Karen Vagelatos, M.L.Arch. & Gordon Brent Ingram Ph.D.

Interim report for a CMHC External Research Grant for Housing Research

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Native plants for residential landscapes:
Design and management guidelines for south-western BC

This is the interim report for the CMHC-supported research, **Native plants for residential landscapes**. The goal of this phase of the research has been to complete a review of all relevant literature in order to develop a case study assessment framework, involving both garden observation and interviews, and to choose a diverse set of sites in three areas of the region: the southern parts of greater Vancouver, the Gulf Islands, and greater Victoria. In the subsequent phases of the project, we will conduct the field assessments, analyze the data, make conclusions, recommendations, and propose guidelines.

Introduction

The concept of "ecological landscaping" (Daar 1979) one of the first to suggest that reliance on native plant species in housing landscape would contribute to "sustainability." She stated that,

"*We need to design and nurture ecologically stable, self-reliant urban landscapes...and encourage the continued existence of native plants and wildlife whose well-being is so intricately linked to our own.*"

This study explores these possibilities for the drier parts of southwestern British Columbia including large parts of both greater Vancouver and greater Victoria. There has been considerable work on native plants in housing landscapes in other parts of Canada notably the remarkably visionary contributions of the late Alexander Wilson for southern Ontario (Freedman 1993, Wilson 1992).

What can be considered "native" / "indigenous" / "local" is based on complex biogeography analysis - some of which are unresolved and contentious. How "native" is a native plant species is an important and debatable concept particularly as related to

1. species that are native to a region but possibly not to a particular site
2. species that are native to a locality but not to a particular site and
3. "provenances" (genetic samples) of a native species that are not from the area.

Designing with local biological diversity and integrating habitat conservation with (some) housing has become a generally accepted goal in (sub)urban planning. Housing design in suburban areas must increasingly minimize impacts on local "biological diversity" (Vogel and Ingram 1993) and the management of "disturbance gradients" (Stanford 1994)

For some plant communities, such as Garry oak on Vancouver Island, careful integration of housing around open space systems of protected oak woodlands will be key to the continued existence of this ecosystem in Canada. There is a growing movement to protect heritage trees in southwestern BC and the *Municipal Act* was recently changed to provide a legal basis for such ordinances. But the thinking behind the conservation, use, and management of native plants in this region is still often unclear and contradictory. In order to take the local appreciation of native plants in landscaping beyond trendiness, it will be necessary to provide successful examples and to help people clarify their particular goals and objectives.

In Daar's 1979 essay on ecological landscaping, she defines ecological landscaping in terms of the following conditions:

1. conservation of the soil native to the housing site;
2. conservation of water;
3. minimization of reliance on fossil fuels as well as chemical pesticides and fertilizers;
4. enhance the native flora and fauna and maximize natural genetic diversity; and
5. enhance the functional role that plants play in sustaining human life.

Daar's perspectives were grounded in northern California with its mild climates and summer drought. They have been difficult to apply in more temperate parts of North America. However, the one part of Canada that has some similarities with Daar's context is the Coastal Douglas Fir Zone of rapidly urbanizing southwestern British Columbia.

In early 1995, Karen Vagelatos, and landscape architect and tourism planner, and Gordon Brent Ingram, an environmental planner and landscape ecologist supervised by Daar in his M.Sc. program in ecosystem management, were awarded a contract with the Central Mortgage and Housing Corporation (CMHC) to look at how to make the use of native plants in CMHC-supported housing better contribute to "sustainability." This is the first CMHC-supported research projects on housing, native plants, and sustainability for the west coast of Canada. We are currently reviewing the literature and various criteria for sustainability, assessing a wide range of housing sites, interviewing residents, and developing design guidelines. The major lines of investigation focus on the following:

- drought tolerance versus dependence on irrigation;
- implications for inputs of fertilizer and pesticides as well as pest management and composting;
- the long-term costs from damage to native vegetation from careful housing construction and the subsequent costs for establishment of more convention landscaping;
- contributions to habitat protection and landscape connectivity;
- contributions to the richness of housing landscapes for play, relaxation, and contemplation; and
- security and safety.

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General theories of sustainability

"*Sustainability cannot be achieved mechanically. It will take endless forms, the very diversity of design possiblities helping to ensure that the whole patchwork of technologies, cultures and values is sustainable*." Sim Van der Ryn 1994

The concept of sustainable development goes back two decades to various discussions that emerged from the 1972 United Nations Conference on the Environment in Stockhold. There were early outlines of "ecodevelopment" particularly those articuled by Lester Brown (1981), Ignaceous Sachs (1984), and Peter Jacobs (1986). "Sustainability" became the central concept with *Our Common Future*, the 1987 final report of the World Commission on Environment and Development. A range of social priorities and development approaches have emerged under the rubric of sustainable development (Rees and Bailey 1989 and Gardner 1989). In recent years, the vision of entire sustainable communities has become increasingly prominent especially as defined as less dependence on fossil fuels and increased emphasis on the recycling of (Inman 1993) as well as the need for some broader management of human impacts on landscape processes (Beer 1993).

Canada has been at the forefront of defining objectives of sustainable development both in terms of national policy and also at provincial and municipal levels. In western Canada, Alberta began to develop a conservation strategy that included as an objective, "to insure that natural landscapes and the biological diversity they support are protected in urban areas" (Public Advisory Committee to the Environmental Council of Alberta 1990, pages 12 to 13). In recent years, municipalities have begun to explore and articulate their own priorities often through reviews of literature such as the one conducted by the City of Richmond, BC (Richmond, City of 1989).

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Housing, sustainability and green architecture

> "*Aldo Leopold said that to be an ecologist is to live "in a world of wounds," conscious of the environmental damage around us. The task of design in the 21st Century will be to heal those wounds. And the process of healing can return to professionals - long deprived of their traditional integrative function - the gift of truly being architects again.*" Lovins and Browning (1992)

Frank Lloyd Wright first articulated the notion of "the natural house" (1954), that involved some kind of harmonious landscape of local materials, though it was three decades before specific requirements for low impact and resource use and recycling were articulated (Butler 1981, Pearson 1989). In recent years, there have been new articulations of notions of "eco-sensitive" design (Gunts 1993), `green design' (Muschamp 1993) and "green architecture" (Wines 1990). Friedman et al. (1993, pages 0.0.1. to 0.0.4) began to explore the relationship of housing to broader societal shifts to sustainability. While there is growing acceptance of the notion of green architecture, there are varying levels of clarity and priorities that can be employed (Fisher 1993). Often architects prefer relatively simplistic guidelines (Alden 1993) which are not always sufficiently adaptable. There is a tremendous need for greater information dissemination on ecologically oriented housing design.

