ARCHITECTURE, DEVELOPMENT AND ECOLOGY: GARRY OAK AND PERI - URBAN VICTORIA

by

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ABSTRACT

This thesis seeks to explain how site-scale design decisions can assist retention of rare plant communities concentrated in and near settled areas. To do so it focuses on a specific species and development context. Explanations are sought through examination of case studies of land-use developments in proximity to retained Garry oak plant communities located in the perimeter of Victoria, British Columbia. In the study region, exponential declines in species populations, health, and diversity of rare Garry oak ecosystems have been largely attributed to impacts from land-use developments. Over the past century, land-use developments have transformed the floral, spatial, structural and functional characteristics of the settled landscape. Isolated islands of imperiled plant associations remain on protected bioreserves: for recruitment and connectivity, these rare fauna rely on private-land greenways. Architectural teams have the potential to influence the decision-making processes that create ecologically-vital greenspace on private land, thereby enhancing survival for declining plant communities. Case-study evidence for the importance of land-use decisions on diminishing Garry oak meadow is gathered through vegetation surveys conducted on Garry oak meadow in proximity to six architectural projects on Victoria's western edge. Observed changes in growth extensions are then categorized in relation to human activities associated with built form, and correlated with principles from Landscape Ecology. An ARC of design strategies, developed in primary research by K. D. Rothley is adapted for architectural use as follows: firstly, AREA of a plant community is kept free of encroachment by the orderly frame established around vegetation; secondly, RARE SPECIES and habitat are identified with borders or signage; thirdly, CONNECTIVITY between retained landscapes is secured by siting roads and buildings to minimize ecosystem fragmentation. To effectively communicate preexisting landscape ecology principles, grouped under the ARC of strategies, illustrations and key-word phrases are developed. These principles, when integrated into architectural teams' structural knowledge, extend the architects' perceived role beyond aesthetics and economic efficiency. Enhancing habitat value through retention or restoration of rare ecosystems at the margins of suburban development, becomes an additional realm of influence for professional teams designing the spatial configurations of peri-urban landscapes.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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CHAPTER 1: SPATIAL CONFLICTS: RARE PLANT COMMUNITIES AND LAND-USE DEVELOPMENTS

1.0 Introduction: Integrating biodiversity with Design Decisions

Progressive aerial photographs of expanding cities show areas of natural vegetation diminishing decade by decade as settlement advances. Along the edges of settlement, at the margins of suburban development, rare native plant associations[1] are in jeopardy of disappearing as habitats are cut through and built upon (Schaefer 1991, Schmid 1996). Native species conserved areas—parkland and covenants—are also threatened not by bulldozer but by their proximity to settlement. It is a matter of urgency that patterns of land-use development change, if we are to contribute to the global struggle to stabilize or improve biodiversity. An important part in sustaining biodiversity is to ensure the survival of native biota that characterize regional landscapes. Architectural teams' decisions, along with those of private landowners, community members, municipal planners, and higher levels of government, affect those landscape patterns.

"Architecture, Development and Ecology" explores a range of possible decisions that affect regional and global biodiversity. It then focuses on the importance of decisions made by architectural teams. Firstly, this research is intended to communicate the exponential ecological losses that will continue unless land-use strategies are revised. The intention is not to return to some idealized ecological equilibrium, but rather to recognize that within changing ecosystem dynamics it is vital to reverse recent precipitous declines in biodiversity. Secondly, a design approach that integrates ecological principles with land-use development decisions is proposed.

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[1] A plant association is defined by B.C. Ministry of Environment, Lands and Parks (BCCDC e-mail document received 19 August 1999) as a unit of vegetation with relatively uniform species composition and physical structure. Plant associations are definable natural entities. A stand of vegetation may progress from one association to another in a process called succession. In some literature, plant association is replaced with plant community.

This approach would enable architectural teams, working within a mosaic of built form and open spaces, to maintain the ecological integrity inherent in the mosaic.[2]

Underlying the proposed design system are a set of principles developed from the science of landscape ecology.[3] Decades of published landscape ecology research prove that specific land-use strategies are effective at protecting biodiversity over a variety of scales and landscape types. From site-scales to regional mosaics, from remote areas to intensively-occupied urban environments, landscape ecologists have conducted empirical research to verify that decisions about spatial patterns strongly influence ecological function (Spirn 1981, Forman and Godron 1995, Dramstad et al 1996, Sauer 1998). Key to architects' realm of influence is the observation that settled areas are as much a part of a landscape mosaic as spaces far from human habitation. The placement and design of built form components—buildings, roads, and gardens—affect movement and changes of plants, animals, microclimates, water and materials (Burgess and Sharpe 1981, Forman and Godron 1986, Dramstad et al 1996). Since decisions about those structural elements and site scale land-uses are often made with the input of architects and their consultants, the landscape ecological approach makes connections between architectural decisions and ecological functions.

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[2] A mosaic is the structural pattern of the landscape, composed of patches, corridor and matrix (Dramstad et al 1996). The structural pattern can be visualized as the pattern seen from an airplane or in an aerial photograph. The spatial pattern strongly controls ecological functions: movements and changes of biota, water, materials and microclimates. Changes in spatial pattern occur as a result of ecological functioning, or a land-use decision such as the insertion of roads or buildings.

[3] Landscape ecology has evolved since about 1950 as a science which uses aerial photographs and other means to study and predict interactions between the environment and biological species, generally at a scale of landscapes (a landscape is a mosaic, usually kilometers wide, over which ecosystems functions and land-uses occur—Dramstad et al 1996). Landscape ecology combines knowledge from biogeography, climatology, natural history, and soil science.

The design approach of "Architecture, Development and Ecology" also recognizes a second essential link between the land-use professions and landscape ecology. Both sets of disciplines acknowledge that human culture is a vital component of any functioning design solution. Just as architecture integrates peoples' cultural and spatial needs with a given piece of land, landscape ecology principles rely upon a meshing of cultural processes—aesthetics, social patterns, economics—with spatially-determined ecological processes—species interactions, soil/food webs, flows of water and materials. Further, both disciplines anticipate and influence change. In this research, as in recent works by landscape architects and ecologists,[4] a symbiosis between principles from landscape ecology and the work of land-use professionals is foreseen. On the other hand, ecologically-inspired designs are imbued with long-term cultural acceptance with the aid of designers' aesthetic skills and influence. The design professions, including architects and landscape architects, have accepted roles as forbearers of aesthetic innovation (although the same professions have knowledge and education that extends well beyond aesthetics). On the other hand, by pairing this aesthetic leadership with principles from landscape ecology, land-use professionals are uniquely positioned to participate in protecting the biodiversity of landscapes.

Biodiversity protection is, in fact, the underlying goal for the argument that architectural culture can nurture ecological health through an integration of landscape ecology principles with human spatial needs. The significance of biodiversity protection, as evidenced by research in the Natural and Applied Sciences (including Conservation Biology, Resource Management, Biogeography and Landscape Ecology), has two main strands. The first strand of significance

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[4] See Spirn 1981, Nassauer 1995, Sauer 1998. Architects do not seem to be included in existing works of applied landscape ecology. The author contends that architects need to know when to incorporate the knowledge of ecologically-trained landscape professionals in the site planning process and in detailed design.

recognizes that ecological, genetic, and species diversity[5] enhance human civilization (Primack 1995, Mugnozza 1996, Schmid 1996). Complex forms of life evolving under varied ecological conditions supply resources for economic growth, artistic inspiration, medicine and nutrition, and recreational opportunities: a richly varied natural environment satisfies many economic, aesthetic, intellectual and social needs. The second strand of biodiversity's significance is its intrinsic value related to unique ecological roles served by component species (Primack 1995). The ecological complexity found in the natural environment is vital to biosphere health and ecosystem stability (Shaefer 1991, Primack 1995, Mugnozza 1996, Schmid 1996).

At times through history, however, the unmitigated exploitation of natural ecosystems, combined with the hegemony of picturesque landscape aesthetics,[6] has led to the deterioration and loss of

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[5] Biological diversity (biodiversity) occurs at three levels. Species biodiversity includes the range of species found within a region. Species-rich areas are those with a high level of species biodiversity. Genetic diversity refers to genetic variation within a species, and is a factor in the ability of a species to adapt to environmental change. Ecological diversity (also known as community or ecosystem diversity) describes the amount of variation in habitat types, and the potential for interaction between species of each habitat (Primack 1995, di Castri and Younès 1996). A decline in ecosystem diversity can precipitate plummeting declines in the other two biodiversity levels.

[6] Picturesque tastes evolved in eighteenth century Britain in poetry, painting, aesthetic theory, and landscape. Christopher Hussey's The Picturesque (1927) notes that during the eighteenth century a stylistic change "occurred at the point where an art shifted its appeal from reason to the imagination" (Hussey 1927: 18). The romanticized approach was seen to "enable the imagination to form the habit of feeling through the eyes" (ibid). The predominantly visual aesthetic began in painting, then was transposed to the landscape itself. The picturesque landscape became an effective means of asserting the landowners' excellent taste, while obscuring acts of land appropriation—enclosures, emparkments and colonization—all of which created private estates while leaving former occupants of the land destitute. Picturesque landscapes embody a transformation to a visually-dominated aesthetic (landscapes are made to look like a "picture"). The key elements in the landscape aesthetic are the breaking down of a landscape into background, strongly-lit middle distance, and foreground framed by clumps of trees; a manmade lake in the middle distance (to reflect light); serpentine forms (in paths, lake or created hillsides); clumps of trees to create diagonal vistas through expanses of turf. The entire assemblage is intended to look timeless. Many of these elements were popularized by Capability Brown (1716-83), who in the 1740's found "a popular formula (for English landscapes) which he

biological communities. Biodiversity losses have occurred at unprecedented rates during the past century as processes of landscape commodification and aestheticization are permitted to dominate (di Castri and Younès 1996, Hironaka 1996). The domination of economically-justified human activities to the point where life forms are eradicated evidences an ideology that natural systems have value only insofar as they can be exploited for economic gain. This ideology is unsupportable given the myriad of economic functions served by the very biodiversity that suffers under the uncontested hegemony of economic processes.

Allied with economic gain is the aestheticization of landscapes for the purposes of increasing property values and demonstrating the landowners' taste and social position. Landscapes reconfigured to look like a picture have also historically been used to disguise transformation resulting from land appropriation, while evoking an appearance of naturalness to obscure the hand of the designer. Techniques of aestheticization have not been restricted to pastoral or garden settings: "wilderness" parks have also historically been carved from land appropriated from former occupants.[7]

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repeated, without alteration, during the next thirty years for an audience of contented landowners" (Watkin 1982, 67). The picturesque continues to be popular into the twenty-first century, as a culturally-entrenched aesthetic which evokes the elitist of historic British gentry, while simultaneously encoding the ample rural lands of colonial North America (Duncan and Duncan 1997).

[7] The concepts of the picturesque (pastoral) landscape and wilderness can be contrasted in the landscape architectural work of Frederick Law Olmsted and his sons. The Olmsteds designed both picturesque suburbs (such as Uplands in Victoria and Riverside in Chicago) and "natural" or "wilderness" parks (including Yosemite National Park and the reconstructed Fens of Boston). The picturesque suburbs' curvilinear streets and painterly vistas "helped to destroy lingering American fears of the wilderness [...]. The picturesque site was chosen, the savage woods extolled" (Tunnard 1953, 81). Similarly, Olmsted's "wilderness" parks were designed and constructed, but the designer carefully hid their artifice behind an appearance of nature-made or natural scenery. Alison Spirn (1996) concludes that this obscuring of artifice robs the constructed "wilderness" or "natural" areas of their functionality. The erasure of design effort also rubbed out evidence that Olmsted's natural parks were designed to purify water, enhance processes of succession, accommodate movement of people, and permit multiple viewers to be

While eighteenth century concepts of wilderness were expressed in sublime landscapes "where one had more chance than elsewhere to glimpse the face of God [...] God was on the mountaintop, in the chasm, in the waterfall, in the thundercloud, in the rainbow, in the sunset" (Cronon 1996, 73), by the mid-nineteenth century, wilderness came to be seen as commodifiable tourist destinations. Wilderness parks, designed by landscape architects such as Frederick Law Olmsted, symbolized the frontier and an escape from industrial society. Like the enclosures of eighteenth and nineteenth century England, however, much North American "wilderness" was actually made empty by the systematic removal of prior inhabitants. The First People who had once called the wilderness home were moved to reservations, so that tourists could appreciate untamed, uninhabited lands. There is a direct correlation between wilderness and the picturesque: both transformed landscapes to a fixed aesthetic image; both obscured the transformations and any acts of appropriation involved in the transformation.

Meanwhile, during the aestheticization of landscapes, many original and planned functions—including ecological functions enabling survival of diverse biota—were also obscured. Designing picturesque landscapes to look like an English watercolour painting, or designing parkland to look like a wilderness, have both been techniques which consciously deceive the viewer into thinking the aesthetically-reconfigured image is "natural" or "timeless".

Recognizing the social and functional impacts of picturesque and wilderness inventions, "Architecture, Development and Ecology" offers an alternative approach for teams concerned

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hidden from one another. Because these functions were deliberately hidden behind an appearance of "naturalness", even Olmsted was unable to convince parks managers to maintain his designs so they could function as planned. After Olmsted's death, Spirn notes that final traces of functionality were mainly lost, and the parkland came to be appreciated purely for aesthetics.

with the configuration of landscapes. The approach recognizes that land-use professionals' work can influence more processes than those of aestheticization and commodification. Teams may look beyond the paired dominance of the sense of vision and economic growth, seeking instead those solutions that also serve diverse ecological and human functions (Palasmaa 2000). Further, design teams may enable the longevity of those functions (including biodiversity protection and enhancement) by revealing, rather than obscuring, the intent of their landscape designs.

Of particular interest to design teams, and therefore to this research, are peri-urban environments: settled areas at the expanding edges of cities. Within these complex habitats, a particular tension between ecological function and built form can be found. Yards, gardens, parks, road edges, and recreation spaces form a significant portion of the peri-urban landscape mosaic. This network of green spaces supports many diverse species of flora and fauna (Spirn 1981, Shaefer 1991, Schmid 1996). Significantly, peri-urban open spaces are often ecologically connected to sparsely-inhabited areas beyond the urban fringe: the peri-urban mosaic therefore bridges between picturesque garden landscapes and "wilderness." To the detriment of ecological functions, however, are inherent problems of peri-urban space, such as the prevalence of the automobile and the hegemony of landscape conventions. These problematic factors have led to biodiversity barriers. For example, a disproportionate quantity of blacktop or lawn characterizes peri-urban mosaics. Neither material has habitat value, and both may act as barriers to ecosystem processes (Spirn 1981). By contrast, one can envision that the spatial and material qualities of the mosaic are selected to enhance biodiversity. In turn, peri-urban biodiversity has cultural benefits that directly influence peoples' daily lives. By the very nature of their accessibility, peri-urban biodiversity enhancements are readily implemented, monitored and incorporated into educational and community processes.

Since architects are deeply concerned with human culture, and have both historic and current involvement in the design of suburban spaces and edge cities,[8] peri-urban biodiversity has particular relevance to "Architecture, Development, and Ecology." To bring a research focus and a geographic immediacy to biodiversity at the city's edge, Garry oak ecosystems—distinctive and habitats found here in British Columbia—are examined. This climax ecosystem, which has the highest plant species diversity of any terrestrial ecosystem in B.C., supports an array of life forms, many of which have disappeared from the region within our lifetimes. Since Garry oak meadow habitats are rapidly disappearing as a result of land-use developments, an overview of land ownership patterns sets the context for how the formerly abundant, 10,000 year old oak meadow ecosystem has so recently become critically imperiled. Land-use patterns are interwoven with cultural attitudes towards the landscape which are unveiled through the brief history of Garry oak meadows found in Chapter one.

After examining the landscape patterns and attitudes that led the oak ecosystems from abundance to rarity, a range of remedies is explored in Chapter two. Here, interdisciplinary strategies to ameliorate losses of rare peri-urban ecosystems are discussed. Within these strategies, the role of conservation-based site-scale decisions is postulated. However, the application of site-scale ecological theories are found to be inhibited by a common fracturing of

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[8] "Edge city", a term coined by Joel Garreau (1991) is a spread-out collection of single family detached dwellings surrounded with grass "that has made America the best-housed civilization the world has ever known" (Garreau 1991, 4). The political and economic processes of edge cities are discussed in Jonas 1999.

research-based and practical knowledges. Closing the schism between disciplines enables essential linkages between the practice of land-use development and ecosystem theory. When research and applications meet in the work of architects, site-scale ecosystems can be designed to enhance regional biodiversity. For example, rare species found on a site that connects to a bioreserve may extend the conservation potential of protected species associations on the bioreserve.

As practical support for achieving the goal of biodiversity enhancement, Chapter two closes with a proposal for culturally-acceptable vegetation uses within Garry oak meadow site series.[9] The landscape proposal is distilled from Landscape Ecology recommendations, biodiversity requirements and historic transformations of the indigenous landscape. Solutions are presented which involve the conservation or reclamation of essential habitat, while acknowledging the cultural factors that make habitats appealing—and therefore sustainable.

Chapters three and four form the empirical research sections of this thesis. In-depth examinations of the actual effects of design decisions on Garry oak meadow ecosystems add immediacy and urgency to the argument for new design criteria and solutions. The case-study sites in these chapters are evaluated against a trio of well-established ecological principles, reorganized by the author as an ARC for measuring ecosystem health. Chapter five expands the ARC—Area, Rare species Representation, and Connectivity—into a series of principles proven by landscape ecologists to be ecologically effective across scales and ecosystem types. The

[9] A site series is a piece of ground with the potential to grow a particular type of vegetation (BCCDC 1999). On a given site series, succession is the process of change in the arrangement of plant associations; however it has been noted by scientists that succession is not a straight-line process. The stages of succession vary in rate, may be regressive, and are often interrupted by disturbance – extinction–causing events (Collins and Glenn 1997).

principles are illustrated and paired with keyword phrases. This format is intended to assist legibility of the ecological ideas, thereby facilitating their use by design professionals. In this way the research also strives to give architects, landscape architects, and planners the arsenal needed to convince project initiators and users of the importance of ensuring that ecosystem function is integrated with land-use decision-making processes.

The conclusions in Chapter six summarize architectural applications for Landscape Ecology, a science that both explains and helps predict the consequences of each design decision on the functioning of ecosystems around us. Following some practical suggestions for integrating ecological principles with each land-use development phase, this chapter presents the peri-urban landscape as an ecological system which is a vital component of global biodiversity. The changes occurring within peri-urban ecosystems can lead to greater ecosystem health if those influencing the change integrate both scientific knowledge and cultural awareness into their decision-making processes. Awareness of the ecological functions of the ecotone between built space and native ecosystems is the first step in seeing ourselves as an integral part of the solutions for greater ecological health.

1.1 Biodiversity and Peri-Urban Plant Associations

Biodiversity worldwide is decreasing exponentially (Schaefer 1995, Schmid 1996). The number and variety of living species ecosystems is plummeting, largely in response to rapid changes in land-use and regional development due to a globalized market economy (di Castri and Younès 1996, Kempton and Boster 1996). The implications of biodiversity losses extend beyond the environmental dimension. Since cultural identities, economic diversification, and social adaptation to change are all affected by the interactions among the ecological systems that characterize biodiversity, significant losses in variability among living organisms impact many facets of human development.

The ramifications of current patterns of development activity on worldwide biodiversity are great. It is estimated that without human intervention, species would become naturally extinct at a rate of less than one per year; with current land-use practices, species are vanishing worldwide at between four thousand and twenty-seven thousand per year (Kempton and Boster 1996). To reverse these rates of decline, the priorities and practices of development need to be analyzed according to their impacts on biodiversity, and then adapted with scientific input and the on-going monitoring of results (Ussery 1993, Schmid 1996).

Within this worldwide problem of biodiversity losses, there is growing interest in protecting the integrity of ecosystems near settled areas. Peri-urban biodiversity—diversity of ecological systems surrounding urban areas—is an imperative component of the larger struggle to reduce biodiversity losses. Diverse plant associations near cities have been shown to contribute to a healthy biosphere (Schmid 1996, Sauer 1998, BCCDC paper 1999), have educational value (di Castri and Younès 1996, Turner 2000), and enhance aesthetic and cultural qualities of settlements. Yet as current forms of land-use development expand beyond the urban periphery, plant associations which rely on characteristic environmental features near cities are becoming rare as the landscape is fragmented.

Habitat fragmentation severely impacts both abundance and diversity within those species communities, such as Garry oak meadows, which have their greatest concentrations in and near settled areas (Schmid 1996, Sauer 1998, Roemer 1999). Such landscapes at the margins of urban development (peri-urban areas) at times provide a haven for native floral species which are endemic—that is, found nowhere else but in a given area (Schmid 1996, Sauer 1998). Since British Columbian Garry oak communities are endemic to south Vancouver Island and the Gulf Islands, both areas favoured by land-use development, landscape fragmentation reduces the only habitat available to these rare plant communities. In these mild lowland areas, warmed by ocean currents and sheltered from the rains that characterize nearby coastlines, human and oak communities vie for space. As with California's now-endangered oaks, British Columbia's oaks are losing the struggle between land for oak meadow and land for roads, structures or non-native landscapes (Pavlik et al 1992, Nosal 1999).

1.2 The Problem: Diminishing Garry Oak Meadows

To study the problems of diminishing peri-urban ecosystems, this research focuses on a critically imperiled plant association found only on southeast Vancouver Island and the Gulf Islands. Within this ecosystem, rarity is exemplified: nearly twenty percent of the rare plants in British Columbia are found in the Garry oak meadow (Ceska 1986, Hebda 1993). Diminishing habitat area is also exhibited: it is estimated that between one and five percent of oak meadows found provincially at the beginning of this century still exist today (Hebda 1993, Fleming 1999).

Garry oak meadows are a climax vegetation type—that is, the meadows are the oldest vegetation association within the gradual (or sudden, disturbance-related) change from one vegetation association to another on a given site series. Climax vegetation types, such as oak meadows, have the highest species diversity and greatest stability (resistance to disturbance or extinction-causing events) of any plant association. The vegetation of the meadows is rich in complexity and diversity: but this diversity is rapidly diminishing. Over one hundred rare plants are found in this province's oak meadows—more than twenty percent of the rare plants in British Columbia (Ceska 1986, Hebda 1993, Douglas and Straley 1998). Not just colorful flora such as Macoun's meadowform, Hooker's wild onion, and prairie violet, are becoming rare. Many birds, insects, mammals, reptiles and amphibians which depend upon Garry oak meadow for habitat are extirpated, or nearing extinction or extirpation.[10] Birds, which were abundant within our lifetimes, that are now extirpated include the western meadowlark, horned lark, Lewis' woodpecker, and vesper sparrow (Erickson 1996, Turner 2000). The Island Marble Butterfly is no longer found, and other butterflies and native bees are seldom seen (Chatwin 1993, Erickson 1999). The alligator lizard, like the once-abundant bulbs and wild strawberries of their sunny meadow habitat, are now scarce. Even where Garry oak meadow habitat has not been removed for land-use development or non-native garden, aggressive non-native invaders such as Scotch broom, orchard grass and starlings have become dominant, thereby reducing the diversity of species. While change is a characteristic of ecosystems, the dramatic rates of change over the last century have reduced a ten thousand-year-old climax ecosystem to a tiny fraction of its former range.

To clarify the processes of accelerated change which have decimated the colorful and diverse Garry oak ecosystem, the next section overlays a history of land-use tenure and development patterns of southeast Vancouver Island with facts of the known history of oak vegetation complexes. Importantly, correlation's between vegetation and land ownership patterns may suggest directions for changes to land-use patterns which will enable oak ecosystem declines to be reversed.

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[10] Extirpation occurs when indigenous species, subspecies or varieties are no longer known to exist in the wild within the area of study (in the case of this research, within British Columbia), but exist elsewhere. Extinction indicates species no longer existing (worldwide).

1.3 How Did We Get To This Problematic Situation? Landscape Transformations and Peri-Urban Development Patterns in Victoria

The past one-and-one-half centuries have entailed changes to land-use and tenure patterns that transformed British Columbia's oak meadows from pre-colonial abundance to current rarity. Across North America, similar attitudes towards the indigenous landscape mosaic influenced nineteenth and twentieth century forms of land-use development. Key ideologies which transformed North American landscapes—the myth of wilderness (Cronon 1996, Sluyter 1999), the rationalization of land-use through commodification (McNeely 1996), and the isolation of biota from its ecological context (Leo Marx 1991, Cronon 1991), can be identified by a brief reconstruction of the history of Garry oak meadows. These three culturally-entrenched ideologies of landscape are shown in this Garry oak history, as elsewhere, to influence the transformation of landscapes (MacCleery 1994, Cronon 1996, Schama 1995, Sluyter 1999); as a corollary, new understandings of landscape can emerge from a disavowal of these paradigms.

Captain George Vancouver, writing of southeast Vancouver Island oak meadows in 1792, enthused that "the landscape is almost as beautiful as the most elegantly furnished pleasure grounds".[11] With an eye for claiming "whatsoever thing they could find [...] in token of Christian possession"[12] including botanical specimens, Vancouver's surgeon- botanist Archibald Menzies collected meadow plants to send back to England. Categorized according to the Linnean system, the plants collected by Menzies were shown isolated from their ecological and cultural setting.

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[11] Captain George Vancouver 1792, quoted in Vancouver Sun (6 Feb., 1999), B1.

[12] Martin Frobisher, "First Voyage, 1576", quoted in Mary Alice Downie, And Some Brought Flowers (Toronto: University of Toronto Press, 1980), xi.

In the words of the eighteenth century explorers, and writers of the subsequent two centuries, Menzies and other European botanists "discovered" British Columbia's plants. Indigenous North American biota was not credited with an existence until imbued with meaning by categorization within the Western Scientific system (Marx 1991).[13]

Captain Vancouver went on to map Vancouver Island's coastal meadows. The sunny, "curious and beautiful"[14] landscapes afforded relief from the "impenetrable stretches of pinery"[15] found elsewhere on the British Columbian coast. The island meadows were colonized half a century later by representatives of the Hudsons Bay Company. The Company's chief factor, James Douglas, admired the oak parklands surrounding his selected HBC fort site on James Bay:

> The place itself appears a perfect Eden in the midst of the dreary wilderness of the North West Coast... one might be pardoned for supposing it had dropped from the clouds. (Douglas 1942, quoted in Segger and Franklin 1996:135)

Dropped from the clouds it had not: at that time, the site had a very real function as the locale of a long-established Coast Salish Village. In a brief skirmish, the HBC fired a nine-pound cannon at the Salish chief's lodge, then dismantled the remains of the village and shipped the structural components of the residences to the less-protected western side of the harbour. The act of occupying space by first rendering it empty or uninhabited, and then incorporating it into a market economy (Marx 1991) is evident in this act of appropriation by the British trade

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[13] For example, parks naturalists /botanical writers C. P. Lyons and Bill Merilees write about pioneer botanists as being lured by "undiscovered flora"; William Anderson is said to have made "The first known collection" of Northwest American plants; Lewis and Clark are credited with the "as discovery of 100 species of "new" plants. See *Trees, Shrubs and Flowers to Know in British Columbian and Washington* (Vancouver: Lone Pine Publishing, 1995), 32.

[14] Paul Kane 1859, Wanderings of an Artist, quoted in Downie 1980, S.V. Camass.

[15] Archibald Menzies 1792, quoted in C.P., Lyons and Bill Merilees 1995, 32.

organization. By transforming the site from fully-occupied to uninhabited wilderness, the colonizers precipitated the widely-held cultural invention that the North American landscape, like Eden, was unoccupied until "discovered" in its pristine original state by Europeans.

Seventy years later, a third cultural invention—the viewing of landscapes as a commodity for consumption—is evident in an advertisement for lots in the newly-subdivided Hudson's Bay Company farm of Uplands:

> Four hundred and sixty five acres of natural park land. Laid out as a residential district by Mr. John C. Olmstead [sic], prominent landscape architect of Brookline, Mass [...] Excellent investment because values will advance rapidly (Victoria Daily Colonist 2 May 1912, quoted from Foreward 1973:13).

These three accounts—by a mapmaker and explorer at the inception of the colonial project, by a future governor of an emerging colony, and by landowners seeking to subdivide and repopulate the land claimed in the name of Western civilization—signify the advance of ideologies of wilderness, ecologically-isolated biota and land commodification. The three accounts also parallel transformations to the southeast Victoria landscape which, by 2000, have nearly eradicated the vegetation complexes which characterized the "pleasure grounds" and "perfect Eden" of early colonizers.

Deeper understandings of the landscape transformations which emerged alongside southeast Vancouver Island's changing cultural and ecological processes are gradually emerging through multi-disciplinary investigations. While there is still much scholarly controversy about impacts of precolonial and colonial processes of change—particularly impacts of First People's burning regimes on forests, colonial agricultural and horticultural systems, and other disturbances to the "natural" processes of succession—all signal ongoing reconfiguration of Garry oak meadows throughout pre-colonial times. Influential British Columbian scientists involved in reconstructing a history of Garry oak meadows, including Hans Roemer and Richard Hebda, recognize that further research is still needed to clarify vegetation and land-use pattern evolution (see Appendix II). While on-going research is vital to the consideration of potential land-use models which differ from those which presently dominate, the same scientists warn that the crisis of plummeting biodiversity demands immediate action. Adaptive management strategies are recommended as a basis for immediate implementation of ecosystem management (Ussery 1993, Dramstad et al 1996, Erickson 1996, Szaro et al 1996).

History provides an instructive background to adaptive management strategies. The necessary understanding of causal relationships among historic land-use practices, changing attitudes towards the landscape, and transformations in vegetation structure is informed by historical analysis. In order to focus on the understanding of ecological consequences of current land-use practices on Garry oak meadows, the following account overlays the relationship between past cultural responses to the Vancouver Island landscape with the resulting changes in meadow structure, function and abundance.

The history of pre-colonial Garry oak meadow can be reconstructed from pollen records, from oral histories of First Peoples, and from journals kept by early colonizing Europeans.[16] Traceable histories of British Columbia's Garry oak meadow began 13,000 years ago, as the receding glaciers left open patches across much of south Vancouver Island. Meadow plants were established over the subsequent 5000 years, and colonizing oaks arrived in these patches

[16] Richard Hebda and Gregory B. A. Allen, "Origin and Meadow of the Garry Oak-Meadow System", *Garry Oak Meadow Colloquium 1993: Proceedings* (Victoria: Royal B. C. Museum, 1993), 8 -13.

about 7,500 years ago. Meadow species assembled in the region at different times and presumably from different sources; this is one of the explanations for the uniqueness of British Columbia's Garry oak meadow, compared with related oak meadows further south (Hebda 1993, Erickson 1996, Roemer 1999).

Pollen records are supplemented by comments from early European visitors to the Victoria area, who described much of the region as open oak grasslands with spectacular displays of wildflowers (Douglas 1842). According to early nineteenth century colonizers, the structure and composition of the oak landscape was at least partially maintained by deliberately-set fires, which removed competing Douglas firs and dense shrubbery (Douglas 1823-7, Grant 1857). First Peoples oral histories, and early colonizers' records, indicate that the bulbs and leaves of Garry oak meadows flora were a significant food source for both indigenous people and colonizers. Since wild onion (*allium* spp.) and camas (*Camassia* spp.) warded off hunger in times of food shortage, there was incentive for First Peoples to keep the evergreen forest from encroaching upon open meadows (Anderson 1990, Botkin 1990, Ussery 1993, Pyne 1997, Turner 2000).

European settlers, however, had other ideas for both land utilization and native plant uses. In 1823, a young botanist named David Douglas was sent to Western North America by the London Horticultural Society, on a mission to collect and preserve botanical subjects and seeds for the purpose of "disseminating among the gardens of Britain the vegetable treasures of those widely extended and highly diversified countries [of the British Empire]."[17] Douglas spent several years in the area, packing and labeling both plants and seeds for shipping back to London. Douglas

[17] David Douglas, quoted in Kruckeberg 1982,6.

also included a box of birds and quadrupeds, and First Peoples' handiwork—presumably to also render those specimens a "meaningful existence" through European recognition. As vegetable, and other, treasures were being shipped overseas to Britain, some British visitors traveled back to the Pacific Northwest to enjoy the riches offered: gold, land and trans-Atlantic trade.

However, British colonizers were not of sufficient numbers to counterbalance waves of American settlers pouring into the area in the 1840's. Both Britain and the Hudson's Bay Company stood to lose Vancouver Island to the burgeoning southern neighbour. Border worries compelled the HBC to hire James Douglas. With his fellow Britons, Douglas constructed a Hudson's Bay Company trade centre and fort adjacent to James Bay Harbour. Self-sufficiency for the new fort necessitated food production. This was enabled by the establishment of two HBC farms, Beckley Farm near James Bay and Uplands Farm in North Oak Bay. More farms were established as potentially profitable enterprises to encourage British immigration and replicate British estate-farm economies (Reksten 1986) (Figure 1). The farms, of between four hundred and one thousand acres in size, were cleared using deliberately-set fires which were of far greater extent than the controlled fires of precolonial peoples (Ussery 1993, Erickson 1993, Dunn 1998). Pastures were created, and sheep and cows introduced. Meanwhile, the human population of southeast Vancouver Island had changed. First Peoples' numbers had been decimated by the colonial wars (Anderson 1990, Slyuter 1999, Arnett 1999).[18] The now nearly

[18] "Wars of extermination" (Harris 1997) were part of the cordilleran (North Coast) fur trade, carried out through the first half of the nineteenth century. European assumptions about justice and fair play did not apply to First Peoples (Harris 1997, Arnett 1999). With the establishment of Colonial governments in the mid nineteenth-century, responsibilities for supreme British control passed from the fur traders to the Crown. "The assumptions and tactics of the [Crown Forces] were (like those) of the fur trade" (Harris 1997:66). Military troops, including warships, arrived in Esquimalt in 1858, having been ordered by James Douglas. Arnett, in Terror of the Coast, relates the history of wars against British Columbia's First Peoples which continued in the ensuing three decades.

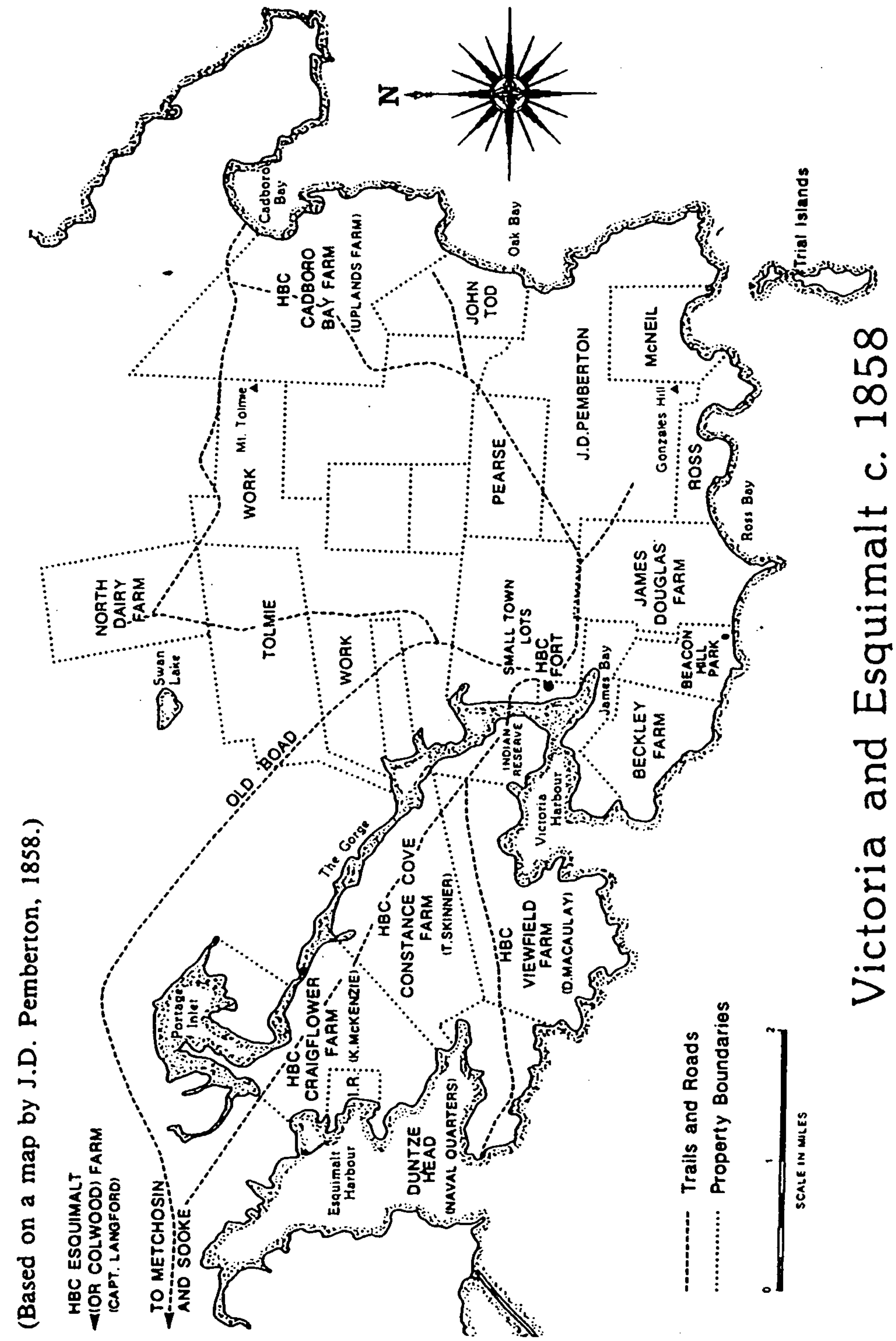

Figure 1. Victoria and Esquimalt c1858, showing layout of farms around the Hudson's Bay Company fort (Reksten 1986, 23).

Pemberton's 1852 town plan formed the basis for residential neighbourhoods like this one. Richard Maynard, one of Victoria's early professional photographers, took this view northeast from Christ Church Cathedral in the early 1870s. The Quadra Street Burying Ground is at right centre.

Figure 2. 1870's photograph of a residential neighbourhood in Victoria, looking northeast from Christ Church Cathedral. The neighbourhood, photographed by Richard Maynard, is based on Pemberton's 1852 town plan. Progressively larger lots can be seen into the distance, reflecting the homeowners' progressively higher class distinction.

vacant land gave colonists powerful feedback that their myth of Victoria as pristine, uninhabited Eden had credence.

To fill the land, it became important to attract a British population sizeable enough to resist both American and Russian threats to colonial rule. A plan for colonization that reproduced the class divisions of England was desired by the HBC, who in 1851 commissioned Irish-born civil engineer Joseph Pemberton for the task. Pemberton's three-tiered plan for development—town lots, suburban lots and twenty-acre country lots (Figure 2)—echoed class stratification: larger lots meant higher classes. All lot types retained stands of trees, which Pemberton insisted were necessary for both windbreaks and beauty. Beyond the country lots were large farms, designed as an attraction to settlement for the upper classes and their staff, as well as for food production. However, summer droughts and uncomfortable living conditions surprised the British gentlemen farmers, and many farms failed to be profitable (Ussery1993, Humphreys 1999).

Prior to cultivation, the settled land contained a combination of deep soil oak meadows (with the largest trees) and shallow soil oak meadows on bedrock. The shallow soil meadows were mostly left intact in these early developments, being less amenable to farming, gardening and construction practices. Deep soils with enhanced fertility due to centuries of ash from fires (Roemer 1993, Erickson 1996) were the first to be ploughed under. Along with town and farm development, other activities undertaken on these "pleasure grounds" by British colonizers were to have enormous impact on native biota. Elk were hunted to extinction (Douglas 1823, Ussery 1993); enormous fires continued to create idealized "empty space"; sawmills constructed at Millstream (adjacent to Mill Hill Park) clear-cut entire areas of oak, fir and cedar. Having claimed the pleasure ground, the colonizers now converted it to a commodity for economic gain.

After the completion of the transnational Canadian Pacific Railway in 1885, Victoria attracted newcomers from Britain, Eastern Canada, and the British Colonies of India and Hong Kong, along with continuing migrations from south of the Canadian border. At first, settlement was concentrated near James Bay, where communications and supplies were most available. Beckley farm, adjacent to the townsite, was divided into properties of between two and twenty acres, while small townsite lots proliferated near the HBC fort. By 1888, after streetcars, mail delivery, septic sewers and telephones had been installed across south Vancouver Island from James Bay to Oak Bay, more distant landowners then found themselves able to increase the value of their holdings by subdivision. Estate farms were subdivided into residential lots as waves of immigration continued through to 1914. From 1900 to 1914, the city experienced years of unprecedented residential expansion—the last years of significant growth in Victoria until the mid-1950's (Segger and Franklin 1996). Assisting in this were the professions of architecture and landscape architecture.

Among the more permanent newcomers were wealthy British remittance men and their families, who demanded fashionable residences and large gardens. In the nineteenth century, most of Victoria's gardens largely followed the picturesque formula (see footnote 5): the developing city derives its epithet "more English than the English" largely from landscape aesthetics[19] (Jackson 1991). The picturesque formula can be found in the 1880's Rockland Estate subdivision, and in the High Victorian Beacon Hill Park (Segger and Franklin 1996). Within picturesque landscapes, some pockets of oak meadow remaining on the rock bluffs that crossed the former

[19] The principles of the English picturesque, including the underlying idea that the owners' eye for beauty proved them to be worthy citizens, influenced North American suburbs through the works of Olmsted and his followers, as well as through the designs of British-trained consultants such as Thomas Mawson and Samual McClure.

farmland were retained, largely because the bedrock substrate of remnant oak patches was arduous to remove and unsuitable to fashionable plantings of the era. The surrounding landforms were reshaped, cleared of vegetation, and planted with introduced vegetation designed to enhance the pictorial qualities of the landscape to match nineteenth century British paintings.

Later garden subdivisions, influenced by the Arts and Crafts and Garden City movements,[20] were designed by internationally recognized landscape architects. Thomas Mawson and Sons (from England) and the Olmsted Brothers (from the United States) were among those who designed new subdivisions for the incoming elite. During the process of subdivision, estates of fertile farmland with rocky outcrops of oak meadow were divided into parcels of valuable residential properties.

The shallow soil oak meadows that had remained between swaths of farmland were fragmented by roads and services, and large stretches were removed where the pre-determined subdivision layout conflicted with a natural meadow. Individual large trees were retained, however, as real estate assets. For example, an advertisements of 1912 boasted the new Uplands Subdivision as "Well treed with maple and oaks" (Figure 3). Judiciously incorporating selected existing large trees which fit into the preconfigured plan layouts, the subdivision landscape was transformed into formalized gardens, an ultimately American landscape based on English antecedents. Under the design hand of popular architect Samual McLure, whose major landscape influences stemmed from English garden writer Gertrude Jekyll (Segger and Franklin 1996), the Victoria

[20]"The Garden City movement was closely linked to the Arts and Crafts movement of the late nineteenth century", notes Janna Tyler (1995). Economic, social and moral enhancement of workers' lives was seen to be linked with a physical model of a community of family houses, each in a private garden. Garden suburbs were smaller-scale developments of residential uses; commercial and industrial uses remained in urban areas beyond the suburb.

garden was formalized. In ideal upper-class subdivisions, park-like front lawns led to rear yards of fruit orchard, cutting garden, terrace, and tennis court or croquet lawn. One side of the McLure-inspired Victoria garden featured evidence of the owners' international botanical interest: a pocket of oriental, alpine or native plant garden was fashionable. It was within these pockets of native plant garden that remnants of Garry oak meadow found refuge within the suburban matrix. However, the perforation of the meadow landscape by irrigated turf, herbaceous borders, and fruit orchards meant that new oak meadow plants had little chance or space for recruitment of new plants. Further, mature oaks reserved as street trees also had no opportunity for propagation and renewal, making Victoria's streets future ecological graveyards for Garry oak.

