

Union Bay Natural Area and
Shoreline Management
Guidelines, April 2009

Draft for Review



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University of Washington Botanic Gardens

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Executive Summary

This document serves to update the *Union Bay Natural Areas (UBNA) and Shoreline Management Guidelines*, published in 1995. It includes a number of guidelines and specific recommended management actions to achieve the long-term goals for this area. An inventory and assessment includes presentation of current conditions by sub-area.

Site

The combined area of UBNA and the University of Washington shoreline is 73.5 acres. Of that area, 14.4 acres have been restored primarily through student projects and volunteer labor. An assessment of the condition of the restored sites indicates that 6.9 acres are in danger of reverting to a weed-dominated condition; 0.9 acres are in need of efforts to restore to the desired condition. Resources are needed both to begin new restoration projects and to maintain previously restored areas.

Staff

UBNA is maintained by a staff gardener, less than 0.5 full time equivalent employee (FTE); faculty-supervised students in class work; volunteers; and a half-time Research Assistant (RA) for two academic quarters each year. The majority of the work is invasive weed control; classes and volunteer groups have performed most of the plantings. Contractors installed two shoreline projects (Dempsey Indoor Practice Facility and Conibear Shellhouse) for the University. Based on staffing rates listed in the Arboretum Master Plan for primarily low-intensity maintenance, the core areas of UBNA, the University Slough, and the shoreline will require 3.5 FTEs to provide an adequate level of maintenance and care.

Volunteers

Volunteer work is central to restoration and maintenance of the natural ecosystem that has developed in UBNA. The RA works almost entirely with students in courses with restoration as a component, as well as students in natural science courses that can take advantage of the site. Potential opportunities exist to restore, teach, and gain active support among interested community volunteers; however, a volunteer coordinator is needed to organize the work of volunteers and recruit new volunteers by taking advantage of public interest in restoration, nature, and horticulture. The volunteer coordinator's time could be shared among the programs of the

UWBG, with a certain percentage of time designated for work with UBNA; or be a restoration coordinator for the UW campus as a whole.

Site Improvements

The trails of UBNA are utilized extensively by the public and offer an important opportunity for teaching, outreach, and relationship-building between UWBG and the community. The trails follow Lake Washington's shoreline and extend through the managed and restored areas. An expansion of the trail system would increase the site's value and its utilization by the public. A loop trail is proposed for the northwest sub-area between wetland and grassland along the slough. Trail and boardwalk systems are also needed, both to access the lakeshore from the Center for Urban Horticulture by way of the small creek that runs into Lake Washington east of Shovelers Pond, and to open the swamp forest in the East Basin. The area behind the Center for Urban Horticulture would require only a short section of boardwalk, while the trail in East Basin would need at least 750' of boardwalk construction. These plans would be coordinated with state agencies responsible for shoreline management.

Site Expansion

Parking lot E-5 has been envisioned as part of UBNA for many years. Its gravel surface is similar to the substrate of natural prairies, and hence the site has great potential for becoming a restored South Puget Sound prairie ecosystem. Approximately one-third of E-5 was turned over to the Center for Urban Horticulture in the mid-nineties and now supports camas, Garry oaks, and Idaho fescue. The expected date to obtain the remainder of E-5 is 2016. The site is suitable for part of a future system of trails and native plant communities. Plant propagation may begin earlier in anticipation of restoration.

Structural Improvements

Structural improvements would add many desirable features to UBNA. These might include bird photography blinds, kayak pullouts, wildlife structures and feeding stations, trail drains; short paths with lookouts for access to wetlands, slough, and the shoreline; and interpretative signage.

Priority Items to Fund

- 3.5 FTE staff
- Volunteer Coordinator/Restoration Coordinator

- Two additional quarters support for UBNA Research Assistant
- Northwest Trail – 2160 feet
- East Basin Loop Trail – 590 feet dry, 750 feet boardwalk
- Center for Urban Horticulture South Trail to UBNA – 460 feet dry, 50 feet boardwalk
- Kayak pullouts
- Bird blind
- Solar trail lighting
- Blue emergency phones

Chapter 1: Introduction and Background

The Union Bay Natural Area (UBNA) is a keystone ecosystem site: as a point of interaction between terrestrial and aquatic systems, it is central to the functioning of a number of lakeside systems. Though it was severely degraded, the area is now an integral element in the second-largest surviving natural ecosystem along the shores of Lake Washington¹. The Union Bay Natural Area is open, free to the public, on a well-travelled hiking and biking trail, adjacent to Husky Stadium, and a major urban birding area. It is without a doubt a highly visible asset of the University of Washington (UW). The UW's restoration program and the Union Bay Natural Area have received national and international recognition.

Botanic gardens may have initially existed to showcase exotic plant species, but plant conservation has long been a mission of major importance to gardens. Restoration is an extension of conservation; it is what you do to protect the environment when there are fewer and fewer surviving natural systems to conserve. Restoration also allows a dynamic, on-site experience with environmental responsibility for members of the community. There is a natural connection between the UWBG study and practice of ecosystem restoration and the ecosystem-based collections at the Washington Park Arboretum. They are two parts of a whole: knowledge of what intact systems look like and the resources and knowledge that allow the reconstruction of damaged systems.

This document was produced to update the 1995 *Management Plan for the Union Bay Shoreline and Natural Areas* (referred to in this text as the *Management Plan*). The *Management Plan* contains maps, historical information, and a discussion of the regulatory environment in which the Union Bay Natural Area (UBNA) developed. It also recommended actions to reach the following overarching goals for the site:

- 1) To maintain and to restore biodiversity and ecosystem functions;
- 2) To increase wildlife habitat;
- 3) To increase research and teaching, and the coordination thereof; and
- 4) To increase the area's service to the public.

Furthermore, this document presents specific recommended actions, in addition to those previously discussed in the *Management Plan*, which would help managers assess the landscape and make informed management decisions.

¹ Mercer Slough in Bellevue is the largest.

(include UBNA map in this page)

Background

The Union Bay Natural Area is built upon an old cultural artifact of the Laurelhurst and University District communities: the Montlake Landfill or Montlake Dump. The dump lay fallow for decades after closing in the late 1960s. Several faculty members at the University envisioned it as part of the new Center for Urban Horticulture, a focus for University teaching, research and public outreach. In a letter proposing this vision, the faculty listed the attributes of the place: it was natural, open, ecologically diverse, and accessible. Almost as an afterthought, they added that it could become a *model for natural area restoration*. Forty years later, UBNA has become such a model; 35 restoration projects have been completed in this area, and over 1500 students have been trained in restoration ecology through UBNA's community-based restoration program, the University of Washington Restoration Ecology Network. This program has received national and international recognition, with a feature article in *Science* and the John Rieger Award from the Society for Ecological Restoration International.

Historically, the riparian systems comprised of Yesler Creek, Kincaid Ravine, and Ravenna Creek converged at what is now UBNA, and the flows of their substantial combined watershed created the delta upon which it sits. To the south, the large forested systems of the Washington Park Arboretum, Interlaken Boulevard, and Lake Washington Boulevard converge on the south shore of Union Bay. Between those two remnant systems lie the Montlake Cut and the Ship Canal, a passageway through which must pass all salmon that swim up the streams that enter both Lake Sammamish and Lake Washington. Conserving and restoring this important natural system is a critical task; the work at UBNA is a significant part of that effort.

Natural resource conservation is one of the main challenges of our time. More than 95% of global terrestrial ecosystems have been degraded or converted to urban and agricultural needs. There is more land to restore than there is to conserve; restoration now must play a vital role in sustaining global ecosystem health. The work of restoring UBNA can add an important habitat to the world's natural systems. The work that is done teaching restoration to students and showing neighbors the results of good land stewardship can multiply that total many fold.

The plan for restoring UBNA is based on working with nature. The land is dynamic and the surface contours have been changing since the landfill days. Ravenna Creek has been re-connected to University Slough, creating a now-living stream. For decades, students have pulled blackberries and planted native plants; woodlands, wetlands, and grasslands currently support diverse plant and animal populations. The overall management guidelines have been, and remain, to plant native plants and increase the site's natural diversity by creating complex habitat for as many creatures as can be supported.

Woody plant restoration projects often begin to yield results after 15 to 20 years. Before then, the woody plants compete with herbaceous invasives and devote significant energy into roots rather than leaf area. After that period, plants are able to put more resources into producing leaf area, biomass, and canopy, hence providing the restoration site with the benefits intended. According

to this principle, UBNA should now be reaching its golden age, where past work pays off in significant habitat improvement.

UBNA is first and foremost an outdoor laboratory of the University. All other outcomes result from the work that faculty, students, and staff provide in support of teaching and research. Using various techniques, UBNA can demonstrate to the public how restoration can change the landscape in a major metropolitan area.

The site has had many significant changes and many names over its short history, including Union Bay Swamp, Montlake Fill, East Campus, Union Bay Teaching/Research Arboretum, Union Bay Research Natural Area (which included the Ecological Research Area), and finally, the Union Bay Natural Area, or UBNA. UBNA is now part of the Center for Urban Horticulture, one of two sites of the University of Washington Botanic Gardens. The other site is the Washington Park Arboretum, jointly owned and managed with the City of Seattle.

