Campus Landscape Study: The Conversion of Turf Areas to Alternative Forms of Ground Cover.

By: S. Hassan

FOR: Environment and Resource Studies 675 C

Professor J. J. Kay

Table of Contents

1. Introduction

The purpose of this study is to examine the possibility and means of converting areas of turf on the University of Waterloo campus to alternative forms of ground cover. The study was undertaken as the university administration expressed some interest in investigating the possibilities of converting turf. This study follows a series of student projects and reports dealing with different issues of the University of Waterloo campus. It thus attempts to build on the work of previous groups and complement this with a practical next step. In addition to providing a review of relevant material, this report provides a practical tool for campus site inventories, suggests appropriate plant species, and recommends planting practices.

The report begins by identifying the primary reasons for the study, the study area, and the primary client. It continues by presenting the background research to the study and the implications of these findings. The section reviews work completed at or for the University of Waterloo and similar initiatives by outside organizations. The report then relates these findings to the needs of the primary client, namely Plant Operations: Custodial and Grounds.

The report moves on to discuss criteria and a process for converting turf areas. This section provides a sample site analysis form that can be used by Plant Operations as it examines different areas of campus. Following this, plant species selection is discussed. The section includes a Plant Chart of suitable species for various planting conditions on campus. The final section of the study makes recommendations with regards to how to deal with specific conditions on campus.

1.1 What and why

The primary purpose of this study is to create a framework whereby the University of Waterloo Plant Operations Staff can identify turf grass areas on campus that are suitable for conversion to other forms of ground cover. It

examines criteria that may influence the process of conversion of turf areas. The study also provides the necessary information to begin implementing turf conversion on campus.

There are ecological, economic, and social reasons for converting turf areas. A number of prior student reports - discussed later in this study - deal with these issues in great detail. However, very briefly stated, from an economic and ecological perspective turf grass lacks biodiversity and is extremely demanding of inputs of energy, time, physical and financial resources. In some locations turf grass is 'maintained' with large fertilizer and pesticide application - this practice has largely stopped at the University of Waterloo. In times of reduced budget expenditures, the inputs required to maintain turf can be extremely taxing. It, therefore, seems appropriate to consider less consumptive alternatives. From an aesthetic point of view, turf areas are often criticized for a lack of diversity that makes them dull. As all of these issues have previously been discussed, thus this study does not address them in any detail. Instead it moves on and examines how to convert turf areas at the University of Waterloo as well as, appropriate species for doing so.

1.2 Study Area

The primary study area is the portion of the University of Waterloo campus within Ring Road. This part of campus contains the majority of campus buildings and services. The 'manicured' campus landscape includes groupings of trees, some planting beds, hard paths, and large areas of turf. Instead of examining particular locations, this study looks at specific ‘conditions’ found within Ring Road. As many of these conditions also exist in other parts of the University campus, the findings should be transferable beyond the study boundary. There are a number of areas within Ring Road that have been identified as future building locations or locations of outdoor recreation. These areas do not form part of this study.

1.3 The 'Client'

The primary client for this study is the University Plant Operations – Custodial and Grounds Department. They have the primary responsibility of caring for and maintaining the campus grounds. They also have the most complete knowledge of what is feasible and needed on campus. Plant Operations has identified priority 'problem' areas for which they would like suggestions. The report attempts to address this need and provide information that is easy to use, pertinent to their needs, and readily implemented on campus.

It is also recognized that students, staff, and general public, as users of the campus, can be considered clients of Plant Operations. Their views are, therefore, important and should be taken into account. This need is addressed through the use of previously conducted surveys.

2. Background Research and Findings

This section reviews and examines previous research related to the University of Waterloo campus landscape, naturalization, and greening initiatives. It begins with work completed at the University of Waterloo and moves on to examine the findings of other institutions and organizations.

2.1 UW Research and Reports

Different groups at the University of Waterloo have examined many aspects of the University campus landscape. WATgreen reports, student projects, books, articles, and the Campus Master Plan, all deal with creating an alternative to the existing University of Waterloo campus. Following is a general overview of the material and its use for this study.

An overriding theme in the WATgreen reports, which span the years from 1991-1998, is environmental sustainability. This theme is the primary motivator for examining the University of Waterloo campus landscape. The reports deal

mainly with issues of turf grass management and campus landscaping in the South Campus area. As background, many of the reports examine the history of the campus landscape. They repeatedly describe the landscape as a park like setting with grass, tress, and a few shrubs. The reports suggest that considering alternatives to the existing landscape form and practices is appropriate.

The majority of the reports deal with issues of turf grass management and alternative landscaping. "A Rationale for the Establishment of Alternative Landscape Practices Based on an Ecological Approach at the University of Waterloo" (1991) is an early report that examines concepts of sustainability and alternative landscaping. Among the sustainable landscape practices that it advocates are "that the landscape meet its own resource requirements and that energy intensive practices, such as the use of annual species is strictly limited or eliminated" (1991, 28). The report goes on to establish ecological, educational, research, community, and technical objectives of ecological landscaping. It also examines a number of related case studies. This report was followed by the "WATgreen Study on Alternative Turf Grass Maintenance Strategies" (1993). This project aimed "to determine the existence and viability of new or alternative turf grass maintenance practices" (2). The work included an extensive study of the experiences of other institutions and an examination of the applicability of these to the University of Waterloo. These two reports and subsequent documents adequately deal with the rationale and feasibility of alternative landscaping. As suggested by the first document, "future student projects should deal with planning, design, and the implementation of alternative landscaping" (1991, 67).

2.1.1 Alternatives to Turf

Many texts suggest that there are aesthetic, economic, and environmental reasons for converting turf to alternative forms of ground cover. These reasons include:

- the desire to reduce energy consumption

- the desire to reduce chemical use and irrigation requirements
- the desire to increase species diversity
- the desire to reduce maintenance

Many of these reasons are highly applicable to the university campus. For example, the Turf Grass Maintenance Action Plan (Department of Plant Operations and Grounds 1994) states that irrigation on campus is difficult due to water restrictions and bans. It seems, therefore, important to use drought tolerant plant species as much as possible. "Bridges to Sustainability" (1996) prepared by the ERS Graduate class provides a valuable review of the history of turf grass management on the University of Waterloo campus. This includes a discussion of the development of the Turf Grass Management Committee and the resulting actions on the campus.