In 1912, renowned British architectural firm Thomas Mawson and sons was commissioned to design a model suburb for a Garry oak meadow fronting Haro Strait[21] (Figure 4). The new suburb, called Meadlands Estate (unbuilt), possessed gently-curving streets and English country style houses which recalled the spatial aesthetics explored in earlier English suburbs. In his model suburb design, Mawson transferred images of the English countryside onto the expanding perimeter of the young Canadian city.

As in his earlier designs for working class villages in England, Meadland's proposed steeply-pitched roofs and prominent chimneys symbolized British estate housing. In selecting these architectural features, Mawson was likely influenced by London's 1875 Garden Suburb at Bedford Park. The curvilinear street patterns of Meadlands were designed in deliberate contrast

[21] Thomas A. Mawson and sons, "Meadlands Estate Victoria. Proposed subdivision and model suburb, 1912 (Unpublished photograph, City of Vancouver archives).

A full-page advertisement that appeared in the Victoria Daily Colonist on May 2, 1912.

Figure 3. Plan and Real Estate advertisement for Uplands Subdivision designed in 1908 by the Olmsted Brothers (Forward 1972, 12).

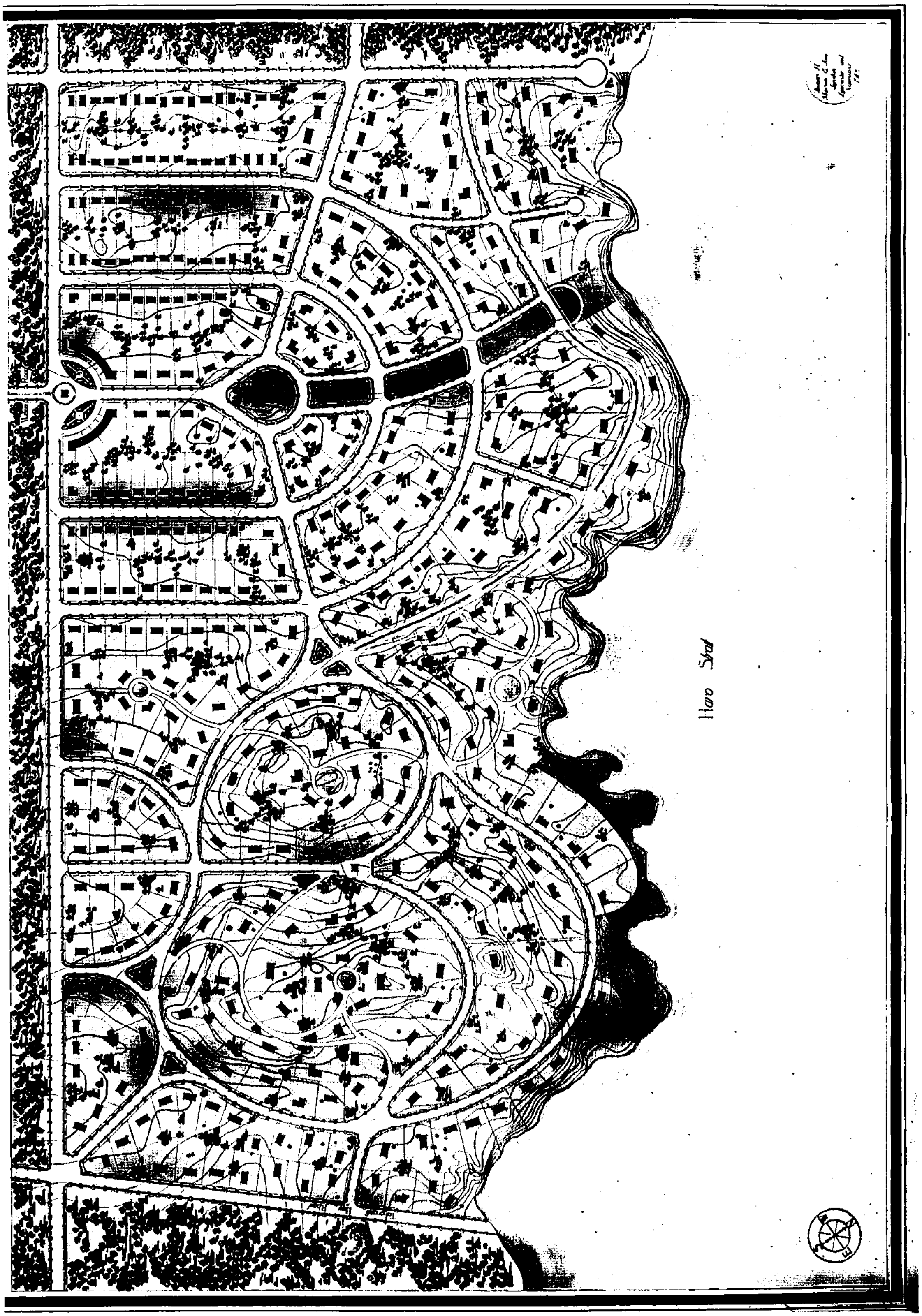

Figure 4. "Meadlands Estate, Victoria proposed subdivison, model suburb, Thomas A. Mawson and sons. Famed Architects, 1912" (City of Vancouver archives photo).

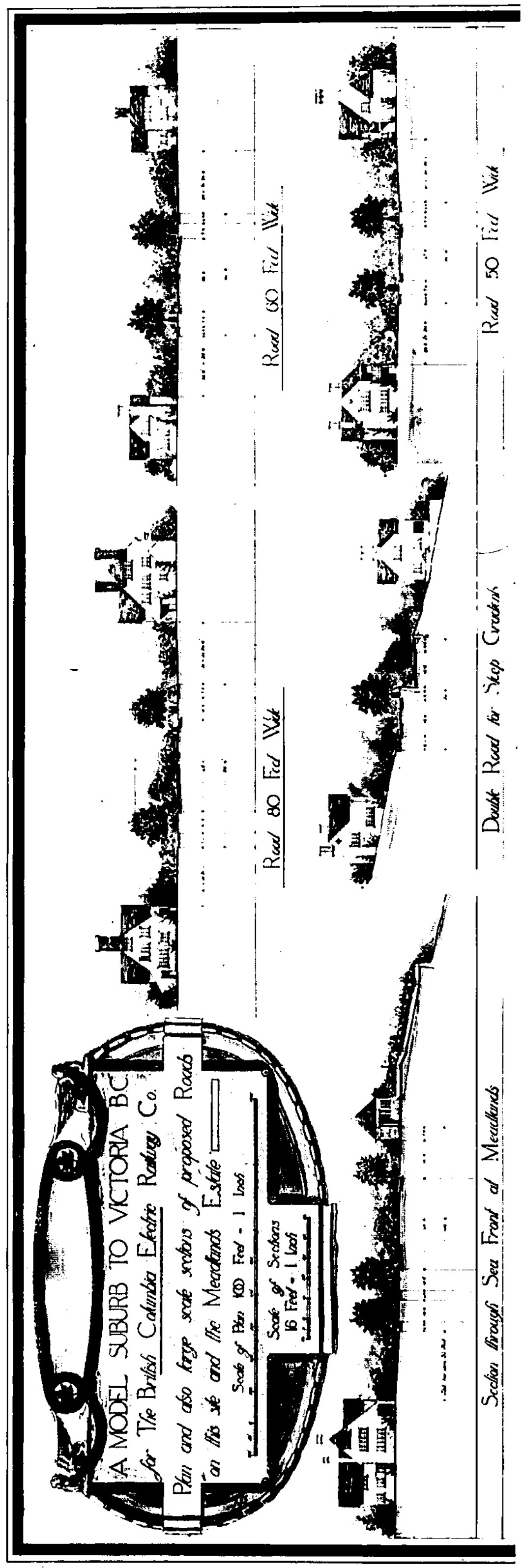

Figure 5. Sections through Seafront of Meadlands. Double road for steep gardens.

with the networks for straight streets found in workers' housing. Meadland's lavishly-planted, winding streets, like those of the Olmsted Brothers' 1908 design for Victoria's Uplands,[22] distinguished the suburb from workers' housing, reflected "principles of adornment and rusticity",[23] deliberately contrasted with surrounding landscapes, and suited the generous lot sizes which satisfied the subdividing landowner's business prospects.

The plan of Meadlands displays a fully reconstructed landscape that recreated nature as a visual complement to Mawson's picturesque housing and roadway layouts.[24] Roads of varying widths and configurations were designed to be lined with non-native trees and ornamental shrubbery. Lavish plantings enhancing Mawson's stately home designs replaced many native oaks, and extensive turfgrass, "one of the greatest charms of an English garden",[25] superceded meadows of wild flowers.

As shown in Mawson's sections, trees became aesthetic and functional elements of composition. Trees and shrubbery formed patterns in the turfgrass landscape: no land was left undesigned. The ecological role of trees as keystone species in a meadow was not Mawson's concern.

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[22] For examples of Olmsted's suburbs see "The Anglo-American suburb" 24 and 33. Olmsted's suburbs contain housing forms which are strongly reminiscent of Tudor or Gothic England. For details on Uplands, see C.N. Forward, "The Immortality of a Fashionable Residential District: the Uplands" in Residential and Neighbourhood Studies in Victoria (University of Victoria, 1973): 1-37.

[23] Quote from Frederick Law Olmsted, describing his design for Chicago suburb "Riverside" constructed in 1869. See "The Anglo-American suburb" ed. Robert Stern, Architectural Design 51 (Oct./Nov. 1981): 24.

[24] Picturesque is defined by Mawson (1901) as the freer, less formal way of grouping housing elements, and the asymmetrical and subtly-grouped landscape elements which complement the "bold and novel" (Mawson 1901: viii) housing designs. Picturesque design originated in mid-eighteenth century England, and by the nineteenth century was popular in France, Germany, and America. See Jackson 1991:130-4.

[25] Thomas Mawson, The Art and Craft of Garden Making (London: Batsford, 1901): 59.

Similarly, the half-timbered, steep roofed housing, placed midway between the roadway and the rear of the garden, was composed to reflect a sense of tradition and a connection to Tudor England (Tyner 1997).

During the early years of the twentieth century, both the forms of peri-urban settlement and the classic Victoria garden evolved. "This [1900 to 1914] was a watershed period for Victoria in landscape design" (Segger and Franklin 1996:135), and the vegetation assemblages which were planted around suburban Victoria residences set a standard for vegetation preferences which are still evident today. A palette of non-native plants materially transformed the former Garry oak meadows into a painterly scene reminiscent of European gardens. Heavily-replanted oak meadow site series within Victoria no longer had sufficient space for survival of diverse indigenous flora and fauna. "The City of Gardens"[26] erased its perfect Eden in search of vegetation that promised landowners the elite position and aristocratic taste perceived as inherent in picturesque landscapes. Aesthetic preoccupations propagated as part of the services tendered by architects and landscape architects fragmented the Victoria landscape to the point that oak meadows are now imperiled as functional entities.

Meanwhile, populations of some meadow species declined; Lobb's buttercup and the golden Indian paintbrush declined rapidly sometime after 1920 (Ceska 1993). Near the same time, populations of species commonly found on the British Isles multiplied in the Victoria area. Particularly populous were importations of Scotch Broom, Gorse and orchard grass. Starlings

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[26] The "City of Gardens" epithet was earned as a result of deliberate efforts of Victoria's city fathers and community groups to beautify the city. In the 1920's the epithet was published in tourist guides to enhance the burgeoning industry. See Segger and Franklin 1996, 134-9.

and English sparrows were brought to Victoria on CPR Steamers (Reckston 1986). Incoming bird populations exceeded those of people in an ironic reversal of the 1920's immigration slogan "Follow the birds to Victoria", which had been coined as a lure to fill Victoria's extensive post-war residential vacancies. The introduction of 'suitable' (British) fauna was perceived as indispensable to the creation of a picturesque landscape: "a variety of colour in the fowl is desirable [...] to supply a means of appropriate decoration and pictorial interest" (F.L. Olmsted 1892, quoted in Rybczynski 1999, 398). The importation of non-indigenous fauna further evoked the aesthetic of the English countryside. While good taste and aristocratic ancestry were implied by the presence of British flora and fauna, the imported species wrought extensive ecological damage as they spread uncontrolled across southern Vancouver Island landscapes.

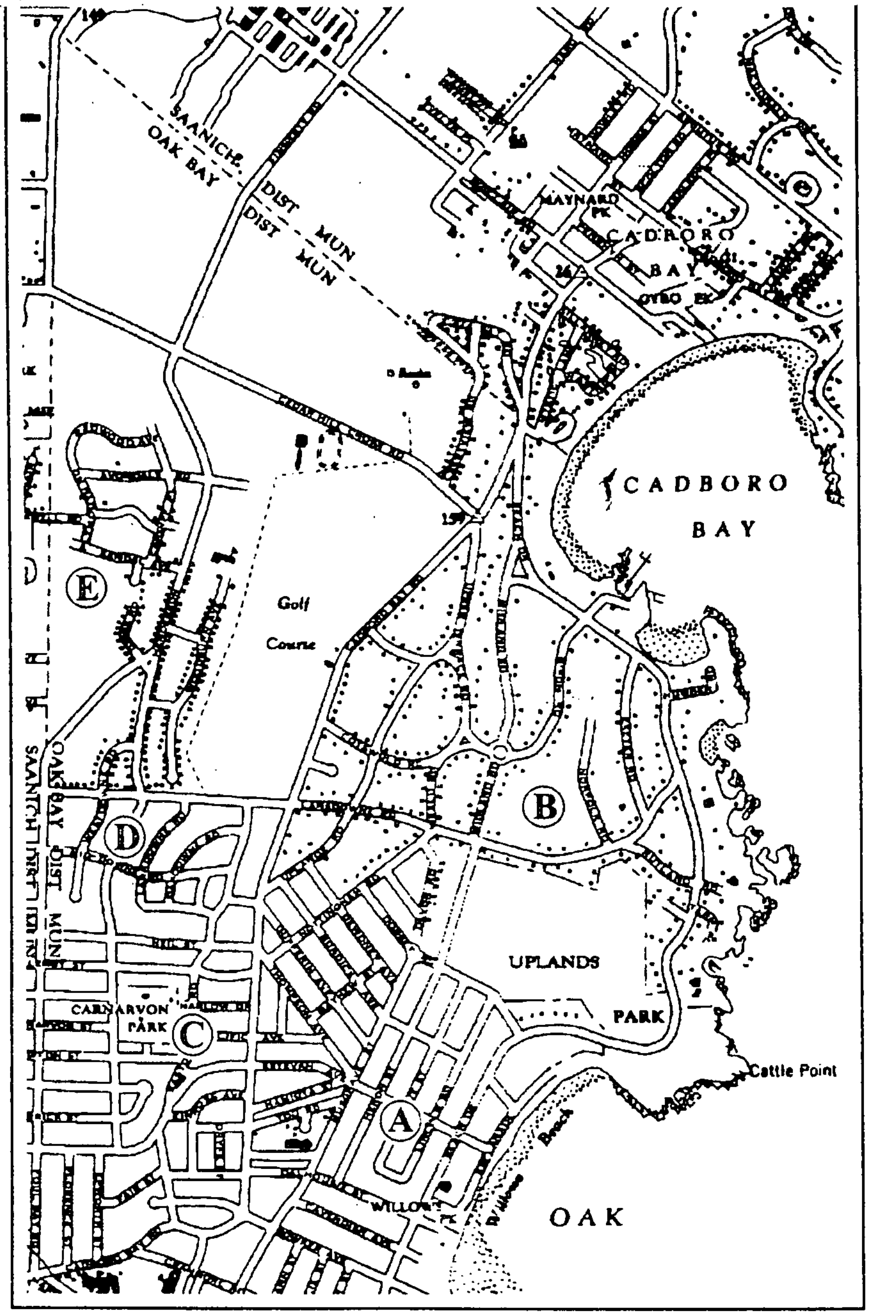
By the 1930's the Hudson's Bay Company began to consider new designs to make their land profitable. The HBC hired engineer William Hobbs to lay out suburban housing forms. Like Pemberton thirty years earlier, Hobbs used a gridded street pattern for neighbourhoods in low-income areas. For more luxurious neighbourhoods in proximity to Uplands, Hobb's plan echoed the Olmsteds' curving, picturesque streetscapes (Figure 6). Hobbs selected the form of suburban streets according to class: efficient and orderly grids were applied to less expensive, small-lot subdivisions, while curvilinear streets improved both the aesthetics and the traffic safety (McCann 1999) of costlier large-lot neighbourhoods. Each neighbourhood accommodated residents of a relatively homogenous and recognized social standing, but the assemblage of detached-home neighbourhoods provided housing for a wide range of incomes and family status (McCann 1999).

Despite design efforts by the HBC, Victoria experienced very little residential expansion from the outbreak of World War I until the mid 1950's. In the 1950's, a revived economy inspired renewed growth. As land-use development resumed and surpassed its pre-1910 pace, a new aesthetic tension awakened in Victoria's built form: historic garden suburbs became neighbors with international style shopping centres, high-rises and freeways (Segger and Franklin 1996).

The proposed "Victoria West, 1990" from the Overall Plan for the City of Victoria 1965[27] (not executed) envisions the Western communities converted from then-predominantly oak meadow and single family subdivisions to an urban form inspired by economic revitalization and high speed traffic (Figure 7). The Urban renewal program advocated in this 1965 dream of the future included high-rises, extensive freeways, and little parkland save for a few greenways adjacent to industrial precincts or freeways. In the perspective sketch, sizeable meadow landscapes are nowhere in evidence.

The urban renewal scheme for Victoria West was not executed, unlike renewal schemes for neighbourhoods closer to Victoria's central core. For logistical, political and economic reasons, the replacement of "aesthetically-undesirable" neighbourhoods near the inner city were the first executed urban renewal experiments. Many executed renewal projects, such as the Rose-Blanchard housing scheme in central Victoria, also proceeded because major roads or highways

[27] 1964 amendments to the National Housing Act provided subsidies and loans for provinces or municipalities to acquire and maintain existing housing, and to construct new housing. To obtain Federal aid for the clearance and reconstruction of "substandard" neighbourhoods, a renewal scheme had to include "a plan designating the buildings and works that [were] to be acquired and cleared by the municipality in connection with the scheme" (Government of Canada, consolidation to 1968). The 1965 perspective of Victoria West is typical of visionary drawings included with the funding applications, showing the "improved" accommodation which was to replace "dilapitated" neighborhoods.



A Grid, pre-1914

B "The Uplands", a residential park by, J.C. Olmsted, 1908

C Modified grid subdivision, c.1949

D Modified grid subdivision, c.1945-51

E Modified neighbourhood unit, c.1952-62

Figure 6. Types of subdivisions in Victoria laid out between the late nineteenth century and 1962 (McCann 1999, 134).

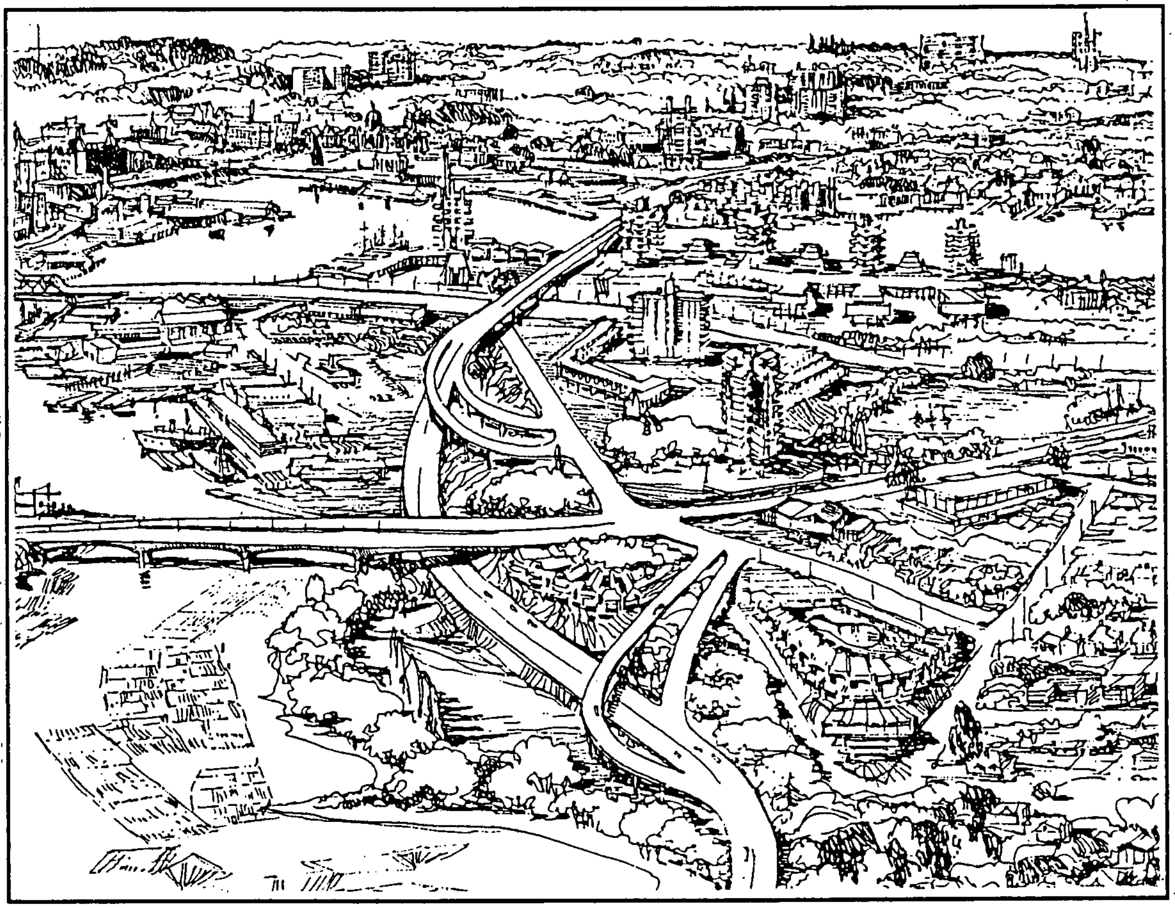


Figure 7. Proposed "Victoria West 1990", a futuristic perspective included in the Overall Plan for the City of Victoria 1965 (Segger and Franklin 1996, 123).

through the area were deemed both essential and in conflict with existing forms of housing. The renewal schemes failed on a number of levels: for example, "twenty-five percent of relocated families experienced a decrease in housing quality, and fifteen percent remained in poor quality housing" (Robertson, 1973, 90). Displaced families were often rehoused far from home, being unable to afford rents or taxes in their gentrified former neighbourhoods. Much higher density accommodation was often the only "affordable" solution for marginal-income families. A 1969

Federal task force recognized many of these problems, and financial support for further renewal schemes was withdrawn.[28]

The last third of the twentieth century saw waves of mainly suburban style development that radiated outward from the urban core near James Bay. The new "neighbourhood units"[29] evolved within a widely-shared culture which combined consumer capitalism with the expanding influence of "a new class of brokers (comprising, for example, land-surveyors, engineers, landscape architects, planners, contractors, lawyers, and real estate agents) who specialized in different phases of suburban development" (McCann 1999, 113). While earlier suburbs had accommodated a range of incomes and social strata, by the latter decades of the century Victoria's newer suburbs (and those of other Canadian cities) benefited mainly the middle and upper income brackets (McCann 1999). The older suburbs farther from the core, such as those in Victoria West, were among the slowest to be redeveloped (Fleming, 1999: see also section 4.0 of this research).

Although aerial photographs of Victoria's historic and most recent subdivisions evidence ample open space relative to built form, the open space contains few extensive or connected oak meadows. Remnant meadows in large gardens, such as those at Government House, rapidly became degraded by invasive species from adjacent ornamental gardens. Broom, gorse and turfgrasses often displaced the native understory. Extirpation of insectivorous native fauna also

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[28] Subsequent research, including the 1973 "Anatomy of a Renewal Scheme" (Robertson), revealed additional social, cultural and economic flaws in 1960's plans for slum clearance and urban renewal.

[29] A neighbourhood unit is a term developed by 1920's and 1930's New York planner Clarence Perry, whose arguments against gridiron planning and community cohesiveness were

occurred, as habitat size became inhospitable to the animals' spatial needs; the inability of small oak patches to withstand insect infestation has been linked to faunal extirpations (Erickson 1995). Decimation of native insectivorous bird populations which nest in the cavities of the declining numbers of old oaks may also be a factor in the insect infestations which are currently troubling remnant oak meadows. Since the Garry oak is a keystone species (a species which determines the ability of a variety of other species to exist in a community), the diminishing health and numbers of oaks can lead to an extinction cascade (a series of linked extinctions which results in a much-lowered genetic, species and ecological biodiversity- Primack 1995).

Although the growing communities of suburban Victoria sometimes included pockets of indigenous plant associations such as the Garry oak meadow, it is notable that twentieth century land-use development processes rarely included deliberate planting of Garry oak plant associations (Kruckeberg 1982). Difficulty of propagating new Garry oaks, combined with aesthetic preference for plantings which complemented historically-derived housing styles, contributed to the dearth of newly planted Garry oaks. Throughout the last century, construction and land-use development have cut down oaks and bulldozed meadows to build new settlements in the prime real-estate areas also favoured by Garry oak plant communities. In these settlements, turfgrass and ornamental plantings based on English garden antecedents continue to be the dominant responses to the landscape. Expansive lawns symbolize both the luxury of the non-productive landscape (Jackson 1991), the neatness indicative of a caring owner (Nassauer 1995, 1998), and the successful marketing strategies of lawnmower companies and garden shops (Jensen 1991). Lawn installation is also inexpensive and rapidly completed; lawn maintenance,

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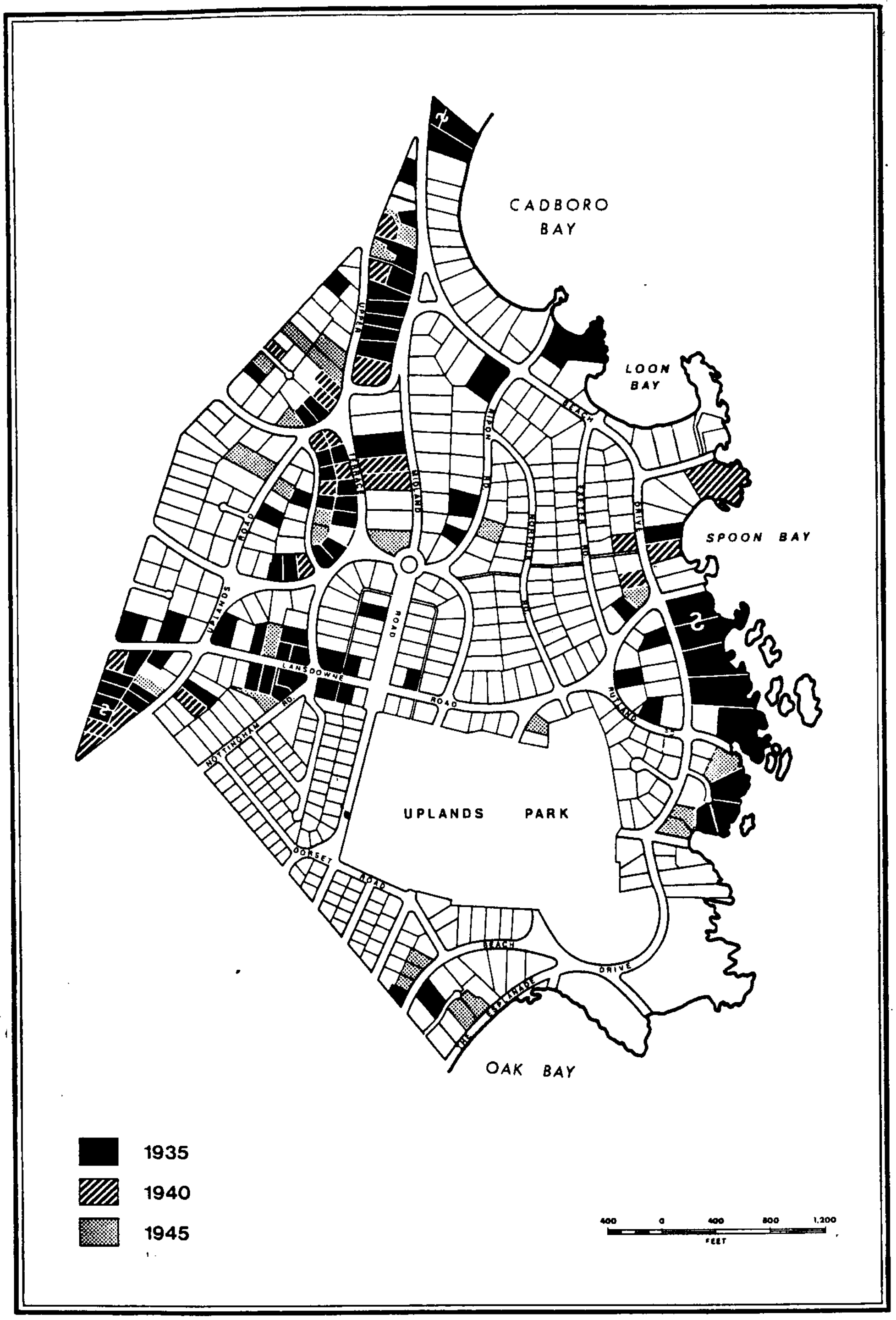
resolved in definable residential districts which had clear boundaries, a recognizable centre, and open spaces. Perry's ideas influenced 1950's and 1960's Canadian suburbs. See McCann 1999.

by contrast, tends to involve non-sustainable use of chemical fertilizers, herbicides, pollution-causing mowers, and on-going irrigation. Developers appreciate lawns for their low initial cost, but property owners often find the maintenance chores more costly than indigenous ground covers. Nonetheless the aesthetic preference for mown lawns continues and developers have little economic incentive to provide alternative landscape solutions. On southeast Vancouver Island, broad green (irrigated and fertilized) lawns and imported plantings have had ecological impacts: indigenous meadow plants were displaced from the limited site series to which they are suited, while the hydrological and chemical landscape qualities ceased to be amenable to meadow plants.

More than suburban landscapes were influenced by formal or picturesque principles of Romantic garden design. Public parks were also created as landscapes which were sources of health and pleasure, works of art, and enhancers of nearby real-estate values (Jackson 1991, Segger and Franklin 1996). In Victoria, the parks near exclusive residential neighbourhoods were mostly planted with lawn and ornamental plantings, designed to complement nearby private gardens and attract new buyers. Popular throughout the twentieth century, this design strategy was exemplified in Uplands Park (a park added in 1946 to Olmsted's plan as a real estate ploy to assist sales when a deflated economy left the subdivision mostly unsold: Figure 8) and later for both the Parliament Buildings grounds and Confederation Square of 1968. Ironically, pocket parks in gridded working-class neighbourhoods (such as Summit Park) were left as oak meadow (Ussery 1999, author's pers. com.). By contrast, many of Victoria's parks in the more picturesque upper-class neighbourhoods were landscaped according to "the standards of correctness and good taste" (Jackson 1991:130), with small pockets of native oak in a sea of



Accretion of houses by five-year intervals, 1935 to 1945.

Figure 8. Uplands Park on land purchased by the municipality of Victoria in 1946 (Forward 1972, 24).

mostly exotic ornamental plantings. Because only small patches of oak were retained on public parkland, larger patches of oak associations became increasingly scarce. By 1993, ecological surveys confirmed that the vast majority of Garry oak meadows were and remain on private land (B. C. Round Table 1993).

Beginning in 1992 Sensitive Ecosystems Inventories were conducted, proving that natural Vancouver Island oak meadow habitats were rapidly disappearing as a direct result of fragmentation by land-use development and degradation by invasive introduced species. The Saanich peninsula and the municipality of Victoria attracted the most development, and the greatest loss of meadows. The more rugged, less populous Western Communities retained more Garry oak meadow than the more populous southern and eastern areas of the Island.[30] However, development pressures on the Western Communities are increasing, and reductions to remnant Garry oak communities are mitigated only by the presence of several protected park areas which were not converted to Romantic-style parkland. (As explained in Section 4.0, the expense of building upon or cultivating the rocky terrain of the Western Communities slowed the conversion of these areas to housing or agriculture).

Clearly, new responses to development are needed to avoid degradation and removal of these remaining meadows. Some of these responses are found within municipal governments. The Western Community municipal administrations, while anxious for land-use development revenue (development cost charges) to fund needed road and sewer infrastructures, have recently

[30] Sensitive Ecosystems Inventory correlated by Tracy Fleming of CRD Parks, unpublished document dated November 01, 1999.

become concerned about depletion of oak meadows on private land.[31] In the mid 1990's some Western Communities tried to reverse the declines in Garry oak populations by requiring the replacement of Garry oak lost to construction and land-use development.[32] To inform the effort, ecologists and native-garden experts were appointed to advisory committees to advise municipal councils concerned with depletion of rare ecological systems.

However, while municipalities, ecologists, and native-garden experts were beginning to extol the virtues of the oak meadow, the author's own experience in the Western Community meadows indicates that the aesthetic qualities of the late-summer meadow are not readily-appreciated by project owners and users. Commenting on insect-ridden, scrubby oak and amber-brown grasses of a remnant rocky meadow, one land developer scoffed "But there's nothing here to save!" The developer, like many gardeners of the region, found the mostly amber summer meadows uninteresting. For the developer, the effort to conserve the meadow fragment and the lost revenue potential of an area which was neither structure nor garden, made the conservation covenant unappealing. In the mind of the developer, turf and planting would have satisfied his economic (resale) needs better than the strip of oak meadow. Finally, the colourful meadow wildflowers and the new green grasses are only ephemerally apparent, whereas the dominant cultural perceptions of landscape as an ornamental adjunct to architecture necessitated gardens with year-round colour and interest.

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[31] For example, the Town of View Royal, incorporated in 1990, required a new sewer system in 1993-5, and placed a moratorium on development as a way to pressure the Provincial Government to contribute to the infrastructure expense. An agreement was made, but the young town was left needing large sums of money to complete its share of the sewers.

[32] For example the 1996 bank development on Admiral's Road and Aldersmith Place was required to plant new Garry oak to replace those lost to development. The meadow understory, however, was not replaced.

Rather than incorporating this functional requirement in an ecologically-healthful way (Nassauer 1995, 1999) gardeners, developers and road-building teams continue to introduce non-native invasive species, notably Scotch broom and gorse. Both species quickly displace the native understory, and have been listed along with land-use development itself as major factors in extirpations and extinctions of rare plants (Ussery 1993, Hebda 1999, Roemer 1999).[33] Drought-tolerance, longevity, rapid spread along roads and other human-created edges, and the absence of natural controls for broom and gorse have enabled these invaders to replace much native vegetation with thickets which are impenetrable to native animals and unattractive to native and migrating birds (Erickson 1996, Roemer 1999). Removal of broom and gorse, while essential if oak meadows are to resist further degradation, is costly and difficult (Ussery 1993, Dunn 1999).[34]

In the 1990's, conservation of the oak meadow was brought to public awareness. The Garry Oak Meadow Preservation Society, founded in 1992, co-sponsored the 1993 Garry Oak Meadow Colloquium. Newspapers recorded the struggle and eventual triumph to save the meadows on the Elkington Lands from land-use development. In 1999, the First International Garry Oak Symposium included a day of Community Involvement workshops and family events. At these educational events, tours were conducted emphasizing the uniqueness of diverse meadow habitats, the destruction of which have contributed to the recent extirpation of the western bluebird, Lewis' woodpecker and the western meadowlark.[35] Symposium attendees of all ages

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[33] See also the pamphlet "Gorse, the spiny competitor", *CRD Newsletter* 1999.

[34] Dunn 1999, 6 -9.

[35] "Six Municipalities take Part in Opinion Poll", CRD Newsletter (Nov. 1999): 11.

learned about rare and vulnerable (blue-listed) animals found in oak meadows, including the western grey squirrel and numerous prairie-dependent butterflies.[36]

Educational events, and other community efforts such as the Sea to Sea Greenway project,[37] have an important effect on broadening the community-wide understanding of Garry oak meadows. Cultural attitudes towards Garry oak meadow can be seen to change within the group of attendees, as education reinforces new paradigms for landscape appearance. As Joan Nassauer urges:

> To be successful these new (ecological-protection) strategies should use the persuasive power of public education. The way people think their neighbours think the landscape should look is as important as their individual, more idiosyncratic tastes or knowledge. (Nassauer 1997:72)

Historic land use planning and subdivision design have not considered ecological objectives: land has been represented as a means to increase property values by subdivision, rather than as a linked mosaic of ecologically-vital habitats. The patterns of land-use and tenure, which evolved over the past one-and-one-half centuries, have devastated indigenous plant communities which are endemic to the subdivided areas. Subdivision, the land-use development term for the parceling of land into smaller lots, is ecologically translated into fragmentation of rare ecosystems.

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[36] Dunn, 3. Blue-listed species include rare vulnerable taxa in B. C. that "could become candidates for the red-list in the foreseeable future. "Red-listed species are candidates for legal designation as endangered and usually occur in endangered or threatened habitats. Definitions from Douglas, Straley and Meidinger 9.

[37] The sea to sea greenway project envisions linking the Sooke Basin to Saanich Inlet by a series of Green (natural) and blue (semi-natural) spaces. See Figure 52.

Land-use development strategies continue to eliminate areas of remaining meadows, according to both ongoing Sensitive Ecosystem Inventories, and ecologists working with Garry oak meadow conservation. New land-use strategies, and new paradigms of landscape to displace myths of wilderness, isolated biota, and land as merely commodity, are needed to reverse the progressive losses of these rare indigenous ecosystems. Since landscape aesthetics both influence the appearance of architecture (Jackson 1991:131) and are partially in response to the form of architectural structures (Mawson 1901:viii) the architect's aesthetic interests become intertwined with landscape ecological possibilities.

Landscapes in peri-urban Victoria have evolved within a consistent cultural perspective which honours the desire for a single family dwelling, the urban edge as a source for land to be bought and sold at a profit, and the role of local government in implementing cultural ideals or preserving long-held values (McCann 1999). Engineers, land-surveyors, planners, landscape architect, architects, and realtors, aided by governments, private organizations, and scientists, have begun efforts to reverse fragmentation and ecosystem losses. The next chapter first looks at some of the solutions that have been proposed worldwide to protect peri-urban biodiversity, then addresses knowledge schisms that impede solution implementation, and finally isolates some site-scale design strategies that influence biodiversity protection.

CHAPTER 2: A RANGE OF SOLUTIONS

2.0 Evaluating Existing Methods for Conserving Peri-Urban Ecosystems

While efforts are now being made to reverse destruction of rare plant associations by protective legislation, zoning, covenants or bioreserve allocations, efforts to date have not succeeded in the goal of biodiversity protection. Since the rate of decline of rare peri-urban ecosystems has accelerated, not declined over the past decade (Fleming 1999) it is clear that present efforts must be evaluated and expanded upon.

One strategy that has received considerable support is the acquisition of remaining ecosystem patches, to be conserved and maintained as bioreserves. This method has some economic advantages: since no amount of money can restore extinct species, and ecosystem conservation is far less costly than restoration (Fleming 1999), purchasing private land for bioreserve seems viable. The reality of bioreserves, however, is that reserved areas within those ecosystems which are endemic to settled areas are rarely adequate to protect rare species. Because land values are high near cities or in fertile valleys, extensive funds would be needed to purchase ecosystem reserves from private owners of peri-urban land. In British Columbia, bioreserves are located predominantly in mountainous or remote regions which presently have limited use for residential subdivision or other land-use development (Parks Canada 1994, Harding and McCallum 1995). Since British Columbia's oak ecosystems are intensely habitable, these rain-shadowed coastal lowlands currently have high property values and very few bioreserves (Figure 9). Further, voluntary retention of ecological systems on private land slated for development is often perceived as reducing the full development potential of those properties (Craighead 1993). As a result, the creation of bioreserves within areas so well suited to many forms of human settlement (cities, agriculture, intensive recreation) requires public or private landowners to either 'sponsor'

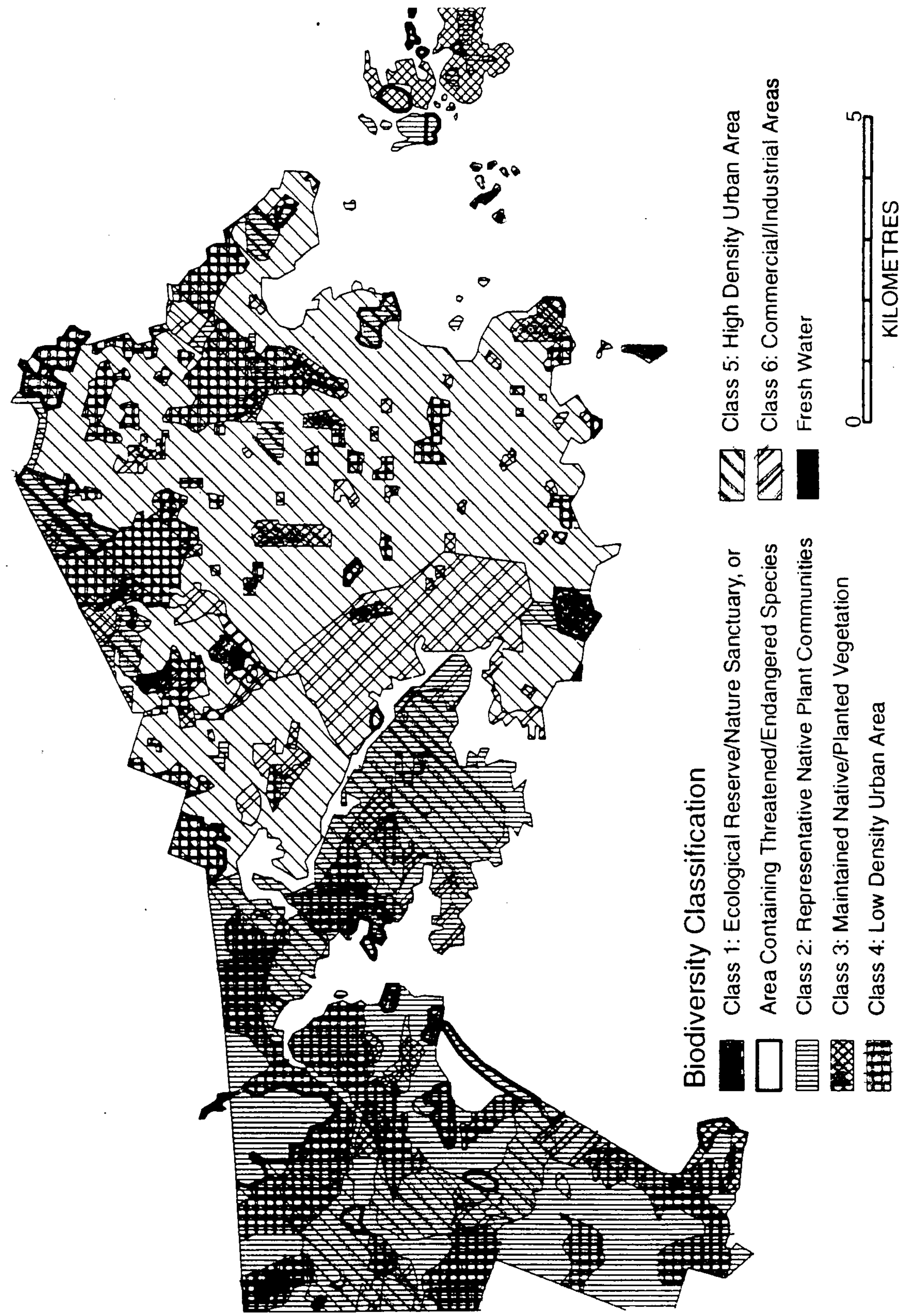

Figure 9. Land-use categories in Victoria and Esquimalt Districts, 1991 (Schaefer 1995, 308).

a bioreserve (often with the assistance of Nature Conservancy Trusts) or forfeit potential real-estate profit (Craighead 1993). Recent bioreserve purchases in the Victoria area confirm that community-based lobbying and support for this type of sponsorship often accompanies a successful agreement between landowner and conservation agency.[38]

An example of bioreserve sponsorship in British Columbia's oak meadows occurred when B.C. Land Conservancy purchased the Elkington Lands, an oak meadow estate near the northern extreme of the ecosystem range and relatively far from Victoria's urban core (Figure 10, "Garry oak meadow on Island preserved" Vancouver Sun 1999). As noted in the 1999 Vancouver Sun article, a community-based effort spurred the acquisition. Closer to Victoria, where land values are higher, there have also been efforts to raise tax dollars for parkland acquisitions ("Six Municipalities take part in opinion poll", Figure 11). These are important efforts, but raising adequate funds to purchase pieces of oak meadow is proving difficult. At the present time, the bioreserve spaces which have been conserved within B.C.'s oak meadows comprise only 0.5 percent of the rare meadows which exist.

