solely rely on these outdated models for our urban open space development. In the words of Anne Whiston Spirn:

> Today the unyielding axes of Versailles and the smug arcadia of Stowe and Stourhead embody an assurance that seems foreign. They stand for views of the world held by seventeenth-century Frenchmen and eighteenth-century Englishmen, but they cannot be normative for current design.[26]

The perpetuation of this anachronism is neither environmentally, nor, in the face of rising maintenance costs, economically sound. A more complete approach involving design based on ecological principles has the potential to deal with these issues in a manner that is environmentally, aesthetically, and economically more successful.

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26 Anne Whiston Spirn, "The Poetics of City and Nature: Towards a New Aesthetic for Urban Design", Landscape Journal, Vol. 7, No. 2 (Fall 1988), p.124.

PART ONE:

EXAMPLES OF ECOLOGICALLY-BASED DESIGN

1.1 EUROPE

1.1.1 Holland

Any examination of ecologically-based design should begin with Holland, as this was the first country in which ecologically-based design was practiced on a large scale. In the years following World War Two, Holland experienced tremendous population growth and a subsequent migration from the countryside to the cities, with the result that Holland today is one of the most densely populated countries in the world. Neither this population shift nor the extensive suburban development it necessitated was an especially unusual postwar scenario among Western nations. What was unusual, however, was the unique physical history of Holland, in which vast areas of the country have been reclaimed, both from the sea and the adjacent tidal flats. This is particularly true of the heavily populated western urban section of Holland, where 2/3 of the country's population of 14 million lives on land that lies below sea level.[27] The resulting polder landscape is something new, a terrestrial environment that was aquatic, a natural environment without a vernacular. Tjeerd Deelstra, in "The Productive City: Urban Forestry in the Netherlands", describes Holland as a country in search of its own indigenous natural landscape:

> We cannot learn from tradition, because the tidal landscape is no longer present, so we have to think of how to make a new landscape. That is the continuous debate: What is nature in our country? What is artificial? Can we imitate things? Can we make little Switzerland? Can we make it all Dutch when we do not know what that is?[28]

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27 Tjeerd Deelstra, "The Productive City: Urban Forestry in the Netherlands" in Green Cities: Ecologically Sound Approaches to Urban Space, David Gordon, ed. (Montreal: Black Rose Press, 1990), p. 88.
28 Ibid..

The combination of a high population density and a highly formalized man-made landscape oriented almost entirely towards agricultural productivity has given added impetus to the desire to reinstate nature and natural areas in Holland. As a result, there has been a trend towards reestablishing nature and natural areas in what is the only nonproductive open space remaining - the Dutch cities. One aspect of this concern has been the establishment of 'heme parks' (home parks) in Dutch cities. These are exact recreations of the ecosystems of Holland including sand dunes, heath bogs and deciduous woodlands. These are staffed by trained ecologists and are intended as educational resources which every schoolchild visits yearly in each of the four seasons.[29]

Elsewhere in Holland this development has been undertaken with the intent of turning idle urban land into a productive resource, an example being the urban forestry which has been an established practice in Dutch cities since the turn of the century. The forests are managed so that an uneven age of stands is maintained through selective cutting and replanting techniques. This harvesting is carefully controlled to ensure that quality and supply are maintained. A notable example is the Amsterdam Bos (literally "Wood") which was first created in 1929 as a 404 hectare urban forest intended to be managed both as a sustainable natural resource and as a visual and recreational amenity (Figure 7). In 1929 the site was a recently reclaimed piece of the polder landscape in need of vegetative cover to provide both wind shelter and a mechanism for drying out the waterlogged soil. Initially, such quick-growing pioneer tree species as willow and poplar were planted. These provided cover for the woodland species such

29 Michael Hough, City Form and Natural Process: Towards a New Urban Vernacular (London: Croon Helm, 1984), p. 265.

as Beech and Maple which then gradually replaced them. Despite incorporating such successional techniques, the Bos was not intended to be an ecological development. However, a number of significant ecosystems have managed to establish themselves in the forest, and the forest itself is one of Amsterdam's valuable 'natural' resources. It was not until the early 1960's that the deliberate design of ecosystems (based largely upon the principles first explored in the development of the Bos) was explored as an alternative form of landscape treatment.

FIGURE 7: URBAN TIMBER HARVESTING IN THE BOS, AMSTERDAM.[30]

30 -from Robert Tregay, "Urban Woodlands" in Nature in Cities, Ian C. Laurie, ed. (Toronto: John Wiley and Sons, 1979), p. 289.

One of the early pioneers of this more natural approach was Louis Le Roy, a Dutch artist and designer. Le Roy has created gardens in urban locations throughout Holland and Europe, including Heerenveen, Oranjewoud, Mildam, Leeuwarden, Rolde, Groningen, Alphen on the Rhine, Eindhoven, Utrecht, Rotterdam, Bremen, Graz and Paris. His methods are more appropriately those of a craftsman than a designer in that he works directly on a site, designing as he goes, creating with what he comes across. Le Roy favours what might be described as an extreme form of ecological design in which the form of the "design" is determined more by the plants and natural materials than by the hand of man. Nevertheless, it is Le Roy's hand that sets the process in motion and he does so in accordance with the two principles of diversity and flexibility. Opportunity for diversity is maximized through manipulation of terrain, a broad application of vegetation and limited intervention in the ongoing maintenance of the site. Initially, variety in terrain is achieved by bringing fill such as building rubble onto the site and then using this material to create changeable topography across the site (Figure 8). Immediately following this shaping of the land, a diverse layer of vegetation is applied to the entire site. Throughout this whole process of site preparation and planting a cellular model is loosely followed with the aim being to create numerous biotopes and microenvironments in close proximity on the site. From this point forward the site is allowed to evolve on its own with no human intervention in the form of traditional maintenance techniques such as weeding, pruning, fertilizing or spraying. Human "interference" is limited to minor maintenance such as trampling down herbaceous growth in the fall and breaking off, but not removing from the site, any dead

branches. Le Roy feels that the removal from the site of any material, organic or inorganic, would be a disturbance of the site's inherent natural cycles of growth and decay. In this way natural forces are harnessed to play the active role in the ongoing development of the garden. Occasionally, however, the garden can be modified through the introduction of new built structures which will transform the whole set of relationships in the garden without affecting their fundamental nature.

FIGURE 8: TERRACING USING BUILDING RUBBLE AT KENNEDYLAAN, HERRENVEEN, IN HOLLAND.[31]

31 -from Dick Hoyle, "Native Plants in Landscape Design" in Landscape Design With Plants, Brian Clouston, ed. (London: Heinemann, 1977), p. 102.

The other essential factor in Le Roy's technique is the flexibility inherent to his design process and the management of the site, which can never be thought of as "finished" in the traditional sense of the word. There is never a drawn plan for Le Roy's landscapes, the design is in the process which he brings to bear on the site. The designer and his assistants create spontaneously on-site, working as craftsmen might with the materials at hand, designing for the individual peculiarities of each site. In the same manner, the future users of the site are an important part of the process and their ideas and energies are essential to the success of each project. One of the first examples of Le Roy's work is to be found in the town of Heerenveen in northern Holland where the Kennedylaan, a strip of land 1500 metres long by 18 metres wide located between two traffic corridors, was developed in 1966 as a green space (Figure 9). Over 1000 plant species initially were used (Le Roy has since documented 4000), including both natives and exotics, and structures such as terracing and walled areas were built entirely from discarded building materials which were dumped onto the site. Originally, the installation of this garden was to be carried out by a volunteer workforce trained by Le Roy, however the town council felt the work should be done instead by their own parks board workers. As a result, the installation costs were much higher than expected, four times the cost of a conventional park. As well, Le Roy has always felt that the park design was compromised from the start by the continued involvement of the parks board in the ongoing maintenance of the park. The diversity expected of Kennedylaan has never materialized although, in the words of Sandra Goode, "in its prime it possessed a quality rarely

found in the conventional municipal park, and which derived from the real aesthetic of nature".[32]

FIGURE 9: KENNEDYLAAN, THREE YEARS AFTER ITS INCEPTION.[33]

Le Roy's work has achieved popular acclaim not only in Holland but also throughout Europe. This is despite the claims of his detractors that his successes, by their nature, are limited. His methods, relying as they do upon the participation of the artist himself, do not readily lend themselves to widespread literal application. His objectives, of energy conservation both through recycling and minimal expenditures of energy in construction and maintenance, and of bringing nature in its pure form into the everyday lives of city dwellers, have proven to be more readily adaptable. Although

32 Sandra Higgins, "The Green Vision of Louis Le Roy", Architect's Journal 5 (February 1986), p. 39.
33 -from Hoyle, p. 105.

in the early 1960's this sort of approach had yet to be shaped into any sort of a design movement, other designers and parks administrators throughout Holland were exploring similar ideas. One of the most influential was J. Landwehr, the Director of Parks for the city of Amstelveen. Landwehr's experiments with native plantings dated to 1940 when, faced with a lack of funds for a new public park, he took the unusual step of using native species. This work was enthusiastically received allowing Landwehr to continue the use of native species to the point where his palette was composed of over 500 species, together with detailed information about their propagation and growth habit. In particular, Landwehr's work focussed on the establishment of native plants in nutrient deficient, sandy soil, a medium that tends to encourage plant diversity and minimize opportunities for weed and grass invasion. This body of knowledge has been invaluable in providing the tools and materials for most of the subsequent Dutch work in ecological designs. Perhaps his most lasting contribution has been to the program of wildflower planting along highway rights-of-way, which he initiated in the mid 1960's. This program was first undertaken as a cost-saving measure, utilizing species and techniques pioneered by Landwehr to provide an acceptable roadside groundcover without the high maintenance costs usually associated with right-of-way plantings. Initial installation costs were expensive due to labour and seed costs, however these have been overridden by the reduced maintenance requirements. Anne Whiston Spirn speaks of a highway right-of-way near Amsterdam that, as of 1979, was an attractive flower meadow despite having remained uncut for five years.[34]

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34 Anne Whiston Spirn, The Granite Garden: Urban Nature and Human Design (New York: Basic Books, 1984), p. 199.

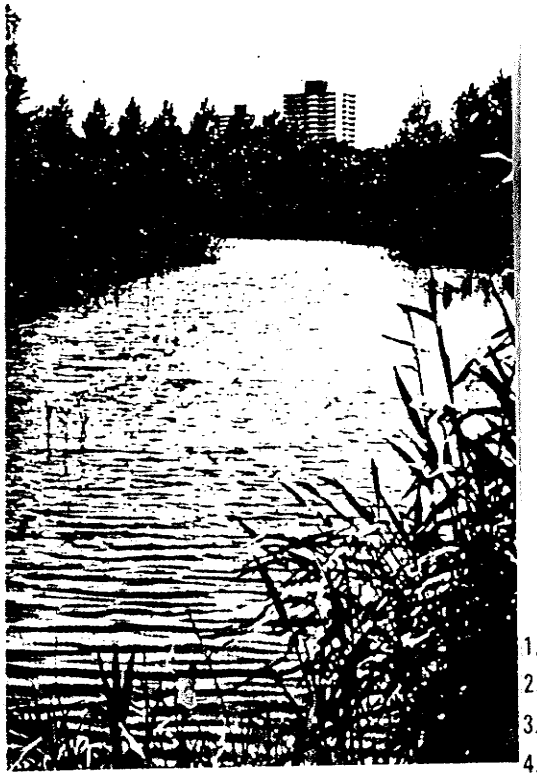
Landwehr's techniques have also been widely adopted for application in landscape designs for high density housing. There has been an increasing trend for Dutch housing developments to adopt an ecological model for their planting plans. As is the case with Le Roy's designs, the goal has been to create landscapes in which the design is open-ended and dynamic, subject to change over time. Natural succession and patterns of human use are the transforming forces in these landscapes, serving to shape the design by taking over much of the management of the site. Initial site planning and development is intended to encourage the natural processes which would inevitably occur on the site were it to be left to its own devices. Lyndis Cole and Caroline Keen, in the article "Dutch Techniques for the Establishment of Natural Plant Communities in Urban Areas", identify the rationale behind this approach:

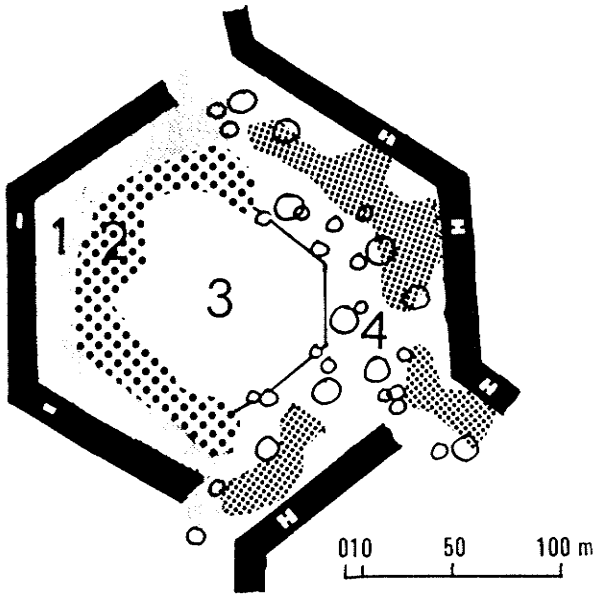
> In the design of these housing estates, the aim is to swim with rather than against the tide of natural development, the initial planting being used only as a tool to speed up what, on that particular site, would naturally be a successional development from bare ground to woodland.[35]

In housing developments in the Amsterdam suburb of Bijlmermeer or in the town of Delft the designers created some of the first of these ecologically-based designs in the mid 1960's. The first, Bijlmermeer, is typical of many of the suburbs that sprang up in the post-war period. It is located outside Amsterdam in the reclaimed polder landscape which is characterized chiefly by windswept sand dunes. The development itself is composed of eight-storey apartment blocks arranged around large

35 Lyndis Cole and Caroline Keen, "Dutch Techniques for the Establishment of Natural Plant Communities in Urban Areas", Landscape Design 116 (1976), p.32.

courtyard areas of 1-2 hectares. The clustered arrangement of the buildings made the wind conditions on the site even worse than they already were (Figures 10, 11).





1. SERVICE ACCESS
2. WOODED TRANSITIONAL ZONE
3. PLAY MEADOW
4. CHILDREN'S PLAY, SITTING, etc.

FIGURE 10: VIEW OF BIJLMERMEER

FIGURE 11: INTERNAL COURTYARD ZONING, BIJLMERMEER[36]

From the start of the project the landscape designers felt it necessary to provide the residents with a functional environment that would also be the antithesis of the sterile settings of traditional developments. Their design was an attempt to extend the character of Amsterdam's urban woodlands, as found in the Bos, into the environment of the housing development. Allan Ruff, in the article "Holland and the Development of an

36 -from Allan Ruff, "Holland and the Development of an Alternative Landscape" in Clouston, p.117.

Alternative Landscape"[37], has noted two principles, borrowed from the urban woodlands, which guided the development at Bijlmermeer. Firstly, plant species were selected on an ecological basis, and the subsequent site management was directed towards achieving specific associations over a period of sixty years. For example, fast growing but short-lived trees planted at the beginning of the project provided the site with an immediate natural framework that could continuously be reshaped through thinning. This implies that the landscape of the site at any specific point in time is determined by the evolution of the site and not by the physical configuration of the site plan. The second principle refers to the necessity of designing each part of the woodland so that it meets, not merely an ornamental goal, but the specific needs of the people by whom it will be used. It follows then that the layout of the planting blocks was determined by climatalogical factors. The first zone receives no sunlight and is therefore reserved for service and access. The second zone serves as a wind break and also provides a visual screen for those using the centre courtyard. The centre court is designed as an active game area as this area alternates between sun and shade. The fourth area, located in the full sun, is intended to serve as a passive area. In Ruff's analysis, Bijlmermeer did not succeed because it was "too architecturally designed" and, as a result, failed to go beyond the appearance of merely being landscaped. To this extent, Ruff argues, Bijlmermeer did not go far enough in the direction of breaking down barriers between people and the land.

37 Ibid., pp. 116-26.

The development at Delft is on a site known as the Buitenhof or "country garden", a 4.5 hectare open space located between large apartment complexes.

FIGURE 12: CENTRAL NATURAL AREA AT DELFT, HOLLAND[38]

The concept for the landscape, as at Bijlmermeer, was to meet the functional requirements of the apartment units while at the same time providing residents with an area of relatively natural "wilderness". In comparison with Bijlmermeer, however, the landscape at Delft was

38 -from H.J. Bos and J.L. Mol, "The Dutch Example: Native Planting in Holland" in Laurie, p. 403.

designed less to meet functional requirements than to meet what the designers felt was a social need for natural contact. The overall site plan allowed access for each ground floor apartment unit to their own small private yard as well as to the children's play areas located around the perimeter. The central area was set aside as the natural precinct(Figure 12). In the initial stages, this area was developed as little as possible and materials left over from excavations and structures such as broken walls were left undisturbed on-site. Following this, some minor shaping of landforms was undertaken to provide a variety of habitat and topography. The designer's approach was to loosely follow the site plan with much of the design resulting from on-site consultation with the landscape architect. At first, pathway connections were constructed only where necessary, with secondary paths being constructed later according to the establishment of desire lines on the site (Figure 13).

FIGURE 13: ESTABLISHMENT OF DESIRE LINES AT DELFT.[39]

39 -Ibid., p.405.

Vegetation for the project came from a number of sources, including the existing vegetation on the site which was protected as well as any plants which invaded during the construction process. The natural precinct was screened at the edges by traditional linear tree planting, which surround inner blocks of woodland plantings consisting of massings of shrubs and tree whips. In the case of the woodland blocks, three separate planting mixes were used with Alder as the predominant nurse crop in all of the three. Site vegetation was not restricted solely to native species. The designers recognized that for a few specialized applications their purposes were better served by exotics. For example, an exotic rose species which had a denser growth habit than its native counterparts was chosen to reduce the potential for vandalism. In a similar manner the herb layer was augmented by clover, which would eventually die off in severe winters, and some annual cereal crops which would pose little competitive threat following their first year. In these situations the designers, showing their tendency for ecological pragmatism rather than purism, placed a greater priority on plants that would thrive than on those that would merely be ecologically correct. In the ongoing management of the site the designers continue to encourage an environment of diversity characterized by spontaneous growth and decay. Throughout the site plant growth is encouraged by prohibiting the use of herbicides. Site maintenance in the open areas is restricted to twice yearly rotary mowing, following which the cuttings are removed so as not to hinder the growth of the less vigorous species. The tree and shrub areas receive little attention other than occasional thinning allowing the dead material to provide nutrients and habitat by being left to decay where it falls.

FIGURE 14: DELFT[40]

Public acceptance of the project at Delft has been favorable and, as Cole and Keen have pointed out, there are especially strong feelings among the residents with regard to the natural precincts:

> ...it is accepted that the public areas should be wilder. There have been no complaints of weed invasion into the gardens- in fact the use of herbicides for the removal of thistles, a species which by law has to be controlled, resulted in public outcry.[41]

The positive public response to the landscape attracted the interest of the Netherlands Institute for Preventive Medicine at Leiden, which conducted a

40 -Ibid., p. 402.
41 Cole and Keen, Ibid., p. 34.

study into the effects of the Delft landscape on its inhabitants, especially its most demanding users, the children. Their observations of the site in use found that, in comparison with conventional environments, the new landscape has proven to be a more attractive feature and a more efficient use of the open space. The final words of their report sum up their conclusions:

> It is thus clear from the results [of the study], that the new design of the outdoor space, characterized by a design based on satisfying several functional requirements, has led to different patterns of activity, a greater appeal and a more efficient use of space.[42]

The report goes on to recommend that more of these parks be constructed, and the Dutch appear to be committed to pursuing this course. Of course, in many cases such as Delft this approach to ecological design was motivated as much by expediency as any other factor. H.J. Bos and J.L. Mol, in their article "The Dutch Example: Native Planting in Holland", refer bluntly to this pragmatism: "The specific value of allowing native vegetation to develop is that the area is made green!"[43] However, what may have initially been a technically based movement has somewhere along the way become a popular aesthetic and philosophical movement. Natural parks and areas are now to be found all over Holland and they are an extremely popular feature. The Dutch have become leaders in the design, construction and management of ecological parks and their techniques have been studied by design professionals from around the world, most notably Great Britain.

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42 Report of the Netherlands Institute for Preventative Medicine, No citation given. Quoted in Bos and Mol, p. 407.
43 Bos and Mol, p. 400.

1.1.2 Great Britain

The British have been profoundly influenced by the Dutch in their techniques and approaches to ecologically-based design. A number of British designers have made regular pilgrimages to Holland to study sites such as Delft and Bijlmermeer. They subsequently reported their findings in the British magazine Landscape Design which became the unofficial organ of the ecological design movement in the late 1970's and early 1980's. Initially much of the British work was along the same lines as the Dutch designs such as housing developments in "third generation" New Towns and road rights-of-way planting. Towards the beginning of the 1980's, however, the British began to develop their own unique approach featuring the rehabilitation of small derelict inner-city sites through the development of ecological infill parks. The development of these pockets of urban wilderness has built upon the earlier success of the New Towns to create a valid alternative to traditional landscape designs.

The development at Warrington New Town in 1977 was a touchstone for the British ecological design movement, as indicated by the many articles and research papers about every aspect of the design. For the first time an environment was designed from the start on an ecological basis, providing the site with a natural framework long before any of the building construction was to begin. Tom Hollick, in the article "Community Landscapes", described the advantages of this new form in comparison with earlier New Towns:

> Basically, the various land uses are separated from one another by blocks of planting forming small woodlands, giving a cellular structure of well-defined and identifiable sites which directly

contrasts with the often criticized 'prairie town' feel of earlier developments.[44]

The development at Warrington involved the construction of a new housing community, complete with roadways and industrial areas, for up to 6000 residents on the 400 hectare site of a demolished Royal Ordnance Factory. The demolition of the factory in 1974 severely disturbed and compacted the soil, destroying much of the ruderal tree and shrub vegetation which for years had covered the site. The resulting landscape was composed of an unconsolidated soil mixture of clay, rubble, railway cinders, shale and small scattered pockets of contaminated topsoil. Remnant scrub vegetation remained only on the perimeter of the site(Figure 15). However, beyond the site was an established woodland with which the design team of landscape architects, ecologists and managers hoped eventually to form natural connections. This team, when faced with the large scale of the site and the poor soil conditions, decided that in order to use the existing subsoil new techniques of site planning and plant

44 Tom Hollick, "Community Landscapes",in An Ecological Approach to Urban Landscape Design, Allan R. Ruff and Robert Tregay, eds. (Dept. of Town and Country Planning, University of Manchester: Occasional Paper #8, 1982), p. 91-2.

establishment would need to be explored.

FIGURE 15: THE DERELICT ROYAL ORDNANCE FACTORY[45]

Initially an extensive site analysis was undertaken, involving both aesthetic and ecological considerations which would assist in the drafting of guidelines both for the implementation of new plantings and for the

45 -from Robert Tregay and Roland Gustavsson, Oakwood's New Landscape: Designing for Nature in the Residential Environment (Warrington and Runcorp Development Corporation, 1983), p. 13.

management of existing natural features. This analysis was crucial to the design process in order to ensure that the design fit the site rather than the other way around. Their design concept was to create a system of interconnected wooded belts which are linked at the outside edge to the existing woodland (Figure 16).

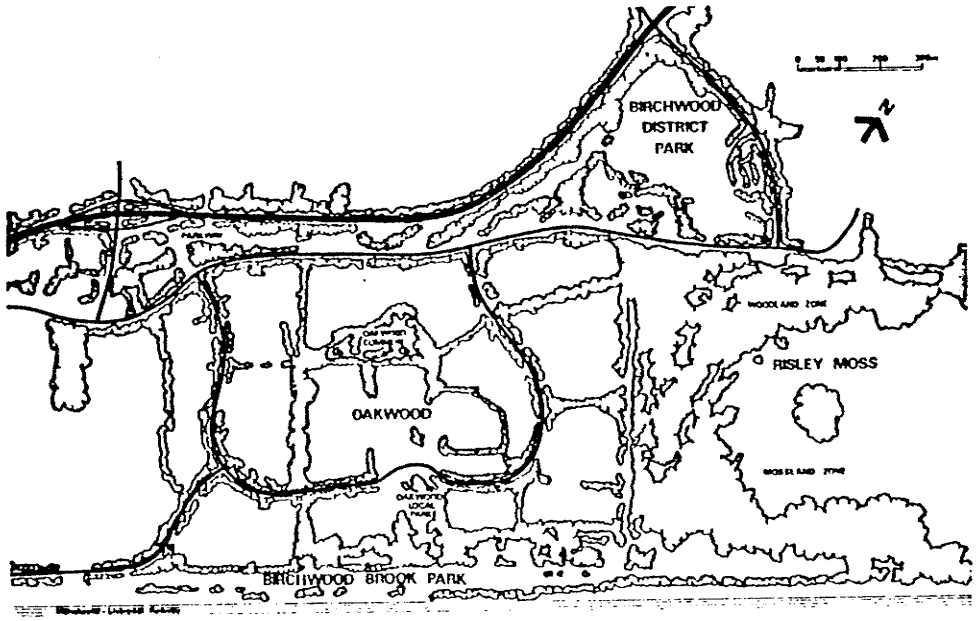

FIGURE 16: WARRINGTON'S ORDERING FRAMEWORK OF VEGETATION[46]

Arranged within these forest belts are the 'cells' of open space which compose the various land uses of the community. The skeleton of vegetation serves as the ordering device for the development. Extending from the forest belts, which are from 10-40 metres wide,are smaller belts of vegetation which further enclose and define the individual spaces. In the words of Robert Tregay, the landscape architect for Warrington:

46 -Ibid., p. 20.

> A web of woodland belts, linked to the existing woods on the margins of the area, is envisaged....[that] define the extent, individuality and 'territory' of residential areas, and reduce the perceived scale of redevelopment....But, perhaps most important, the belts with their links to the surrounding countryside, can be seen by people as a continuous thread of nature through their residential environment.[47]

It is this woodland linkage which ensures that the connection with the greater natural environment which is so important to the Warrington development is always present and continuous throughout the community(Figure 17).

FIGURE 17: THE WOODLAND BELTS AT WARRINGTON.[48]

47 Robert Tregay and Duncan Moffat, "An Ecological Approach to Landscape Design and Management in Oakwood, Warrington", Landscape Design 132(November 1980), p.33.

48 -Tregay and Gustavsson, p. 23.

The early development of a viable forest framework was essential to Warrington, so much so that the planting of whips of indigenous tree species was completed three years before any housing construction was completed (Figure 18). The benefits of this approach were twofold; the one obvious asset of an exixting treed environment for the first residents, and the other, less obvious, advantage of lower costs resulting from the initial planting of tree whips.