Chapter 2: History of Site

Ravenna Creek once flowed out of Green Lake in a southeastern direction through what is now Ravenna Park before emptying into Union Bay. Ravenna Boulevard approximates the course that the old channel took out of Green Lake. Over the time period between the last glaciation and now, between 10,000 and 15,000 years ago, the creek deposited an underwater delta into Lake Washington; the mouth of the creek was near the location of the Burke-Gilman trail crossing 25th Ave NE. In 1911, at the recommendation of the Olmsted brothers, Green Lake was lowered about seven feet to provide additional parkland. As a result, the lake stopped flowing into Ravenna Creek. Since then, groundwater within Ravenna Park provides the primary flow into Ravenna Creek. The creek was subsequently disconnected by re-routing its flow into the sewer system near the lower end of Ravenna Park.

In 1916, the level of Lake Washington dropped by about nine feet with the construction of the Ship Canal; the lake level has subsequently been regulated with a single water control structure at Ballard's Chittendon Locks. With the lowering of the lake, the subaqueous delta of Ravenna Creek was exposed, and wetland vegetation began to colonize the area. The delta is now the location for the University Village shopping center and the University's E-1 parking lot, the golf driving range, intramural fields, the soccer and baseball stadiums, and the Union Bay Natural Area.

According to Dunn (1966), the Union Bay site was used as a repository for waste soon after the lake was lowered; infilling with rubbish started in 1925 (*Center for Urban Horticulture Draft Environmental Impact Statement* 1980) and the site opened for public dumping in 1933. It was hoped that the filled site eventually could be used for buildings or for other uses (such as parking by University of Washington students). The City of Seattle began formal disposal of domestic garbage in 1956. Because the deltaic deposits below UBNA initially were composed of as much as 50' of soft clay, 20' of soft peat, upon which 15' of wood fill and 20' of landfill were deposited, the surface began to subside. Today, it continues to subside, though rates of subsidence have slowed (Shannon and Wilson 2008). Methane was produced in large enough quantities to be flared from the site for several years after the landfill was closed and still is produced in sufficient quantities to require accommodations in both construction and facilities operation. The public disposal site closed in 1964, and garbage landfilling ceased in 1966. Filling, grading, and seeding of the surface continued until 1971. A University Advisory Committee on Arboreta selected the location in 1971 for a new arboretum site. The Master Plan for the Union Bay Teaching/Research Arboretum (later to become the Center for Urban Horticulture) was submitted to the University in 1976. Construction of the first CUH buildings (at the eastern end of the landfill area) began in 1983 and finished in 1984 (old Merrill Hall and NHS Hall). Isaacson Hall was completed in 1985 and Douglas Conservatory in 1988.

In 1972, the Ad Hoc Study Committee for East Campus Development made the following recommendations for the site, later summarized in the CUH Environmental Impact Statement (Union Bay Planning Committee 1994):

- 1) Maintain the marshy shoreline for its educational, recreational, wildlife, and aesthetic values.
- 2) Provide limited shoreline access.
- 3) Allow shoreline areas to settle and vegetate naturally.
- 4) Provide for ecological demonstration areas.
- 5) Retain the ponds (wetlands) to the extent feasible.
- 6) Reduce parking as permitted by lessening demand.
- 7) Improve the site with plantings.
- 8) Allow minimal building construction

These recommendations have been followed, and most objectives have been reached.

In 1976, the *Jones and Jones Master Plan* proposed that the landfill be used for plant collections and for landfill research. There would need to be protection of the ephemeral ponds, grasslands, associated wildlife, and remnant marsh (referred to as the Unmanaged Wildlife Area). Further, it was proposed that additional ponds and peat islands should be established and shrub and tree cover should be increased. The eastern channel should be re-excavated: University Slough is the west arm of a horseshoe-shaped drainage channel that once carried runoff from the landfill area into Lake Washington. In order to achieve the establishment and protection of this natural system, limits to access would be inevitable. The plan proposed a woody plant teaching collection along the east bank of University Slough.

The *Draft Environmental Impact Statement for the Center for Urban Horticulture at Union Bay* (1980) stated that the focus of the Center and its surrounding open lands would be activities to further urban horticulture: the study of plants as functional units to maintain and enhance the urban and suburban environments. The major portion of the site would continue to be open grassland (including parking lot E-5, converted to grassland—see map, Appendix A), utilized for passive recreation and interdisciplinary research projects compatible with the site's existing recreational and wildlife uses. The area would be lightly managed, and ponds would be retained. It was expected that new ponds would form with continued subsidence. A proposal to dredge the eastern canal was deleted from the Master Plan. An interpretive walk through the Unmanaged Wildlife area, shelters, new ponds, and artificial peat islands were also removed from the plan. The *Final Environmental Impact Statement* (1981) added little to the basic proposals for use of the site; shrub buffers would be planted between research collections, and grassland and deciduous trees valuable to wildlife would be planted.

In the early days of the Center for Urban Horticulture the capped landfill was used infrequently, but there were plans to begin developing the proposed woody plant teaching collection. Himalayan blackberry colonized the site and began to spread. An initial effort to clear and prepare the site for the proposed teaching collection caused some mortality among nesting birds, and bird-watchers complained to the President of the University. As a consequence, in 1986 a committee was formed to develop management guidelines for the then-designated Union Bay Research Natural Area, and Professor Eugene Hunn was appointed its chair.

A committee letter dated 14 May 1987 and entitled “Draft: Management Proposal for the Union Bay Research Natural Area of the University of Washington” outlined the goals and rationale for management (Hunn 1987). The natural area included the present day UBNA described in the Draft CUH EIS and included the adjacent shorelines under University control. The functions of the natural area were correlated with activities defining the mission of the University: teaching, research, and public service. The research value of the site was attributed to its ability to serve as a focus for the study of ecological processes, particularly in urban environments. Maintaining a diverse ecosystem close to the University provided research value. The public service value was as a public amenity with great views and excellent bird-watching. The characteristics that made it valuable in these areas were listed as:

- 1) a natural environment in an urban area
- 2) an open space, unusual for western Washington,
- 3) a diverse natural habitat, and
- 4) accessibility

A range of potential intervention levels for management was proposed. These levels ranged from minimal maintenance, to management to protect the character of the site, to intensive management for horticultural, silvicultural or other experimental or management regimes. Different parts of the site might be appropriate for more- or less-intense intervention. Whatever the level of management, it was clear that the prescribed level should be intended to preserve and enhance the valuable characteristics of this unusual place. A faculty manager was to be appointed to oversee the operations of the site, with the assistance of a committee of faculty who worked on or had interest in the site. Further, there was to be an advisory committee of faculty, staff, and neighborhood and community groups. Finally, under a section identified as a “vision for the future,” it was proposed that the area could be made into a national and international model of natural area restoration.

Initially, the University of Washington committee charged with recommending the goals and management requirements for the closed Montlake Landfill, around 1970, was focused on preventing erosion of the un-vegetated surface and resultant problems with dust and the

unearthing of fill materials. The committee prescribed broadcast seeding with a common pasture grass mix that contained an assortment of European grasses.

The Montlake Landfill Oversight Committee was formed by the University of Washington in 1999 to "provide administrative oversight of future landfill activities, track on-going development, and respond to public requests for information regarding the landfill." (Montlake Landfill Work Group 1999). The committee includes representation from relevant departments at the University of Washington, as well as the Seattle-King County Department of Public Health, Seattle Public Utilities, Washington State Department of Ecology, and Washington State Department of Health.

A study of the vegetation of the area in 1986 found 150 species of flowering plants and noted that "most vascular plant species on the Wildlife Area are not native." The study also found clumps of Himalayan blackberry and Scotch broom scattered across the open area (Huang 1988).

Ecological restoration of the site began in 1990 with the removal of purple loosestrife (*Lythrum salicaria*), from Shovelers Pond. This invasive species covered UBNA wetlands in 1990. Acres were removed by hand, but in the mid-1990s the Washington Department of Agriculture and the King County Noxious Weed Control Board cooperated in the experimental release of *Gallerucella* beetles on the site. *Gallerucella* is a genus adapted to feed on purple loosestrife in its native landscape. As a bio-control it was quite effective, reducing the very large number of loosestrife plants inhabiting every wetland in UBNA to a few widely spaced plants. The plants continue to act as hosts to the beetles, and the beetles continue to control the expansion of loosestrife.

In the mid-1990s the Himalayan blackberry posed an obvious threat to plant diversity. Blackberry bushes were 10 feet tall and pressed into the trail from both sides of Wahkiakum Lane. Comparison of sequential aerial photographs of UBNA showed Himalayan blackberry cover of 0% in 1975, less than 5% in 1986, 20% in 1992 and almost 40% in 1996. As a consequence, it was decided to mow blackberry for control in open grassland areas. This practice has been carried out late in summer every year since 1998.

Thirty five restoration projects, impacting about 10 acres of the land available for restoration in the core of UBNA, have been completed by students and volunteers to date. Adjacent to the Conibear Shellhouse and the Dempsey Indoor Practice Facility, private firms under contract with the University have initiated 3.7 more acres of restoration. An additional 1.0 acre is undergoing restoration at the time of this writing by King County. See Appendix B for a list of restoration projects.

In the early 1990's, there were no graveled trails in UBNA other than Wahkiakum Lane, and the cumulative length of social trails used by walkers and birders was very much greater than the total length now. The improvement of the loop trail with all-weather surfacing focused use on that trail; the network of unwanted social trails began to diminish (but did not disappear).

Another significant action that improved site conditions was the reconnection of Ravenna Creek with the University Slough. In 2006, the waters of Ravenna Creek, which had been discharged into the regional sanitary sewer system for decades, were released into Lake Washington through the University Slough.

