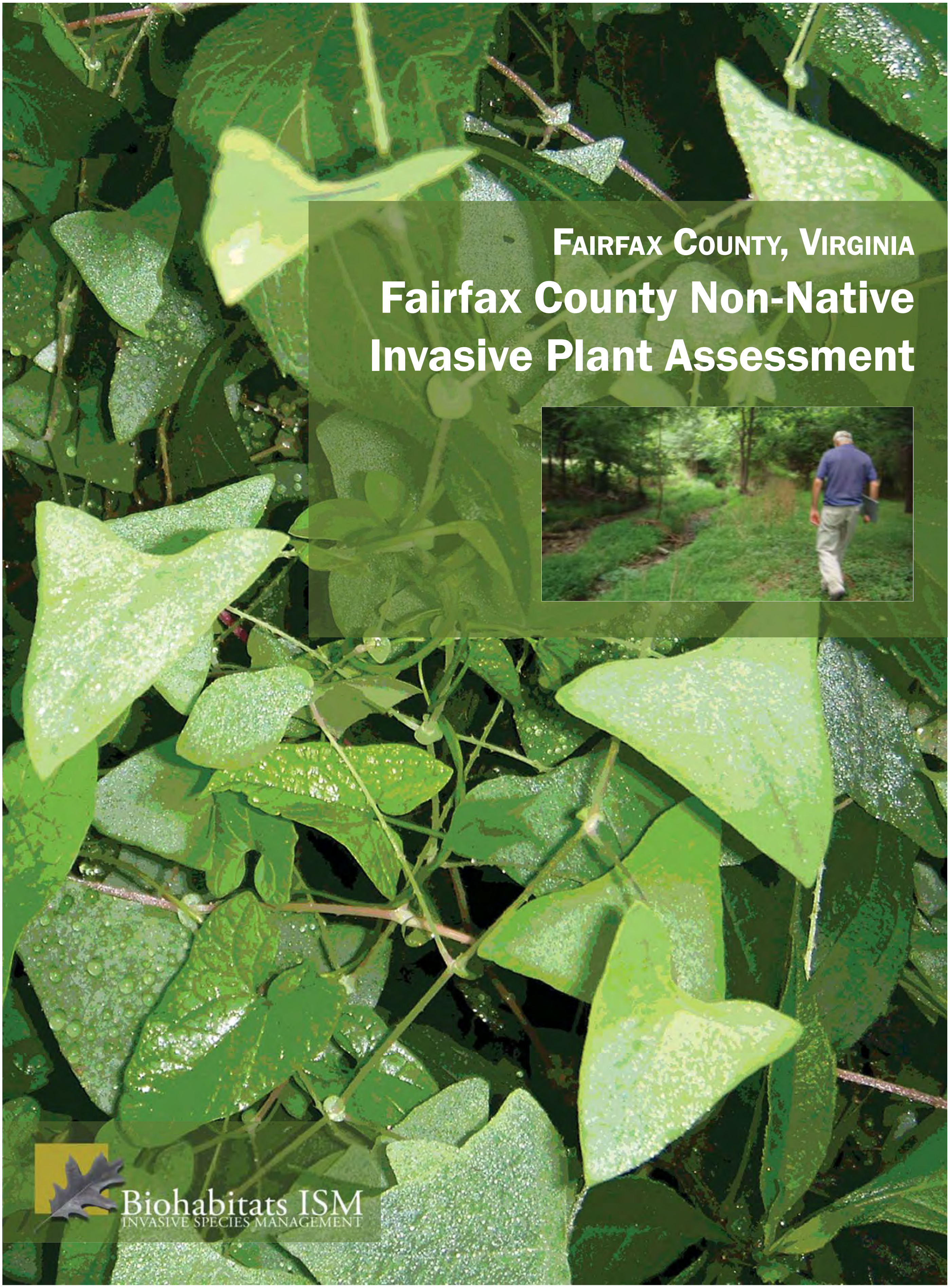

Fairfax County, Virginia

Fairfax County Non-Native Invasive Plant Assessment

Biohabitats ISM
INVASIVE SPECIES MANAGEMENT

Acknowledgements

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Executive Summary

In Fairfax County extensive urbanization and forest fragmentation have created conditions that foster the establishment of non-native invasive plant species. With over 400 park units and approximately 24,000 acres, the county park system is under direct threat from these organisms and is at risk of losing many of the natural assets that led to the acquisition of these lands. Left unchecked, invasive plant species will undermine the regenerative capacity of the county forestland and ultimately produce a degraded resource that fails to meet many of the key objectives desired of the parks system.

Given the dynamic nature of the invasive species threat, along with the need to maximize the effectiveness of finite control resources, the Fairfax County Park Authority commissioned the development of a comprehensive response strategy and site treatment prioritization model. The primary goal of this project was to develop a defensible work prioritization model to be used by the Fairfax County Park Authority in assessing the relative level of risk of biological invasion on parklands and in determining the proper allocation of limited resources for control. This report summarizes the project results and details the intervention methodologies recommended for implementation.

The project consisted of two major initiatives; a qualitative assessment of the field and spatial conditions associated with the presence of invasive plants within the park system, and the development of a stakeholder and science-driven response approach.