Recently, there has been a `second generation' of ecological design that better embodies complex social programs through the broader framework of the "eco-village" (Van der Ryn 1991). Van der Ryn (1994, page 6) also advocates a more practical notion of "nature" in design,

> "*Designing with the "n" nature means making natural processes visible and active in very ordinary ways on the household, neighbourhood and city levels.*"

Much of the new perspectives on the use of native plants species in housing landscaping have originated from this vision of small "n" nature assuming that was is locally adaptive will ultimately be more socially satisfying, adaptable, and cost-effective.

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Bioregionalism

Even under the rubric of more sustainable and ecologically oriented design, there are a range of possible visions of naturalness, preservation and restoration (Baldwin et al. 1994). One framework for developing goals is based around more carefully appreciating local and regional ecological process and biogeography. This is often called "bioregionalism" and was originally articulated by Peter Berg (1978) for the San Francisco Bay Area. Some of the initial notions of bioregionalism were developed by visionaries such as Gary Snyder who blended an appreciation for both west coast Native cultures and Japanese buddhism (Snyder 1969, 1994). There have been various ordinations for the drier parts of southwestern British Columbia being that it on the northern cusp of a "bioregion" sometimes called Cascadia (McCloskey 1994, Snetsinger 1994) or Oregonia.

There have been various "uses" of bioregionalist ideas. They are sometimes used as scientific goals while in other situations are more of a vague ideal for a regionally based aesthetic (Alexander 1990). The bioregion has been employed as the basis for the boundary of what species are considered native though this framework breaks down when considering island ecosystems.

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Native plants in landscape horticulture

The first major west coast North American discussion on the value of native plants in gardens was written by Lee Lenz in 1956 (Lenz 1956, Lenz and Dourley 1981). The Saratoga Horticultural Foundation, established in 1951 south of San Francisco, was a major source of native cultivars and was the first major of the more common native species of the drier zone of southwestern British Columbia.

The concept of "weed trees" (Beatty 1973) preceded the native plant movement and did the California based critiques of landscaping that required high levels of irrigation. The seminal articulation for use of landscape plant not dependent on irrigation is Russell A. Beatty's 1977, "Browning of the Greensward." Beatty outlined how irrigation-dependent landscaping was the product of the imposition of a water-intensive "English" aesthetic being imposed on the (summer drought) California landscape. Appreciation of "vacant lot niches," and the aesthetics of urban weediness (Kastner 1993) has gradually increased over the last two decades.

The aesthetics of native plant use have been articulated in many different ways over the last century. In North America, Jens Jensen developed an approach around natural successional and local plant material (Grese 1992).

Native plants are often conceived as being central to restoration programs (*The New York Times* 1987). Today, many native ecosystems, including associated plants, are under extreme threat and sometimes from housing. Residential landscaping with native species, particularly original material that is maintained, is often important to conservation strategies (Payne 1990). The policy significance of retention of use of native plant species has increased over the last decade such as with June 198, 1989 editorial by The New York Times. Along with the recognition of the advantages and ethical values associated with reliance on native plants, there is an awareness of a need for gradual shifts and increased knowledge of the actual sources and propagation requirements specific material in specific garden ecosystems (Raver 1992b). In a similar vein, Raver (1992a) linked efforts for the successful re-establishment of native species with the control of exotic species in public parks. She stressed what a slow process this often involves.

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Integrated garden ecosystems

The notion of "ecological restructuring" (Hahn and Simonis 1991a & b) of cities has emerged as a paradigm for planning in urban cores. Certainly conservation of materials and energy, stability, and diversity are central qualities of such integrated systems. This suggests more increment shifts than more comprehensive but difficult to manage, master plans. But piece-meal decision-making is never enough and broader decisions must be made through "integration regional planning" (Calthorpe 1993, pages 34 to 36). One approach to environmental planning decisions is the early protection of the lands with best wildland and habitat values (Smith 1989) before there are other development decisions but this could best be made compatible with the needs for water and public transportation corridors. In fact, advancing a cohesive vision related to standards for public transportation, water, sewage disposal, and the conservation of biological diversity and other landscape values, could provide the structure for new urbanization.

The "yard" as an ecological matrix in the neighbourhood was articulated by the Farallones Institute in 1979 (pages 420 to 451). John and Nancy Jack Todd developed a very "New Age" concept of "bioshelter" and articulated in several books, the most widely read being the 1980, *Tomorrow is Our Permanent Address*. There has been an expanding notion of the values of maintaining steady-state ecosystems, that involve food production, such as embodied in the term "permaculture" (Kennedy 1991).

At broader scales, there has been considerable interest in "sustainable new towns" (Battle and McCarthy 1994), the "green city" emphasizing restoration of "natural processes" (Hough 1984) and linkages across regions called "greenways."

The problem of unsustainable levels of input into garden ecosystems, especially of water, has given rise to the objective of the "xeriscape" (Walters 1992) with low maintenace and low watering often relying on native plant species.

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A criterion for landscape sustainability: installation factors

First using native species that are already present on a site are always cheaper and more cost-effective than introduced horticultural varieties. Similarly, reliance on native species that are already established on a site is always preferable to installation of new material no matter how local are the sources.

Other factors that emerge in considering the advantages of native versus non-native species in installations include:

- requirements for care in installation;
- seasonal limitations on installation;
- knowledge, and labour requirements in installation; and
- additional materials required including fertilizer and innoculants necessary in the installation.

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A criterion for landscape sustainability: plant growth, inputs, maintenance requirements, and labour

The "costs" of a landscape over time comprise a central question of sustainability. Inputs include water, fertilizers, pesticides, and most costly, human labour and associated knowledge and education. Certain elements of the conventional housing landscape, such as lawns, require a tremendous amount of inputs and care and there is a growing movement "to get...lawns off drugs" (Cox 1995).

Central to maintenance is sufficient knowledge for management under a wide range of contingencies. In his discussion on the re-establishment of native plants, as part of broader ecological restoration efforts, Morrison (1994) stressed the need for an "inventory-monitoring" component. Linked to the knowledge of the manager of the composition and condition of the plant material in the landscape, on an ongoing basis, would be ongoing evaluation in order to generate "hypotheses" and for subsequent experimentation for successful management, in terms of a range of criteria. All of these requires extensive interest, economic and domestic stability, and a relatively high degree of education, though not necessary from a university or college.