In 1993, the University Provost commissioned a broad synthesis of management guidelines for the UBNA site. The formal title of the synthesis document was *Management Plan for the Union Bay Shoreline and Natural Areas* (hereafter referred to as the *Management Plan*), and it was published in 1995. This Management Plan cited the 1992 University of Washington General Physical Development Plan, which called for "...management of the area (UBNA) in a manner which respects the substantial environmental values and resources of the area. This includes removal of invading species to preserve the open grassland areas."

The recommendations from the *Management Plan* were divided into nine broad categories of action:

- 1) Remove invasive non-native plants and animals.
- 2) Add native plants.
- 3) Maximize habitat diversity and native biodiversity.
- 4) Control human impacts.
- 5) Monitor physical and biological conditions.
- 6) Increase and coordinate teaching and research.
- 7) Enhance personal safety.
- 8) Ensure public accessibility.
- 9) Provide educational interpretation.

These recommendations have been followed, and the objectives are being accomplished to the extent possible given limited funding. New guidelines and management actions related to each of these areas are discussed in Chapter 4.

Chapter 3: Inventory and Assessment of Current Conditions

The University of Washington now uses the Union Bay Natural Area primarily as a natural laboratory for the teaching of restoration ecology. A closed landfill that is being successfully restored, it is a natural ecosystem--the second largest remaining natural system along the shore of Lake Washington. As such, the site provides many ecological services. Ecological services are associated with high-quality habitat and are of significant financial value. They include natural stormwater regulation, biodiversity preservation, reduction of pathogens and pollutants, recreational opportunities, aesthetic value, and other services. The site is excellent for bird watching and other passive outdoor recreation.

For evaluation and management purposes, UBNA has been divided into eight sub-areas (see Appendix A). These are:

- Loop Trail (25.5 acres)
- Parking Lot E-5 restored area (4.7 acres)
- Northwest (13.9 acres)
- Wahkiakum Prairie (3.8 acres)
- East Basin 6.3 acres)
- UW South Shoreline (4.1 acres)
- North University Slough (2.1 acres)
- Unmanaged Wildlife Area (6.7 acres)

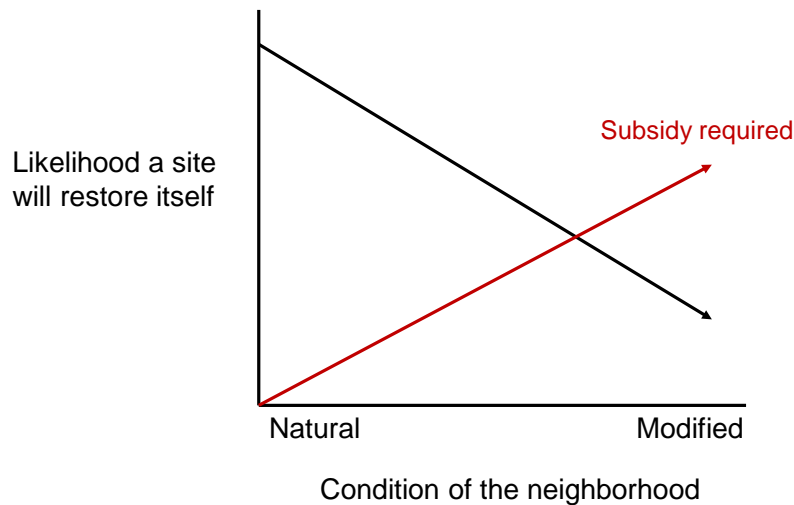
Each of these sub-areas has distinctive characteristics, may be managed as a unit, and will have slightly different management goals or objectives.



Base map accessed from Google Earth in December, 2008. Union Bay Natural Area Management Sub-units: A (North University Slough), B (Northwest), C (Wahkiakum Prairie), D (Parking Lot E-5), E (Loop Trail), F (Unmanaged Wildlife Area), G (East Basin), H (Conibear Shellhouse restoration), I (Dempsey Indoor Practice Facility restoration).

Restoration

Restoration projects, have been carried out in all of the sub-areas except the Unmanaged Wildlife Area (see Appendix B). Restoration involves invasive removal, mulching, installation of plant material, irrigation if necessary, and monitoring and maintenance of the sites. The largest restoration project has been initiated in the South Shoreline sub-area (3.7 acres, performed by contractors). Other restoration areas include work done by students and volunteers in the parking lot E-5 sub-area (3.4 acres) and the Loop Trail (2.6 acres), Northwest sub-area (1.3 acres), East Basin (1.3 acres), and Wahkiakum Prairie (1.1 acres). King County is restoring the east bank of University Slough north of Clark Road as mitigation for a 2008 sewage spill; the project is underway at the time of this writing, and will encompass 1.0 acres.



Source: Ewing, Denman Lecture 2008

UBNA is surrounded by urban vegetation, water features, and hardscapes (paved surfaces). The figure above (Ewing, Denman Lecture 2008) uses concepts from landscape ecology (Forman and Godron 1986) to illustrate how the surrounding environment might impact UBNA's restoration. UBNA is a parcel of native vegetation in the middle of a matrix composed of mixed ornamentals, invasive species, and some natives. Such a parcel would be unlikely to regenerate itself quickly into a natural community for several reasons: few native plant propagules are available nearby; as a disturbed site, it is extremely receptive to colonization by invasives; and historically there was purposeful introduction of non-native grasses. UBNA falls well to the right on the graph, toward the modified end of the spectrum of neighborhood conditions. As a corollary of the inability of an ecosystem to restore itself in such conditions, UBNA's restoration will require greater resources than less disturbed sites: it will take more energy, more manpower, more planting, more weeding, and more attention.

The impacts of the surrounding environment on UBNA itself are seen when the current condition of restoration projects initiated in UBNA is assessed (see Appendix B). Projects were placed into three categories: 1) good, 2) threatened, and 3) poor. Projects in Category 3 are those that have been re-colonized by invasives to the extent that reclaiming them would essentially involve repeating the restoration project. Projects falling in the threatened category generally have suffered from two or more years of little or no maintenance, or had rushed site preparation that did not allow adequate removal of the extensive root systems of blackberry. Much of the East Basin is in this category, as are some projects in the Northwest sub-area and the western part of

Wahkiakum Prairie. Sites that have done well are those that receive annual maintenance, or are located where class restoration projects are repeated year-after-year.

Wetlands

Wetlands on UBNA are almost all ephemeral except for Central Pond and, in some years, the wetland adjacent to the Corporation yard, in the northeast corner of the Northwest subarea (see map page 11). The number of wetlands in the interior of UBNA has increased over time as differential subsidence resulted in more, deeper depressions scattered across the landscape. The internal wetlands (with the exception of Central Pond) are all created by precipitation in the sub-basins and subsequent runoff into the low spots occupied by the wetlands. Evaporation and evapotranspiration in spring and summer dry out most of them for half the year or more. The University Slough and banks may be described as 100% wetland and riparian buffer. The Conibear restoration is almost 100% wetland. Percentage of wetland cover varies across UBNA sub-areas:

- Unmanaged Wildlife Area 96%
- East Basin 52%
- Dempsey restoration 21%
- Loop Trail 15%
- E-5 restoration area 13%
- Northwest sub-area 12%
- Wahkiakum Prairie 9%

Canopy

Developing canopy cover is important as a way of achieving a certain amount of vertical and horizontal structure and encouraging biodiversity. Part of the strategy for suppressing invasive blackberry is to create shade by developing canopy cover. On the other hand, the open nature of UBNA is valued by the public. Ultimately, a mixture of trees and grasslands will provide the optimal blend in the central part of UBNA; under several ecological classification schemes, natural ecosystems like savannas and woodlands have a maximum of 30% woody cover. Current canopy cover is:

- North University Slough 100%
- Unmanaged Wildlife Area 74%
- East Basin 67%
- Dempsey restoration 58%
- Conibear restoration 51%

- Northwest sub-area 22%
- E-5 restoration, 18%
- Loop Trail 10%
- Wahkiakum Prairie 9%

Ecological Potential

It is not valid to say that wetlands or forests have a higher value than grasslands, but in landscape ecology, ecotones (transitions between ecosystem types) have particular importance as landscape features² (Forman and Godron 1986). In UBNA, forested areas next to grasslands provide habitat for raptors; the raptor may sit in a treetop and search the grassland for small mammal prey. Management will proceed under the assumption that adding both horizontal and vertical vegetation complexity will invite a diversity of habitat users to the site. From landscape ecology, the addition of water features to the landscape further increases a site's attractiveness to users. There are many opportunities for incorporating water features into projects in UBNA. A rough assessment can be made of the sub-areas, evaluating the way that features like structural complexity and water are combined. The Loop Trail area is large, heavily visited, presents outstanding views, and could benefit from more canopy cover. Wahkiakum Prairie is close to the buildings and event venues at CUH and can be a good demonstration site for prairie restoration without requiring additional canopy.

Sub-area	Size (acres)	% Wetland	% Canopy cover	Adjacent water features
E-5 restoration	4.7	13	18	Univ. Slough
Loop Trail	25.5	15	10	Lk. Washington, Shovelers, Central Ponds
Northwest	13.9	12	22	Univ. Slough
Wahkiakum Prairie	3.8	9	9	
East Basin	6.3	52	67	Lk. Washington
Unmanaged Wildlife Area	6.7	96	74	Lk. Washington
Conibear	1.3	100	51	Lk. Washington

² For instance, elk are fond of forest clearings because they can feed in the clearing and find quick protection by moving back into the forest.