Of the WATgreen reports, few deal with the practical aspects of converting turf areas. However, Section Seven of “Bridges to Sustainability” (1996) provides useful information about various alternatives to turf. It discusses a number of options that include; natural regeneration to a native grassland landscape, modified natural regeneration, wildflower meadows, and ground covers. Each of the options is discussed in some detail and plant species choices are given for certain options. The plant species choices indicated would be more useful if detailed growing conditions were given for each. This study attempts to address this by providing a detailed plant chart of species useful for the university campus. Not all of the alternatives presented in “Bridges to Sustainability” are suitable for this study however, the general information and case study examples are useful references.

2.1.2 Campus Trees

There are three reports that examine the state of trees on campus. These reports are “Preliminary Tree Inventory for the University of Waterloo Campus” (1994), “ An Analysis of the Austrian Pines of the University of Waterloo Campus” (1996), and “A Campus Tree Inventory” (1998). The reports explain that there is

little species diversity within the trees on campus. They also explain that the existing tree species are primarily exotic. The reports recommend increasing species diversity, increasing the use of native vegetation, and actively planting trees to enhance the campus environment. These points are echoed in the Campus Master Plan (Berridge Lewinberg Greenberg Ltd. et al. 1992) that advocates the use of native plant materials and "the development of a more sustainable version of the formal landscapes on campus" (1992, 23). It also suggests that future designs should create naturalized, low maintenance settings, and encourage ecological approaches, with self-sustaining natural and formal landscapes. These recommendations are taken into account in this study.

2.1.3 Bare Berms

The report "Bare Berms on Campus" (1997) focuses on the existence of 'desire lines' on campus. The report identifies the problem condition of bare soil paths as both an aesthetic and ecological concern. The areas of bare soil cause problems of soil erosion and compaction, plant root exposure, and damage to the surrounding vegetation. The report suggests developing a campus path network based on 'natural landscaping techniques' that would include extensive understory planting in order to discourage the continued use of the paths. The study presents a number of valuable ideas, in particular the suggestion of increasing the biodiversity of campus vegetation. Further study would, however, be useful in order to determine the practicality of implementing the suggestions.

The above studies lay the ground-work for this project. Although they are not all immediately relevant to the work of this study, they valuably present a number of guiding principles. They suggest that alternatives to the current campus landscape are feasible. The alternatives should seek to increase the ecological diversity of the campus landscape. They should function to reduce campus energy consumption, irrigation requirements, and maintenance inputs. Any changes to the landscape should also acknowledge the interests of various campus users.

2.2 Other Sources of Information

Apart from the material produced at or for the University of Waterloo, a number of other sources of information where consulted. The WATgreen and Campus Ecology web sites have a number of links to additional sources of information on campus greening and naturalization. Universities and colleges, with student groups or faculties interested in campus sustainability, maintain many of these sites. Other institutions, such as conservation authorities, municipal and regional governments that have implemented naturalization programs often maintain similar web. There are also a number of landscape related journals which, on occasion, deal with the topic and issues of naturalization.

These are all valuable sources of information. Typically, the documents focus on the value, motivations, and positive experience of becoming a 'greener' more sustainable entity. However, it is relatively difficult to find practical 'how to' information for converting turf areas to other forms of ground cover. Few sources discuss the steps, techniques, or species most appropriate for this process.

One exception to this is Hough (1995), who talks extensively of urban woodland restoration and naturalization in *Cities and Natural Process*. Woodland restoration is not a priority for the areas of campus included in this study. It could, however, be considered for other parcels of campus and examined in more detail in future studies. In such a case, the volume by Hough is a useful source of information. It discusses woodland establishment "based on a principle of natural succession speeded up and assisted by management" (1995, 114). Hough describes a three-phase process by which this is accomplished and illustrates the techniques using examples from the National Capital Region, in Ottawa. The document "Bridges to Sustainability" similarly discuss some of these techniques and makes reference to the work of Hough. The City of Kitchener has also produced an extensive master plan for woodland restoration and conservation that could be reviewed should the University choose to undertake any similar initiatives.

Some resources suggest strategies for the analysis and design of naturalized areas. With the exception of a paper by Hilsenrath et al., most of these are extremely site specific. The Hilsenrath et al. paper proposes design guidelines for native plantings and restored ecosystems. Their guidelines are described as "transitional steps between the highly-managed ornamental landscapes…and ecologically diverse habitats" (1997, 95). Their "recommendations for designing naturalized landscapes that look cared for without being over managed" (95) are as follows:

(1) Selective mowing: for areas that are reverting to natural habitat, mow the edges along the roadway. This conveys the idea that the remaining area is being intentionally left unmowed.
(2) Large masses, Bold patterns: people respond positively to bold, clearly-visible patterns.
(3) Bright flowers; plants with larger, brighter flowers gain notice.
(4) Sign and symbols: educate passers by to the intent of a natural or ecological landscape management approach with signs…other clues such as birdhouses and wildlife feeders can provide an effective message using familiar symbols.

(Hilsenrath et. al. 1997, 94-95)

This resource does not explain ‘how to’ naturalize but it does offer valuable suggestions that would help a project to meet with the greatest possible public approval. The principles should be considered by Plant Operations when they choose plant material and management practices. If woodland restoration as described by Hough is considered, the principles established by Hilsenrath et al. will also prove to be valuable.

As many of the resources describe initiatives that are relatively recent, there is little documentation of long-term monitoring and project evaluation. Therefore, beyond the initial enthusiasm and implementation suggestions, it is difficult to

track the long-term successes or failures of the projects described (Metropolitan Toronto and Region Conservation Authority, Parks and Recreation Department - City of North York). This difficulty is both a result of the fact that many of the projects are too new for there to be any long-term data and that in others there has not yet been a thorough follow-up on the initiatives. As a result, it is difficult to find a suitable and proven precedent on which to base new initiatives at the University of Waterloo.