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A criterion for landscape sustainability: sources and genetics of native plant material

The source of plant material, including seeds, seedlings, and cuttings, and in deed the extent of its nativeness and its previous aclimatation to the landscape conditions has become a central set of questions for the sucess of use of native plants. There are two basic types of sources of material in use of native plants in housing landscapes. There are on-site sources from vegetation that has been retained and there are off-site sources (Knapp and Rice 1994). But exact criteria for acceptability in terms of what is considered on-site and acceptable off-site site sources must be set for each situation and project.

The economic dynamics at work for the many new nursuries and seed companies are unpredictable as Tomsho (1992, B1) noted,

"*In a volatile market where a forest fire can double prices in a week and a sudden storm can scatter a crop in a few minutes, no one is certain how big the native seed business has become.*"

Such concerns often involve highly specialized seed gathering and propagation activities. There are business secrecy factors that often limit access to information on the exact source of material. There is a broader problem of lack of disclosure of site information as seed gatherers, who are often sub-contractors, are loath to provide exact information that could be used by competitors.

There has been a steady growth in native plant nurseries. In a New York Times article, Lynch tells the story of Garden in the Woods Nursery in Massachusetts that is owned and operated by the New England Wild Flower Society. The nursery is active in propagation of endangered species and manages a wide range of propagation activities including some utilization of tissue culture.

Much of the native plants obtain in nurseries poses some serious problems particularly in terms of delivery of natural services and requirements for maintenance and inputs. These problems are sometimes framed in terms of "genetic purity" (Millar and Libby 1989) though the scientific and management issues are far more complex. Smith (1993) notes that there are often problems in the survival of native plants because there has been "aesthetic selecting" of genetic material rather than a concern for the appropriateness in terms of incompatible environments between source and plant site. Smith's 1992 article on propagating what we call in Canada "arbutus," *Arbutus menziesii*, is a case in point. This wide ranging species extends along the west coast of North America from Cortes Island, near Campbell River, BC, to the mountains of Baja California. There is thought to be a huge amount of genetic diversity with the Canadian populations nearly always growing on relatively dry southwest facing slopes with the southern and Baja California populations associated with dark, wet canyon bottoms. Today in nurseries, it is still very difficult to obtain information on the geographic and ecological locations of source populations and genotypes adapted to other conditions are probably often used for inappropriate conditions. Unlike many native species, arbutus can be propagated by seed, though this seed is best treated, through scarification, and innoculation by the mycorrhizal fungi associated with its roots probably increases chances of survival and rapid growth. All of these requirements, are difficult for most commercial nurseries in BC to monitor at the present time.

There are also a range of other issues under the rubric of genetic contamination. For example, the native oak, *Quercus garryana*, of this region are the same species that hybridize extensively with other native oaks, such as Q. *douglasii*, to the south in California (Tucker 1990). In the cases of the rarer oaks species of the west coast, there have been discussions on banning the planting of non-native oaks in housing landscaping, in order to maintain the gene pool and prospects for fitness, in adapting to changing environments (Scott 1990).

As for soutwestern BC, Forestry Canada, which has been the leader in issues of local tree genetic resources, has developed Project Acorn for distributing Garry oak seedlings. In addition, there is a native plants nursery on Salt Spring Island that caries many of the 300 vascular plants "that

thrive in the [Garry oak] meadows" (Kennedy 1995)

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A criterion for landscape sustainability: siting of buildings and vegetation

Ecological urban design has been a field for well over 25 years and its vision goes back to the inception of modern landscape architecture and urban and regional planning. In recent years, there has been a proliferation of priorities, criteria, and design responses which have all claimed to be "ecologically correct" (Freedman 1993). But as the ecological design discourses have expanded, the central principles applicable to particular contexts have become less clear. A range of different schools for different problems and social priorities are emerging. This presentation takes stock of where ecological urban design has come from and options for adapting it to a wider range of situations.

Ecological urban design is inherently based on a "site specificity" that has been increasingly well articulated in public art but in planning and the designs of buildings has not progressed much beyond vague forms of "bioregionalism." The "paradigm" that has dominated much of ecological urban design in recent decades was that articulated by Ian McHarg and labelled "ecological determinism." It tended to emphasize optimization of ecological factors and economic pressures rather than identification of a number of alternative scenarios each with different social implications. In the process of rejecting a monolithic notions of ecological "compatibility" and "sustainability," we create opportunities to see the choices in ecological urban design as ultimately social ones.

In recent years, various debates have emerged around plant material and security. Certainly, more natural vegetation does not have to be any more of a haven for criminal activity and threats to residents, as more conventional planting. However, some of the more denser configurations of native vegetation can obscure views and must be managed accordingly.

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A criterion for landscape sustainability:
vulnerability of local biodiversity (natural species and ecosystems) to housing

The notion of preserving all of the "parts" of natural ecosystems, particularly vulnerable species, often referred to as "biodiversity conservation," has become the dominant paradigm in both land ethics and land management. As well as irreversible destruction of wildlife and habitat, biodiversity is vulnerable to loss from fragmentation of remaining forest. In North America today, many rare plant species are under threat from poorly located and designed housing. But even with the new initiatives for the conservation of biological diversity, in such areas as California, the role of better siting and design of housing has barely been explored (Jensen 1991).

There are increasing public pressures, for housing design in suburban areas to minimize impacts on local "biological diversity" (Vogel and Ingram 1993) and for the better management of disturbance gradients. For some plant communities, such as Garry oak woodlands on Vancouver Island, careful integration of housing around open space systems of protected oak woodlands will be key to the continued existence of this ecosystem in Canada. There is a growing movement to protected heritage trees in southwestern BC and the *Municipal Act* was recently changed to provide a legal basis for such ordinances.

In Victoria, a "backyard biodiversity" program is being implemented by the Garry Oak Meadow Preservation Society to encourage the protection of the full range of natural plants and animals in housing landscapes. Coate (1983) noted that watering of exotic vegetation under heritage oaks is a major threat to their survival.