FIGURE 18: ADVANCE PLANTING AT WARRINGTON.[49]

According to Tregay, in addition to their low cost, whips will have caught up to standard trees within three years of planting and will show healthier growth and a more natural form. At the start, only woody species were planted, but these included a complete range from the canopy trees to the understorey shrubs to the nurse species. Herbaceous plants were left out of the composition until after the third year when the wooded blocks were

49 -Ibid., p. 21.

well-established. The plant composition and techniques for the woody species varied according to the size of each forest belt. Each size block or strip would be reflective of the kind of structure and diversity that would be found in their naturally-occurring counterpart. For example, Tregay describes the narrow woodland belts as consisting of two edges back to back, whereas the larger blocks display a more appropriate complexity of plants and associations.[50] In order that these woodlands developed in an appropriate fashion their maintenance and management, particularly in the first three years, was of crucial importance. R.D. Greenwood and J.D. Moffatt, writing about Warrington, refer to an error common to other, less successful ecological designs: "Too often 'natural schemes' involve nothing more than the planting of native species with aftercare being 'left to nature'."[51] Greenwood and Moffatt feel that Warrington succeeded because from the beginning the design team took into account the role of short-term maintenance and long-term management in the success or failure of the project. In their own words:

> One of the most significant advances in the implementation process at Warrington has been the change in emphasis which now recognizes that preparation and aftercare are of equal significance to the design in the ultimate success of the scheme.[52]

Following planting the rapid development of the wooded areas was aided by the suppression of the potentially competitive grass and herb growth for an initial three year period. Subsequently the herb layer was allowed to develop with the help of herbicides which were used selectively for two

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50 Ibid., p.33.
51 R.D. Greenwood and J.D. Mofatt, "Implementation Techniques for More Natural Landscapes" in Ruff and Tregay (1982), p.40.
52 Ibid., p.42.

more years to control any unwanted weed growth. In the following years the shape of the woodlands would be manipulated through traditional techniques of thinning and coppicing applied selectively at various stages of development. As the woods matured, however, traditional woodland methods were modified so as to produce a more open canopy. This enabled the herb and shrub understorey to develop with more vigor and diversity than a closed canopy would allow. The aim of this final management phase was to maintain the diversity of the successional phase and to discourage the development of the continuous high canopy of mature woodlands. Particular attention was paid to treatment of the edges so that they would not merely be an undifferentiated wall of vegetation, but contains a variety of spaces and ecological niches (Figure 19).

FIGURE 19: RESIDENTIAL ENVIRONMENT AT WARRINGTON[53]

53 -Ibid., p. 25.

In a follow-up article on Warrington eight years after its creation, Tregay remarks on the tendency of politicians, managers and some design professionals to regard ecological designs as primarily a means of cutting maintenance costs. While not disputing this characteristic, Tregay emphasizes that, as with any design, costs are dependant on many unrelated factors. In general, although cost reductions were not the primary goal at Warrington they did become a factor in its final evaluation. As Tregay remarks, "...early indications are that nature-like landscapes can create high quality environments at low or modest maintenance costs."[54] Regardless of any cost savings the real success of Warrington lies in the successful transformation of a barren industrial site into a green residential community complete with well-established natural precincts in the relatively short period of eight years.

The creation of a 'natural' environment for a New Town development, regardless of the approach, is largely a technical problem with technical solutions. While its overall residential framework may be a realistic approximation of a natural environment, the guiding principles behind Warrington are really those of Ebenezer Howard and his concept for the Garden City of the late nineteenth century. Howard felt the British public would be better served by new Garden Cities which integrated Town and Country than by attempts at rehabilitation of existing cities (Figure 20).

In a letter to a colleague, Howard raised this issue rhetorically:

54 Robert Tregay, "A Sense of Nature", Landscape Design 156(August 1985), p.38.

"The simple issue to be faced and to be faced resolutely, is can better results be obtained by starting on a bold plan on comparatively virgin soil than by attempting to adapt our old cities?"[55]

Essentially the development at Warrington is the modern-day extension of this Utopian tradition.

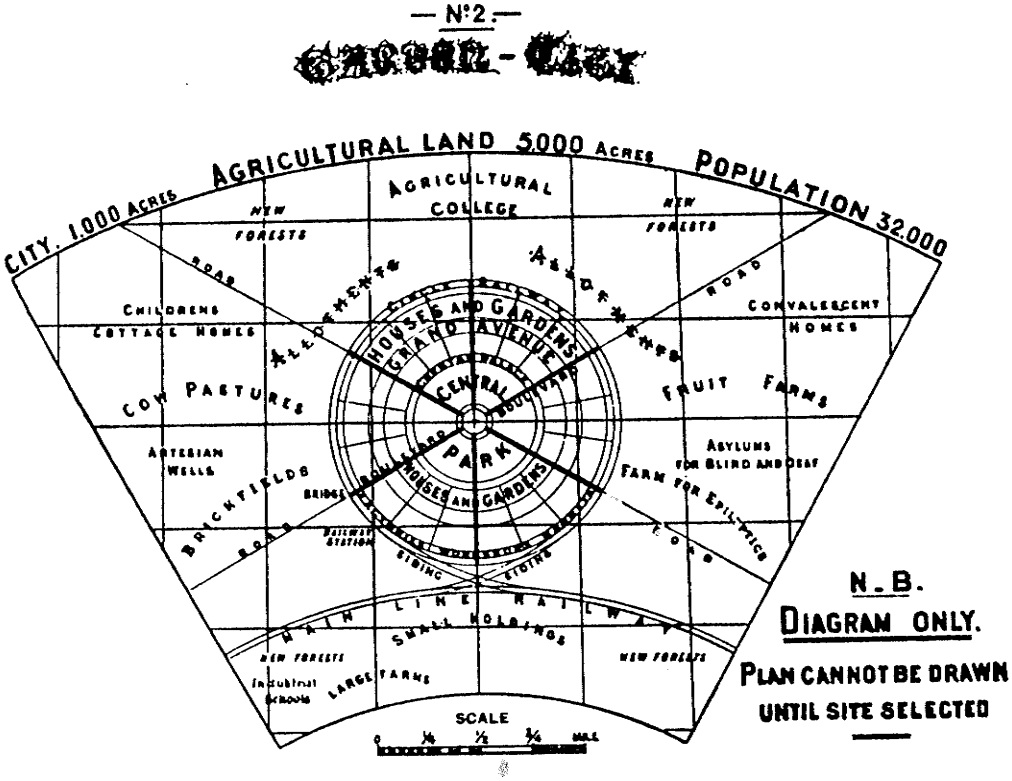

FIGURE 20: EBENEZER HOWARD'S GARDEN CITY[56]

A more contemporary example of British ecologically-based design is located in a far more commonplace environment than Warrington's pastoral setting. The William Curtis Ecological Park was built in 1977 on a 1 hectare site in a former industrial area of Central London. The site was a

55 Ebenezer Howard in a letter to Henry George, quoted by Sandra Higgins, "Old Visions: New Twist", Architects Journal 5 (February 1986), p. 33.

56 -from Spirn, p. 33.

temporarily vacant lot located between office buildings which was finally developed in 1985. However during the short eight year life span of the park it was certainly the most celebrated and most heavily visited 'wilderness' site in the city of London. The park was conceived as a demonstration site for the rehabilitation of unused urban land, serving primarily as an educational resource for London school children and as a research centre for urban ecology (Figure 21).

FIGURE 21: WILLIAM CURTIS ECOLOGICAL PARK[57]

The park was created and managed by the Ecological Parks Trust who were responsible for staffing and monitoring it on a regular basis. The original site offered nothing in the way of natural features. It had formerly been a parking lot and, as might be expected, the soil was heavily compacted from use. Over 350 truckloads of fill from construction sites were brought to the site and these were shaped by a largely volunteer

57 -from Hough, p. 146.

workforce into a variety of habitats including a pond, an open meadow and a variety of scrub and woodland blocks (Figure 22).

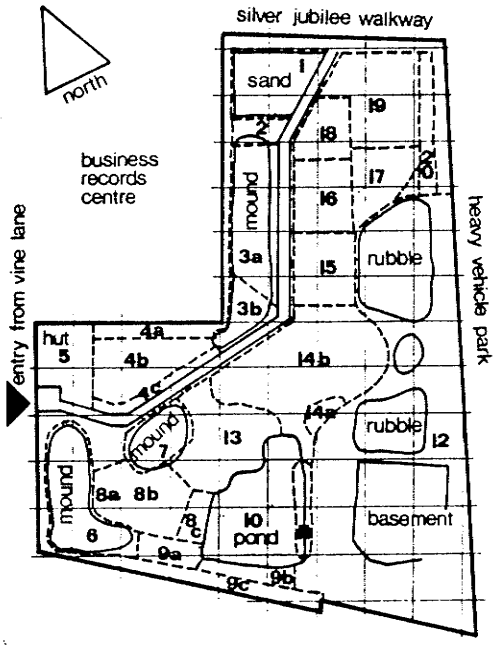

FIGURE 22: PLAN OF WILLIAM CURTIS ECOLOGICAL PARK[58]

The site was initially planted with over 1000 native tree whips and was seeded with a mixture of native grasses. However, by far the greatest number of plants came from the ruderal species which arrived either on the wind or in the loads of fill. Eventually over 300 species of native and naturalized plants were recorded on the site. The 480 square metre pond was fed by rainwater from an adjacent roof and planted with 34 species of emergent and submergent plants. Lyndis Cole, in his article "Urban Opportunities for a More Natural Approach" comments that the pond in particular seemed to thrive in its urban setting:

> What is particularly interesting about this pond is that, unlike the grassland, it would appear that trampling [by visitors] held in check

58 Ibid..

> the spread of aggressive species, a natural balance being maintained public pressure. For example, up until 1980 water-milfoil, *Myriophyllum* was the dominant submergent and covered all but a small tongue of water. Yet by 1981, trampling in the northern half of the pond had become so intense that *Myriophyllum* had been almost completely eliminated in this area.[59]

During the life of the park it was visited by a total of fifty thousand people, one third of whom were school children on field trips. As Cole indicates, this intensity of use created some unique management problems which had to be addressed as they arose. Michael Hough, in City Form and Natural Process, describes how these issues were dealt with in the areas beyond the pond:

> As the park evolved, problems had to be faced and resolved. One was soil compaction. The solution was to reproduce soil processes of the vegetation type as closely as possible; for instance, by spreading leaves over the emerging woodland area; spreading sedge peat on the wet meadow area.[60]

The maintenance and management of the park was a struggle between the opposing realities of the urban and natural environments. And yet it succeeded as an ecological park because of its urban location and in spite of its finite life span. Its success lay in the fact that its location made it remarkable to those who visited it or read about it. In its role as an educational resource it served as an inspiration and model for other similar

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59 Lyndis Cole, "Urban Opportunities for a More Natural Approach" in Ecology and Design in Landscape: The 24th Symposium of the British Ecological Society, A.D. Bradshaw, D.A. Goode & E.H.P Thorp, eds. (Oxford: Blackwell Scientific Publications, 1986), p.429

60 Michael Hough, (1984), p. 148.

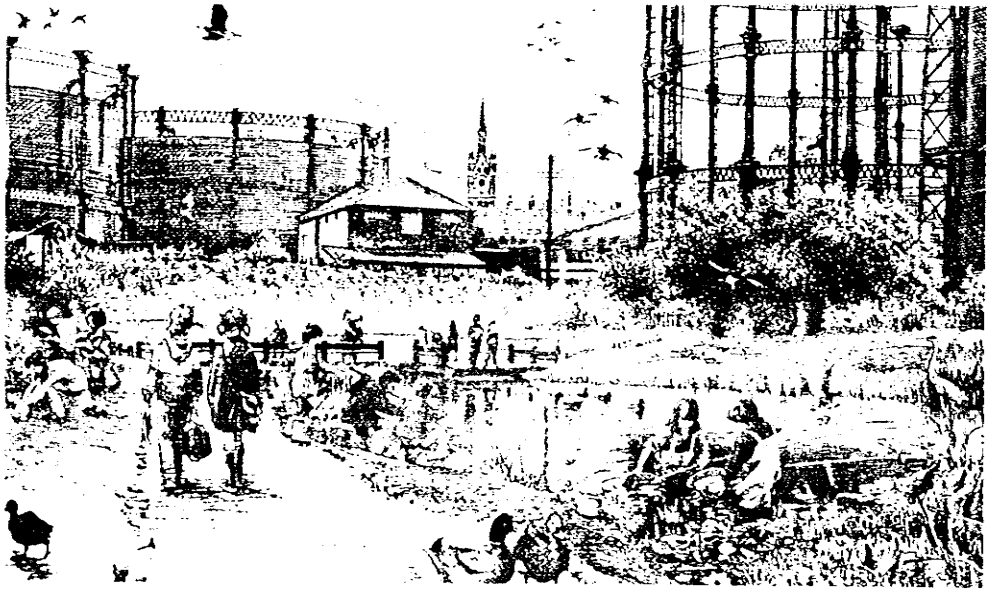
projects throughout London. These include Gillespie Park, established in 1981 on a 1.6 hectare piece of land that was formerly a coal works[61] (Figure 23), Lavender Pond Nature Park which is 1 hectare in size and includes a large wetland area, and Stave Hill Nature Park, the largest of the ecology parks at 2.3 hectares.

FIGURE 23: GILLESPIE PARK[62]

Perhaps the best known of the current ecology parks is Camley Street, located behind London's King's Cross railway station on the 1 hectare site of a former coal yard(Figures 24, 25). The site had already been partially colonized by naturalized vegetation and an attempt was made to incorporate these communities in the site development. The final design includes a large central pond fed by a nearby canal, which leads to a marsh area and then to a woodland of willows. Each habitat has its own

61 -see Ken Coyne, "Nature in the Park", Landscape Design 188 (March 1990), pp.23-4.
62 -Ibid., p. 23.

management regime which are adhered to strictly. Again, the primary function of the site is educational, both for children and as a demonstration project for adults from around Britain.



FIGURES 24, 25: CAMLEY STREET PARK[63]

63 -from Sandra Higgins, "David Goode", Architects Journal 5 (February 1986), p. 45.

Most of these projects have been overseen by the Greater London Council under their senior ecologist, Dr. David Goode who has been the guiding force behind their development. A priority for his department was the establishment of conservation policies for each of London's 33 boroughs, and subsequently to provide a survey of any remnant natural habitat in each of the boroughs. This resulted in the identification of a total of 2000 sites over 4.94 hectares in size. The boroughs were informed of their existence and funding of over several hundred thousand pounds was granted for their protection and development of these sites. This is all part of a program called the 'citywild', which Sandra Higgins describes in an article about Dr. Goode:

> ...a concept of having nature where people live and work, in the middle of the city. It means a natural habitat which can be created in any odd corner by making the most of what's already there. For example, in citywild areas the establishment of a diversity of natural vegetation is encouraged instead of ornamental or formal plantings. It can be as small as a brickbat filled with wild flowers in a modern building or as large as the creation of a woodland in a Tower Hamlet's cemetary. And, contrary to nature conservation in the past, the citywild concept refers not only to improving the physical environment but to ways of ensuring pleasure for the user.[64]

Dr. Goode obviously feels that the seeds for the success of any of these schemes lies in their accessibility to the public.

The popular success of citywild areas and the ecological parks in London has been mirrored throughout Britain in cities such as Liverpool,

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64 Ibid., p. 46.

Sheffield or Manchester. While the lack of any other opportunities for contact with nature is certainly a factor in their success, they largely owe their existence to the rapid social and physical collapse of the large inner-city cores which has become endemic to post-industrial Great Britain. The widespread availability of vacant land in the city centres has enabled experiments such as ecological parks to be carried out. The reality is that rehabilitation of the derelict land by conventional means such as infill building is simply not possible. The scale of the deterioration makes cost and expediency the major concerns in rebuilding the urban fabric. In writing about this issue, Tom Hollick describes urban rehabilitation through the application of ecological design as being among the most cost-effective and therefore realistic approaches to this dilemma:

> ...the method of improvement would centre around the application of least-cost planting techniques based upon the economy of natural plant associations and characteristics- the 'ecological approach'. Emphasis would be placed on the use of reclaimed materials, and the use of voluntary labour from schools and community would foster a responsibility towards work carried out and reduce the current impact of vandalism.[65]

The methods he recommends are similar to those employed at Warrington; mass plantings which are later thinned, herbicide applications in the early stages to discourage colonizing weeds, and taking maximum advantage of a variety of soil and ground conditions to create niches and points of interest. Often the most successful approach towards these parcels is to take advantage of the naturally-colonizing vegetation which inevitably appears

65 Tom Hollick, Ibid., p. 101.

on vacant land. It is the role of the designer to enhance the favorable aspects and create a proper context so that the lots do not appear to be merely weed patches and garbage collectors. O.L. Gilbert refers to these areas as "Urban Commons" in his article of the same name, by this he includes all publicly accessible derelict land within cities. As Gilbert sees it, the challenge lies in creating a designed setting for areas which have a tendency to appear haphazard and unplanned:

> The chief design problems are probably achieving the correct balance of formal to informal landscape treatment for a given locality; manipulating scale with structure planting; and designing the interface with other types of landscape. Nature will provide variety, incident, local character and the excitement of a landscape which changes both seasonally and over the longer term.[66]

Gilbert sees these areas as being assets, assets which are unique to their region and which were relatively unexplored until circumstances forced planning authorities to take advantage of them. The circumstances in modern-day Britain are extreme but certainly the same issues can be encountered in any urban centre.

66 O.L. Gilbert, "The Urban Commons", Landscape Design 149 (June 1984), p. 36.

1.1.3 West Germany

The physical realities of West Berlin make it unique among European centres. Located as it is entirely within the territory of East Germany, the city is a virtual island without a hinterland.[67] The additional fact that it was virtually levelled during the Second World War makes West Berlin an ideal candidate for development of natural spaces within the city. Following the war the predominant landscape type within Berlin was, of course, a thick layer of rubble that was several metres thick in many places. As usual, colonization by native and naturalized vegetation and rapid succession soon turned these sites into shrub or woodland environment. In many ways Berlin is an ongoing experiment in large-scale urban ecosystems. However, as Berlin is slowly being reconstructed many of these natural resources are in danger of disappearing. Concern for their preservation has led to public pressure which in turn has resulted in the enactment in 1979 of the Berlin Nature Conservation Act by the federal government of West Germany. Essentially the Act raises nature conservation within Berlin to the strategic planning level, where it has a profound effect on the natural systems of Berlin. The initial step was a complete ecological survey of the city identifying the extent and composition of the natural areas, which could then be evaluated according to their relative value as ecosystems. Following this, policies were formulated which have positively effected the long-term promotion and protection of these communities. H. Henke and H. Sukopp, in the article "Natural Approaches in Cities" identify some of the areas the Act influences:

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67 H. Henke and H. Sukopp, "A Natural Approach In Cities" in Ecology and Design in Landscape(1986), p. 310.

-Prevention of avoidable impacts on natural systems and landscapes....

-Establishment of priority areas for nature conservation....

-Consideration of natural development in the city....

-Preservation of different habitat conditions....

-Preservation of large undivided open spaces....

-Functional integration of buildings into the ecosystem....[68]

This wide-ranging document obviously reflects a very real concern for the survival of Berlin's native and naturalized ecosystems. The planning authorities recognize the status of Berlin as a microcosm within which a wide variety of conditions and contexts must be accommodated. A similar harmony is apparent in the work of the Berlin landscape designer Hermann Barges who, while not an ecological designer in the same sense as Le Roy, does have a unique way of designing ecologically-functioning urban landscapes(Fig. 20). For example, he describes his work as follows:

> To create urban renewal in harmony with nature one must first understand towns in a new way. For example, towns can be seen as concrete mountains where the streets are ravines and valleys and the houses are like stones or rocks. The roofs of the houses correspond to alpine meadows and pastures. The facades of the houses are slopes, vineyards and terraces....If we visualize urban areas in this way we will be able to resettle nature within the town while considering the natural forms we are trying to evoke and thereby how we expect plants to create these illusions for us.[69]

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68 Ibid., pp. 320-21.

69 Hermann Barges quoted by Sandra Higgins, "Hermann Barges", Architects Journal 5 (February 1986), p. 40.

Barges' work is evocative of nature and natural processes, but as they would be transformed within an urban context. In spirit his work is quite the opposite of the usual natural materials employed to an architectural purpose, it is architectural materials being applied to a natural purpose.

1.2 NORTH AMERICA

1.2.1 United States

Ecologically-based design in North America does not have the same exposure that it does in Europe. While in Europe it has evolved into a design movement, in North America ecologically-based design consists of a number of individuals who are deeply committed to their ideals; theories and principles of ecological design have yet to be given form and put into widespread practice. On the one hand the United States does have a great deal of cumulative technical experience in the area of reclamation and rehabilitation of degraded lands such as mining sites and road right-of-ways. However, urban applications of similar approaches and techniques have not been explored to the same degree. One individual who has made significant contributions to both the theoretical and practical realms is Darrell Morrison. Morrison, Dean of the School of Environmental Design at the University of Georgia, was formerly with the Department of Landscape Architecture at the University of Wisconsin where he did much work with ecological landscapes. In particular, Morrison was opposed to what he referred to as "The Standard Accepted Designed Environment"[70], and his 1972 design for the 6 hectare grounds of CUNA Mutual Insurance Society in a suburban area of Madison, Wisconsin was a notable and successful alternative to the more traditional forms of corporate landscaping (Figure 26).

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70 Darrell G. Morrison, "Restoring the Midwestern Landscape", Landscape Architecture, Vol. 65, No. 5 (October 1975), p. 398.

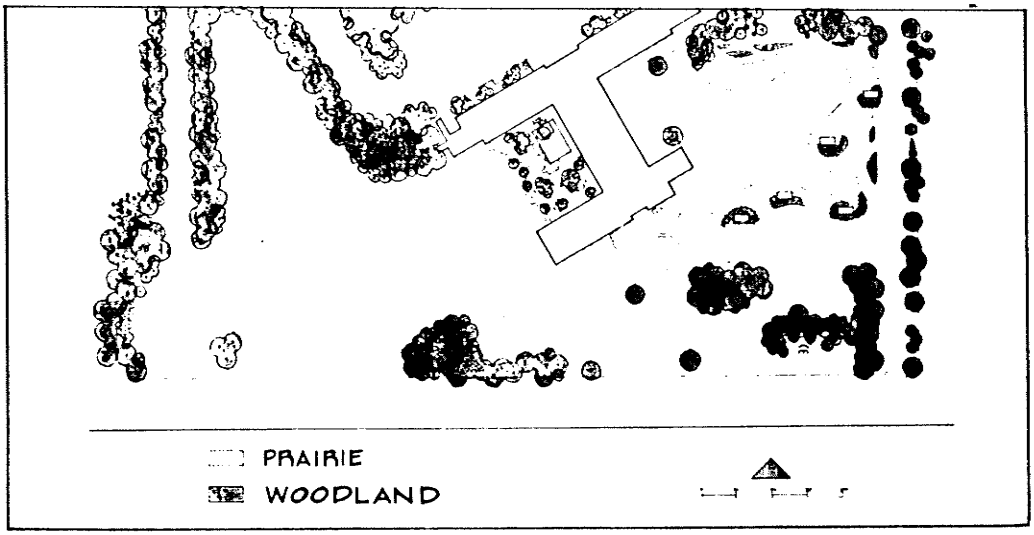

FIGURE 26: DARREL MORRISON'S PLAN FOR THE CUNA GROUNDS[71]

In addition to a large expanse of turf and a conventionally planted terraced area near the cafeteria, the grounds are also composed of large areas of woodland and native prairie. The woodland plantings consist mainly of dense massings of native Wisconsin deciduous trees and shrubs. These are supplemented each year by additional seedlings to provide complexity. As well, until the canopy developed sufficiently to provide shade and protection for the herbaceous layer, sun tolerant groundcovers such as Wild Strawberry (*Fragaria virginiana*) or Virginia Creeper (*Parthenocissus quinquefolia*) were planted annually so as to inhibit the invasion of weedy plants. The woodland edge is allowed to spread and meander without much restrictions as the native prairie comes between the woodland and turf areas. The belts of prairie planting were initially seeded with a cover crop of oats. The following year such prairie species as Little Bluestem (*Andropogon scoparius*) and Indian Grass (*Sorghastrum nutans*)

71 -Ibid., p. 400.

were sown by hand. Following an early burst of weedy growth, which was controlled by cutting as well as extra seeding of natives, the prairie was able to take shape. The role of the prairie is diminished to a certain extent by the adjacent turf buffer zone which ensures that a traditionally-grassed area is the aspect of the landscape with which the public comes into closest contact. Morrison refers to this design decision in his article "Restoring the Midwestern Landscape":

> The major concession to conventional landscape approaches was in the inclusion of still extensive lawn areas. These contrast with the naturalized portions of the site, give them form; and assure the general public and the corporation that the whole site is not being neglected. It is quite possible that if the lawn areas had been planted as the prairie border, none of the prairie plantings would have survived the pressure from the public and corporate management during the early successional years.[72]

While Morrison leaves no doubt about his respect for the integrity of a purely native environment he is, on the other hand, pragmatic enough to recognize the need for an acceptable public face for these landscapes. In a 1974 design for the 32 hectare site of the General Electric Medical Systems complex, Morrison was able to implement a larger and more extensive native prairie environment(Figure 27).The site is located in a suburban area of Waukesha County, Wisconsin and, like the CUNA grounds, had been disturbed by roadbuilding and construction activities. The program called for a low-maintenance design that would prevent erosion and have attractive visual characteristics.

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72 Ibid., pp. 401-2.

FIGURE 27: PRAIRIE PLANTINGS AT THE GENERAL ELECTRIC FACILITY IN WANKESHA COUNTY, WISCONSIN.[73]

Morrison's approach was what he called a "'two-layer' planting plan", in which a base layer of prairie grasses would be overlayed by the planting of native forb species. In late May of 1974 the grasses were planted in broad areas of differing seed mixes using a seed drill. A few days later the forbs were seeded and raked by hand in scattered patches throughout the site. In this first year of planting the site was mowed three times at a height of approximately 10 centimetres in order to limit the growth of weedy plants. However, in the next five years very little in the way of maintenance or management was undertaken. Morrison comments that in the third year of the project a drought occured which had the beneficial effect of eliminating many of the shallowly-rooted weeds such as Quackgrass (*Agropogon repens*) which could not compete for scarce moisture supplies with the more deeply-rooting native species.[74] This is a

73 -from Darrel G. Morrison, "Tallgrass Prairie in the Landscape", Landscape Architectural Review (May 1985), p. 10.
74 Ibid..

graphic illustration of the competitive advantages many of the indigenous plants have over the exotic weeds. A controlled burn which was carried out in the spring of 1980 was the first major management technique to be practiced on the entire site. The success of this burn in clearing out dead material, suppressing invading exotic species, and returning nutrients to the soil in an accessible form makes a long-term management program of controlled burning both a practicable and a desirable approach. In a follow-up article written 10 years after installation Morrison was able to report on the project's success:

> Based on this experience, it can be said that the general visual characteristics of tallgrass prairie can be restored to a prairie/savannah region in less than a decade.[75]

However, further in the same report Morrison cautions against viewing prairie reconstructions as replacements for the real thing:

> Because restoration plantings are almost always, by necessity, simplifications of their natural models, they should never be considered a substitute for preservation of true natural ecosystems. They do, however, hint at the beauty of the natural landscape....[76]

Morrison's work in native prairie reestablishment, especially in the corporate settings, is a successful example of the ways in which these designs can succeed in what would seem to be the unlikeliest of settings. Catherine Howett, in her paper "Systems, Signs, Sensibilities: Sources for a New Landscape Aesthetic", writes of Morrison's success:

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75 Darrel G. Morrison, "Case Study: A Prairie Decade", Landscape Architecture, Vol. 73, No. 3 (May/June 1983), p. 87.
76 Ibid..