Major Findings

- Invasive species of concern were found across the entire range of park and habitat types.
- Forest regeneration is being negatively impacted by invasive plants.
- Significant local spatial variability can be found regarding levels of infestation.
- Riparian corridors within the park system display a higher level of infestation than adjacent upland areas.
- Invasive abundance within the county parks is closely correlated to disturbance regimes in the form of; white-tailed deer herbivory, stormwater surges, infrastructure modification, and park maintenance
- Invasive species are directly impacting the quality of the park visitor experience

Recommendations

- Modify intervention goal metrics to focus upon the inherent regenerative capacity of a site to produce a sustainable native plant community as opposed to the invasive plant infestation level.
- Adopt a goal of "**protect the best first**" that targets high value sites for restoration.

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- Implement **prioritization** of site treatment using a scoring system model based upon ecological value, invasive threat, and cultural use.
- Practice **prevention** through the adherence and enforcement of best management practices on county parklands.
- Institute a phased treatment program for prioritized sites that utilizes contractual, internal, and volunteer resources appropriate to the level of intervention required.
- Undertake the development of a systematic assessment of park ecological assets and liabilities using both professional and volunteer resources.
- Seek deferred and yearly maintenance funding for invasive control consistent with scale of threat.
- Support a reduction in the county-wide population of white-tailed deer to levels consistent with the ecological carrying capacity.
- Support restoration of individual watershed hydrology and stream geomorphology in order to reduce disruptive stormwater surging.
- Disseminate invasive plant information to public stakeholders.

Introduction

Human migration across the globe has resulted in rapidly accelerating changes to the earth's ecosystems. Biotic communities that have evolved and diverged through millennia of relative geographic isolation into unique expressions of biodiversity are now being threatened with dramatic and sudden change. Conservation biologists rate the intrusion of invasive species as the second greatest threat to biodiversity following habitat destruction. The introduction of invasive organisms into native systems represents an insidious threat, in many ways greater than traditional abiotic pollution. Invasive species are self-propagating and will multiply without the addition of new "discharges". Their disruptive presence in a given ecosystem is unlikely to decrease over time without direct intervention.

Quantifying the impact of invasive species in the United States is difficult as the damage costs are not always captured directly in the marketplace. Along with habitat destruction and fragmentation, invasive species collectively rank as one of the top global threats to biological diversity in natural areas, (e.g., Pimentel at al. 2000, Schierenbeck 1995, US Congress 1993). They can affect multiple levels of biological organization (species, communities, ecosystems, and landscapes) and cause negative changes in ecosystem structure and function, populations of native species and the compostion of native plant communities (e.g., Ehrenfeld et al. 2001, D'Antonio and Vitousek 1992, Vitousek and Walker 1991, Blackburn et al. 1982). The most fundamental effects are alterations of ecosystem structure and function as non-native invasives can change the basic rules governing specific ecosystems. Problems that arise from invasive species are sometimes permanent and may be the most pervasive influence on biological diversity in many systems (Coblenz 1990).

Of particular relevance to the Fairfax County Park Authority, invasive species are recognized as a major and urgent threat to conservation areas and other sites managed primarily for their natural values (e.g., Timmons and Owen 2001, Randall 1996, Macdonald and Frame 1988). Invasive species are identified as a major threat in 70% of the ecoregional plans that have been completed by The Nature Conservancy (J. Randall, unpublished data). A recent review of sixty-two Nature Conservancy site-specific conservation plans revealed that invasive species were the most frequently cited critical threat, listed in 74% of the plans (J. Randall, unpublished data). Nature Conservancy land managers have reported in surveys conducted in 1988, 1992, and 1995 that invasive plants are among their worst conservation problems (J. Randall, unpublished data).

Given the global scale and regional significance of the invasive species problem, the Fairfax County Park Authority recognizes the need for an integrated and coordinated response to this threat. This project was designed to provide pragmatic and scientifically defensible tools of value in the long-term protection and enhancement of the ecological resources of the county park system.

1.0 Methodology

1.1 Definition

For the purposes of this project and report, non-native invasive species (NNIs) are defined according to the description provided by former President Clinton's Executive Order 13112 (Section1e) and subsequently adopted by the National Invasive Species Council:

An invasive species is an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

In accordance with this definition, native species that may be competing with the development of desirable vegetation on a local level are excluded. Examples would include such species as native grape, black locust (*Robinia psuedoacacia*) or poison ivy (*Toxicodendron radicans*); all of which are adapted to disturbed edge environments and can produce rapid "weedy" growth. While site-specific restoration goals might require suppression of these species, they do not pose the same level of system-wide threat as invasive plants.

1.2 Project Approach

The primary goal of this project was to develop a defensible work prioritization model to be used by the Fairfax County Park Authority in assessing the relative level of risk of biological invasion on parklands and in determining the proper allocation of limited resources for control.

In support of this goal a multi-phase approach was utilized. Phase one involved field visits to approximately ¼ of the park units within the Fairfax system by a team of professional restoration ecologists, foresters, and invasive suppression experts. Larger park units were inspected in multiple locations as a high degree of vegetative spatial and attribute variability was apparent both between, and within, parks. A complete listing of visited parks can be found in appendix A. Qualitative field observations were performed and the relative ecological integrity of individual sites ranked. Metrics ranked included, but were not limited to, plant community type, vegetative composition of forest strata, successional stage, regeneration levels, invasive species composition and cover percentage, presence of deer herbivory, and evidence of recent site disturbance.