Land-use development conventions and expectations contribute to the difficulty of conserving areas of Garry oak ecosystem, which are within the most developable lands in British Columbia. Sensitive Ecosystem Inventories (SEI)[39] undertaken in the 1990's indicated that the greatest percentages of conserved oak ecosystem on Vancouver Island are both farthest from urban

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[38] Two land transactions—the Elkington Lands (purchased in 1999 for 800,000 by the Nature Conservancy of Canada and three community associations) and the Abkhazi Gardens (purchased in 2000 for 1.35 million by The Land Conservancy)—were the culmination of community meetings, numerous published appeals, and lobbies by diverse organizations.

[39] Sensitive Ecosystem Inventories were initiated in 1992 to systematically identify, map and evaluate ecologically - significant areas in British Columbia.

Rare Garry oak meadow on Island preserved

STEPHEN HUME
VANCOUVER SUN

The Garry oak meadow is B.C.'s most rare and endangered ecosystem but a significant remnant was preserved this week in Maple Bay when the Nature Conservancy of Canada purchased 12 hectares for $900,000.

"I'm ecstatic," said Barb Stone, the Cowichan Valley resident who launched a community-based effort to raise funds to preserve what's known as the Elkington Farm.

Still occupied by Gerald Elkington, who celebrated his 100th birthday earlier this year and is a son of the original homesteader, the farm was considered for subdivision and development.

About 40 minutes drive north of Victoria, the property lies in the midst of a region that has experienced rapid growth over the last decade.

Usually comprised of a sequence of open oak forest and open meadows punctuated by rocky outcrops, the Garry oak ecosystem provides habitat for many wildflowers and rare species of butterflies, insects and small animals. When the Maple Bay site was studied by botanists and biologists they found species on the provincial government's red list for plants and animals threatened with extirpation from their range.

Garry oak forests once characterized the landscape of southern Vancouver Island. Sir James Douglas described it as "a perfect Eden" when he came ashore to found Fort Victoria for the Hudson's Bay Company in 1843 and painter Emily Carr wrote about the mesmerizing effect of fields that blazed with blue camas lilies behind the house where she grew up on the edge of what later became the manicured urban gardens of Beacon Hill Park in Victoria.

But the very attributes of the ecosystem that made it so beautiful also made it the most sought-after land for home sites. Today it's estimated that somewhere between 95 and 99 per cent of B.C.'s Garry oak forests have been destroyed. Of what remains, only 0.5 per cent is protected.

"I often walked past the Elkington farm and enjoyed the

GERALD ELKINGTON

Easter lilies, shooting stars and blue camas and, of course, those magnificent oak trees," Stone said. "When I learned that the family might have to sell it to developers I was very, very alarmed. I was also deeply concerned about how we could preserve it while making sure the family's interests were protected."

Starting in 1997, she forged a partnership between a committee of 24 local people with similar concerns, the Cowichan Community Land Trust that provided an office and issued tax receipts for donations and the Nature Conservancy of Canada.

"The Nature Conservancy asked if we could raise $100,000 locally toward the purchase price. We held a walk-a-thon, garage sales, that kind of thing. The community response was overwhelming. Donations — we got large donations, but we got many, many small donations of $25 or $50 from people who often couldn't really afford it.

"Duncan elementary school gave $100. The high school donated money and the high school's environment club made a separate donation. And now the big money from government and corporations has put us over the top."

Earlier this week, Shell Canada announced a $200,000 contribution to the fund, part of $750,000 the oil company will use to boost Nature Conservancy projects over the next three years. Ottawa has contributed $100,000 through the Georgia Basin Ecosystem Initiative.

RARE ECOSYSTEM SAVED: Part of a Garry oak forest near Maple Bay on Vancouver Island is being Preserved as the Nature Conservancy of Canada has purchased 12 hectares for $900,000.

Figure 10. "Garry oak meadow on Island Preserved" (Vancouver Sun , 6 Feb., 1999, B1 and B2).

Six Municipalities Take Part in **Opinion Poll**

On election day, November 20, voters in six municipalities will give their opinion on a proposed fund that would help buy parkland for the Capital Regional District.

Called the *Parkland Acquisition Fund,* this special fund would enable CRD Parks to expand its parks and trails systems.

Six municipalities are asking voters, in an opinion poll, if they would accept a tax increase to support the *Parkland Acquisition Fund.* Victoria, North Saanich and Sidney are asking the question at the $6.00 per average **regional** household level. ($2.64 per $100,000 assessed value). Langford is asking the question at $4.50 per average **Langford** household ($2.64 per $100,000 assessed value). Saanich and the Highlands are asking the question at the $10.00 per average **regional** household level ($4.40 per $100,000 assessed value).

In 1998, there were 2.2 million visits to regional parks and trails.

Background

Back in August, the CRD Board asked all regional municipalities and electoral areas to put the following question to their voters on November 20—

Do you support the imposition of a property value tax at a rate of $2.64 per $100,000 of assessed property value (about $6 per average regional household) for the purpose of establishing a regional parkland acquisition fund?

Official results — CRD Parks-parkland acquistion funding question on municipal election ballot

Municipality*	Yes	No
Saanich ($10)**	10,301 (71.2%)	4,174 (28.8%)
Highlands ($10)**	407 (50.9%)	392 (49.1%)
North Saanich ($6)**	2,136 (67.8%)	1,015 (32.2%)
Sidney ($6)**	1,324 (59.9%)	887 (40.1%)
Victoria ($6)**	10,757 (78.9%)	2,884 (21.1%)
Langford ($4.50)***	1,400 (62.5%)	840 (37.5%)
TOTAL	**26,325 (72.1%)**	**10,192 (27.9%)**

*Several municipalities and electoral areas which did not carry out an opinion poll indicated their support for establishment of a parkland acquisition fund. ** opinion expressed on a $ per avg - regional household per year. *** represents $6 per avg regional household in Langford.

Figure 11. "Six municipalities take part in opinion poll" (CRD Parks Newsletter, 1999).

centres, and comprised of steep, rocky, barely-buildable terrain.

Even if acquisition funds become available, additional strategies are still needed, particularly since conservable oak ecosystems within Capital Regional District's parklands acquisition plan are not contiguous. Isolated patches of oak meadow are more likely to experience extinctions than are patches that are interconnected or within seed dispersal distance from one another (MacArthur and Wilson 1967, Sullivan 1981, Fahrig and Merriam 1993). Greenspace on private lands that are not available for parkland acquisition may therefore help to avoid localized extinctions of rare species on bioreserves. By connecting isolated patches of endangered populations, private-land meadows can provide the important ecosystem function of connectivity. Rare species recolonization (reestablishing young plants in patches where the species is nearing extinction) on bioreserves may rely upon site series on private land for seed source and dispersal. Extending the bioreserve site series so the total habitat is amenable to recruitment of new plants is vital for regional survival of fragmented populations (Fahrig and Merriam 1993).

Enabling recolonization between patches of public- and private-use lands requires setting aside landscape elements that are spatially suitable for seed dispersal and plant regeneration. Landowners wishing to contribute part of their land for rare ecosystem retention can benefit from a landscape ecological analysis that determines which parcels are particularly suitable to the inter-patch matrix through which seeds can be dispersed.

Private land dedications can be voluntary or legislated. Voluntary dedications can be encouraged by tax incentives, such as waiving or reducing property taxes on land that contains a bioreserve. Tax incentives to ecological donations in Canada are few; there are, however, tax obstacles. For example, the Income Tax Act currently levies Capital Gains taxes on privately held land donated as ecological reserves. Changes to tax-action to encourage setting aside private land as conservation covenant is a strategy recommended by the Nature Conservancy (Vancouver Sun, Feb 6, 1999). Another strategy is the use of conservation covenants, which are registered on the title of the land for perpetuity. Covenants may describe how the vegetation on the parcel is to be protected or maintained, and the operational activities that may occur on the registered area. The problem with many conservation covenants, however, is that the vegetation on the protected land sometimes fails to survive, due to displacement by exotic species or for other reasons. Many of these reasons are predictable using principles of landscape ecology, but covenants are frequently drafted without input from science.

Legislation of land dedications can occur when landowners apply to a municipality to change the use or density of their land. This type of dedication is particularly important where remnant plant associations, such as Garry oak meadows, are a vital component of regional biodiversity, and regional extinctions are imminent. Legislated dedications can be perceived as incentives or punishment. The incentive system grants the landowner a development 'bonus'—an advantage that is beyond the outright provisions of zoning bylaws—in exchange for sensitive ecosystem reclamation and/or conservation covenants (Pavlik et al 1992). As with tax-incentive covenants, the description and surrounding uses of the covenant may be vital to the survival of protected plant associations.

Legislation which may appear punitive includes bylaws which "down-zone" ecologically-sensitive land—that is, the development potential of a parcel is reduced below the normal provisions of municipal bylaws. Ecological devastation has been known to result, as some landowners clamor to remove sensitive ecosystems from their land before down-zoning bylaws can be enacted. (In the author's experiences, forested areas have been clear-cut and streams filled with heavy clay just before subdivision applications are filed, to avoid "punitive" stream setbacks and tree protection regulations which would limit the form of development). The underlying principles that rationalize such a response are twofold. Firstly, post World War II escalations in mass production, consumption and human population are connected to the spread of an ideology wherein economic growth is valued more highly than biodiversity (Hironaka 1996). More specifically, "the narrow and special interest of the commercial subsystem of our society have been elevated to the status of society's basic values, and consumption is overwhelming conservation" (McNeely 1996:268). The domination of economic processes over all others leads to a variety of unsustainable practices. The converse—sustainable development—depends both upon recognition that people are dependent upon nature, and upon people's knowledgeable management of earth's resources (Campeau 1996). Unfortunately, when sustainable development regulations are seen as confrontational rather than cooperative, a "brownlash" or reaction against the legislation is anticipated (Nassauer 1995, Campeau 1996, Nassauer 2000). The second principle underlying rejection of imposed legislative controls relates to our cultural appreciation of property as a private, profitable expression of individualism. Land is seen as a secure investment: "down-zoning" threatens the security of that investment, and is likely to be opposed.

Ecosystem-protection legislation, which is perceived as non-punitive, must somehow mediate among the hegemony of economic growth, the ideology of possessive individualism,[40] and sustainable land uses. One proposal recommended by ecologists is to require landowners that seek zoning amendments to set aside space as park dedication or ecosystem covenant. Erickson (1996) recommends that land-use development parcels allocate between thirty-five to seventy-five percent of site area to ecological conservation space. His recommendation is based on the observation that the more common ten percent open space dedications often nearly vanish due to encroachment of surrounding land uses. Recommended antidotes to observed shrinkage of covenanted open space include instituting a system of buffers (Ussery 1993, Erickson 1996) and controlling the spread and further planting of invasive exotic flora (Dunn 1998, Roemer 1999, Erickson 1999).

Like open space dedication requirements, tree bylaws have mixed ecological results. For example, negative bylaws intended to protect mature oaks in California resulted in a decrease in the number of surviving oaks. California's bylaws enforced fines on anyone cutting native oaks over a specified height and girth. Some landowners, unhappy with the prospect of fines and the principle of forcible control over vegetation on private land, responded to the bylaws by cutting down all oaks smaller and younger than bylaw size. Before the law was enforced, some mature oaks were cut down to avoid future fines (Pavlik et al 1992, Nosal 1999).

The future of oaks in California was therefore negatively impacted by bylaws that focussed on large trees of the present. It may be deduced from the California experience that bylaws that

[40] See Duncan and Duncan (1997) for discussion of possessive individualism. The components of the ideology are "private ownership, democracy among equal individuals, and local control" (164).

levy fines for mature-tree cutting collide with cultural resistance to unwanted control. Bylaws prohibiting removal of trees larger than a specified height and girth also ignore the principle of Conservation Biology that all aspects of a species' life cycle are vital to population dynamics (Ussery 1993). The larger problem indicated by these bylaws is that while many conservation principles are clearly defined in academia, they are poorly-defined and limited in law. By contrast, property values are well-defined and are protected in law (Craighead 1993, McNeely 1996). This imbalance between the legal rights of biological diversity and the legal rights of property owners, leads to a possible conclusion that trees on private property can be uncontestably protected only if the property upon which they grow is owned by a conservation agency, or if the ecologically-sensitive land is otherwise removed from the land bank of developable space. Yet tree bylaw successes are also evident. Bylaws to save Garry oaks enacted in Saanich and Oak Bay have community support, and are recognized as having successfully raised public awareness of Garry oak trees' ecological, aesthetic and cultural value. A more recent bylaw drafted in 1999 (but not yet enacted) by the city of Victoria protects seedlings as well as mature oaks (Appendix VII). Community support is not yet evident, but will be necessary, for this bylaw which protects seedlings, saplings or slender oaks. Also missing in all enacted bylaws to date are supportive clauses for the approximately one hundred rare plants of the Garry oak meadow community.

Plant communities can be either conserved or restored with community support. This has been demonstrated in Kanagawa Prefecture, Japan. In this densely populated region, waste areas near cities are being revegetated with a diverse, ecologically-balanced patchwork of native floral species (Miyawaki 1996). The ecologist-led effort relies entirely on community groups—including school children—for soil preparation, planting and maintenance.

On this continent, waste sites abound in and near cities. Blighted landscapes "where human activity or natural catastrophe has visited the land," (Kruckeberg 1982:16) are ideal sites for ecologically-valuable plantings of native vegetation complexes. Abandoned industrial land, sanitary land fills, gravel quarries, damaged stream corridors, seaport wastelands, construction site edges, and other abused habitats can be reclaimed as repositories for native plant communities, as an alternative to leaving sites as collectors of non-native weeds. Both public and private sector involvement, as well as community support, are valuable components of revegetation efforts.

In this section, numerous strategies that influence peri-urban biodiversity have been summarized: bioreserve acquisition; private land conservation by tax incentive or development bylaws; tree protection bylaws; reclamation of blighted landscapes. Bioreserve acquisition is often the focus of conservation groups such as Nature Conservancies; yet bioreserves alone are inadequate to ensure rare plant community survival. Protected islands of conservation within a rapidly changing landscape are limited in both area and site series type. It is estimated that even with extensive acquisition efforts, the cumulative worldwide area of bioreserves will never exceed ten percent of the earth's area (Heywood 1996). A bioregional approach, which integrates protected areas with their total landscape context, enables biodiversity efforts to extend beyond reserve boundaries (Sullivan 1981, Heywood 1996, Sauer 1998). Community- and site-scale reserves of native species within settled areas are vital components of bioregional conservation (Craighead 1993, Erickson 1996, Heywood 1996). Strategies for designing sites and landscapes to effectively retain rare species habitat have been developed within the science of landscape ecology. It is important to note that ecological strategies are not limited to protected areas.

When integrated with community needs, landscape ecology can enhance a variety of land-use categories, particularly in areas where bioreserves are in short supply. It is important that ecological site-scale solutions be communicated to land-use professionals whose decisions may influence retention of rare species communities that are endemic to settled areas.

As stated in Chapter one, landscape ecology principles function across scales and landscape types. When merged with social, demographic, legal and other site-specific information, ecological principles used in a design can maintain or improve the biodiversity of a region. Retaining a diverse array of natural habitats has been correlated with improved carbon dioxide assimilation (Schmid 1996), high educational value (Reduron 1996, Heywood 1996, Schmid 1996), enhanced cultural diversity, and visual and aural amenity (Sullivan 1981, Kempton and Boster 1996). People, not just ecological systems, benefit from an array of indigenous plant communities. Biodiversity can be assisted by the analytical and (partially) predictive systems presented in landscape ecology. At a site scale, the needs of human settlement can be considered alongside habitat values of the site and its surrounds.

2.1 Closing the Schism Between Disciplines

While there are some site-scale solutions to problems of habitat fragmentation and species losses which have been verified by landscape ecology, these solutions are not often implemented by those who design and manage land-use development sites (Dramstad et al 1996). For example, ecologists have correlated changes in hydrological patterns with reduction in or extirpation of rare species, yet land-use developments employ both de-watering and irrigation as "standard" construction practice. Further, escalation of habitat loss has been correlated with extirpation or extinction of species; meanwhile habitats favoured by rare species communities are being swallowed by growing peri-urban settlement. Ecologist B. Schmid warned in 1996:

> Peri-urban environments suffer from high human impacts such as pollution and habitat fragmentation [...] Habitat fragmentation in peri-urban environments is often caused by road building, condominium development, and intensive agriculture. [...] Our diagnosis of the problem is severe, because a series of events appears to trigger a vicious cycle of habitat change—reduced biodiversity—disturbed ecosystems—further habitat change—etc. that eventually may even disturb human culture. (Schmid 1996:576)

Despite the ongoing habitat fragmentation due to land-use development, and the absence of implementation of known ecological solutions into land-use development processes, several disciplines have begun to convey an awareness of the conflict between the spatial needs of limited-range plant communities, and the demand for peri-urban growth. In 1999, the North American Journal Planning recorded recent efforts by the LTER (Long-Term Ecological Research) branch of the National Science Foundation to document the ecological health of two American cities. Prior to this, the LTER had concentrated on sites far from habitation. This change in the focus of scientific interest is noted by Mari Jensen: "For most ecologists, big cities are off limits. Ecological research usually focuses on locations that appear unaltered by human activity [...] Today, those attitudes are changing."[41]

The interdisciplinary teams working on peri-urban projects for LTER involved planners, ecologists and landscape architects—but no architects. Yet architects are often the team leaders who direct site-planning decisions and set project goals. Architects are also speaking with renewed interest about the integration of landscape with architecture. Two speeches made to architects in 1999—one to the International Congress of Architects in Beijing, and the other to

[41] Mari Jensen, "Ecology Moves Downtown", Planning (July 1999):4.

the Royal Institute of British Architects' award ceremony in London—speak of wedding architecture with landscape strategies:

> If architecture is an art, a cultural effort, it must be an act of innovation towards the future [...] Perhaps the only possibility open to architects is [...] that architecture should be primarily a consequence of the form of the city and of the landscape, and should participate in the new configuration of these.[42] (Bohigas 1999)

> Few options are available that are truly capable of improving the socio-cultural and ecological character of the average urbanized region [...] one possible [approach] seems to be universally- applicable: the blanket application of landscape strategies.[43] (Frampton 1999)

This renewed architectural interest in the configuration of landscape as an integral part of architectural form and function needs to be directed towards ecological rather than predominantly aesthetic solutions, if Biodiversity protection is the goal. However, a working knowledge of landscape ecology is rarely part of the architects' (or clients') design arsenal. For example, the problem of diminishing peri-urban plant communities, known by ecologists, is rarely addressed specifically by architects.

There are several explanations for architects' and ecologists' differing spatial and conceptual responses to the landscape. Ecologists focus on entire species communities, their interdependency, and their physical environments. Individual-species conservation is a last

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[42] Oriol Bohigas, quoted in "Ten Points for an Urban Methodology", Architectural Review 1231 (September 1999): 90.

[43] Kenneth Frampton, speaking to the twentieth Congress of the International Union of Architects (UIA) in Beijing, as quoted in "View", Architectural Review 1230 (August 1999): 16. Frampton also stressed the importance of society's understanding and acceptance of "environmental design".

resort, recommended by ecologists only for the rarest of species.[44] These scientists also work over an extended temporal term: three years of data collection is considered a relatively brief ecological survey. Architectural teams, by contrast, work with land surveys that are usually produced in days or weeks. Land surveys typically show topography, and trees with chest-high diameters of six inches or greater. With land surveys as their site-planning tools, architects usually focus their conservation efforts on individual trees (Craighead 1993). Further, duration of the site-planning phase of an architectural project is generally weeks to months, and rarely exceeds one year.

Different data collection methods (Geographic Information System mapping for ecologists, land surveys for architects), different data shown on the maps (species communities for ecologists, trees and topographic changes for architects), and different time frames (years for ecologists, weeks or months for architects) lead, not surprisingly, to contrasting awareness of, and response to, the problems of species losses due to land-use development within rare ecosystems. There is an apparent schism between ecological processes recommending conservation of rare species communities, and existing conservation efforts within land-use development processes, including architectural efforts at conservation.

2.2 Bioregional Diversity and Site-scale Solutions

In this chapter, the importance of biodiversity, and the threats of biodiversity losses in our own province, have been emphasized. As one remedy, communication among scientific (ecological) disciplines, land-use professionals, and those who commission and use the professional services

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[44] K. D. Rothley, "Designing Bioreserve networks to satisfy multiple, conflicting demands", Ecological Applications 9 (August 1999): 743.

of architects is recommended in the effort to reverse habitat fragmentation which has resulted from speculative commodification, ecologically-unhealthy aesthetic preferences, and subdivision of landscapes. To be effective, ecological principles must be organized in such a way that they can become structural, intrinsic knowledge for land-use professionals, while decisions made by land-use professionals require correlation with their ecological results. Architectural teams can assist ecologists to design ecologically healthful solutions in a culturally acceptable way so people will recognize them and maintain them appropriately (Nassauer 1995, 1999; Sauer 1998).

Methods of establishing three-way communications among landscape ecologists, architectural teams, and project users are initiated in this research. Communication strategies are derived from case-study evaluations of six architectural sites, and from published ecological principles. Together, these research sources are used to explain, and illustrate, impacts of land-use decisions on ecological processes of adjacent and on-site plant communities. In providing illustrated remedies for these impacts, it is recognized that architects tend to speak of landscape as something other than ecological processes: a range of cultural and functional roles are played by landscape in architects' work. The multifarious cultural roles of landscape include reflecting the owners' standard of care (Nassauer 1995), encoding meaning of order and power (Hunt 1991), and evoking a philosophical link between nature and architecture (Frampton 1991). It is argued here that nature and architecture can also be functionally linked, by bringing a working understanding of ecological principles into architects' realm of knowledge. Ecological principles, when merged functionally and culturally with architectural form, allow new linkages among cultural attitudes to landscape, common landscape practices, land-use decisions, and landscape ecology research.

Ecological links to land-use development apply to decisions made during pre-design, design and documentation, construction, and occupancy. Ecological principles also apply across scales, from the smallest site to a regional landscape (Dramstad et al 1996, Sauer 1998). This research emphasizes the importance of the timely integration of land-use decisions with ecology, to affect a reversal of environmental declines leading to extinctions and biodiversity losses.

2.3 Garry Oak Meadows and the Orderly Frame: Native and Exotic Plant Uses

Garry oak meadows are a vital part of British Columbia's ecological health. Biodiversity is enhanced: numerous rare birds and butterflies are uniquely suited to Garry oak landscapes. Restoration of mature oak meadows offers potential for successful reintroductions of western bluebirds, and other extirpated native species. These reintroductions have significance to cultural as well as ecological health, as shown in anthropological research demonstrating that songbirds are among the most culturally-valued natural amenities found near cities (Kempton et al 1996). If rare fauna, including songbirds, are to be saved from extinction, it is important to understand the role of native plants in the ecological food web. For example, many geophytes (with bulbous or corm forming root systems) have prominent flowers which are an important early nectar source for birds and migrating butterflies (Johnson 1999). Garry oak meadows in British Columbia boast an unusual diversity of geophytes, in combinations found nowhere else in the world (Roemer 1993, 1999). Depletion of these floral species parallels depletion of rare and colourful fauna. Both flora and fauna are ecologically and culturally valued: both are at risk.

The meadows also have historical-cultural significance to both indigenous and immigrating populations, as demonstrated earlier in this chapter. Yet unmitigated planting of native species in favour of any exotic species (biota with origins elsewhere in the world) is not always culturally appreciated (Nassauer 1999). Further, plant species, like people, migrate "naturally" from one continent to another: glaciers, for example, distributed several species in a circumpolar ring from Russia to Baffin Island. Advocates of "natural landscaping" would need to research many millennia of history to find which plants are truly "native", only to find that this is not a useful exercise: being good environmental stewards does not imply total rejection of any environmental change which may have occurred since deglaciation.

This thesis proposes that there is a place for both exotic and native plants, within the overall project of conserving ecosystems that have ecological and cultural value. Non-invasive exotic plants, carefully used, can help naturalized landscapes to look colourful, neat and orderly. For example, non-native, large flowered plants can be used to form a colourful frame around a native ecosystem (Nassauer 1999). Exotic plants in this application, however, need to be carefully screened for hydrological compatibility with native species, as well as for non-invasive properties. (For example, many Victoria gardens are still being planted with a reputedly "sterile" variety of broom: however, the new variety is more difficult to control than the original broom, and is proving extremely destructive to oak meadows in nearly parks and private landscapes).

There are other instances where native plant communities, such as oak meadows, offer obvious aesthetic, ecological and cultural improvement over standard revegetating practices such as sodded or hydroseeded grasses. In residential areas where native plants and plant communities are rare or endangered, "backyard stewardship" replenishes and conserves pockets of rare species (Hebda 1993, "Plants in Peril" 2000) (Figure 12). Suburban homesites and neglected rural woodlands are enhanced by judicious retention and addition of native plants (Figure 13).

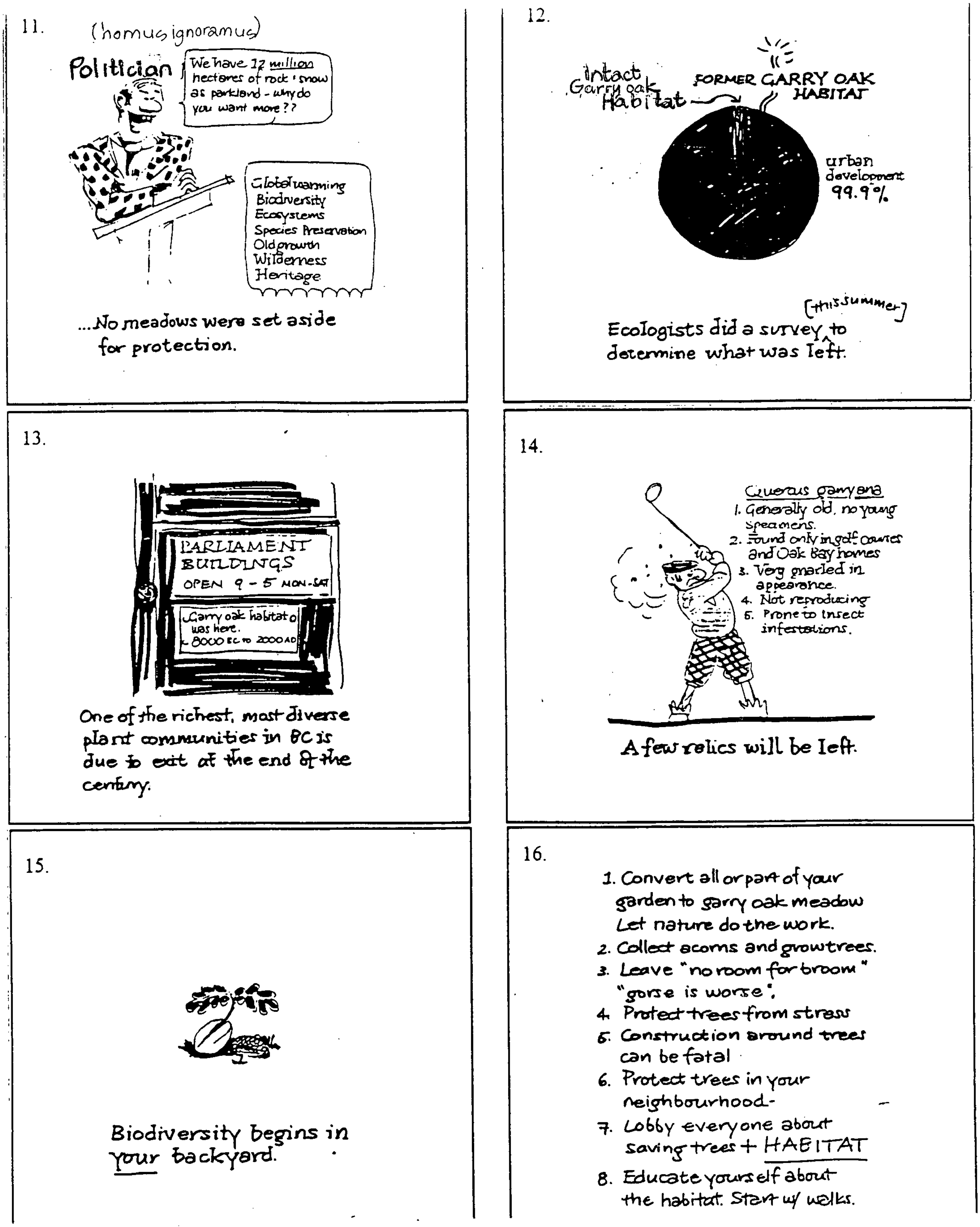
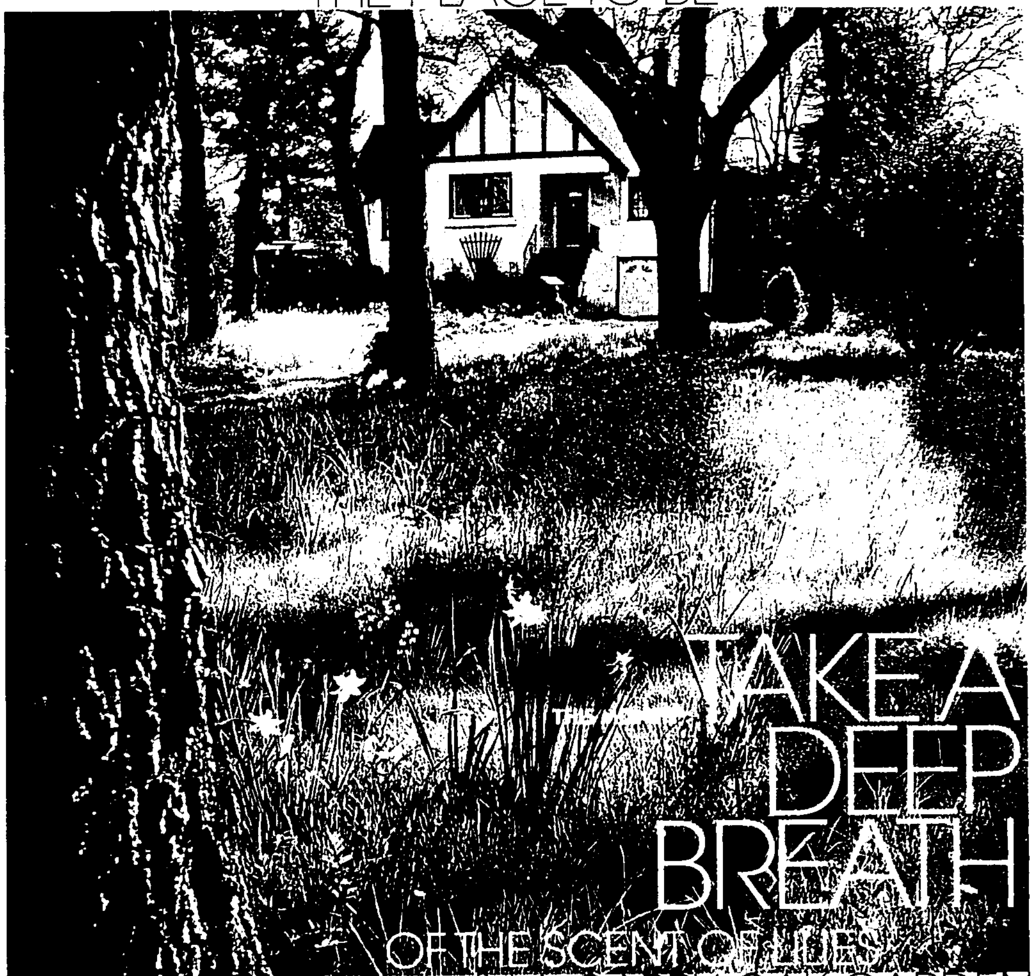


Figure 12. Biodiversity begins in your backyard: drawings by Brioni Penn (Hebda and Aitkins 1994, 72).

THE PLACE TO BE



TAKE A DEEP BREATH OF THE SCENT OF LILIES IN A GARRY OAK GARDEN IN SAANICH, B.C.

You could call it a lawn. But how many lawns cause traffic jams as dozens of people clamber out of their cars to take pictures? The group gawk begins in spring, when the yard at this Victoria-area home turns sea-blue from hundreds on hundreds of camas lilies.

Under the mature canopy of stately Garry oak trees, the camas lilies burst into riotous bloom in late March, accompanied by dozens of other Garry oak meadow species such as white fawn lilies, chocolate lilies and shooting stars.

"How many did you originally plant?" I once asked (the late) Don Vincent of his display. "Not one!" he set me straight. "People ask me, how did you do that? And I say, do nothing! The camas lilies have been there for 10,000 years." Benign neglect was never sweeter.

By June, the grass is hip-high, the lilies have set their seed and the meadow is ready for mowing—more appropriate to call this maintenance a seed-dispersal technique than conventional lawncare, since the reproductive schedule of the camas dictates the timing.

Post-cutting, the meadow looks like any other traditional lawn, but the camas bulbs are busy underground, replenishing their store of hidden energy, getting ready for next spring's spectacular show.—*Lorraine Johnson*

GREGG ELIGH

90 WESTERN LIVING APRIL 1999

Figure 13. Take a deep breath of the scent of Lilies" (Western Living 1999, 90).

North American peri-urban areas characteristically offer a large percentage of open space, much of which is predominantly covered in lawn or paving. It is possible to envision the sea of suburban front lawns converted to a landscape of greater ecological health. For example, lawns could be replaced with native grasses and ground covers that thrive free of watering and chemicals. Artistically-arranged groups of colourful native herbs, shrubs and trees can further enhance the residential environment. This thesis proposes that the small pocket garden of native plants found in many ideal Victoria gardens take center stage, and exotic plants be used to enhance the native plants in a reversal of traditional roles. Thus the residential garden idealized in the early twentieth century, Victoria's "watershed period in landscape design" (Segger and Franklin 1996, 135), can experience a change of scale, with native plants predominating and exotic plants adding colourful "accents". A native landscape palette copes better with climate than its predominantly exotic forerunner: Victoria's summer droughts are compatible with oak meadows hydrological needs. Further, as B.C. summers are now getting hotter and dryer, Victoria-based paleo-botanist Richard Hebda notes that Vancouver Island's climate will soon be replaced by hotter, drier conditions similar to those experienced 7000 years ago when Garry oak arrived on B.C. shores. The English garden, "for so long the ideal of many householders, will become less sustainable under hotter drier conditions; the oak meadows, by contrast, will serve as a logical replacement.

Institutional and commercial projects can also benefit from native plantings. Wildlife sanctuaries in parks or schoolyards can be created by pockets of ecological restoration, since native plants have been shown to attract songbirds more readily than non-native plant groups (Spirn 1982). Roadside plantings of native groundcover and wildflowers have proven their worth in the Victoria area: stretches of spring wildflowers delight both visitors and residents. Commercial and Industrial sites benefit from screening by native plants (Kruckeberg 1982).

These applications can be instituted by architectural teams working on diverse project types: site-planning decisions to set aside space for native plant conservation or restoration must occur throughout the land-use development process. In configuring landscapes, architects and landscape architects can recognize that their influence is not simply to place a "leave as is" notation adjacent to site plan graphics which locate existing trees or ecosystem pockets. Leaving individual indigenous plants or plant associations as fragments is a first step to survival, but unless rare species can thrive into the future, biodiversity assurance has not been achieved. As shown in the case studies that follow, the "leave-it-alone" design approach to native ecosystems tends to result in unhealthy, damaged or non-recruiting plant associations. Leaving fragments of "nature" as islands in a sea of construction disturbance is an action that matches the ideology that wilderness is immutable, natural, and pristine (Cronon 1996, White 1996, MacCleery 1998). The contrasting action is to use landscape ecology principles to design spatial characteristics of sites, acknowledging that landscapes are neither immutable nor essentially pristine.

Within an ecologically-innovative design process, architectural teams also need to recognize and reflect upon the role of aesthetics as a player in economic evaluations. Aesthetics recognized as a reason for long-term acceptance of ecosystem-enhancing solutions, influences design decisions about the landscape. At the same time, it is important to see architectural solutions as more than an instant visual image (Pallasmaa 2000). A depth of understanding about landscape processes offers the architect a range of design responses that challenge the hegemony of the picturesque and other visually-oriented solutions. The multi-sensory perception offered by ecologically-rich landscape space engages the user in processes of change.

CHAPTER 3 CASE-STUDY RESEARCH STRATEGIES

3.0 Introduction

Conducting research into the ways site-scale design decisions impact rare plant communities near settled areas requires input from diverse disciplines. Urban Landscape Ecology, Botany, Biology, Landscape Architecture, Restoration Ecology, Architectural History and Theory, and cultural history are all fields which deal with some aspect of the interface between human settlement and natural ecological systems. The literature from these diverse fields evidences the fracturing of knowledge along distinct disciplinary lines: ecological science, Garry oak meadow history and ecology, applied sciences, and existing developmental strategies. In collating this existing knowledge, one finds a litany of requests for an interdisciplinary approach designed to lessen the impacts of peri-urban development on biodiversity. Clearly, solutions are needed to address the schism between research on the environment and land-use activities that degrade the environment.

Redressing the schism between research and practice becomes the leitmotif that reunites fractured, divergent research paths. Bridges to span the schism between practices of land-use development and theories of landscape are sought in this case-study research. To close the mid-span gap between ecosystem theory and ecologically-inspired land-use development, specific strategies are needed which are both culturally and ecologically acceptable:

> For new forms of ecologically rich landscapes to be sustained, the forms must be recognized and perpetuated by people in everyday situations [...] This way of incorporating human nature into a concept of ecological responsibility is very different from requiring human beings to be confronted with ecologically destructive behavior.[45]

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[45] Nassauer II, 169.

"Architecture, Development, and Ecology" strives to improve communications among ecologists, architectural teams and "people in everyday situations" as an important step in "incorporating human nature into a concept of ecological responsibility."

3.1 Case-Study Research Methodology

To explore the schism between ecological theory and land-use practice, seven sites containing both land-use developments and a component of ecological reserve are evaluated. Each of the selected sites is first described according to its ecological function and its land-use program. The interrelationship between these functions is then explored in empirical research: specifically, impacts of land-use developments on case-study sites near bioreserves are evaluated. The strategy used in this research evaluates selected sites for post-development changes in keystone species[46] and growth relative to distance from architectural intervention. This technique of keystone species-biological monitoring is "[...] especially valuable in helping to identify the effects of habitat fragmentation, a common form of alteration of terrestrial environments that result from human activity. Monitoring can help determine the minimal sizes of patches required by species, and how this rate of occupancy of suitable sizes declines as distance between habitat increases."[47]

Therefore, growth and health of keystone species (in this case Garry oak) has spatial implications related to area and connectivity of a bioreserve. Further, keystone species monitoring indicates whether environmental conditions are conducive to the growth and

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[46] Keystone species is one that, if added or removed, has maximal influence on a community. In the case of Garry oak meadows the look is a keystone species (although it can be argued that people are the keystone species anywhere near settled areas).

[47] National Research Council, Ecological Knowledge and Environmental Problem Solving, (Washington D. C.: National Academy Press, 1986), 86.

recruitment of plant communities associated with keystone species. However, when associated plant communities contain many rare plant types (as in the case of oak meadow), keystone species health is only a spatial indicator that rare species are able to survive: non-spatial factors of survival such as trampling or removal for resale are not indicated by keystone species health. Because human nature needs to be incorporated into strategies for greater ecosystem health (Nassauer 1995) the case-study research looks for cultural as well as spatial explanations for post-development alterations to keystone species. These explanations are then correlated with the design team decisions that can influence the ecological richness of peri-urban landscapes.

CHAPTER 4 CASE STUDY EMPIRICAL RESEARCH

4.0 Introduction: Purpose and Location of The Empirical Research

The purpose of this chapter is to present case-study documentation and empirical research results, then to correlate explanations for the observed results with both decisions made during land-use development phases (pre-design, design, construction, post-occupancy) and with oak meadow qualities—area, rare-species representation, and connectivity—three ecological qualities which are impacted by those decisions.[48] In the pursuit of explanations for ways site-scale design decisions impact Garry oak meadow remnants, specific sites were needed for empirical observation and analysis.

Case-study site selection began with a search for a region of south Vancouver Island where the interface between land-use development and Garry oak habitat could be evaluated. The Western Communities were selected for several reasons. Western Communities have more remaining Garry oak meadows than either the Saanich Peninsula to the east or Victoria to the south.

This is due to three main factors: the Western communities have a more rugged terrain, lower-density settlements, and a greater percentage of parkland (protected area) than other south

[48] In the evaluation of ecological impacts on case-study sites, three ecological principles developed by K. D. Rothley (1999) are used: connectedness, area, and rare species representation. In his journal article "Designing bioreserve networks to satisfy multiple conflicting demands", Rothley explains that once area, connectedness and rare species representation are resolved using computer programming techniques, then planners can refocus their efforts on those social, cultural, and economic aspects of bioreserve design which are too complex to represent on a graph or computer model. In Rothley's methodology, social and cultural processes are reintegrated with ecological processes by planners after key decisions are made. While this thesis employs Rothley's classification system for ecological principles, it introduces two essential transformations. Firstly, the principles are fully integrated with an understanding of how their cultural context impacts ecological change. Secondly, *Area* is placed at the beginning of the trio, since the area of bioreserves is a major economic factor in land use development solutions. The result is an ARC: area, rare-species representation, and connectivity, but the ARC is refracted by the presence of people within the studied ecosystem.

Vancouver Island municipalities. These three characteristics of the Western Communities have made the spatial conflict between land-use development and Garry oak meadow more visible and current. Firstly, the rugged terrain influenced the Western Communities' slower rate of development, since rocky sites are more costly for conventional construction than level sites. Slower development means that there are still "undeveloped" private lands, some of which contain Garry oak meadow. Secondly, the lower population densities in these areas are in the process of change towards greater densities: several single-family uses are being rezoned to multi-family uses, and greater residential densities often inspire more commercial/institutional uses. These density changes provide new opportunities for land-use development, and more opportunities for observing their impacts. Finally, the Western Communities have the largest concentration of Greater Victoria's parkland. This is for the most part because "the lands that are less suitable for housing and agriculture [...] are now [regional] parks" (Tracy Fleming 1999, CRD Parks). Parkland in the Western communities is now being influenced by neighbouring land-use developments.