> Darrell Morrison's early work in replicating and restoring Midwestern prairie landscapes represents the most significant American expression of this new enthusiasm, and has helped to popularize in this country the idea of using native plant communities in what would normally be considered "ornamental" planting situations. Morrison's example represents the best possible thrust for this effort, because he begins by justifying the planting on ecological grounds, a lesson first patiently imparted to clients and then absorbed slowly, by observation over time, by the general public.[77]

Another proponent of ecologically-responsible design operating within a different forum than Morrison, is Anne Whiston Spirn. The publication in 1984 of her book The Granite Garden: Urban Nature and Human Design[78] (at the same time as Michael Hough's very similar City Form and Natural Process: Towards a New Urban Vernacular[79]) may have sparked the beginning of a new ecological sensitivity among North American designers. In brief, the book is an examination of the city as a functioning ecosystem which is seriously diminished by the relegation of nature and natural processes to minor supporting roles. In an earlier paper, Spirn gave a concise definition of this position:

> We have been conditioned by centuries of intellectual and religious traditions to view nature and city as opposites. In fact, nature is a continuum; city and wilderness are at its poles. Today, there are few parts of the world, however wild, that are untouched

77 Catherine Howett, "Systems, Signs, Sensibilities: Sources for a New Landscape Aesthetic", Landscape Journal, Vol. 6, No. 1(1987), p. 6.
78 Anne Whiston Spirn, The Granite Garden: Urban Nature and Human Design (New York: Basic Books Inc. Publishers, 1984).
79 Michael Hough, City Form and Natural Process: Towards a New Urban Vernacular (London: Croon Helm, 1984).

by human activity. Natural processes do not cease to operate at city limits. The city is a part of nature, however altered.[80]

Spirn's response is to examine the city's many systems and to suggest ways by which these systems may be enabled to function in a more harmonious and efficient manner.

Whatever influence Spirn may have had among the landscape community, there are a number of individuals and firms throughout the United States that are commited to increasing the popular exposure of ecologically-based design. One of these is the Philadelphia-based firm of Andropogon, whose principals were among the many University of Pennsylvania students to be influenced by Ian McHarg, which has since gone on to become a leading force in the design of naturalized landscapes. Preservation and Replication of naturally-existing ecosystems are the key principles Andropogon brings to their projects. In their own words they describe their approach:

> 'First, if there is any existing natural habitat on the site, we preserve it and the systems that support it. Second, if there is disturbed or damaged habitat on the site, we fix it and manage it. Third, if an opportunity exists to reestablish a habitat that once existed, or could exist on the site, then we reestablish it.'[81]

Obviously, this approach will enhance the natural vernacular of any of the project settings, but such a predisposition to a specific approach to design and use of materials may limit widespread application.

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80 Anne Whiston Spirn, "The Role of Natural Processes in the Design of Cities" in Changing Cities: A Challenge to Planning- Annals of the American Association of Political and Social Scientists 451 (September 1980), p. 99.

81 Frederick Steiner and Todd Johnson, "Fitness, Adaptability, Delight", Landscape Architecture, Vol. 80, No. 3 (March 1990), p. 99.

Urban ecologically-based design in the United States is still in it's infancy, especially in comparison with the developments in Great Britain or Holland. In Canada the situation is similar, a number of individuals or groups pursuing similar but separate ends without a substantial degree of public awareness.

1.2.2 Canada

The late Robert Dorney was the leading Canadian figure in the development, application and distribution of practical information about ecologically-based landscape design. Dorney completed his doctoral degree in Veterinary Science but applied his talents to a wide range of environmental pursuits. A professor in the School of Urban and Regional Planning at the University of Waterloo, Dorney also operated a private practice as a consulting ecologist and environmental scientist. He was not content to limit his activities to the theoretical and academic worlds and, as the founder and chairman of Ecoplans Ltd., sought to apply his philosophy to the actual design and construction of ecological landscapes based upon the indigenous ecotypes of Southern Ontario. As a direct offshoot of this company Dorney was also involved with the Natural Woodland Nursery Ltd. in Waterloo, Ontario, through which he undertook the commercial propagation of native plants. Through all of these activities, he became recognized as a leading Canadian authority in the field of ecologically-based landscape design. In his work and writings, Dorney justified his approach on the grounds of reestablishing the geographic and ecological relationships which would have originally existed within the regional context of a site. While these environments may have been preserved in such large areas as Banff National Park or Vancouver's Stanley Park, Dorney felt that their disappearance from the everyday world of small urban spaces was lamentable. Their replacements, what he refers to as "genetic junkyards" of dissimilar species, are basically the same generic landscape which has been repeated throughout the urban open spaces of the world, regardless of situation or context. The spaces Dorney had a

particular interest in were those areas which are left over as the inevitable byproducts of urban development:

> ..."scraps" severed by highways, service corridors, or building foundations [which] generally are regarded as too small to be left in a natural condition. Their usual fate is either complete removal or conversion to an "urban savannah", by which is meant that sodding will be done under the trees, resulting in an open-grown tree-grass ecosystem.[82]

Dorney feels that this ongoing loss of natural and regional identity within urban environments contributes to a sense of alienation from the natural world amongst city dwellers. He alludes to this in the article "Re-creating the Early Ontario Landscape in a Front Yard":

> The rich natural heritage afforded by these combinations of climate, geography and time are by and large forgotten among the automobiles, power lawn mowers, and swimming pools of our contemporaries. Although urban man is trying to understand and capture his newfangled technology rather than be overwhelmed by it, the understanding of himself as part of the changing panorama of local land uses is only now being inserted into educational curricula in the grade and high schools. Is there, then, a way to capture some of this past, to provide historical continuity, to augment the sense of place, while at the same time helping young men and women to develop their personal identity?[83]

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82 Robert S. Dorney, "The Mini-Ecosystem: A Natural Alternative to Urban Landscaping", Landscape Architecture Canada, Vol. 3, No. 4 (December 1977), pp. 56-63.

83 Robert S. Dorney, "Recreating the Early Ontario Landscape in a Front Yard", Landscape Architecture, Vol. 65, No. 5 (October 1975), p. 420.

Elsewhere in the same article this approach is also referred to as "an evolutionary return to [the] past".[84]

Dorney's way of recapturing the past was to plant small sites- in this case 1/100 of an acre (40 square metres)- so as to replicate at least one of seven ecologically symbolic models common to the landscape of Southern Ontario. These models are Dorney's own physical approximations of historically significant Southern Ontario ecosystems. He frequently cites the design for his own residence as an example of this approach. In this design, a typical suburban residential lot in Waterloo is transformed through a combination of elements drawn from two of the ecotype models identified by Dorney; the Carolinian Forest and the Maple-Beech Forest(Figures 28, 29).

FIGURES 28, 29: ROBERT DORNEY'S FRONT YARD.[85]

84 Ibid.
85 -Ibid, pp. 420-3.

Despite the small size of the site -a crescent-shaped piece of land 32'x 60' (9.7 metres x 18.3 metres)-Dorney was able to employ around 125 species, including Red Maple *(Acer rubrum),*White Pine (*Pinus strobus*), Trembling Aspen (*Populus Tremuloides),* Red Oak *(Quercus borealis),* Yellow Oak (*Quercus muhlenbergii*), Grey Dogwood (*Cornus racemosa),* Nannyberry (*Viburnum lentago),* Elderberry (*Sambucus canadensis),* Raspberry (*Rubus* sp.) , Eastern Redbud *(Cercis canadensis),* Beech *(Fagus grandifolia),* and a selection of herbaceous woodland plants including Bellwort *(Uvularia* sp.), Maidenhair Fern *(Adiantum pedatum),* Solomon's Seal *(Polygonatum canalictulatum),* Wild Strawberry *(Fragaria virginiana),* Narcissus Anemone *(Anenome parviflora),* Cinquefoil *(Potentilla* sp.), Wild Colombine *(Aquilegia canadensis),* Milkweed *(Asclepias* sp.), Trillium (*Trillium* sp.), and Blue Cohosh *(Caulophyllun thalictroides).*

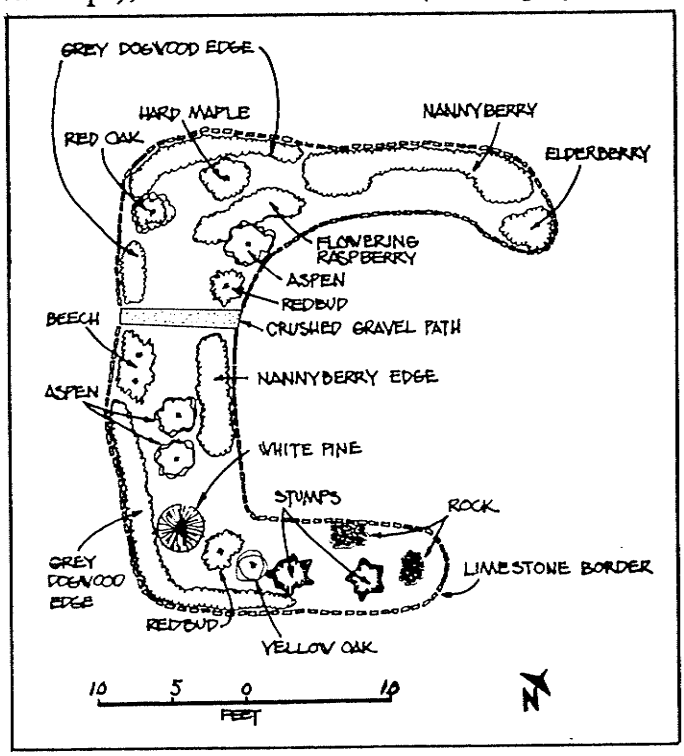

FIGURE 30: PLAN OF ROBERT DORNEY'S FRONT YARD.[86]

86 -Ibid., p.421.

An extensive plant list such as this is characteristic of Dorney's work and it is notable that, five years after planting, over 80% of the original species were flourishing. Much of this success may be attritubuted to Dorney's careful consideration of each plant's location with respect to it's relation to the surrounding plants and the various site and microclimatic conditions. In addition to the flora, Dorney also recognized the symbolic importance of other inanimate components to the composition, including, in this instance:

> ...the physical elements of this forest [which] were white pine or hardwood stumps, burned pine snags, occasional limestone blocks, pine stump fences or stone walls...[87]

This thoroughness, typical of Dorney, emphasizes the scientific/educational aspect of ecological design which was so important to him and which was so compelling in his work. As Dorney himself wrote, his aim was to create

> "...a landscape [in which] future naturalists would be able to discover nature for themselves on 1/100th of an acre rather than having to watch someone else's safari on T.V..[88]

Dorney was also involved in the development of perhaps the most visible of Canada's ecologically-based parks, Toronto's Ecology Park(Figure 31). This was initially a 0.2 hectare vacant lot located in the heart of downtown Toronto near the campus of the University of Toronto, first leased by Pollution Probe in 1984. The site, the "backyard" of the Pollution Probe headquarters, was developed by them with the intention of being a demonstration park for alternative landscape treatments, namely

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87 Ibid., p. 421.
88 Ibid., p. 423.

ecological design and edible landscaping. The land, leftover from the 1978 construction of the Spadina Street subway line, had remained undeveloped largely due to the proximity - 1.2 metres below grade- of two subway tunnels. An adjacent bus terminal contributed significant amounts of airborne pollutants to the site, while the sandy gravel soil overlying a layer of asphalt mixed with pockets of construction debris had no nutrient value. The site preparation included the removal of this underlying asphalt and its replacement with several truckloads of imported topsoil. Following this, an interim site planting of trees, shrubs, wildflower seeds and buckwheat and rye grass (as "green manure" to be tilled into the soil) was undertaken to fill the period between site clearing and final planting. This "occupation planting" was both a gesture of Pollution Probe's intentions for the site and a way of providing temporary visual relief for the derelict site until the final design was implemented.

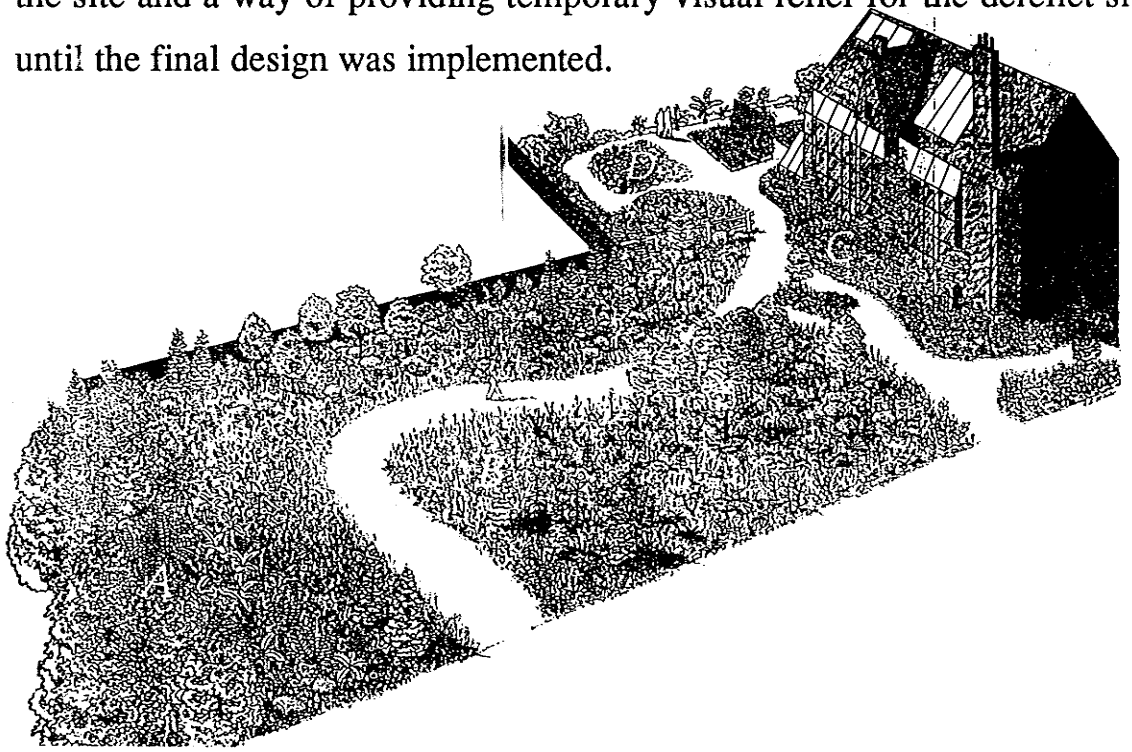

FIGURE 31: ECOLOGY HOUSE [89]

89 -from Ecology Park: A Site Guide (Toronto: Pollution Probe Foundation, 1988).

The program for the site included five major elements; Prairie, Woodland, Trombe Wall garden, Backyard garden, and the Pond(Figure 30). The prairie stretches across the frontage of the site and consists of alternating bands of Tall grass and shorter grasses planted so as to achieve the undulating effect often seen in true prairies. Beyond this a pathway through the site provides a transition between the prairie and the woodland, which covers most of the site. The woodland contains plants which would have been native to the Toronto area prior to European settlement.

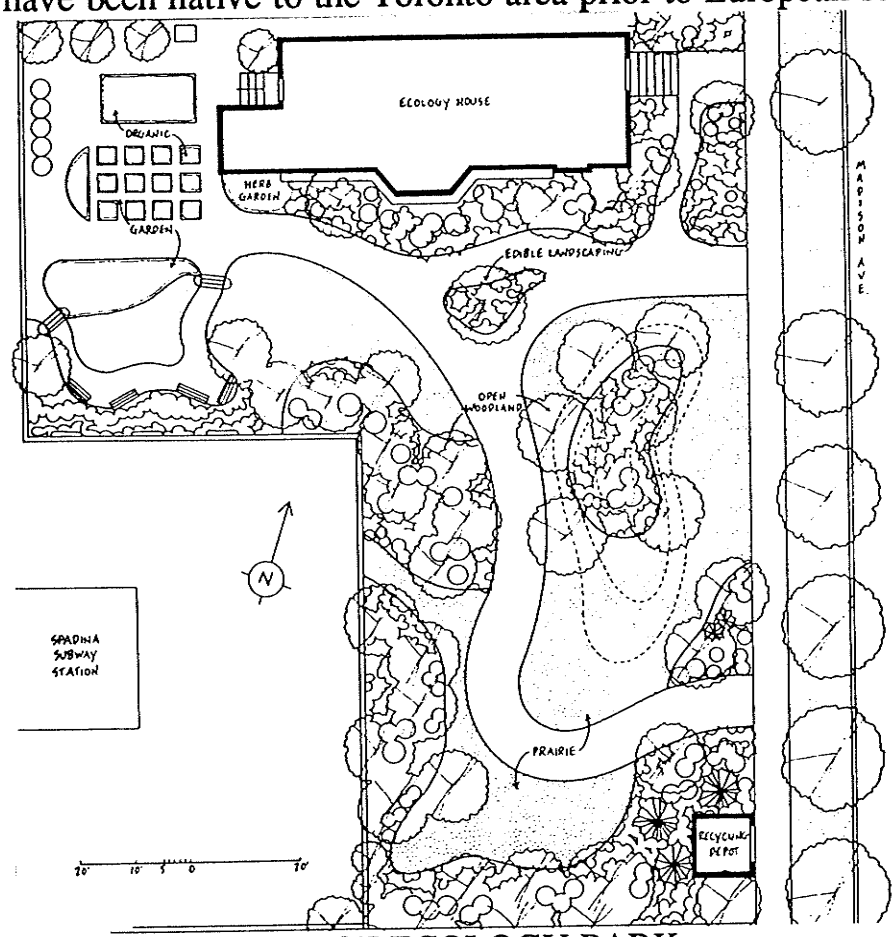

FIGURE 32: PLAN OF ECOLOGY PARK.

Plant specimens were obtained largely through "plant rescues" from development sites throughout the Toronto area. The Trombe Wall garden serves two purposes- as an example of foundation planting as a means of

improving the microclimate of buildings and as a food production area. The clinging vines alternately shade the building in summer and allow for passive solar heating in the winter, while the surrounding garden of fruit trees, herbs and edible groundcovers provides a sustainable food supply. The Backyard garden demonstrates the use of a variety of organic gardening techniques for food production. The adjoining Pond provides biological pest control through it's function as a habitat for beneficial insects and amphibians.

From its inception the park met with wide support from the community at large. Numerous donations of money and supplies from corporations, various levels of Government, and other organizations indicate, not only the success of Pollution Probe's fundraising mechanisms but, most importantly, the acceptance of the idea of an ecological park by the community. The park itself could never have been completed without the assistance of the volunteers who carried out every aspect of its design, planning and construction.

However the value of the park may be reduced somewhat through its temporary nature and, more significantly, through its largely passive educational role. From the beginning Pollution Probe was aware that the lease for the site was temporary, liable to be cancelled with one month's notice. At the most, the creators of the park felt that its life span, including the construction time, would be five years. This is a very brief time frame within which native plant communities can begin to establish themselves. Other similar projects suggest that three to five years is a realistic minimum period for invasive plants to be brought under control and the

visual characteristics of native communities to begin to fully develop.[90] As of this writing, however, the woodland and prairie elements have developed quite successfully, although maintenance is a problem as it is done strictly on a volunteer basis.[91]

The role of the park as a tool for educating the public about ecological issues as they specifically relate to the urban environment has been limited, especially in comparison with the London ecology parks (such as William Curtis Ecological Park) upon which the Toronto park is largely based.[92] Media interest in the project was significant, but with the exception of some informational brochures, very little in the way of outreach programming has been undertaken. However, the project differs from the publicly-funded British models in that it was carried out by a private sector organization without direct government sponsorship. Given the difficulty of such an approach, Ecology Park represents a significant step forward.

Michael Hough has long been a vocal advocate of the need for an ecologically-based design aesthetic throughout his writings, most notably in his influential 1984 book, City Form and Natural Process: Toward a New

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90 -Darrel Morrison, ["Prairie Grasses, Monarch Butterflies, Rose Hips...the 'Wild' Moves in on the Backyard", Landscape Architecture,Vol. 69, No. 2 (March 1979), pp. 144-5)], and Robert Dorney, ["The Mini-Ecosystem: A Natural Alternative to Urban Landscaping", Journal Landscape Architecture Canada (Architecture Paysage Canada), Vol. 3, No. 4 (December 1977), p. 62], both suggest a five year establishment phase should be expected for most naturalized plantings, especially in the case of prairie plantings.

91 -March 1990 correspondence with Henrietta Markus, former member of the Ecology Park steering committee.

92 David Gordon, "Toronto's Ecology Park" in Green Cities: Ecologically Sound Approaches to Urban Space, David Gordon, ed. (Montreal: Black Rose Books, 1990), p. 185.

Urban Vernacular.[93] At the centre of this book Hough explores the contradictions implicit in the two separate landscapes which coexist in every city- the cultivated landscape and the naturalized landscape. The cultivated landscape is the landscape of manicured lawns, trees, flower beds, fountains, and all the other elements that go to make up our "planned places". Systems such as these are reliant upon constant commitments of expensive time and energy towards both their creation and maintenance. On the other hand, the naturalized landscape is composed largely of those leftover pieces of land which are inevitably forgotten in the development process, including such areas as vacant lots, rail, road or transmission line rights-of-way, remnant forest land, and lots or fields awaiting development. These are the unplanned areas which thrive on neglect, which reflect the indigenous character of a region, but which are routinely overlooked as open space resources.

Hough advocates an approach to landscape design motivated by a concern for greater variety and regional identity within North American cities. He acknowledges the importance of the cultivated landscape in cultural terms as having, in his own words, "a high value in the public mind as an expression of care, aesthetic value and civic spirit."[94] However, he regrets the exclusion of the naturalized landscape from the urban environment, an omission which has contributed to the sameness of North American built environments. Nevertheless the naturalized landscape claims large areas of our cities and its continued suppression not only

93 Michael Hough, City Form and Natural Process: Toward a New Urban Vernacular (London: Croon Helm, 1984).
94 Ibid., p. 7.

consumes increasing amounts of time and money, but also eliminates a valuable resource. In Hough's words:

> ... all efforts are directed towards nurturing the [cultivated landscape] and suppressing the [naturalized landscape]. The rehabilitation of "depressed" or "derelict" areas involves reducing diversity, rather than enhancing it. The question that arises, therefore, is this: which are the derelict sites requiring rehabilitation? Those fortuitous ecologically diverse landscapes representing urban natural forces at work, or the formalized landscapes created by designers?[95]

For Hough the answer to this question is obvious and lies in taking maximum advantage of those fortuitous opportunities and resources which are already present in all urban environments. As a pragmatist Hough accepts the impossibility of "cultivating" the entire urban setting, and urges us instead to recognize and exploit the materials which are at hand. Throughout his writings, he oftens returns to a quote from Patrick Geddes to describe his priorities in urban design:

> Civics as an art has to do not with imagining an impossible no-place where all is well, but making the most and the best of each and every place, especially of the city in which we live.[96]

In support of this position, Hough examines the city with respect to each of four basic environmental characteristics- Climate, Water, Plants and Wildlife. In each section these environmental characteristics are examined as natural processes and as urban processes. A large number of examples

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95 Michael Hough, "Integrating Urbanism and Nature: A Basis for Education and Practice", Landscape Architectural Review, Vol. 7, No. 4 (September/ October 1986), p. 17.

96 Patrick Geddes, as quoted in Hough, City Form and Natural Process, p. 3.

are given of places where the natural and urban processes have been accomodated so as to work together harmoniously. For example, under the chapter dealing with climate Hough looks at the city of Stuttgart, where parks have been sited so as to accentuate the cyclical movement of fresh air from the surrounding hills into the valley within which the city is located. This has alleviated a serious air pollution problem which had previously affected Stuttgart as well as providing a network of green spaces throughout the city. Under "Water", he discusses LeBreton Flats in Ottawa where short-term stormwater drainage is provided by a dual purpose catchbasin/ play area. In the "Plant" chapter, the ecological designs at Delft and William Curtis Ecological Park are examined as well as the urban forestry programs of Zurich. Under the heading of "Wildlife", he looks at examples including the Toronto Outer Harbour Headland, a man-made spit of land in the middle of the Toronto harbour which has developed into one of the largest bird colonies in the region of the Great Lakes and a significant natural resource.

These and many other case studies from Europe and North America are discussed by Hough as showing positive directions for future urban development. The final section of the book examines methods which can begin to integrate the diverse environments and ecological factors to be found within cities. To a greater extent than Spirn's The Granite Garden, Hough presents an approach to urban design in which the city is approached as an integrated system having the potential to bridge and reinforce the continuum between man and nature. Whereas in the past other writers have focussed on the use of indigenous species and naturalized plantings as ways to achieve an ecologically sound design, Hough looks more at the system as a whole instead of just the component

parts. Included in this are such important considerations as cultural perceptions of landscape, which Hough values equally highly. Above all, the city must meet Hough's basic demands for Process, Economy of Means and Diversity as the esential elements in urban development. In his own words he describes his goals as follows:

> Design principles, responsive to urban ecology and applied to the opportunities the city provides through its inherent resources, form the basis for an alternative design language. They include the concepts of process and change; economy of means that derives the most benefit from the least effort and energy; diversity as the basis for environmental and social health; an environmental literacy that begins at home and forms the basis for a wider understanding of ecological issues ; a goal that stresses an enhancement of the environment as a consequence of change- an integration of human with natural processes at its most fundamental level.[97]

97 Ibid., p. 25.

PART TWO:

A PRIMER OF ECOLOGICALLY-BASED DESIGN

2.1 BASIC CONCEPTS OF ECOLOGY

The word 'ecology' has relatively recent origins, coined in 1850 by the German biologist and philosopher Ernst Haeckel, from the Greek derivatives *oikos,* which means 'house', and *logos*, or 'study'. The 'house' referred to is the natural environment, and the 'study' is of its inhabitants- organisms- and their relationships with their surroundings. Eugene P. Odum, a leading figure in the study of ecology, refers to the Webster's Unabridged Dictionary definition of ecology which describes it as "the totality or pattern of relations between organisms and their environment". Collectively, these organisms are known by the following terms: a population is the group of one type of organism, the collection of all organisms which live in a particular area is known as a community, while an ecosystem is comprised of the community of all the living (biotic) organisms and the non-living (abiotic) environment which they occupy. As these organisms are living, they respond to their environment which in turn responds to them. Being alive, the organisms are in a state of flux in that they are in constant need of materials to survive and they are always returning materials to the environment. Ultimately, of course, all is returned to the environment and in its turn is cycled through the system. As a result the living organisms which are part of an ecosystem are neither independent of each other nor of the physical and chemical components which complete the ecosystem. This leads to some complicated relations within the ecosystem which, at its simplest, can be represented by a diagram containing four elements- producers, soil, climate, heterotrophs- and the whole swirl of connections between them (Figure 33).