In the few cases where detailed information is given, the material is of moderate use as it is not local. The plant species suggested, the issues and concerns identified, and the techniques implemented are not transferable to Southern Ontario; what is appropriate in Florida or California can not be readily applied to the University of Waterloo. This problem is particularly true of documents that deal with planting techniques and plant species choices. The document *Backyard Habitats Brochure* (Federation of Ontario Naturalists) is an exception to this. In conjunction with more technical plant species texts, it can be used to select species suitable for various campus locations.

The main value of these resources is, therefore, that they show that naturalization efforts are both possible and feasible. Given the absence of suitable precedents, any efforts at the University of Waterloo will have to adopt an attitude of innovation, initiative and experimentation. The University has already adopted this attitude in some of its efforts at increasing the sustainability of campus. The stream-bank regeneration projects, the Dorney Garden, and the 'no-mow' areas around campus are the most notable examples of this.

The documents also highlight the importance of biodiversity, the need for locally relevant information on suitable plant species, and the fact that aesthetic considerations are important as they impact the user acceptance of new and alternative planting initiatives.

2.3 Views of Concerned Parties

2.3.1 The Use of WATgreen Surveys

This study does not include a general survey of the university community concerning its views and opinions with regards to the state of the University of Waterloo campus landscape. However, as previously mentioned the university community can be considered a "client" with an interest in the nature and state of the University campus. To account for this, material and studies previously undertaken were used to ensure that community views were kept in mind. To this end, certain opinions have been derived from surveys of the university community - staff, students, and others who frequent the campus - in the WATgreen reports. The results of the surveys repeatedly highlight the importance of a ‘safe’, ‘aesthetically appealing’, and ‘ecologically sound’ campus environment. The term 'safe' is generally used in reference to night time security. There are wide interpretations of what is considered aesthetically appealing. The report “Master Plan and Landscaping of the University of Waterloo Campus” provides an example of possible interpretations as the stakeholder / student survey indicates a desire for “more flowers / more colour, more wooded areas / trees, and more places to sit”. This could be interpreted to mean that the respondents enjoy a highly manicured landscape, it could also be understood to mean that they would favour areas of naturalization. When asked about campus ecology, many of the surveyed individuals indicate that they would like the campus to be ecologically sound. They, however, give no indication of what this entails beyond reduced chemical use on campus. Finally, the surveys indicate that certain turf areas on campus are valuable for recreation as they are used and enjoyed by survey respondents. These are particularly indicated to be large areas suitable for sports such as ultimate frisbee, as well as casual games of soccer and football. The surveys are valuable as they indicate that the university community is concerned about the nature of the campus landscape. The most important points to keep in mind are the desire for a ‘safe’, ‘aesthetically

appealing', and 'ecologically sound' campus environment. These points must be considered as the university begins to alter the campus landscape.

2.3.2 Plant Operations - Custodial and Grounds

The WATgreen report "A Rational for the Establishment of Alternative Landscape Practices Based on an Ecological Approach at the University of Waterloo" states that Plant Operations is to "maintain the ideals of the original plan" for the campus landscape (1991, 18). Although this may be the case and is still possible, since the conception of the original landscape plan, landscape practices and the requirements of Plant Operations have changed. One example of this is the change of attitude towards chemical spraying and the drastic reductions in chemical use on campus.

Discussions with individuals in Plant Operations have highlighted a number of their primary concerns with regards to the campus landscape. Plant Operations has indicated that the ease, functional requirements, and costs of maintenance are important. Campus aesthetics are also a prime concern, particularly when they concern high profile areas. Plant Operations expressed that naturalization and the use of native species is acceptable in the right situations but, is not a high priority for the campus.

On a more specific level, Plant Operations has indicated that budget cuts and reduced resources make high maintenance landscape practices unfeasible. There are turf areas on campus that are unsightly and demand excess inputs of time and resources. Plant Operations would like specific proposals for converting these areas to other forms of ground cover. In particular, Plant Operations has identified: (1) areas where turf grows poorly due to compaction, pest and disease problems; (2) locations where the slope angle makes maintenance difficult; (3) areas where small patches of turf make mowing an unnecessary annoyance; and (4) the planting islands in campus parking pots as priorities for conversion. Many of these conditions are characterized as being

compacted, dry, and difficult to access. As a result, turf grows poorly or is difficult to maintain. For this reason, Plant Operations would like to see suggested alternatives. The planting discussed later in this report focus on species that are able to tolerate the difficult growing conditions identified.

There are specific areas that should remain turf covered. These include formal and informal playing fields, areas used for outdoor functions such as orientation events, and areas that pose no mowing problems. This project attempts to focuses specifically on the needs of Plant Operations and on the problem conditions that they have identified. It discusses social, ecological, and economic criteria and issues that could affect whether or not areas of turf are converted and how this process occurs.

3. Issues to Consider in Converting Turf Areas

Before any area of turf is converted to another form of ground cover there are a number of questions, often specific to each of the areas identified, that should be addressed. The questions might include; how is the area currently used, who uses the area, and how often do they use it? Other questions may deal with the ecological condition and biodiversity of the area. The following section discusses campus users and criteria for conversion.

3.1 Campus Landscape Users

A knowledge of the users as well as their interests and concerns will help to inform the suitability of different alternatives for dealing with the campus landscape. Briefly given below is a sample of the individuals who have an interest in the campus landscape and the issues that may concern them. The issues, many of which are common to all the users, can be generally categorized into economic, social, and ecological concerns.

3.1.1 Administration

Concerns / Issues

- the aesthetic appearance of the landscape – particularly at key times such as convocation
- the ecological condition and sustainability of the landscape – particularly as it may impact human health
- the impact of time and energy inputs on the university budget

3.1.2 Custodial and Grounds

Concerns / Issues

- the safety of working conditions
- the health of workers
- the aesthetic appearance of the landscape
- time and energy inputs – particularly as they may impact operating budgets
- the ease of maintenance – particularly as it may affect worker safety

3.1.3 Students and Staff

Concerns / Issues

- the provision of space for outdoor recreation
- the aesthetic appearance of the landscape
- the ecological condition and sustainability of the landscape
- the safety and security of day and night use of the campus

3.1.4 Other Users / Visitors to Campus

Concerns / Issues

- the aesthetic appearance of the campus
- their personal health and safety when visiting the campus
- the existence of opportunities for recreation - i.e. community use of green spaces

3.2 Establishing Criteria

Building on the previous sections of this study, the following section elaborates upon the social, economic, and ecological issues that will affect what is done to any portion of the campus landscape. The ideas presented could be used to evaluate each area considered for conversion in order to determine what is most suitable and thus, to guide the conversion of turf areas. The answers to the questions may affect whether and how areas are converted.