Dempsey	3.8	21	58	Lk. Washington
North University Slough	2.1	100	100	

Visitor Contact

Education is central to the University of Washington Botanic Gardens’ mission, of which the Union Bay Natural Area is a part. Additionally, community perception of the site improves during the presence of restoration activity and interpretive signage explaining how projects benefit the environment. For these reasons, restoration projects near heavily-traveled trails can yield positive public results. Continued restoration of UBNA should be planned with these issues in mind.

Wahkiakum Trail is heavily traveled, and the Loop Trail appears to have similar visitor levels. Projects arrayed along these trails will have high educational value and will have high potential to garner community support. By these standards, projects in the northwest corner of UBNA are less visible. A trail through this area, perhaps included as part of a plan for the decommissioning of Douglas Road, could make more of UBNA attractive to walkers and add value to restoration projects done along that trail. Such a trail would be about 2200 feet long. A loop trail has been created in the East Basin area, which is flooded in summer, and would require 750 feet of boardwalk. If a loop boardwalk is not built, a dry trail could be constructed from the west side of the East Basin site (starting near the east vehicular gate to the Douglas Conservatory) to near the vicinity of the lift station on Surber Drive.

Public Safety

A security survey of UBNA site was conducted in 2008 with representatives of the University Police Department. The Police Department recommended the following items to improve safety of persons using UBNA path system:

- 1) Code Blue emergency telephones (phones requiring no payment that connect directly to campus police) should be installed at both entrances to UBNA along Wahkiakum Trail (in parking lots E5 on the west and E16 on the east).
- 2) Low-level solar lighting should be installed along Wahkiakum Lane to increase visibility for nighttime users.
- 3) Vegetation should be cleared back three to five feet from the graveled trails so that users could see any suspicious activity.

Chapter 4: Elements of the Management Strategy

The landscape of UBNA has changed substantially from its condition as an unused, capped landfill overgrown with blackberry. Major advances in research and teaching have gone hand-in-hand with the improvement of the area. The goal is to continue the restoration that has resulted in major site improvement since 1990. The strategy has been to plant native plants on the site and to create habitat and species diversity, while utilizing the site for teaching and research.

The use of new management techniques and practices should be encouraged and their utility should be evaluated. Some decades in the future, the restoration of the site may near completion, and the restoration mission of UBNA may need to be modified. However, even if restoration is considered complete, on-going monitoring and maintenance will be required .

This section discusses the components of UBNA and guidelines for meeting management goals that describe the responsibilities of its managers, and specific management actions that describe specific activities necessary to sustain the viability of the site as a restored ecosystem.

These components are organized in the categories of recommended actions listed in the 1995 *Management Plan*. For further details, including justification, scope, and specific recommendations, see *Management Plan for the Union Bay Shoreline and Natural Areas*, 1995, available in the Miller Library at the Center for Urban Horticulture. The recommendations from the *Management Plan* were divided into nine broad categories of action:

- 1) Remove invasive non-native plants and animals.
- 2) Add native plants.
- 3) Maximize habitat diversity and native biodiversity.
- 4) Control human impacts.
- 5) Monitor physical and biological conditions.
- 6) Increase and coordinate teaching and research.
- 7) Enhance personal safety.
- 8) Ensure public accessibility.
- 9) Provide educational interpretation.

Invasive Species Management

Since UBNA's inception, the flourishing of non-native plant species has interfered with the stated goals of creating native plant diversity and habitat. Two papers published in 2002 described experimental plantings of south Puget Sound prairie plant species at locations in UBNA and the subsequent difficulties of maintaining the natives in the face of competition from non-native

species (Ewing 2002a, 2002b). A 2006 paper described the successful use of live willow stakes to suppress the invasive wetland grass, *Phalaris arundinacea* (reed canary grass) (Kim et al. 2006). UBNA is an excellent demonstration site for weed-control technology and exploring the tension between the goal of restoring with native species and the need to remove and control invasives. Innovative, low-technology approaches have been tried, (e.g., mulch, mulch over cardboard, developing canopy shade, live-staking), and the limits to their utility explored. The public demonstration of the effectiveness of what seem to be common-sense procedures for invasive plant management has helped restoration practitioners convince managers and clients to support the use of such methods.

Recommended Action 1: Remove Invasive Non-native Plants and Animals (from Management Plan)

The University of Washington utilizes an Integrated Pest Management policy which calls for use of the least environmentally damaging method for controlling unwanted vegetation, animals, or other organisms. The effectiveness of any given method depends on the availability of personnel and must be balanced against the perceived threat from the invading organism.

Guidelines:

- Himalayan blackberry (*Rubus armeniacus*) will be controlled with the goal of eventual suppression in all sub-areas.
- Reed canarygrass (*Phalaris arundinacea*) will be pulled or treated with herbicides in upland sites and will be shaded out in moist or wet sites where appropriate or possible.
- Removal of other non-native grasses will not be a high priority.
- Class A and B designated weeds will be removed as specified by the King County Noxious Weed Control Program.

Specific Management Actions:

Mowing.

Mowing is scheduled for late summer, after grasses have senesced and when the use of the site by nesting birds is minimal. Mowing is a management technique that targets woody species (especially blackberry)

Specific invasive plant removal.

Blackberry control by mowing is practiced as part of a triage of management methods. Grasslands are mowed, wetlands are too wet for blackberry, and woodland areas will create shade that eventually make blackberry uncompetitive. In woodland areas,

surviving blackberry roots must be removed by hand, or individual plants must be subjected to herbicide application.

Non-chemical methods such as mulching and live-willow staking to produce shade have proven successful against *Phalaris arundinacea* (reed canary grass). On the other hand, *Lysimachia vulgaris* (garden loosestrife) is currently a Class B Noxious Weed in King County and its eradication using herbicides was mandated in 2008. At the time of this publication, target invasives in UBNA include *Cirsium arvense* (Canada thistle), *Senecio jacobaea* (tansy ragwort), *Lysimachia punctata* (yellow loosestrife), *Phalaris arundinacea* (reed canarygrass), *Rubus armeniacus* (Himalayan blackberry) and knotweeds *Polygonum cuspidatum* (Japanese) and *P. sachalinense* (giant).

Long Term Goals of Stewardship

One of the original UBNA site plan analyses estimated that the ongoing subsidence of the site will have created many more wetlands and connections with Lake Washington by 2025 (Jones and Jones 1976). Indeed, an increase in the number of wetlands has been observed: three appear in aerial photographs after the landfill was closed, but 27 were found in a recent inventory (K.D. Kim, personal communication). Over time, the complexity of UBNA continues to increase.

Another site change is increased canopy cover as a result of restoration projects. The open nature of the site has been identified by visitors as one of its assets, and this sentiment will need to be balanced with increased numbers of trees on the site. Woodlands and savannas, two open kinds of ecosystems, are characterized by an intermixing of grasslands and trees. The percent cover of trees in such systems may vary, but the maximum is about 30% (McPherson 1997). The current tree cover varies in different parts of UBNA, but in the central area it is about 10%, and it is very patchy around wetlands and along borders. As restoration projects mature, the tree cover percentage will increase and should be monitored.

Protection of Riparian, Shoreline, and Wetland Areas

Government regulations protect water features in UBNA. The Washington State Wetland Rating System sets procedures to determine wetland classes and function levels (Hruby 2004). The shoreline buffer requirement is 100 feet. Regulations restrict the use of herbicides and fertilizer within 50 feet of water bodies.

The “*Regulations for Environmentally Critical Areas*”, part of the Seattle Municipal Code, restricts building and other activities adjacent to streams and wetlands. These regulations specify stream buffers of 75’ for larger streams with anadromous fish and 50’ for smaller streams. Salmon have been observed in University Slough between the mouth and the Clark Road culvert; improvements to the area north of Clark Road in the near future may make the stretch between Clark Road and 45th St. NE navigable.

Regulations for buffers for wetlands specify:

- Category I and II wetlands over 100 square feet in size require 100’ buffers from the edge of the wetland; this increases to 110’ for wetlands with moderate habitat function and 200’ for wetlands with high habitat function.

- Category III wetlands require a 60' buffer, or 85' for moderate or better habitat function.
- Category IV wetlands of 1000 square feet or more in size require a 50' buffer, while those with area less than 1000 square feet do not require a buffer but may require mitigation.

Much of the restoration in UBNA is for protection of the biological integrity of such areas; stewardship responsibilities include the care of both the aquatic resources and riparian areas. Hundreds of thousands of salmon comprising the entire salmon run for the Lake Washington, Cedar River, and Sammamish River watershed pass through Union Bay at the Montlake Cut, adjacent to UBNA. This large watershed, including lakes, rivers, and tributaries, supports several species of salmon, including the federally protected Chinook salmon. Federal, state, and local governments are spending millions of dollars to protect and restore these salmon runs. UBNA shorelines and contributing wetlands should be protected and improved in proportion to the value of the resource they support.

Increasing biodiversity

UBNA is considered one of the best bird-watching sites in Seattle, and over 200 bird species have been sighted there (Audubon 2008). Even before restoration began, the open nature of the site and the presence of water features, combined with connecting corridors to the Arboretum, Ravenna Creek, Interlaken, and other vegetated areas made this location a good site for both migratory and resident bird populations. Other wildlife in UBNA includes such mammals as coyotes and beavers, such reptiles as turtles, and a wide variety of insects.

The charge to managers is to maximize diversity and habitat. Management goals are geared toward increasing complexity, not homogeneity. In some cases initial restoration plantings comprise only a few plant species planted repeatedly, because those species have been proven to establish and modify a site so that a diverse complement of later successional species can then be installed.