The two primary objectives in inspecting a range of parks across the county were to become acquainted with the distribution and ecological processes behind NNIs occurrence in the park system and to gain insight into the variability of ecological resources located on parklands.

Prior to undertaking field visits, a spatial analysis of the Fairfax park system was performed using geographic information systems (GIS) and the conservation planning tool FRAGSTATS. (McGarigal, Marks 1995) This tool allows for the remote determination of landscape parameters of significant importance to ecological integrity. These include, but are not limited to; interior core forest size, patch size, forest connectivity, forest edge levels, and forest edge contrast. Determination of these values allowed for a more informed stratification of the park field visits and provided a statistical basis for understanding the landscape variability inherent in the park system. Larger park units with interior core forest were given priority for assessment as conservation biology principles indicate that these units will tend to have a higher probability of containing viable native plant communities. Two of the FRAGSTATS parameters, core forest area & edge quality, were subsequently integrated into the prioritization model. A breakdown of park units and their ranking scores for spatial configuration metrics can be found in appendix B.

The second thru fifth phases of the project involved the development of a stakeholder-driven, scientifically defensible model for the prioritization of potential invasive suppression sites and the development of operational recommendations for addressing NNIs within the Fairfax County Park Authority. An analysis of the existing peer-reviewed literature related to objectively prioritizing invasive suppression work efforts was performed. In addition, a review of the current Fairfax County Park Authority operational response to NNIs was undertaken and recommended control strategies, best management practices, and budgetary allocations developed. This review included the full complement of invasive response strategies being employed by the Fairfax County Park Authority including volunteer programs, early detection and rapid response, and current management practices. The intervention model developed was based upon justifiable action thresholds and an adaptive management modality. Multiple stakeholder feedback sessions were performed in order to produce an operational approach that reflected both the fundamental goals and objectives of the Fairfax County Park Authority and a consensus as to the implementation methodology best suited to anticipated resource levels. As the prioritization model is but one tool in a multifaceted response to the challenge of invasive species within the parks, additional programmatic recommendations were developed in accordance with an integrated approach.

2.0 Results / Discussion

2.1 Field Results

2.1.1 Species & Spatial Distribution

Qualitative assessment of approximately seventy-five (75) individual parks (larger parks were sampled at multiple locations) indicated that there is a large range of variability in the ecological integrity both within, and between, different park units. In general, however, the same suite of NNIs were seen across the entire county. The primary species of concern identified as having established populations in the park system are listed below in alphabetical order.

- Autumn Olive (*Elaeagnus umbellate*)
- Bush Honeysuckle (*Lonicera maackii, L. morrowii, L. tatarica, L.standishii*)
- English Ivy (*Hedera helix*)
- Exotic Viburnum (*V.plicatum & V. dilataum*)
- Garlic Mustard (*Ailiaria petiolata*)
- Japanese & European Barberry (*Berberis thunbergii, Berberis vulgaris*)
- Japanese Honeysuckle (*Lonicera japonica*)
- Japanese Stiltgrass (*Microstegium vimineum*)
- Lesser Celandine (*Ranunculus ficaria*)
- Mile-a-Minute (*Polygonum perfoliatum*)
- Mimosa (*Albizia julibrissin*)
- Multi-flora Rose (R*osa multiflora*)
- Norway Maple (*Acer platanoides*)
- Oriental Bittersweet (*Celastrus orbiculatus*)
- Porcelain berry (*Amplelopsis brevipedunculata*)
- Privet (*Ligustrum species*)
- Tree-of-Heaven (*Ailanthus altissima*)
- Wineberry (*Rubus phoenicolasius*)
- Winged Euonymus (*Euonymus alata*)

A handful of species were located that, at the present time, have relatively confined populations suitable for a rapid response approach and subsequent eradication. These included:

- Kudzu (Pueraria montana)
- Spreading Bamboo (Phyllostachys species)

Clear differences were detected between the levels of NNIs in upland systems as opposed to riparian corridors. Riparian (adjacent to watercourses) forests displayed a significantly greater cover percentage of invasive plants in the understory than the adjacent upland woods. This distribution pattern may be due to a number of factors such as; the frequent disturbance pattern in riparian corridors due to urban stormwater surges during rainfall events, the higher soil nitrogen levels in the floodplain, and more prominent vectoring of NNIs propagules along stream corridors by animal and human transport.

The observation that the primary invasive species of concern can be found across the entire county range indicates that these populations, while displaying local spatial variation, are not new introductions to the area. Given the widespread geographic distribution of this suite of plants, suppression and containment are the most viable control options available. This has direct implications regarding the need for a treatment prioritization model that recognizes landscape differences on a site-specific scale. Understanding where suppression is most feasible and has, ultimately, the greatest chance of restoring a viable native plant community is going to be critical to creating a defensible treatment program. This contrasts directly with the early detection / rapid response model which is appropriate for invasive species that are relatively new to the area and currently limited to specific localized populations. Plants such as kudzu and spreading bamboo fall outside of the prioritization model as eradication is still a feasible option in most of their current locations.

While limited populations of kudzu and spreading bamboo were detected during the qualitative assessment phase, it is highly probable that, given the size and geographic scope of the Fairfax parks system, other new introductions of currently limited, yet potentially problematic, invasive plants are present on park property. As mentioned previously, newly detected populations of invasive organisms are suitable candidates for a rapid response and eradication approach.