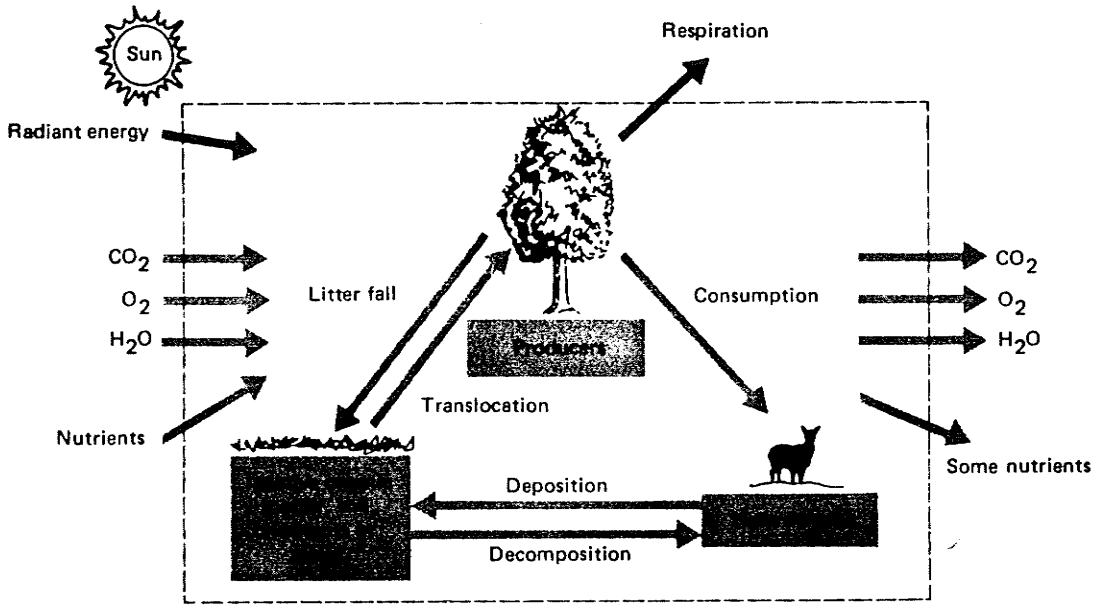

FIGURE 33: SIMPLIFIED DIAGRAM OF RELATIONSHIPS BETWEEN ORGANIC AND INORGANIC COMPONENTS[98]

The most important aspect of this diagram is what occurs in the areas between the four elements, the relations and dependencies which must be integral to any functioning ecosystem, interruption of any of which will lead to a breakdown of the system. Of this interreliance, Odum has the following to say:

> ...from the standpoint of interdependence, interrelations and survival, there can be no sharp break anywhere along the line. The individual organism, for example, cannot survive for long without its population any more than the organ would be able to survive for long as a self-perpetuating unit without its organism. Similarly, the

98 -from Eugene P. Odum, Fundamentals of Ecology (Toronto: N.B. Saunders and Co., 1971), p. 33.

community cannot exist without the cycling of materials and the flow of energy in the ecosystem.[99]

Therefore, cycles and their maintenance are among the most important priorities of any ecosystem.

Another important aspect of ecosystems is the unique position of component organisms within the system. An ecological niche refers to the physical space, both above and below ground, occupied by an organism and also to its position in relation to the environmental factors of temperature, light, soil, moisture, ph and other elements. Every organism, whether individual or community, occupies a specific place in a gradient of these factors within the ecosystem, a place that is not occupied by any other organism. Effectively they are subdividing the habitat, each exploiting it in a different manner. For example, since photosynthesis is a key element in the survival of green plants, the ability to exploit available light resources is essential for each plant. Some plants have developed an ability to tolerate the low light levels that result from shading by others, while all species differ in height, shape and leaf arrangement. The variation in levels throughout the ecosystem is known as stratification. In a woodland environment the highest level is the canopy species which, by blocking much of the sunlight and precipitation from the lower species play a significant role in altering the environment. Below are the understory plants which must take full advantage of the early spring when they are able to receive enough sunlight to reproduce. Each of these differences results from competition as plants struggle to exploit their own ecological niche. The effects of competition, specifically the competitive exclusion

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99 Ibid., p. 5.

principle, ensures that two species cannot coexist in the same specific habitat indefinitely. The simple fact that they are exploiting similar basic resources will lead to the diminishment and eventual crowding out of either one of the species.

Ecosystems operate in relatively predictable and reliable routines given the variables which may be affecting them. The principles of ecological succession give a theoretical framework on which to build a model of ecosystem development. Of course, ecosystems do not develop in a strictly linear manner, there are many complex processes occurring simultaneously, sometimes in opposition, which ensure that any processes will be continuously evolving and impacting upon each other. Overall, however, ecosystems do develop in accordance with a number of theoretical assumptions about their behaviour. Odum identifies three parameters of ecological succession which help in understanding ecosystem development.[100] The first is that ecological succession is an orderly, relatively directional process of community development involving changes in species structure and community processes over time. This is therefore a pattern which can be predicted. The second is that succession results from modifications made to the physical environment by the community itself. In other words, the community triggers succession and makes it possible, even though the physical environment determines the form and rate of development and often limits the extent of development. The third parameter is that development tends toward a stabilized ecosystem which maintains both a maximum biomass and symbiosis between organisms in relation to the amount of total energy available. An ecosystem naturally evolves towards the greatest, most complex biomass which can safely and securely be supported by its physical environment. The system starts out at a pioneer stage and proceeds inexorably towards the climax stage, in which an equilibrium between the biotic organisms and the abiotic environment is

100 -from Eugene P. Odum, "The Strategy of Ecosystem Development", Science, Vol. 164, No. 3877 (April 18, 1969), p. 262.

reached. It follows then that the "'strategy" of ecosystem development', to use Odum's phrase, is increased control of the physical environment through a process of minimizing disturbances.

2.2 *ECOLOGY IN THE BUILT ENVIRONMENT*

The physical difficulties which natural communities and urban dwellers alike must surmount are considerable, including hostile air, water, climate, and soil conditions.Urban climatic conditions are markedly different from the surrounding countryside, being typically characterized by increases in temperature, wind speeds, particulate and gaseous pollutants, and by a decrease in the quality and quantity of usable ground- and surface-waters.

Temperature in urban areas is affected by reflection and trapping of solar radiation and by heat emissions from buildings and vehicles. The effects of these factors within the vertical concrete environment of the city can be dramatic. The reflective qualities of concrete, the absorptive capabilities of asphalt, and heat emissions from vehicles and buildings can all contribute to an overall temperature difference of up to 20° F between the city and its suburbs.[101] This phenomenon, known as the "urban heat island"[102], is further characterized by the cycling of warm urban air back out into the surrounding countryside. This warm urban air rises in a column which carries with it suspended particulate pollutants. These minute particles attract moisture which condenses as fog, eventually thickening to become smog, which itself affects air quality and increases the air temperature. Through this process cities begin to generate their own self-perpetuating climatic conditions. On a large scale, both Spirn[103] and Hough[104] describe how cities such as Stuttgart have positively affected the

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101 Anne Whiston Spirn, The Granite Garden: Urban Nature and Human Design (New York: Basic Books Inc., Publishers, 1984), p. 52.
102 William P. Lowry, "The Climate of Cities", Scientific American (August 1967).
103 Spirn, pp. 82-5.
104 Hough, City Form and Natural Process, pp.59-63.

temperature and quality of their urban air. In Stuttgart this was accomplished through by creating a interconnected and functional open space system which serves as "fresh air channels" for the city, allowing for the constant exchange of air from countryside to city. On a smaller scale, these conditions can be mitigated simply through the use of canopy vegetation which provides shading. For example, street trees alone can reduce the effects of incoming solar radiation to the extent that temperatures beneath the canopy can be 10° F lower than in the open.[105] This cooling effect is most noticeable when the trees are used in large masses which maximize the canopy area, instead of the individual specimens which are more commonly used .

Wind speeds in the city are stronger and more erratic due to the effects of tall buildings and long straight roads. High wind speeds give rise to the dust-blown conditions of summer and the chilling winds of winter which can have such a significant effect on all forms of urban life. Unpleasant conditions for humans often translate into near-impossible conditions for natural plant communities, as the stunted trees on windy city corners will attest. As well, buildings must be equipped to cope with tremendous heat losses through the cooling actions of wind, adding to their increased reliance upon expensive mechanical systems. Simple measures such as the planting of shelter belts of trees can reduce wind speeds by as much as 50%, while large blocks of woodland plantings can have even more significant effects. Winnipeg in particular is exposed to the full force of winds, prompting Garry Hilderman, a local landscape architect, to call

105 Spirn, p. 52.

for the planting of large masses of Trembling Aspen to serve as indigenous "natural wind sponges"[106] for the urban area.

Urban air contains pollutants, both particulate and gaseous, which can poison organisms or block systems. These air-borne pollutants are a fact of life which are most effectively treated at the source, but they can also be filtered and reduced by plants. The efficiency of plants in gas exchange also makes them able to process pollutants. Trees, for example, having ten times the surface area of the ground beneath them can act as effective sinks for gaseous pollutants. One study has shown that a 15 inch (38.1 centimetre) diameter Douglas Fir is able to remove 43.5 pounds (19.7 kilograms) of air-borne sulphur dioxide per year without any damage to the tree.[107] Levels of other gases occurring along roadsides, such as carbon monoxide, can also be reduced through the actions of plants.

The hydrological cycles within cities differ from those of more natural environments in the extremities of their effects. The combination of extensive concrete or asphalt surfaces and drainage systems designed for rapid removal of surface circumvents the natural hydrological cycling which would otherwise be taking place. The sealing up of porous surfaces with hard paving reduces infiltration of runoff which is necessary for the replenishment of groundwater supplies in the soil. The chances of localized flooding and erosion can be increased by drainage systems which rapidly collect water at specific collection points. However, once this water enters the drainage system it is quickly removed from the environment to a location where it can do no harm to the city, but where it is also of no

106 M. Garry Hilderman, "Aspens can Make Effective Wind Sponges for Prairie Cities", Winter Cities Newsletter, Vol. 6, No. 4 (August 1988), pp. 23-4.
107 Michael Hough, City Form and Natural Process, p. 43.

benefit. This translates into less water available for plants and other organisms, and a continued reduction of groundwater supplies. In addition, the surface water which may be available to natural communities in the form of natural impoundments or as runoff is often poisoned with a variety of pollutants.

Urban soil, where it can be found, is not a very hospitable medium for any plants. Roadside soils are polluted with contaminants such as lead, from automobile exhaust, or salt, from winter spreading, while fertilizers, herbicides and pesticides all accumulate in the soil away from roads. Compaction of soil through the weight of buildings, automobiles, paving and people is a serious problem in all urban areas. Spirn points out that while an ideal soil composition is fifty percent minerals and humus and fifty percent pore space filled with air and water, typical urban soils have only thirteen percent pore space.[108] By reducing the pore space in the soil this causes a number of problems for natural communities, among them the inhibition of root growth, a reduction in the movement of air and water through the soil, and the elimination of the microorganisms which are essential for plants. Finally, through the disturbances brought on by construction and development, urban soils lose their natural soil horizons and must be expensively "improved" with imported topsoil. This is a poor substitute for the naturally developed soils which have been formed specifically by and for that environment.

Traditional landscape designs have been sustained in this hostile environment only through the expensive and ongoing importation of plants, soils, water, and chemicals. These landscapes are historically based on an

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108 Spirn, p. 105.

incomplete understanding and application of ecological principles. The end result has been overly simplified and artificial landscape environments. These communities do not use the available resources in an efficient manner, and they leave holes in the ecological strata which are rapidly filled by invasive weeds. Combatting these native or exotic weeds requires intensive long-term maintenance programs of weeding, watering, and fertilizing which must be uninterrupted to be effective. Of course, continuing these well-entrenched maintenance practices is an expensive, labour-intensive prospect. The City of Winnipeg Parks and Recreation Department has compiled maintenance cost comparisons for four levels of park development.[109] The highest level, containing heavily-used "showcase parks" which require the most extensive maintenance, has annual costs of $10,103.00 per hectare. This pays for the maintenance of lush, weed-free turf and of horticultural features such as flower, shrub and tree beds. In contrast, the lowest level of park development costs just $603.00 per hectare per year to maintain. Included in this latter category are such "nature parks" as Assiniboine Forest and Living Prairie Museum. All that is required in these parks is infrequent mowing (only where necessary) and biweekly litter collection. Installation and initial maintenance costs of new ecological landscapes may be equal to or higher than traditional landscapes, but over time the costs of the ecological landscape diminish. For example, Robert Dorney has examined the relative costs of installation and maintenance of an ecological landscape on a 0.2 ha site in Southern Ontario.[110] On this small site, Dorney converted the existing sod to a

109 -City of Winnipeg, Parks and Recreation Department memorandum, September, 1990.
110 Robert S.Dorney, "Costs of Woodland, Lawn Restoration and Maintenance Compared (Ontario)", Restoration and Management Notes, Vol. 1, No.4 (1983), pp. 22-3.

woodland ecosystem typical of Southern Ontario. His findings indicate that, while the initial installation and maintenance costs of the woodland were competitive with an equivalent turf landscape, these costs sharply declined with time, so that by the fifth year and beyond, as the site became established, the woodland became progressively less expensive to maintain. On a larger scale, the City of North York has since 1982 been converting existing ornamental parkland to low-maintenance naturalized woodland landscapes. For purposes of comparison the two landscapes were planted simultaneously beside each other and their costs of installation and three years of follow-up maintenance were recorded. The ornamental areas were planted with large specimen size trees and shrubs while the naturalized woodland areas used mass plantings of native seedlings.Through this program they have been able to reduce the costs of installation and three years maintenance from $44,028.00 per acre ($17,825.00 per hectare) for formal, manicured parkland to $4,800.00 per acre ($1942.00 per hectare) for the reforested parkland.[111] This factor alone provides a persuasive argument for the introduction of ecological designs.

However, as most ecological design advocates point out, all cities already have an extensive and self-sustaining natural environment that remains ignored and forgotten. This resource is the unseen naturalized landscapes which flourish quite independently throughout the city, usually as a direct function of man's absence. From an address given by Anne Whiston Spirn comes the following, representative observation:

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111 William Granger, "Naturalizing Existing Parklands" in Green Cities: Ecologically Sound Approaches to Urban Space, David Gordon, ed. (Montreal: Black Rose Books, 1990), p. 108.

> Bits of untended nature linger in forgotten corners of most cities in vacant lots, abandoned quarries, wet lowlands, and old estates. These natural areas are frequently more expressive of the special character of a particular city- its geologic origins, topographic setting, and native vegetation- than its manicured parks.[112]

From the weeds colonizing a vacant lot or pushing through the sidewalk's cracks, to a puddle of standing water in a poorly drained lot, or to the raccoons or deer which suddenly materialize in the car headlights on a dark street- natural systems are at work in cities, adapting a hostile habitat into something that will provide sustenance and give support. A German study goes so far as to suggest that these naturalized urban landscapes will be the prevailing ecosystems of the future, due to their vigour in adapting to the ever-widening effects of urbanization.[113] It is important to take advantage of the strengths which these urban-adapted organisms have to offer and to recognize from their example that, as with all organisms, they do not live in isolation but are parts of a community which is part of an ecosystem. Seizing this opportunity to discover, create and, in some cases, preserve the conditions under which ecosystems can prosper is the key to ecologically-based design.

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112 Anne Whiston Spirn, "The Role of Natural Processes in the Design of Cities" in Changing Cities: A Challenge to Planning- Annals of the American Association of Political and Social Scientists 451 (September 1980), p. 103.

113 H. Sukopp, H. Blume, and W. Kunick, "The Soil, Flora and Vegetation of Berlin's Wastelands" in Nature in Cities, Michael Laurie , ed. (Toronto: John Wiley and Sons, 1979), pp. 115-32.

2.3 ECOLOGY IN THE DESIGNED ENVIRONMENT

Ecologically-based design is more than simply designing landscapes as ecological systems, it also implies a complete view of the idea of "landscape". For example, Michael Hough laments the narrow view which has led to public open space becoming almost solely the domain of recreational pursuits, at the expense of any environmental or productive functions which might be served.[114] Culturally, our perceptions of open space have become limited and, accordingly, our expectations have been lowered. Most of the proponents of an ecologically-based landscape approach are in agreement that ultimately a new aesthetic is needed, one that embraces rather than curtails the possibilities of a landscape. It is along these lines that Anne Whiston Spirn has suggested the following definition, emphasizing the importance of the perception of ecologically-based landscapes:

> This is an aesthetic that celebrates motion and change, that encompasses dynamic processes, rather than static objects, and that embraces multiple, rather than singular visions. This is not a timeless aesthetic, but one that recognizes both the flow of passing time and the singularity of the moment in time, that demands both continuity and revolution. This aesthetic engages all the senses, not just sight, but sound, smell, touch, and taste, as well. This aesthetic includes both the making of things and places and the sensing, using, and contemplating of them.[115]

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114 Michael Hough, City Form and Natural Process, p. 14.

115 Anne Whiston Spirn, "The Poetics of City and Nature: Towards a New Aesthetic for Urban Design", Landscape Journal, Vol. 7, No. 2 (Fall 1988), p. 108.

For Spirn, landscape design based on ecological principles can lead to a more holistic experience of the natural environment. Catherine Howett, in the article "Systems, Signs, Sensibilities: Sources for a New Landscape Aesthetic", also welcomes what she describes as "an expansion, not a diminishment, of sensibility"[116] that comes from ecologically-based design. She too sees it as being essentially a dynamic, process-oriented technique which springs from a realistic and contemporary understanding of nature, resulting in a more accurate and honest portrait of the natural world:

> ...a model that emphasizes process over time and authentic patterns of growth as an alternative to an artificial appearance of closure, of static and idealized perfection.[117]

Owen Manning, one of the British practitioners of ecologically-based design, is more specific in his choice of words, defining his approach in concrete terms that still manage to impart the character of these environments:

> ...An approach which seeks to substitute for the restricted, artificial and expensive creations of conventional design, a looser and apparently more natural landscape, marked by species-diversity, structural complexity and freedom of growth, and achieved above all by the use of indigenous vegetation sensitively managed in order to exploit natural growth processes (especially successional) and the natural potential of the site.[118]

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116 Catherine Howett, "Systems, Signs, Sensibilities: Sources for a New Landscape Aesthetic", Landscape Journal, Vol. 6, No. 1 (!987), p. 7.

117 Ibid., p.6.

118 O.D. Manning, "New Directions 3: Designing for Man and Nature", Landscape Design 140 (November 1982), p. 30.

Implicit to all of these definitions is the importance of process, of change, of materials and techniques that are, if not indigenous, then at least ecologically appropriate. At the heart of ecologically-based design lies an understanding of the site and the processes which are acting and interacting upon it. Site inventory and evaluation, especially within the local or regional context, naturally takes on a far greater role in ecologically-based design. Darrell Morrison emphasizes the importance of this awareness with five basic ground rules that can be applied to all ecologically-based designs.[119]

1. Know the Community

The first rule is that the designer must know as much as is possible about the community that is being modeled. Details such as species composition, soil requirements, and climatic conditions are essential as well as information about the structural composition and organization of the ecotype.

2. Know the Site

The second rule deals with the importance of detailed site information and analysis. Environmental factors and site conditions will play the significant role in the evolution of the design.

3. Match the Community to the Site

Once the site and the appropriate communities are sufficiently understood, the designer must match the two, paying particular attention to the microconditions on the site such as microclimate and soil variations. These represent opportunities to vary the overall design scheme and introduce greater diversity.

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119 Darrell Morrison, "Restoring the Midwestern Landscape", Landscape Architecture, Vol. 65, No. 5 (October 1975), p. 403.

4. Anticipate Change

Morrison refers to the initial site planting as only a "framework" which allows for natural processes of reproduction and spreading to take place. Within this context invading species should also be expected and, as much as may be possible, planned for. These changes should be anticipated and, in some cases, may be initiated. It may be necessary to consider phased development, for example in the form of additional plantings of varying sizes, as the design evolves.

5. Skilled Maintenance

The highly disturbed setting of most ecological designs in their early phases makes them an inviting environment for invading weeds. Identification and suppression of these plants will allow for the survival of the intended species and reduce the liklihood of negative public perceptions. This will require highly skilled maintenance particularly in the first few years of a project.

In addition, techniques of bioengineering will naturally play a far greater role in ecological design. For example, soil improvements can be accomplished through the importation of topsoil, but other techniques such as using nitrogen-fixing legumes will contribute far more to the long-term functioning of the community. Vegetation can also be employed as a type of 'building material', to be used in aiding slope and soil stabilization. Hydrological cycles already in existence on a site can be maintained and improved through enhancement of existing channels and maintenance of floodplains, or they can be augmented through the construction of new temporary floodwater retention areas. Beyond this, however, there are a number of distinct ways of treating a site within an ecologically-based framework. All are similar, differing mainly in the degrees to which their

principles are applied. In general, there are five broad categories of ecological design using plants, loosely adapted from categories described by A.D. Bradshaw[120] and Cynthia Cohlmeyer.[121] These categories are:

1. Scientific Replication
2. Restoration
3. Incorporation
4. Naturalization
5. Indigenous Planting

1) Scientific Replication

Scientific Replication refers to the task of constructing a copy of an ecotype native to the region. Strictly speaking, this would represent a model of the community as it existed in the pre-settlement period before man had managed to disturb the site. In this sense this category is a practical impossibility, due to the significant and irreversible changes which man has brought to the native environment. For example, the impact both of prairie fires and trampling by the Buffalo herds, which played such integral parts in the ongoing structural development of the Tall grass prairie, are factors which no longer exist and for which adequate substitutions can not easily be made. Similarly, in many instances the exact species composition of these ecosystems can only be approximated due to a lack of direct knowledge about their original composition. Cohlmeyer[122]

120 A.D. Bradshaw, "Ecological Principles in Landscape" in Ecology and Design in Landscape: The 24th Symposium of the British Ecological Society, A.D. Bradshaw, D.A. Goode & E.H.P. Thorp, eds.,(Oxford: Blackwell Scientific Publications, 1986), pp. 15-36.
121 Cynthia Darling Cohlmeyer, The Aspen Parkland and its Application to Landscape Design, (Winnipeg: Unpublished Master's Practicum, Department of Landscape Architecture, University of Manitoba, 1977), pp. 71-5.
122 Ibid., p. 72.

cites the Curtis Prairie in Madison, Wisconsin as a notable but inherently flawed example of a replication of Tall grass prairie (flawed to the extent that the site is not true Tall grass prairie but only a man-made approximation of the modern ecotype). Nonetheless, she describes it as an important resource in the sense of being a natural laboratory which affords a controlled study opportunity.

2) Restoration

In the process of Restoration the task is simplified somewhat by the fact that the native community is already existing but has been threatened or adversely affected by human factors. Where it is necessary, the restoration of the diversity and health of the community is accomplished by replenishing the populations of the community and attending to the health of the abiotic environment by addressing any negative human influences on the site. In many cases the site may require only minimal intervention but is in need of future protection. In such cases community functioning is allowed to proceed as before with monitoring to ensure environmental degradations do not occur. In Winnipeg, the Living Prairie Museum is an example of a community that, by being saved from development for preservation as a living ecological museum, was restored.

3) Incorporation

Incorporation takes Restoration one step further by combining existing indigenous communities with newly designed and developed landscape communities. The existing materials and features are then managed or manipulated to meet the designer's ends. This is a long-standing tradition in landscape design combining the best of the natural and built environments, as the following ironic passage from the notebooks of Frederick Law Olmsted indicates:

"The landscape architect André formerly in charge of the suburban plantations of Paris was walking with me through the Buttes-Chaumont Park, of which he was the designer, when I said of a certain passage of it,'That to my mind, is the best piece of artificial planting of its age, I have ever seen.' He smiled and said 'Shall I confess that it is the result of neglect?'"[123]

It is important, however, that the incorporation of these natural areas be carried out with the long-term health of the community in mind. Often, as a consequence of development, such important environmental factors as drainage, microclimate, edge conditions, and increased adverse human contact are altered to the extent that the future viability of the native community is compromised. In these situations the designer has the power to save or destroy the ecosystem according to how well the ecological relationships already in motion on the site are acknowledged and maintained in the new designed arrangement.

4) Naturalization

The technique of Naturalization is an urban hybrid that is similar in approach to Incorporation with the exception that the natural community being preserved does not represent an indigenous ecosystem. The products of human activities, these communities are found exclusively on disturbed land, they are the colonizers of vacant lots across every city. In species composition these communities differ from the native ecosytems they have displaced but functionally they are typical of early successional ecosystems which are able to successfully exploit the disturbed conditions of urban

123 Frederick Law Olmsted, as quoted by Robert Smithson in "Frederick Law Olmsted and the Dialectical Landscape" in The Writings of Robert Smithson, Nancy Holt, ed.,(New York: New York University Press, 1979), p. 117.

sites. Initially, they are predominantly composed of pioneer annual and biennial plants but within a few years these are forced out by perennials which, in turn, eventually give way to trees. Spirn describes this process in these terms:

> As succession proceeds, organic material accumulates, shade and soil moisture increases, soil structure develops, mineral cycling is enhanced, and temperature variations moderated. The original "weeds" are urban resources which require no fertilization and no soil amendments and whose energy may be harnessed and directed.[124]

These communities, which Michael Hough refers to as the "Naturalized Urban Plant Community"[125], are held in high esteem by many ecologically-minded designers due to the resilience and omnipresence which, it is argued, makes them worthy of serious design consideration. British designers, in particular, are enthusiastic about the possibilities offered by naturalized communities (to a large extent this is a pragmatic response to the widespread physical and social deterioration of Britain's inner cities). Jane Smart, writing in the British journal Landscape Design, refers to these communities as "urban commons" which can even be viewed as a unique form of "urban countryside."[126] However, the strengths of the naturalized communities can also be their weaknesses. On the one hand, they are a varied and self-perpetuating natural resource but on the other they can often have a public perception as eyesores due to their vigourous and unchecked growth. Responses to this problem can include giving special attention to the integration of the site with its surroundings, educating the

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124 Anne Whiston Spirn, The Granite Garden, pp. 187-8.
125 Michael Hough, Ibid., pp. 117-24.
126 Jane Smart, "Species-Rich Sidings", Landscape Design, No. 182 (July / August 1989), p. 43.

public so that people become aware of the relative richness and diversity of these communities, and ensuring through design intervention that such environments are recognizable as planned and managed natural resources.

5) Indigenous Planting

A compromise approach, Indigenous Planting seeks to create designed ecosystems using a majority of plants and landscape forms that are native to the particular region. To the extent that ecosystems are not copied exactly this is a less rigorous technique than Scientific Replication, but nevertheless a good understanding of the species and the composition of various native communities is required. In some cases a representation of a particular native community might be accomplished through the employment of a few carefully chosen dominant species. The landscape could be complete in itself or it might simply be a singular component within a larger composition. An example of this latter approach is Darrell Morrison's design for the CUNA Mutual Insurance grounds in which the native woodland and prairie plantings were used to augment the more conventionally landscaped turf and terrace areas.

Overall, general landscape design principles will apply to ecologically-based designs. Specific techniques tend to be greatly dependent on the particular characteristics of site and community, but certain techniques are common to the wide range of ecological designs. Site preparation is important to the success of any design and this is particularly true of ecological designs where the community is intended to be essentially self-sustaining. From the start the landscape should be able to efficiently exploit all the abiotic materials at its disposal, therefore it is important that these be easily accessible and present in sufficient quantities. As well, working with the potential of the site rather than imposing wholesale

alterations is more in keeping with the guiding philosophies of Self-sustainability and Economy of Means. Wherever possible and desirable the existing site conditions should be preserved and taken advantage of. Environmental factors such as drainage, slope, exposure, ph, existing structures and vegetation can provide opportunities for localized habitat variations and ecological niches. Soil conditions, in particular, are crucial to the functioning of the designed ecosystem. A problem with most disturbed sites is that the soil horizons are destroyed as a result of the compaction and disturbances caused by grading. Traditionally the response to this has been to add a layer of topsoil to the site or to the planting holes. However some designers, the British and Dutch in particular, insist that no topsoil should be added to the site. For their purposes, which are usually in categories such as Incorporation or Naturalization which are not concerned specifically with indigenous species, their findings are that the most species-rich communities are found in soils that are low in nutrients but that will retain moisture.[127] These soil characteristics will ensure the suppression of vigorous plants that might otherwise take over the community. The colonizing vegetative communities will then immediately begin to act upon and transform the soil. As A.D. Bradshaw writes:

> Indeed soil, as we know it, is only developed under a vegetation cover....Yet in much recent work in urban areas this fact is nearly always forgotten, and topsoil is imported at great expense when

127 Allan R. Ruff, "Holland and the Development of an Alternative Landscape" in Landscape Design with Plants, Brian Clouston, ed.(London: Heinemann, 1977), p. 122.

plants could do the job of soil improvement at a fraction of the cost.[128]

Where necessary, soil structure can be improved through the incorporation of peat into the subsoil. The most important consideration is to prepare the subsoil as a base by removing the topsoil and any unwanted vegetation. Pockets of varied subsoil materials such as sand and rubble may also be introduced so as to create localized diversity. These variations in subsoil texture, together with changes in gradient in relation to the water table, create environments that are hydric, mesic or xeric. (A hydric environment is defined as an area that collects water from adjacent areas and which has standing water for most of the year, a mesic environment is one in which precipitation soaks in and which neither collects runoff nor has standing water, the xeric environment is characterized by rapid runoff or percolation of precipation.[129]) Of course, these different moisture regimes will support completely different ecosystems across the site, adding to the natural variety of the landscape. Many of these European approaches to ecologically-based design borrow techniques developed for the reclamation of severely degraded landscapes such as surface-mined sites or abandoned industrial landscapes. As such their intentions lie in the revegetation of the site without paying much attention to particulars of native ecotypes or species composition.