Recommended Action 2: Add native plants (from Management Plan, 1995)

Recommended Action 3: Maximize habitat diversity and native biodiversity (from Management Plan, 1995)

Guidelines:

- Management will focus on creating habitat diversity and native plant and animal biodiversity.
- Canopy cover in the Loop Trail sub-area will not exceed 30%.

- Management activities will be carried out in a manner that minimizes impact on water quality and improves aquatic habitat.
- Open areas will be maintained in specified locations in UBNA to improve habitat.

Recommended Action 4: Control human impact (from Management Plan, 1995)

(See recommendations for trails under Recommended Action #8, page 22--these serve both purposes.)

Recommended Action 5: Monitor Physical and Biological Conditions (from Management Plan, 1995)

Guidelines:

- Restored sites will be monitored and maintained so that they do not become re-colonized with invasive plants.

Recommended Action 6: Increase and coordinate teaching and research (from Management Plan, 1995)

UBNA has appropriately been used to teach classes in restoration, invasive plant management, environmental science, landscape architecture, wildlife science, plant science, biology, and other academic fields. It has hosted tours that focus on birds, restoration, plant identification, ecology, entomology, landfill reclamation, and other subjects. The assets that UBNA possesses include its accessibility, good maintenance, the ease with which it can be traversed, safety, and a dynamic nature, which includes increasing plant and animal diversity. Knowledgeable faculty, staff, and students are available to support hikes, classes, and talks. Its natural beauty, great views of mountains and water, fresh air, hands-on projects for students to get involved in, and adequate size impresses upon people that it is an important landscape unit. It is also a natural area on the edge of a major university in the middle of a large city, one of few such areas with so much access. It must continue through teaching and research to expand knowledge, accessibility, and respect for the land.

Tools and equipment are available to support teaching activities and there are locked areas for storage of class equipment if needed. Additional assets that would improve UBNA as a teaching resource include added interpretation, radio communication for talking to large groups, additional trails, boardwalks through wetlands, additional and replacement tools for restoration and maintenance activities. Expanded support for outreach and classes (web site, newsletters, docents, graduate student talks and teaching, etc.) would increase public involvement. Programs for K-12 students could also be offered.

Restoration supports the use of the site as a full-scale living laboratory for restoration ecology research and for teaching. Restoration ecology classes gain hands-on experience when they do restoration on the site. Because of the subsequent increase in landscape complexity, biology, ecology and environmental science classes find that it is a good place to observe biological processes and interactions. As an article on the UW Restoration Ecology Network describes it, “The field of ecological restoration showcases the necessity and merits of interdisciplinary approaches to real-world problems.” (Gold, et al. 2006)

Guidelines:

- Restoration projects can be used to teach a wide variety of subjects in the natural sciences and beyond; this use will be encouraged and supported.
- Faculty will be encouraged to engage classes in restoration projects on UBNA as long as there is support (tools, assistance, plants, mulch, maintenance) for this restoration from UWBG.
- Students in classes will not be used to do UBNA maintenance, unless enrolled in a maintenance class; volunteers will be encouraged to become involved in the maintenance activities that support UBNA.

Research in UBNA

Past research projects in UBNA have included:

- investigations of methods of prairie restoration
- benefits of site conditioning using mulch
- suppression of weedy species by using live willow stakes
- comparison of effectiveness of live staking using a variety of native woody species
- growth of salvaged vs. acorn-grown Garry oak
- comparison of horticultural techniques to aid in the growth of urban trees
- comparison of Garry oak response to mesic (moist) and stressful sites
- response of Scotch broom to different control methods and effect of compost additions on runoff and soil percolation
- the relationship between methane venting and vegetation structure

Potential future study areas include using UBNA as an urban long term ecological study site. With climate change predicted and occurring, urban sites like UBNA can be used as analogs for future sites under a changed climate. A current advantage of UBNA is that its use is still

somewhat flexible; it is large enough so that experiments may be done in one area without jeopardizing restoration projects in adjacent areas.

Guidelines:

- Access to UBNA for the installation of research plots will require submission of a request to the faculty manager of the site. The manager will confer with a research committee that is made up of UWBG faculty, and with the facilities and grounds manager. Research must be appropriate for the site.
- Any proposed disturbance of the site must not negatively impact adjacent ongoing restoration or research and must not appreciably diminish wildlife or environmental values.
- Upon the completion of a project, the researcher must return the site to a condition acceptable to the research committee.

Recommended Action 7: Enhance personal safety.

(See discussion of public safety and recommendations from University of Washington Police in chapter 3.)

Recommended Action 8: Ensure public accessibility.

Transportation and circulation corridors in UBNA. Both Wahkaikum Lane and the loop trail are used recreationally by walkers, runners, and cyclists. Wahkiakum Lane is heavily used by commuting walkers and cyclists. When there are football games at UW's Husky Stadium, thousands of fans park in various locations around UBNA and walk through the site. While the 2001 Seattle Campus Master Plan does not project any circulation improvements for Wahkiakum Lane, its "Opportunities for New and Enhanced Pedestrian Circulation" map shows a "new pedestrian connection" (a footbridge across Montlake Boulevard) feeding into an "enhanced pedestrian connection" (on Canal Road behind the baseball and soccer fields), terminating at Wahkiakum Lane where the current footbridge crosses University Slough (Office of Regional Affairs, University of Washington 2001). It can be assumed that the increased pedestrian use of such corridors will continue onto Wahkiakum Lane and across UBNA.

It is the intention of the University to eliminate parking lot E-5 and close Douglas Road as a vehicular access (CUH Final EIS 1981) as soon as the demand for use of E-5 has diminished. When closed, a portion of Douglas Road may be used as a pedestrian trail. A trail system in the Northwest sub-area would improve public access, increase visibility of restoration projects installed there, and increase the total length of the trail system in UWBG, making the area more attractive to recreational users.

Guidelines:

- Wahkiakum Lane will continue to be a major pedestrian and bicycle access route to the campus; this use will be supported and continued.
- The Loop Trail, corporation yard path, and any future trail in the Northwest sub-area will provide access to the natural area and will be managed and maintained in a way that creates minimum impact to the surrounding habitat and wildlife.

Specific Management Actions:

Trail management. Both Wahkiakum and the loop trail are maintained to Americans with Disabilities Act (ADA) standards for Class I trails. (Access Board, 1991) Such trails have a minimum width of 8'; the minimum cleared zone is this width plus two feet on either side of the trail, and 10' vertical clearance. Surface aggregate is to be clean, crushed, evenly graded aggregate, 100% passing 3/8" sieve, with some binder fines. Special care will be taken to maintain a non-rutting surface to sustain a good cycling surface during annual gravel applications (by selecting sharp-edged aggregate, adding fines, watering, and rolling). Where possible, the trail will be crowned to eliminate ponding of water as a result of rainfall or snowfall. Because of surface subsidence, some depressions periodically appear and cause ponding, especially in fall and winter; efforts will be made to add material at such sites to bring them back to grade and maintain trail passability for pedestrian use.

Recommended Action 9: Provide educational interpretation (from Management Plan, 1995)

The University can deliver information to members of the public in a number of ways. UBNA has been used to create demonstrations of restoration, invasive plant control, and land management. Tours led by faculty, staff, and students have been well received. The visibility of students engaged in restoration projects along the trail system has led to positive interactions with neighbors and visitors, and has raised the community perception of UWBG. Conflicts with user groups like recreational cyclists or birders are less likely when they understand the goals and plans for UBNA and how we plan to achieve them, and when their representatives serve on UBNA advisory committees.

Restoration in UBNA connects the non-University public with the school's teaching, research, and stewardship. Projects are arrayed along Wahkiakum Lane and the loop trail in a fashion that allows easy inspection by passing members of the public and local community. Special efforts are made to encourage neighbors to learn more and become involved in UBNA restoration. This interaction with the public and with groups such as the Audubon Society allows information about University-developed technology to be transferred to non-University users. To increase community support for University activities, it is important to demonstrate the technically competent and innovative projects that are carried out on site.

Guidelines:

- Public education will be promoted by interpretation, tours, lectures, use of print and electronic media, by promotion of the UWBG trail system, and by holding environmental and community events.
- Educational and interpretive materials will be produced in the appropriate format and in accordance with the UW Botanic Gardens' communication strategy.
- Signage will follow the Washington Park Arboretum Interpretive and Wayfinding Plan guidelines and the UW guidelines for form and size.
- The accessibility of a potential UBNA restoration site for education and public outreach will be considered as a factor in selection.

Specific Management Actions:

Interpretation

Interpretive signage is located at either end of Wahkiakum Lane at the east and west intersections of the loop trail. Such signage provides maps, rules, and information on the research and education missions of UBNA. In addition, at the location of specific research or restoration projects, scenic views, or wildlife watching areas, etc., explanatory signage appropriate for each site may be installed. Temporary signage about class projects, maintenance operations, and during best viewing periods for birds and flowering plants will be encouraged.

Additional Recommendation--Recommended Action 10: Community Involvement

Restoration in UBNA allows UWBG to meet its responsibilities for the management of a University resource. Using best practices for land stewardship is a goal in the UWBG Strategic Plan (UWBG, 2006). It supports the University's efforts to be a good steward of a valuable remnant natural system that has been much modified but continues to provide ecological services and has a great deal of potential for improving its functioning. In the documents that have been reviewed to determine management priorities for UBNA, the value of the site as an important ecosystem element and classroom has been reiterated. Improvements to the shorelines and shallows around UBNA could have great positive benefits for salmon runs through Lake Washington. Almost 20 years of restoration have resulted in incremental but impressive increases in plant biomass and diversity in the terrestrial landscape of UBNA.