General observations on the natural systems and settlement patterns of the Western Communities, then, indicate that these Communities contain the key element for case-study sites in this research: land-use developments in proximity to retained Garry oak plant communities, found in or near the perimeter of Victoria. Further, the Western Communities' Garry oak meadows, while more abundant than in other parts of Greater Victoria, are still isolated remnants of functioning ecosystems. Importantly, parkland in these communities supports biota which is critically imperiled,[49] since twenty percent of rare plants in British Columbia are found only in Garry oak meadow.

[49] See SEI reports in Chapter 4.

From the Western Communities, six research sites were selected which contain bioreserve areas with similar dominant plant communities; similar proximities between phased land-use developments and bioreserve; and similar placement within the landscape mosaics of Greater Victoria and parklands. Other similarities of the six sites included accessibility of aerial photographs, development plans, and vegetation surveys.

All are sizable developments of several hectares each. The sites are deliberately dissimilar, however, in post-development land uses: one site has institutional uses, two sites are single-family developments, and three sites multi-family (townhouse) projects. This dissimilarity serves two research functions. Firstly, post-development impacts due to different site-management regimes can be separated from impacts due to form of development. For example, multi-family sites have different management processes than the institutional site (community centre). Although building footprints are of similar size and proximity to a bioreserve, the management impacts of the two sites can be contrasted. Management-related impacts can thereby be separated from impacts due to built form and siting. Finding explanations for results requires being able to separate spatial from management qualities. Also, since this research is an overview to explain how site-scale design decisions impact rare plant communities, it is vital to look at different types of projects commonly undertaken by architectural teams. In this way, the applications of the research are broader, and more readily assimilated into land-use development practices.

4.00 Maps, surveys, plans, graphs and charts: data sets provided for each site grouping

As stated above, all six case study sites upon which empirical studies were completed contain land-use developments incorporating, and adjacent to, Garry oak landscapes. The sites are located within three of the Western Communities of Victoria. All three areas are at the interstices of parks, undeveloped lands, waterfront or other open spaces (Figure 14). Five sets of data trace the impact of land-use developments on rare plant communities: habitat condition, uses and forms of land-use development, tree health in conserved areas relative to development decisions, landscape ecology reasons for changes in tree health, and comparative summaries. These five data sets are further described as follows. Firstly, Rare Element Occurrence surveys (of vegetation, topographic characteristics, soil types, and depleting factors such as insect pests and exotic invasive vegetation), describe how the case study regions act as refuge areas for native plant species. Secondly, land use development plans and site photographs, convey how people choose to build on the case study areas. Thirdly, surveys undertaken in this research portray effects of the proximity of land-use constructions and people's activities on growth extensions of keystone tree species in reserved vegetation areas. Growth extensions of keystone species, a recognized monitoring device for human impacts on plant communities,[50] are shown on graphs. Fourthly, known or likely reasons for changes in growth patterns are related to land-use development decisions. Finally, the six sites are compared to one another and results are summarized.

4.01 Six case-study sites classified by community

The six case-study sites are located within three Communities: Colwood, View Royal, and Langford. The first site, Juan de Fuca Recreation Centre in Colwood, has been developed in stages since 1967. Millwoods and Crystalview Estates are two separate single-family development sites in Langford dating from the mid 1990's. Three separate, contiguous multi-

[50] National Research Council, Ecological Knowledge and Environmental Problem-Solving (Washington DC: National Academy Press, 1986)

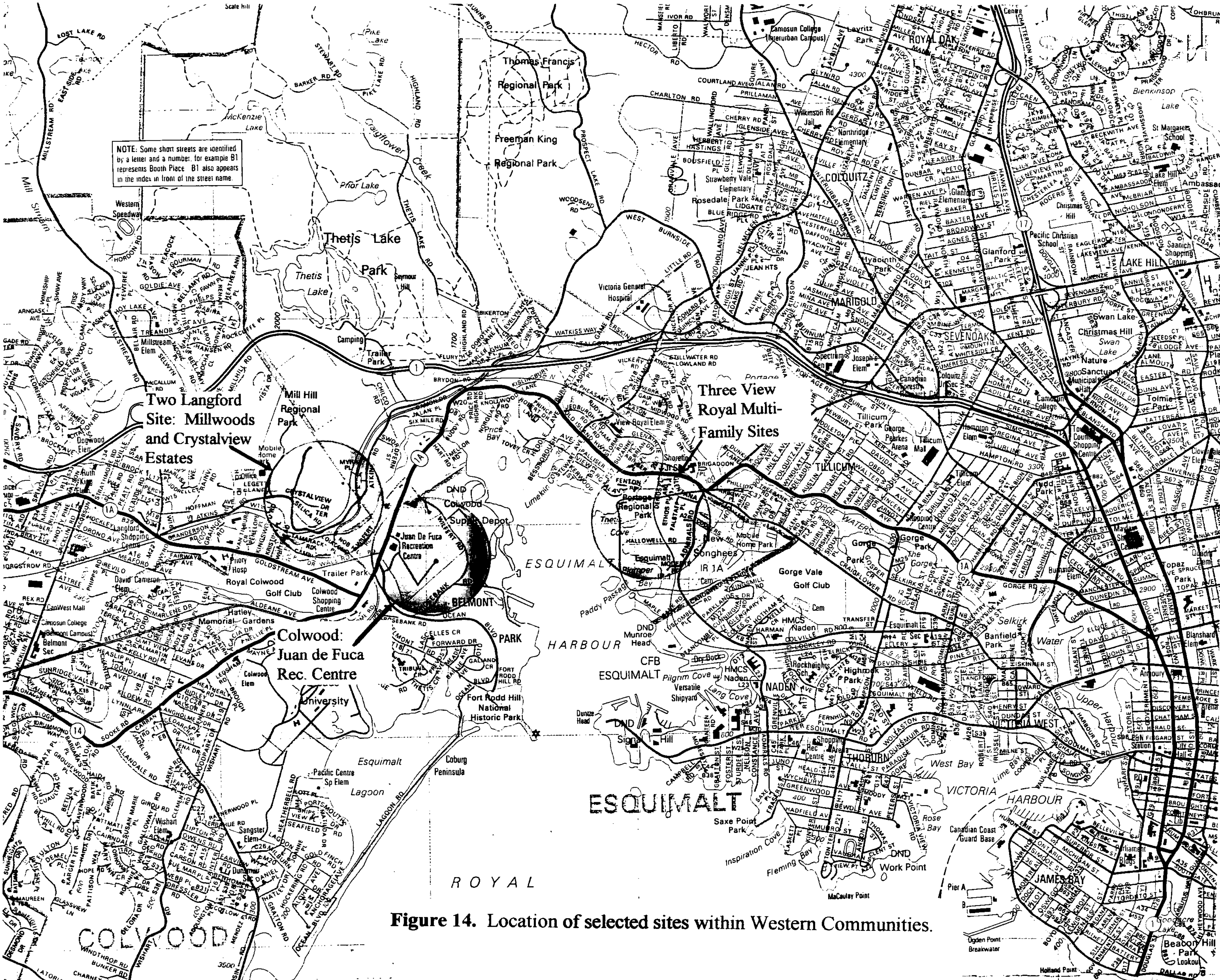

Figure 14. Location of selected sites within Western Communities.

family sites in View Royal, developed at different times since 1995, show contrasting land-use concepts.

4.1 Colwood: Juan de Fuca Recreation Centre

4.10 Bioreserve description

The rocky site at Juan de Fuca is an exposed, salt-sprayed hillside with some rocky outcrops. (Figures 15, 16 & 17) The Garry oak bioreserve is just north of the Juan de Fuca Recreation Centre. The reserve, nicknamed "Monk's head" because of the grassy knoll in the centre, is surrounded with mixed forest on the North and an oak stand on the South. A jogging trail rings the one-half hectare oak stand, and a hiking trail crosses the one-half hectare grassy knoll. This oak stand is a few hundred meters in length and about fifty meters wide.

Changes in local abundance and health of rare species can be traced through successive vegetation surveys conducted on the Juan de Fuca parkland during the 1990's. The 1992 survey for B.C.C.D.C by parks biologist Joel Ussery reports extensive invasion by Scotch broom. At the time of the 1992 survey the broom was of recent introduction, being only one to two years old. *Camassia* species, *Zygadenus* species and *Saniela* species were dominant herbs (Appendix V). From 1993 to 1995, biologist Wayne Erickson expanded on the Ussery surveys by evaluating existing and potential wildlife habitat of the oaks at Juan de Fuca.[51] Wildlife habitat is an important inclusion, because dispersal and regeneration of Garry oak communities is related to associated wildlife populations.[52]

[51] Wayne Erickson 1996, 270 - 80.
[52] Ibid., 280.

Erickson observed that oaks of larger diameter, with ample tree cavities, attracted cavity-using birds: chestnut-backed chickadees (*Parus rufescens*), common flicker (*Colaptes auratus*), Bewick's wren (*Thyromanes bewickii*), and others. The areas formerly supported western bluebirds (*Sialia mexicana*) and Erickson suggests that the area may be suitable for future reintroductions. The rocky knolls and grassy hillsides continue to provide habitat for butterflies such as Sarah orange-tip (*Anthocaris sora flora*) and anise swallowtail (*Papilio zelicaon*). Since regeneration of oak stands is essential for meadow wildlife habitat, Erickson evaluates the relative regeneration potential at Juan de Fuca. Abundance of oak saplings on dry, rocky sites means high regeneration potential for those sites; by contrast, low numbers of seedlings in wetter pockets means low regeneration potential of oaks in wet concavities. Erickson concludes with recommendations that *Allium acuminatum* (Hooker's onion), which has yellow (potentially vulnerable) status, be protected, and that *Cytisus scoparius* (broom) be eliminated,(Erickson 1996) if habitat potential and oak regeneration are to be maximized.

Parks managers were convinced of Erickson's pleas to eliminate broom from Juan de Fuca. In a 1999 interview with the author, Ussery noted that a new maintenance programme of systematic broom removal had enabled native plant communities at Juan de Fuca to regenerate. As noted in the following section, the vegetation surveys undertaken in this research in early 2000 revealed that Scotch broom has been removed, and the shrub layer is now dominated with snowberry (*Symphoricarpos albus*). The standard of care for native vegetation at Juan de Fuca had changed in 1999 with the commencement of systematic invasive species removal.

Resultant regeneration of native vegetation has ecological values as noted by Erickson: improvement in health of oaks and diversity of understory makes the site a likely candidate for reintroduction of Western bluebirds and other extirpated species.

Ecological and recreational reasons have led to current brush (broom) removal at Juan de Fuca. Juan de Fuca's recreational and ecological value is further enhanced by its geographic location centered among four sizable parklands containing Garry oak meadow: Fort Rodd Hill, Royal Roads, Galloping Goose Trail, and Thetis Lake Regional Park. The ecological advantage of additional Garry oak habitat in close proximity to "the Monk's head" is that stepping stone connectivity is possible—that is, species can be recolonized by moving between remnant plant communities using the remnants as stepping stones. In this case, birds can easily fly from one oak stand to the next, distributing acorns (Steller's Jays)[53], controlling insect outbreaks, reseeding bulbs, and otherwise enhancing ecological processes. Further, the proximity of two large parks, Thetis Lake and Mill Hill Regional Parks, means not only that Juan de Fuca species can be recolonized by these large bioreserves (thereby minimizing local extinctions—extinctions within the park itself), but also that Juan de Fuca will act as part of a stepping stone network, along with Fort Rodd Hill and Royal Roads, to recolonize species in the large parks.[54] The landscape spatial structure is of central importance to population survival within the remnant oak populations.

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[53] Marilyn Fuchs, "Seedy Behavior: Can a Garry oak trust a Steller's Jay to Plant its Acorns?" Presentation to the First International Garry Oak Symposium, May 1999.

[54] Discussion on connectivity summarized from Lenore Fahrig and Gray Merriam, "Conservation of Fragmented Populations", Conservation Biology 8 no. 1 (March 1994), 50 - 9.

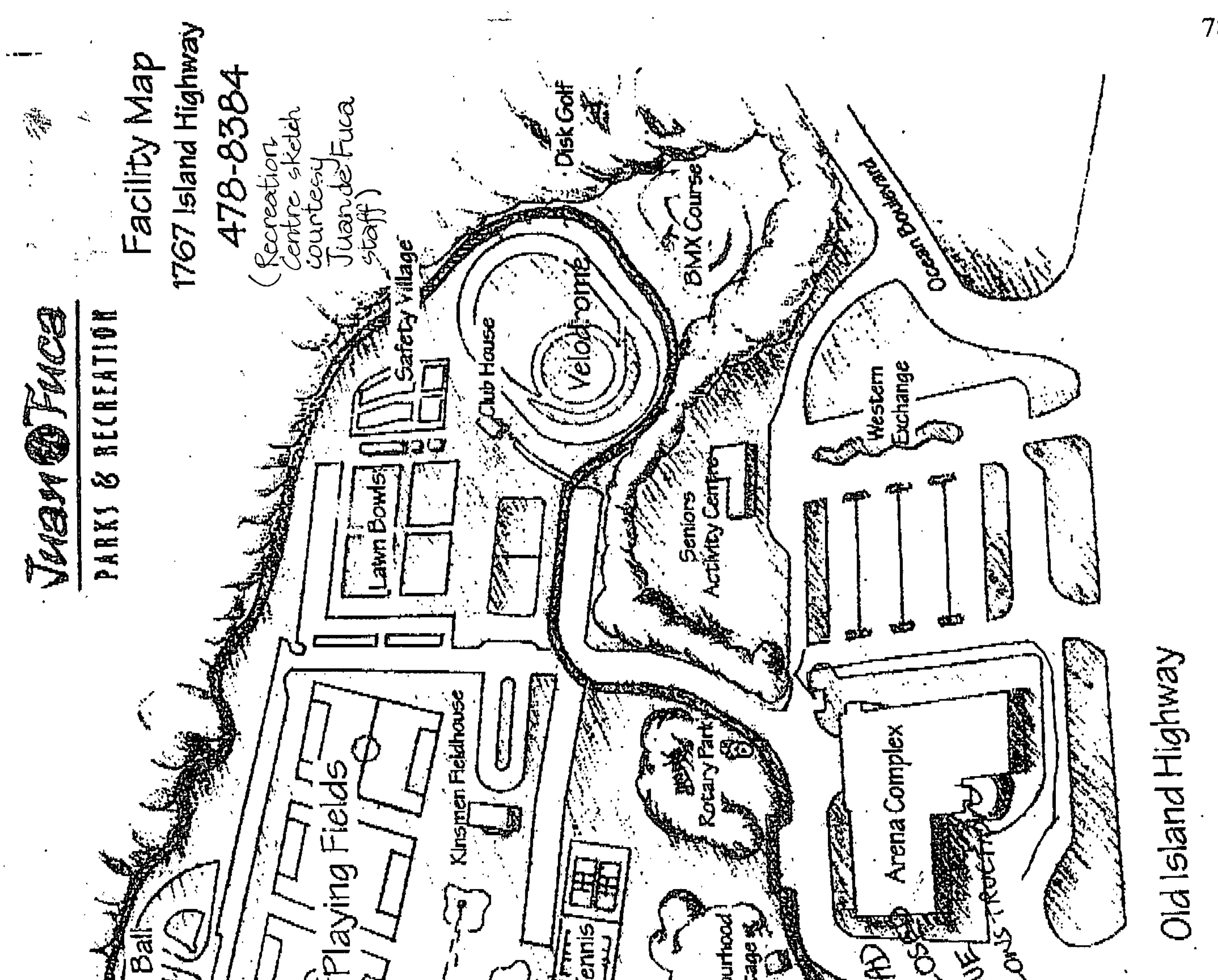

Figure 15. Sketch of Juan de Fuca site.

Figure 16. Aerial photograph of Juan de Fuca site.

Figure 17. Aerial photograph of Juan de Fuca site.

4.11 Land-use developments and associated activities adjacent to and within bioreserve

The recreation centre at Juan de Fuca includes a library, seniors' activity centre, Arena, Pool and associated outdoor recreation uses. It is centrally-located for use by the Colwood community as well as by Garry Oak plant communities. Accessible via Island Highway, construction activity on this site near Esquimalt Harbour began in 1967, and has been completed in various stages. Immediately adjacent to the oak reserve is the library, for which construction was initiated in February 1997.

A new swimming pool is currently being built on the site. A two-ring buffer separates the library and pool buildings, roadways, and parking from the oak reserve. Both rings have a function related to recreation centre uses. Immediately adjacent to the "natural" oak area is a two-and-one-half meter wide chip trail. At one time this area was used as a Frisbee court, but extensive off-court trampling led the recreation centre management to revise this active use to the more passive, and contained, activity of jogging. Between the chip trail and the buildings is a "semi-natural" area of mostly shrubby oaks interspersed with some of the largest oaks on the site. Mowed lawn surrounds the oaks in the semi-natural area, which serves as a filter for runoff from road chemicals, an "orderly frame" which demonstrates vernacular maintenance practices (mowing), and a space for spontaneous social interactions and children's play.

4.12 Effects of proximity of land uses, land-use activities, and management on tree growth

Vegetation surveys were undertaken between 28 January and 10 February, 2000. All oaks located within belt transects of five meters wide (forty-eight trees in total) were sampled. Transects were located within the lawn area as well as within the semi-natural area encircled by the chip trail. Visual estimation to fills, cuts, excavation, buildings, roadways, watering and fertilizers, and the chip trail are shown in the table below[55]:

Table 1. Percentages of sampled oak trees located within different distance classes from construction-related disturbances at Juan de Fuca Recreation Library. Percentages in relation to the chip trail are not included because distances were measured only if the trail was the closest disturbance.

Distance to disturbance (m)						
	Fill	Cut	Excavation	Building	Road	Watering and Fertilizing
0-1	0.0	0.0	0.0	0.0	0.0	14.6
>1-2	0.0	0.0	0.0	0.0	0.0	0.0
>2-5	0.0	0.0	0.0	0.0	0.0	4.2
>5-10	0.0	10.4	8.3	4.2	22.9	14.6
>10-15	0.0	2.1	0.0	0.0	4.2	20.8
>15-20	0.0	0.0	12.5	12.5	2.1	0.0
>20-25	0.0	0.0	16.7	4.2	22.9	2.1
>25-30	0.0	8.3	2.1	16.7	2.1	0.0
>30-35	0.0	0.0	8.3	6.3	2.1	8.3
>35-40	0.0	2.1	2.1	2.1	0.0	14.6
>40-45	0.0	0.0	10.4	14.6	0.0	4.2
>45-50	0.0	0.0	8.3	8.3	14.6	8.3
>50	100.0	77.1	31.3	31.3	29.2	8.3

Growth extension of tree branches was recorded, going back from spring 1999 to February 1994 (three years before the start of construction on the library). Three branches were selected from each sampled tree for extension measurements. Extensions were measured visually (using binoculars) or directly (when the branch was low enough to be reachable).

As shown in Figure 18 below, post-construction growth was considerably greater than pre-construction growth, and ranged primarily between 124 - 275%, with two trees exceeding 400%. Overall average current growth was 201%.

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[55] Graphs and surveys in this chapter were prepared in conjunction with ecologist Marilyn Fuchs

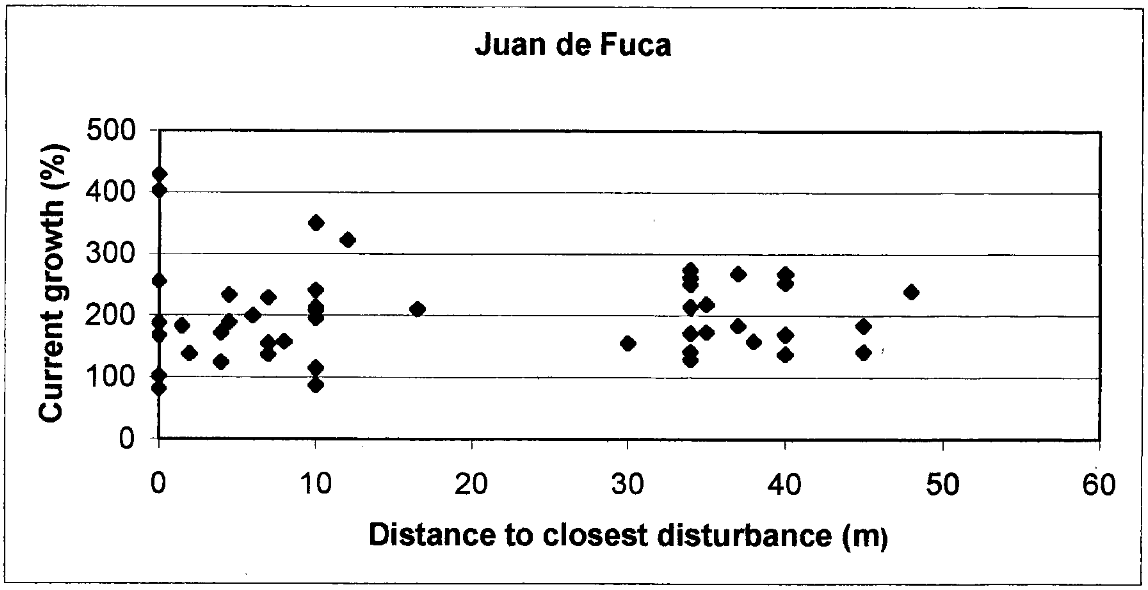

Figure 18. Current growth (post-construction growth expressed as a percent of pre-construction growth) in relation to distance from development-related disturbance at Juan de Fuca Library.

Figure 19. Photograph of Juan de Fuca Library, showing orderly frame (buffer) between structure and bioreserve.

Figure 20. Construction activity remains outside the orderly frame at Juan de Fuca.

Figure 21. The outer buffer, or orderly frame.

4.13 Known or likely reasons for changes in growth at Juan de Fuca, Colwood

Improved post-construction growth at Juan de Fuca is attributable to specific and general courses of action. On-going removal of invasive Scotch Broom can be traced to excellent communications between management and ecological experts: knowledge about the damaging effects of Scotch Broom was conveyed from theory into practice. The same cross-disciplinary exchange resulted in discontinuation of herbicide use, and monitored irrigation of buffer zones. Communication also facilitated ecologically-correct design solutions: the buffer zones at Juan de Fuca simulate a model of inner-outer buffer zone design recommended by the American Planning Association: use of the inner buffer (in immediate proximity to conserved habitat) is changed from active play to biking, hiking, and walking. The culturally-activated outer buffer—rows of oak trees in a mown "orderly frame" defines the protected edge and shields natural systems from buildings and traffic.

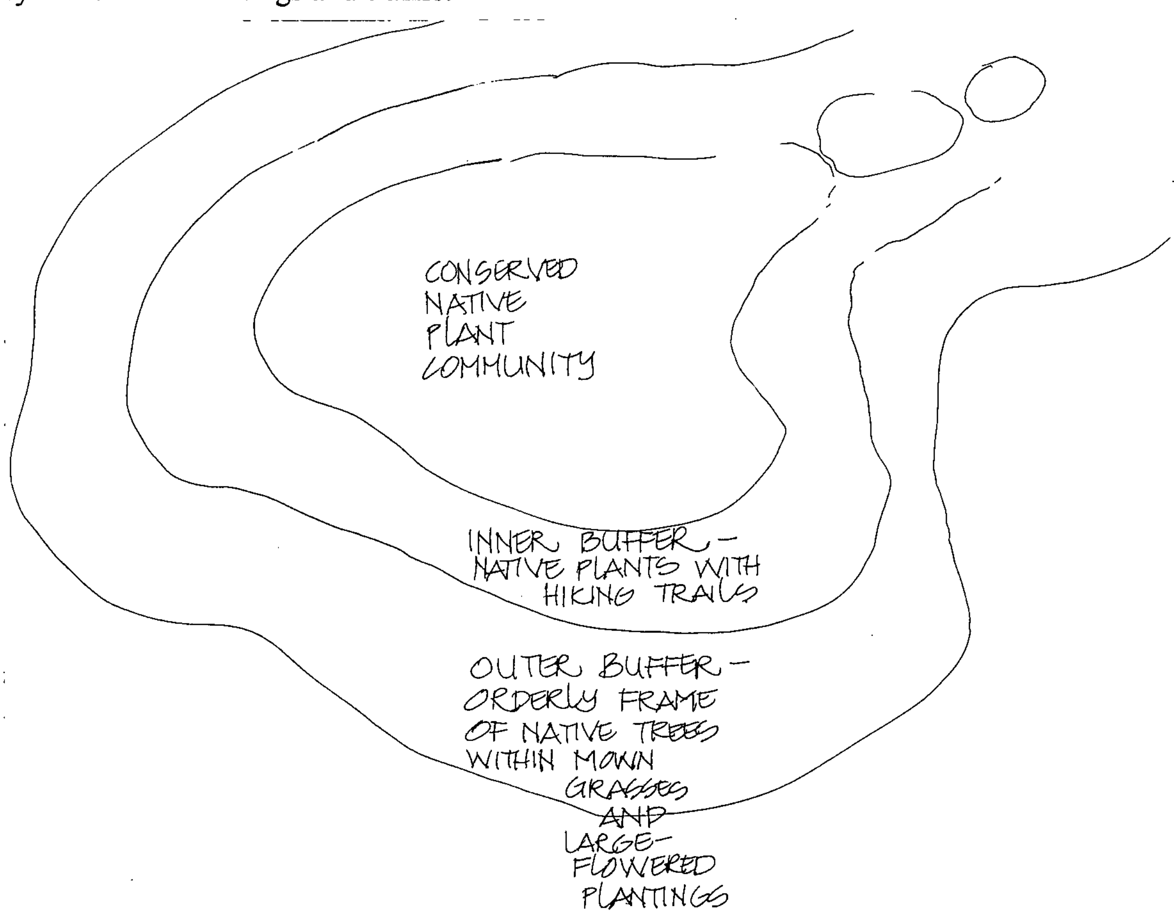

Figure 22. Diagram of two-ring buffer.

Cross-disciplinary knowledge was the vehicle that conveyed this design from its source in ecological and planning theory into design and management practice. The cumulative result of this "communication among knowers, planners and doers" (Turner 2000, 10) is the improved health and increased colonization of keystone tree species; observable regrowth of rare plants; increase in diversity of the plant understory; and optimism for future reintroductions of extirpated western bluebirds and rare butterflies to the region. Still to be done is protection of specific clumps of rare *allium acuminatum* (Erickson 1996) (see Figure 23).

Figure 23. *Allium acuminatum.*

Specific cause for growth changes	**Landscape Ecological or General Cause**	**Reference (s)**
On-going removal of invasive Scotch Broom by recreation centre maintenance.	• Surveillance and inventory used to note presence of invasive species before it caused irreversible damage. • "Communication among knowers, planners and doers" (Turner 2000, 10).	Joel Ussery personal comments; NM personal observation; Nancy J. Turner et al, *Protected Area Management—a threat or benefit to populations of rare and Unusual Plants?* (Unpublished, 2000)
Hydrological stability of stand despite new construction drains, roadways.	• Stand is up hill from development; pre-development rocky-xeric soils were hydrologically-consistent.	Joel Ussery, 1999 personal comment; NM personal observation 2000.
Avoidance of herbicides, and monitored irrigation of buffer zones.	• Management incorporates protection of rare plants and plant communities into day-to-day maintenance regimes.	N. M. personal observation 2000.
Buffer uses reduced from very active and uncontained use (frisbee courts) to contained use (marked jogging trail and tree lined grassy gardens). Buffer zone (jogging trail) further ringed by "orderly frame" of oaks in a mown lawn.	• It is recommended that the inner buffer (in immediate proximity to wildlife habitat) be limited to hikers or non-motorized transport. Around the inner buffer, a second buffer, such as a row of trees, defines the protected edge and shields natural systems from buildings and motorized traffic.	American Planning Association, *Habitat Protection Planning: Where the Wild things are* (Chicago: APA publications, 1997) Joan Nassauer II.

4.2 Two Langford Sites: Millwoods and Crystalview Estates Single-Family Housing Developments

4.20 Bioreserve descriptions

Both sites are located adjacent to Mill Hill Regional Park in Langford, British Columbia. The oak patch adjacent to Millwoods is within Mill Hill Regional Park, and is about fifty by twenty meters in size. Oaks are mostly small and shrubby in form. The terrain is mostly moss-covered rock, and Scotch broom dominates the shrub layer. Crystalview Estates contains an eighty meter by twenty meter mixed stand of Garry oak and arbutus (*Arbutus menziesii*). The oaks are small in girth but relatively tall, and are located within undeveloped lots that are for sale. Terrain is rocky outcrops with some areas of deeper soil. As at other case-study sites, Scotch broom dominates the shrub layer, although there is also tall Oregon grape (*Mahonia aquifolium*) on Crystalview Estates.

The adjacent park, Mill Hill, has a long and varied history. Archeological artifacts found at the park contain cultural material as much as 3000 years old. After becoming a Mill Site, a federal "insectry", and home to British Columbia forest services, Mill Hill became a park in 1965. Large oak and rare plants are notable: shown on the CRD Parks pamphlet (Appendix VI), many species of wildflowers and shrubs are found in Mill Hill Park. Over the past decade, parks biologists have surveyed vegetation of the park interior. Smaller oaks at park edges, with the dominant Broom shrub layer, are noted by Erickson (1996) as providing "good conditions for foliage gleaners such as orange crowned warbler (*Vermivora celata*) and yellow rumpled warbler (*Dendroca coronata*)," due to increased numbers of insects.[56] Like oak stands at Juan de Fuca, these areas formerly supported western bluebirds (*Sialia mexicana*) and the blue-listed Lewis'

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[56] Erickson 1996, 283.

woodpecker (*Melanerpes Lewis*). Erickson continues his discussion of the Mill Hill Park edges by acknowledging that introduced broom reduces aesthetic appeal (probably he is referring to the loss of wildflowers and other herbs, and to the monotonous foliage of the broom-dominated landscape). Further, he opines that Scotch broom control or removal may be necessary to permit oak regeneration. It may be noted that, in the author's surveys of January and February 2000, there was no evidence of broom removal on these two sites.

4.21 Land-use developments adjacent to and within oak stands

Over the past several years, single-family residential development has progressed uphill on both sites. The most recent phases of both developments began in the fall of 1998 through winter of 1999. As shown on the photographs that follow (Figures 24 25 & 26), roads and topographic changes directly abut conservation areas. There are no buffer zones in evidence.

4.22 Effects of proximity of land use activities and management on tree growth

Vegetation surveys occurred between 28 January and 10 February 2000. Every sixth tree within the entire width of the site was sampled, while moving from one end of the area to the other. The first tree to be sampled in each area was selected by random draw of one to six. At Millwoods and Crystalview, distance to excavation and distance to building were combined into a single variable because both sites are under construction, with buildings in various stages of completion. Visual estimations to construction-related disturbances are shown in Tables 2 and 3.

Table 2. Percentages of sampled oak trees located within different distance classes from construction-related disturbances at Millwoods.

Distance to disturbance (m)					
	Fill	**Cut**	**Building or Excavation**	**Roadway**	**Watering and Fertilizing**
0-1	12.5	0.0	0.0	0.0	0.0
>1-2	12.5	0.0	0.0	6.3	0.0
>2-5	6.3	0.0	0.0	6.3	6.3
>5-10	18.8	0.0	0.0	18.8	0.0
>10-15	25.0	0.0	12.5	18.8	6.3
>15-20	18.8	0.0	18.8	31.3	6.3
>20-25	6.3	0.0	18.8	12.5	12.5
>25-30	0.0	0.0	6.3	0.0	6.3
>30-35	0.0	0.0	18.8	6.3	18.8
>35-40	0.0	0.0	25.0	0.0	0.0
>40-45	0.0	0.0	0.0	0.0	0.0
>45-50	0.0	0.0	0.0	0.0	0.0
>50	0.0	100.0	0.0	0.0	43.8

The majority of trees were fifteen to twenty meters from fill. It is likely that excavated fill was kept on-site for economic reasons, since hauling of excavated material to remote fill sites is expensive.

Figure 24. Photograph of construction edge at Mill Hill Park. There are no buffers in evidence.

Table 3. Percentages of sampled oak trees located within different distance classes from construction-related disturbances at Crystalview Estates.

Distance to disturbance (m)					
	Fill	Cut	Building or Excavation	Roadway	Watering and Fertilizing
0-1	6.7	0.0	0.0	0.0	0.0
>1-2	13.3	0.0	0.0	0.0	0.0
>2-5	20.0	0.0	0.0	0.0	0.0
>5-10	13.3	6.7	6.7	33.3	13.3
>10-15	13.3	20.0	6.7	13.3	13.3
>15-20	26.7	26.7	13.3	13.3	20.0
>20-25	6.7	6.7	20.0	26.7	6.7
>25-30	0.0	6.7	6.7	6.7	20.0
>30-35	0.0	26.7	13.3	6.7	20.0
>35-40	0.0	6.7	20.0	0.0	6.7
>40-45	0.0	0.0	6.7	0.0	0.0
>45-50	0.0	0.0	6.7	0.0	0.0
>50	0.0	0.0	0.0	0.0	0.0

Once again, the construction-related disturbance that affects most trees is fill. The above data was collected from 1996 (three years before construction start) to 1999. As shown in Figures 27 and 29, post-construction growth is less than pre-construction growth for almost all trees at Millwoods and Crystalview estates. Millwoods' post-construction growth ranged from a low of 34% of pre-construction growth, with an overall average of 80%. Crystalview estates ranged upwards from a low of 30% of pre-construction growth, with an average of 84%.

Figure 25. Aerial photograph of Crystalview and Millwoods.

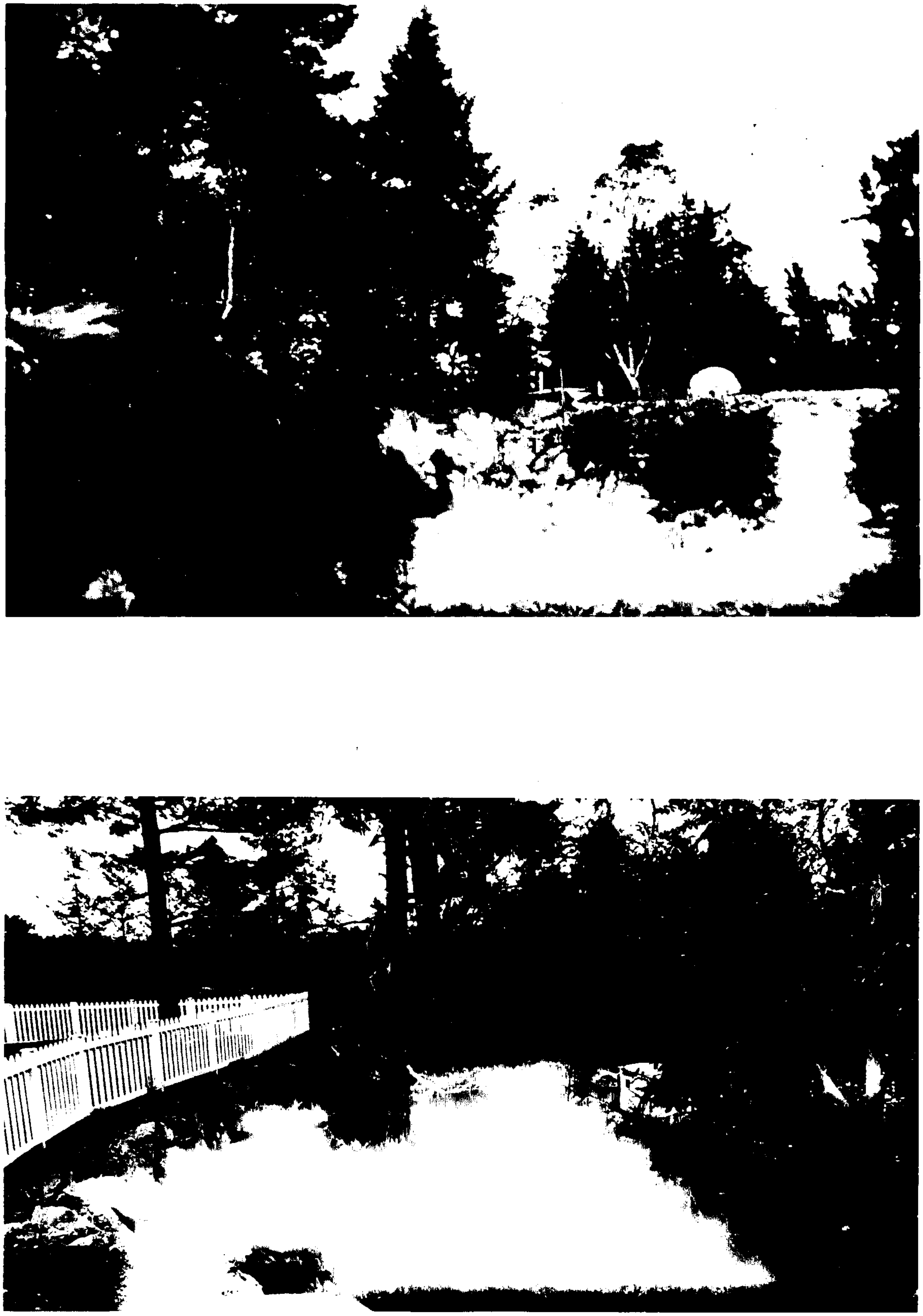

Figure 26. Photographs of construction edge at Millwoods, showing sudden topographic and soils changes.

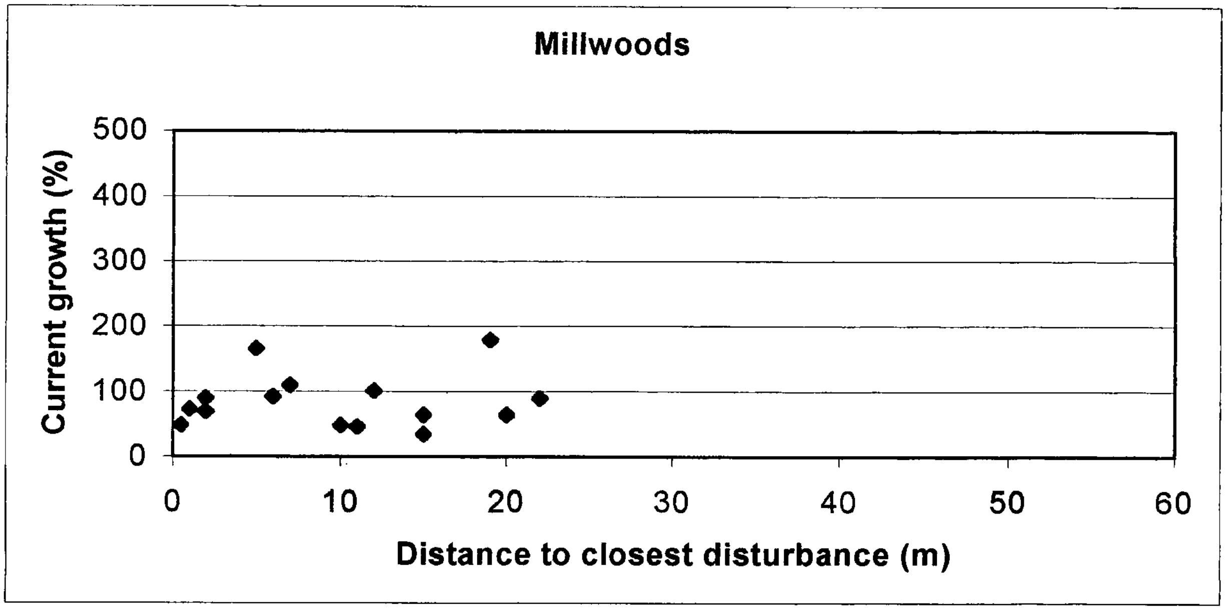

Figure 27. Current growth (post-construction growth expressed as a percent of pre-construction growth) in relation to distance from development-related disturbance at Millwoods.

While most of the trees' growth rates declined post-construction, trees' health remained almost constant and two trees' health improved post-construction. It is possible that site clearing removed some overshadowing effects for the two improved trees, as increased sunlight access can facilitate growth.

Figure 28. Photograph of construction blasting at Millwoods.

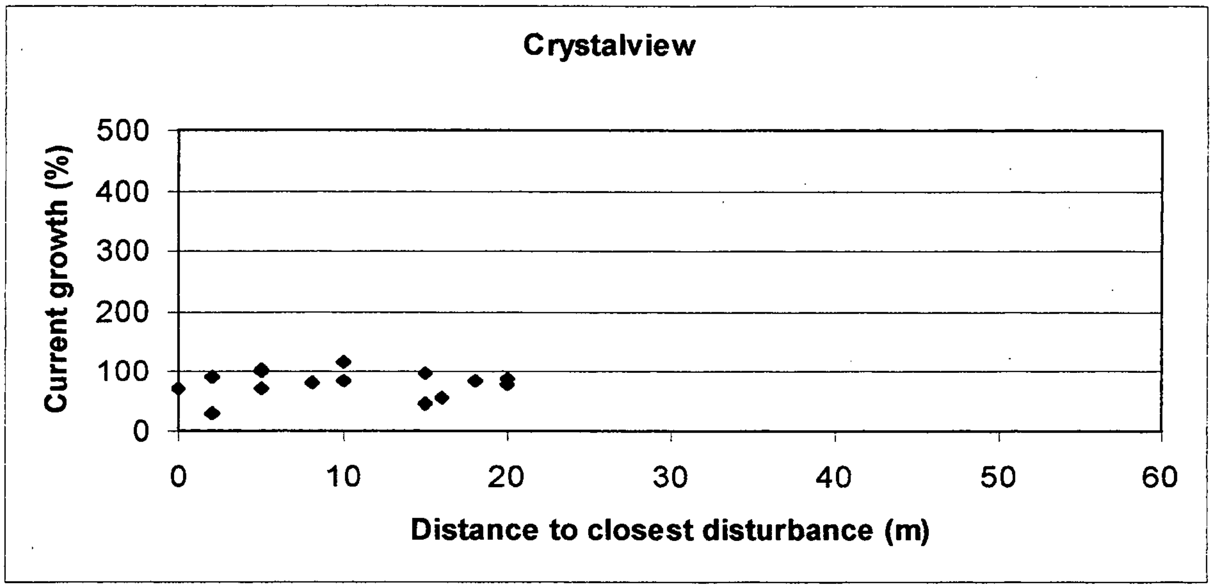

Figure 29. Current growth (post-construction growth expressed as a percent of pre-construction growth) in relation to distance from development-related disturbance at Crystalview Estates.

All but three trees' growth declined post-construction at Crystalview; three trees had constant or slightly improved growth.

4.23 Known or likely reasons for changes in growth

Reductions in growth of trees at Millwoods and Crystalview Estates are partially attributable to application of widely-held cultural misunderstandings of ecological theory. For example, the myth that "natural" conserved areas require no management is held even among some parks managers (Turner 2000), yet ecologists, biologists and pre-European peoples have ascertained that brush removal is critical to the health of this ecosystem. Indeed, recruitment of new meadow plants is impossible without removal of invasive, sunlight-shading shrubbery and non-native grasses. Because this ecological (and First Peoples') knowledge has not been convincingly-conveyed to those planning, managing, constructing and using Millwood and Crystalview Estates, degradation of 'natural' areas is swiftly progressing. Assisting this degradation are construction practices which undercut oak roots and blast rock upon which "protected" roots grow, and large construction machinery could be observed driving over the oak root zone. Ecological need for a buffer zone was not conveyed to the design and planning teams, nor to construction teams. The result of this undisseminated knowledge is immediate declines to keystone tree and understory health. Further declines are anticipated, since opportunities do not exist for protective buffers (roads and buildings directly abut meadow edges) and maintenance practices have not been instituted. The degradation will probably not stop at development site edges. It is predictable that invasive material will spread from Crystalview and Millwoods to Mill Hill Park. On-Site hydrological changes caused by footing drains and irrigation are also visibly changing hydrology along adjacent edges of Mill Hill Park.