3.2.1 Social criteria

Aesthetic considerations:

Many previous studies highlight the importance of an aesthetically pleasing campus. The document by Hilsenrath at al. suggests that aesthetically pleasant areas will increase user acceptance of new planting initiatives. The following points should be considered in judging the aesthetic quality of areas being considered for conversion.

(1) General turf condition - poor turf conditions may indicate an opportunity for conversion to alternative species and increased biodiversity
(2) Presence of bare spots in turf – may be considered unattractive and warrant consideration for alternative species
(3) Presence of insects / disease in turf – may impact the health and thus visual appearance of the turf
(4) Presence of weeds / unwanted species – may impact the visual appearance of the turf
(5) Visibility of location to the public - high visibility areas that are in poor conditions should receive high consideration for conversion
(6) Aesthetic views to and from the area - if aesthetic views exist, these should be capitalized upon by providing an attractive planting area
(7) Opportunities for seating in pleasant microclimate - areas with a pleasant microclimate could be considered for conversion to seating / gathering areas

Safety and security considerations:

It is important to consider the safety and security of both the individuals responsible for campus maintenance and those using the campus landscape. The following conditions may affect the safety and security of the landscape.

(1) Slope angle steep for mowing / walking – steep slopes should be considered for conversion as they pose a risk to the safety of campus users

(2) Ease of access / maintenance – steep slopes are difficult to maintain with ease

(3) Isolation of area - it is important to maintain visibility to all isolated areas, plantings that have the potential to obscure views should not be considered

(4) Existing vegetation heights and densities - it is essential to maintain site lines into and out of areas on campus

(5) Proximity of planting areas to pathways – plantings that may obscure clear or important site lines should not be considered

3.2.2 Ecological criteria

(1) Current vegetative diversity - areas with poor diversity could be considered for additional plantings in order to increase species present in the area

(2) Current water demands – areas with a high water demand could be considered for conversion to species with a low water budget

(3) Current level of energy demand – areas which currently demand heavy inputs of time and energy could be considered for plantings which limit this demand

(4) Presence of roots / objects that inhibit digging – this may affect the ease of implementing new plantings and may reduce the ability to increase species diversity

(5) Circulation patterns – heavy pedestrian circulation in an area may result in trampling of newly planted species – if the area is to be planted there should be a method to limit pedestrian circulation in the area

3.2.3 Economic criteria

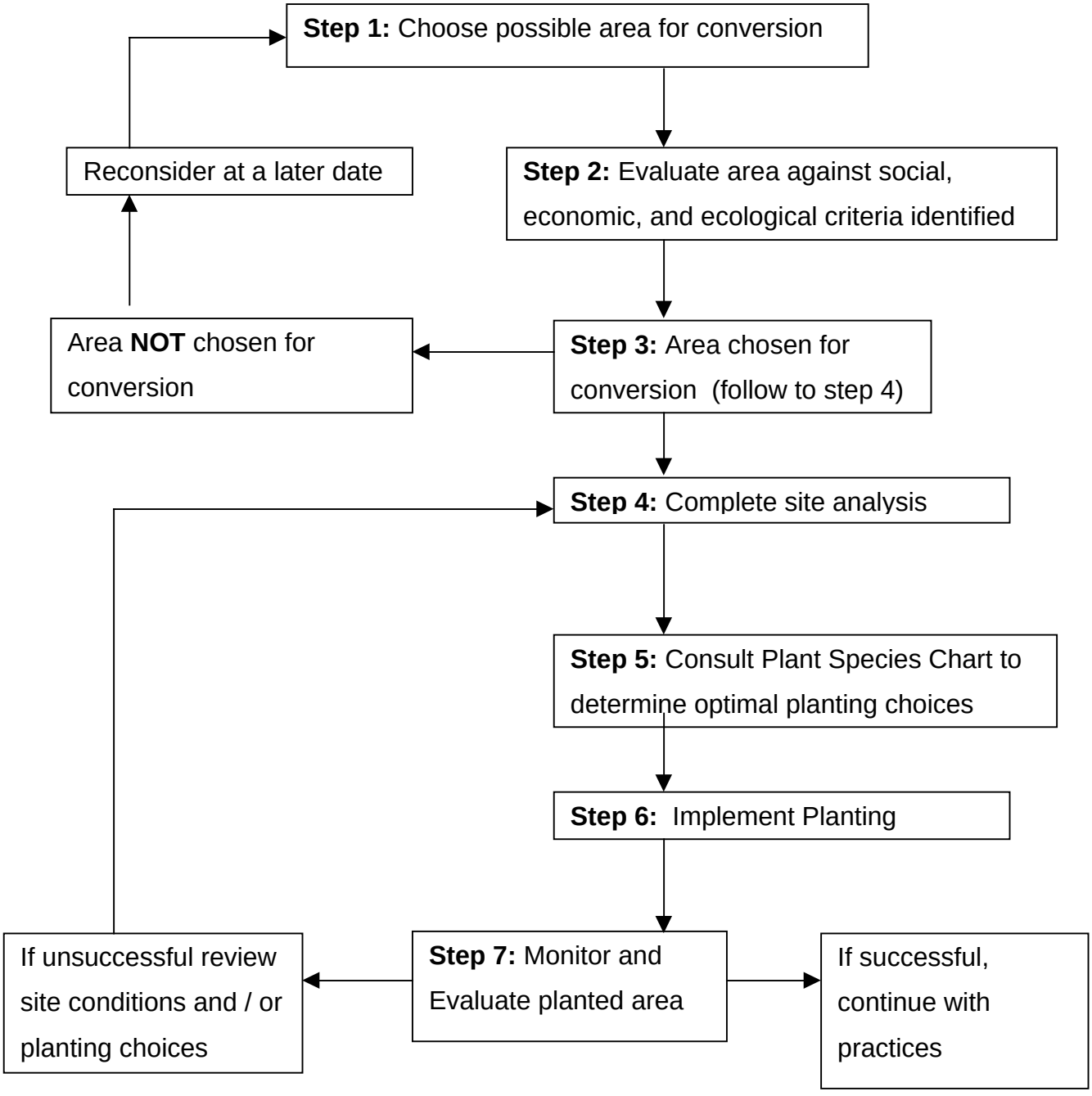
(1) Size of area with regards to mowing practices – mowing small area may prove to be inconvenient and time consuming and may warrant conversion from turf