Guidelines:

- Restoration projects carried out by neighborhood, corporate or civic volunteer groups in UBNA will be encouraged and supported.
- Restoration will continue at a sustainable rate in UBNA, using students, staff, volunteers, and commercial contractors.

Chapter 5: Management Structure

Activities in UBNA are proposed, reviewed, and carried out with the approval of the UWBG Director, through a structure that includes faculty, staff, and students. This structure includes a staff Facilities and Grounds Manager, a faculty manager, and a student manager (a graduate student paid as a Research Assistant and supervised by the faculty manager). An Advisory Committee is in place to make recommendations to the UWBG Director concerning policy for the management and use of UBNA; it is made up of the faculty at UWBG, a University staff member in charge of permitting, and representatives from bird watching organizations (Audubon and Washington Ornithological Society). In addition, the Teaching Assistant for a restoration ecology class that does an annual restoration project in UBNA assists the managers and supervises students in management and maintenance activities during that class.

The University of Washington Botanic Gardens manages 73.5 acres of UBNA and shoreline. Removing from this total the Unmanaged Wildlife Area, permanent open water, the active portion of parking lot E-5 and Douglas Road, the remaining portions of UBNA requiring horticultural maintenance total 63.7 acres. These are:

- UBNA core: 55.6 acres
- University Slough: 3.2 acres
- University shoreline: 4.9 acres

Staffing rates utilized in the *Washington Park Arboretum Master Plan* (Arboretum and Botanical Garden Committee 2000) consist of five levels of maintenance for the Arboretum. These are based on national surveys of public gardens. The lower three categories are appropriate for UBNA:

Medium to low intensity	Core collections, e.g., the ecogeographic exhibits and others in woodland settings or open turf areas, requiring approximately 0.20 FTE per acre for plant care and weed/invasive control.	0.20 FTE/acre
Low intensity	Open space, e.g., wet natural areas, requiring approximately 0.05 FTE per acre to mow during dry season and to control weeds/invasives.	0.05 FTE/acre
Low intensity	Low maintenance collections, e.g., native habitats, requiring approximately 0.05 FTE per acre to maintain habitat quality and to control weeds/invasives.	0.05 FTE/acre

At the lowest intensity management, the core UBNA would require 2.8 Full Time Equivalent employees (FTEs) (55.6 acres x 0.05 FTE/acre). The University Slough would require 0.2 FTE and the University shoreline would require 0.2 FTE. This subtotal would require 3.2 FTE.

Making the assumption that recent (up to three years old) restoration plots require the medium to low intensity level of care (0.20 FTE/acre), a slight upward adjustment should be made. Not including projects undertaken by outside parties for mitigation, almost ten acres of UBNA have undergone restoration in the last 15 years, or about .67 acres/year. At the 0.2 FTE/acre maintenance intensity, this would result in the need for 0.4 instead of 0.1 FTE for recently restored sites, given the current rate of restoration. The horticultural staffing level required for the managed area of UBNA, using the values, assumptions and calculations discussed above, would be 3.5 FTE total. The current staffing level is 0.29 FTE.

Maintenance of Special Features

Special features may range from something as small as piles of stones to provide snake habitat to something as large as a constructed blind for viewing birds or a viewpoint for watching waterfront traffic or the sunset. At the restoration level, like environmental art, habitat features may be constructed so that they are transitory. More expensive structures that have been discussed include boardwalks, bird blinds, and other viewing areas. Unless structures are designed to decompose and become part of the environment, any construction should come with adequate maintenance funding to last the predicted lifespan of the installation, through endowment or budget line item.

Community and Volunteer Base

Almost all UBNA restoration has been the result of work by University of Washington classes or volunteer workdays by corporations, groups, and clubs. Neighborhood participation remains low, though there is a good relationship with the community around UWBG. Individuals have volunteered and worked in UBNA, but volunteer workers tend to become more engaged when activities are social, and most of the work in UBNA is solitary. An active volunteer coordinator would be able to add an element of support and follow-through. One of the jobs of the student manager of UBNA is to support and assist volunteer work, but the majority of this has involved the recruitment of University classes and other student groups to come to work at UBNA for a field experience or as part of an outdoor lab.

Appendix B lists six restoration projects that were initiated in UBNA but have reverted to a condition similar to that found before the restoration activity. In almost every case the culprit is Himalayan blackberry, abetted by little or no maintenance. The total area lost is only about an acre and a half, but a substantial and visible part of that is in the East Basin sub-area. Efforts to gain community participation to assist in the maintenance of East Basin restoration projects have only been minimally successful at this time.

With restoration one of the core components of the UW Botanic Gardens, UBNA and the Washington Park Arboretum will need to function and be presented as integrated and complementing elements of UWBG.

As an important academic discipline, UW restoration faculty members have received national awards. The educational structure of the hands-on education that is practiced there has been recognized in the Education Forum of *Science* (Gold et al.2006), which is a major scientific publication in North America.

On a community level the Center for Urban Horticulture is considered a destination in Seattle, (NWSOURCE 2002) and the gardens and natural area contribute to that public measure of appreciation. Staff and faculty have continued to communicate with neighborhood groups in the Laurelhurst, Bryant, and University District neighborhoods. Our classes engage in restoration projects in areas all over Seattle; the Union Bay Natural Area is the largest demonstration site of this restoration activity.

The University must continue to care for the natural area in a thoughtful and progressive way, and invite citizens at all levels to come look at what we have done and discuss the lessons learned. UWBG will encourage the University to acknowledge and support UBNA as an important location for community interaction, as a natural landscape under the University's management, and as an academic resource.

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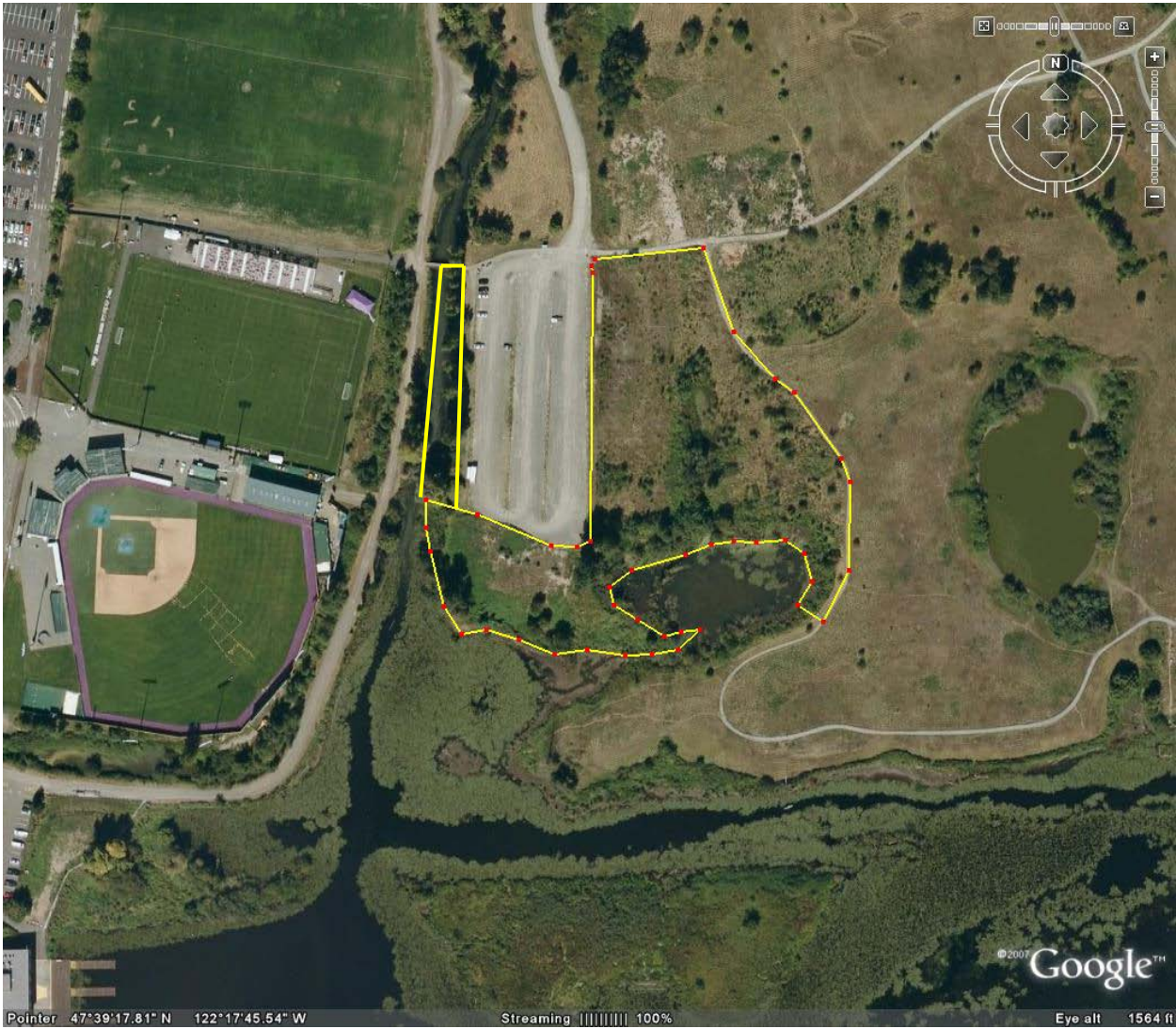
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Acknowledgements