2.1.2 Ecological Drivers

As the primary goal of the field assessment was to develop a qualitative understanding of the ecological conditions associated with invasive plant activity in the parks, particular attention was paid to identifying patterns and processes that were related to invasive plant infestation. Invasive plants tend to be early successional colonizers that produce copious quantities of offspring in response to landscape disturbance. In the majority of cases invasive plants are associated with a past or current land use or disturbance regime that provides a competitive advantage for the invader in getting established. The successional trajectory of the woodland is then altered to the detriment of the historic plant community and regional biodiversity.

During the field assessment of the Fairfax County parks system, a number of disturbance patterns were found to be associated with invasive plant activity. These disturbance regimes should be recognized as important ecological drivers of invasive colonization and will need to be integrated into all treatment prioritization decisions. Correcting the primary causal agent behind ecological disruption is, ultimately, a more cost-effective solution than repeated treatment of symptoms. Ideally, interventions should be coordinated with disturbance reduction in order to assure a sustainable level of NNIS suppression.

In Fairfax County the primary ecological drivers of invasive expansion were found to be:

- Excessive white-tailed deer herbivory
- Stormwater surges and scouring of riparian woodlands
- Construction of park infrastructure
- Maintenance of park infrastructure

2.1.2a Deer Disturbance

There is a broad consensus within the scientific community that high deer densities are seriously degrading the ecological condition of forests in the northeastern United States (Audubon 2003). Excessive deer herbivory alters forest succession, reduces native plant species, and facilitates the spread of invasive vegetation. Deer tend to preferentially feed upon desirable native plants and, as a result, can act as a primary agent of forest disturbance. As mentioned previously, invasive plants respond well to disturbed sites and, if their seed source is in proximity, will rapidly colonize these locations. In many of the Fairfax parks, deer have effectively halted forest regeneration and created an unstable forest system susceptible to sudden catastrophic loss. As an example, large expanses of the Sully Assemblage lack native understory and desirable regeneration due to deer damage. Invasive plants are but a symptom of a more systemic problem – excessive deer densities.

Unfortunately, the options for deer control are limited. In suburban areas exclusion and harvest tend to be the only viable options. However, both of these methodologies have limitations. Exclusion with fencing is, at best, a temporary solution as it does not restore the entire ecosystem to a healthy condition. Harvesting of deer by recreational hunting is of limited effectiveness in suburban settings due to the ready availability to deer of refuge locations (such as suburban lawns). Professional sharpshooters or trained local volunteers can have dramatic impacts on deer densities within a single year but their value as a management tool can be challenging to communicate to the general public. The key factor is removing a large percentage of the deer herd without allowing the remaining population to become "skilled" at avoiding harvest.

Absence of forest regeneration due to deer herbivory – Sully Assemblage

As Fairfax County previously contracted for a deer management plan (Shissler 2001), the Biohabitats team strongly recommends that it be fully funded and implemented. As professional sharpshooting can range from \$200 to \$600/deer, local volunteer talent is a much more attractive option. The direct relationship between excessive deer densities and the prevalence of NNIs in the understory of many Fairfax county parks (example – Huntley Meadows) can not be overstated. The local level of herbivory pressure from deer is often the primary variable impacting restoration success.

2.1.2b Stormwater Disturbance

Impervious surfaces in urban areas reduce the capture and soil infiltration of water during rainfall events, resulting in an excessive flow of runoff to stream channels. Stream degradation begins to become evident when more than 10% of the watershed is occupied by impervious surface. In Fairfax county stormwater discharges are of significant enough volume to change not only the geomorphology of receiving streams, but in addition, the riparian understory vegetation. Frequent disturbance in the form of heavy scouring of floodplains, coupled with the transport of invasive propagules (seeds and vegetative parts) has allowed for the establishment and eventual dominance of undesirable invasive plants.

Clear evidence of this mechanism of dispersal can be seen in the spatial pattern of Japanese stiltgrass in riparian corridors. Stiltgrass is an annual plant and is readily spread through water transport. In Fairfax County, stiltgrass was found to predominate along the lower sections of stream valleys. It was much less prevalent in headwater areas. Movement of stiltgrass propagules via roadside drainage catchbasins and culverts allows this aggressive plant to enter and colonize previously uninfested areas. Over a period of years, coupled with deer damage, a monoculture of stiltgrass becomes established.

An excellent example can be seen in the following photographs from Sugarland Run Stream Valley. The photo to the left is a heavily armored catchbasin designed to quickly move heavy volumes of stormwater off of the landscape and into the receiving stream of Sugarland Run. The photo to the right illustrates the carpet of stiltgrass that results from this excessive runoff.
The disturbed hydrology of this site is typical for many of the riparian parks in Fairfax and has important repercussions for invasive treatment. Until the hydrology is repaired, suppression of invasive plants within a lower floodplain such as Sugarland Run, has little chance for long term success. Re-infestation is guaranteed unless the upstream seed source can be eliminated. Unfortunately, that seed source is likely to reside on private property and fall outside of the jurisdiction of the Fairfax County Park Authority

SUGARLAND RUN

Upstream

Downstream

Should invasive treatment be warranted in a riparian corridor, it would be prudent to begin the treatment process in the headwaters if possible. Over a period of years treatment can progress downstream as propagule reservoirs become depleted in the upstream region.