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A criterion for landscape sustainability: habitat conservation and landscape connectivity

Habitat conservation objectives have rapidly moved to a "landscape ecology" (Forman and Godron 1986, Barbault 1995) paradigm emphasizing protection, management, and restoration of ecological processes and flows across sites, neighbourhoods, and regions. Landscape ecology also provides a more powerful framework for mapping and analyzing the myriad of human impacts on relatively intact native vegetation (Everitt et al. 1990).

The remaining tracts of old growth forest are vulnerable to destruction, further fragmentation, and loss of species. The drier plant communities and the few remaining bogs are vulnerable to degradation. Open space recreational values are rapidly declining outside of established parks. Transportation routes are increasingly congested and infrastructure is increasingly at carrying capacity. Natural panoramas are being increasingly marred. The following are the major constraints on high impact / "unsustainable" urbanization on southeastern Vancouver Island. As the population increases, there will be diminishing access to transportation and possibilities for commuting. There will be growing shortages of water. The currently established protected natural areas will provide barriers for large urban development and there are pressures for more cohesive open space networks.

The expanded modern concept of urban sprawl as an ecological threat is barely two decades old (Banham 1971). A concept of comprehensive "habitat conservation planning" (Beatley 1994, pages 9 - 12), that might well include restraints and incentives for landscape plants has been increasingly articulated in order to avoid the legal conflicts that have sometimes been associated with implementation of the U.S. *Endangered Species Act*. On example of a long-term conservation planning and ecosystem management effort, focused on the control of the impacts of urbanization on the biodiversity of oak woodlands and meads is the San Bruno Mountains (Beatley 1994, pages 54 - 68). The expanded modern concept of urban sprawl as an ecological threat is barely two decades old (Banham 1971).

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A criterion for landscape sustainability: water use

Central to the discussions on the value of native plants in housing landscape has been the fact that water use will need to be lowered. Between 40 and 60 % of summer water use in the U.S. is for landscape maintenance. The seminal articulation for landscape plantings not dependent on irrigation is Russell A. Beatty's 1977, "Browning of the Greensward," outlined how irrigation-dependent landscaping was the product of the imposition of a water-intensive "English" aesthetic being imposed on the California landscape with its summer drought. The visions of the "dry garden" emerged as "a collection of drought resistant plants, natives and otehrs, of like requirements, assembled to make a relatively self-sufficient garden" (Schmidt 1977, page 8).

More recently, the movement to control irrigation of housing landscapes has often used as its objective the notion of the "xeriscape," a term coined in 1981 by the Denver Water Department, for "water conservation through creative landscaping" (Walters 1992). There is a growing body of technical information being compiled for each bioregion (Beck 1990, Ellefson et al. 1992). Xeriscaping often involves techniques developed in Mediterranean climates to conserve summer water and minimize irrigation. As of 1992, over 40 U.S. states have xeriscape education programs. Recently, the technical aspects of xeriscaping were explored by Friedman et al. (1993, pages 1.9.01 to 1.9.10) for Canadian contexts. There have also been explorations of combining lower requirements for irrigation, such as through reliance on native plant species in landscaping, with with conservation technologies and new sources such as from recycled grey water (Cox 1991, Lyle 1994, pages 141 to 185).

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A criterion for landscape sustainability: pest management

By virtue of their diverse natural gene pools, native plants are sometimes more resilient to disease especially in comparison to the requirements of highly bred ornamental plants. Notions of the "natural control of pests" and "integrated past management" (Farallones Institute, 1979, pages 360 to 419) have been articulated for home gardens for well over several decades.

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A criterion for landscape sustainability: aesthetics and public perception

As the global environmental crises have deepened in recent decades, there have been naturalist responses to modernist design that have emphasized the beauty of ecological relationships, no matter how messy-appearing (Laurie 1989). There has been a gradual shift in the landscape aesthetics of the North American public towards preference of what is perceived as being natural (Thorne and Huang 1991, Magill 1992). Native plant landscapes may be somewhat more "natural" than conventional plantings but their perception will vary a great deal on management and maintenance factors in combination with the type of vegetation forms (Lamb and Purcell 1990). The experience of more "sustainable landscapes" may involve some major departures and Thayer (1990, abstract) notes that the

> "*traditional notion of `aesthetics' is ... insufficient to describe the totality of the experiential quality of sustainable landscapes.*"

One framework for tracking the particular perceptions of nature in native plant housing landscapes is through environmental evaluations of "transactions" (Hartig 1993) between built and unbuilt spaces. A new aesthetic emerges which values those elements that contrast most greatly with architectural forms and which is particularly complex, formally.

The notion of aesthetics has been progressively expanding from visual responses to a broad set of experiences grounded in the extent of feelings of community, communal belonging, pride, health, safety, security, sense of self, and emotional stability. In recent decades, there has been emergence of the aesthetics of "environmental art" (Matilsky 1992, pages 36 to 59) with the emphasis on site and locally derived material. This is illustrated in the work of Alan Songfist, such as his "Time Landscapes" with emphasis on nurturing plant succession on urban sites (Matilsky 1992, pages 80 to 85) and Patricia Johnson's "Habitat-Gardens" (Matilsky 1992, pages 60 to 65).

In his discussion of public appreciation of native plants in restoration projects, Schulhof(1989) predictably found that the greatest attention was on large colourful flowers, relative uniqueness of form and rarity, and a sense of the broader ecosystem that might be termed "mysterious."

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A criterion for landscape sustainability:
municipal and legal aspects of retention of natural vegetation

There are a growing number of neighbourhood conflicts around housing siting versus the retention and protection of heritage native trees (Smith 1995)

Conservation of heritage native oaks has becoming a growing municipal issue especially in California (Ewing 1990). The philosophical and legal aspects of restricting the rights of landowners to destroy or endanger heritage oaks has been discussed for well over a decade (Huntsinger and Standiford 1990). There have been "oak ordinances" enacted and various debates as to their effectiveness (Rossi 1990). There are questions of emphasis such as on restriction of land use activities versus providing incentives for conservation. And there is a widely recognized need for more coordinated efforts such as through resource management plants across neighbourhoods and districts.

In his discussion of strategies for conservation of natural vegetation in New Zealand farmland, Wilson (1994) stressed the need for local authorities setting and enforcing conservation standards. In British Columbia, official have historically been loath to set habitat conservation standards in developed areas particularly on private land. Under English Common Law, the plants, as opposed to provincial ownership of the wildlife, are also the property of the land owner.