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Appendix A: UBNA sub-areas



E-5 Restoration and University Slough shoreline, 4.65 acres



Loop Trail, 25.45 acres



Northwest sub-area, 13.87 acres



Wahkiakum Prairie, 3.81 acres



East Basin, 6.33 acres



Unmanaged Wildlife Area, 6.69 acres



Conibear restoration and University Slough shoreline, 1.32 acres



Dempsey restoration and UW shoreline, 3.76 acres



North University Slough, 2.07 acres

Appendix B: Area of Restoration Projects by sub-area

Restoration by UBNA sub-area

	Acres†	Condition*
Loop Trail		
Shovelers Pond	0.79	1
Shovelers Pond buffer	0.10	1
Central Pond buffer (north)	0.10	1
Dukbut Creek at Wahkiakum	0.03	1
Dukbut Creek W. buffer	0.09	2
High Point woodland S.	1.25	1
Six experimental snowberry plots	0.12	2
Miscellaneous: Ribes, Arbutus, Garry oak	0.15	1
Total	2.63	
E-5 restoration		
Former gravel lot	1.31	2
Shrub buffer	2.05	1
Total	3.36	
Northwest		
High Point Woodland N.	0.54	1
Centennial Grove	0.67	2
Intro class, S of Clark Road Culvert	0.05	3
Miscellaneous: Ribes, Arbutus, Kim wetlands	0.05	3
Total	1.31	
Wahkiakum Prairie		

Dukbut Pond	0.28	1
Experimental fescue plots (2)	0.35	1
Experimental mound area	0.35	1
Early snowberry plot near corp yards	0.05	3
Miscellaneous: Ribes, camas, Amelanchier	0.05	2
Total	1.08	
Unmanaged Wildlife Area		
No restoration projects	0.0	
East Basin		
Intro class willows	0.19	1
Kim experiment willows	0.27	1
Central open area	0.04	2
Dry bank near greenhouse fence	0.17	3
Surber corner	0.34	3
East basin trail	0.31	3
Total	1.32	
Sub-total for work done by us	9.70	
South Shoreline UW		
Dempsey restoration	2.58	2
Peninsula N of Conibear	1.09	2
Total	3.67	
Slough North of Clark Road		
East bank	1.03	2

	Total	1.03	
	Grand total	14.40	

† Areal extent of each sub-area and restoration project was determined using maps generated by the 1992 Wetland Delineation of the site (Pentec Environmental 1992).

*Condition Categories for Restoration Projects:

1. Good condition. Plants surviving, growing. Invasives controlled.
2. Threatened condition. Restoration vegetation established, but either high mortality of restoration plants or vigorous growth of invasive species.
3. Poor condition. Sites have either been re-taken by invasives or plantings are in the process of being shaded out or out-competed by invasives. This category indicates that restoration needs to be re-done.

Appendix C: Wetland and Canopy Cover by Sub-area

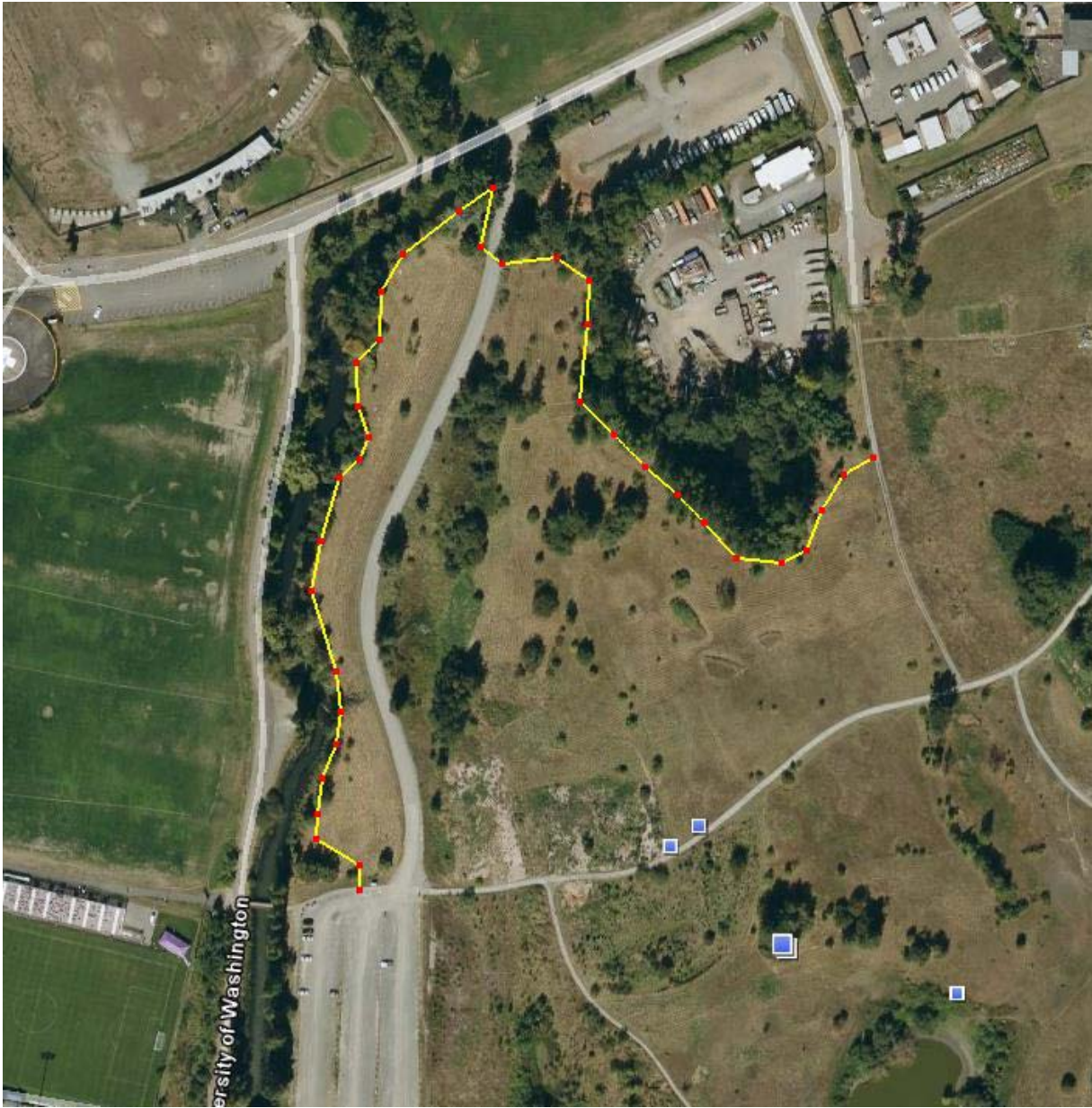
UBNA Sub-area	Percent Wetland	Percent Canopy Cover
E-5 Restoration	13	18
Loop Trail	15	10
Northwest sub-area	12 (wetland) 5 (slough)	22
Wahkiakum Prairie	9	9
East Basin	52	67
Unmanaged Wildlife Area	96	74
University Shoreline, South		
Conibear	100	51
Dempsey /Waterfront Activity Center	21	58
North University Slough	100	100