In contrast, North American approaches tend to be more discriminating in the use of indigenous species and ecosystems. Under these circumstances North American designers tend to place more emphasis on

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128 A.D. Bradshaw, "Landscapes as Ecosystems" in An Ecological Approach to Urban Landscape Design, Allan R. Ruff and Robert Tregay, eds.(University of Manchester: Department of Town and Country Planning, Occasional Paper #8, 1982), p. 14.
129 Cynthia Cohlmeyer, Ibid., p. 38.

the importation of topsoil, and the importance of matching such factors as the soil moisture regimen, nutrient, acidity and textural requirements of the ecosystem being modeled. Site preparation is still important, the goal being the suppression and eventual elimination of weeds and dormant seeds. For small sites, Dorney recommends covering grass and weeds with a dense carpet of newspaper to a depth of about 6 millimetres, approximately eight months in advance of planting. Following this period the ground should be relatively free of weeds and the disintegration of the newspaper will provide organic detritus.[130] Larger sites with grass and weeds will need to have the soil turned several times and the weeds and grass removed, or a summer fallow technique can be adopted prior to a fall planting. It is important that the soil be turned over more than once to ensure that dormant seeds still in the soil can germinate and be destroyed. On large sites with a lot of weed growth a sequence of herbicide spraying followed by tilling, repeated three to five times in the year prior to planting, may be necessary to eliminate weeds that would otherwise persist.

Following soil preparation the plant communities are selected and introduced to the site. The most important factor in planning planting compositions is that, in order for them to be self-sustaining, the community structure must be respected. This can be modeled on the available information on the ecotypes of the region. There are a number of specific techniques of planting and community development being continually explored that are beyond the scope of this practicum. Planting techniques including specimen planting, mass plantings of whips, direct seeding, fortuitous revegetation, and the use of nurse species such as Aspen, or

130 Robert S. Dorney, A Guide to Natural Woodland and Prairie Gardening (Waterloo, Ontario: Natural Woodland Nursery, 1978), p. 30.

cover crops such as Canada wild rye, are all successful under different conditions. In general, Woodland plantings are put in at high densities with additional plantings of seedlings or herbaceous material being phased in over a period of a few years. It is important that these plantings have an appropriately broad species composition. This means that a variety of species should be planted, with species from both the pioneer and mid-successional stages represented. A popular technique is to use mass plantings of whips such as Aspen or Alder which are often planted in advance of other development on a site. This technique was employed with great success in the three years prior to construction of the housing project at Warrington in Britain. In this type of new housing application such a preestablished wooded landscape can make a great difference in environmental quality. Usually with this approach the landscape development will take place over several years, in the case of Warrington at least eight years. The woodland framework is treated as a medium to be shaped and to which new components are progressively added.

In contrast, landscape designs containing prairie grasses and forbs are usually grown from seed and allowed to develop their final form over time, although both prairie sod and seedlings have been used in smaller-scale applications or as sections within larger projects. Darrel Morrison has experimented with many prairie establishment techniques, most of which involve using a seed drill or hand-broadcasting the large areas. Into this base seeding Morrison selectively plants what he refers to as "islands" of forbs, seeded and/or transplanted throughout the site to serve as focal points.[131]

131 Darrell Morrison, "Case Study: A Prairie Decade", Landscape Architecture, Vol. 73, No. 3 (May/June 1983), pp. 86-7.

Techniques of Naturalization involve some type of fortuitous revegetation which, in most cases, requires encouragement and directing. However, many of the naturalized European sites are simply left to develop as spontaneous pieces of semi-wild landscape with very little human intervention. The views expressed by the Dutch authors H.J. Bos and J.L. Mol. are representative of this approach:

> In new building areas, native greenery develops in between the housing blocks during and after the building....This green space has otherwise for the greater part, little biological or ecological value. The specific value of allowing native vegetation to develop is that the area is made green![132]

For the most part, North American ecological designers follow a more rigorous approach recognizing the importance design has to the functioning of these spaces as urban objects and to their public acceptance as such. Michael Hough often emphasizes this point in his writings:

> One of the problems of naturalization, in terms of its public acceptance, is the fact that it is not seen in design terms. It is always seen as the kind of biological approach of leaving things alone without any basic design structure....that makes naturalizing look purposeful, rather than simply abandoned.[133]

Management of the natural communities to ensure variety and interest is one important means of accomplishing this, but essentially the community must, within limits, follow an anticipated and designed pattern. Aesthetic considerations can be combined with the physical requirements of the

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132 H.J. Bos and J.L. Mol, "The Dutch Example: Native Planting in Holland" in Nature in Cities, Ian C. Laurie, ed.(Toronto: John Wiley and Sons, 1979), p. 400.

133 Michael Hough, "Naturalizing Parks and Nonpark Open Spaces" in Green Cities, David Gordon, ed., p. 96.

ecosystems to guide this process. Just as species have particular roles within their physical environment, they must have roles within the design beyond the merely functional. For example, edge species can play three important and distinct roles within a composition. Firstly, in ecological terms, they constitute one of the most diverse parts of a natural community. Second, in aesthetic terms, the edge species provide a visual transition between the urban outside and the 'natural' inside. And third, in cultural terms, typical edge species such as Hawthorn (*Crataegus rotundifolia*) or Wild Rose (*Rosa* sp.) are thorny, thus providing a natural barrier to disturbances from intruders.

All forms of ecologically-based design, whether they involve starting from scratch or from an existing naturalized community must include elements that are familiar along with the unfamiliar and unexpected. This will give ecologically-based designs the stamp of legitimacy that people demand from their outdoor spaces. In time, people may come to see that, in Catherine Howett's words, "what is being called for is an expansion, not a diminishment, of sensibility."[134]

134 Catherine Howett, "Systems, Signs, Sensibilities: Sources for a New Landscape Aesthetic", Landscape Journal, Vol. 6, No. 1, p. 7.

PART THREE:

SITE SELECTION CRITERIA

SITE SELECTION CRITERIA

Throughout this practicum I have endeavored to examine the philosophy and application of ecologically-based design to ordinary, everyday urban open space situations. Through the site selection process a similar direction was followed so that principles and practices examined within the written component of the practicum could be applied to a typical and representative urban site. Towards this end I felt it was important that the site be of a type which could just as easily be found in any urban centre across Canada. In this respect a site located alongside the Red or Assiniboine Rivers would be geographically unique to Winnipeg, and for that reason would be less suitable. For the purposes of this study, a site that is physically undistinguished provides a demonstration model that has more universal applications. Of course, as the subject is "urban" ecological design, it was also important that the site be located within a distinctly urban setting dealing with urban issues. The size of the site was not an issue, however, the larger the site the greater the opportunities for demonstration of a variety of communities.

In a development of this type, user impact on the natural communities is a very real factor which has the potential to threaten the viability of the design. This can be addressed and solved through design decisions but the context and nature of the site can also play a significant role. To this extent an ideal site would be one with a great deal of visual access and provisions for some physical access, but with limits on uncontrolled access that might have a negative impact on the communities. On a site such as this, the designed communities can then be protected from the disruptions of intensive on-site activities.

In addition to these contextual issues, the site type was also an important factor. As many of the advocates of ecologically-based design point out, urban rights-of-way occupied by roadways, hydro or pipelines are underutilized and overlooked open space resources. Traditionally, these sites have been uniformly treated as the manicured turf and tree landscapes which Dorney calls "urban savannahs" and Michael Hough refers to as "no man's land". Nevertheless, both authors recognize that they have significant qualities which are well-suited to ecologically-based design. For example, as pathways to the city, roadways are frequently the first introduction of a city to any visitors. Naturalized, indigenous plant communities would give an immediate and unique impression of the character and place of a city to newcomers, an impression that would be unlike that of any other city. As well, these predominantly linear sites link a variety of urban objects and environments and, in doing so, provide a strong degree of continuity throughout cities. However, at the same time, linear elements change along their length and as they come into contact with various disparate elements of the city. As William Whyte points out:

> Per acre, linear strips are probably the most efficient form of open space...when they are laid out along the routes people walk or travel...the spaces provide the maximum visual impact and the maximum physical access. The linear concept...provides us a way of securing the highly usable spaces in urban areas where land is hard to come by, and in time, a way of linking these spaces together.[134]

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134 William H. Whyte, The Last Landscape (Doubleday, Garden City, New York, 1968; Anchor edition, 1978) as quoted by Michael Hough in City Form and Natural Process, p. 261.

In ecological terms, these linkages can often provide wildlife with pathways into and about the city. Ecosystems which had been fragmented by urban development can be reconnected while opportunities can be created for the establishment of new ecosystems. Also, the extensive edges of linear sites provide greater opportunities for the establishment of edge communities which, as mentioned earlier, are among the most diverse and interesting of the natural plant communities. This variety and diversity has ecological, aesthetic and cultural benefits which add to the potential of any design. Within this context, natural communities have the potential to create variety and visual excitement where typically there is none.

PART FOUR:

SITE ANALYSIS AND DESIGN

4.1 INTRODUCTION

The site which was chosen is the Bishop Grandin Boulevard extension, a four lane roadway allowance between Waverley Street and Pembina Highway. The site is linear, approximately 2000 metres in length and an average of 400 metres wide, with a total area of approximately 82 hectares. Of this, approximately 1/4 of the site is occupied by the road allowances, Hydro right-of-ways, and surface drainage channels. As this is a new roadway extension, much of the lanscaping is not yet complete, but the proposed landscape treatment for the site will be predominantly hydroseeded grass, individual trees and shrubs, with small pockets of 'wildflower' seeding and some sodding in high visibility areas.

As it is currently designed, a large percentage of the site will be essentially unused land requiring large yearly expenditures of maintenance dollars for very little return. The Parks and Recreation Department of the City of Winnipeg estimates that the projected yearly expenditure just to keep the grass cut on a site of this size would be $11,137.57, an average of $135.82 per hectare.[135]

In terms of natural history, a general description of this area appears in the narrative of the Hind expedition of 1857. This account describes the ground lying between the Assiniboine River to the north and La Riviere Sale to the south as being"very marshy, and ... covered with willows and clumps of small aspen."[136]

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135 -personal correspondence with Jim Paterson, Design and Project Coordinator, City of Winnipeg Department of Parks and Recreation.
136 Henry Youle Hind, Narrative of the Canadian Red River Exploring Expedition of 1857 (Edmonton: M.G. Hurtig Ltd.), p. 155.

As it appears today, the site is evocative of such linear features as the river valleys, bluffs and moraines which have always been unique and notable landscapes in the prairie environment. The presence of an important surface drainage channel- the Lot 16 drain- running the length of the site adds to this character, turning the site into the modern-day equivalent of a river valley. The physical characteristics of the site are quite varied, from open water and low-lying marshy areas to dry upland conditions. This wide range of environmental conditions and aesthetic qualities allows for a design with maximum variety and interest.

4.2 STATEMENT OF GOALS AND OBJECTIVES

The goals of the design were framed within the context of the overview of ecologically-based design. These goals can be stated in the following terms:

4.2.1 Design Goals:

To create an ecologically-based design that will provide maximum biological and aesthetic diversity, require minimal ongoing maintenance and operational inputs, and create passive recreation opportunities both for the immediate neighbourhoods and for the whole city.

4.2.2 Design Objectives:

The specific design objectives were as follows:

1) To provide biological, visual and aesthetic diversity through a variety of landforms, plant communities and environmental types.

2) To employ indigenous plant materials and communities.

3) To match the plants and plant communities to their appropriate ecological niches.

4) To create an environment that will evolve over time with little need for human interference.

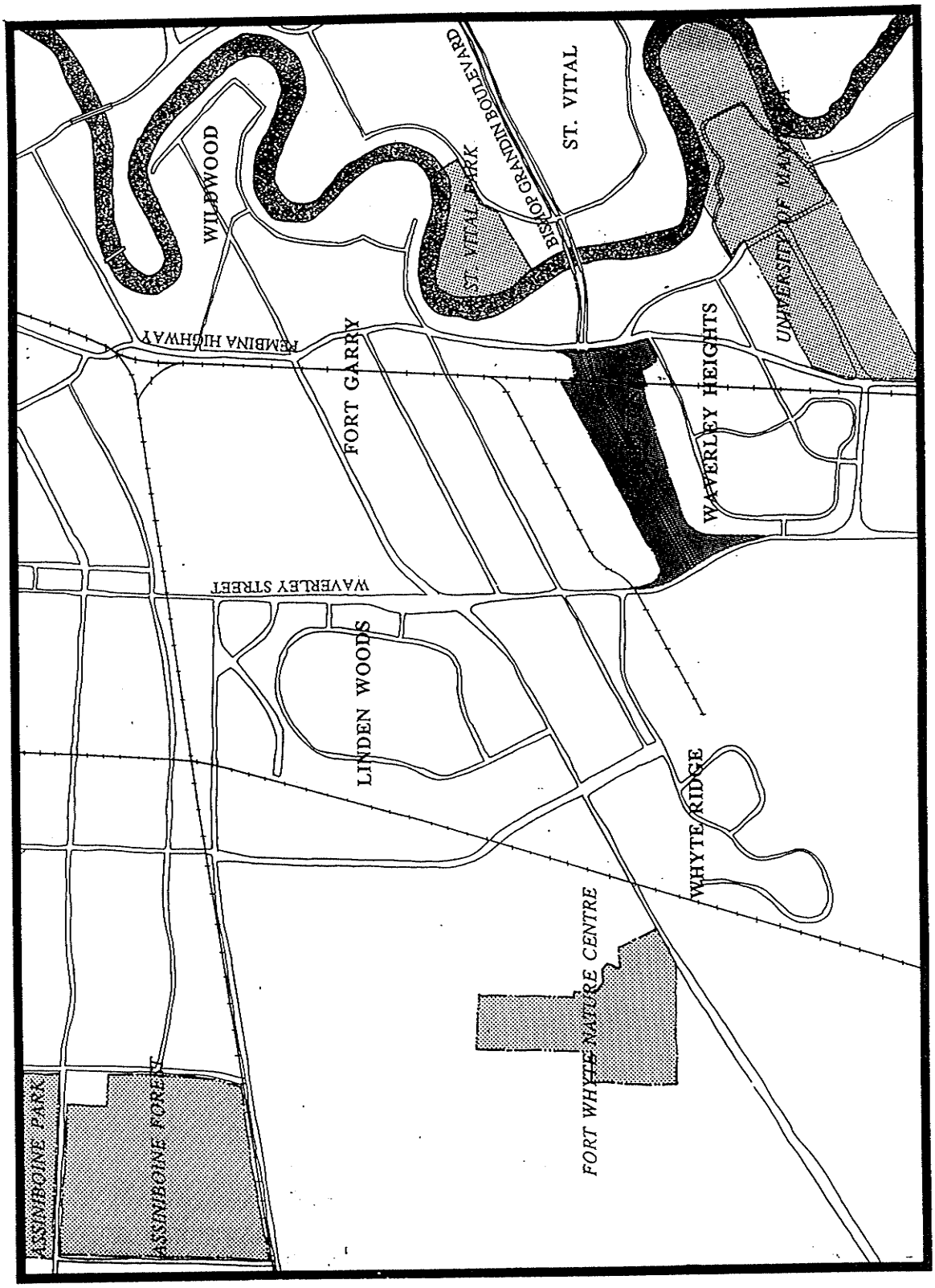
5) To provide habitat for wildlife as a result of the communities that are created on-site.

6) To provide for passive recreational activities on-site, including walking and cycling, and to consider the site as a recreational linkage within the context of the larger city.

4.3 SITE ISSUES

4.3.1 Location- (Map One)

Map One shows the location of the site in relation to the important local and regional features nearby.To the west of the site is the residential development of Whyte Ridge, as well as the Fort Whyte Nature Centre. To the north is the Linden Ridge residential area, as well as the older residential areas of Fort Garry. To the east, the Red River, beyond which is St. Vital and St. Vital Park, a significant regional park. To the southeast of the site is the University of Manitoba, while to the immediate south is the residential development of Waverley Heights. Further south is St. Norbert and La Berriere Park. Within this larger area, the site occupies a significant and underdeveloped central position. Firstly, as a potential recreational and natural resource for the surrounding residential communities. Secondly, as an additional and possibly linking element within the context of the nearby natural and open space resources. As a result, the site has the potential to be a linkage as well as a destination in its own right.



MAP ONE: LOCATION AND OVERALL CONTEXT OF THE STUDY SITE

4.3.2 Land Use- (Map Two)

On either end the site is contained by major roadways, Waverley Street to the west and Pembina Highway to the east. Both are high volume roads, the speed limit on Waverley is 80 kilometres an hour while on Pembina Highway it is 60 kph. The main C.N.R. southbound route, a 30.5 metre (100 foot) wide, raised railroad right-of-way bisects the site from north to south.

To the south mainly single-family residential housing, with one 3-storey and one 5-storey apartment block located along the southeast edge of the site. One medium-size community level park (Lake Albrin Park) adjoins the site to the south. It is largely a passive park with an overlook area, seating, and a small play area. As well, there is a residential retention pond with a small strip of parkland running around the shoreline and three narrow (4-10 metre wide) walk-through sites which are classified as community level parkland.

Chancellor Drive marks the southeast edge of the site, an area that also contains the only naturally-occurring trees on the entire site, a scattered stand of mostly Manitoba Maple (*Acer negundo*) and American Elm (*Ulmus americana).*

Located along the eastern edge of the site is a major bus transfer area for students at the nearby University of Manitoba. Also nearby to the east, the Red River is located approximately 650 metres from the site.

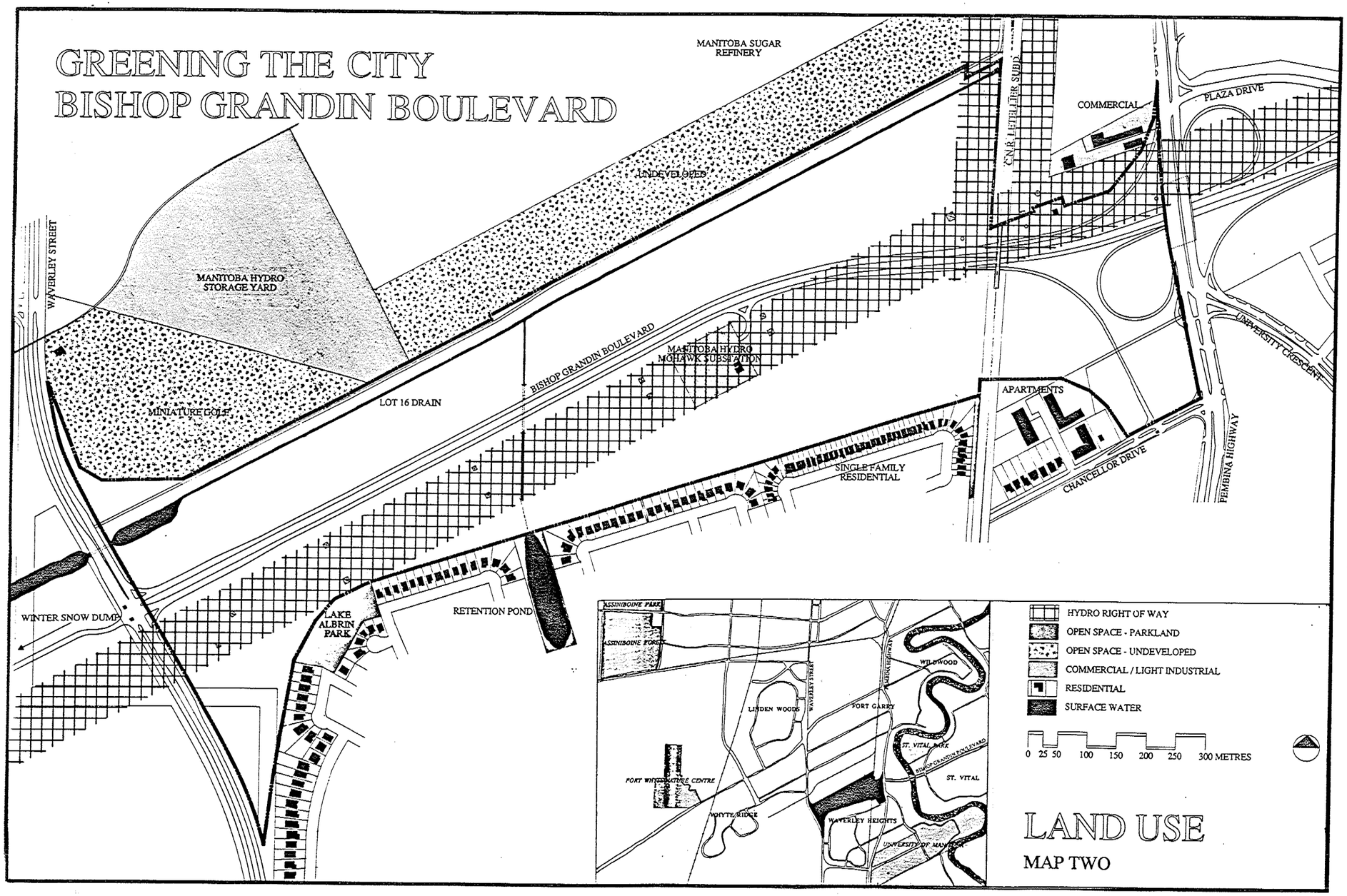
The northeast corner of the site is bordered by a commercial strip development, specifically two franchise restaurants. Located in the northeast corner is a 125 metre wide northern extension of the Manitoba Hydro right-of-way as well as the 110 metre wide east-west Hydro right-of-way that continues lengthwise down the centre of the site.

The northern edge of the site is bordered entirely by the Lot 16 drain and an associated dirt road. The adjacent properties are undeveloped open space zoned for light industrial use. Approximately 200 metres to the north is the Manitoba Sugar refining plant, as well as a considerably large and high spoils pile. Further to the west along the north edge is a light industrial site used as a storage yard by Manitoba Hydro.The northwest edge of the site has been developed as a driving range and miniature golf course.

To the west, beyond Waverley, is agricultural land and beyond that, although not visible from the site, is a large winter snow dumping area. The Lot 16 drain passes under Waverley Street and continues west, where much of the adjacent land is occupied by a large Oak/Aspen forest that is clearly visible from the site.

Within the site the Manitoba Hydro right-of-way takes up a 110 metre wide strip running the length of the site. Located along this strip are 15 large towers and the Mohawk substation, a chainlink fence enclosure containing transformers and a service building.

GREENING THE CITY
BISHOP GRANDIN BOULEVARD



LAND USE

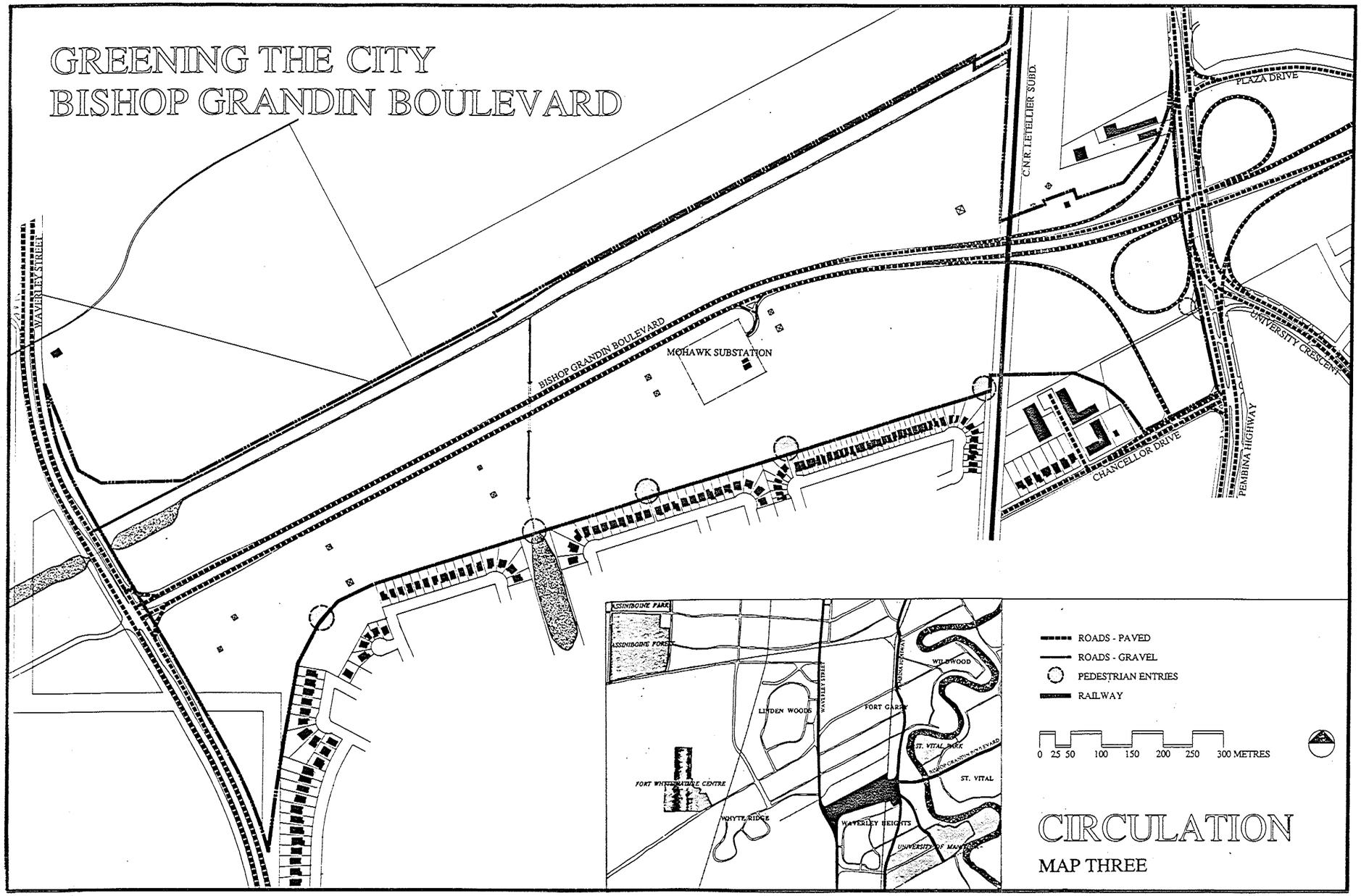
MAP TWO

4.3.3 Circulation- (Map Three)

In addition to the roadways bordering the site, the Bishop Grandin Boulevard is a 33 metre wide, four lane traffic corridor running the length of the site, splitting it very nearly in half. This is a high-volume road with a maximum speed of 80 kilometres-per-hour. At the Waverley end of the site is an on-grade intersection controlled by traffic lights. Towards the east, the boulevard passes beneath an underpass at the railway line and again at Pembina highway, continuing east over the Red River. This end of the site is also taken up by three offramps from Bishop Grandin Boulevard and Pembina Highway.