Specific causes for growth changes	**Landscape ecological or General Cause**	**References (s)**
No removal of exotic invasive shrubs (Scotch broom).	Management of 'natural' areas seen as unnecessary.	Ussery comment 1999.
Lack of vegetation surveys that would enable site planners to plan development with as little impact as possible.	Pre-development data collection is essential to protection of rare species.	Nancy Turner
Absence of buffers between construction zones and trees intended to be conserved.	Lack of communication among with developers, landscape and site planners, homeowners contractors, and biologists/ecologists about the fragile nature of natural areas and stewardship opportunities.	American Planning Association, *Where the Wild Things Are*; Joan Nassauer, "Messy Ecosystems, Orderly Frames" J. W. Ranney, MC. Bruner, and J. B. Levenson, "The importance of Edge in the Structure and Dynamics of *Forest Islands" in Forest Island Dynamics in Man-Dominated Landscapes* (New York: Springer-Verlay, 1981): 67 - 97.
Hydrological changes to oak stands blasting of rocky terrain.	Roots exposed by construction machinery, which also creates an abrupt edge: generally an abrupt edge has fewer colonizations than a graduated edge.	N. M. personal observation, 2000.

4.3 View Royal Projects: Three Multi-Family Projects Adjacent to a Regional Park

4.30 Bioreserve descriptions

The only available field surveys for the View Royal sites are those conducted by the author's team in July, 1999. As a result, this research encompasses more extensive field surveys than were undertaken on the previous three case-study sites. Five locations were surveyed in this research. Protected oak stands within the three case-study development lots (A, B, and C) were supplemented with surveys of the roadway leave strip, and of a ten-percent-of-site-area park dedication which adjoins the south edge of the park. The two supplemental areas were selected as conservation spaces during the development process, and therefore complete the portrait of land dedication with a conservation motive.

The reserved oak stands in Lot A are protected by tree-protection covenant, which simply states that no trees shall be removed from the covenant area. The protected area is the ridge of a rock outcrop, approximately one hundred meters by twenty-five meters. Small, scattered Garry oaks and moderate-sized arbutus dominate the tree layer. Like the previous case-study sites, the shrub layer is dominated by Scotch broom. Other shrubs include Tall Oregon grape (*Mahonia aquifolium*), snowberry (*Symphoricarpos albus*), Himilayan blackberry (*Rubus discolor*), and ocean-spray (*Holodiscus discolor*). The herb layer is dominated by introduced grasses. Licorice fern (*Polypokium glycyrrhiza*) grows on exposed rock. Wildflowers in spring include dog-tooth violet (*Erythronium spp.*) nodding onion, and blue camas.

Lot B contains several reserved oak stands, none of which are protected by legal covenant. These stands, composed mostly of small shrubby oaks, are located on a west-facing rock cliff and within strips of relatively-flat benches along the top and bottom of the cliff. The larger trees on the site are Douglas fir and arbutus, although many arbutus at the top of the cliff are dying. Shrubs include Saskatoon (*Amelanchier alnifolia*), the invasive non-native spurge laurel (*Daphne lawsola*), ocean-spray, tall Oregon grape, Indian plum (*Oemleria cerasiformis*), willow (*Saliz* sp.) Mountain-ash (*Sorbus* sp.), trailing blackberry (*Rubus uisinus*), rose (*Rosa* sp.), hairy honeysuckle (*Lonicera hisidula*) and snowberry. The herb layer is dominated by introduced grasses and flowering annuals. Licorice fern, starflower (*Trientalis latefolia*) foam flower (*Tiarella trifoliata*), sweet-cicily (*Osmorhiza chilensis*) are native herbs present; wall lettuce (*Lactuca muralis*) is an introduced herb. There are numerous drifts of dog-tooth violet (*Erythronum spp.*) in spring, although many of these were removed.

The undeveloped area in Lot C comprises an area protected by legal covenant, as well as areas slated for development, and is about eighty meters by one-hundred meters in size. The lot slopes to the southwest, towards the waterfront. The eastern and western portions of the lot are mixed forest containing arbutus, Douglas-fir (many with their tops missing), Douglas-maple (*Acer glabrum*) and western yew (*Taxus brevifolia*), with wetter areas dominated by black cottonwood (*Populus balsamifera*) red alder (*Alnus rubra*) Grand fir, cascara (*Rhamnus purshiana*), big-leaf maple (*Acer macrophyllum*) and willow. The central portion of the lot is dominated by Garry oak trees, and is therefore the area most comparable to the other case-study sites in this research. Along with the introduced shrub species (including English ivy) spurge laurel, holly, and Broom, are native shrubs including Saskatoon, red-osier dogwood (*Cornus stologifera*), salal (*Gaultheria shallon*), tall Oregon grape, Indian plum, bitter cherry (*Prunus emarginata*), roses, salmonberry (*Rubus spectabilis*), and snowberry. Rocky knolls are densely covered in spring-flowering bulbs including dog-tooth violet (*erythronium* spp.) and nodding onion. Wetter pockets have starflower, stinging nettle, and ferns. The road-leave strip of approximately one-hundred meters by four meters has a dense tree canopy that does not include oaks. The pie-shaped park dedication also has a dense tree canopy dominated by Douglas fir and arbutus, with oaks not in evidence. Therefore, conservation of oaks is limited to dedicated areas within the development parcels.

4.31 Land use development and associated activities adjacent to and within reserved area

Forty townhouses were constructed on Lot A, twenty initiated in August 1995 and twenty in July 1996. The lot area is four acres (1.62 ha or 174,400 ft^2), with a density of ten units per acre. Sixty-nine townhouses are in the process of being constructed on Lot B, with phased construction initiated in December 1997. The lot area is eight acres (3.24 ha or 348,800 ft^2) with a density of 8.63 units per acre. This lot features water (ocean) views, as does Lot C. The views were important factors in the form of development, since housing placement and orientation had to maximize views in order to maximize development profit. Twenty-eight townhouses will be constructed on Lot C, with construction commencing July 1998. The lot area is 3.41 acres (1.38 ha or 148,600 ft^2), with a density of eight units per acre (See Figures 30 & 31).

The form of development of the three sites are contrasted in the following diagrams.

Lot A: Two townhouse-lined 6 meter wide roadways terminate in cul-de-sacs. A rocky covenanted strip runs North-south between the central rows of townhouses, almost linking with the park dedication at its northernmost end and linking with the road-leave strip on the south. The strip contains oak meadow, but most of the oaks are relatively shrubby in form and less that four meters high.

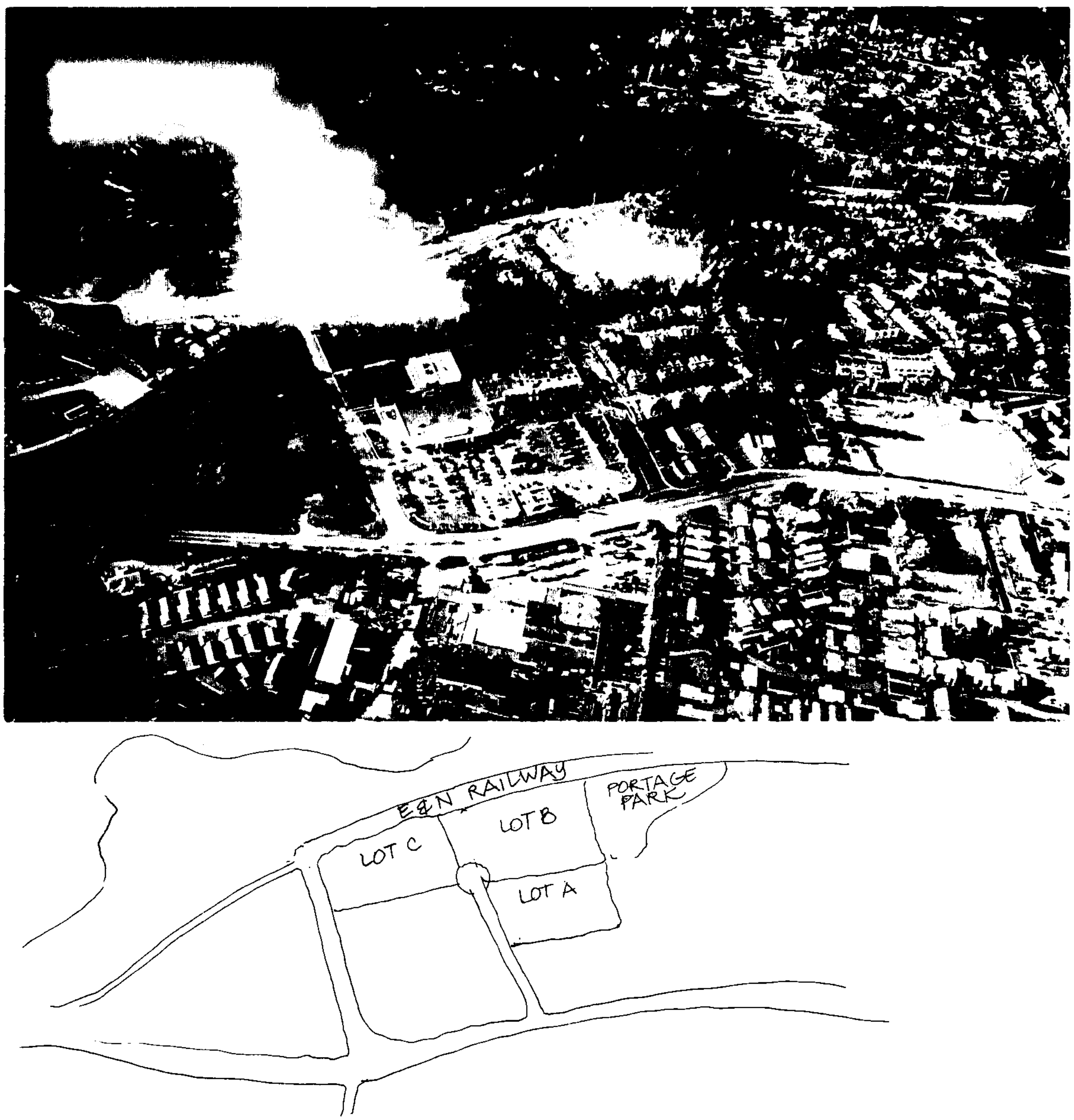

Figure 30. Aerial photograph, and key, of View Royal lots.

Lot B: Roads and townhouses are looped through the site, with small strips of "natural" areas interspersed between housing. Long driveways (generally 7 meters to 7.5 meters long) were legislated by the development permit of this parcel. Main roadways are legislated at 7.5 meters wide. There are no legal covenants on this site, and the general planning approach was to save individual trees as opposed to areas of meadow. Saved trees were not ranked according to rarity: oak, fir, arbutus and maple were all considered equally valuable. Only those trees indicated on legal surveys (greater that six-inch diameter at chest height) were considered as possible trees to be saved.

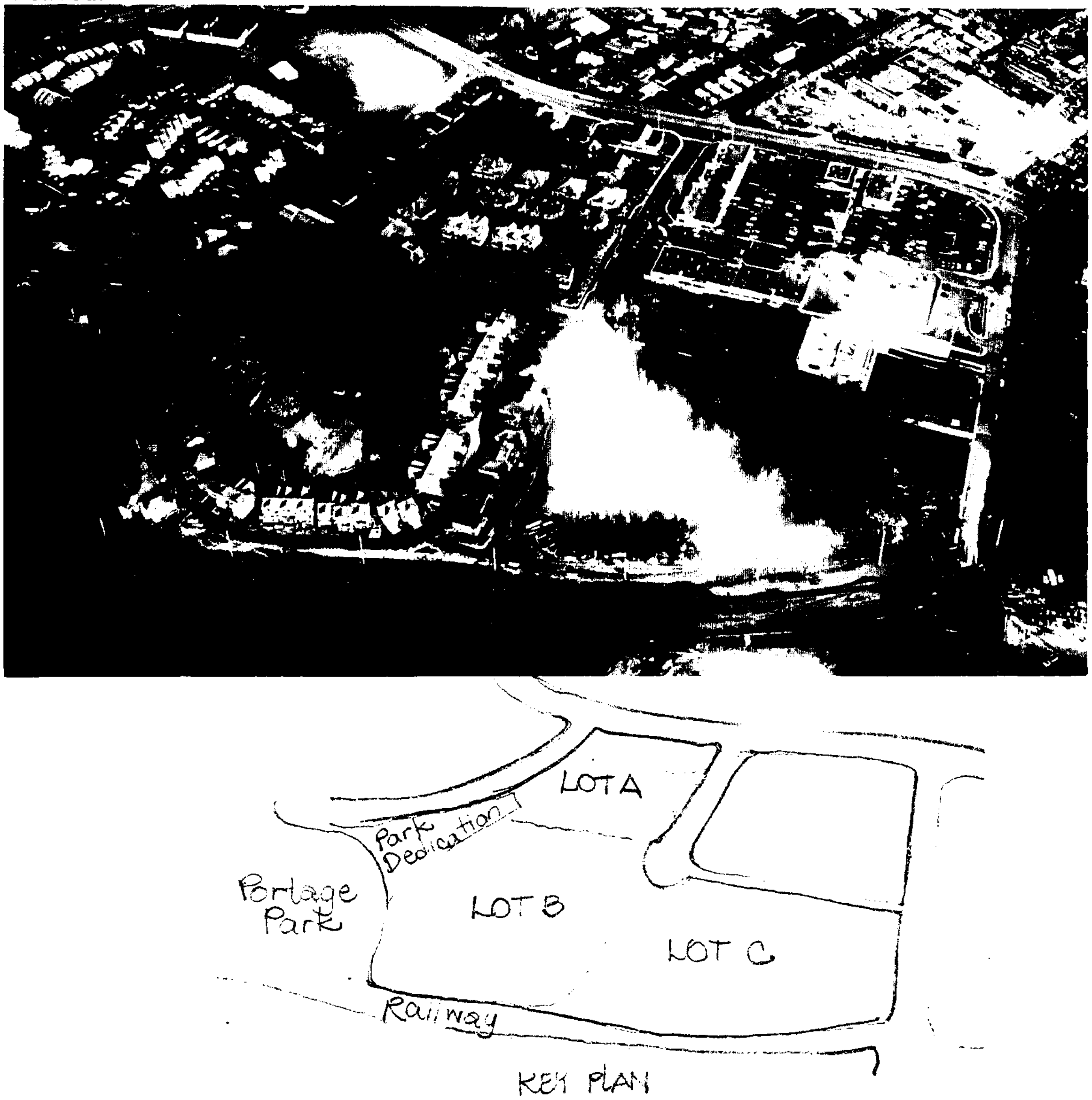

Figure 31. Aerial photograph of View Royal lots.

Lot C: A six meter wide roadway rings the site. Short driveways lead to the townhouses, which are set back an average of four meters from the perimeter roadway. The central meadow, which has rocky terrain abundant with Garry oak trees and saplings, and with associated geophytes (particularly *alluim* spp., and *erythronium* spp.), has been conserved as a covenant area. The registered legal covenant states, in part:

> Hereafter, to protect the natural areas of the Land from disturbance, no building or other structure shall be constructed, reconstructed, extended, placed or located on or moved to, nor shall there be any removal of vegetation nor importation, placing, excavation or removal of any soil, nor any other changes to the Land at a distance greater than 3 meters from the footprint of any improvements on the Land [...] by any person without the prior written permission of the Transferee. Provided nevertheless, the Transferor shall have the right to undertake landscaping works within 6 meters of the foot print of any improvements on the land [...] so long as no protected trees shall be removed or damaged within any portion of the Conservation Covenant area.[57]

The covenant goes on to say that the Conservation Covenant area must be kept free of herbicides, insecticides or pesticides, pollution and waste; that written permission must be obtained to interfere with the hydrology; and that commercial gathering of wildlife and grazing of domestic animals is prohibited.

It is notable that the covenant precludes removal of any vegetation, including exotic invasives. The working of the covenant therefore blocks restoration by exotic species removal - one of the best-known ways to facilitate Garry oak meadow regeneration.[58]

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[57] Land Titles Office, Parcel Identifier 023-57-262.

[58] Patrick Dunn, "Prairie Habitat Restoration and Maintenance on Fort Lewis and within the South Puget Sound Prairie Landscape" (Fort Lewis: The Nature Conservancy of Washington, 1998), 1.

Although the project landscape architect recommended exotic species removal be a requirement of the covenant, this design-stage recommendation was not reflected in covenant provisions. Rather, the covenant reflects the prevalent altitude that "natural" areas do not need to be managed (Ussery 1999). In fact, many native species areas will not survive if invasive non-natives are not removed. Even certain native species, aided by fertilizers and irrigation, will take over formerly-diverse plant communities. Day-to-day management of natural areas needs to be incorporated into protective covenants to deal with exotic species and damage from visitor use (Turner 2000).

The fact that "natural" areas need to be managed conflicts with an ideology which pervades western cultural thought: that wilderness (nature) is totally separate from any aspect of human settlement. "The place where we are is the place where nature is not",[59] defines the ideology of wilderness. Extrapolated from this ideology is the myth of non-maintenance of nature: "The dream of an unworked natural landscape is very much the fantasy of people who have never themselves had to work the land to make a living."[60] The daily operations of "working" the conserved ecosystem differ from regimes used in conventional gardening; manual invasive plant removal, soil regeneration through decomposing leaf litter, and protection from trampling, are the maintenance regimes which replace conventional watering, fertilizing and pruning. However, the habit of thinking about natural areas as something in need of no care is destructive to the diversity within ecosystems that we are resolving to protect. As William Cronon adds, "To the extent that biological diversity (indeed, even wilderness itself) is likely to survive in the

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[59] William Cronon, "The Trouble with Wilderness, or Getting Back to the Wrong Nature", *Uncommon Ground: Rethinking the Human Place in Nature* (New York: Norton, 1956): 81.

[60] Ibid.

future only by the most vigilant and self-conscious management of the ecosystems that sustain it, the ideology of wilderness is potentially in direct conflict with the very thing it encourages us to protect."[61]

4.32 Effects of proximity of land-use activities and management on tree growth

Vegetation surveys on the three development sites, and the road-leave and park dedication strips, were undertaken on 28 and 29 July, 1999. The trees sampled in this case included four different species, in order to compare reactions of Garry oak, arbutus, Douglas-fir and Grand-fir to construction-related disturbance. The trees sampled are shown in the chart below.

Tree species	Location				
	Lot A	Lot B	Lot C	Park	Road
Arbutus	2	11	11	10	3
Garry oak	10	1	8		
Douglas-fir		3	4	9	2
Grand fir			2		3

Table 4. Trees sampled at View Royal lots, grouped by species

The table shows that Lot A has the highest density of oak remaining on the site. Lot B, which prior to construction had several large oak groves, has retained the fewest oaks. This is due to the "tree-by-tree" savings plan on Lot B, which saved trees irrespective of their species or role in a plant community. Lot C has groves of oak and arbutus retained in the central covenants. The association between oak and arbutus was present on all sites pre-construction, but post-construction only Lot C retained the association. Lot A lost all arbutus which bounded the covenant strip pre-construction (no buffers were used). Lot B retained individual arbutus, but

[61] Cronon 1996, 81-2.

without their Garry oak association. Those that were retained have been severely limbed to permit unobstructed water views from new residences.

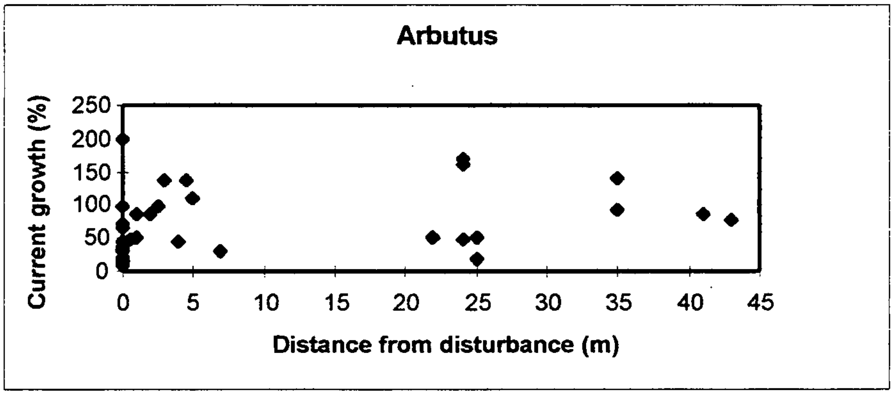
The park does not contain Garry oak, probably because of its history as a fill site for construction. The clay deposited on the park made significant hydrological, soils type and topographic changes to the park. (It has been noted in 2000 by Tracy Fleming of CRD Parks that those trees remaining in Portage Park are suffering root rot). The road leave strip is the most disturbed site; existing oaks were removed by road clearing in the early 1990's. Visual estimation to cuts, fills, excavation, buildings, roadways, watering and fertilizers are shown in the table below:

Distance (m)	Disturbance						
	Fill	Cut	Excavation	Building	Road	Watering	Fertilizing
0-1	30	8	9	8	8	41	34
>1-2	8	3	4	3	0	3	1
>2-5	16	15	30	29	14	9	11
>5-10	6	20	11	11	37	3	8
>10-15	3	5	8	8	9	0	0
>15-20	10	1	4	15	3	8	8
>20-25	11	0	10	3	15	1	1
>25-30	4	1	3	3	1	5	5
>30-35	3	5	10	3	8	1	1
>35-40	3	0	5	10	1	4	5
>40-45	0	3	4	6	5	3	3
>45-50	0	5	1	1	3	0	0
>50	4	34	1	1	0	23	24

Table 5. Visual estimation to construction-related disturbance at View Royal

As shown in this chart, the majority of trees are within five to ten meters of Fill, Excavation, Building, Watering, or Fertilizing, and nearly forty percent of trees are only one to two meters from fill, watering or fertilizing. Clearly, there is no hydrological or soil buffer, and minimal excavation buffer.

The following figures show current growth in relation to distance from construction-related disturbance for each species. It should be noted that all grand firs were within five meters of a disturbance, and Douglas-firs had almost fifty percent of individuals at least 20 meters from a disturbance. As shown in the graphs, the evidence for effect of disturbance in close proximity to sampled trees is strongest for Arbutus and Garry oak (see Figure 32).



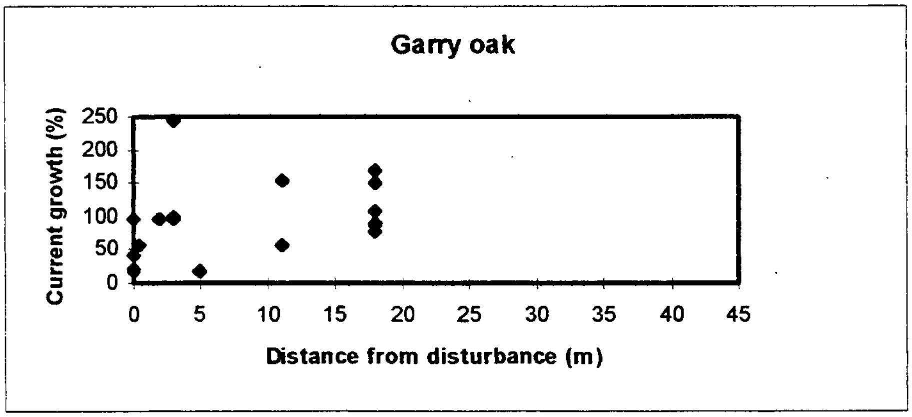
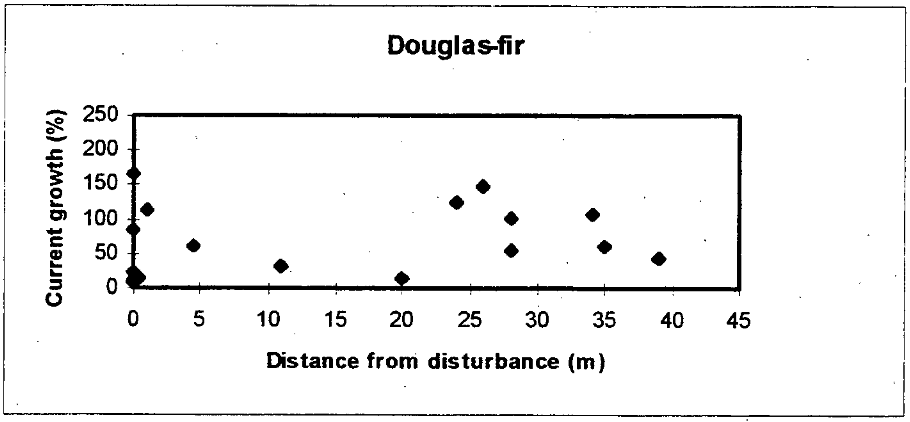


Figure 32. Current growth in relation to distance from construction- related disturbance for each species at View Royal lots.



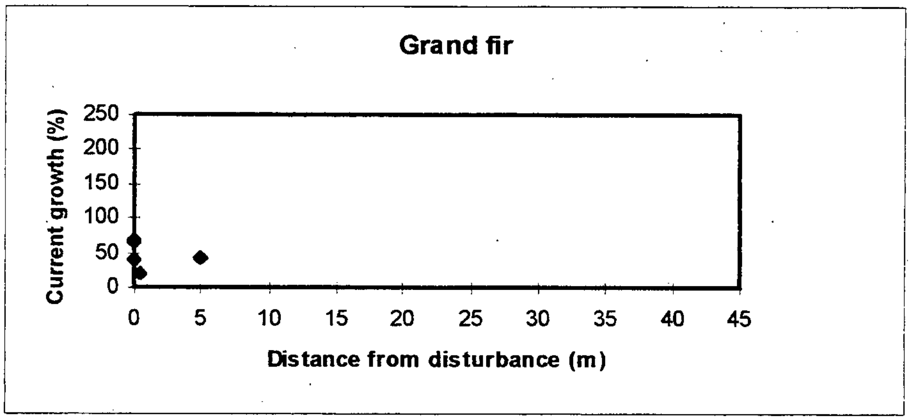


Figure 32. (cont.)

In order to compare results from the View Royal sites with those of the previous three case-study sites, the Garry oak results are now isolated. As shown in Fig. 18, five of the ten oaks within seventeen meters of construction-related disturbance had dramatic declines in growth. Post-construction growth varied between fifteen percent, and fifty-five percent of pre-construction growth. Three individuals had consistent growth pre-development and post-development, and two individuals grew faster. The post-construction growth averages 87% of pre-construction growth.

To make results on tree health more conclusive, these three sites were also surveyed for canopy condition (Figure 33). It may be noted that all sampled canopies more than thirty-five meters from disturbances were in good condition, and canopies in good condition were confined almost exclusively to trees further than twenty-five meters from a construction-related disturbance.

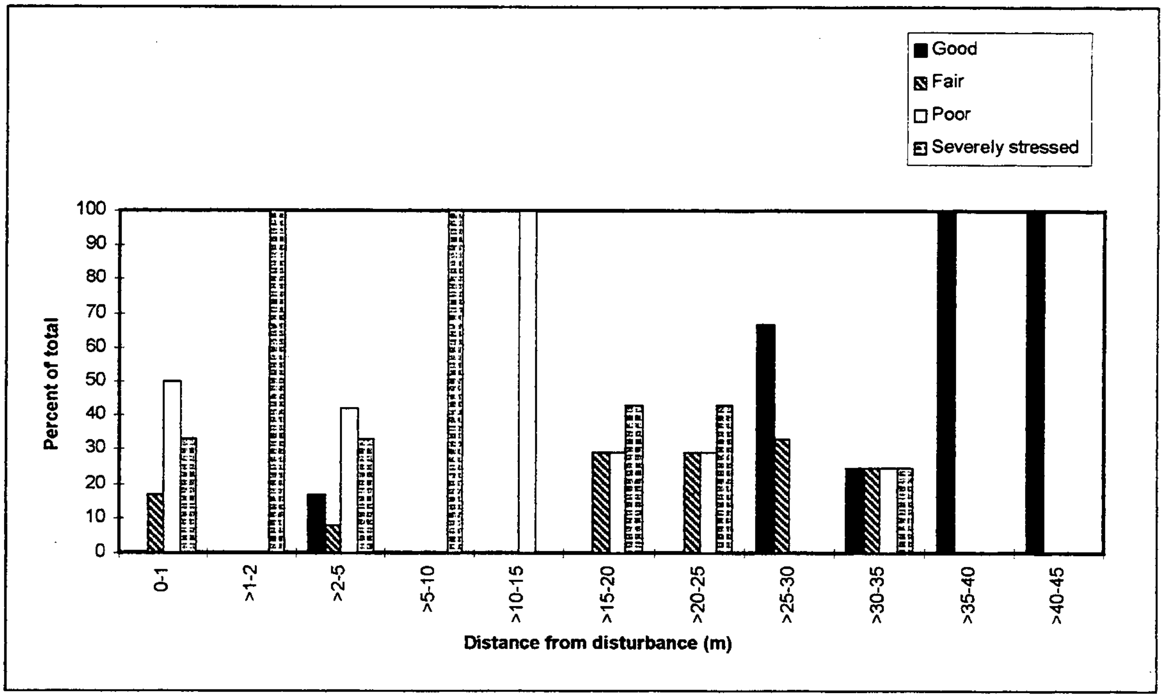


Figure 33. Canopy condition related to distance from disturbance.

These figures indicate the extreme need for buffer zones, minimally fifteen meters wide and optimally twenty-five meters wide. If site planners can provide some protective space between rare plant systems and construction activity, then rare ecosystems can continue to thrive despite their proximity to settlement.

Further examination of the trees within two to five meters from construction that remained healthy indicates that those trees were uphill from disturbance. Results suggest that, in some cases, an uphill buffer may be somewhat narrower that a downhill buffer, since hydrological and soils changes tend to spread more readily to trees below the disturbance.

4.33 Known or likely reasons for changes in growth at the three multi-family sites in View Royal

At View Royal sites, the area of meadow is observed to shrink over time as a result of on-going and progressive encroachments. Further, reduced health and growth of post-construction keystone tree growth is measurable. These reductions in ecosystem area and health are generally attributable to a lack of dissemination or acceptance of known ecological ideas among site planners, land-use developers, home-owners and contractors. Widely held cultural misconceptions about management of natural areas have not been countered as a result. The impacts of ineffective communication are wide-reaching: the legal covenant on protected areas legally enforce the myth "leave natural areas unmanaged": the result is rapid degradation and invasive plant encroachment. Yet restoration ecologists such as Patrick Dunn were simultaneously proving that invasive plant removal is critical to meadow retention and rare species survival!

Invasive-species spread is only one ecological problem evidenced at the View Royal sites. Encroachment of human uses onto conserved areas took many forms: severing of main branches to open water views, planting of invasive and overshadowing species, trampling by people and pets, deliberate removal of highly-valued native bulbs for resale, irrigation and fertilizing. These post-occupancy impacts added to extensive impacts by heavy construction machinery, blasting, dumping of fill, undercutting of tree roots, canopy damage, site dewatering. Some of these impacts were the result of valuing commercial gain over ecosystem protection (limbing for views, selling native bulbs, use of heavy machinery to speed construction processes); all of the impacts reveal a lack of, or disinterest in, the integration of ecological principals with project planning, design, construction, and occupancy.

Specific cause for growth changes	Landscape Ecological or General cause	Reference (s)
Absence of buffers between construction zones and trees intended to be conserved; extensive trampling, planting irrigation, and pet use of protected areas.	Area of conserved areas reduced over time by on-going and progressive encroachments.	B. Windjack observation 1999.
No removal, or plan to remove, exotic invasive shrubs and herbs.	Lack of communication among developers, landscape and site planners, homeowners, contractors and ecologists/biologists about stewardship; wording of covenant prevents invasive species removal.	B. Windjack observation 1999; plan to keep "natural" areas untouched noted by Joel Ussery 1999.
Removal of rare geophytes from development sites.	Inadequate protection for Rare species; commercial profit (bulbs valued at \$5 - \$15 each).	N. M. personal observation 1999.
Extensive hydrological changes on sites A and B (e.g. former xeric cliffs became running streams even in midsummer.)	Lack of knowledge by those doing the work.	N. M. personal observation 1999.
Blasting (damage to tree roots.)	Inadequate legislation; rocky terrain of remaining oak remnants often requires topographical revisions. Creation of abrupt edge reduces tree health and recolonization potential.	Ramney et al, 1981.

4.4 Case Study Results, Land-Use Development Phases, and The Arc of Ecological Qualities.

> Urban development and competition of introduced European species are two main threats to the Garry oak meadow habitat and the rare plants occurring in them.[62]

In this summary, it will be argued that the case-study sites demonstrate how bioreserve area, rare-species representation, and connectivity—an ARC of ecological qualities—is facilitated, or neglected, by the presence or absence of integrated knowledges. The phases of decision-making in land-use developments—pre-design, design, construction and post-occupancy (maintenance)—are shown to be the facilitators of improvements or declines in the ARC of ecological qualities. Further, the results on the six case-study sites underscore the importance of bringing together design and maintenance practices with an integrated knowledge of site-specific plant communities, ecosystem processes, and human-use effects. When practice and theory coexist, ecosystem function is enhanced.

Of the six sites explored in this research, only Juan de Fuca Recreation Centre had improved post-construction growth of Garry oak, improved rare-species retention, unreduced bioreserve area, and connectivity potential. This is also the only site where monitoring plant communities and ecosystem knowledge led to a change in management practices.

This process of change in management practices is the result of a three-step process: first undertaking inventories of site-specific plant communities; secondly analyzing ecosystem processes and receipt of recommendations to restore species interdependencies; thirdly analyzing human-use impacts and modifying them as needed to protect the ecosystem. This process was

[62] Adolf Ceska, "Rare plants of the Garry oak meadow vegetation, in Garry oak Meadow Colloquium 1993 (Victoria, B. C.): 25-6.

applied at Juan de Fuca. Firstly, successive plant surveys identified the plant communities at Juan de Fuca as being transformed from Garry oak—grasses—rare geophytes (bulb-forming species uncommon outside B. C., increasingly rare within B. C.) to Garry oak—Scotch broom. Secondly, other ecosystem processes were analyzed (by Ussery 1992 and 1999, and Erickson 1993-5), and recommendations made for systematic broom removal to restore plant and wildlife interdependencies. Stepping-stone connectivity among Juan de Fuca and nearby reserved meadows is another likely (but unstudied) ecosystem process. Thirdly, human activities (frisbee chasing) were monitored and revised to suit recommended buffer uses (hiking and jogging). A two-ring buffer zone was designed into the landscape which acts as an ecological step-down transformer: high-impact (vehicular traffic and buildings) uses are visually divided from natural areas by a ring of oaks within mown grasses; then a low impact recreational use (hiking/jogging trail, with signage) forms the inner buffer; finally broom-cleared meadow and rock bluffs provide renewed habitat for Garry oak plant communities.

These management responses included design, construction and post-occupancy (maintenance) strategies. Together, these strategies were able to have positive impacts on bioreserve conservation and renewal. Positive impacts of pre-design, design, construction and post-occupancy decisions on Garry oak meadow habitat are evident in the three components of the ARC of ecological quantities, as shown in the following chart.

AREA	RARE-SPECIES REPRESENTATION	CONNECTIVITY
Pre-design: Bioreserve established, leaving space between proposed building sites and the bioreserve.	**Pre-design:** Bioreserve is located at the interface of several ecosystems (ocean, coniferous forest, and meadow) which contributes to species richness, diversity of ecological processes, and prevention of rarity extirpation and extinctions due to those diverse processes.	**Pre-design:** Stepping stone connectivity vital to reintroduction of extirpated species, is found among Juan de Fuca, Mill Hill and Regional Parks, and Fort Rodd Hill.
Design: Bioreserve area is maintained by the two-ring buffer zone, which protects habitat from encroachment and damage by human uses.	**Design:** Rare species are protected by the two-ring buffer zone, which inhibits trampling of rare species by people and pets.	**Design:** The conserved space, at the interface of several ecosystems (ocean, oak meadow, and golf course) has a "blue space" (working greenspace) connection to nearby oak meadows.
Post-occupancy: Broom removal permits regeneration of the herb layer, and permits oak saplings to find sunlight and space to grow.	**Post-occupancy:** Broom removal enables rare species to find room to grow.	**Post-occupancy:** The Juan de Fuca oak meadow is currently protected from construction or land-use development, as are nearby Mill Hill Park and Fort Rodd Hill.

Impact of Land-Use Development Decisions on 'ARC' of Bioreserve Quantities at Juan de Fuca

The next five sites demonstrate the reverse: a lack of integration of plant community knowledge with ecosystem-processes analysis and the effects of human activity is traced to measurable declines in both the area of bioreserves, and the quality of habitats as evidenced by the decline in keystone species growth. These declines are demonstrated in this research as being related to decisions made during design, construction and project occupancy. The decisions made throughout all project phases on the five residential-use sites contribute to decreased area, rare-species representation and connectivity. Declines in bioreserve size are most marked in the oldest project (Lot A View Royal), where five years of occupancy have resulted in significant encroachment of human activities and invasive species. Declines in tree health due to direct damage inflected by construction machinery are evidenced on all five sites. Inadequate inventory for all sites has led to the destruction of pockets of rare geophytes. Removal of rare bulbs for commercial resale was noted on one of the sites. The negative impacts of design, construction and post-occupancy decisions on Garry oak meadow habitat on the ARC of ecological qualities are shown for each case-study site:

AREA	RARE-SPECIES REPRESENTATION	CONNECTIVITY
Pre-design: No buffer zone set aside.	**Pre-design:** No detailed inventory of plant species.	**Pre-design:** Mill Hill Park is connected to other parks, both directly and as stepping stones. The location of the developments distances Mill Hill from some stepping stones.
Design: Design and Construction oak reserves bisected and otherwise fragmented by roads and Structures.	**Design:** Rare species were not recorded on site plans, but do occur within Mill Hill Park.	**Design:** Small remnants are not connected; there is little opportunity for new plant recruitment from one fragment to another. Recruitment from Mill Hill Park may be possible.
Post-occupancy: Area of Garry oak meadow has been reduced by the development.	**Post-occupancy:** Development has removed most opportunities for geophytes.	**Post-occupancy:** Small oak remnants have no opportunity for post-occupancy connectivity.

Impact Of Land-Use Development Decisions On The 'Arc' Of Ecological Quality At Millwoods And Crystalview Estates

The absence of buffer zones for, and connectivity among, Garry oak meadow remnants is a direct result of site-planning decisions which first place houses and roads then designate remnant areas as landscape. Further, the landscape is seen as an amenity for housing, rather than a component of ecological rarity and diversity.

AREA	RARE-SPECIES REPRESENTATION	CONNECTIVITY
Design: The narrowness of the bioreserve creates an all-edge bioreserve, which exacerbates human-use and invasive species encroachment.	**Design:** Many plots of rare species disappeared under housing and roads, due in part to the absence of detailed plant inventories.	**Design:** The bioreserve strip is truncated at the north end by housing, which interrupts— the possibility of connectivity with the adjacent park dedication strip.
Construction: Large machinery and blasting created abrupt edge.	**Construction:** Large machinery and blasting disturbed rare-plant sites.	**Construction:** Subtrades hydroseeded invasive non-native "wildflower mix" all along park dedication edge, further severing park dedication from bioreserve.
Post-occupancy: Encroachments were dramatic; garden encroachments reduced the bioreserve to much less than its post-construction width.	**Post-occupancy:** Rare species have diminished from trampling, irrigation across bioreserve, shading from planted Douglas firs.	**Post-occupancy:** Area between bioreserve and park dedication was made into private garden of turfgrass and non-native plants.

The Arc Of Ecological Quality As Observed On Lot A

As seen in the case-study examples, changes in the Area, Rare-species representation, and Connectivity of settlement-impacted ecosystems can be directly correlated with decisions made during design, construction and project occupancy. Decisions which impact rare species communities begin with planning sites without detailed plant inventories; creating fragmented bioreserves which are too narrow to support rare species; placing buildings next to plant communities without buffers to mitigate human impacts; permitting large machinery and blasting to damage a far greater area than necessary; and not leaving "clues to care" (Nassauer

1997) for future occupants. Architectural processes and decisions are shown to have direct impact on ecological quality.

CHAPTER 5: ECOLOGICAL STRATEGIES AND THE ARC OF QUALITIES: AREA, RARE-SPECIES REPRESENTATION, AND CONNECTIVITY

This chapter will develop the interface between dynamic cultural and ecological systems, by weaving landscape ecology concepts with research evidence for their cultural acceptability. The organizational strategy for concepts is the ARC of qualities that both facilitate ecological health and are impacted by land-use development decisions. In review, the ARC (briefly introduced in the last chapter) is a classification system used within this research for three dynamic ecological processes: change in habitat AREA; change in RARE-SPECIES representation; and change in degree of habitat CONNECTIVITY; and all three processes are considered in relation to cultural processes. The results of the author's case-study research support the conclusion of others (Turner 2000, Dramstad et al 1996), that lack of communication among knowers (ecologists and other scientists), planners (architectural teams) and doers exists (land-use developers, contractors, site maintenance teams): clearly, a communications strategy is vital. To this end, the illustrated design strategies, grouped under the ARC classification system, are intended to deliver ecological strategies to land-use development teams 'in a way that is useful and memorable.

5.0 Derivation of The Arc System of Classifying Ecological Qualities

The system used to organize diverse ecological principles for use by design teams is objective-based, since the author contends that architects make decisions based on stated objectives towards which their designs will strive. Indeed, architectural teams often include a myriad of objectives in their design decisions, and multi-objective programming requirements must be resolved. As mentioned earlier, K.D. Rothley presented systems for resolving multiple ecological objectives. In his review of historical and ecological reserve design, Rothley found that the three most common criteria in identifying ecosystem networks are diversity, rarity and naturalness. Rothley extrapolates from these three attributes alternative characteristics that can be assigned without the detailed sampling and analysis required for diversity, and without the subjective quality of the term naturalness. Since reserve size has been shown to be related to both species diversity and the prevention of extinction,[63] Rothley replaces diversity with area. Further, since *naturalness* is most appreciated when one doesn't have to move from the natural area through patches of urbanity, Rothley replaces naturalness with connectivity. Connectivity, an ecological principle researched in many scientific papers, is also referred to in parks planning. For example connectivity meets the naturalness vision of the Green/Blue Spaces strategy gradually being implemented by Capital Regional District Parks, in which connected greenways will emphasize the image of "wilderness at Victoria's doorstep."[64] The third criteria, *rarity*, is a value also adopted by the British Columbia Ministry of Environment, Lands and Parks. Indeed, protection of rare species is urgent, since rare species are those in danger of extirpation or extinction, and while current rates of extinction (with human-caused changes) are estimated to be between four thousand and twenty-seven thousand per year.[65] (By contrast, extinction rates are estimated to occur naturally [without human intervention] at a rate of less than one per year).

Using the above arguments, this research groups ecological principles according to how they improve or maintain the *area*, *rarity*, or *connectedness* of the adjacent conserved ecosystem. *Area*, *rarity*, *connectedness*—an ARC of qualities—must, however, be recommended in a way

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[63] R. H. MacArthur and E. O. Wilsons *The Theory of Island Biogeography*, Princeton: Princeton University press, 1967.

[64] "Celebrate our success: progress report on *The Green/Blue Spaces Strategy*, CRD parks Newsletter Number 3 (July 1999): 2.