(2) Current level of demand of energy and resources – if these are high for any particular area, the area should be considered for conversion to a less demanding alternative

The responses to the above issues may affect whether it is suitable and feasible to convert an area form turf to another form of ground cover. The sloped piece of land on the West side of the Physical Activities Building (PAC) can be used as an illustration. The site lies between the PAC and Ring Road. A small parking lot and a recently redesigned seating area front it. The slope receives full sun exposure and is covered with turf only. The slope is relatively steep and could pose a safety concern either for individuals mowing the area. The turf on the slope seems to be in poor condition. Individuals at Plant Operations have suggested that dry summer conditions have led to grub infestations of the area. This, in turn, has led to poor turf growth and there are numerous bare patches. Not only is this unsightly but, it could also lead to problems of soil erosion on the site. As the slope faces an area that is used for gathering during convocation, it is important that the area appear well maintained. It seems as though are adequate reasons to convert the area to another form of ground cover. A switch could additionally increase species diversity in the area and prevent people from using the steep slope a short cut.

The chart on the following page describes a simple process that could be used for the conversion of other turf areas on campus.

3.3 Turf Conversion Process



4. Site Analysis and Species Selection

Before selecting suitable species for planting, it is important to analyze the site conditions in each potential planting area. Site conditions dictate the most appropriate species for each area. In some cases, the site analysis may reveal that the area is not suited to vegetative cover and that a treatment such as mulch may be more appropriate. The site analysis could also reveal that the area might benefit from practices such as soil re-mediation or soil preparation before planting.

Following is a simple Site Analysis form that can be used to inform planting choices. The form is based on the information retrieved in standard site inventory and analyses. As the form has not been designed specifically for the University of Waterloo campus, the responsible individuals at Plant Operations should feel at liberty to alter any portion of it to suit their needs.

Campus Landscape Site Analysis

1. Location on Campus: _____

2. Approximate Size of Area: _____

3. What currently covers the area?

- ❑ Turf
- ❑ Bare Soil
- ❑ Other (describe) _____

4. List vegetation in the area: _____

_____

3. Solar Exposure (circle / check one):

- ❑ Sun (5-6 hours of sun / day)
- ❑ Semi- Shade (3-4 hours of sun / day)
- ❑ Shade (0-2 hours/ day)

4. Soil Conditions (circle / check one):

- ❑ Permanently Wet
- ❑ Moist
- ❑ Average / well drained
- ❑ Dry / Sandy

5. Soil Compaction (circle / check one):

- ❑ Not Compacted
- ❑ Moderately Compacted
- ❑ Highly Compacted

6. Slope (circle / check one):

- ❑ Slight Slope (0 - 7% slope)
- ❑ Moderate Slope (8% to 25%)
- ❑ Steep Slope (26% +)

7. Is a large amount of snow dumped on the area?

- ❑ Yes
- ❑ No

8. Are there tree roots or other objects that will make digging difficult?

- ❑ Yes
- ❑ No

9. Is the area subject to 'urban conditions' - excess compaction, pollution, damage from heavy equipment?

- ❑ Yes
- ❑ No

10. What are the current uses of the area? _____

11. What are the potential uses of the area? _____

12. Other Notes / Comments:

4.1 Plant Species Selection

The information from the Analysis should be used to select appropriate plant species. This section contains a *Plant Chart* that suggests a range of suitable species for campus. To be considered for the *Plant Chart* species had to satisfy the criteria outlined below:

- Hardiness: The plants are hardy in the Waterloo area.
- Pests & Disease: The plants are not prone to pest or disease problems.
- Species: The plants are not known as invasive aliens in the province of Ontario and are not poisonous to humans or animals. The plants are suitable for massed plantings and will spread relatively quickly under the right conditions. The plants are generally long-lived and do not need to be replaced or re-seeded under normal conditions.
- Maintenance: The plants have relatively low maintenance requirements.
- Availability: The plants are readily available for purchase from Ontario nurseries and growers.
- Size: The plants do not exceed a height of 1.25m. This requirement addresses a concern for safety and security on campus and the need for clear sight lines. If Plant Operations deems species of 1.25m too high, the species can be removed from the choices on the Plant Chart. If there are areas in which larger material is deemed appropriate, suitable species can, similarly, be added to the chart. In such cases, it seems appropriate to indicate the specific conditions and circumstances under which taller material will be permitted.
- Aesthetics: Plants were considered if they looked 'good' for an extended period of time.

Additionally, the plant selection focuses on species suitable for problem areas such as parking islands, heavily sloped areas, and dry areas. Not all the plants listed will tolerate each of these conditions; the chart indicates those that are most suitable. The list derived by no means includes all the possible suitable

choices. A larger list of suitable species was narrowed in order to simplify the choices and planting decisions. Plants on the ‘short list’ were chosen as they satisfied all the criteria listed above and had additional desirable qualities such as further aesthetic qualities and extended bloom times.

From an ecological point of view, the larger list may be useful. However, based on practical implementation the given list should be sufficient. The list provides Plant Operations with a group of plants to choose from. It seems reasonable to test these plants in order to see how they perform. If they do not do well or if at a later date more variety is desired, then more plant species options could be explored.

Although it is often desirable to indicate the plant species that could be grouped together to form ecologically self-sustaining patches, this report refrains from doing this. Making such suggestions might be possible in theory but implementation depends heavily on the actual site-specific conditions. Thus, what might work on paper may not be at all suitable for certain conditions. Once again, the Plant List is meant as a framework and a starting point. Beyond this, a certain amount of experimentation will be required.