In the urban areas of British Columbia, there has been increasing public pressure to protect large heritage trees, some of which are native species, from destruction. This movement became more earnest in the last decade as pressures for residential construction caused a trend towards housing construction leaving little outdoor portions of lots. But this backlash against "monster houses," often involving a disturbingly xenophobic subtext, has not provided a framework for the stewardship of the more mature and vulnerable elements of the urban landscape. It took an amendment of the provincial *Municipal Act* to allow for heritage tree ordinances (Dunster 1994) but the extent of the powers of enforcement of associated conservation standards, for private lands, have yet to be tested. It may require some "red tape" to cut down a heritage tree but there are few constraints on its gradual destruction through appropriate landscape design and maintenance decisions and few incentives for more ecologically viable management.

As for encouraging water conservation, surcharges, such as for excess water use assumed to be for landscape maintenance, are a growing means of controlling reliance on expensive inputs (Walters 1992). There are a range of limitations and fees for excessive use that can, in effect, encourage sustainable landscapes and more locally viable planting species through making fees to home owners more realistic and higher.

At the international level, Canada is very active in implementing the *Convention on Biological Diversity* (Harvey and Fraleigh 1995). Over the last year, there have been three national consultative groups for the development and implementation of the Canadian Biodiversity Strategy:
1. the Biodiversity Working Group;
2. the Biodiversity Convention Advisory Group; and
3. a federal interdepartmental committee (Harvey and Fraleigh 1995).

As a Canadian agency, CMHC is therefore mandated to not threaten biological diversity particularly those species associated with prospective sites for housing construction. This extends to loans as well as to direct construction. CMHC could contribute to Canadian contravening of the Convention if it ever funded housing or related construction and infrastructure that threatened or contributed to the destruction of local biological diversity, including native vegetation. Unfortunately, it is difficult for federal agencies to fulfill their maintains unless rare and endangered species and associated "critical habitat" is clearly identified such as under the auspices of a national Endangered Species Act. Unfortunately, neither a Canadian or a British Columbian framework for tracking such critical habitat currently exists.

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Environmental overview

In the following sections of this interim report, the literature on the region is reviewed as it relates to the composition and ecology of natural vegetation. All of these study areas are in the Coastal Douglas Fir Zone (*CDF*) of southwestern British Columbia. This ecological zone extends from the coastal mountains of northern California to just north of Campbell River on the east coast of Vancouver Islands. And because of its mild climate, this region has become the most rapidly urbanizing region in Canada - one whose water resources are being increasingly overused through irrigation of conventional housing landscaping.

The Coastal Douglas Fir (CDF) bioregion in Canada

The southern parts of the Fraser Valley, the Gulf Islands, and souteastern Vancouver Island consist of a series of valley lowlands, low mountains up to 500 m, and islands. There is relatively recent igneous rock with some older sandstones along shores being pushed up because of the buckling of the North American and Pacific plates.

As for geomorphology, soil, and hydrology, the entire area has been heavily glaciated with shores, lowlands, ridges and valleys moving northwest to southeast. The heavy glaciation has left shallow soil with poorly developed horizons, little alluvium, and considerable areas of exposed rock. There are extensive moraines, directly to the north of Victoria in Saanich, with complex mosaics with better drained gravels as well as clays. The watersheds are numerous and small and the aquifers problematic. These aquifers are particularly vulnerable to ineffective septic systems and the rising sea level (from global warming).

As for climate, this is the "Banana Belt" of Canada with the warmest winters, little freezing, and long summer droughts. This is in the biogeographic zone sometimes called "Oregonia" or "Cascadia" that extends from midway up of the east coast of Vancouver Island through the Puget Sound of Washington State to the higher elevations of northern California. Annual precipitation ranges from roughly 70 cm to 120 cm. There is considerable variability in precipitation between years, produced by the "Pacific High" weather formation, with the possibility of drought years that generate wildfires. Given the topography, there are a remarkably range of microclimates produced by prevailing winds, proximity to shores, aspects, and exposed slopes.

The Coast Douglas Fir Zone (*CDF*) (British Columbia 1988) which on deeper and richer soils are highly productive for trees. In the drier sites with south / southwest aspects on better drained soils are Garry oak, *Quercus garryana*, woodland a species that extends to the Santa Cruz Mountains south of San Francisco and that is associated with wildfire as is Douglas Fir, *Pseudotsuga menziesii*. There are still fragments of "old growth" Douglas Fir.

There are many definitions of old growth forests and they should be defined for particular ecosystems and regions. All old growth forests have canopies dominated by relatively old trees at or near the maximum levels of biomass accumulation possible for those sites. Thus, many Douglas Fir forests with only 100 year old trees, no matter how large and impressive, are hardly old growth and there are many ancient forests on poor sites where the trees are not particularly big. The key ecological concept is that of relatively high levels of standing and fallen biomass (live and dead wood) which provides considerable food and a diversity of habitat structures for a wider range of animal and plant species. And any forest that has any kind of mechanical timber harvesting, even when it is selective, can no longer be considered old growth. For background from Washington State and Oregon.

On north facing slopes, that have been spared by wildlife, a dry form of Western Hemlock, *Tsuga heterophylla*, forest, less complex than temperate old-growth rainforest, occurs. There is some riparian forest with Alaska cottonwood, *Populus tremuloides*, some complex but small bog systems, and some xeric (very dry) coastal strand with species such as cactus.

In terms of wildlife and biogeography, southeastern Vancouver Island has some of the most diverse landscapes, in terms of richness of plant species, in Canada. Vancouver Island and the Gulf Islands are missing a number of large vertebrates such as grizzly bear. None of the vertebrates endemic to Vancouver Island occur in southeastern Vancouver Island. There are, however, a number of endemic sub-species. There are virtually no species that are confined to this area but numerous plants, vertebrates, and invertebrates with disjunct distributions or where their only occurrences in this area is on the Gulf Islands and southeastern Vancouver Island.

Much of the native species of the CDF Zone have their geographical centres, where there is still remarkable diversity and evolutionary dynamics, in the Klamath Mountains of southern Oregon (Wallace 1983).

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Environmental overview: oak woodlands and meadows

Garry oak, *Quercus garryana*, woodlands are on some of the choicest real estate in Canada (Kennedy 1995). The pressures for both conservation and luxury housing in the remaining natural oak woodlands, outside of the few parks and ecological reserves, are on private intensifying. This association within the *CDF* Zone has the highest concentrated of rare and threatened plant and insect species in Canada.