[65] Kempton et al, 27.

that can receive sociological and cultural acceptance.[66] Since sociological and cultural factors affect the acceptance and ultimate success of landscape ecology solutions,[67] this chapter integrates ways in which the ARC of principles can be applied with cultural acceptance and long-term success. The approach of this chapter is to bring the peri-urban cultural context (from literature and case-study observations) together with landscape ecology design principles, to produce a set of usable design strategies.

5.1 Design Principles Which Help to Maximize The Area of Bioreserves

When an architectural team is selecting parts of a land-use development site to remain as a repository for native plant communities, the first ecological consideration is to maximize the area of open space containing native plants. Since Landscape Ecology recognizes the correlation between large-size bioreserves and the number and variety of species,[68] numerous ecological references have coached designers to reserve one large area, as opposed to several small fragments. The basis of this instruction is the 1967 "Theory of Island biogeography,"[69] in which MacArthur and Wilson showed that a large bioreserve area enhances species diversity, and reduces extinctions.

Figure 34. Large bioreserve enhances diversity of species and reduces extinctions.

[66] Rothley 742.
[67] Nassauer 162.
[68] Wayne Erickson 300.

However, the "maximized area" principle has not remained unchallenged. Evidence has also been presented that the money spent to acquire large reserves may deplete limited resources available for on-going monitoring and management.[70] An application on South Vancouver Island is noted: Capital Regional District (C.R.D.) Parks attests to the high cost of invasive species removal in medium-sized or large parks such as Mill Hill, as compared with successful removal programmes in the relatively-small reserve at Juan de Fuca Recreation centre.[71] Nonetheless, correlations between diversity of species and larger bioreserve area have been documented to be partially due to the sizable amount of interior habitat as opposed to edge habitat, found in single, large woodlands. Plants and animals that require an interior habitat tend to be less commonly found in peri-urban environments because suburban fragmentation of open space leads to a decrease in the amount of interior woodland or parkland. Moreover, the area of a bioreserve protecting interior species can only be measured as the amount of interior habitat conserved. Interior habitats are less common where the open space is fragmented into small patches (Spirn 1982, Schmid 1996).[72]

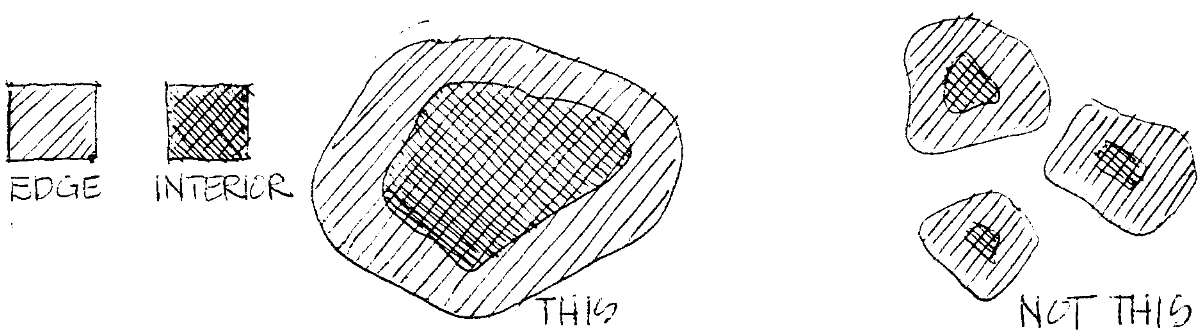

Figure 35. A large, single patch generally offers a more diverse mix of edge and interior species.

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[69] MacArthur and Wilson 1967.

[70] E. Russell, "The use of theory in land management decisions", *Biological Conservation* 37 (1994): 263 - 8.

[71] Interview by author with CRD Parks, December 1999.

[72] Patch is defined in Dramstad et al (1996: 19) as a habitat which exhibits some degree of isolation from similar habitats, the effect and severity of such isolation being dependent upon the species present.

The more stable nutrient and moisture regimes often found in interior habitats result from the edge habitat serving as a buffer to shelter interior zones from drying winds and nutrient transformations; stability of interior habitat, in turn provides conditions needed to sustain and germinate many rare plant species.

Animals that facilitate plant recolonization may also prefer interior habitats, in which wind and sun have different effects than on woodland edges. Wind "buffets edge trees, enhances seed dispersal, alters temperature fields, and changes soil moisture by increasing evapotranspiration."[73] However, these woodland-edge effects and dynamics change when they are observed in landscapes containing or adjacent to architectural interventions. Woodland edge environments adjacent to peri-urban settlement are contrasted with isolated woodland-edge environments in the diagrams below:

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[73] J. W. Ramney, M. C. Bruner and J. B. Leverson, "The importance of edge in the structure and dynamics of forest edges", *Forest Island Dynamics in Man-Dominated Landscapes* eds. Robert L. Burgess and David M. Sharper New York: Springer-Verldg, 1981):69.

Major influences on plant habitat in bioreserve edges next to peri-urban environments:

- Trampling.
- Recolonization by invasive non-native plants.
- Watering and fertilizing.
- Deliberate removal of plants.[74]

Major influences on plant habitat in isolated bioreserve edges.

- Wind alters temperature.
- Solar radiation increased, hydrology affected.
- Recolonization by native plants of adjacent patches.

Figure 36. Contrast between peri-urban edge and woodland edge effects.

Edge habitats, which occur more abundantly in fragmented bioreserves than in large bioreserves have been found to be less-conducive to the presence of rare species than interior habitats. The author found evidence within the six case studies for reductions in rare species near bioreserve edges. For example, it was observed that rare geophytes could only be found more than twenty feet from the edge of conserved native plant communities on the townhouse sites in View Royal.

[74] Nancy Turner II.

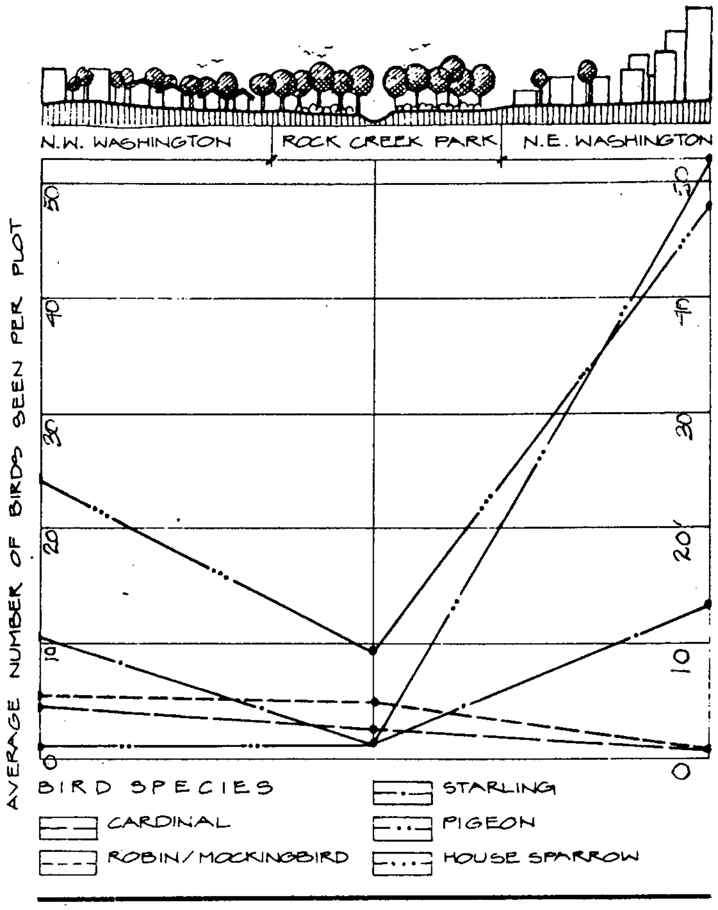

Figure 37.

Correlation between bird diversity and abundance and urban landscape in Rock Creek Park and adjacent Washington, D.C., neighborhoods. Songbirds, common within the park and landscaped neighborhood to the west, are rare in the barren, densely settled neighborhoods to the east. Pest species are far more prominent on the east.

Reasons for this decline in rare species near human-influenced bioreserve edges were offered by Carmen Cadrin during ecological surveys of southern Vancouver Island. In her inventories undertaken for B.C.C.D.C. in the 1990's, Cadrin observed that human factors generally led to more invasive species and reduced diversity of native species in unbuffered reserve edges.[75] Another reason is given by Landscape Architect Alison Spirn. Spirn records the correlation between bird diversity and abundance and the distance from densely settled neighbourhoods. The graph at left, reproduced from Spirn's study, also shows that the architectural layout of densely- populated, built-form-dominated neighbourhoods negatively affect the abundance of birds, whereas landscaped low-density housing contain a greater abundance of birds. In the graph, increases in urban density are also shown to be positively-correlated with introduced species and negatively-correlated with the more rare (and, opines Spirn, culturally - desirable) robins, mockingbirds, cardinals, catbirds, blue jays, song sparrows and wood thrushes.[76]

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[75] Carmen Cadrin, "Inventory of Garry oak Plant communities in British Columbia :from 1993 Symposium: 83.

[76] Spirn 220 - 3.

Using the results from Spirn's study, one may further describe the "area" principle for peri-urban woodlands as the need to set aside single large areas which offer the greatest proportion of interior habitat, with the width of the surrounding edges variable depending, in part, on the site-coverage, uses, and density of nearby architectural structures. This extension of the "area" principle defines a variable edge, or buffer, which has a width which increases proportionally with adjacent land-use densities.

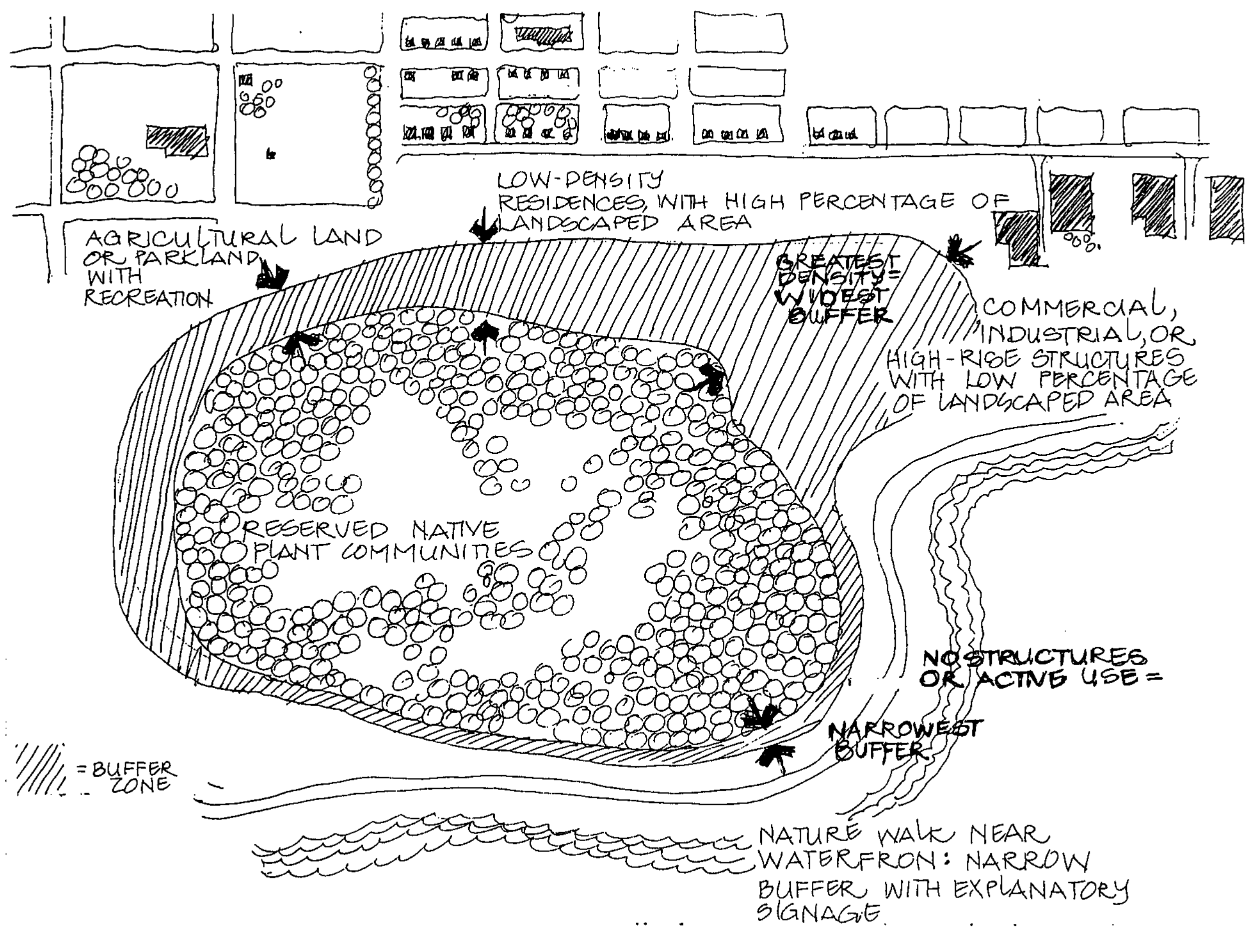

Figure 38. Buffer width increases proportionally with density of adjacent land-uses.

As argued in the Theory of Island Biogeography (MacArthur and Wilson 1967), single large areas are generally better at preventing extinctions and maintaining species diversity than several smaller ones; however, other factors may take priority over the principle of large area. The ability to control invasive species, rare species representation, the role of the reserve in the creation of greenways, and the nature of adjacent peri-urban uses may all influence decisions as to how to relate land-use developments to bioreserves. When planning for native-species conservation, it is important to identify tradeoffs between different conservation strategies and objectives.[77] One consistent objective, however, is to maintain the area of a peri-urban bioreserve over time: ensure that adjacent human uses do not encroach on the reserved area, thereby gradually reducing the space where native plant communities can flourish.[78]

SCOTCH BROOM OUTCOMPETES MANY NATIVE SPECIES.
Joel Ussery photo

URBAN ENCROACHMENT IS A MAJOR THREAT TO GARRY OAK ECOSYSTEMS. *Joel Ussery photo*

Figure 39. Threats to Garry oak ecosystems; exotic invasives and urban encroachment.

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[77] Rothley, 742 - 4.

[78] This principle is derived from the author's View Royal case studies, in which several examples of encroachment of architectural interventions into land set aside for native plant conservation may be found.

To minimize human encroachment, and to define the width of edge habitat relative to architectural density, buffer zones are proposed. Successful design characteristics of buffers, defined in this work as spaces to reduce the impact of human activities on bioreserves, have been evolved from literature and from observation. The dynamics of buffering edges depend on their spacial and functional characteristics, such as tree canopies, edge shapes, and peoples' activities on adjacent landscapes.

Research on forest recolonization of landscapes indicates that edge structure and dynamics are affected by the positioning of buffer strips relative to the canopy of trees within the reserved area. The following diagram paraphrases the empirical research of 1981 undertaken on forest edges by Ranney, Bruner and Levenson:

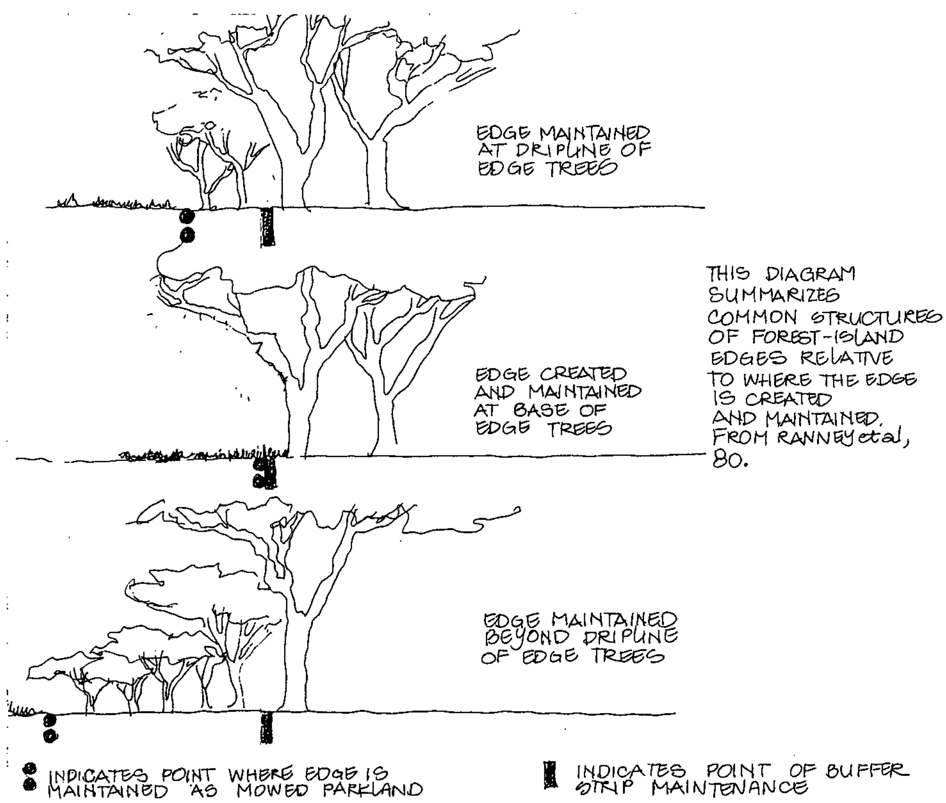


Figure 40. Structural complexity of edge.

Secondly, convexity or concavity of woodland edges have been shown to affect the migration of new species across the edge; as demonstrated by Hardt and Forman in their study of edges of reclaimed surface mines:[79]

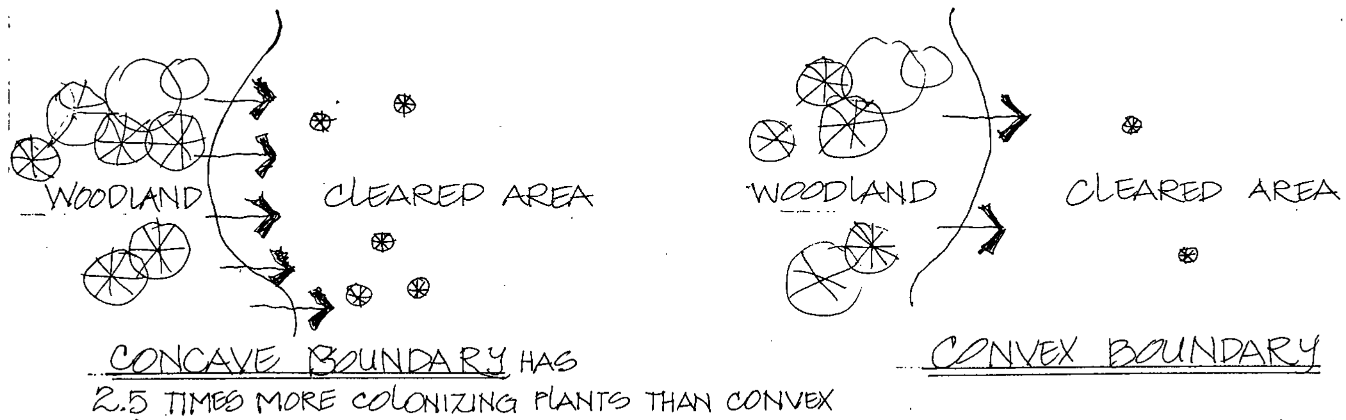
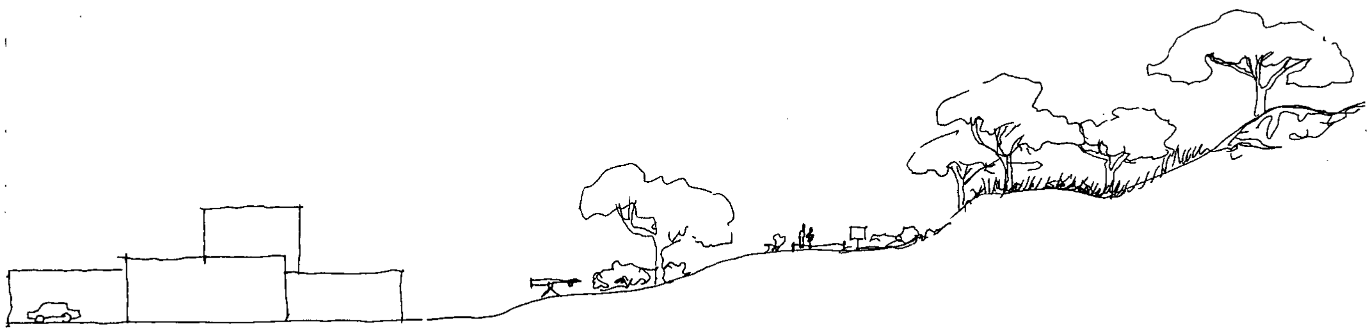


Figure 41. Concave boundaries enhance plant colonization.

However, the author's observations would suggest that human factors outweigh either of the above edge qualities, when the study sites are within a peri-urban context. More important than edge shape and placement are factors such as minimizing changes to topography within the buffer zone, eliminating the use of pesticides and chemical fertilizers, and systematic invasive-species removal. These three factors are listed by the B.C.C.D.C. for buffers between agricultural land and conservation areas, and it is argued here that the same factors may be applied to buffers between land-use development and conservation areas. To do so addresses concerns that bioreserves be buffered from damage due to human uses, particularly construction and land-use development. Examples of damage to native plant communities in the absence of buffers is shown in Figure 25,an aerial photograph depicting residential uses next to Mill Hill Park. To contrast the Mill Hill Park example, an edge that avoids topographic or chemical changes is shown in the aerial photograph of Fort Rodd Hill (Figure 47).

[79] Richard A. Hardt and Richard T. T. Forman "Boundary Form Effects on Woody

The diagram below summarizes these initial design characteristics of the edge, or buffer, between human uses and native plant communities.

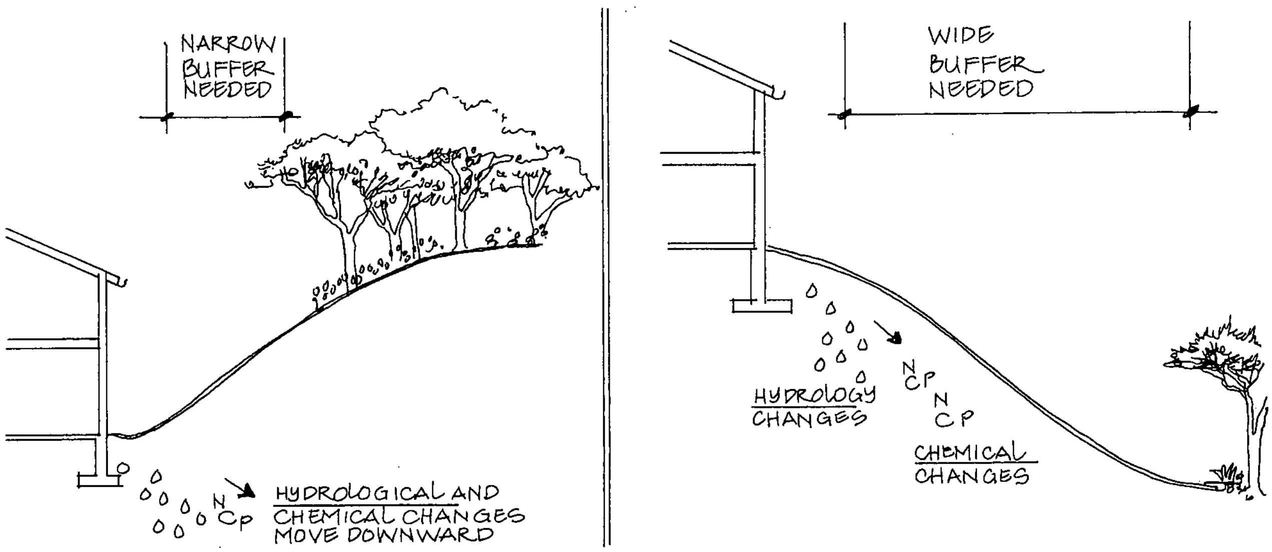


HUMAN USES	BUFFER ZONE	RESERVED NATIVE BIOTA
• Topography altered for buildings, access.	• No changes in Topography.	• No change in topography.
• Chemical changes (Pesticides, fertilizers, construction. Materials' leaching)	• Filters chemical changes caused by nearby human uses.	• Soil chemistry changes as part of natural process (e.g. Leaf litter decomposition.)
• Introduced plant species dominate in many gardens.	• Removal of invasive plant species.	• Native plant communities are conserved and restored.

Figure 42. Buffer zone between human uses and bioreserve.

Colonization of Reclaimed Surface Mines", Ecology 70 no. 5 (1989): 1252 - 60.

Additional design characteristics for buffer zones have been developed through observations on the case study sites, and the author's interviews with ecologists. Observations on the case-study sites indicate that buffer zones needed to protect rare plant communities growing on a hillside above human uses are narrower than buffers for plant communities on a down-slope below human uses:[80]



Human uses below bioreserve:
Narrow buffer

Human uses above bioreserve:
Wide buffer

Figure 43. Narrower buffer zones on a hillside above human uses.

Buffers need to be designed so that conserved biota are protected from damage due to invasive plant species, trampling by people and domesticated animals, fertilizers, pesticides, and hydrology changes.[81]

[80] This observation was also noted during an interview by author with Joel Ussery, CRD Parks, December 13, 1999.

[81] Ussery, Joel, "Managing Garry oak Meadows for Conservation", in Hebda: 67.

When planning a site to retain some space for ecological uses, architectural teams need to find ways to plan human uses more efficiently in order to leave space for buffer zones and native plant reserves. Minimizing the area required for automobile storage and circulation helps to retain open space. The reserved open space, in turn, offers visual, cultural and ecological amenities.

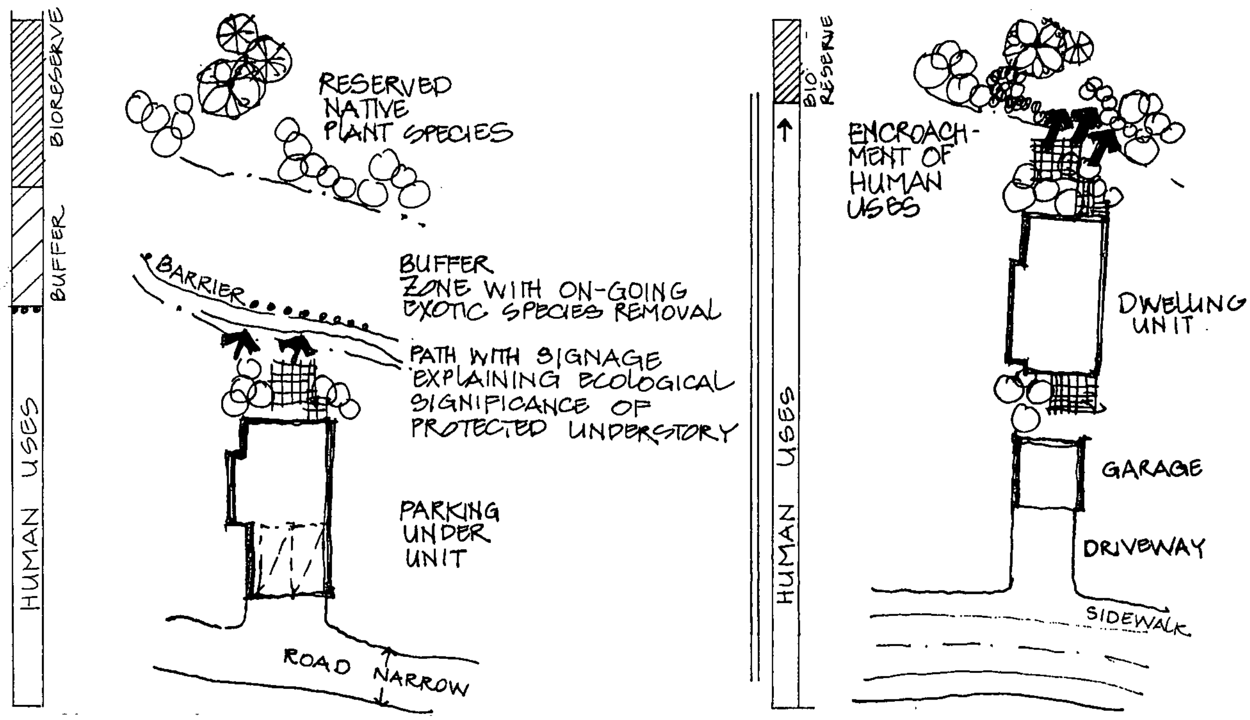


Figure 44. Efficient planning of human uses leaves space for buffer zones.

An example of this can be shown by contrasting two separate multi-family developments in the View Royal Portage Park case study. One townhouse development followed municipal requirements for long (7.5 meter) driveways; the later project of the same density proposed very short driveways (averaging two meters). A relatively large bioreserve was accommodated in the second project, whereas the first project left highly fragmented, quickly degraded pockets of oak and arbutus. Little understory survived in the project with long driveways.

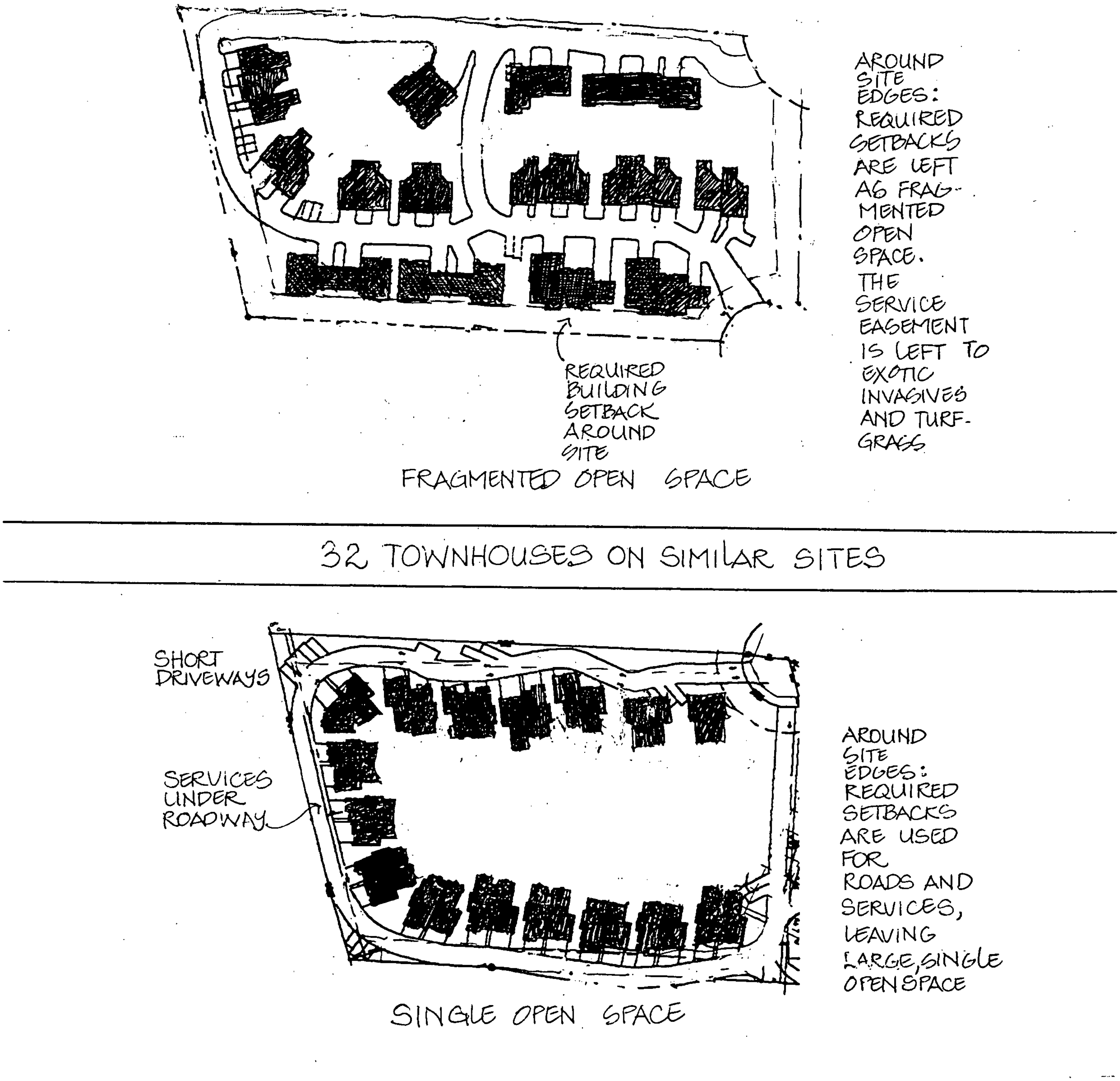
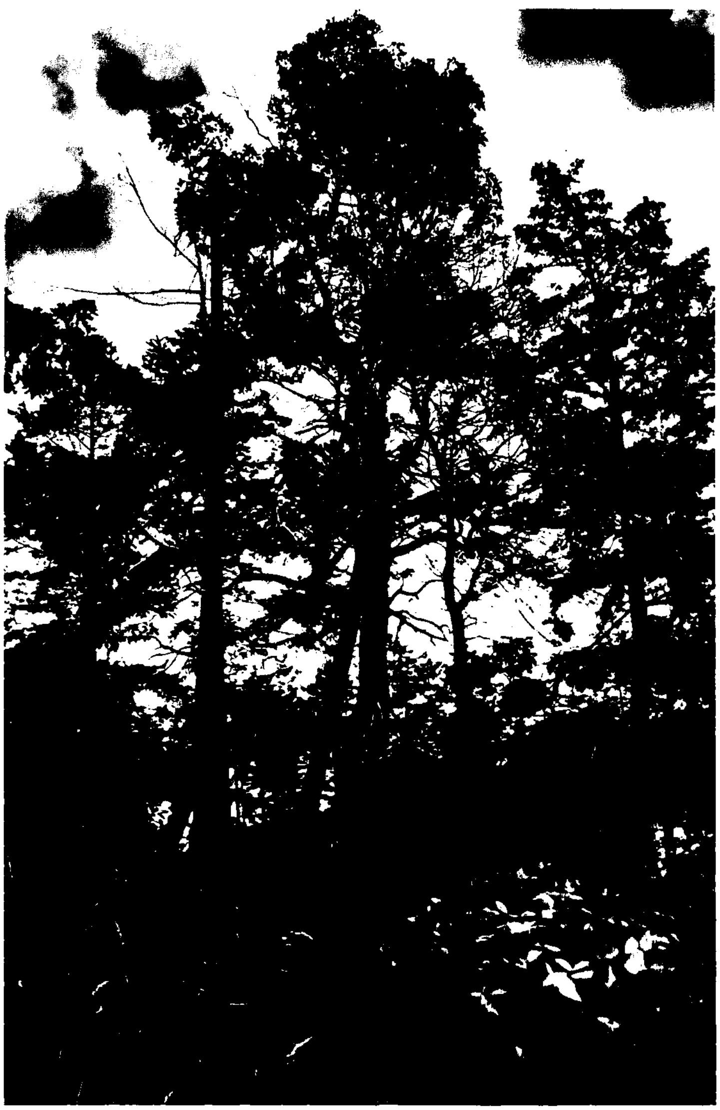


Figure 45. Remnant open space in a project with long driveways is smaller than open space within a project with short driveways.

Biogeography research indicates that the shape of bioreserve area affects the diversity of species, and that the optimal shape for bioreserves is wide rather than linear.[82] Observations on the View Royal case study site support this dictum. On Townhouse Site A, gardens and other human uses moved into plant communities more quickly when the adjacent native-plant reserve is linear rather than wide, possibly because narrow greenspaces leave little room for buffers. This effect is shown in photographs and diagrams:



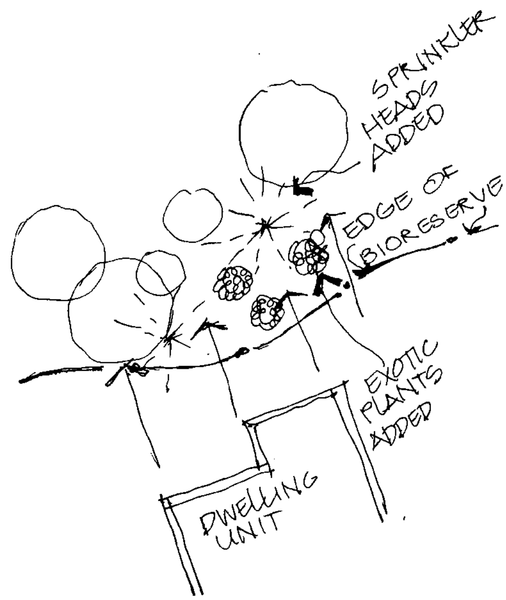


Figure 46. Narrow greenspaces leave little room for buffers to disturbance or encroachment.

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[82] Spirn 1984, 219.

In some cases, however, a linear bioreserve within a land-use development site may serve as a link between larger bioreserves with similar vegetation composition, within or beyond site boundaries. In this case, a linear bioreserve may help to connect islands of vegetation. (Dramstad, Forman & Hartley 1996) The associated buffer zone, also linear, may be edged by a trail with signage explaining the ecological significance of the protected understory, as at Fort Rodd Hill.

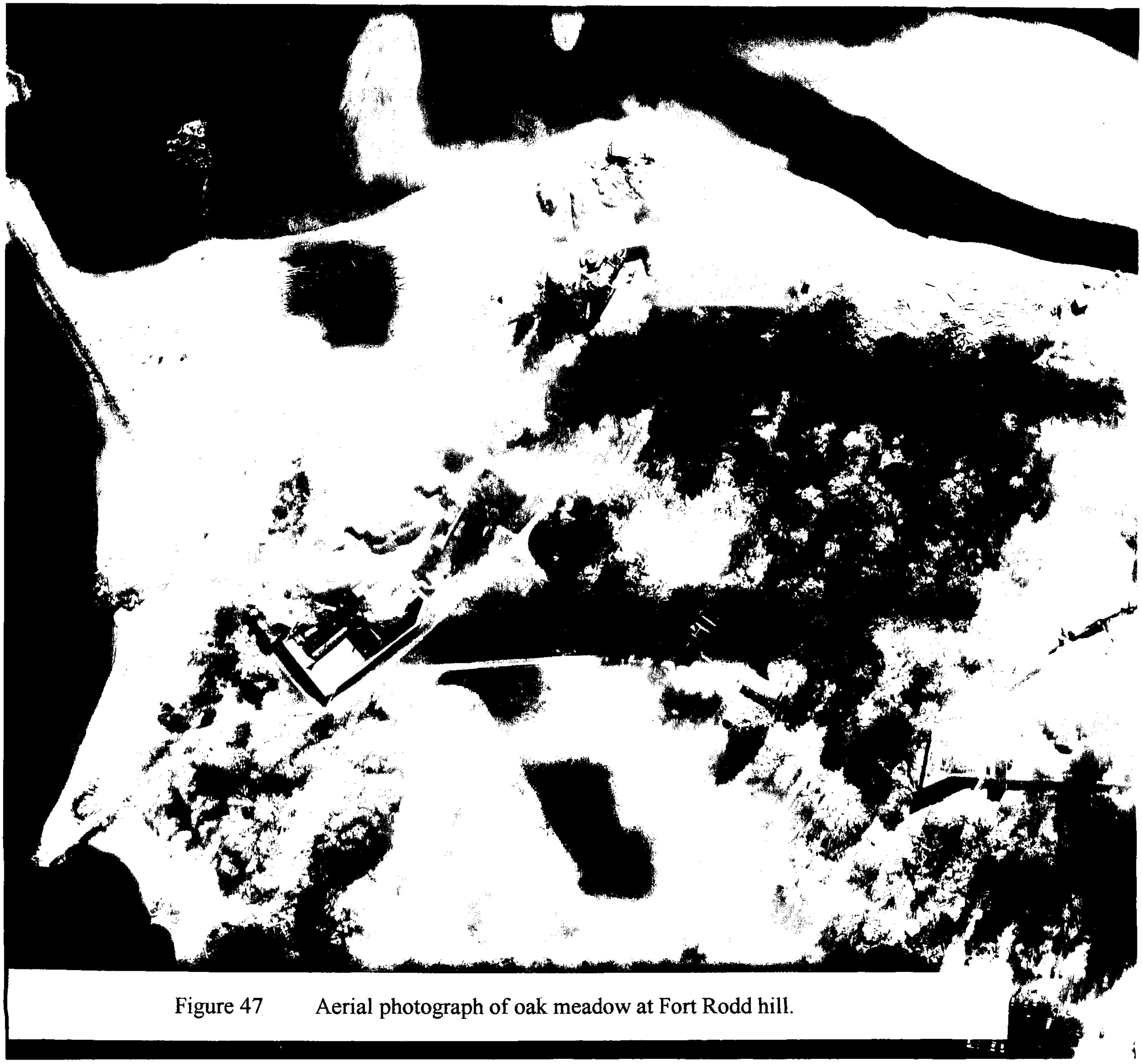


Figure 47 Aerial photograph of oak meadow at Fort Rodd hill.

5.2 Design Principles to Support Retention of Rare Species In and Around Development Sites

Rare-species representation is reliant on careful inventory of developable land. A designer may only choose not to build on a part of a site if it is known that portion supports Red-or Blue-Listed species, or is adjacent to a bioreserve containing rare species whose survival may depend on qualities provided by the adjacent land-use development parcel. Inventories can resolve conflicts between which portions of a site should be set aside for bioreserve or buffer.

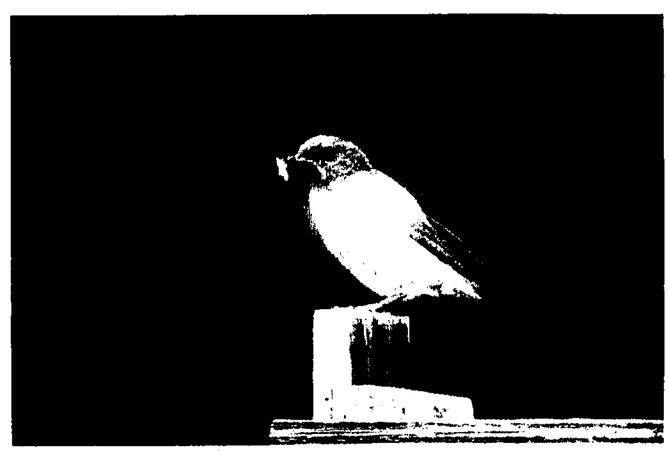
Another way to retain rare species on a land-use development site is to lift rare bulbs, shrubs and perennials from excavated areas; and use them to replant the site after completion (Kruckeberg 1982). Design teams may specify this procedure, while ensuring that the replanted species will have suitable soil, microclimate and hydrology.

EARLY SPRING FLUSH OF CAMAS AND BUTTERCUP IN A HEALTHY GARRY OAK ECOSYSTEM. *Graham Osborne photo*

H. ROEMER

GOLDEN INDIAN PAINTBRUSH (Castilleja Levistica) IS NOW FOUND ONLY IN ECOLOGICAL RESERVES

HORNBY ISLAND'S GARRY OAK ECOSYSTEMS ARE HOME TO THE RARE TAYLOR'S CHECKERSPOT BUTTERFLY. *Trudy Chatwin photo*



WESTERN BLUEBIRDS HAVE VIRTUALLY DISAPPEARED FROM THE OPEN WOODLANDS OF SOUTHWESTERN B.C. *Steve Cannings photo*

Figure 48. Rare or extirpated species in British Columbian oak meadows.