2.1.2c Construction / Maintenance Disturbance

The third major disturbance variable that was found to be enhancing the establishment of invasive vegetation within the park system is the construction of incompatible infrastructure and associated maintenance practices. The sighting and development of park hardscape can have a tremendous impact on native plant communities and their inherent capacity to resist NNIs. Activities that create gaps in the forest canopy through excessive pre and post-construction tree mortality allow light levels to increase on the forest floor. If a population of NNIs is present prior to tree loss, or if a local seed source is nearby, the additional light penetration will cause an explosive increase in the percent cover of these species on the forest floor. During the site review, multiple examples of tree decline and death as a result of construction related root damage were clearly evident. The inadvertent loss of decade's worth of accrued canopy cover creates impacts that ripple through the entire local ecosystem. Fortunately, simple tree preservation tools are available that can avoid most of this damage if adopted and implemented during the project design and construction phases.

While the trail system is a major asset that draws residents into the park system and engages them with the landscape, it is also, conversely, the primary park infrastructure element that is adversely impacting ecological integrity. Tree loss, as mentioned above, is clearly evident adjacent to newly constructed

Adoption of invasive Best Management Practices offers a cost-effective, preventative approach that will save thousands of dollars in future remedial restoration expenses.

Japanese Stiltgrass "hitchhiking" on mower deck

trail sections. In addition, changes in site hydrology associated with poorly designed stormwater culverts are directly vectoring Japanese stiltgrass propagules into formerly uninfested areas. These trail-related conditions are common within the park system. In general, it was found that; the larger the trail width, the greater the ecological footprint penetrated into the forest.

The maintenance of trail edges is also a major source of invasive spread and propagation. Trailside mowing and drainage clearing are currently responsible for massive incursions of Japanese stiltgrass into the forest understory. Mowing after seedhead production transfers stiltgrass along the trail corridor where it then eventually migrates into the neighboring woodland. Evidence of this dispersal mechanism was seen in parks of all sizes and locations. The problem is so ubiquitous within the Fairfax park system that the Virginia Department of Conservation & Recreation has utilized trail examples from Fairfax to demonstrate the negative ecological consequences of improper trail maintenance (Fleming 2009).

Of particular concern given the trailside proximity that this species enjoys is the degradation of the user experience. For many park patrons the trail system is the closest opportunity that they have to interacting with the native biota of Fairfax County. The replacement of desirable native species with stiltgrass along the park trail system, in effect, "teaches" park users that this is a "normal" landscape.

Fortunately, the invasive-propagating disturbance associated with infrastructure construction and maintenance practices is readily amendable to correction through internal policy and organizational adjustments. It is strongly recommended that the Fairfax County Park Authority implement and enforce the recommended Best Management Practices (BMPs) developed as a component of this project (appendix C). Adoption of invasive Best Management Practices offers a cost-effective, preventative approach that will potentially save millions of dollars in future remedial restoration expenses.

2.1.3 Forest Regeneration

The sustainable management of a primarily forested landscape, such as that present on the parklands of Fairfax County, requires an understanding of long-term successional trajectory. The forest of the future requires planning today. Field assessment of the county parklands indicates that the majority of the sites are composed of even-aged stands of secondary and tertiary forests. These are remnant woodlands that likely became established following the cessation of historic land use disturbances such as agriculture or timber and fuelwood extraction. Under normal circumstances most of these stands would begin to convert to shade tolerant species in the understory. However, in many of the parks there is a pronounced lack of desirable tree regeneration on the forest floor. High deer densities have removed much of the native regeneration. Invasive plants, unpalatable to deer, have moved in to occupy the vacant ecological niches. Large areas of the county park system are not regenerating forest cover and will cease to be occupied by a desirable tree canopy without active intervention.

Large areas of the county park system are not regenerating forest cover and will cease to be occupied by a desirable tree canopy in the future without active intervention.

Ultimately, the suppression of invasive species is about protecting the future forest. As invasives dominate the understory they will effectively inhibit the establishment of tree seedlings. Without advance regeneration, upon failure of the current tree canopy these forested sites will revert to a brushy, weedy plant composition. The benefits and values associated with a complex, dynamic level of tree cover will be lost. Given the current age and composition of many of the forest canopies within the park system, this transition should become evident in many areas within the next forty (40) years.

Protect the Best, First.

2.2 Site Prioritization Model

Constructing a rational, defensible, and transparent methodology by which to determine the most effective allocation of limited invasive resources was a central focus of this project's work effort. In order to accomplish that objective a review of the established invasive prioritization literature was performed, several of the leading park districts across the United States were contacted and interviewed, and multiple stakeholder sessions were conducted in Fairfax County. The insight gained during this analysis provided a clear direction for the invasive suppression program – "Protect the Best, First". This simple mantra captures the paradigm shift that is required to manage a massive invasive challenge with finite, limited resources. It moves the program objective from a myopic focus on "weed killing" to a more comprehensive "ecological restoration" mindset. Instead of measuring success by the acres of invasives treated, the metric becomes the acres of forest restored or protected. This simple, yet profound, shift in emphasis will directly reduce treatment costs per acre as monies become diverted to sites that have a greater inherent capability for regenerating native vegetation. Healthy ecosystems have a higher level of resistance to biological invasion than degraded, disturbed environments. Identifying and limiting NNIs intrusion into these areas will allow the county to maintain a greater return on its investment in invasive control dollars.