Of the ecosystems of the Canadian *CDF* Zone, oak woodlands have been the most damaged, structually, by exotic species. This situation occurs on the west coast to southern California. Introduced species tend to outcompete many native species,[1] interfere with the regeneration of dominant cover species such as oaks, and yet are not able to support comparable ecosystem processes. The best investigations of these problems, so far, have been at the University of California Hasting Reservation on the central California coast (Knops et al. 1995). The only comparable programmes in similar ecosystems in Pacific Canada have been with the ecological reserves program of the Province of BC but there have been persistent problems from lack of adequate management (Ingram 1981).

Garry oak is limted to the drier parts of the Pacific coast of North America from the Santa Cruz mountains to just north of the Courtney-Comox area on the east coast of Vancouver Island. Except for two mainland sites, one at Sumas Mountain in the Fraser Valley and the other further east near Yale on the Fraser River, all of the Canadian Garry oak woodlands are on islands and though very similar to those ecosystems in Washington State are less diverse because of their isolated and insular contexts. Canadian Garry oak biogeography is essentially a subset of the more diverse complexes centred in northern California. Over the last 40 million years, oaks on the west coast of North America have been evolving with varying summer droughts. Their adaptations and the structure of their ecosystems are closest to the Mediterranean, and not the British, oak woodlands that extend from eastern Spain to Greece and Turkey.

There is extensive genetic variation within California oaks (Millar et al. 1990) and though there are few studies, as yet, to actually confirm this there is considerable evidence to suggest local variations, races, and possibly sub-species.[2] Hence the erroneous notion in the Victoria area that those relatively oak and majestic oaks are a unique species. Regardless, there is need for both greater ecogeographical surveying (Ingram 199) of Q. *garryana* and classification of local oak ecosystems that are consistent with those of more diverse ecosystems to the south with the same species (Allen 1990).

Fire has played a central role in maintaining oak woodlands in this part of the range of Garry oak (Kennedy 1995). Without wildfire, Douglas fir seedling can grow quickly and strangle mature oaks. The Salish-speaking peoples of the region traditionally employed fire to maintain these

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[1] The most aggressive introduced perennials are the brooms, particularly Scot's broom, *Cytisus monspessulanus* (Mountjoy 1978), though there are growing problems with the invasive gorse, *Ulex europeaus*.

[2] Garry oak is in the white oak group, Q. *douglasii*, Q. *engelmanni*, and Q. *lobata*, and will hybridize with the following species:
Q. *douglasii* to form Q. X *explingii*;
Q. *durata* to form Q. X *subconvexa*; and
Q. *dumosa* to form Q. X *howellii*.
The taxonomy of hybridization with Q. *lobata* and Q. *sadleriana* is less clear (Griffin and Muick 1990).

woodlands and meadows.

In his discussion of restoration of the oak woodlands south of Chicago, Bronney (1989) found the grazing history was central to subsequent strategies and necessary activities. Less grazed areas had considerably more in their "seed banks" and therefore did not need the same interventions necessary for populations to be re-established and regenerate. There are underlying questions about how to characterize areas of native vegetation (Noss 1985) and, in deed, of the successional progressions at work. Two different successional models could yield very different visions of a restored native plant ecosystem, particularly one with extensive housing, and different maintenance criteria and management goals with rather different regimens in terms of species compositions and maintenance requirements (Packard 1993). The debates about the significance of wildfire become particularly heated.

Central to the restoration of oak woodlands is to re-establish young populations of roughly the same genetic composition as those heritage specimens in the woodland canopy. A range of strategies are possible, as related to germination, predation, and competition, depending on the conditions and the extent of the degradation of the oak woodland ecosystems (McCreary 1990). There has been extensive experimentation on G. *garryana* propagation, particularly in California and Oregon. Bush and Thompson (1980) suggest that acorns not be stored for very long and, if so, in polyethylene bags that allow for some gas exchange. Once germination begins the acorns should be planted as soon as possible - preferably in the autumn. Screens are often necessary to protect seedlings from deer browsing. Given the importance of acorns and seedlings as food sources (Tietjal 1990), a strategy to minimize predation becomes a central component of a regeneration effort.

There have extensive discussions on the diseases and infestations of Garry oak in the Victoria area. Larger, older trees are often more prone to disease though often the entire tree is not killed. In the communities in California, also build in woodlands with many mature oaks, there have been extensive reviews (Swiecki 1990, Raabe 1990). There are leaf spotting fungi such as *Cylindrosporium polytricha*.

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Environmental overview: forest

The forests of this zone, dominated by Douglas fir, are some of the most spectacular in Canada particularly that which has not seen logging and is therefore often ancient and "old growth." Within this forest, there is also arbutus on drier sites and Red alder, and Big-leafed maple in more damp areas. There are several other species of conifers, including Red cedar and Western hemlock on damp sites, as well as Grand fir and Rocky Mountain juniper. One of the rarest conifers, is the Pacific yew which is threatened by fragmentation. It is experiencing losses in its intra-specific variation and possible fitness, its ability to adapt to chaing conditions (Scher 1991).

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Development of hypotheses on benefits & development of hypotheses

Our field work and interviews will lay the basis for evaluating each site in terms of contributing to the previously mentioned criteria for sustainability and to test the following hypotheses.

1.In our interviews with garden designers, managers, and users, what are the most important concepts and terms related to use of native plants in housing landscapes, for decision-making over sites and neighbourhoods? What are the conceptual and technical linkages between the use of native plants in housing landscapes and sustainable development?

2.What are the current design criteria and priorities used by clients, municipalities, developers, and design professionals in southeastern BC for preserving and actively using and planting native species around housing?

3.What is the range of uses of native vegetation in landscape around housing? What have been the specific social and ecological functions of their use and when have these uses of native species been successful?

4.How have the perceptions and judgements around the use and success of native plants in housing landscapes changed with growing concerns for native plants?

5.Given the ecosystem-based criteria for sustainability, explored in the literature reviews, what are the various indicators of success (and failure) used for evaluating the use of native plants in housing landscapes?

6.What are more scientific, and practical, methods for evaluating the use of native plants for evaluating designs, retention patterns, and installations with native plant species that related directly to the servicing of social needs and to long-term sustainability?

In order to explore these questions, the following hypotheses will be tested through an observation and interview format.

1.Housing landscapes with native plants are cheaper to maintain in the long-term.

2.For this region, the more native plant material there is in a garden, the lower will be the household's demand for water.