Saving rare bulbs, shrubs and perennials raises problems. The first problem is spatial: construction sites are often fully utilized with maneuvering zones for large trucks, material storage; and fabrication space. The second problem is economic: the resale value of native bulbs and perennial is substantial, so the more lucrative landscaping solution is to sell the expensive native material to nurseries or private users, and replant the construction site with seemingly less-expensive, and more floristic exotic nursery stock. Design teams may assist in three ways. They may propose a spatial solution for native plant storage during construction, ensure that the native plant restoration is part of the permit process secured by a landscape bond held by the municipality until restoration is complete, and emphasize the cost-saving benefits of native plant material: less fertile soil is required (Kruckeberg 1982) and no irrigation is needed.

Many of the rare species in Garry oak plant communities are found in the understory rather than among tree populations. In saving understory plants, architectural teams "establish the most critical problems of its plant communities and establish priorities for their resolution."[83] Within Greater Victoria "There will always be oaks" opined Joel Ussery of CRD Parks[84]-but many understory plants are on a downward spiral toward rarity and extirpation.

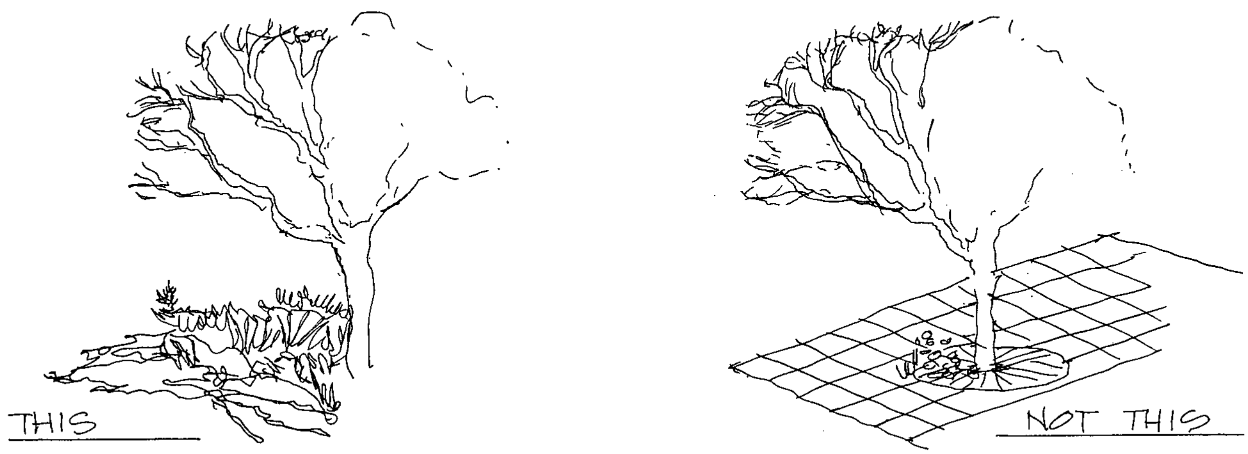


Figure 49. Conserve both the understory and the tree.

An important objective is the conservation of entire plant communities. This objective requires a different architectural response than the more common conservation strategy of saving existing trees among roads, buildings, and services. The architect needs to identify sizable areas of native plants that are to be left undisturbed. Construction fencing is needed to ensure protection from machinery and vehicles.

[83] Spirn, 260.

[84] Interview by author at Mill Hill Park with Joel Ussery, CRD Parks, 13 December 1999.

Further, the buffer zones noted earlier need to be planned as an integral part of a land-use development. Functions of the buffer zones are specified, and may include propagation space for rare plants, educational walks, garden space adding aesthetic interest to the less-appealing ecological reserve beyond. As a maintenance measure, end-users should be advised that rare plants have a greater chance of survival when buffer zones are kept free of invasive species (Ussery, 1993).

Once gorse becomes established it can be very difficult to control. Gorse is best controlled by not providing it with an opportunity to become established.

Figure 50. Maintain buffer zones to be free of invasive species.

5.3 Design Principles Which Maximize Connectivity

By linking one small island of an ecosystem with another similar island, a wildlife corridor may be created, which in turn may assist in the dispersal of seeds and in the number and variety of species that can thrive.[85] The ecological function of connectivity is endorsed by the cultural support for connected greenspace: people feel they are truly experiencing nature" if they don't have to cross a road or subdivision. The cultural and ecological value of connectivity leads to such Parks strategies as the Green Blue Spaces strategy of Greater Victoria, which includes numerous community-led projects to improve and expand (natural) and Blue (semi-natural) areas

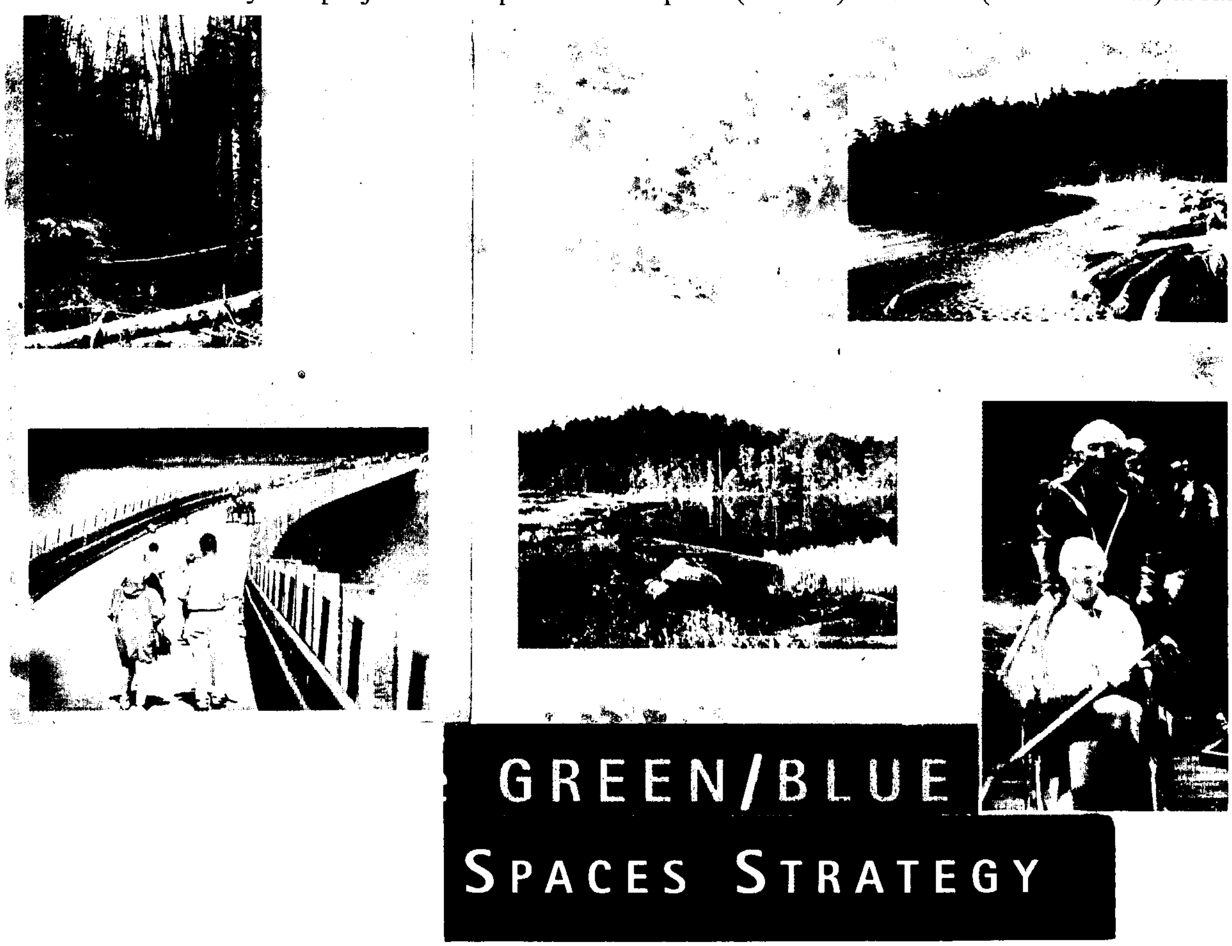


Figure 51.

[85] Dramstad, Wenche E., D. Olson and Richard T. T. Forman, Landscape Ecology Principles in Landscape Architecture and Land-Use Planning, Washington D. C.: Island Press, 1996:35.

[86] "Celebrate our success: Progress report on the Green/Blue Spaces Strategy", CRD Newsletter No. 3 (July 1999): 2.

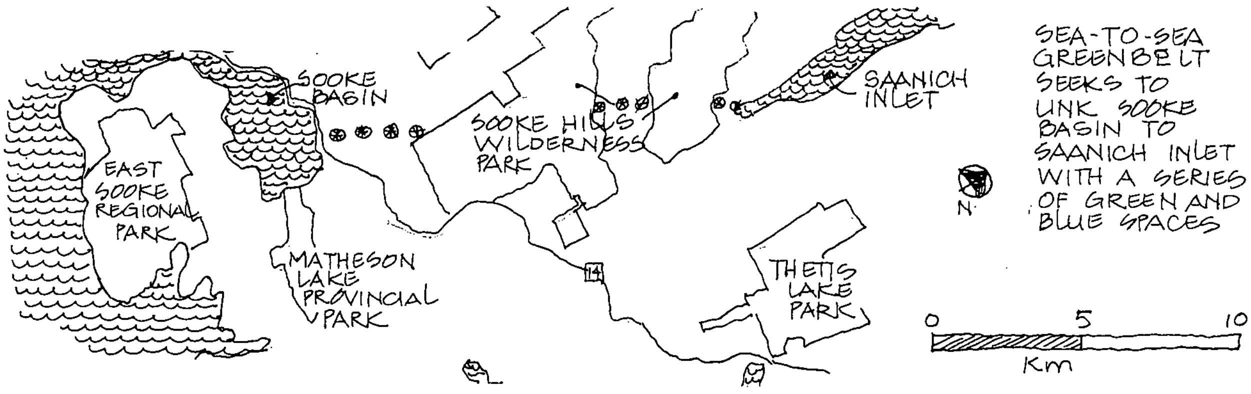


Figure 52. Sea-to-sea Greenbelt proposal.

Linkages among open spaces have proven ecological benefit (Forman 1996, Sauer 1998). However, when an open space corridor takes the form of a roadway or powerline right-of-way, this connection may act as a barrier to species movement and a reduction in the self-sustaining diversity of plant populations (Dramstad et al 1996).

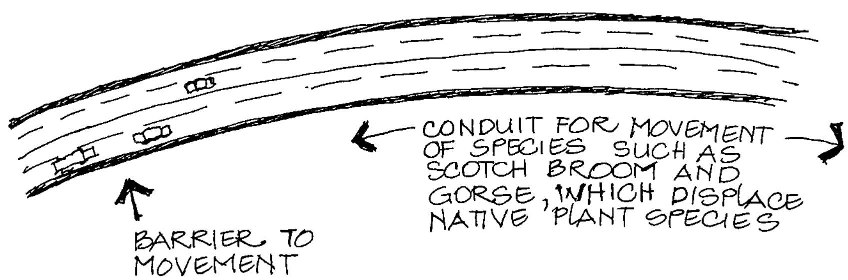


Figure 53. Roadways as barriers to species movement.

In other cases, a powerline may be a remnant meadow, and cutting down large evergreens within the right-of ways has been known to permit the growth of rare, sun-loving meadow species. To assess whether a site can contribute to connected greenspaces of a region, a designer needs to consider relationships between the land-use development site, and the patterns of vegetation of surrounding areas. Data on surrounding sites is assessed by aerial photographs, visual analysis, and surveys provided by agencies such as the Sensitive Ecosystem Inventory or the Conservation Data Centre. Plant communities of similar composition are then linked with linear hedgerows of vegetation, or by stepping-stone connectivity. Linear connectivity is useful when existing land-use developments preclude the provision of one large area. Stepping-stone connectivity can be a way to provide connectivity when a continuous hedgerow or other connection is impossible due to existing uses.

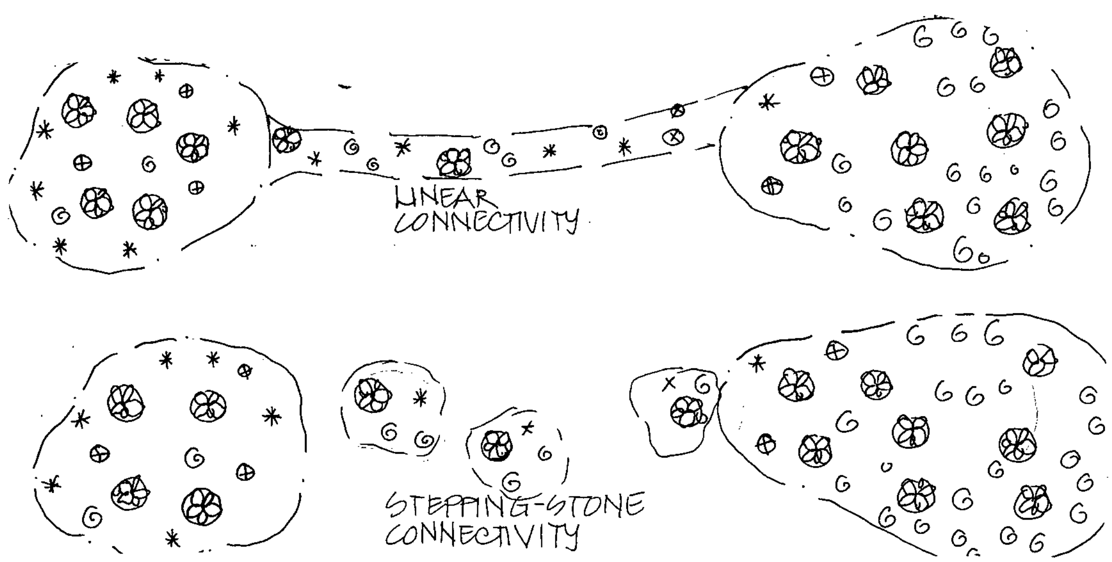


Figure 54. Linear and stepping-stone connectivity.

Connectivity accommodates "flows of energy, materials, or species across heterogeneous ecosystems" and is "an essential property of the landscape scale."[87] Landscape scale is that scale which is large enough to permit ecological processes to occur, and is relative to the biota in the landscape. In the case of Garry oak ecosystems, Carmen Cadrin declares the minimum landscape scale to be at least 0.25 ha.[88] Since service easements often interrupt landscape connectivity, trenchless technology can be considered. Trees and shrubs can grow undisturbed over services that are tunneled far below the surface:[89]

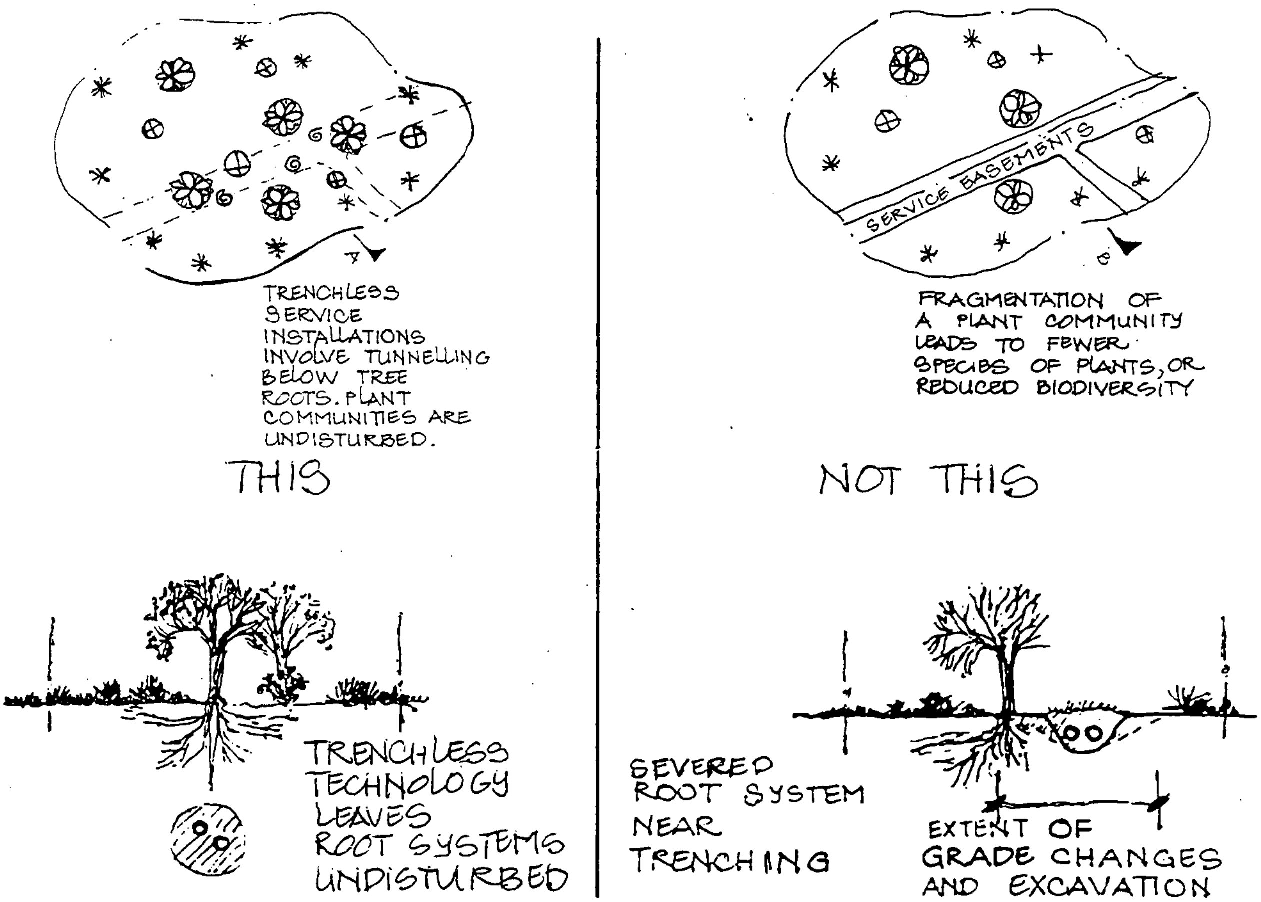


Figure 55. Trenchless technology reduces habitat fragmentation and rare species losses.

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[87] Joan Nassauer, "Cultural Sustainability: Aligning Aesthetics and Ecology" in Placing Nature: Culture and Landscape Ecology (Washington D. C.: Island Press, 1997): 73.

[88] Cadrin, 84 However, there is also an appeal in Landscape Ecology for small-scale ecological conservation. See 5.3.

[89] "Trenchless Technology", in Journal of Commerce (May 3, 1999): 3 - 6.

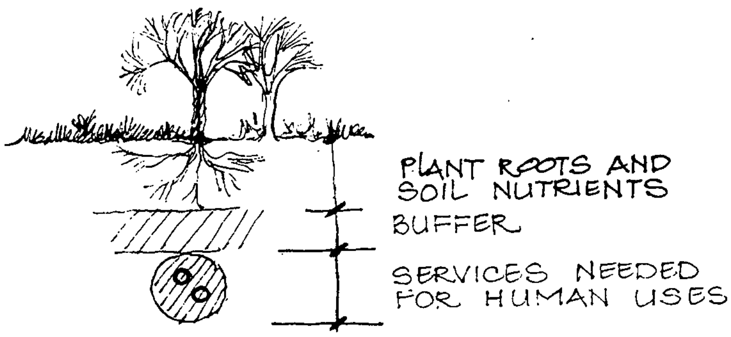

Figure 56. Trenchless technology affords a vertical buffer between human uses and bioreserves.

To comprehend ways of connecting Oak meadows, an architectural team may need to define the nature of connectivity to maintain the diversity of species that exists in the system. For example, species movement may occur between meadows that seem to be isolated islands, if the interjacent landscapes have characteristics that permit seed dispersal and other ecological processes.[90] While there is a shortage of data to measure the resistance of landscapes to species movement,[91] the Knaapen et al research and the graphs by Spirn (1984, reproduced earlier in this chapter), indicate that a high site coverage and high density of architectural uses offers more resistance to species movement than landscaped yards, woodland and forest.

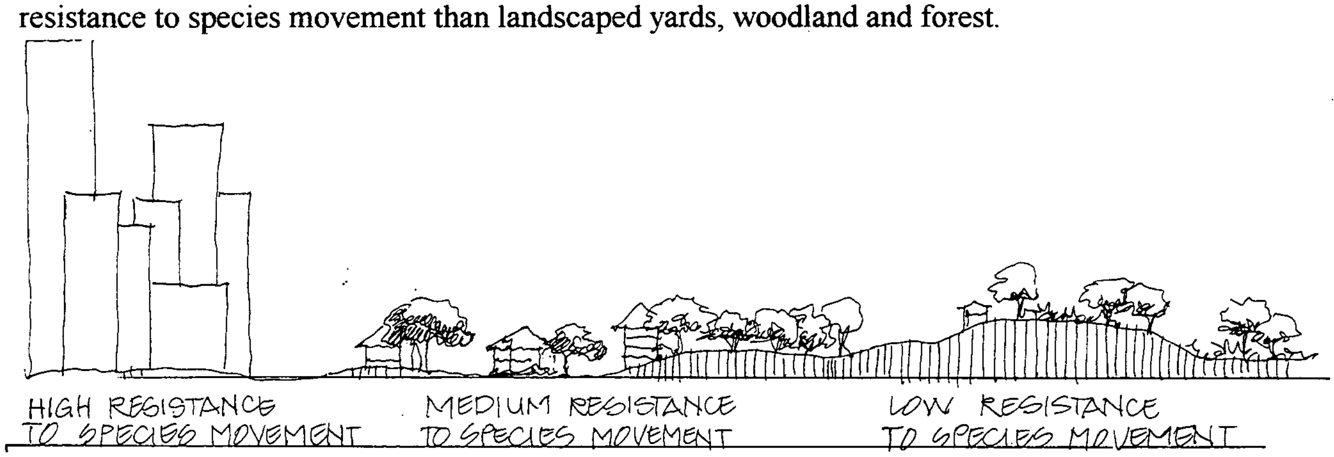

Figure 57. Site-coverage and density of land-uses affect resistance to species movement.

[90] Jan P. Knaapen, Marten Scheffer and Ben Harms, "Estimating habitat isolation in landscape planning", Landscape and Urban Planning 23 (1992) 1 - 16.

[91] Ibid.

5.4 Hydrology, Microclimate, Soil Chemistry and Other Less Visible Site Conditions

In order to assure the survival of entire plant communities, design teams must consider factors which are less visible on a plan: specific site conditions such as soil, micro-climate, and hydrology that maintain the health of native plants must be considered. Soil required for native plant community reconstruction is often less deep, and therefore less expensive to install, than conventional landscape soils (Kruckeberg, 1982):

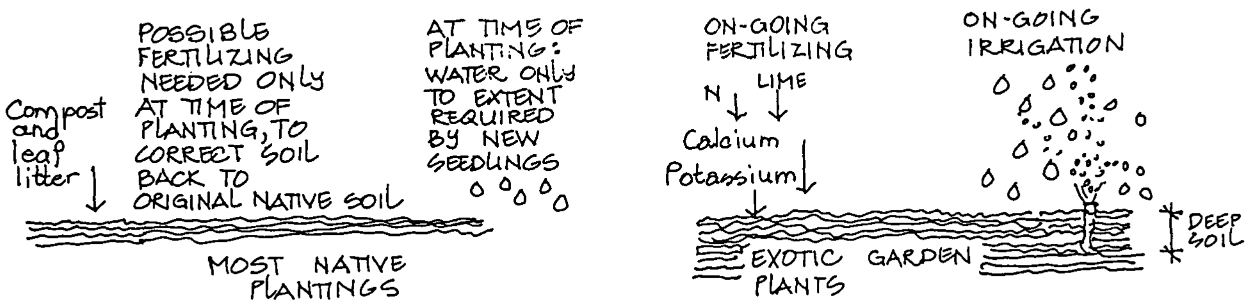

Figure 58. Soils required for native plant reconstruction are shallower than conventional landscape soil.

Micro-climates affect plant growth, and are often altered by building construction. "Effects of winds and solar radiation are paramount" (Ramney et al 1981:69) Conserving a rare plant community may rely, in part, on maintaining the amount of sunlight needed by those plants. In newly created edges, increased or decreased light intensity affects shade-tolerant plants differently from sun-loving species such as Garry oak.

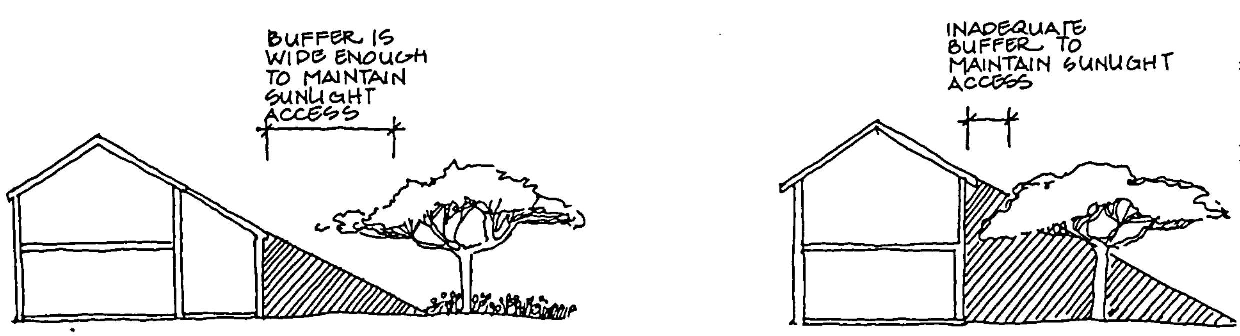

Figure 59. Buffers maintain sunlight access for native plant communities.

Hydrology and plant health are also interdependent. Garry oak plant communities are found in a variety of moisture regimes, but a change in moisture regime for any given community often leads to a decline in plant health.[92] The goal for design teams, therefore, is to keep water tables and moisture patterns as unchanged as possible. This is a difficult task, since the insertion of roads and buildings, and the associated changes in topography, nearly always affect the way water is carried across a site. Once again, the buffer zone can be of assistance:

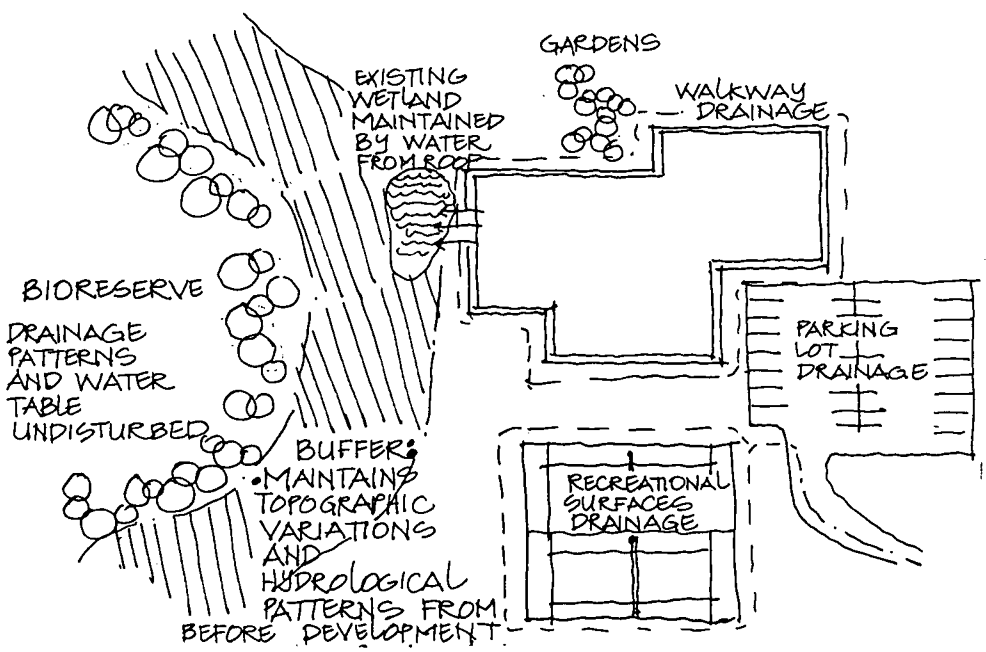

Figure 60. Buffers protect water table and drainage patterns of bioreserves.

During and after construction, footing drains and other subsurface drainage systems are often used to keep a site as dry as possible, which in turn makes irrigation seem necessary. Irrigation is not tolerated by most Garry oak plant communities.[93] Subsurface drainage systems need to keep site hydrology similar to pre-development conditions, in order to facilitate retention of rare Garry oak woodland and grassland.

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[92] Marilyn Fuchs, pers. com.
[93] Erickson

5.5 Factors Influencing The Acceptance of Ecological Principles: Evidence from Case Studies and The Literature Review

The insertion of architectural uses into rare peri-urban plant communities is one of the main causes of decline in the number and type of native species.[94] It is important that architectural teams address the need to protect the landscape required to support these declining ecosystems. Decline in native plant health is noted when architectural interventions directly abut bioreserves. Direct contact with human uses generally changes site conditions, which can in turn render the bioreserve incompatible to the rare species it was created to protect. Architectural teams may address this problem, in part, by designing buffer zones or "Orderly frames" which shield bioreserves from changes due to architectural intervention.

The orderly frame is a term coined, and discussed at length, by Nassauer. Because native landscapes are not necessarily scenic, Nassauer recommends rimming ecosystems with "bold, crisp bands"[95] of native plants that will drift into softer patterns over time but initially will introduce people to the aesthetic qualities of local plant materials. Other recommendations for buffer zones by the same author include using native plants with larger, brighter flowers (small flowered species tend to be seen as weeds), adding wildlife feeders to attract songbirds (Kempton et al found songbirds to be one of the most valued attributes of healthy ecosystems),[96] and using mowed native grasses as a filter between ecosystems and runoff from road and garden chemicals (mowed grasses are a culturally-accepted indicator of an orderly, well-tended landscape).

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[94] Hebda 1993, 5.

[95] Nassauer I, 168.

[96] Kempton et al 1996.

Buffer strips, or orderly frames, can be designed as part of a private land-use development, serving as a special-purpose project garden or open space. Another possibility for private land uses to contribute to native-species conservation is by the aggregation of several yards into a larger woodland or prairie, which can then provide additional wild life habitat while protecting native species in adjacent woodland. As Nassauer urges, "Now imagine that blanket of turf [of yards in a subdivision] replaced by cover that might exhibit greater ecological health."[97] This recommendation requires adjusting cultural expectations about the look of yards. One way to adjust the aesthetic of yard planting is through popular literature which shows successful examples of retained peri-urban plant communities (such as the aforementioned Western Living article) colourfully depicting a backyard oak meadow.[98]

Cultural acceptance of ecological change is evidenced in the case-study at Juan de Fuca, where a Frisbee court formerly circled the oak woodland. Realizing the detrimental effects of foot traffic chasing into reserved areas in search of an errant Frisbee, managers of the centre changed the uses of the woodland perimeter to jogging trails marked with explanatory signage about the adjacent ecosystem.

Private-use developments fared less well. Perhaps due to an unmarked edge between private gardens and bioreserves, residents have introduced irrigation, invasive species, overshadowing evergreens, patios and dog-runs into the area designated as protective covenant for native species.

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[97] Nassauer II, 72.
[98] "Take a deep breath of the Scent of Lilies", in Western Living 29 no. 3 (April 1999): 90.

To prevent such encroachments, landscape ecologists such as Nassauer have shown, through their landscape projects, that the orderly frame or buffer must convey its intended ecological function to adjacent users. Ecological principles applied to peri-urban settings are dependent, in part, on cultural factors. Architectural teams can assist in long term conservation of peri-urban native plant communities by considering both the ecological and cultural recommendations found in Landscape Ecology literature.

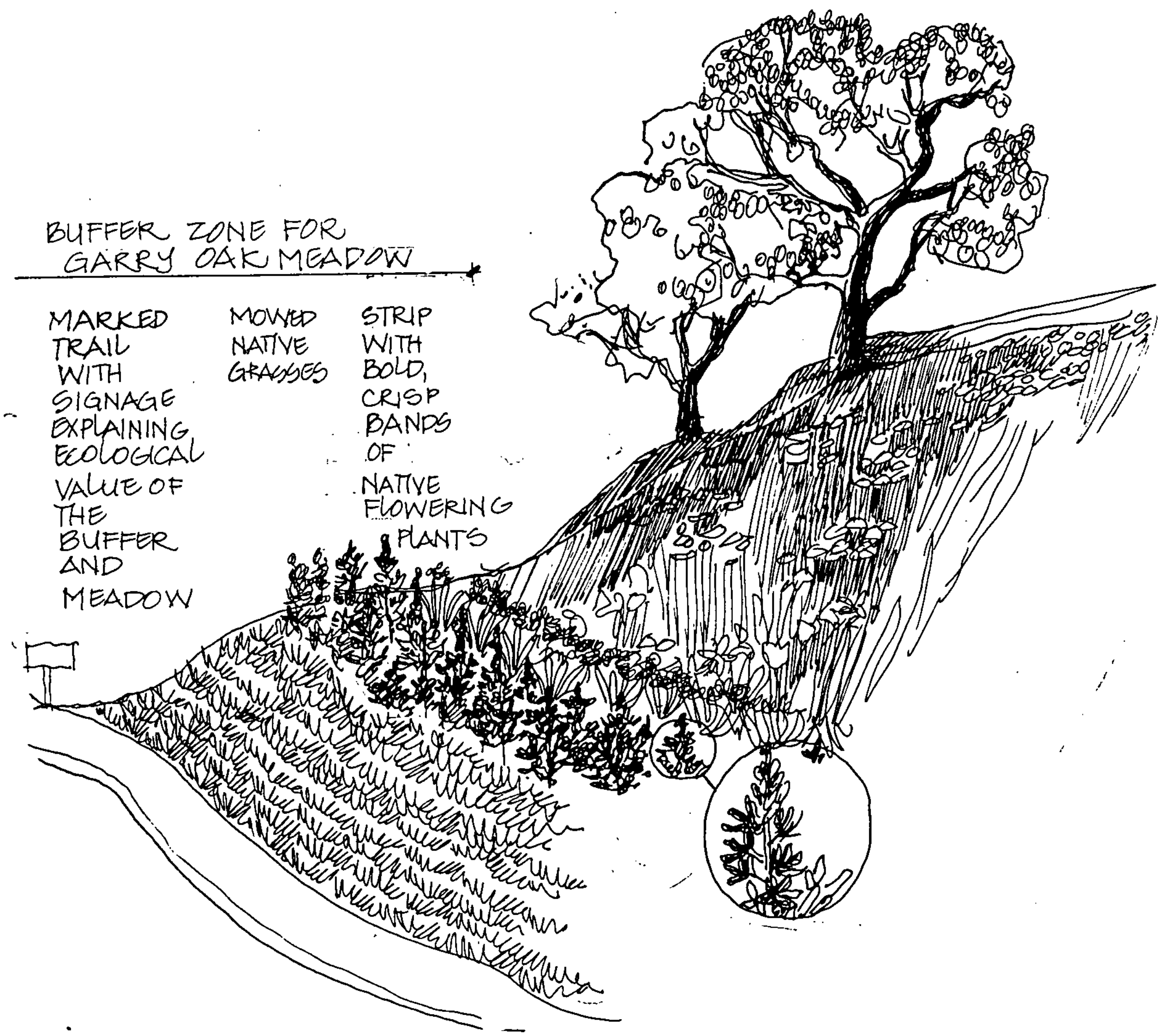

Figure 61. An "orderly frame" buffer for a Garry oak meadow.

CHAPTER 6: CONCLUSIONS

6.0 Timing of Applications of Ecological Principles

The treasures of oak meadows and other rare plant communities are irreplaceable. Preservation of these ecosystems is vital to faunal food webs and biosphere health. Land-use decision makers have the opportunity to influence the patterns of open space within the limited site series which are essential to the survival of rare species endemic to settled areas. For making these decisions, architectural teams need both ecological knowledge, and support from municipalities, landowners, contractors and project occupants, in order to minimize impacts to these rare ecosystems. The applications of ecological knowledge and communication of essential strategies among all land-use development participants, need to begin before project inception and continue through the life of the project.

Architectural teams can begin applying landscape ecological strategies before the first line is drawn. Pre-development plant inventories provide detailed knowledge of on-site, and nearby off-site, rare species communities. Pre-development hydrological tests record water tables. Inventories and hydrological tests minimally last from February to June for Garry oak plant communities, and through seasons of ephemeral plant growth in any region. Pre-development plant inventories and hydrology information are overlaid onto land surveys, and rare species communities are highlighted. During the design process, rare species communities (on and off site) need to be buffered by an orderly frame (a landscape of planted native species). The orderly frame needs to be permanently separated from active land uses (for example, a double row of trees can separate the orderly frame from roads and buildings). Protected plant communities and the orderly frame need to be kept environmentally and ecologically stable: not irrigated, overshadowed or dessicated by subsurface drainage systems. Protected areas around rare plant communities need to be as large as possible and as wide as possible, to minimize edge effects. Optimizing possibilities for connectivity with similar plant communities offers both ecological and aesthetic benefits. Interconnected greenspaces enhance both biodiversity and our social awareness of being part of nature.

In some cases private land, such as land-use development sites, can provide new, planted connections between existing disconnected bioreserves. After pre-development inventories are completed and overlaid on a land-survey, design teams plan the development, ensuring the protected areas remain buffered from active land uses, are connected to one another, and are as large as possible. Existing parks, waterways and other natural amenities provide a matrix of habitats which encourage species diversity and recruitment (growth of new plants.) Protective covenants are useful for ensuring lasting protection of rare species communities (but the wording is best reviewed with ecological teams.) During construction, hydrological tables are monitored, and water tables of conserved areas are matched closely to pre-construction levels. Blasting, soil dumping and heavy machinery are kept five meters or more from rare plant community reserves. After construction is complete, strategies are needed to communicate ecological goals to occupants. Signage and "cultural indicators" (the orderly frame plantings, paths with defined borders) keep active use away from protected areas. Strategies are needed to ensure maintenance (manual, chemical-free weed and shrub control) and protection (against digging up of trampling) of rare plant communities are consistently applied. On-going monitoring of rare-species health and regeneration is essential, to allow management and protection activities to be modified as needed.

Restoration of depleted ecosystems and excavated lands with native plant communities is a vital part of project completion. Excavated areas, "yards" and common lands can be restored to native plant communities, (Kruckeberg 1982) thereby improving overall ecological health and connectivity. All these strategies require communication among scientists, landowners, contractors, architectural teams, and project users. Interdisciplinary solutions are urgently needed to avoid further losses of irreplaceable plants and animals, particularly those that are endemic to areas in and near growing cities. The combined expertise of ecological scientists and land-use practitioners can spawn land-use solutions that benefit people while allowing other living things to survive.

6.1 The ARC of Principles Extends the Function of Bioreserves Beyond Arks

The history of declines in Garry oak ecosystems exemplifies the dominance of "civilizing" urban growth on indigenous vegetation systems. The growing concern over the protection of the rare climax ecosystem also evidences a desire for a culturally satisfying environment in which people and nature coexist. A non-dominant, sustainable concept of land-uses stems from an awareness of peoples' placement not within a stable empire, but rather within a dynamic ecological web which is affected by daily choices of individuals, land-use teams, communities and countries. To sustain the ecological web from irreparable fractures, a transformation in the representation of landscapes is needed. Earlier misrepresentations of the landscape as a picture composed of culturally-entrenched arrangements of flora and fauna can be replaced by a sustainable representation of each landscape as a component within its larger ecological context. Within this more broad-reaching landscape ecological approach, each change in land-uses or site designs needs to be evaluated for its ecological consequences. For example, does the land-use plan reduce the area of an important reserve of natural habitat? Are there rare species on the site which need to be protected from disruption or eradication? Is there an opportunity to use design strategies that allow for open space connections between habitat patches, thereby improving or maintaining the integrity of ecological function? Area, Rare-species representation, and Connectivity—the ARC of strategies—are particularly applicable in peri-urban settings, where a large percentage of open space is matched by a high degree of interest in the visual amenities of nature.

Peri-urban ecosystems contain the open spaces that can act as a distributive network for rare species found in bioreserves. Rather than leaving bioreserves as isolated and confined storage spaces—arks—for rare species, architectural teams have an opportunity to use the ARC of principles from Landscape Ecology to enhance habitat value while considering the space needs of human settlement. The opportunity exists to select land-use patterns that retain environmental values and restore blighted landscapes. Bringing landscape ecology analysis and design principles into the design process is a vital step towards the protection and extension of habitat islands in peri-urban landscapes.

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Appendix I: Research sources on the ecotone between human settlement and natural ecosystems

It is only recently that the ecological sciences have acknowledged the importance of peri-urban ecosystems to overall ecosystem health and the biodiversity of species. If habitats at the edges of settlement are to be protected, then the cultural factors which impact ecosystem retention must be linked with knowledge from the natural sciences. The interdigitation of cultural and ecological processes is a key to retention of rare peri-urban ecologies, since it is at the edge of cities that these two systems become partners in landscape change (Dramstad et al 1996, Cronon 1991). One way to view the relationship between cultural and ecological processes is to understand the transition zone between types of human settlement and areas of retained natural habitat. This transition zone, or ecotone, between two communities (the human community and the native species community) has been studied at length in landscape ecology (Farina 1998, 93-108; Dramstad et al 1996), in landscape architecture (Spirn 1984, Sauer 1998), in cultural geography (Cronon 1991, 1996), and in urban planning (Knaapen, Scheffer and Harms 1992). To further understanding of how design decisions contribute to ecotone characteristics, empirical research correlating architectural form with resistance to self-perpetuation and health of rare native species is needed. Such research is found in the works by Landscape architect Professor Anne Whiston Spirn.[99] For example, Spirn notes that dense human settlements, with a high building to site ratio, are seldom visited by songbirds. By contrast, lower density settled areas with landscaped yards have more songbirds.

[99] Anne Whiston Spirn, The Granite Garden: Urban Nature and Human Design (New York: Basic Books, 1984).

These observations relate to Garry oak ecology, since oak meadows support numerous rare and sensitive bird species (Dunn 1998, Erickson, 1996). Further, the presence of songbirds has a vital role in peoples' appreciation of, and support for, retained native ecosystems.[100] To facilitate ecosystem health and appreciation, Spirn urges design teams to cluster development in order to secure a sizable, linked open-space system as native species habitat. Spirn's empirical research demonstrates that the numbers of songbirds increase in proportion to distance from dense settlement. This observation further emphasizes the ecological importance of less-dense, well-landscaped suburban areas, for these areas provide habitat for a range of less-common species. Further, if one role of peri-urban areas is to act as an ecological transition zone, then the cultural processes occurring in those areas need to be compatible with the ecological processes. Heavy uses of insecticides, for example, will have an impact on health of insectivorous birds. Since mature oaks develop natural cavities that are ideal nesting sites for cavity-nesting birds, old oaks need to be conserved.[101] For people to allow retention of aging oaks, and to avoid the abuse of insecticides, knowledge about the importance of peri-urban environments must be disseminated.