5. Plant Chart

Plant Species Chart

Botanical Name	Common Name	height	spread	sun	semi shade	shade	spring bloom	summer bloom	fall bloom
Evergreen Shrubs & Broadleaf Evergreens									
Cotoneaster dammeri (?)	Bearberry Cotoneaster	10 cm	60 cm	_	_				
Euonymus fortunei	Euonymus	1.0 m	40 cm	_	_	_			
Juniperus spp.	Juniper	varies	varies	_					
Junieprus horizontalis	Creeping Juniper	varies	varies	_					
Deciduous Shrubs & Ground Covers									
Caragana aurantiaca	Dwarf Peashrub	1.2 m	1.0 m	_				_	
Cornus sanguinea	Red Dogwood	1.0 m	1.0 m		_	_			
Cornus sericea 'Kelsey'	Red Osier Dogwood	60 cm	60 cm		_	_	_		
Potentilla fruticosa	Cinquefoil	90 cm	90 cm	_				_	_
Rhus aromatica 'Grow-Low'	Fragrant Sumac	90 cm		_	_	_			
Spirea bumalda	Spirea	varies	varies	_	_			_	
Spirea japonica	Spirea	varies	varies	_	_			_	
Symphoricarpus albus	Broadleaf Snowberry	1.2 m	1.5 m		_	_			
Rosa carolina	Pasture Rose	1.25 m	1.25 m	_				_	
Rosa wichuriana	Memorial Rose	30 cm	30 cm	_				_	
Vines									
Parthenocissus quinquefolia	Virginia Creeper			_	_				
Grasses									
Andropogon scoparius	Little Bluestem grass	90 cm	75 cm	_	_				_
Deschampsia caespitosa	Tufted Hair Grass	75 cm	30 cm	_				_	_
Heliototrichon semperviens	Ornamental Oats	70 cm	60 cm	_				_	
Panicum virgatum	Switch Grass	1.0 m	80 cm	_	_				_

Plant Species Chart

Botanical Name	fall colour	drought tolerant	well drained soil	moist soil	slope stabilizer	native
Evergreen Shrubs & Broadleaf						
Cotoneaster dammeri (?)	_		_		_	
Euonymus fortunei	_		_			
Juniperus spp.			_			
Junieprus horizontalis			_			_
Deciduous Shrubs & Ground C						
Caragana aurantiaca		_				
Cornus sanguinea	_		_	_		
Cornus sericea 'Kelsey'			_	_	_	
Potentilla fruticosa			_	_		_
Rhus aromatica 'Grow-Low'	_	_	_		_	_
Spirea bumalda			_			
Spirea japonica			_			
Symphoricarpus albus		_	_		_	
Rosa carolina			_			_
Rosa wichuriana					_	
Vines						
Parthenocissus quinquefolia	_		_		_	_
Grasses						
Andropogon scoparius	_		_			_
Deschampsia caespitosa			_			
Heliototrichon semperviens		_	_			
Panicum virgatum	_		_	_		_

Plant Species Chart

Botanical Name	notes
Evergreen Shrubs & Broadleaf	
Cotoneaster dammeri (?)	
Euonymus fortunei	
Juniperus spp.	
Junieprus horizontalis	
Deciduous Shrubs & Ground C	
Caragana aurantiaca	
Cornus sanguinea	
Cornus sericea 'Kelsey'	
Potentilla fruticosa	
Rhus aromatica 'Grow-Low'	
Spirea bumalda	
Spirea japonica	
Symphoricarpus albus	good for dry, shady, or steep areas - limited ornamental value
Rosa carolina	
Rosa wichuriana	good slope cover
Vines	
Parthenocissus quinquefolia	suitable for ground cover
Grasses	
Andropogon scoparius	
Deschampsia caespitosa	
Heliototrichon semperviens	
Panicum virgatum	

Botanical Name	Common Name	height	spread	sun	semi shade	shade	spring bloom	summer bloom	fall bloom
Perennials									
Achillea millefolium	Yarrow	45 cm	60 cm	_				_	
Achillea ptarmica	Yarrow	50 cm	75 cm	_				_	
Ajuga reptams	Bugleweed	15 cm	60 cm		_	_	_		
Alchemilla mollis	Lady's Mantle	35 cm	60 cm	_	_		_		
Anthemis tinctoria	Golden Marguerite	75 cm	75 cm	_				_	
Asarum canadense	Wild Ginger	20 cm	45 cm		_	_			
Asclepias tuberosa	Butterfly Weed	60 cm	30 cm	_				_	
Asclepias incarnata	Swamp Milkweed								
Aster ericoides	Heath Aster	90 cm	90 cm	_					_
Aster novae-anglia	New England Aster	90 cm	90 cm	_					_
Astrantia major	Masterwort	70 cm	40 cm	_	_			_	
Boltonia asteroides	Boltonia	1.0 m	90 cm	_	_				_
Chrysogonum	Goldenstar	25 cm	60 cm	_	_	_	_		
Chrysopsis	Golden Aster	90 cm	50 cm	_					_
Coreopsis palmata	Stiff Coreopsis								
Echinacea angustifolia	Narrow Leaf P. Conefl.								
Echinacea pallida	Pale Purple Coneflower								
Echinacea purpurea	Purple Coneflower	80 cm	60 cm	_				_	
Fragaria vesca	Strawberry	15 cm	1.0 cm	_	_		_		
Fragaria virginiana	Wild Strawberry								
Galium odoratum	Sweet Woodruff	15 cm	45 cm		_	_	_		
Gaultheria procumbens	Wintergreen	15 cm	25 cm	_	_			_	
Geranium x cantabrigiense	Cranesbill	40 cm	30 cm	_	_	_		_	
Geranium macrorrhizum	Bigroot Geranium	20 cm	60 cm	_	_	_		_	
Hemerocallis spp.	Daylily	varies	varies	_	_			_	
Hosta spp.	Hosta	varies	varies		_	_		_	
Lamium maculatum	Spotted Nettle	20 cm	45 cm	_	_			_	
Liatris spicata	Dense Blazing Star	80 cm	30 cm	_				_	
Mazus reptans	Mazus	5 cm	30 cm	_	_	_	_		
Oenothera fruticosa	Sundrops	45 cm	60 cm	_				_	
Penstemon barbatus	Beard-Tongue	80 cm	45 cm	_				_	_
Penstemon digitalis	Smooth Penstemon	80 cm	30 cm	_				_	
Phlox stolonifera	Phlox	20 cm	30 cm	_	_	_	_		
Polygonum affine	Fleeceflower	25 cm	60 cm	_	_	_		_	
Rudbeckia fulgida	Gloriosa Daisy	60 cm	60 cm	_				_	_
Rudbeckia hirta	Black-eyed Susan	80 cm	60 cm	_	_			_	_
Sedum spectabilis	Showy Sedum	50 cm	50 cm	_				_	_
Solidago nemoralis	Gray Goldenrod			_					
Solidago rigida	Stiff Goldenrod								
Solidago speciosa	Showy Goldenrod								
Tiarella cordifoliia	Foamflower	12 cm	30 cm		_	_	_		
Walsteinia	Barren Strawberry	15 cm	45 cm	_	_	_	_		