Pedestrian circulation on the site is minimal and no provisions have been made for it, however, there are six existing or potential pedestrian entrances. Five are via the southern Parks and Recreation properties, and the sixth is located at the eastern bus stop. In addition, an informal system of bicycle monkey trails runs north to south along the eastern side of the railway line. With the construction of the Boulevard this connection was severed.

GREENING THE CITY
BISHOP GRANDIN BOULEVARD



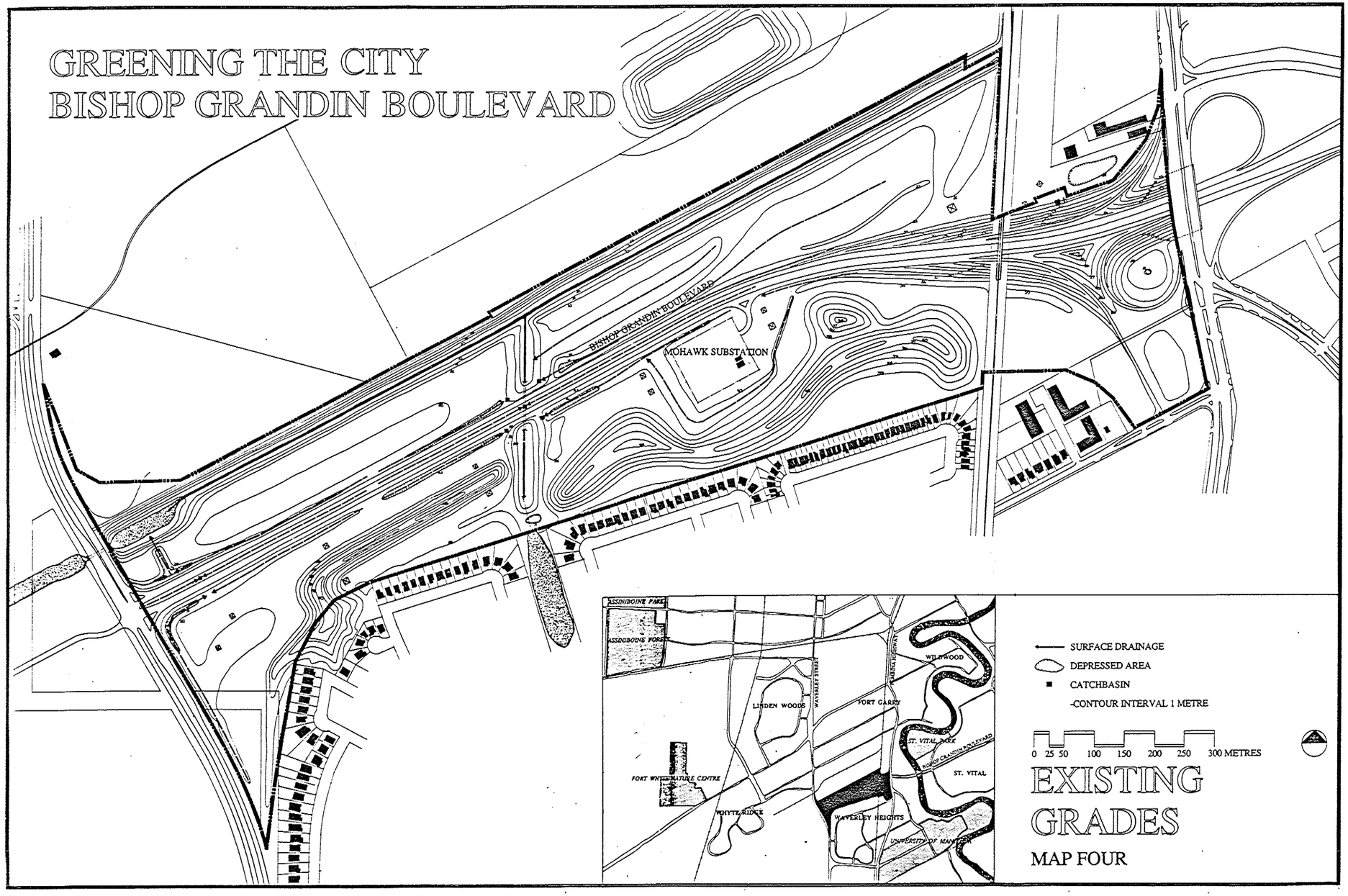
CIRCULATION

MAP THREE

4.3.4 Existing Grades and Drainage- (Map Four)

As originally designed, the site features significant earthworks designed to provide a noise and visual barrier for the southern residential area. These linear berms rise to a maximum height of 6 metres above the surrounding land. Lake Albrin Park to the south is an offsite extension of these berms, reaching the maximum height of 6 metres. Within the site there are a number of low-lying areas, apart from the road grading all are designed to provide for surface drainage of runoff. The Boulevard is bordered on either side and in the centre strip by drainage swales. A permanently-filled drainage ditch passes beneath the boulevard, connecting the residential retention pond with the Lot 16 drain, which itself is a watercourse with a 5-6 metre deep channel flowing from west to east. This is an important surface drain; not only does it serve all of Waverley Heights and Linden Woods, it is also an agricultural drain and collects the meltwater from the snow dump just to the west of the site. Most of the other site drainage is overland to this channel by means of shallow swales. The eastern end of the site is up to 7 metres lower than the overall level of the site due to the railroad and Pembina Highway overpasses.

GREENING THE CITY
BISHOP GRANDIN BOULEVARD



EXISTING GRADES

MAP FOUR

4.4 SITE ANALYSIS- (Map Five)

A number of important visual features are to be found in or near the site. These include the area of significantly higher ground to the north of the site, the Oak/Aspen bluffs to the west of the site, and Lake Albrin Park and the residential retention pond which are both located immediately to the south. On-site, the only features of any real interest are the surface water drainage systems bordering the north of the site and cutting through the middle of the site. All of these features can be taken advantage of in the design of the space.

Areas offering a poor image include beyond the northern edge of the site where the view is of light industrial buildings scattered across the horizon. As well, the Manitoba Sugar refinery also to the north presents a view of towers and smokestacks. On the site, the Manitoba Hydro Mohawk substation presents a view of transformers and chainlink fencing that is not attractive, but is nonetheless part of the context of a Hydro right-of-way. The Hydro towers running the length of the site reinforce the site's east-west orientation. Their size makes any attempts at buffering futile, and since they do provide the site with much of its context their overall impact becomes a nonissue. There is, however a functional requirement to limit any planting within the right-of-way to herb and shrub species, and to observe the existing grades for the tower footings.

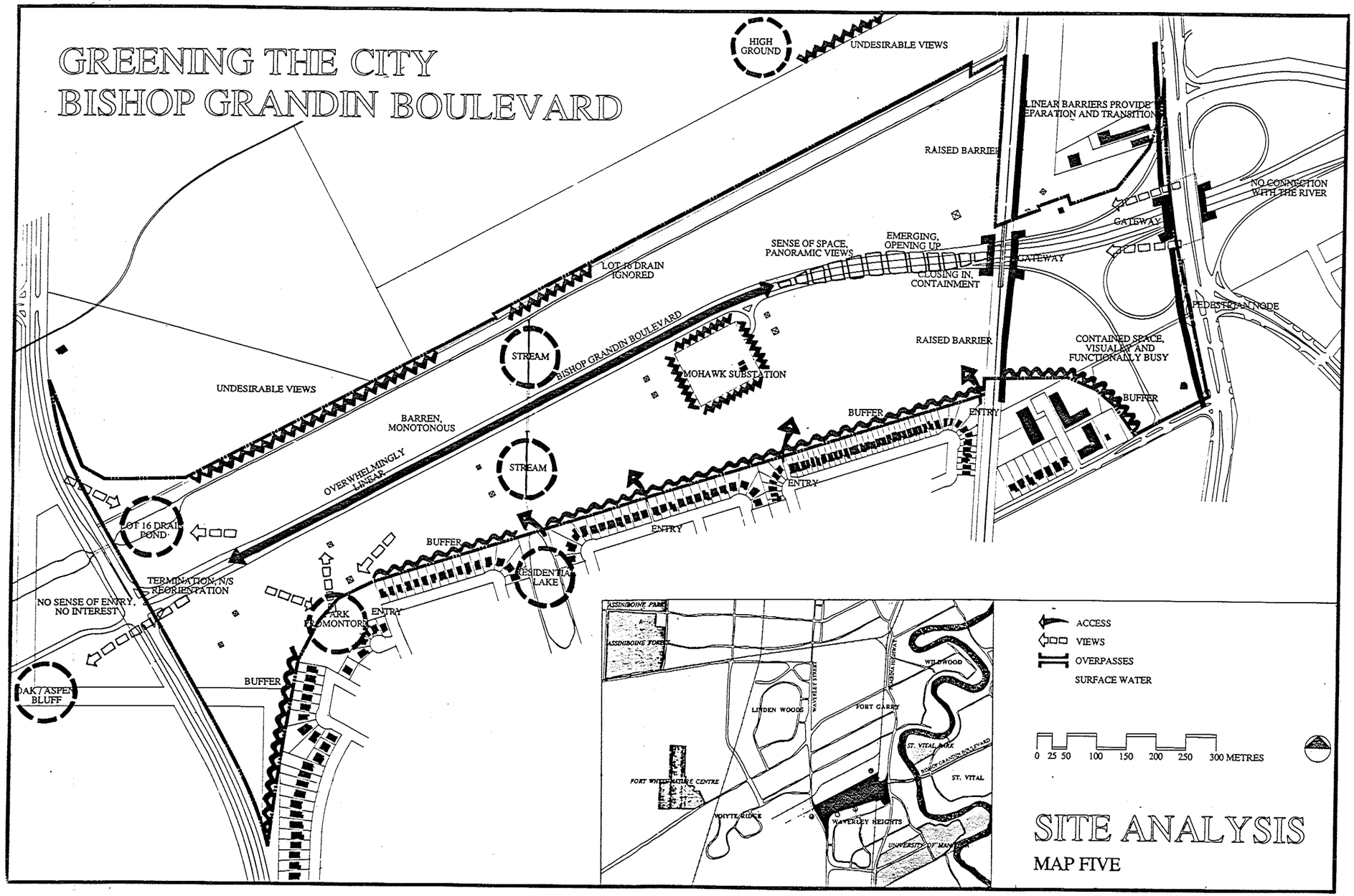
The site's strongly linear nature determines the quality of much of the visual experience of the site. The impression is of one long frame of images one after the other. Proceeding from east to west, the site begins with the Pembina Highway overpass which serves as an effective entry gate to the site (or exit , depending on the direction of travel). Proceeding through this gate one enters an area that is visually and functionally busy

with offramps on either side, and that is strongly contained by the raised barriers of Pembina Highway and the C.N.R. right-of -way. Passing under the railway overpass, which serves as a secondary entry to the site for the traffic exiting from Pembina Highway, there is an immediate sense of entering through a gateway into a dramatically different environment. As the roadway begins to climb up to the level plain the experience is one of opening up or emergence. The breadth of the view is in contrast to the containment of the preceding area. However, this panoramic sense of space soon gives way to an appearance of barrenness and even monotony. The site lacks defining elements that would enable it to be broken down into recognizable visual units, so that ultimately the linear nature of the site becomes its sole characteristic. The berms on the south side of the roadway are undistinguished and functional in appearance and, in many cases, actually hide some of the appealing views to the retention pond and Lake Albrin Park. The berms do, however, meet a functional need to provide noise attenuation and some type of visual buffering for the adjacent residential area.

The surface water channels, which have the potential to be unique areas of interest, are treated only as entirely functional elements. As well, there are opportunities to make off-site connections with the Red River to the east and with the Oak/Aspen bluffs to the west which are ignored. The western edge of the site gives no impression either of exit from, or entry to the site. The Boulevard meets Waverley at a 90° angle and simply stops. There is nothing to indicate that there is a change in orientation from north-south to east-west. Similarly, entering the site from Waverley, there is no forewarning and nothing of visual interest that would draw one into the site. The site is simply and suddenly there.

Within the site there are no physical provisions made for either pedestrian or bicycle movement. The six pedestrian entry areas are not featured at all, they don't lead anywhere except to a large open field. The only slight concession made to pedestrians is at the bus stop on Pembina Highway, where an ornamental seating area is sited within the area enclosed by one of the Pembina Highway offramps. In addition, the overall scale of the site and it's design are obviously intended for the vehicular user, as it is far too open and lacking in small-scale interest for the pedestrian or cyclist.

GREENING THE CITY
BISHOP GRANDIN BOULEVARD



SITE ANALYSIS

MAP FIVE

4.5 DESIGN CONCEPT- (Map Six)

Beyond the overall goals and objectives some particular points can be raised which relate more to this site in particular.

1) Framework for change

The initial planting will be intended to provide a framework for change as the plant communities expand and shrink in relation to one another. Bird, in Ecology of the Aspen Parkland of Western Canada in Relation to Land Use describes this tension between forest and grassland:

> According to the pressure of the dominant factors... the grassland may advance on the forest when the trees are unable to survive... or it may retreat as conditions become more favorable for forest growth.[137]

In adopting this as a model, the design will be dynamic, creating favorable conditions for certain landscape types to evolve over time.

2)Ecological variety

The design will exploit the existing environmental site factors as much as possible. In particular, all surface drainage will be held on-site and directed to the plant communities according to their moisture requirements. The surface drains currently running through the site will be significantly enlarged and their shapes altered to provide maximum edge conditions and habitat. Landforms will be manipulated so as to provide interest, and also to maximize microclimatic conditions of wet and dry pockets, solar orientation, wind protection, subsoil conditions, and snow trapping. These measures will help to ensure that the site can be partially self-maintaining and will provide an assortment of environments.

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137 Ralph D.Bird, Ecology of the Aspen Parkland of Western Canada in Relation to Land Use (Ottawa: Queen's Printer, 1961), p. 2.

3) Environmental variety

The size of the site and the fact that much of the land has no real function allows for a greater freedom in the creation of a variety and complexity of landscape types. Access in the form of path systems will be provided to approximately 3/4 of the site, with the final 1/4 remaining accessible but not in a planned fashion.

4) Indigenous plant communities

The design approach for the site will follow an approach of indigenous planting. Native plant species will be used throughout the site, except in those few areas where functional or aesthetic considerations require a more manicured approach (such as high traffic areas or for purposes of contrasting the "natural" and the manicured landscapes). These native plants will be grouped so that they approximate naturally-existing communities in appearance and function. From a list of nine major natural plant communities that are representative of the Winnipeg area (see Appendix One), I have summarized four major design plant communities. These communities are:

1)Aspen parkland community

2)Floodplain community

3)Grasslands

4)Aquatic community

Within these plant communities there will be variations according to the environmental conditions of the application. The plant lists for the four communities are intended to serve as resource lists from which specific plant types can be drawn. For example, the Aspen parkland community tree layer is dominated by the Trembling Aspen (*Populus tremuloides*) on well-drained sites, but drier sites will support Bur Oak (*Quercus*

macrocarpa), while poorly-drained sites will tend to be dominated by Balsam Poplar (*Populus balsamifera*). The Grassland is divided into three categories: Sloughgrass, Tallgrass,and Upland grasses. Each of these are suited specifically to particular moisture conditions, sloughgrass occupies wet sites with standing water through most of the summer, tallgrass requires drier conditions, while upland grasses are able to survive the driest conditions.The plant communities will be matched to the appropriate environmental conditions of the site and the design. This will include "naturally" occurring conditions such as solar orientation, wind exposure and moisture levels, but must also take into account such "urban" factors as road runoff and height restrictions under the Hydro right-of-way. Of course, the aesthetic characteristics of the species and communities will be an important consideration.

The design communities are listed below, where there is a clearly dominant species it is listed first. Plants which are followed by an"S" or "O" are species which are salt or oil-tolerant respectively. These species are especially appropriate in locations where they will be affected by runoff from roads or other hard surfaces. On locations within the area of Hydro right-of-way the height restriction of 5 metres limits plant selection to the shrub or herbaceous species.

1.Aspen Parkland community

Tree layer

Trembling Aspen (*Populus tremuloides*)- Dominant; well-drained, sandy sites
Bur Oak (*Quercus macrocarpa*)- well-drained sites
White Birch (*Betula papyrifera*)- north-facing slopes
Balsam Poplar (*Populus balsamifera*)- poorly-drained sites

Shrub layer

Hazelnut (*Corylus americana* or *C. cornuta*)- Dominant; well-drained locations
Red Osier Dogwood (*Cornus stolonifera*)- moist locations(O)
Highbush Cranberry (*Viburnum opulus* var. *americanum*)- moist locations
Speckled Alder (*Alnus rugosa*)- moist locations
Saskatoon (*Amelanchier alnifolia*)- edge species (S)
Silverberry (*Eleagnus commutata*)- edge species(S)
Choke cherry (*Prunus virginiana*)- edge species (S)
Pin cherry (*Prunus pennsylvanica*)- edge species
Rose (*Rosa* sp.)- edge species
Raspberry (*Rubus idaeus* var. *strigosus*)- disturbed land (S, O)
Buffaloberry (*Sheperdia argentea*)- (S)
Wolfberry (*Symphocarpus occidentalis*)- edge species
Snowberry (*Symphoricarpus occidentalis*)- edge species (S, O)

Herb layer, upper stratum
Wild sarsparilla (*Aralia nudicaulis*)
Red Baneberry (*Actaea rubra*)
Lindley's Aster (*Aster ciliolatus*)
Sweet-scented Bedstraw (*Galium triflorum*)
Grooved Agrimony (*Agrimonia striata*)
Wild Columbine (*Aquilegia canadensis*)
Twining Honeysuckle (*Lonicera dioica var. glaucescens*)
Anise Root (*Osmorhiza longistylis*)
Northern Gooseberry (*Ribes oxyacanthoides*)
Wood's Rose (*Rosa woodsii*)
Carrionflower (*Smilax herbacea* var. *lasioneura)*
Fringed Loosestrife (*Steironema ciliatum*)
Snowberry (*Symphoricarpos albus*)
Purple Meadow-rue (*Thalictrum dasycarpum*)

Herb layer, lower stratum
Pink Wintergreen (*Pyrola asarifolia*)
Bunchberry (*Cornus canadensis*)
Blunt-leaved Sandwort (*Arenaria lateriflora*)
Woodland Strawberry (*Fragaria vesca* var. *americana*)
Strawberry (*F.virginiana*)
False Lily-of-the Valley (*Maianthemum canadense* var. *interius*)
Dewberry (*Rubus pubescens*)
Star-flowered Solomons's seal (*Smilacina stellata*)
Three-leaved Solomon's seal (*S. trifloria*)
Northern Grass-of-Parnassus (*Parnassia multiseta*)

2.Floodplain community

Tree layer

Manitoba Maple (*Acer negundo* var. *interius*)- Dominant
Green Ash (*Fraxinus pennsylvanica* var. *lanceolata*)
Cottonwood (*Populus deltoides*)
Basswood (*Tilia americana*)
Peach-leaved Willow (*Salix amygdaloides*)
American Elm (*Ulmus americana*)

Shrub layer

Red Osier Dogwood (*Cornus stolonifera*)- (O)
Peachleaf Willow (*Salix amygdaloides*)-(O)
Sandbar Willow (*S.interior*)-(O)

Herb layer

Ostrich Fern (*Pteretis pensylvanica*)
Wood Nettle (*Loportea canadensis*)
American Hop (*Humulus americanus*)
New England Aster (*Aster nova-angliae*)
Flat-topped White Aster (*Aster umbellatus*)
Beggar-ticks (*Bidens glaucescens*)
Wild Mint (*Mentha arvensis* var. *glabrata*)
Silverweed (*Potentilla anserina*)
Flat-topped Goldenrod (*Solidago graminifolia)*
Marsh Hedge Nettle (*Stachys palustris* var. *pilosa*)
Stinging Nettle (*Urtica procera*)

3.1.Grassland community (Tallgrass)

Grass layer

Big Bluestem (*Andropogon gerardi*)- Dominant, edge species
Little Bluestem (*A. scoparius*)
Wheat grass (*Agropyron* spp.)- edge species (S)
Canada Wild Rye (*Elymus canadensis*)- edge species
June grass (*Koeleria cristata*)
Porcupine-grass (*Stipa spartea*)

Forb layer

Leadplant (*Amorpha canescens*)
Canada Anemone (*Anemone canadensis*)

Willow Aster (*Aster praealtus*)- edge species
Ground Plum (*Astralagus caryocarpus)*
Northern Bedstraw (*Galium septentrionale*)
Blazing Star (*Liatris* spp.)- edge species
Prairie-lily (*Lilium philadelphicum* var. a*ndium)*
White Prairie Clover (*Petalostemon candidum*)
Purple Prairie Clover (*P. purpureum*)
Prairie Rose (*Rosa arkansana*)- edge species
Canada Goldenrod (*Solidago canadensis*)- edge species

3.2.Grassland community (Sloughgrass)

Grass layer

Prairie Cord grass (*S. pectinate*)- Dominant
Northern Reed Grass (*Calamagrostis inexpansa* var. *brevior*)
Canada Wild Rye (*Elymus canadensis*)- edge species
Switchgrass (*Panicum virgatum*)
Alkali Cord grass (*Spartina gracilis*)

Forb layer

Baltic Rush (*Juncus balticus* var. *littoralis)*
Canada Goldenrod (*Solidago canadensis*)- edge species

3.3.Grassland community(Upland)

Grass layer

Porcupine-grass (*Stipa spartea*)- Dominant, edge species
Western Wheat grass (*Agropyron smithii*)- (S)
Side-oats Grama (*Boutelous curtipendula*)
June grass (*Koelaria cristata*)

Forb layer

Leadplant (*Amorpha canescens*)
Rhombic-leaved Sunflower (*Helianthus laetiflorus* var. *subrhomboideus*)- edge species
Western Red Lily (*Lilium philadelphicum* var. *andium)*
Silverleaf Psoralea (*Psoralea argophylla*)- edge species
Prairie Rose (*Rosa arkansana*)- edge species
Missouri Goldenrod (*Solidago missouriensis*)

4.Aquatic community

Emergent vegetation

Soft-stem Bullrush (*S. validus*)
Slough grass (*Beckmannia syzigachne*)
Sedge (*Carex* sp.)-(S)
Reed grass (*Phragmites communis*)
Hard-stem Bullrush (*Scirpus acutus*)
Prairie Bullrush (*S. paludosus*)
Spangletop (*Scolochloa festucacea*)
Cattail (*Typha latifolia*)

In addition to these four main plant groupings, there is a fifth category that will occur in association with all of them. This category contains the edge communities that occupy the ecotones between two adjacent communities- usually forest and grassland. A more particular look at the interrelationships between communities is shown in Map 9; a detailed plan and sections through a small area of the design. These illustrations show some of the plants that might occur in the various communities and the postions they would occupy. As these communities represent an extension and merging of the two communities they share many of the characteristics of both, but with greater biological variety and diversity than either. Usually the edge community combines small trees and shrubs from the forest with herbs from the grassland. In design terms it is desirable to maximize edge conditions so as to take advantage of this diversity.

Within this ecological model, the design concept for the site is guided by three intentions. First, to break down the overwhelmingly linear nature of the site into a number of distinct and unique landscape elements. Secondly, to make connections- physical, visual, and implied- with the surrounding city. And finally, to create an environment that not only provides an interesting visual experience for the passing motorist, but also meets the physical and visual needs of the pedestrian, the cyclist, the neighbour and the visitor. Entrances to the site, both pedestrian and

vehicular, will be developed as significant nodes, while path systems will provide exposure to all of the environments on the site. Currently the positive qualities of the site, such as views on and off-site, are underutilized and these will be featured in the final design

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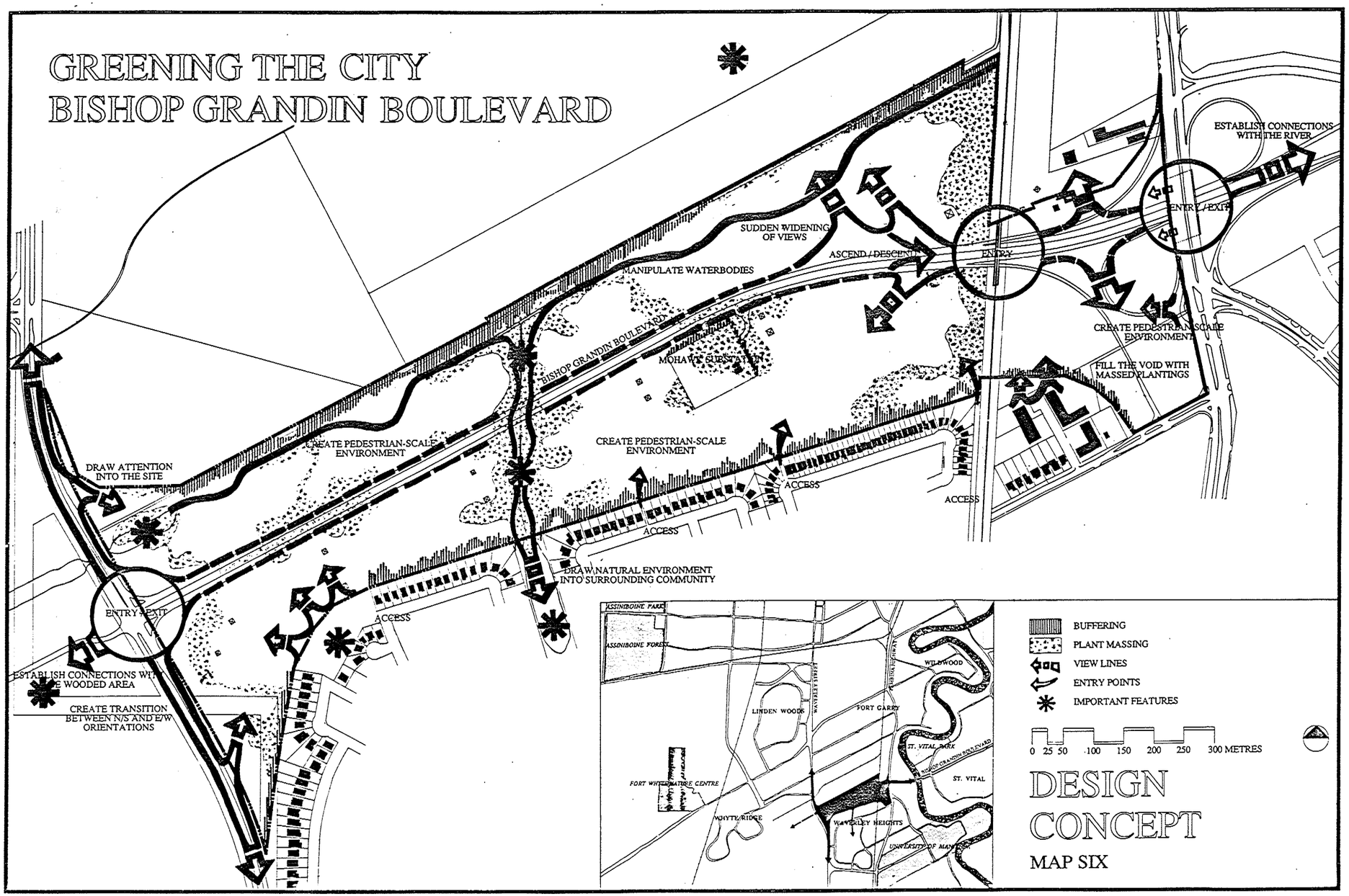

DESIGN CONCEPT

MAP SIX

4.5.1 Proposed Grades and Drainage- (Map Seven)

The proposed grading is intended to serve three purposes: first, to meet the noise and visual attenuation needs of the adjacent residential neighbourhood, second, to provide a variety of microenvironments on the site, and third to create interesting and varied landforms. The majority of the large landforms are located on the south end of the site, between the roadway and the houses. There are a number of depressed areas throughout the site which will provide microclimatic variations in temperature, solar orientation, wind protection, and available moisture. As mentioned earlier, all site drainage will be surface drainage which will be used throughout the design.