3.In this ecological zone, numbers of native species on particular sites, sometimes referred to as "biological richness," decline when non-native plant material requiring irrigation is always installed.

4.Where non-native ornamental plants are installed on sites with already established native vegetation, the numbers of native species will then decline in the long-term.

5.Where native plant species associated with divergent ecological conditions are mixed on the same site, the long-term requirements for inputs, including water, fertilizer, pesticides etc., increase over that necessary for the original native vegetation.

6.Housing on sites of high native plant species richness contributes more to local disappearance of rarer species that in construction on less rich sites. There are relationships between the extent of the housing in terms of density, type, and associated technologies and human activities, and the long-term prospects for maintaining the full diversity of native plant species on a housing site.

7. Housing landscapes with native plants better contribute the continued presence of local wildlife than those with conventional landscapes plants through better landscape connectivity and functioning as part of habitat corridors.

8.The success of both native plant retention and planting is very much the result of the treatment of the soil in the construction phase of housing. The more destruction of the social mantle, the less likeley are the chances of the survival of both retained plants and newly installed ones.

9.When there is a perception of the difference, native plants are preferred by residents over conventional outdoor plant material.

10.Native vegetation is no more hazardous to public safety than is conventional plant material.

11. The more the designer / gardener / owner knows about the source of their native plant material, and therefore make decisions accordingly, the better the persistence and growth on respective sites.

12.The retention or new planting of native vegetation enhances the "sense of place." Resulting perceptions of the congruency of the combined aesthetic and ecological aspects of housing sites are more positive. These perceptions extend to social factors as related to security, safety and attractiveness for play, relaxation, and education.

Data sets and field research methods

The heart of this project is the visiting and assessment of particular gardens with native plants. For each of the previous hypotheses, a series of questions, with observational and interview data categories, are developed for the assessment and interview formats. Some of these questions emphasize observation, description and measurement. To answer some of these questions, interviews to determine opinions and preferences are necessary. The following are the major types of information that will be collected.

■ ordinal

The following information will be noted on maps:
1. location, on a topographic map, within the *CDF* Zone and in the southwestern BC region;
2. location within natural plant communities and associations already mapped; and
3. location within respective urbanizing areas in terms of categories of housing and development pressures.

■ spatial

The following information will be sketched on "plans":
1. the boundaries of each property;
2. the types of uses and vegetation outside of the property and directly adjacent to the property lines;
3. the location of the housing and other structures including their heights and surface materials;
4. the location of all of the vegetation including delineation of areas with native and non-native plants; and
5. the location of driveways, walkways, patios, play areas and other outdoor use areas.

■ biophysical factors

The site will be categories in terms of the following environmental parameters:
general ecosystem types: forest / woodland and meadow / riparian and wetland / shore;
topography: flat to steep;
aspect: southwest, northeast, northwest, southeast;
soils texture;
vegetation associations including Douglas fir - Western hemlock - Red cedar; Douglas fir - Arbutus; Garry oak meadow; Pacific crabapple woodland; riverine woodland; and beach strands; and
successional phases such as early, mature, old-growth and "natural," heritage / culturally modified; and
status of vegetation including: original native vegetation retained, native vegetation primarily planted.

■ site history

Any information on the historical and cultural forces at work on the landscape ecology of the neighbourhood will be listed including:
1. maps;
2. descriptions of remnant native vegetation nearby; and
3. historical accounts.

■ compositional

Lists of landscape elements will be compiled including:

1. the native plant species original to the site;
2. the installed native plant species;
3. the installed non-native plant species;
4. volunteer weed species;
5. relevant fixtures such as facets, compost heaps, benches, and other maintenance technologies and added use and aesthetic features.

■ measurements

Given time constraints and the nature of the research, it is not necessary to measure many dimensions or diameters. However, some measuring may be necessary to ascertain the following:

1. proportions of the area of the site in terms of structures, use areas, and native and non-native plants;
2. rough heights of trees;
3. extent of canopies; and
4. extent of use areas.

■ diagnostic checklist: biophysical

In this checklist, we will be looking for signs of and trends in success and failure of landscape sustainability and native plants. The most important indications that we will be looking for are the following:

1. regeneration of native plants;
2. disease in native plants;
3. native tree condition and health;
4. extent of standing and fallen dead biomass;
5. evidence of the detrital food web such as dead wood;
6. evidence of successional patterns and directions;
7. appropriateness of plant native species for site conditions;
8. changes in the hydrology regimen and signs of extent of watering if any; and
9. presence of aggressive introduced plants that appear to be spreading; and
10. missed opportunities for native plants to satisfy particular social uses and aesthetic amenities.

■ social use: observational

Though we will only be able to spend no more that one to two hours in each site, we will observe and question interviewees in order to ascertain the following:

1. outdoor activities in yard;
2. active versus passive uses;
3. children's activities;
4. elderly activities;
5. current or potential security problems;
6. "backyard natural history" - eating native plants;
7. "backyard natural history" - watching wildlife such as birds;
8. "backyard natural history" - nature interpretation and aesthetic appreciation.

■ social use checklist: diagnostic

We will look for signs of workable "use" of native plants in yards with an emphasis on signs of:

1. zones of comfort (and when) and a range of well-lit and shady areas;

2. the range of uses;
3. extent of outdoor activities by residents;
4. propagation and cultivation of native plants;
5. protection of naturally reproducing native plants;
6. composting and mulching;
7. damage to native plants from activities such as play;
8. whether design and plant care decisions emphasize "authenticity" or artistic license

Interviews

The objective with these semi-structured interviews is to include the widest set of experiences and opinions as possible.