2.2.1 Literature Review

Our review of the invasive plant literature has shown that considerable research has been devoted to determining which invasive plant species are most important to control but little attention has been given to where control on the landscape should occur. A recent example of the former strategy is the I-Rank approach developed by Randall et al. (2008). This and other approaches to ranking invasive species for control (e.g., Hiebert and Stubbendieck 1993, Hiebert 1997) generally reflect the potential of a particular species to be a pest and the susceptibility of the species to control actions. This research has been useful in that it acknowledges that all invasive plant species are not identical in their adverse impacts or in their manageability. In addition, the species ranking approaches encourage resource managers to focus their limited time and resources on those invasive species that are most damaging and which can be feasibly controlled. Unfortunately, these approaches are best suited to identifying specific species to target for intervention prior to widespread dissemination across the landscape. They also tend to focus the risk analysis on the biological and genetic factors that pertain to invasive traits inherent within the given organism. Little attention has been given to determining the spatial ranking of treatment sites based upon the assets at risk or the vectoring mechanisms working on the landscape. As such, none of these models is appropriate as a decision making tool for treatment prioritization in the Fairfax County park system.

Several authors have recognized and lamented the lack of comprehensive strategic approaches to dealing with invasive species (DiTomaso 2000; Hobbs and Humphries 1995; Macdonald 1990; Temple 1990). The best examples in the literature include; Wittenberg and Cock (2001) who reviewed best prevention and management practices,. Shine et al. (2000) who summarized legal and institutional approaches for managing invasive species, and Filbey et al. (2002) who addressed efforts on the state level in the US to prevent and control invasive species. Of these, only Macdonald (1990) attempted to provide a comprehensive strategy for protected areas.

Given this paucity of information or model templates, it is not surprising that land managers do not often follow a strategic approach to invasive species management.

2.2.2 Existing Pragmatic Approaches

Phone interviews with representative park managers across the country indicated that an "ad-hoc" approach is widely used in determining where to allocate invasive resources. This approach does not involve any strategic decision-making nor does it integrate any monitoring of restoration success. Rather, decisions about invasive plant control efforts are based on factors that may be valid at least in some situations, e.g., ease of access to invasive plant populations, availability of staff or contractors to apply herbicide, and complaints by members of the public. However, an "ad-hoc" approach does not consistently apply relevant criteria to management decisions. The metric most frequently applied in determining the effectiveness of treatment is reported as the amount of brown foliage evident a few weeks after herbicide application. Quantitative measurements of site re-colonization by either desirable or undesirable vegetation are typically limited and follow-up site applications in subsequent years are highly dependent upon funding.

Tree-iage Analysis

The Green Seattle Partnership (GSP) developed an approach called the Tree-iage model to assess forest conditions and identify priority areas. Each category in the Tree-iage model requires a different restoration strategy. This model will be used on GSP sites to help prioritize restoration efforts.

	LOW THREAT less than 5% invasive cover	MEDIUM THREAT 5%–50% invasive cover	HIGH THREAT more than 50% invasive cover
HIGH–VALUE FOREST Seattle's highest-quality forest stands are dominated by mature, native evergreen canopy species with more than 50% native conifers, madrone or forested wetlands.	1 Monitoring and Stewardship	2 Invasive plant reduction	3 Major invasive plant reduction
MEDIUM–VALUE AREAS have more than 25% native tree cover, but less than 50% cover by conifers or other native evergreens.	4 Planting	5 Invasive plant reduction and planting	6 Major invasive plant reduction and planting
LOW–VALUE AREAS are forested, but have less than 25% native tree cover.	7 Evaluation and major planting	8 Invasive plant reduction and major planting	9 Major invasive plant reduction and major planting

In effect, the majority of park managers contacted indicated that their invasive control programs were not systematic, targeted, or based upon a quantitative analysis of the relative risk threat or cost/benefit. The consensus reported was that, based upon the scale of the NNIs presence, their invasive problems were not being properly addressed and that funding levels were inadequate. A summary of park systems contacted can be found in Appendix D.

Of the jurisdictions contacted, a handful of programs stood out as potential templates for the Fairfax model.

2.2.2a Seattle Parks & Recreation, Seattle, Washington

Mr. Mark Mead, the City Forester for Seattle, indicates that the city parks program covers 6,500 acres, 2,500 of which are in naturalized forest. This forest resource has gradually degraded over a period of decades and is targeted for complete restoration by 2025. Billed as the "largest urban forest restoration in the United States", project costs are estimated at $52 million over 20 years. This equates to a per acre forest restoration cost of approximately $20,800. It should be recognized that this per acre cost includes a substantial investment in understory planting and mechanical control of invasives. Regulatory constraints within the City of Seattle preclude the use of most herbicidal materials which directly impacts the cost effectiveness of invasive control efforts.

Of particular interest to the needs of the Fairfax County Park Authority is the City's development of a site ranking matrix that categorizes and prioritizes forest areas for restoration. Titled "Tree-iage" this ranking system is based upon the intersection of two axis; invasive cover percentage and forest type. Working off of a complete inventory (produced in 2005) the city has broken the forest complex into nine (9) separate ranking levels. High quality forests with low invasive cover ("Protect the Best, First") will be addressed within the first five years of the program. The lowest quality forests with the highest proportion of invasive plants are targeted for the final program years.
Other important components of the Seattle approach include the initial effort to produce a complete site inventory. This assessment was completed in 2000 with the aid of funds from a private benefactor. As herbicide application is extremely limited and mechanical invasive control the only viable option, the city draws heavily from a volunteer labor pool. Contractual crews are primarily utilized in areas of underserved communities where volunteer labor is in short supply. The city estimates volunteers are approximately 40 to 50% as efficient as outside labor.