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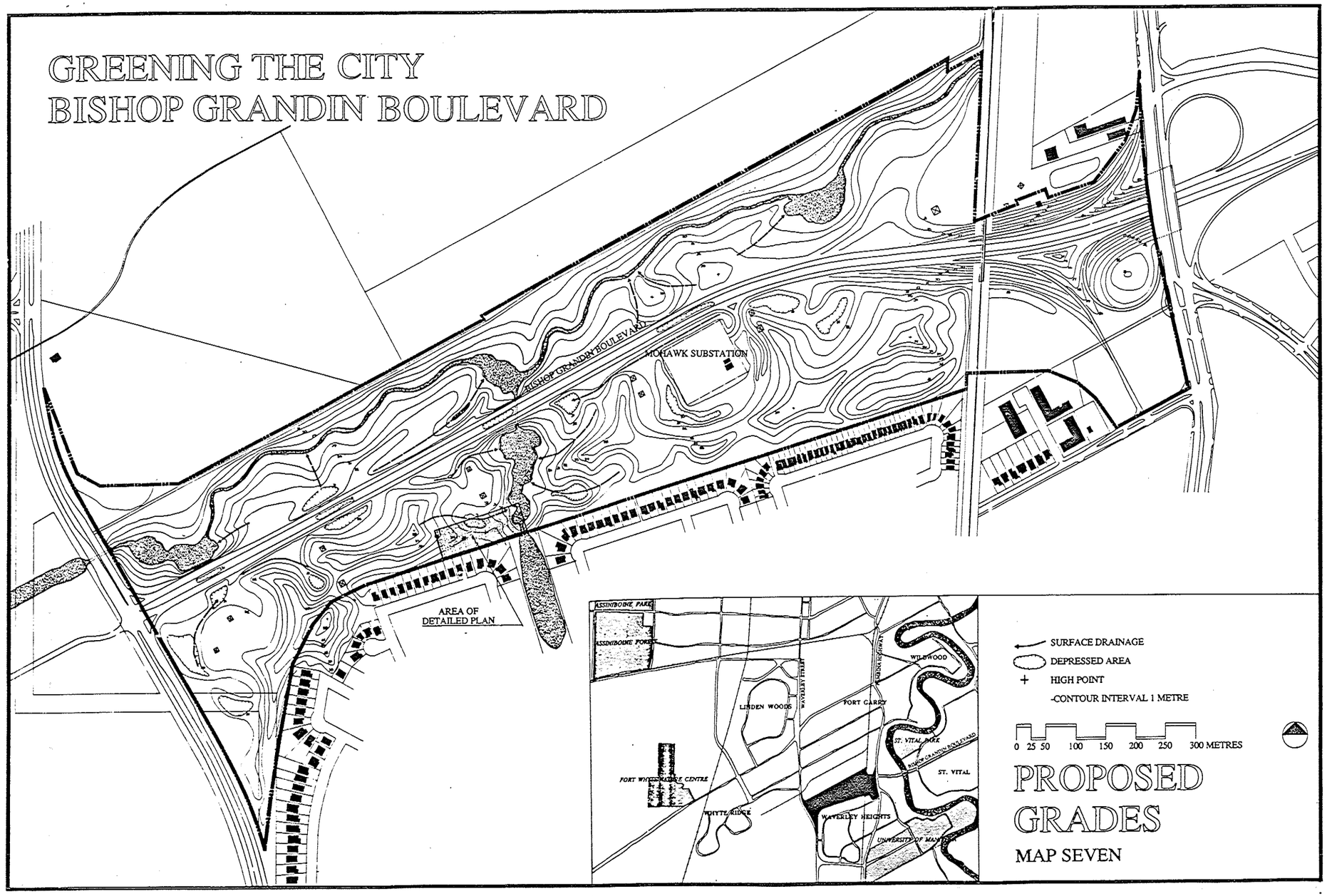

PROPOSED GRADES

MAP SEVEN

4.5.2 Ecological Communities- (Map Eight)

The four major plant communities are distributed across the site according to environmental conditions and the physical and aesthetic demands of the design. The overall outlines of the communities include the edge communities and therefore are not at all fixed or clearly defined. The limits of each community will roughly correspond to this plan, however their ecological functioning will ensure that their edges are in constant flux, advancing and retreating in more or less predictable patterns. Accordingly, the character of the plantings is designed to correspond to Bird's description of the Aspen parkland:

> [An] intermingled mosaic of irregular isolated patches and more or less solid stands [within which] the grassland may advance on the forest...or it may retreat as conditions become more favorable for forest growth.[138]

In general, low-lying areas will support the Floodplain communities, Aspen parkland will dominate better-drained locations, while the three Grassland communities will cover the higher ground according to their moisture requirements.

Where the plant communities fall within the limits of the Hydro right-of-way the height restriction of 5 metres precludes any tree planting, only shrubs and herbs may be employed. Planted areas adjacent to roadways will be composed of species from the appropriate communities that show salt and/or oil tolerance.

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138 Ibid., p. 3.

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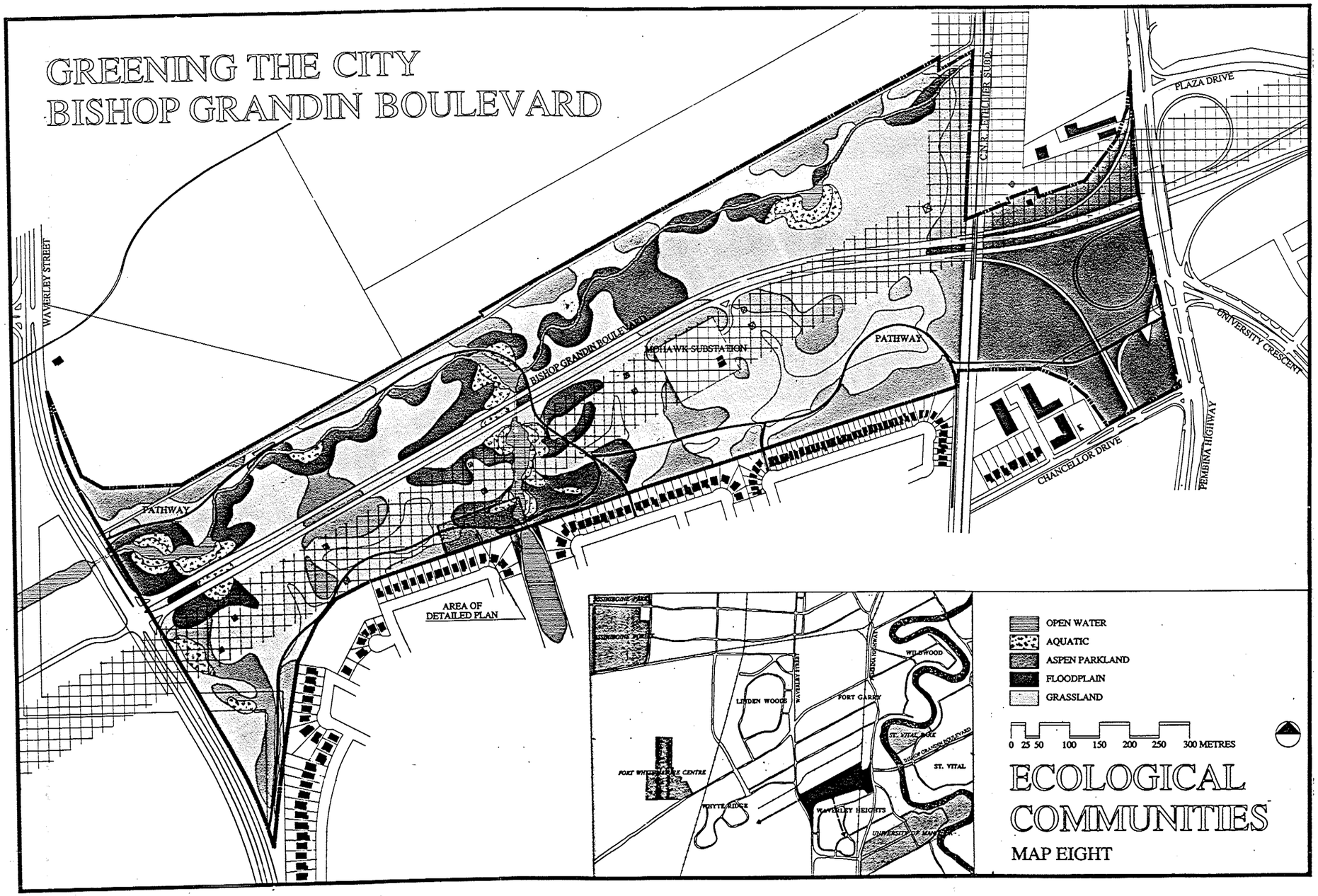
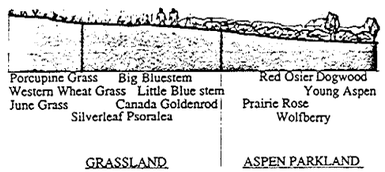
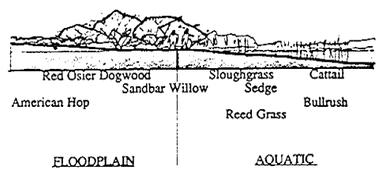


ECOLOGICAL COMMUNITIES

MAP EIGHT



SECTION ONE



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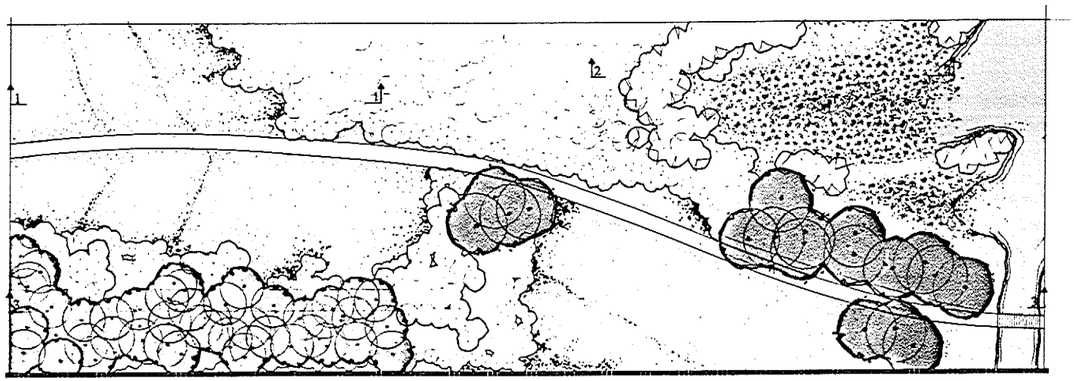

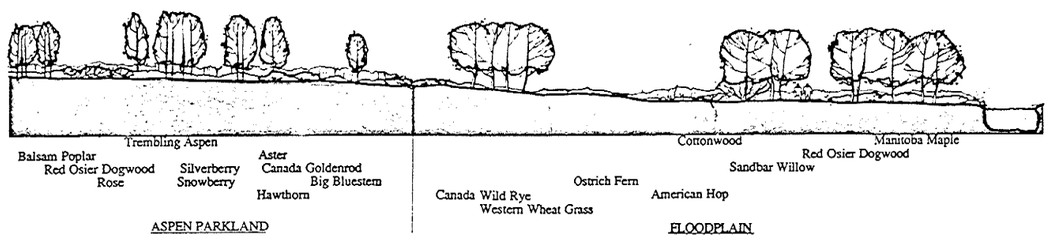

SECTION THREE

0 3 6 12 18 24 30 36 METRES

DETAIL PLAN AND SECTIONS

MAP NINE

4.5.3 Final Design- (Map Ten)

The final design is composed of four major component parts. The interaction of these parts provides the resolution of the goals and objectives. Beyond their physical and functional roles, each of the parts must meet certain design criteria. The four components are:

1)Water

2)Landforms

3)Plant Communities

4)Pathways and Access

1) Water

Waterbodies have been enlarged and their connections strengthened, so that they are now a significant natural system. Nearly all of the most immediate views of the site, especially those from the roadways, are provided with visual access to the waterbodies. Where the waterways come into close contact with the roads, for example at the Waverley intersection, their size and the variety of habitats they support increases. The waterways then become significant points along the length of the parkway. The meandering course of the water channels creates a number of visual opportunities for pedestrians and drivers, and it also maximizes the potential for habitat formation.

Some of the water features are designed to be temporary in nature. A number of areas immediately adjacent to water are intended to be intermittent waterbodies, separating from the main channel and eventually drying up as the summer proceeds. These zones will support a different type of ecosystem than nearby areas that are permanently under water. Other areas are designed to be flood-prone and will be under water only in the spring.

The waterbodies will also be able to serve as a canoe route passing through the site. A short portage will be necessary at the Bisop Grandin Boulevard crossing. This route connects with the Waverley Heights lake system, forming the basis for a greatly expanded recreational waterway system.

2)Landforms

In general, the landforms rise in elevation from north to south so that either side of the roadway has a different character. The landforms are also designed to counteract the predominantly east-west orientation of the site by cutting at right angles across the roadway. The shape and position of the landforms reveals and manipulates views, both on and into the site. In particular these views include: the dramatic opening-up of views to the northwest of the railroad underpass, the on-site and off-site views of the waterbodies, and the views to off-site features such as Lake Albrin Park, the Sugar Refinery promontory, and the western woodlot.

3)Plant Communities

The plant communities of the site meet a number of specific needs, including: complementing the waterways, landforms or pathways, screening, buffering, or shaping views, and creating different qualities of environments.

The eastern end of the site is dominated by massed plantings of floodplain species. These completely fill the space between Pembina Highway and the railroad embankment. The large trees which occupy most of this section give way to a massed shrub planting which runs north to south through the centre of the area. The entry and exit ramps which had previously dominated this space now simply become cuts through the tree masses. Towards the Pembina Highway edge the tree canopy begins to open

up, but the natural character of the community is maintained. The tree plantings which extend east from the site begin to reestablish the natural connections with the Red River. As well, future planting plans for the adjacent shopping mall to the south of the site could begin to make connections with the belt of forest. These off-site connections are continued along the southern pedestrian entry points. Fingers of native vegetation extend out into the community by way of these entries. The western edge plantings also extend beyond the site, in this case to connect with the nearby system of woodlots.

Throughout the site mass plantings are often used to soften the edges of such features as the Mohawk substation or the western edge of the railroad embankment. In cases such as these the intent is not to hide, but rather to reduce the visual impact of these potentially overwhelming physical features. Other features which demand a stronger screening treatment include the northern edge of the site, which is marred by a fragmented view of light industrial sites. Screening is also provided for portions of the Waverley Heights residential community, but not to the extent that it separates the community from the site.

The plantings are also used to break the linearity of the site down into smaller, but still connected, components. In conjunction with the landforms, the plantings extend across the roadway, linking one side to the other and forming spaces along the road. The road cuts through every community on the site in this manner.

4)Pathways and Access

Pathways and Access to the site are among the most important components of the design, since they direct the visitor to the key features of the site.

Each vehicular entry point is marked by a notable natural feature, giving them a character that will be unique to the site as well as to the city. The western entry at Waverley Street is bordered by a large waterbody and associated Aquatic plant community. The visibility of this feature from the street makes it an important element which will impart a special character to the intersection and serve as an introduction to the site. Similarly, the forest massing at the eastern entry point immediately sets the site apart from its surroundings and sets the stage for the environment beyond the embankment.

The path system becomes an important linkage between Pembina Highway and Waverley Street, creating a safe and interesting route for cyclists, pedestrians, and cross-country skiers. The path is routed so that it avoids the roadway, and the western entry point for cyclists is via an underpass so that it eliminates a potentially dangerous crossing of Waverley Street.

Along its length the path travels through all four plant communities, including the Aquatic community. The pathway route begins along slightly higher ground at the Waverley entry point, providing a view of the prairie before descending slightly to the lower levels of the floodplain.The path then enters an aquatic community before passing beneath Bishop Grandin Boulevard. Emerging on the south side of the site, the main path continues east along the higher ground, weaving among the high points. A secondary path continues west to join up with Lake Albrin Park and Waverley Street. Throughout this area both paths pass through varied zones of tallgrass prairie, upland prairie and aspen parkland. Three paths join the main path from the residential area to the south. The path adjacent to the railroad embankment serves as a main entry point for pedestrians or cyclists from

Pembina Highway via Chancellor Drive. The main path continues east over a level crossing at the railroad tracks to meet Pembina Highway. This would be the route taken by cyclists bound for the University of Manitoba or continuing east along Bishop Grandin Boulevard.

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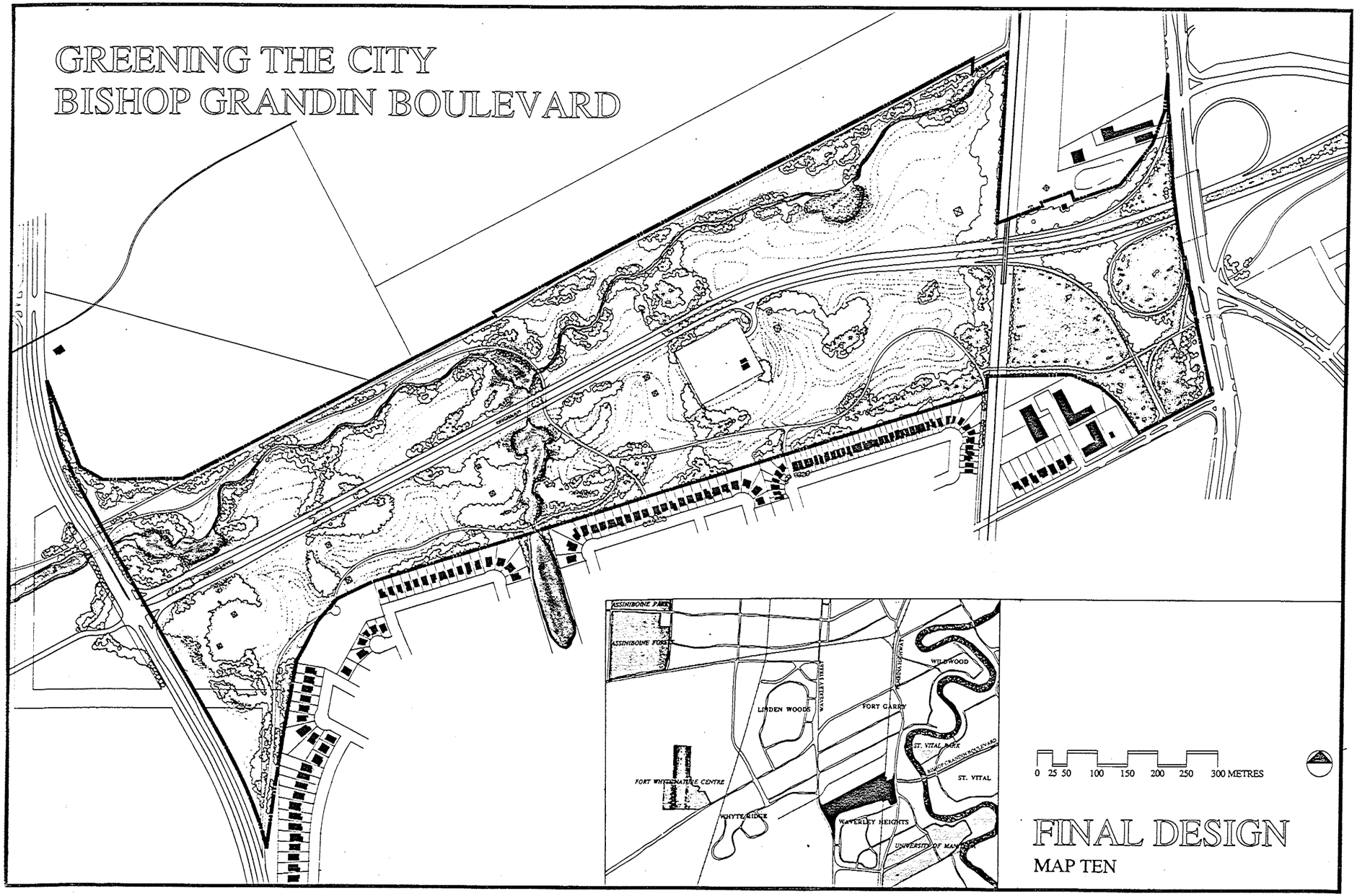

FINAL DESIGN

MAP TEN

CONCLUSION

CONCLUSION

Modern cities often seem to represent a triumph of engineering over nature. Natural forces are treated as impediments to the otherwise smooth and orderly functioning of the city. Nevertheless, despite all attempts to suppress them, spontaneous natural processes continue to function in the city. Rivers flood; plants colonize vacant lots; birds and other animals go about their lives. Ecologically-based design can be as simple as recognizing the presence of these elements of urban nature and working with, rather than against them. The result can be environments which are more in harmony with their setting; which are expressive of an authentic local or regional character rather than some disembodied international design aesthetic. In the words of Anne Rosenberg:

> The design should foster an awareness on the part of the users of their own place in the environmental continuum, and a sense of "connectedness" to both the human and natural elements of their environment.[139]

A design which incorporates natural processes and species variation provides tremendous interest and diversity. The many levels of these landscapes encourage examination through human interaction. The ecologically-based landscape may include wildlife to be observed, berries to be picked, or flowers to be smelled. The urban dweller will be exposed to the plants, communities, and processes which are environmentally appropriate to a particular time and geographical location. On a more fundamental level, such a landscape will show entire cycles of life, death, and regeneration occurring daily. The ability to experience living,

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139 Ann M. Rosenberg, "An Emerging Paradigm for Landscape Architecture", Landscape Journal, Vol. 5, No. 2 (Fall 1986), p. 80.

functioning communities, able to survive and evolve without man's intervention, would be of very great value in making the natural world a real and tangible factor for urban dwellers.

In more practical terms, by returning a degree of control back to the natural world, ecologically-based designs tend to be a more economical and environmentally-healthy way of treating open spaces. Traditional landscape design relies on constant intervention to maintain a static appearance. Ecologically-based designs, which value process over objects, tend to be self-maintaining over the long-term. In terms of health, an ecologically-based design.In addition, the biological depth of ecological designs through species diversity gives them additional resilience and health. This means that the plant communities are less likely to be uniformly devastated by disease or insect infestation. The destruction wreaked in Winnipeg and across North America by Dutch Elm Disease shows the dangers of reliance on monocultural planting designs. Reducing this risk would have financial benefits, as well as ensuring that the city's urban landscape could not be decimated overnight.

A site such as Bishop Grandin Boulevard is ideally suited to an ecological development. It represents a very common type of marginal land which, for most cities, have become open space liabilities rather than assets. Traditionally, these sites receive the standard landscaping treatment of turf and trees which yields minimal practical or aesthetic returns, and which requires a significant ongoing investment in maintenance. While installation costs of an ecologically-based design would be equal to or slightly higher than the traditional landscape, the long-term maintenance costs would show real savings.The City of Winnipeg estimates that the maintenance of sites such as the current Bishop Grandin Boulevard would cost $4661.00 per

hectare annually. In comparison, annual maintenance of the same "naturally" landscaped site would cost $631.00 per hectare.[140] Over the 82 hectares of Bishop Grandin Boulevard, such a difference would amount to an annual savings of $322,542.00 for the same, naturally landscaped site.

An ecological design would bring to the site other, less pragmatic values in addition to the financial considerations. Beyond its basic function of linking road systems and areas, the site would have additional recreational and environmental functions. The site could become an important element in reconnecting the scattered natural landscape resources which are spread throughout the city. The future development plans for Bishop Grandin Boulevard include a western extension to connect with Kenaston Street. Development of this or any other section of the roadway as a linear natural feature would represent a significant step towards achieving the Plan Winnipeg goal of an interconnected urban parkway system.

The popular resurgence of the environmental movement provides a moral and political incentive to explore the possibilities of ecologically-based design. Shrinking budgets at all levels of government provide a financial incentive; the widespread visual impoverishment of the urban landscape adds an aesthetic impetus. The next step is to promote ecologically-based design as a realistic and achievable means of developing large areas of urban open space which can add to the quality of the urban environment. Public awareness is always an important tool for implementation. Any professionals who are involved in the planning and design processes may also need to be informed of the existence of

140 -City of Winnipeg, Parks and Recreation Department memorandum, September, 1990, based on Maintenance levels 3 and 4 respectively.

ecologically-based design as a practical alternative. For many, giving any degree of control back to nature would be the antithesis of their training. As Michael Hough points out: "...aesthetic doctrine supported by horticultural and engineering technologies still determines the design of the urban landscape ."[141] Nevertheless, challenging the status quo begins with the demonstration of a viable alternative. The alternatives examined and demonstrated in this study can provide a direction for future development of this site or similar sites throughout Winnipeg.

141 Michael Hough, "Nature and the City", Landscape Architecture, Vol. 79, No. 7 (September 1989), p. 42.

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-Examines the potential for development of ecologically designed sites to maximize habitat for wildlife within urban areas. In addition, the paper argues that steps must be taken to ensure minimal human disturbances, which is a significant factor in determining the range of species on a given site.

Gordon, David, ed., Green Cities: Ecologically-Sound Approaches to Urban Space. Montreal: Black Rose, 1989.
- A good assortment of papers dealing with environmentally-friendly urban design from around the world.

Grime, J.P., "Manipulation of Plant Species and Communities" in Ecology and Design in Landscape, Ibid., pp. 175-94.
-An ecologist explores the idea that the available information on plant ecology is sufficient to form the basis for an ecological approach to landscape management.

Grubb, P.J., "The Ecology of Establishment" in Ecology and Design in Landscape, Ibid., pp. 83-97.
-An examination of the botanical aspects of plant establishment, with an emphasis on the special requirements of pioneer plants in landscape designs.

Gustavsson, Roland, "Nature-like Parks and Urban Open Space in Housing Areas in Sweden" in An Ecological Approach to Urban Landscape Design, Ibid., pp. 119-34.
-Discusses the state of ecological designs in Sweden, their current emphasis and their appropriateness to Britain.

Handley, John, "Nature in the Urban Environment" in City Landscape, A.B. Grove, ed.. Toronto: Butterworth's, 1983, pp. 47-59.
-Discussion of the environmental parameters involved in ecologically-based design in Great Britain.

Henke, H. and Sukopp, H., "A Natural Approach in Cities", in Ecology and Design in Landscape, Ibid., pp. 307-24.

Higgins, Sandra, "Old Visions, New Twist", Architect's Journal 5 (February 1986), pp. 30-6.
-An introduction to a special issue of Architect's Journal entitled "The City Green". Provides a good perspective on the "city green" movement, focussing primarily on Great Britain.

Higgins, Sandra, "Louis Le Roy", Ibid., pp. 38-9.
-An overview of the work of the seminal Dutch "ecotect" Louis Le Roy, creator of the ecological park at Kennedylaan in Heerenveen, among others.

Higgins, Sandra, "Hermann Barges", Ibid., pp. 40-2.
-Looks at the work of the Berlin-based designer and horticulturalist Hermann Barges. His interests lie in harmonizing urban renewal and natural processes.