■ interviews with residents

At least one resident per site will be interviewed on the following questions:

■ major influences in using native plants:
books
teachers / educational institutions / courses
televisions programs
radio programs
newspaper articles
journal articles
friends
neighbours
travel experiences
visits to public gardens
■ term of residency
■ status: owner (free hold), strata / coop, rentor
■ extent of involvement of a landscape architecture professional
■ extent of resident's involvement in use of native plants, installation, preservation, management, and maintenance
■ seasonal sequence and extent of resident's appreciation
■ motives for using native plants - phrases and sentences
■ propagation / preservation of edible or medicinal species
■ aesthetic appreciation - phrases and sentences
■ extent of satisfaction with native plants on the site
■ nature of protection of original native plants in housing construction
■ nature of installation of native plants in landscaping
■ knowledge of source of the material and their sites of origin
■ resident's level of knowledge level and educational background
■ security concerns
■ their definition of "sustainable" housing landscapes and the role of native vegetation

■ interviews with designers

Where housing sites have involved architects and landscape architects, the designers involved in the external decisions will be interviewed on the following questions:

■ major influences in using native plants:
books

teachers / educational institutions / courses
televisions programs
radio programs
newspaper articles
journal articles
friends
neighbours
travel experiences
visits to public gardens

- What have been their primary inspirations in the use of native plants?
- Has the choice of plant material been directedy by concerns for plant succession and conservation of biodiversity or for the ornamental characteristics of native plants?
- How do they specific the retention of native plants?
- How do they specify the installation of native plants?
- review of plan for respective housing landscape site
- review of the goals, objectives, and program for the respective housing landscape site
- perceived barriers to use of native plants
- preferred strategies to overcome barriers
- evaluation of their own effectiveness in using native plants for respective housing site
- How many designs have you completed and that have been built did you do before this site?
- What other experts did you involve in design development? biologist / ecologist? hydrologist? horticulturalist? others?
- What was your order in the overall design of the housing site?
- extent of awareness of supplier of native material and sustainable technologies
- extent of knowledge of the precise locational / genotypic sources of the plant materials
- their definition of "sustainable" housing landscapes and the role of native vegetation

■ municipal officials

The municipal and other local government officials, with jurisdictions for particular sites, will be interviewed on the following questions:

- review of municipality's history of heritage trees and other plant conservation with local interpretations and standards;
- local policies for water conservation in outdoor landscapes;
- local policies for minimization of garden-associated pollution;
- local policy for conservation of natural habitat and biological diversity;
- local policy for connectivity of open space / green space;
- relevant decisions about native plants and housing sites;
- perspectives on obstacles to greater reliance on native plants in housing landscapes;
- role of public pressure for retention and installation of native plants;
- their major influences in their perspectives on native plants:

books
teachers / educational institutions / courses
televisions programs
radio programs
newspaper articles
journal articles
friends

neighbours
travel experiences
visits to public gardens
■ their definition of "sustainable" housing landscapes and the role of native vegetation

■ representatives of societies and organizations

Various members of local garden, housing, and environmental groups will be interviewed with an emphasis on the following questions:

■ perspectives on local history of conservation;
■ perspectives on policy for water conservation in outdoor landscapes;
■ perspectives on policy for minimization of garden-associated pollution;
■ perspectives on policy for conservation of natural habitat and biological diversity;
■ perspectives on local policy for connectivity of open space / green space;
■ perspectives on relevant decisions about native plants and housing sites;
■ perspectives on obstacles to greater reliance on native plants in housing landscapes;
■ perspectives on strategies for bringing public pressure for retention and installation of native plants;
■ their major influences in their perspectives on native plants:

books
teachers / educational institutions / courses
televisions programs
radio programs
newspaper articles
journal articles
friends
neighbours
travel experiences
visits to public gardens

■ their definition of "sustainable" housing landscapes and the role of native vegetation

■ managers and maintenance personnel

For the larger projects, with maintenance professionals, semi-structured interviews will emphasize the following questions:

■ extent of involvement in site;
■ extent of commitment / responsibilities for the site;
■ their land ethic was related to conservation;
■ current maintenance procedures in terms of:

labour
pesticides
herbicides
chemical fertilizers
compost / mulch
pruning / thinning / tree maintenance;

■ perceived benifits of native vegetation;
■ current management problems;
■ projected management problems;

■ define what is aesthetically acceptable on the continuum between unmanaged and weedy versus heavily manicured;
■ their definition of "sustainable" housing landscapes and the role of native vegetation

■ nursery personnel

The sources of installed native plants will be identified and some managers will be interviewed with an emphasis on the following topics:

■ their definitions of native plants;
■ the extent of their knowledge of the locational sources of the material;
■ list of the "native plants" that they sell and their catalogue;
■ extent of the nursery's involvement in procurement of native plant material for propagation
■ extent of the nursery's involvement in propagation of native plant material;
■ what species have they been willing to propagate and market and why?
■ what percentage of their business is from sales of native material?
■ what percentage of this business is for housing?
■ their definition of "sustainable" housing landscapes and the role of native vegetation

Contacts

■ municipalities and other governments

The relevant offices in the following governments will be contacted.

City of Vancouver
Municipality of Richmond
Municipality of Delta
Municipality of Burnaby
Municipality of Surrey
Corporation of the District of Saanich
Corporation of the District of Central Saanich
Corporation of the District of North Saanich
Corporations of District of Oak Bay
City of Victoria
Municipality of Esquimalt
Greater Vancouver Regional District
Capital Regional District
Islands Trust

■ agencies and organizations

The following technical and advocacy organizations will be contacted.

BC Conservation Data Centre, Victoria
Victoria Natural History Society
Garry Oak Meadow Society
Burns Bog Society
Shaunessay community group
Garry Oak Working Group (City of Victoria)
Greenways initiative (Provincial Capital Commission)
Special Ecosystems inventory project (Capital Regional District)

■ nurseries

Maureen S. Kruckeberg, MSK Nursery
Pacific Nursery in Vancouver
Reid Collins in Vancouver
Project Acorn, Pacific Forestry Project, Victoria

Garden site selection

Atleast 20 to 30 sites will be assessed. The represent a wide range of environmental, housing, and social conditions. We are selecting a set of sites that primarily represent these categories.

Housing types
1. high density apartments
2. multi-family townhouses and semi-detached houses
3. subdivisions of single family homes

Vegetation associations
1. Douglas fir - Western hemlock - Red cedar
2. Douglas fir - Arbutus
3. Garry oak meadow
4. Pacific crabapple woodland
5. riverine woodland
6. beach strands

Within the matrix formed by these two lists, we will attempt to choose the most widely representative set of sites as possible based on the following factors:

geographical representation
1. lower mainland
2. Gulf Islands
3. southeastern Vancouver Island

ecosystems
1. forest
2. woodland and meadow
3. riparian and wetland
4. shore

topography
flat to steep

aspects
southwest
northeast
northwest
southeast

soils
hydrology: wet and dry
texture: rocky, clay, and sand

successional phases
early / mature / old-growth
natural / heritage / cultural modified

original native vegetation retained / native vegetation planted

Social groups
families
singles
women
children
elderly
youth
disabled
specific cultural groups including Native and non-English-speaking