2.2.2b Fairmount Park System, Philadelphia, Pennsylvania

The Fairmount Park System includes 9,200 acres, with 5,600 acres of natural areas and 63 neighborhood parks. The primary invasive species of concern inhabit riparian corridors. Fairmount Parks contracted for a baseline resource inventory with the National Academy of Sciences and sites were prioritized for restoration based upon site quality, sociological, and cultural values. Biohabitats, Inc. developed restoration plans for 80 of the identified restoration sites. Invasive species interventions within the park system are closely aligned with these restoration locations. (The actual acreage targeted for invasives treatment on a yearly basis was not available). All restoration sites are closely monitored and include follow-up interventions for invasive plant control. Contract herbicide applications, mainly foliar and basal bark treatments, are done at priority sites and cost about $25,000 per year. The park system employs two certified applicators, however, no internal staff persons are exclusively dedicated to invasive control. The park employs only one part-time person to address invasive species. However, there is a large volunteer program with dedicated volunteer recruitment staff, and lots of volunteer led invasive work using mechanical control year-round. The US Department of Agriculture coordinates a deer culling program using sharpshooters as deer have historically been a major disturbance agent promoting invasive species colonization. Prioritization for treatment is determined based upon the following variables:

1) Active restoration has been done in the past to the site,
2) Site is affiliated with a location about to be restored,
3) Population represents a new, isolated patch.
4) Invasive species has an available biological control option available (e.g., beetles for purple loosestrife and mile-a-minute).

2.2.2c City of Boulder Open Space & Mountain Parks, Boulder, Colorado

This program is responsible for about 45,000 acres of land over a gradient of habitat types. As a city on the Front Range of Colorado the primary species of concern are diffuse knapweed, Dalmatian toadflax, common teasel, Canada thistle, and Mediterranean sage. Working off of land cover maps the city has developed a treatment prioritization model that ranks species according to their threat level in the various identified habitats. Working off of an inventory, Boulder treats species of greatest threat to a given habitat first.

Approximately $200,000 per year is spent on invasive control, including the salaries of two full-time staff persons and summer seasonal workers. Most invasive plant control work is done in-house, however, large projects are contracted out. There is modest use of volunteers for invasive control.

2.2.2d Bureau of Reclamation, Denver, Colorado

The Bureau of Reclamation developed a site-specific ranking model to help managers of Bureau lands in the western US prioritize invasive plants for management (Carpenter and Murray 2001). These lands typically abut reservoirs that are managed for flood control, irrigation water storage, and recreation. The model is one of the few examples of invasive prioritization protocols that take into account spatial variables such as the proximity of desirable lands and the potential vectoring channels. The following is abstracted from Carpenter and Murray (2001).

The model incorporates explicitly objective information about the size and location of weed occurrences, along with information about weed species biology. The model calculates numerical scores for seven different factors that have been suggested in the literature to be important when considering the priority of noxious weed occurrences and species for management. These factors are listed below in decreasing order of importance in the model:

1) location of the occurrence with respect to high-value lands
2) innate ability of the dominant weed species in an occurrence to be a pest
3) size of the occurrence
4) local rarity of the dominant weed species in an occurrence
5) feasibility of control of the dominant weed species in an occurrence
6) proximity of an occurrence to dispersal corridors
7) abundance of the dominant weed species in an occurrence

The user of the model supplies input data from a noxious weed inventory. The output of the model is a numerical total score for each weed occurrence in a management area. The model rank-orders these total scores to create a prioritized list of weed occurrences.

2.2.3 The Fairfax Park Authority Invasive Prioritization Model

In order to be relevant, the prioritization model developed by the Fairfax County Park Authority needs to reflect not only the ecological risk faced by the park system but also the mission, vision, goals and values of the Park Authority. Two central strategic objectives of the Fairfax County Park Authority, as identified in the 2006 – 2010 Strategic Plan, are addressed through the elements integrated into the model:

- *Protect and Enhance Natural & Cultural Resources: Reflects the first half of the Park Authority mission statement, which states "to set aside public spaces for and assist citizens in the protection and enhancement of environmental values, diversity of natural habitats and cultural heritage to guarantee that these resources will be available to both present and future generations."*
- *Advance Stewardship; To exercise our obligation and responsibility to protect and preserve our natural and cultural resources, and position the Park Authority as a leader in the education, advocacy and demonstration of stewardship best practices.*

The model also needed to be suitable for a quick, rapid field assessment of targeted sites, be accessible to field personnel with a basic understanding of forest ecology, and be applicable to the large diversity of cover types and infestation levels evident in the park system.

Several iterations of the model were vetted thorough a stakeholder feedback process and a two-tiered format eventually settled upon. This format consists of the following:

- Level One Scoring – a rapid assessment, one page scoring sheet that addresses the ecological and cultural value of the resource in addition to the invasive risk level.
- Level Two Scoring – a more comprehensive site analysis format that allows for a more detailed ranking of the ecological, cultural, and invasive site components. Level two scoring is reserved for sensitive or complex sites that warrant a fuller analysis.