Higgins, Sandra, "David Goode", Ibid., pp. 44-6.
- An examination of the work of the Greater London Council's senior ecologist, Dr. David Goode. He is responsible for the creation of Camley Street, an ecological park behind King's Cross Station in London, among others.

Higgins, Sandra, "Vision of a Green and Pleasant Land", Ibid., pp. 52-63.
-Examination of the problems facing post-industrial Birmingham, where derelict industrial land is being converted from an eyesore into a green urban landscape.

Hilderman, M. Garry, "Aspens can make Effective Wind Sponges for Prairie Cities", Winter Cities Newsletter, Vol. 6, No. 4 (August 1988), pp. 23-4.
-The author makes a case for the massing of trees in urban areas as a way of ameliorating harsh climatic conditions.

Hind, Henry Youle, Narrative of the Canadian Red River Exploring Expedition of 1857. Edmonton: M.G. Hurtig Ltd..

Hoepfner, Eva, "Wildflower Meadows: Trials and Triumphs with the Latest in Ground Covers", Harrowsmith 73 (May/June 1987),pp.62-72.
-Written from a horticultural perspective, this article is a do-it-yourself guide to native landscaping.

Hollick, Tom, "Community Landscapes" in An Ecological Approach to Urban Landscape Design, Ibid., pp.89-101.
-Discusses the relationship of ecological designs and community involvement.

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-This book, along with Spirn's The Granite Garden, represents a new approach to urban design in which the city is approached as an integrated system which bridges and reinforces the continuum between man and nature. Whereas in the past other writers on the subject have focussed on the use of indigenous species and naturalized plantings as the ways to achieve an ecologically-based design, Hough looks more at the system as a whole instead of just the component parts. In this manner the book is an excellent introduction to holistic design from a philosophical rather than pragmatic viewpoint.

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Hough, Michael, "The Urban Landscape: The Hidden Frontier", IFLA Yearbook 1982/83, Versailles, France: International Federation of Landscape Architects, (1982), pp. 153-7.

Hough, Michael, "Nature in the City", Landscape Architecture, Vol. 79, No. 7 (September 1989), pp. 42-4.
-A reiteration of Hough's views on the importance of treating the city as a holistic entity.

Howell, Evelyn A., "Woodland Restoration: An Overview", Restoration and Management Notes, Vol. 4, No. 1 (Summer 1986), pp.13-17.
-Compares techniques for creating woodlots for a variety of applications, namely Recreation, Landscaping and Reclamation. An excellent resource.

Howett, Catherine, "Systems, Signs, Sensibilities: Sources for a New Landscape Aesthetic", Landscape Journal, Vol. 6, No. 1 (1987), pp. 1-12.
-An examination of three sources for landscape architectural theory-ecological design, semiotics and environmental psychology. The author shows how these areas may work in conjunction to provide the basis for a new landscape aesthetic.

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-A general introduction to the use of native plants in landscape design, particularly with regard to Great Britain.

Kaplan, Rachel, "Impact of Urban Nature: A Theoretical Analysis", Urban Ecology, Vol. 8, No. 3 (October 1984), pp. 189-98.
-A brief survey of the psychological effect of urban natural areas on the inhabitants of cities.

Keel, Andreas, "Lean and Dry Grasslands as Natural Elements in Built-up Areas", Anthos 1, 21 (January 1982).
-Looks at the installation and maintenance of grasslands as an alternative form of roadside landscaping in the Zurich area. Primarily technical.

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-An excellent discussion of the technical aspects of wildlife habitat construction for reclamation of surface mines in Eastern and Central United States. Concentrates on successional plants and includes planting lists and schedules.

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-Examines the character of Berlin's vacant and derelict land, emphasizing the importance of preserving the natural, ruderal vegetation which has flourished on most of these lots.

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-Discussion of the tradition, in England, of urban commons- their natural history, visual and ecological characteristics, and present management and maintenance- and the application of these landscape forms to future urban development.

Laurie, Ian C., "Nature and City Planning in the Nineteenth Century" in Nature in Cities, Ibid., pp. 37-63.
-A good concise historical overview of the events and conditions which contributed to the formation of our present urban parks systems.Makes the point that an essentially 19th century romantic landscape tradition does not meet the needs of our modern urban context.

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-An examination of the beleaguered existence of urban trees.

Loidl-Reisch, Cordula, "Growing Wild-A Sign of Hope", Anthos 3, 89.
-A very brief study of the phenomenology of native landscapes.

Manning, Owen, "Designing for Nature in Cities" in Nature in Cities, Ibid., pp. 3-36.
-A general discussion of the place of nature in cities under the headings "The context of design", "Attitudes and interpretations", "Design implications", "Some general principles of design" and "The symbolic expression of Nature". A good introduction to the subject.

Markus, Henrietta, "Tallgrass Prairie and Woodland Restoration: A One Year Record", Restoration and Management Notes 5, 1 (Summer 1987), pp. 27-8.
-Notes on the conversion of a .2 Hectare vacant lot in downtown Toronto into a restored woodland and prairie ecosystem. Includes plant types and propagation methods.

Miess, Michael, "The Climate of Cities" in Nature in Cities, Ibid., pp. 92-114.
-Thorough discussion of the effects of urbanization on the microclimates of cities.

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-An article describing techniques for implementation and management of ecologically-based designs in England.

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-Case-studies of two attempts at re-creation of the native woodland and prairie ecosystems in Wisconsin. The first site is a small 1/2 acre park in Madison, the second site is the 15 acre grounds of an insurance company, also in Madison.

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-Description of the author's efforts in establishing native tallgrass prairie at his own residence in Madison, Wisconsin.

Morrison, Darrel G., "Case Study: A Prairie Decade", Landscape Architecture, Vol. 73, No. 3 (May / June 1983), pp. 86-7.
-A follow-up article on the success of the prairie installation at the General Electric site at Waukesha County, Wisconsin.

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-A good introduction to the application of native plantings in the tallgrass prairie of the Midwest states. Includes a good historical and environmental overview with examples of current native plantings.

Morrison, Darrel G., "On Aesthetics and Restoration and Management", Restoration and Management Notes 5:1 (Summer 1987), pp. 3-4.
-An excellent discussion of the value of restored natural landscapes, with particular respect to the actual and perceived values of these landscapes.

Neuenschwander, Eduard, "A New Environmental Culture in Landscape Design Too", Anthos 3, 1989.

Nicholson-Lord, David, The Greening of the Cities. London: Routledge and Kegan Paul Ltd., 1987.

Nohl, Werner, "The Role of Natural Beauty in the Concept of Open Space Planning: A Plea for a Nature Aesthetic", Garten und Landschaft, Vol. 81, No. 11, pp.885-91.
-An attempt to articulate an aesthetic theory with regard to the place of nature within the rational, technological urban environment.

Odum, Eugene P., Ecology. Toronto: Holt, Rinehart and Winston, 1963.
-The standard work on principles of ecology. Scientific but readable and relevant.

Odum, Eugene P., "The Strategy of Ecosystem Development", Science, Vol. 164, No. 3877 (April 18 1969), pp. 262-70.
-A scientist's perspective on ecosystem development through succession and the potential this has for landscape planning. Technical but generally useful.

Parker, J.C., "Low-cost systems of Management" in Ecology and Design in Landscape, Ibid., pp. 211-8.
-Looks at the management implications of naturalized plantings.

Pitt, D., Soergall II, K., and Zube, E., "Trees in the City" in Nature in Cities, Ibid., pp. 206-29.
-General discussion of the attributes of tree planting within cities, and identifies some of the problems whiuch may affect urban trees. Limited value.

Pryce, Suki, "Woody Plants in Nature-like Environments" in An Ecological Approach to Urban Landscape Design, Ibid., pp.60-9.
-An overview of principles and practices required for the creation of ecological designs. Emphasis on the integration of design and management techniques.

Raderschall, Roland, "Natural Garden- A Paradox", Anthos 3, 89.
-Critique of "natural gardening" based upon a fairly literal and one-dimensional understanding of the aims and methods of ecologically-based designers. Nevertheless an interesting and spirited defence of "garden culture".

Rich, S., "Trees and Urban Climate" in Trees and Forests in an Urbanizing Environment, Ibid., pp. 23-8.
-Examines the role of vegetation in reducing levels of gaseous and particulate pollutants within urban environments.

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-Very brief account of the results of a study into the uptake of gaseous pollutants within cities.

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-Incomplete history of garden design from an ecological point of view. Emphasis on German history with serious omissions.

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-Examines alternatives to standard topsoil mixes for use in landscape designs.

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-A selective study of ecologically-based designs in Holland, particularly Bijlermeer in Amsterdam and Buitenhof in Delft. Also contains a good study of ecological principles and techniques.

Ruff, Allan R., Holland and the Ecological Landscape. Stockport, Cheshire: Deanwater Press, 1979.
-An examination of the Dutch approach to ecologically-based landscapes and socially-responsible planning. The author looks at all aspects of park design, implementation and management for all of the most important ecological parks in Holland. In addition, the major figures in Dutch landscape design are identified and their influence examined. A thoroughly researched work which offers a definitive overview of this important design movement- includes plant lists of native species.

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-The proceedings of a workshop at which the discussion centered around ecologically-based landscape designs and their application to the British landscape. The discussion was broken down into three main subject areas- Philosophy, Techniques, and Community and the Landscape.

Ruff, Allan R., "An Ecological Approach to Landscape Design" in An Ecological Approach to Urban Landscape Design, Ibid., pp. 4-11.
-A paper outlining the basic tenets of ecological design, but one which fails to recognize the essential validity of the landscape tradition within which all landscape design must be contained. The author hastily and thoughtlessly denigrates traditional forms of landscape design as ill-conceived and poorly executed.

Schmidt, Eike, "The Natural Garden: A New Direction?", Garten und Landschaft, Vol. 81, No. 11, pp. 877-84.
-A reaction to the work of Le Roy, Urs Schwartz and others. The author disagrees with the exclusiveness of these designers and calls for a more moderate approach to the use of native plants.

Scott, D., Greenwood, R.D., Moffatt, J.D. & Tregay, R.J., "Warrington New Town: An Ecological Approach to Landscape Design and Management " in Ecology and Design in Landscape, Ibid., pp. 143-60.
-Description of the establishment and management techniques involved in the construction of Oakwood and Gorse Covert, two residential areas developed along ecologically-based lines. More thoroughly described elsewhere but a good follow-up.

Scott, David, "The Greening of Warrington", Landscape Design 197 (February 1991), pp.24-5.

Seiberth, Hermann, "The 'Railway Track Triangle' Natural Park-When Will They Ever Learn?", Anthos 1, 21 (January 1982), pp. 8-19.
-Relates the findings of a study done at the Berlin Technical University which looked at the creation of a natural park in the centre of Berlin. Examines the potential for development of a site that has been allowed to "go wild".

Shay, C.T., "The History of Manitoba's Vegetation" in Natural Heritage of Manitoba: Legacy of the Ice Age, James T. Teller, ed.(Winnipeg: Manitoba Museum of Man and Nature, 1984), pp. 93-125.

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Sopper, W.E., "Effects of Trees and Forests in Neutralizing Wastes" in Trees and Forests in an Urbanizing Environment, Ibid., pp. 43-50.
-Detailed and technical account of the role of vegetation in affecting concentrations of pollutants within cities.

Spirn, Anne Whiston, "The Role of Natural Processes in the Design of Cities" in Changing Cities: A Challenge to Planning- Annals of the American Association of Political and Social Scientists 451(September 1980), pp. 98-105.
-Concise version of The Granite Garden containing six case studies which are further discussed in the book.

Spirn, Anne Whiston, The Granite Garden: Urban Nature and Human Design. New York: Basic Books Inc. Publishers, 1984.
-As with Hough's City Form and Natural Process, this book points the way to a new holistic view of the city as an ecological system. More detailed than Hough's book, this is likewise an excellent primer for ecologically-based urban design. The epilogue, "Visions of the Future" provides contrasting pessimistic and optimistic scenarios of future cities and is, in itself, an convincing argument for the urgency of the ideas contained within the book. Excellent and complete bibliography.

Spirn, Ann Whiston, "Urban Nature and Human Design- Renewing the Great Tradition", Journal of Planning Education and Research, Vol. 5, No. 1 (Autumn 1985), pp. 39-51.
-An overview of the tradition of city planning based on an understanding of the natural processes at work. A good, concise historical survey.

Spirn, Anne Whiston, "The Poetics of City and Nature: Towards a New Aesthetic for Urban Design", Landscape Journal, Vol. 7, No. 2 (Fall 1988), pp.108-26.
-A further exploration of the themes contained within The Granite Garden with an emphasis on an alternative aesthetic theory for urban design. Wide ranging and provocative.

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-The author presents his manifesto concerning the neglect of nature in cities and the need for greater integration of natural processes in urban design.

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-Examination of the philosophy and some of the pioneering work of the Dutch "ecotect" Le Roy.

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-Describes the philosophies and works of three practitioners of 'natural' garden design- Louis Le Roy, the Zurich architect Eduard Neuenschwander and the Swiss botanist Urs Schwarz. The author is a fervent advocate of ecologically-based urban design.

Stirrat, Roy, "The Urban Forester of Cincinatti", Landscape Design 159 (February 1986), pp. 23-5.
-Brief look at the city of Cincinatti's program of urban forestry. Examines the potentials of a resource-based approach. Good, basic bibliography.

Stunzi, Peter, "Management of Natural Green Spaces in Built-up Areas", Anthos 1, 21 (January 1982), pp. 2-7.
-The author, the head of the Municipal Gardens office in Zurich, presents his thoughts regarding "naturalized" landscapes, primarily from a maintenance and management point of view.

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-Discussion of the naturally-occuring flora and fauna to be found in the various soil types of Berlin's waste lands.

Sutton, Christine, "Home on the Nuclear Prairie", New Scientist (August 1985), pp. 36-9.
-A description of native tallgrass prairie restoration on the grounds of the Fermilab particle accelerator in Western Illinois.

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Thomsen, Charles H., "The Native Landscape- The Use of Native Plant Materials in the Prairie Region", Landscape Architecture Canada (1982), pp. 20-2.
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Tregay, Robert, "Nature and an Ecological Approach to Landscape Design-Some Thoughts on Basic Philosophy" in An Ecological Approach to Urban Landscape Design, Ibid., pp. 22-31.
-This paper provides some thoughts on a philosophical framework for ecologically-based design which is compatible with landscape traditions.

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-A discussion of the role of urban woodlands in providing variety and relief in the urban landscape. Also includes a brief discussion of urban forestry. A good source of basic information on this topic.

Tregay, Robert, "Design and Ecology in the Management of Nature-like Plantations" in Ecology and Design in Landscape, Ibid., pp.275-84.
-Looks at the importance of collaboration between landscape designers and managers in the ongoing maintenance of ecologically based landscape designs.

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-A report in two parts documenting the implementation of an ecologically-based landscape design for the new town of Oakwood in England. The first part of the report describes the design, development and management of the site as part of an ongoing process of experimentation and trial and error techniques. The result is a valuable body of knowledge which represents the best and latest technical information on ecologically-based design. The second part of the report is written by a Swedish landscape research team studying the site. Their report is an analysis of the vegetation structure of the finished (in relative terms) design. It is quite technical and contains some interesting insights but seems to be

lacking in contextual information which would facilitate it's application to a larger landscape context.

Tregay, Robert, "A Sense of Nature", Landscape Design 156 (August 1985), pp. 34-8.
-An examination, eight years after its establishment, of the ecological greenways of Oakwood, a new residential area of Warrington New Town. In particular, maintenance techniques are described with an examination of cost benefits.

Trillisch, Falk, "The Wild Garden at the University of Berlin", Garten und Landschaft, Vol. 97, No. 7 (1987), pp. 28-32.

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Watts, F.B., "The Natural Vegetation of the Southern Great Plains of Canada" in Vegetation, Soils and Wildlife, J.G. Nelson and M.J. Chamber, eds.. Toronto: Methuen, 1969.
-A thorough and well-written description of the plants and plant communities native to the southern half of the three Canadian Prairie Provinces.

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Wenzel, Jurgen, "Understanding Nature in Landscape Architecture", Anthos 3, 89, pp. 58-64.

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Zube, Ervin H., "The Natural History of Urban Trees", Natural History (November 1973), pp. 48-51.
-Basic but fairly comprehensive overview of the history of trees in the city.

APPENDIX ONE:

NATIVE PLANT COMMUNITIES

APPENDIX 1: NATIVE PLANT COMMUNITIES

These lists include the representative plant communities that could exist on a typical Winnipeg site in an undisturbed state.[143] They are the scientific descriptions of the plant communities, from which the designed plant communities are derived. In most cases, where there is a dominant species it is the first listed.

1.ASPEN PARKLAND COMMUNITY

-Tree layer

Trembling Aspen (*Populus tremuloides*)- Dominant; well-drained, sandy sites
Bur Oak (*Quercus macrocarpa*)- well-drained sites
White Birch (*Betula papyrifera*)- north-facing slopes
Balsam Poplar (*Populus balsamifera*)- poorly-drained sites

-Shrub layer

Hazelnut (*Corylus americana* or *C. cornuta*)- Dominant; well-drained locations
Red Osier Dogwood (*Cornus stolonifera*)- moist locations
Highbush Cranberry (*Viburnum opulus* var. *americanum*)- moist locations
Speckled Alder (*Alnus rugosa*)- moist locations
Saskatoon (*Amelanchier alnifolia*)- edge species
Silverberry (*Eleagnus commutata*)- common pioneer species when Aspen invades grassland
Choke cherry (*Prunus virginiana*)- edge species
Pin cherry (*Prunus pennsylvanica*)- edge species
Rose (*Rosa* sp.)- edge species

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143 -a number of sources were consulted for this information, these include Ralph D.Bird, Ecology of the Aspen Parkland ofWestern Canada in Relation to Land Use. (Ottawa: Queen's Printer, 1961), C.T. Shay, "The History of Manitoba's Vegetation" in Natural Heritage of Manitoba: Legacy of the Ice Age, James T. Teller,ed.(Winnipeg: Manitoba Museum of Man and Nature, 1984), pp. 93-125., and F.B. Watts, "The Natural Vegetation of the Southern Great Plains of Canada" in Vegetation, Soils and Wildlife, J.G. Nelson and M.J. Chamber, eds.(Toronto: Methuen, 1969), pp.93-111.

Raspberry (*Rubus idaeus* var. *strigosus*)- disturbed land
Buffaloberry (*Sheperdia argentea*)
Wolfberry (*Symphocarpus occidentalis*)- common pioneer species when Aspen invades grassland .
Snowberry (*Symphoricarpus occidentalis*)- edge species

-Herb layer, upper stratum

Wild sarsparilla (*Aralia nudicaulis*)
Red Baneberry (*Actaea rubra*)
Lindley's Aster (*Aster ciliolatus*)
Sweet-scented Bedstraw (*Galium triflorum*)
Poison Ivy (*Rhus radicans* var. *rydbergii*)- not appropriate for design purposes!

-Herb layer, lower stratum

Pink Wintergreen (*Pyrola asarifolia*)
Bunchberry (*Cornus canadensis*)
Blunt-leaved Sandwort (*Arenaria lateriflora*)
Woodland Strawberry (*Fragaria vesca* var. *americana*)
Strawberry (*Fragaria virginiana*)
False Lily-of-the Valley (*Maianthemum canadense* var. *interius*)
Dewberry (*Rubus pubescens*)
Star-flowered Solomons's seal (*Smilacina stellata*)

-Other herbs which may also be present

Grooved Agrimony (*Agrimonia striata*)
Wild Columbine (*Aquilegia canadensis*)
Twining Honeysuckle (*Lonicera dioica var. glaucescens*)
Anise Root (*Osmorhiza longistylis*)
Northern Grass-of-Parnassus (*Parnassia multiseta*)
Northern Gooseberry (*Ribes oxyacanthoides*)
Wood's Rose (*Rosa woodsii*)
Three-leaved Solomon's seal (*Smilacina trifloria*)
Carrionflower (*Smilax herbacea* var. *lasioneura)*
Fringed Loosestrife (*Steironema ciliatum*)
Snowberry (*Symphoricarpos albus*)
Purple Meadow-rue (*Thalictrum dasycarpum*)

2.FLOODPLAIN COMMUNITY

-Tree layer

Manitoba Maple (*Acer negundo* var. *interius*)- Dominant
Green Ash (*Fraxinus pennsylvanica* var, *lanceolata*)

Cottonwood (*Populus deltoides*)
Peach-leaved Willow (*Salix amygdaloides*)
Basswood (*Tilia americana*)
American Elm (*Ulmus americana*)

-*Shrub layer*
Red Osier Dogwood (*Cornus stolonifera*)
Sandbar Willow (*S.interior*)

-*Herb layer*
Ostrich Fern (*Pteretis pensylvanica*)
Wood Nettle (*Loportea canadensis*)
American Hop (*Humulus americanus*)
New England Aster (*Aster nova-angliae*)
Flat-topped White Aster (*Aster umbellatus*)
Beggar-ticks (*Bidens glaucescens*)
Wild Mint (*Mentha arvensis* var. *glabrata*)
Silverweed (*Potentilla anserina*)
Flat-topped Goldenrod (*Solidago graminifolia*)
Marsh Hedge Nettle (*Stachys palustris* var. *pilosa*)
Stinging Nettle (*Urtica procera*)

3.WILLOW COMMUNITY
Pussy Willow (*Salix discolour*)- better-drained locations
Sandbar Willow (*Salix interior*)
Basket Willow (*Salix petiolaris*)
-there is not generally any herb layer below willows.

4.1.EDGE COMMUNITY (WET-MESIC)
-*Tree layer*
Balsam Poplar (*Populus balsamifera*)
Trembling Aspen (*P. tremuloides*)

-*Shrub layer*
Speckled Alder (*Alnus rugosa* var. *americana*)
Red Osier Dogwood (*Cornus stolonifera*)
Rose (*Rosa* sp.)
Beaked Willow (*Salix bebbiana*)
Pussy Willow (*S. discolor*)
Slender Willow (*S. petiolaris*)
Gray Willow (*S. humilis*)

Wild Plum (*Prunus americana*)
Highbush Cranberry (*Viburnum trilobum*)

-*Herb layer*

Big Bluestem (*Andropogon gerardi*)
Canadian Anemone (*Anemone canadensis*)
Canadian Milk-vetch (*Astralagus canadensis*)
Blue-joint (*Calamagrostis canadensis*)
Northern Reed grass (*C. inexpansa* var. *brevior)*
Small Yellow Lady's slipper (*Cypripedeum calceolus* var. *parviflorum*)
Canada Wild Rye (*Elymus canadensis*)
Wild Licorice (*Glycyrrhiza lepidota*)
Narrow-leaved Sunflower (*Helianthus maximiliani)*
Meadow-sweet (*Spiraea alba*)
Veiny Meadow-rue (*Thalictrum venolosum*)
American Vetch (*Vicia americana*)
Heart-leaved Alexanders (*Zizia aptera*)

4.2.EDGE COMMUNITY (MESIC)

-*Tree layer*

Trembling Aspen (*Populus tremuloides*)
Bur Oak (*Quercus macrocarpa*)

-*Shrub layer*

Saskatoon (*Amelanchier alnifolia*)- edge species
Hawthorn (*Crataegus* spp.)
American Hazelnut (*Corylus americana*)
Beaked Hazelnut (*C.cornuta*)
Silverberry (*Elaeagnus commutata*)
Pin-cherry (*Prunus pennsylvanica*)
Choke-cherry (*P. virginiana*)
Rose (*Rosa* sp.)
Snowberry (*Symphoricarpos albus*)
Wolfberry (*S. occidentalis*)
Raspberry (*Rubus idaeus* var. *strigosus*)
Buffalo-berry (*Sheperdia argentea*)
Nannyberry (*Viburnum lentago*)
Downy Arrow-wood (*V. rafinesquianum*)

-*Herb layer*

Blue Giant Hyssop (*Agastache foeniculum*)

Spreading Dogbane (*Apocynum androsaemifolium*)
White sage (*Artemesia ludovviciana* var. *gnaphalodes*)
Smooth Aster (*Aster laevis*)
Canadian Milk-vetch (*Astragalus canadensis*)
Fireweed (*Epilobium angustifolium*)
Joe-Pye-Weed (*Eupatorium maculatum* var. *bruneri)*
Wild Licorice (*Glycyrrhiza lepidota*)
Narrow-leaved Sunflower (*Helianthus maximiliani)*
Pale Vetchling (*Lathyrus ochroleucus*)
Purple Vetchling (*L. venosus* var. *intonsus*)
Meadow Blazingstar (*Liatris ligistylis*)
Wild Bergamot (*Monarda fistulosa*)
Silverleaf Psoralea (*Psoralea agrophylla*)
Tall Coneflower (*Rudbeckia laciniata*)
Snakeroot (*Sanicula marilandica*)
Canada Goldenrod (*Solidago canadensis*)
American Vetch (*Vicia americana*)

5.1.GRASSLAND COMMUNITY (TALLGRASS)

-Grass layer

Big Bluestem (*Andropogon gerardi*)- Dominant
Little Bluestem (*A. scoparius*)
Wheat grass (*Agropyron* spp.)
Canada Wild Rye (*Elymus canadensis*)
June grass (*Koeleria cristata*)
Porcupine-grass (*Stipa spartea*)

-Forb layer

Leadplant (*Amorpha canescens*)
Canada Anemone (*Anemone canadensis*)
Willow Aster (*Aster praealtus*)
Ground Plum (*Astralagus caryocarpus)*
Northern Bedstraw (*Galium septentrionale*)
Blazing Star (*Liatris* spp.)
Prairie-lily (*Lilium philadelphicum* var. a*ndium)*
White Prairie Clover (*Petalostemon candidum*)
Purple Prairie Clover (*P. purpureum*)
Prairie Rose (*Rosa arkansana*)
Canada Goldenrod (*Solidago canadensis*)

5.2.GRASSLAND COMMUNITY (SLOUGHGRASS)

-Grass layer

Prairie Cord grass (*S. pectinate*)- Dominant
Northern Reed Grass (*Calamagrostis inexpansa* var. *brevior*)
Canada Wild Rye (*Elymus canadensis*)
Switchgrass (*Panicum virgatum*)
Alkali Cord grass (*Spartina gracilis*)

-Forb layer

Baltic Rush (*Juncus balticus* var. *littoralis)*
Canada Goldenrod (*Solidago canadensis*)

5.3.GRASSLAND COMMUNITY (UPLAND)

-Grass layer

Porcupine-grass (*Stipa spartea*)- Dominant
Western Wheat grass (*Agropyron smithii*)
Side-oats Grama (*Boutelous curtipendula*)
June grass (*Koelaria cristata*)

-Forb layer

Leadplant (*Amorpha canescens*)
Rhombic-leaved Sunflower (*Helianthus laetiflorus* var. *subrhomboideus*)
Western Red Lily (*Lilium philadelphicum* var. *andium)*
Silverleaf Psoralea (*Psoralea argophylla*)
Prairie Rose (Rosa arkansana)
Missouri Goldenrod (*Solidago missouriensis*)

6.AQUATIC COMMUNITY

-Emergent vegetation

Soft-stem Bullrush (*S. validus*)
Slough grass (*Beckmannia syzigachne*)
Sedge (*Carex* sp.)
Reed grass (*Phragmites communis*)
Hard-stem Bullrush (*Scirpus acutus*)
Prairie Bullrush (*S. paludosus*)
Spangletop (*Scolochloa festucacea*)
Cattail (*Typha latifolia*)