Botanical Name	fall colour	drought tolerant	well drained soil	moist soil	slope stabilizer	native
Perennials						
Achillea millefolium		_	_			
Achillea ptarmica		_	_			
Ajuga reptams			_	_		
Alchemilla mollis			_	_		
Anthemis tinctoria		_	_			
Asarum canadense				_		
Asclepias tuberosa		_	_			_
Asclepias incarnata						_
Aster ericoides			_	_		_
Aster novae-anglia			_	_		_
Astrantia major			_			
Boltonia asteroides		_	_			
Chrysogonum			_			
Chrysopsis		_	_			
Coreopsis palmata						
Echinacea angustifolia						_
Echinacea pallida						_
Echinacea purpurea		_	_			_
Fragaria vesca		_	_	_		
Fragaria virginiana						_
Galium odoratum			_	_		
Gaultheria procumbens			_	_		
Geranium x cantabrigiense	_	_	_			
Geranium macrorrhizum	_	_	_			
Hemerocallis spp.			_		_	_
Hosta spp.			_			
Lamium maculatum			_			
Liatris spicata			_	_		_
Mazus reptans			_	_		
Oenothera fruticosa	_	_	_			
Penstemon barbatus			_			
Penstemon digitalis			_			_
Phlox stolonifera			_	_		
Polygonum affine	_	_	_	_		
Rudbeckia fulgida			_	_		
Rudbeckia hirta			_	_		_
Sedum spectabilis		_	_			
Solidago nemoralis		_	_			_
Solidago rigida						_
Solidago speciosa						_
Tiarella cordifoliia				_		_
Walsteinia		_	_	_		

Botanical Name	notes
Perennials	
Achillea millefolium	prefers a poor but well drained soil
Achillea ptarmica	prefers a poor but well drained soil
Ajuga reptams	fast spreading, attractive all season
Alchemilla mollis	prefers moist soil with organic matter, leaves attractive all season
Anthemis tinctoria	aggressive spreader, self seeding, good for large areas
Asarum canadense	requires soil rich in organic matter, slightly acidic ph
Asclepias tuberosa	
Asclepias incarnata	
Aster ericoides	good in urban conditions
Aster novae-anglia	good in urban conditions
Astrantia major	spreads quickly, tolerates dark shade in a moist soil
Boltonia asteroides	
Chrysogonum	tolerates dry shade, spreads quickly without being invasive
Chrysopsis	easy to grow in poor sandy sites
Coreopsis palmata	
Echinacea angustifolia	
Echinacea pallida	
Echinacea purpurea	
Fragaria vesca	spreads rapidly
Fragaria virginiana	
Galium odoratum	prefers rich, moist soil
Gaultheria procumbens	acidic soil, peaty, moist but well drained
Geranium x cantabrigiense	spreads rapidly
Geranium macrorrhizum	spreads rapidly, tolerates dry shade
Hemerocallis spp.	tolerates snow load, should be divided every 3-5 years
Hosta spp.	prefers rich moist soil, tolerates some drought once established
Lamium maculatum	fast growing and spreading, tolerates some drought
Liatris spicata	
Mazus reptans	
Oenothera fruticosa	tolerates infertile soil
Penstemon barbatus	
Penstemon digitalis	
Phlox stolonifera	fast spreading
Polygonum affine	
Rudbeckia fulgida	
Rudbeckia hirta	
Sedum spectabilis	better in rich soil
Solidago nemoralis	
Solidago rigida	
Solidago speciosa	
Tiarella cordifoliia	prefers moist rich soil
Walsteinia	

6. Recommendations for Specific Conditions

Generally speaking, each new area considered for conversion should be evaluated individually. Thus a site analysis should be completed and plant choices should be made based on the specific conditions. However, there are a number of conditions on campus for which simple, preliminary recommendations can be made.

6.1 Highly compacted sites

- Determine the cause of compaction and whether planting will solve or help alleviate the problem
- If compaction will likely continue regardless of planting determine whether it is better not to attempt to plant
- Ameliorate the soil if required (i.e. break up / de-compact soil)
- Determine suitable plant species for the specific conditions (i.e. compaction may warrant use of drought tolerant species)

6.2 Steeply sloped sites

- Determine whether the conditions are suitable for planting
- Choose plant material with fibrous root systems that will help to hold soil and reduce the potential for slope erosion
- It may be appropriate to plant through a slope cloth in order to prevent soil erosion while plants become established

6.3 Sloped sites with lots of roots

- Determine whether excessive root material and the slope angle will inhibit the growing environment of new plant material (i.e. Low moisture conditions may create high levels of competition, between established and new material, for surface soil moisture. Existing roots may also provide little room for root growth of new plant material).
- If the area is suitable for planting, it may be useful to plant through a slope cloth

- If the area is unsuitable for planting, non-vegetative options such as mulch cover could be considered