Appendix D: Worksheet for area calculation†

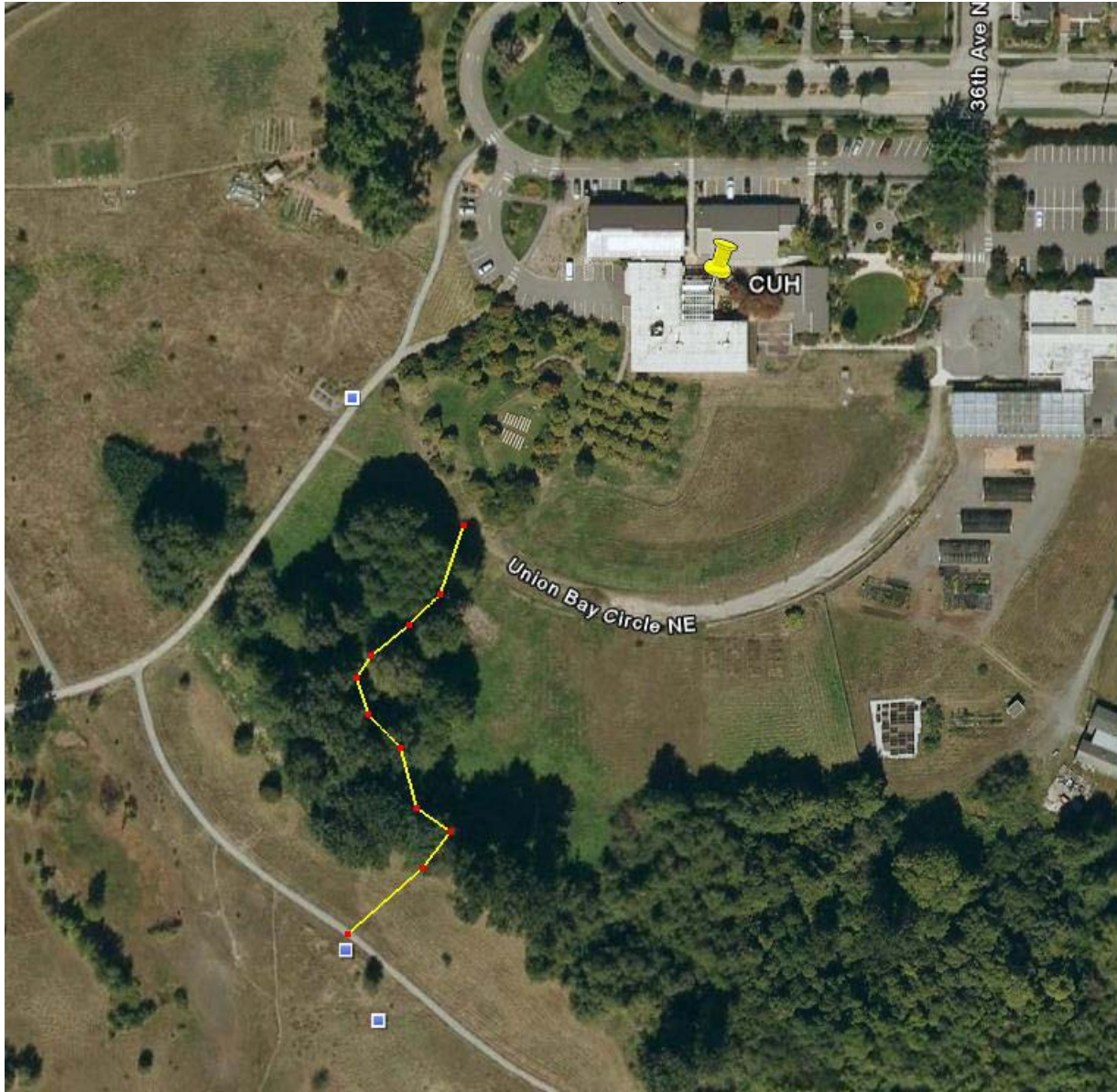
Union Bay Natural Area and Shoreline		
Parcel	Description	Area (acres)
E5 restoration		1.31
Shrub border	East of E5 restoration	1.96
South of E5		1.02
Carp pond wetland	Connected to Lk Washington	2.54
South of Wahkiakum	North parcel	5.36
	South parcel	6.21
Shovelers Pond	When full	0.79
Central Pond		1.64
Wetland C tract	North parcel	5.02
	South parcel	6.43
Unmanaged Wildlife Area		6.69
East Basin		6.33
West of Douglas Road		2.65
North of Wahkiakum		11.22
Wahkiakum Prairie		3.81
	Subtotal	62.98
Slough North of Clark Road	900' x 100' wide	2.07
Slough South of Clark Road	W shore, old bridge to shell-house restoration (10' wide)	0.15
	W shore, old bridge to new bridge (10' wide)	0.08
	Both shores from Clark Road to new bridge (10' each)	0.56
	E shore next to E5 (40')	0.36
	Subtotal	3.22
Parking lot E5	Portion used for parking	1.86
Douglas Road	25' width	0.61
	Subtotal	2.47
Restoration at shellhouse	Peninsula N of shellhouse	1.09
Dempsey	Dempsey restoration (239' x 470')	2.58
	From S. end of Dempsey restoration to paved path that leads down to sailboats	1.18
	Subtotal	4.85
	Total	73.52

† Areal extent of each sub-area in Appendix D was determined using maps generated by the 1992 Wetland Delineation of the site (Pentec Environmental 1992).

Appendix E: Potential Trails and Alternatives



Possible route for Northwest Trail (2160 feet)



Possible route of creek crossing behind CUH (510 feet)

Appendix F: Summary of Recommended Actions, Guidelines, and Specific Management Actions

Recommended Action 1: Remove Invasive Non-native Plants and Animals (from Management Plan)

Guidelines:

- Himalayan blackberry (*Rubus armeniacus*) will be controlled with the goal of eventual suppression in all sub-areas.
- Reed canarygrass (*Phalaris arundinacea*) will be pulled or treated with herbicides in upland sites and will be shaded out in moist or wet sites where appropriate or possible.
- Removal of other non-native grasses will not be a high priority.
- Class A and B designate weeds will be removed as specified by the King County Noxious Weed Control Program.
- (other invasives?)

Specific Management Actions:

Mowing.

Mowing is scheduled for late summer, after grasses have senesced and when the use of the site by nesting birds is minimal. Mowing is a management technique that targets woody species (especially blackberry)

Specific invasive plant removal.

Blackberry control by mowing is practiced as part of a triage of management methods. Grasslands are mowed, wetlands are too wet for blackberry, and woodland areas will create shade that eventually make blackberry uncompetitive. In woodland areas, surviving blackberry roots must be removed by hand, or individual plants must be subjected to herbicide application.

Non-chemical methods such as mulching and live-willow staking to produce shade have proven successful against *Phalaris arundinacea* (reed canary grass). On the other hand, *Lysimachia vulgaris* (yellow garden loosestrife) is currently a Class B Noxious Weed in King County and its eradication using herbicides was mandated in 2008. At the time of this publication, target invasives in UBNA include *Cirsium arvense* (Canada thistle), *Senecio jacobaea* (tansy ragwort), yellow loosestrife, reed canarygrass, *Rubus armeniacus* (Himalayan blackberry) and knotweeds *Polygonum cuspidatum* (Japanese) and *P. sachalinense* (giant).

Recommended Action 2: Add native plants (from Management Plan, 1995)

Recommended Action 3: Maximize habitat diversity and native biodiversity (from Management Plan, 1995)

Guidelines:

- Management will focus on creating habitat diversity and native plant and animal biodiversity.

- Canopy cover in the Loop Trail sub-area will not exceed 30%.
- Management activities will be carried out in a manner that minimizes impacts on water quality and improves aquatic habitat.
- Open areas will be maintained in specified locations in UBNA to improve habitat.

Recommended Action 4: Control human impact (from Management Plan, 1995)

(See recommendations for trails under Recommended Action #8—these serve both purposes.)

Recommended Action 5: Monitor Physical and Biological Conditions (from Management Plan, 1995)

Guidelines:

- Restored sites will be monitored and maintained so that they do not become re-colonized with invasive plants.

Recommended Action 6: Increase and coordinate teaching and research (from Management Plan, 1995)

Guidelines:

- Restoration projects can be used to teach a wide variety of subjects in the natural sciences and beyond; this use will be encouraged and supported.
- Faculty will be encouraged to engage classes in restoration projects on UBNA as long as there is support (tools, assistance, plants, mulch, maintenance) for this restoration from UWBG.
- Students in classes will not be used to do UBNA maintenance, unless enrolled in a maintenance class; volunteers will be encouraged to become involved in the maintenance activities that support UBNA.

Guidelines:

- Access to UBNA for the installation of research plots will require submission of a request to the faculty manager of the site. The manager will confer with a research committee that is made up of UWBG faculty, and with the facilities and grounds manager. Research must be appropriate for the site.
- Any proposed disturbance of the site must not negatively impact adjacent ongoing restoration or research and must not appreciably diminish wildlife or environmental values.
- Upon the completion of a project, the researcher must return the site to a condition acceptable to the research committee.

Recommended Action 7: Enhance personal safety.

(add - code blue phones etc. from current conditions section)***

Recommended Action 8: Ensure public accessibility.

Guidelines:

- Wahkiakum Lane will continue to be a major pedestrian and bicycle access route to the campus; this use will be supported and continued.
- The Loop Trail, corporation yard path and any future trail in the Northwest sub-area will provide access to the natural area and will be managed and maintained in a way that creates minimum impact to the surrounding habitat and wildlife.

Specific Management Actions:

Trail management. Both Wahkiakum and the loop trail are maintained to American Disabilities Act (ADA) standards for Class I trails. (Access Board, 1991) Such trails have a minimum width of 8'; the minimum cleared zone is this width plus two feet on either side of the trail, and 10' vertical clearance. Surface aggregate is to be clean, crushed, evenly graded aggregate, 100% passing 3/8" sieve, with some binder fines. Special care will be taken to maintain a non-rutting surface to sustain a good cycling surface during annual gravel applications (by selecting sharp-edged aggregate, adding fines, watering and rolling). Where possible, the trail will be crowned to eliminate ponding of water as a result of rainfall or snowfall. Because of surface subsidence, some depressions periodically appear and cause ponding, especially in fall and winter; efforts will be made to add material at such sites to bring them back to grade and maintain trail passability for pedestrian use.

Recommended Action 9: Provide educational interpretation (from Management Plan, 1995)

Guidelines:

- Public education will be promoted by interpretation, tours, lectures, use of print and electronic media, by promotion of the UWBG trail system, and by holding environmental and community events.
- Educational and interpretive materials will be produced in the appropriate format and in accordance with the UW Botanic Gardens' communication strategy.
- Signage will follow the Washington Park Arboretum Interpretive and Wayfinding Plan guidelines and the UW guidelines for form and size.
- The accessibility of a potential UBNA restoration site for education and public outreach will be considered as a factor in selection.

Specific Management Actions:

Interpretation

Interpretive signage is located at either end of Wahkiakum Lane at the east and west intersections of the loop trail. Such signage provides maps, rules, and information on the research and education missions of UBNA. In addition, at the location of specific research or restoration

projects, scenic views, or wildlife watching areas, etc., explanatory signage appropriate for each site may be installed. Temporary signage about class projects, maintenance operations, and during best viewing periods for birds and flowering plants will be encouraged.

Recommended Action 10: Community Involvement - NEW

Guidelines:

- Restoration projects carried out by neighborhood, corporate or civic volunteer groups in UBNA will be encouraged and supported.
- Restoration will continue at a sustainable rate in UBNA, using students, staff, volunteers and commercial contractors.