But dissemination of ecological knowledge is not enough. Ecological quality may not "look right": the standard of care we are accustomed to seeing may be offended by uncut meadows and gnarly trees. Old trees may even look "dangerous" to nearby human occupants.[102] To render native plant communities acceptable, landscape ecologist Professor Joan Inverson Nassauer offers ways to design ecosystems "so that people will recognize their beauty and maintain it

[100] For discussion of the importance of songbirds to people's cultural appreciation of native ecosystems, see Kempton, et al 1996.
[101] Garry oak meadow colloquium 1993: 54.
[102] Ussery 1993: 67.

appropriately."[103] Her specific design response is to frame ecosystems in a culturally-acceptable way. More than design is needed, however: cultural expectations must adapt to "recognize new landscape forms that include greater biodiversity."[104] Garry oak meadows are an example of ecosystems that may look "messy", and be in need of an "orderly" frame to make them culturally acceptable. Oak meadows are often lacking in aesthetic appeal: during midsummer, brown prairie grasses or rocky barrenness typify these B. C. oak ecosystems, and broken snags of dead branches and trunks seem "dangerous" rather than good nesting sites.[105] Framing these ecosystems in a culturally-acceptable way enables people to appreciate their unique aesthetic qualities. Since aesthetics is regarded as a perceived domain of architectural teams (including landscape architects), these professionals are uniquely positioned to design ecosystems into their projects and have them found acceptable.

Landscape Ecology, as exemplified by Nassauer, is sometimes described as a "soft science" because the scale of landscape ecology tends to emphasize the complexity of systems within a human context, and therefore tends to lack the repetitive data needed to make statistical conclusions.[106] By contrast, Zoological, biological and ecological research tend to look at either very large or very small samples, within which repetition can often be found and statistical analysis applied. By 1996, diverse scientific studies presented at an international forum at UNESCO headquarters were often linked by an interdisciplinary approach, but a need was still

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[103] Joan Iverson Nassauer, "Messy Ecosystems, Orderly Frames", Landscape Journal 14 no. 2 (July 1995): 166.

[104] Nassauer II, 167.

[105] Joel Ussery, "Managing for Conservation", in Garry Oak Meadow Colloquium 1993: Proceedings (Victoria: Royal B. C. Museum, 1993), 67.

[106] Idea presented by Dr. Susan Glenn, Landscape Ecologist at the University of British Columbia, in a lecture January 07, 2000.

seen for bridges between the social and biological sciences.[107] A number of the UNESCO studies were dedicated to the issue of diminishing rare plant communities near settled areas. Research spanning a wide geographic range, from peri-urban forests in Japan, to global warming measurements in Basel, Switzerland, to diagrams of urban ecology gathered in Argentina,[108] all comment on the cultural values and ethics needed to maintain biological diversity in and near cities. These scientists acknowledge the effects of people on their empirical research conclusions, although the conclusions from their International forum emphasize planning intervention as solutions, rather than cultural change, as a key to influencing acceptance of new landscapes.

Both Nassauer's initiatives, and those of the scientists at the UNESCO forum, share the goal of building bridges between biological and cultural disciplines. In contrast, ecologists often separate the influences of people from their research. This separation is evidenced in the work of ecologist K.D. Rothley.[109] In the selection of land to be set aside as bioreserve, three ecological principles are used: connectedness, area, and rare species representation. Rothley explains that once area, connectedness and rare species representation are resolved using computer programming techniques, then planners can refocus their efforts on those social, cultural, and economic aspects of bioreserve design which are too complex to represent on a graph or computer model. In Rothley's methodology, social and cultural processes are reintegrated with ecological processes by planners after key decisions are made. While this thesis employs Rothley's classification system for ecological principles, it introduces two

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[107] Biodiversity, Science and Development: Towards a New Partnership, F. di Castri and T. Younès, eds. (New York: CAB International, 1996).

[108] Biodiversity, Science and Development, Chapters 49, 51, 53 respectively.

[109] K.D. Rothley, "Designing bioreserve networks to satisfy multiple conflicting demands", Ecological Applications 9 (August 1999): 741-50.

essential transformations. Firstly, the principles are fully integrated with an understanding of how their cultural context impacts ecological change. Secondly, *Area* is placed at the beginning of the trio, since the area of bioreserves is a major economic factor in land use development solutions. The result is an ARC: area, rare-species representation, and connectivity, but the ARC is refracted by the presence of people within the studied ecosystem.

Indeed, the problems associated with ecology's traditional sequencing of decisions is that integration of culture with ecological decisions comes too late. Those more involved in design of landscape systems emphasize this early integration of knowledge. Landscape ecology, a merging of landscape architecture and ecology, evidences some integration of cultural and ecological factors. The "father of landscape ecology,"[110] professor R.T.T. Forman, asserts that the impacts of a land-use plan must be "considered within the overall ecological context of a landscape or region."[111] The ecological recommendations translated into design concepts by Forman's team have been a model for my own research. Existing landscape ecology principles, however, are integrated with the physical processes of suburbanization to avoid leaving remnant islands of vegetation in a sea of construction and pavement.

While land-use development and ecological requirements are brought together in the field of Landscape Ecology, dissemination of this knowledge is incomplete.

Ecological degradation in the face of outwardly-expanding cities continues. This is evidenced in British Columbia. Scientific papers presented to Garry oak conferences in 1993 and 1999

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[110] Dr. Susan Glenn in a Landscape Ecology Lecture January 1999 at the University of British Columbia.

[111] W.E. Dramstad, D. Olson and Richard T.T. Forman, Landscape Ecology Principles in Landscape Architecture and Land-use planning (Washington D.C.: Island Press, 1996).

repeatedly attest to the collision between land-use development and ecological requirements. (Hebda 1993, Ussery 1993, Fuchs 1999, Roemer 1993 and 1999).

Appendix II: Research sources explaining ecosystem-specific complexities

Responding to changes in any complex ecosystem requires an understanding of the composition, dispersal methods, interdependencies, and rarity of the chosen plant communities. Also essential is an understanding of the impacts of land-use development on the ecosystem: because development can lead to extirpation of rare endemic species, it is vital to know the nature of rare plants, and their susceptibility to habitat change. This knowledge—the number, type and associations of rare plants within Garry oak meadow—is found in Adolf Ceska's 1986 "Annotated list of rare and uncommon vascular plants of the Victoria area,"[112] and twelve years later in Douglas and Straley's comprehensive, illustrated volume Rare Vascular Plants of British Columbia.[113] These two works verify that rare plants in Garry oak meadow—about ninety rare species in total—comprise twenty percent of all rare plants in British Columbia. Processes leading to the decline of these plants into rarity include spread of invasive species, and losses in area and connectivity of habitat due to land use development. Evidence for culpability is traced in over three decades of research by Dr. Hans Roemer. Beginning with empirical data collected in the 1960's and published in his 1972 Ph.D. dissertation "Vegetation and Ecology of Garry Oak Woodlands,"[114] Roemer's long-term ecological research on declines in Garry oak meadow

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[112] A. Ceska, "An annotated list of rare and uncommon vascular plants of the Victoria area," The Victoria Naturalist 43.5 (March-April 1986): 1 -14.

[113] George W. Douglas, Gerald B. Straley and Del Meidinger, Rare Vascular plants of British Columbia (Victoria: Province of British Columbia, 1998).

[114] Hans L. Roemer, "Forest vegetation and environments on the Saanich Peninsula, Vancouver Island" (Ph.D. diss., University of Victoria (Canada), 1972).

species continues into the twenty-first century.[115] This long duration has enabled him to perceive differences between British Columbian Garry oak meadows and meadows elsewhere in North America. For example, the high proportion of geophytes in British Columbia Garry oak communities is unique, when compared to other North American Garry oak communities.[116]

Roemer's observations reinforce the importance of the conservation initiative in British Columbian meadows: these plant communities are not duplicated anywhere in the world. Uniqueness of the Red- or Blue-listed plants that are found only in British Columbian, Garry oak meadow[117] means that as province-wide habitat is lost, world-wide biodiversity is affected. To prevent losses of rare species, ecologists agree that even small bioreserves containing those species are vital.[118] Site-scale conservation efforts, which architects can influence, may signify the difference between rare-species survival or extinction. These observations add importance to the case-study research strategies, and site selections, of "Architecture, Development, and Ecology."

Land-use development continues to take over remaining habitat fragments; management of existing fragments is inadequate; public awareness is needed. As evidenced in Garry oak conferences, the meadows are rapidly declining in the face of overwhelming habitat loss.

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[115] Hans L. Roemer, "Vegetation and Ecology of Garry Oak Woodlands", in Garry Oak Meadow Symposium Proceedings 1993 (Victoria: Royal British Columbia Museum, 1993), 19 - 22., and his unpublished presentation to the first International Garry Oak Symposium, Victoria, B. C., 6 May 1999.

[116] Hans Roemer, "Vegetation and Ecology of Garry oak Woodlands", in Hebda: 20.

[117] George W. Douglas, Gerald B. Straley and Del Meidinger, Rare Vascular Plants of British Columbia (Victoria: Province of British Columbia, 1998) Red-listed is defined as native plant taxa which are candidates for legal designation as threatened (likely to become endangered) or endangered (facing extinction or extirpation in B. C.) Blue-listed are taxa that could become candidates for the Red-list in the foreseeable future.

Further, losses of meadow flora lead to losses of fauna associated with the meadow. Interdependencies of flora and fauna are a vital part of understanding Garry oak meadow ecology. For example, the reasons for extirpation of Western bluebirds and rare butterflies and the potential for reintroduction of extirpated fauna into conserved or restored areas, must be clarified. Site-scale conservation efforts take on new meaning when these interdependencies are highlighted. The wider ecological impacts of continued erasures of native plant community interactions, and the urgency of intervention against continuing habitat declines, are emphasized in the works of biologist Wayne Erickson. Erickson's 1996 Masters' Thesis (University of Victoria), and his presentations to Garry oak conferences, offer both ecological understanding of, and optimism for, restoration of flora and reintroduction of fauna.

Garry oak meadow ecology is complex: Erickson, Roemer, Ceska and Douglas et al offer differing classification systems and explanations for community structure. Indeed, one of the difficulties faced by design teams is this complexity and the amount of knowledge needed to comprehend ecological interdependencies. Site reviews, visual observations, and interviews help to translate complex ecologies into more useful images. As ecologists build knowledge of Garry oak systems, some surprising facts come to light. Native plants, such as Douglas fir, are invasive within oak meadows except as single large specimens. Native snowberry can also overrun rare meadow plants. The protection of regional biodiversity then, goes beyond retaining all native plants, explains restoration ecologist Patrick Dunn.[119] Dunn's research on oak meadow restoration within army bases in Washington State emphasizes invasive species removal. Like Erickson, Dunn is optimistic about the potential of meadow restoration, but notes that invasive

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[118] K. D. Rothley, "Designing Bioreserve Networks to Satisfy Multiple, Conflicting Demands", Ecological Applications 9, no. 3 (1999): 741.

species removal is time consuming and must be frequently redone. He recommends the on-going control of native and non-native invasive species, and successive transplantation of native Garry oak plant communities over several years. These techniques have application to land-use development sites, which are often in need of restoration even before development. After development, "ecological wastelands" of endless mown lawn (Nassauer 1995) can be avoided. Colourful oak meadows can, instead, be restored to developed sites.

Finally, there is a body of data documenting site conditions and changes to case-study and other meadow sites. Included in this data base are maps and surveys from the SEI (Sensitive Ecosystem Inventory), aerial photographs, and ground-based photographs. Additionally, project owners and architects provide plans for the chosen sites. Legal covenants, where applicable, were found in land registries. Both ecological data, and land-use development documentation (maps, SEI surveys, aerial photographs, project plans), weave a modern history which shows a current cultural response to Garry oak meadow's value.

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[119] Patrick Dunn, "Prairie Habitat Restoration and Maintenance on Fort Lewis and within the South Puget Sound Landscape" (Fort Lewis: Nature Conservancy of WA, 1998).

Appendix III: Research sources on the "Ideology of Wilderness"[120] or the "Pristine Myth"

Modern histories specific to Garry oak are embedded within North American and European landscape architecture, architecture and related cultural histories: histories of built form as they relate to landscape patterns in peri-urban environments. Since the history of permanent fragmentation of the North American landscape is also a history of the "elimination of wilderness" by colonizing Europeans (Leo Marx 1991, Stilgoe 1988), William Cronon, John Stilgoe, and Jane M. Jacobs, among others have noted the "isolation of human life from the ecosystems that contain it" resulting from colonizing processes (Cronon 1991, 8). The impact of colonialism on the North American landscape is further developed in essays of the anthology Denatured Visions: Landscape and Culture in the Twentieth Century.[121] In this anthology, Leo Marx's "The American Ideology of Space" explains the attitudes of colonizers' towards the "new" world. To colonizers, western North America was a blank canvas, a great void waiting to be filled with European civilization. This attitude of colonizers was devastating to native plant communities, since nature was seen as nonexistent except in its role to serve humanity. By the turn of the twentieth century, natural systems served "as a vehicle and occasion for expressing the human spirit."[122] For architect Louis Sullivan, "the more nature had been worked by an inspired human imagination, the more beautiful it became."[123] This transformation of nature is epitomized in the picturesque aesthetic, which, through the nineteenth and early twentieth

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[120] "The ideology of wilderness" is a term coined by Dr. William Cronon in "The Trouble with Wilderness, or getting back to the wrong nature" to signify the "national frontier myth" – wilderness as a totally separate entity from the "ugly artificiality of modern civilization. See Uncommon Ground (New York: Norton, 1996): 78.

[121] Denatured Visions Landscape and Culture in the Twentieth Century: ed. William Henry Adams (New York: Museum of Modern Art, 1991), 65.

[122] William Cronon, Nature's Metropolis: Chicago and the Great West (New York: Norton, 1991): 14.

[123] Ibid.

centuries, reshaped North American parks and suburbs,[124] with resulting losses of native habitat. An example of the picturesque transposed to Victoria, B. C. is the aforementioned model suburb designed in 1912 by Thomas A. Mawson and Sons.[125] (Fig. 1) Mawson's suburb creates a picturesque "English countryside" out of a totally-transformed wilderness. A different move to the countryside was advocated by Frank Lloyd Wright: "Try to live [...] deep in nature. Be native as trees to the wood, as grass to the floor of the valley [...] rise out of the confusion of communal life in the city to a creative civilization of the ground."[126] Wright's exhortation to escape the city's confusion and move to beyond urban borders was symptomatic of the expansion of North American cities into sprawling suburbs.[127] The architectural solutions to Wright's dream eroded native plant communities, just as the planted "grass [on] the floor of the valley" was invasive turfgrass imported from Europe. By contrast, the 1999 architectural response by Brennan and Associates'[128] shows an integration of native plant communities into the cultural and environmental programme of a health centre. These two different approaches to transforming landscape, and their ecological impact, are explained in landscape architect Leslie Jones Sauer's A Once and Future Forest (1999).[129] Whereas the picturesque cut through native ecosystems and transformed them completely, Brennan's plan restores and manages the native ecosystem.

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[124] For the evolution of the picturesque, and its importance in the expansion of North American suburbia, see John R. Stilgoe, Borderland (New Haven: Yale University Press, 1988)

[125] See also chapter two for mention of the picturesque aspects of Mason's plan.

[126] Frank Lloyd Wright, When Democracy Builds, 1945: 7.

[127] See Joel Garrett, Edge City (New York: Doubled, 1988).

[128] Brendan and Associates, "US Tribal Health Village Landscape Plan," presented at the annual meeting of the SEA August 11, 1999 in Spokane WA.

[129] However, Jane M. Jacobs warns that over-idealizing indigenous landscapes can be another form of Colonial landscape domination, if in doing so indigenous peoples' culture is commodified. See "Detouring the Map", in Edge of Empire (London: Routledge, 1996), 136.

The Brennan plan closes the schism between built form and ecological restoration, whereas earlier picturesque and suburban architectural visions exacerbated the isolation of people from native ecosystems.

Appendix IV Additional research sources on cultural acceptance for native plant ecosystems

The private sector in Victoria, however, has evidenced some interest in site-by-site restoration of native plant communities. Published examples of "backyard restoration" are found in two recent issues of Western Living magazine.[130] "The Garden that Love Built" documents public resistance to a proposed land-use development that would destroy "dramatic outcroppings of glaciated granite, and an extensive grove of Garry oaks."[131] "Take a deep breath of the scent of lilies" describes the beauty of an oak meadow underplanted with *erythronium oregonum*.[132] These articles suggest growing cultural acceptance for native plant systems. This cultural acceptance is vital: there is still overwhelming resistance in North America to making ecologically-inspired lifestyle changes, despite widespread awareness of declining environmental health,[133] assert the authors of Environmental Values in American Culture.[134] In this 1996 monograph, Willet Kempton and his team of M. I. T. anthropologists document, through semi-structured interviews and fixed-form surveys, the environmental views widely held in [North] America.

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[130] See "Take a Deep Breath of the Scent of Lilies", Western Living (April 1999) and "The Garden that Love Built", Western Living, (Winter 2000):11-8.

[131] "The Garden that Love Built": 12.

[132] Unfortunately, shortly after the publishing of this article the author noticed that a clump of *erythronium oregonum* had been removed from a View Royal site.

[133] Nassauer II, 169.

[134] Willett Kempton, James S. Boster, and Jennifer A. Hartley, Environmental Values in American Culture (Cambridge, Mass: MIT Press, 1996)

Through their cultural modeling, Kempton and associates conclude that environmental improvements can occur, as long as a concerted effort is made to “overcome the [cultural] disconnection between cause and effect.” (p. 26) when searching for solutions to environmental problems.

Appendix V 1991 Plant surveys of Juan de Fuca Recreation Centre by Joel Ussery for BCCDC

Name of observer Joel Ussery

Address/phone # 4-3225 Wicklow St Vic V8X 1C9 358-5860

Location (be as precise as possible, preferably to within 100 m; however, even very general information will be used)

Just north of the Juan de Fuca Recreation Centre, East side of highway 14, Colwood

UTM grid reference (from blue grid on 1:50,000 NTS map):

ZONE (e.g. 10U) 10U EASTING 4657 NORTHING 53160 92B6

Date day 14 month 07 year 92

Community

Dominant plant species:

Trees Garry oak dense stand. (some rock outcrop here)

Shrubs Oceanspray / a few clumps Scotch broom snowberry very thick under oaks None on bald

SS/FORB Herbs Camas spp & Zygadenus spp Sanicula spp Short grass Aira praecox

Moss (if possible and appropriate) A caryophyll

Habitat (a general description of area)

A grass bald, approximately ½ ha in size surrounded on all sides by several hundred garry oaks (2½ ha) The oaks have been invaded extensively by Scotch broom

total 1ha

Elevation 45 metres feet (*circle one*) **Slope** ≃20° **Aspect** all

Comments/Remarks (collections, threats to habitat, etc.) A jogging trail rings the stand, a trail crosses the centre of the grass bald, most of the broom is 1-2 years old no seed set

Our primary need is for location to be as precise as possible. A photocopy of a 1:50,000 topographic map, showing exact or approximate location would be appreciated, although not necessary. You can indicate precision of location with the letters: S = within 100 m radius; M = within 1 km; G = within about 10 km.

Please return forms to: CDC, c/o Wildlife Branch, 780 Blanshard St., Victoria, B.C. V8V 1X5

ELEMENT OCCURRENCE RECORD FORM

ELCODE: C1B3AG9HDI PROVINCIAL NAME: Quercus - ~~Bromus~~ Holodiscus

EO #(3): 012 ID(Y,N,?): ___ SITE CODES:S.CABCCDC* ___ * ___ * ___
Check site log.

SURVEY SITE: Juan de Fuca Recreation Centre, Colwood

PRECISION(S,M,G,U): S REGDIST:BC CAP1 LOCAL JURISDICTION: Colwood

MAP NAME: 92-B/Victoria MAP #: 92-B6 DOT #: 77 TEN TEN: 1.2

LAT/LONG: ___ ___ ___N ___ ___ ___W

DIRECTIONS: Park at Juan de Fuca Recreation Centre in Colwood, East side of Highway 14 (1A?). Site is just North of the Recr. Centre.

WATERSHED: 920 SURVEY DATE(YYYY-MM-DD/YYYY-MM/YYYY-AAAAA): ___

LAST OBS: 1992-07 FIRST OBS: 1992-[07]

EO RANK: ___ EO RANK DATE(YY-MM-DD): ___-___-___ EO RANK COMMENTS: Although there is dense broom it is still young and no seed has yet been cast. Good possibility of control of broom.

EO DATA: This site is on a small hill, a grass bald (≈ ½ ha) at the apex with a dense stand of Quercus garryana (≈ ½ ha) ringing the bald. Rock outcrops also occur in the oak stand. Some Holodiscus discolor and Symphoricarpos albus are present in the shrub layer. Cytisus scoparius is very dense in this layer. Forbs include Camassia spp., Zygadenus venosus, Sanicula crassicaulis. Grasses include Aira praecox and Aira caryophyllacea

CONTACT: Ussery, Joel CONTACT #:(___)-___-___

EO TYPE: ___

GEN DESCRIPTION: This site is in a "natural" area adjacent to a recreation area. A jogging trail rings the oak stand and a trail crosses the grass bald.

ELEV(m): MIN: 45 [MAX: ___] SIZE(ha): 1

MACODES:M.CABCCDC* ___ * ___ * ___ MANAMES: ___
Check MA log. Enter if no code exists.

CONTAINED(Y,N,?): ___ TNC INVOLVE(Y,N): ___ MGMT COMMENTS: ___

PROTECTION COMMENTS: __________

OWNER COMMENTS: On lands surrounding Rec Centre

COMMENTS: __________

OPT1 - ECOSECTION(3): NAL OPT2 - BGC: CDFmm/3/2 OPT3 - FOREST DIST(2): 16

OPT4 - DATA SENSITIVITY COMMENTS: __________

OPT5 - UTM for animals, communities(e.g. 09U 1234 12345): 10U 4657 E 53660 N

____ ____ E ____ N ____ ____ E ____ N

OPT6 - UTM for plants: ____ ____ E ____ N

OPT7 - SPECIMEN CODES:S __________ BCCA S __________ BCCA
S,year(2),collector(3),collection # for plants or accession # for animals(6),museum code(2),BCCA.
Put more detailed specimen information in EO DATA.

OPT8-TFLs/TSAs: __________ OPT9:-IRs: __________
Enter if available.

OPT10 - HABITAT KEYWORDS: Terrestrial Forest Broadleaf

DATA SENSITIVITY(Y,N): N BOUNDARIES(Y,N,?): N PHOTOS(Y/P,Y/S,Y/B): N[__]

SOURCE CODE: F92 USS01 BCCA ____ BCCA ____ BCCA
(first one BEST SOURCE)

TRANSCRIBER(YY-MM-DD AAA): 92-07-17 CMC EDITION(YY-MM-DD):[92-07-17]

EDITION AUTHOR:[Cadrin, C.M.]

DIST MAP REVISED(Y,N): ___ MAPPER(YY-MM-DD AAA): 92-07-23 DHM

QC1 INSPECTION: ___ QC1 MAP MARGIN: DFS QC1 ELEMENT LOG: DFS

QC1 COMPLETE:[__-__-__ ___] QC2 COMPLETE:[__-__-__ ___]

MANUAL FILE NOTE:[__________]

Appendix VI Wildflowers at Mill Hill

WHAT'S Up on Mill Hill

WILDFLOWERS

- Alumroot, Small-flowered (*Heuchera micrantha*)
- American Brooklime (*Veronica americana*)
- Anemone, Lyall's (*Anemone lyallii*)
- Avens, Large-leaved (*Geum macrophyllum*)
- Bedstraw (*Galium spp.*)
- Bleeding Heart, Pacific (*Dicentra formosa*)
- Blue-eyed Mary, Small-flowered (*Collinsia parviflora*)
- Buttercup, Creeping (*Ranunculus repens*)
- Buttercup, Small-flowered (*Ranunculus uncinatus*)
- Buttercup, Western (*Ranunculus occidentalis*)
- Camas, Common (*Camassia quamash*)
- Camas, Death (*Zygadenus venenosus*)
- Camas, Great (*Camassia leichtlinii*)
- Cancer-root, One-flowered (*Orobanche uniflora*)
- Catchfly, Small-flowered (*Silene gallica*)
- Cat's Ear, Hairy (*Hypochaeris radicata*)
- Chamomile, Field (*Anthemis arvensis*)
- Chickweed, Mouse-ear (*Cerastium arvense*)
- Clover, Red (*Trifolium pratense*)
- Clover, White (*Trifolium repens*)
- Columbine, Western (*Aquilegia formosa*)
- Coral-root, Spotted (*Corallorhiza maculata*)
- Coral-root, Striped (*Corallorhiza striata*)
- Cornflower (*Centaurea cyanus*)
- Daisy, English (*Bellis perennis*)
- Daisy, Ox-eye (*Chrysanthemum leucanthemum*)
- Dandelion, Common (*Taraxacum officinale*)
- Dock, Western (*Rumex occidentalis*)
- Enchanter's Nightshade (*Ciraea alpina*)
- Eriophyllum, Wooly (*Eriophyllum lanatum*)
- Fairy-bell, Hooker's (*Disporum hookeri*)
- Farewell-to-Spring (*Clarkia amoena*)
- Fireweed (*Epilobium angustifolium*)
- Foam Flower (*Tiarella trifoliata*)
- Fool's Onion (*Brodiaea hyacinthina*)
- Foxglove (*Digitalis purpurea*) •
- Fringe-cup, Tall (*Tellima grandiflora*)
- Geranium, Dovetail (*Geranium molle*)
- Grove Lover (*Nemophila parviflora*)
- Gum Weed (*Grindelia integrifolia*)
- Harebell, Scouler's (*Campanula scouleri*)
- Harvest Brodiaea (*Brodiaea coronaria*)
- Hawkweed, White-flowered (*Hieracium albiflorum*)
- Hellebore, Green (*Veratrum viride*) •
- Helleborine (*Epipactis helleborine*) •
- Hemlock, Poison (*Conium maculatum*) •
- Hemlock, Water (*Cicuta douglasii*) •
- Horsetail (*Equisetum spp.*)
- Indian Consumption Plant (*Lomatium nudicaule*)
- Indian Pipe (*Monotropa uniflora*)
- Larkspur, Menzies' (*Delphinium menziesii*)
- Lettuce, Wall (*Lactuca muralis*)
- Lily, Chocolate (*Fritillaria lanceolata*)
- Lily, Tiger (*Lilium columbianum*)
- Lily, White Fawn (*Erythronium oregonum*)
- Lily-of-the-Valley, False (*Maianthemum dilatatum*)
- Miner's Lettuce (*Montia perfoliata*)
- Miner's Lettuce, Siberian (*Montia sibirica*)
- Miner's Lettuce, Small-leaved (*Montia parvifolia*)
- Mitrewort, False (*Tiarella laciniata*)
- Monkey-flower, Baby (*Mimulus alsinoides*)
- Nettle, Hedge (*Stachys cooleyae*)
- Nettle, Stinging (*Urtica dioica*)
- Nipplewort (*Lapsana communis*)
- Onion, Hooker's (*Allium acuminatum*)
- Onion, Nodding (*Allium cernuum*)
- Orchid, Calypso (*Calypso bulbosa*)
- Orchid, Slender-spire (*Platanthera unalascensis*)
- Paintbrush (*Castilleja spp.*)
- Path-finder Plant (*Adenocaulon bicolor*)
- Pea, Purple (*Lathyrus nevadensis*)
- Pineapple Weed (*Matricaria matricarioides*)
- Plantain, Lance-leaf (*Plantago lanceolata*)
- Plantain, Rattlesnake (*Goodyera oblongifolia*)
- Plectritis, Long-spurred (*Plectritis macrocera*)
- Queen Anne's Lace (*Daucus carota*)
- Rose Campion (*Lychnis coronaria*)
- Sandwort, Large-leaved (*Arenaria macrophylla*)
- Satin-flower (*Sisyrinchium douglasii*)
- Saxifrage, Early (*Saxifraga integrifolia*)
- Saxifrage, Rusty (*Saxifraga ferruginea*)
- Sea Blush (*Plectritis congesta*)
- Self-heal (*Prunella vulgaris*)
- Shooting Star, Broad-leaved (*Dodecatheon hendersonii*)
- Shooting Star, Few-flowered (*Dodecatheon pulchellum*)
- Skunk Cabbage (*Lysichitum americanum*)
- Skunk Weed (*Navarretia squarrosa*)
- Snake Root, Western (*Sanicula crassicaulis*)
- Sorrel, Sheep (*Rumex acetosella*)
- Sow-thistle, Perennial (*Sonchus arvensis*)
- Spring Gold (*Lomatium utriculatum*)
- Starflower, Broad-leaved (*Trientalis latifolia*)
- St. John's Wort, Common (*Hypericum perforatum*)
- Stonecrop, Broad-leaved (*Sedum spathulifolium*)
- Stork's-bill, Common (*Erodium cicutarium*)
- Strawberry, Wild (*Fragaria virginiana*)
- Sweet Cicely (*Osmorhiza chilensis*)
- Tarweed, Chilean (*Madia sativa*)
- Toothwort (*Cardamine pulcherrima*)
- Trillium, Large White (*Trillium ovatum*)
- Twayblade, Heart-leaved (*Listera cordata*)
- Twin-flower (*Linnaea borealis*)
- Twisted-stalk, Clasping (*Streptopus amplexifolius*)
- Vanilla Leaf (*Achlys triphylla*)
- Vetch, Common (*Vicia sativa*)
- Violet, Yellow Wood (*Viola glabella*)
- Woodland Star, Small-flowered (*Lithofragma parviflorum*)
- Yarrow (*Achillea millefolium*)
- Yerba Buena (*Satureja douglasii*)

SHRUBS

- Blackberry, Evergreen (*Rubus laciniatus*)
- Blackberry, Himalayan (*Rubus procerus*)
- Blackberry, Trailing (*Rubus ursinus*)
- Currant, Flowering Red (*Ribes sanguineum*)
- Daphne (*Daphne laureolis*)
- Elderberry, Red (*Sambucus racemosa*)
- False Box (*Pachistima myrsinites*)
- Hardhack (*Spirea douglasii*)
- Honeysuckle, Orange (*Lonicera hispidula*)
- Honeysuckle, Purple (*Lonicera hispidula*)
- Huckleberry, Red (*Vaccinium parvifolium*)
- Indian Plum (*Osmaronia cerasiformis*)
- Kinnikinnick (*Arctostaphylos columbiana*)
- Ocean Spray (*Holodiscus discolor*)
- Oregon Grape (*Berberis nervosa*)
- Oregon Grape, Tall (*Berberis aquifolium*)
- Rose, Dwarf Woodland (*Rosa gymnocarpa*)
- Rose, Nootka (*R. nutkana*)
- Salal (*Gaultheria shallon*)
- Salmon Berry (*Rubus spectabilis*)
- Saskatoon Berry (*Amelanchier alnifolia*)
- Scotch Broom (*Cytisus scoparius*)
- Snowberry (*Symphoricarpos albus*)
- Thimble Berry (*Rubus parviflorus*)

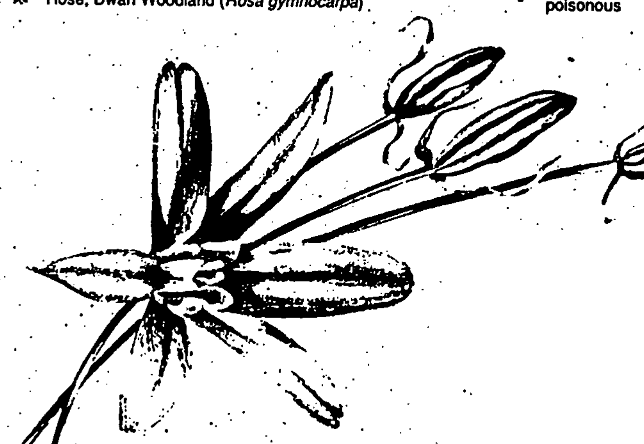
FERNS

- Bracken Fern (*Pteridium aquilinum*)
- Licorice Fern (*Polypodium vulgare*)
- Sword Fern (*Polystichum munitum*)

TREES

- Alder, Red (*Alnus rubra*)
- Arbutus (*Arbutus menziesii*)
- Cascara (*Rhamnus purshiana*)
- Cedar, Western Red (*Thuja plicata*)
- Cottonwood, Black (*Populus trichocarpa*)
- Dogwood, Pacific (*Cornus nuttallii*)
- Dogwood, Red Osier (*Cornus stolonifera*)
- Fir, Douglas (*Pseudotsuga menziesii*)
- Fir, Grand (*Abies grandis*)
- Hemlock, Western (*Tsuga heterophylla*)
- Holly (*Ilex*)
- Maple, Broadleaf (*Acer macrophyllum*)
- Ninebark (*Physocarpus capitatus*)
- Oak, Garry (*Quercus garryana*)
- Willow (*Salix ssp.*)
- Yew, Pacific (*Taxus brevifolia*)

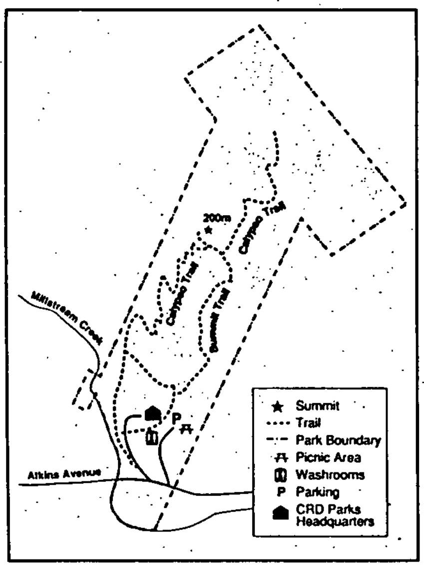
• poisonous



Harvest Brodiaea

Mill Hill Regional Park, headquarters for CRD Parks, is located on Atkins Road in Langford, approximately 30 minutes from Victoria.

To reach Mill Hill, take the Trans Canada Highway (#1) from Victoria to Millstream Road. Turn left on Millstream, follow it to Atkins, and turn left. Signs direct you to the park entrance.



Capital Regional District Parks
490 Atkins Avenue
Victoria, B.C. V9B 2Z8
(604) 478-3344 Fax 478-5416

SR DESIGN Printed on 100% recycled paper, all post-consumer waste 94-5,000

WILD FLOWERS

of Mill Hill

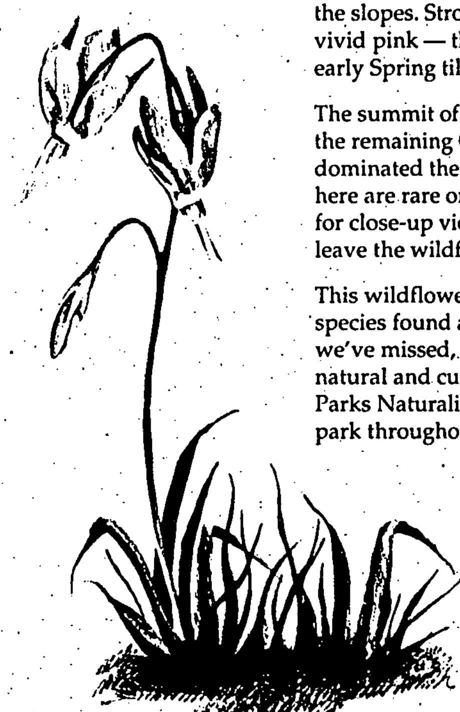
White Fawn Lily

Capital Regional District Parks

Welcome Spring on the sun-warmed slopes of Mill Hill Regional Park. The trail to the top leads you through cool forest to rocky outcrop. Here a multitude of wildflowers grace the park with vibrant colours and delicate fragrances. Satin Flower brightens the hill by early March. A month later, it's joined by Early Saxifrage, Blue-eyed Mary and Spring Gold. Deeper in the forest, you'll find White Fawn Lily and Large White Trillium. By May, Western Buttercup, Common Camas and Sea Blush compete for space as they carpet the hill. In June, Harvest Brodiaea and Broadleaf Stonecrop cling to the slopes. Strong white, electric blue, bright yellow, vivid pink — these are just some of the colours from early Spring till Summer's end.

The summit of this 53-hectare park protects one of the remaining Garry Oak communities that once dominated the region. Many of the wildflowers found here are rare or endangered. Take a magnifying glass for close-up views, and a camera for memories. Please, leave the wildflowers where you find them.

This wildflower list notes both common and rare species found at Mill Hill. If you sight something we've missed, let us know. To find out more about the natural and cultural history of Mill Hill, join a CRD Parks Naturalist for interpretive programs held in the park throughout the year.



Shooting Star

HARVEST BRODIAEA

Appendix VII Draft City of Victoria Tree Protection Bylaw

DRAFT

NO. 99-103

TREE PROTECTION BYLAW

A BYLAW OF THE CITY OF VICTORIA

to provide for the protection and preservation of trees on private property.

Under its statutory powers, including sections 708 to 715 of the *Municipal Act*, R.S.B.C. 1996, c. 323, the Municipal Council of The Corporation of the City of Victoria enacts the following provisions:

1. This Bylaw may be cited as the "TREE PROTECTION BYLAW."

2. In this Bylaw,

"alter" means

(a) to remove the top portion of a tree or tree seedling;
(b) to remove from a tree or tree seedling any branch, trunk or piece of tree bark that is 10 cm or more in diameter;
(c) to cut, damage or destroy by any means the roots of a tree or tree seedling within the protected root zone;

"building envelope" means that part of a lot on which a building, including an accessory building, may be sited under the setback regulations of the City's Zoning Regulation Bylaw as varied by a development permit, a development variance permit, a heritage alteration permit or the Board of Variance;

"building envelope line" means a building's setback established under the City's Zoning Regulation Bylaw as varied by a development permit, a development variance permit, a heritage alteration permit or the Board of Variance;

"certified arborist" means a person certified by the International Society of Arboriculture;

"cut down" means to cut, saw or chop down, kill or otherwise remove a tree or tree seedling by any means;

"Director" means the City's Director of Engineering and Parks;

DRAFT

"dripline" means a line on the surface of the ground around the trunk of a tree or tree seedling, the radius of which is the distance between the outermost twigs of the tree and the centre point of the trunk, or its vertical extension;

"hazardous" includes:

(a) unstable or severely leaning and in danger of falling;

(b) interfering with, or in such proximity to, utility wires as to create a dangerous situation;

(c) interfering with, blocking or damaging a drainage, water or sewer system or other parts of the improvement;

"lot" means a parcel of land;

"protected root zone" means the area of ground under the branches of a tree or tree seedling and within the dripline that contains the bulk of the critical root system of the tree or tree seedling;

"protected tree" means any of the following trees:

(a) Garry Oak (Quercus garryana);

(b) Arbutus (Arbutus menziesii);

(c) Pacific Dogwood (Cornus nuttallii);

(d) a tree that

(i) its owner has voluntarily agreed to retain as part of an application for a permit that would affect the tree, and

(ii) is protected by a restrictive covenant in favour of the City;

"protected tree seedling" means any of the following tree seedlings:

DRAFT

(a) Garry Oak (Quercus garryana);

(b) Pacific Dogwood (Cornus nuttallii);

"tree" means any living, erect, woody plant that is

(a) 10 cm or more in diameter, and

(b) 5 m or more in height,

located on private property;

"tree seedling" means any young, independent, living, erect, woody plant that is greater than .5 m in height and less than 5 m in height

located on private property.

3. For the purposes of this Bylaw:

(a) the location of a tree or tree seedling on a lot must be measured at the point at which the trunk of the tree or tree seedling meets the ground;

(b) a tree or tree seedling is considered to be located on the same side of a building envelope line that the major part of the trunk of that tree or tree seedling is located;

(c) the diameter of a tree is determined by dividing the circumference of its trunk, measured at 1.4 m above the ground, by 3.142;

(d) the diameter of a tree having multiple trunks 1.4 m above the ground is the sum of

(i) 100% of the diameter of the largest trunk; and

(ii) 60% of the diameter of each additional trunk.

Prohibition

4. A person must not cut down or alter a protected tree or protected tree seedling.

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5. Section 4 does not apply to cutting down or altering a protected tree or protected tree seedling if

(a) the protected tree or protected tree seedling is located within the building envelope of a lot;

(b) cutting down or altering the protected tree or protected tree seedling is required for the construction or installation of any of the following works:

(i) a driveway;

(ii) any off-street parking required under the Zoning Regulation Bylaw;

(iii) municipal or public utilities service connections;

(c) cutting down or altering the protected tree or protected tree seedling is required or permitted under any of the following provisions of the City's bylaws:

(i) section 85 of the Streets and Traffic Bylaw;

(ii) sections 4, 6, or 7 of the Trees and Insect Control Bylaw;

(d) roots or branches of the protected tree or tree seedling encroach into the building envelope, or interfere with construction or maintenance of a lawfully sited building or buildings.

Tree Permit

6. (1) The owner of a protected tree or protected tree seedling may apply to the Director for a permit to cut down or alter the protected tree or protected tree seedling if the protected tree or protected tree seedling is dying of natural causes, dead of natural causes, or hazardous.

DRAFT

(2) An applicant for a permit must provide the information required by the application form attached as Schedule A to, this Bylaw.

(3) If the Director is satisfied, based on accepted arboricultural practices, that the protected tree or protected tree seedling is dead of natural causes, dying of natural causes, or hazardous, the Director must issue a permit in the form attached as Schedule B to this Bylaw.

(4) The Director or a person authorized by the Director may enter at all reasonable times on any property to make an assessment or inspection for any purpose under this Bylaw.

(5) If the Director refuses to issue a permit and the applicant for the permit provides the Director with a report of a certified arborist certifying that the protected tree or protected tree seedling is dead of natural causes, dying of natural causes, or hazardous, the Director must issue a permit in the form attached as Schedule B to this Bylaw.

(6) The following conditions apply to a permit:

(a) if the permit holder cuts down a protected tree or protected tree seedling, the permit holder must plant and maintain a replacement tree or tree seedling of the same species, or of a different species authorized by the Director in accordance with accepted arboricultural practices, in approximately the same location as the tree or tree seedling that has been removed;

(b) for the purpose of ensuring the performance of the requirements set out in paragraph (a), the applicant for a permit must provide to the City security in the form of cash or a letter of credit in the amount of the cost of planting the replacement tree or tree seedling plus the estimated cost of maintaining it for 3 years.

(7) The application fee for a protected tree permit is $30.00.

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Offences and penalties

7. (1) A person who contravenes a provision of this Bylaw commits an offence and is subject to the penalties imposed by this Bylaw and the *Offence Act*.

(2) The minimum penalty for each protected tree or protected tree seedling that is cut down or altered in contravention of this Bylaw is a fine of

(a) $500.00 for a first offence, and

(b) $1,000.00 for a second or subsequent offence.

8. (1) Any person who is authorized by the Council and who has reason to believe that another person has committed an offence under this Bylaw may deliver an offence notice to that other person.

(2) An offence notice may be delivered by giving it to or by sending it by prepaid registered mail to the person believed to have committed an offence.

(3) An offence notice may indicate the alleged offence and the amount of the voluntary penalty that may be paid to the City for the alleged offence.

(4) A prosecution must not be started for an offence described in an offence notice if a voluntary penalty is paid in accordance with this Bylaw before an information is sworn and a summons is issue.

9. (1) The voluntary penalty for a first contravention of a provision of this Bylaw is

(a) $300.00 if paid within 14 days from the date of the offence notice;

(b) $400.00 if paid after 14 days but within 45 days from the date of the offence notice;

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(c) $500.00 if paid after 45 days from the date of the offence notice.

(2) The voluntary penalty for a second or subsequent contravention of a provision of this Bylaw is

(a) $800.00 if paid within 14 days from the date of the offence notice;

(b) $900.00 if paid after 14 days but within 45 days from the date of the offence notice;

(c) $1,000.00 if paid after 45 days from the date of the offence notice.

10. Bylaw No. 94-194, the Tree Protection (Interim) Bylaw and any amendments are repealed.

Passed and received third reading by the Municipal Council on the day of 1999.

Adopted by the Municipal Council on the day of 1999.

DIRECTOR OF CORPORATE SERVICES MAYOR