6.4 Areas with heavy snow load

- Woody plant species may be poor choices for areas where snow is piled (i.e. stiff twigs may be prone to breaking under the load)
- As twig structure of perennial species dies back for the winter, perennials may be more appropriate
- Although it is difficult to recommend specific perennials, daylilies are commonly know to be quite tolerant of snow load

6.5 Parking Lot Berms

- It is important to maintain good visibility and site lines in parking areas - both for safe driving conditions and issues of night time safety
- Appropriate plant heights and massings are critical to ensure visibility
- With this in mind, dense plantings and taller plant material should be avoided

7. Conclusion

This study examines the possibility and means of converting areas of turf on the University of Waterloo campus to alternative forms of ground cover. The document presents and builds on previous research and highlights the rationale for converting turf areas. It presents social, ecological, and economic issues that should be considered in the conversion process. It also identifies the different users groups and their interests in the campus landscape. The document presents three pieces of information that are meant to be practical and to aid in implementation. These items are the Flow Chart of suggested turf conversion process, the Site Analysis Form, and the Plant Chart. This material is meant to provide a basic framework and should be altered by Plant Operations as suits their needs. Based on this document, it seems as though there are opportunities for future research. This study could be continued by actually going through the

process of converting turf areas on campus. This would entail site selection, conducting a site inventory and analysis, choosing plant material, and planing the selected areas. Another option for further study would be to document the work done to date at the University of Waterloo. More specifically, this would involve examining areas that have been converted from turf to other plant material. Knowledge of what species where planted, the quantities installed, as well as the survival and growth rates could inform future planting decisions. It is hoped that continued research could help to create an ecologically sound, biologically diverse, and aesthetically pleasing campus landscape.

8. Works Consulted

Arnold, T., K. Druar, L. Hood, K. Lukavsky, C. Nishitoba, J. Steeghs, and E. Stephens (1996) Master Plan and Landscaping of the University of Waterloo Campus. University of Waterloo WATgreen Report.

Bamford, T., and J. Franssen (1994) Preliminary Tree Inventory for the University of Waterloo Campus. University of Waterloo WATgreen Report.

Berridge Lewinberg Greenberg Ltd. et al. (1992) Campus Master Plan: Framework for Development.

Bormann, F.H., D. Balmori and G. Geballe (1993) Redesigning the American Lawn: A Search for Environmental Harmony. Yale University Press: New Haven.

Bywater, J., B. Campbell, S. Cohoon, S. Cooke, T. Delmatto, and M. Gurr (1995) Riparian Buffer Design Study for Safety, Aesthetics, and Sustainability. University of Waterloo WATgreen Report.

Campeau, D., B. McIntosh, S. Ross, and I. Taylor (1996) An Analysis of the Austrian Pines of the University of Waterloo Campus. University of Waterloo WATgreen Report.

Cento, G., C. McLaughlin, J. Proud, T. Rehder and P, Smith (1991) A Rationale for the Establishment of Alternative Landscape Practices Based on an Ecological Approach at the University of Waterloo. University of Waterloo WATgreen Report.

City of Kanata - http://www.city.kanata.on.ca/

City of Kitchener - http://www.city.kitchener.on.ca/

City of Toronto - http://www.city.toronto.on.ca/

Connon Nurseries (1998) Plant Catalogue. Waterdown, Ontario.

Deane, Lloyd (1993) WATgreen Study on Alternative Turf Grass Maintenance Strategies. University of Waterloo WATgreen Report.

Department of Plant Operations and Grounds (1994) Turf Grass Maintenance Action Plan. University of Waterloo: Waterloo.

Dirr, Michael (1975) Manual of Woody Landscape Plants. Stipes Publishing Company: Champaign, Illinois.

Ecological Services for Planning (1992) Inventory of Environmental Resources: University of Waterloo Campus.

ERS 669 Graduate Class (1996) Bridges to Sustainability: Sustainable Landscape Maintenance at the University of Waterloo.

Federation of Ontario Naturalists (no year) Backyard Habitats Brochure. Federation of Ontario Naturalists: Don Mills, Ontario.

Gepraegs, R., B. Smith, and C. Manson (1997) Bare Berms on Campus. University of Waterloo WATgreen Report.

Hilsenrath, E., B. Harper-Lore, C. Adams and G. Hoer (1997) "Transforming Mid-Atlantic Highway and Transit Corridors". Paper for the American Society of Landscape Architects Opportunities in Development: Strategies for the Chesapeake Basin Conference. College Park, MD.

Hosie, R.C. (1990) Native Trees of Canada. Fitzhenry & Whiteside Ltd.: Markham, Ontario.

Hough. Michael (1995) Cities and Natural Process. Routledge: New York.

Loiselle, Paul et al. (1997) Catalogue of Perennial Plants. Kiwi Gardens: Perth, Ontario.

Mahler, D., and J. Walther (1988) "Habitat Restoration on a Central Texas Office Building Site". Paper for Environmental Restoration: Science and Strategies for Restoring the Earth Conference. Berkeley, CA.

Metropolitan Toronto and Region Conservation Authority (no year) Don Valley Brick Works Guide. Metro Parks and Culture: Toronto, Ontario.

Metropolitan Toronto and Region Conservation Authority (no year) Tommy Thompson Park Guide. Metro Parks and Culture: Toronto, Ontario.

Nassauer J. I. (1995) "Messy Landscapes, Orderly Frames". Landscape Journal 14 (2) pp. 161-170.

Parks and Recreation Department - City of North York (no year) "Integrating Nature Through Urban Forestry - Fact Sheet." North York, Onatrio.

Schmitz, E. (1994) Artistic Landscape Designs Ltd. - Catalogue of Plants. Ottawa, Ontario.

Schultz, W. (1982) The Chemical Free Lawn. Rodale Press Inc.: USA.

Toronto and Region Conservation Authority - http://www.trca.on.ca/

Tripp, C., and S. Keith (1992) Herbicide Use at the University of Waterloo: Practices, Attitudes, and Perceptions. University of Waterloo WATgreen Report.
Turgano, R. C. Galbrand, T. Latulippe, K. Blackburow, L. Cherevaty, and C. Hainsworth (1998) A Campus Tree Inventory. University of Waterloo WATgreen Report.

WATgreen meeting minutes.