2.2.3a Level One Scoring

Level one is composed of three separate scoring domains; Ecosystem, Non-native Invasive Species, and Cultural Value. Within each domain a matrix exists allowing for a range of point values from one to five. For instance, under the ecosystem score a site with high biodiversity and low disturbance patterns, such as a 200 year old stand dominated by white oak (Quercus alba) would be given five points. Conversely, a site of low biodiversity and high disturbance, such as a monoculture of pole size tulip poplar in a floodplain, would score only one point. The metrics within each domain are:

- Ecosystem Score – biodiversity level (y axis), disturbance level (x axis)
- Non-native Invasive Species Score – infestation level (y axis), control difficulty (x axis)
- Cultural Value Score – visitation level (y axis), ownership (x axis)

A particularly unique aspect of this ranking system is the integration of cultural with ecological conditions. While on the surface this may strike traditional natural resource managers as counter-intuitive (more visitation = more degradation), it speaks directly to the primary purpose behind the Fairfax County park system. The parks have been acquired and are designed to be resources for the residents of the county. The experiential component of a visitor interacting with the regional biodiversity is central to the park mission. Areas that experience frequent visitation and that engender strong public affinity for the natural resources have an inherent value that should be captured in the evaluation procedure.

In addition to the five point maximum possible in each category, an additional point is applied to sites that have been previously treated for invasives within the last twelve months. The minimum point score is three (3) and the maximum point score is sixteen (16) on level one. Within this system, sites with the highest point values represent priority areas for treatment. Ranked scoring between differing sites within the park system will allow for systematic and defensible decision-making regarding invasive suppression resource allocation.

A sample level one scoring sheet is provided in Appendix E along with a detailed instruction sheet.

2.2.3b Level Two Scoring

Level two mirrors the format of level one but delves deeper into the observational categories behind each of the domains. Biodiversity, for instance, has been broken into ten different scoring metrics dealing with the spatial context of the landscape, the forest structure, and key environmental features. The disturbance level is provided with five different components, each with an accompanying score value.

Unique to level two, two of the spatial metrics - core forest area & forest edge quality, have been pre-determined for all of the park units. These values were computed during the initial FRAGSTATS analysis of the county park system and can be entered into the level two scoring prior to entering the field. A complete list of these values is provided in appendix B.

The greater level of detail in level two allows for a wider range of final scores; a maximum of eighty-four (84) points and a minimum of twenty-two (22) points. This will provide for greater flexibility in determining resource allocation between complex or challenging sites.

Given the greater degree of ecological expertise that is required to effectively and consistently rank the metrics located within level two, it is advised that only senior and experienced personnel representing the Fairfax County Park Authority attempt to perform this level of analysis.

A sample level two scoring sheet is provided in Appendix F.

3.0 Operational Recommendations

While review of the literature and the initiatives of other park systems failed to produce a clear-cut operational approach that would be suitable for the Fairfax County Park Authority, it did illustrate the need for a strategy based upon both prevention and prioritized intervention. As virtually all land management agencies face a chronic limitation in maintenance funding levels, it is vital that resources be applied to areas that produce the greatest return on investment. Prevention and prioritized intervention offer opportunities to maximize the benefits realized from limited invasive suppression funds.

3.1 Prevention

Prevention is a multi-faceted tool that can be implemented in a cost-effective manner within the Fairfax County Park Authority. As a municipal land management entity, the Park Authority can practice management strategies within the park units that minimize opportunities for NNIs plant populations to become established and to expand into new uninfested areas. Outreach is also a logical corridor for the Park Authority to pursue in implementing prevention. Invasive organisms do not respect legal property boundaries and, given the fragmented nature of the park system, land management activities of park neighbors will directly impact the sustainability of park ecosystems. While outreach recommendations were outside of the scope of this project, it is strongly recommended that the Park Authority continue to pursue these initiatives in order to protect park resources.

Prevention and prioritized intervention offer opportunities to maximize the benefits realized from limited invasive suppression funds.

As witnessed during the field inspection, one of the primary drivers of disturbance and invasion biology in the Fairfax park system is the operational procedures followed during construction and maintenance activities. Relatively minor changes in field operations, such as modifications in mowing timing, mowing sequence and vehicle hygiene, can yield major returns on reduced infestations and, ultimately, avoided expenditures for intervention. For instance, movement of Japanese stiltgrass populations along trail corridors is currently being fostered by mowing and maintenance activities that physically transport seeds of this annual plant to previously uninfested locations. As stiltgrass seed viability in the soil can last for several years, any activity that re distributes or transfers contaminated soil will promote the spread of this organism. Three simple solutions are available:

1. Do not operate mowing equipment during the period when seedheads are present on the plants (late summer, early fall).
2. Sequence mowing regimes such that equipment does not move directly from infested areas into uninfested areas.
3. Carefully clean and wash all equipment after operating in an infested area.

Preventative recommendations such as that offered for stiltgrass are specified in the best management practices document developed for this project (appendix C). Adoption and implementation of these practices is vital to addressing the invasive species challenges facing Fairfax County. Examples of other suggested best management practices include, but are not limited to:

- Minimization of ground disturbance during construction activity
- Treatment of invasive plants prior to construction disturbance
- Daily cleaning of weed seeds and propagules from equipment
- Prompt establishment of native vegetation following construction
- Use of weed-free seed and mulch in all landscaping
- Preservation of tree canopy
- Protection of existing site hydrology
- Limiting infiltration of invasive plants from neighboring landscapes

3.2 Prioritized Intervention

Given the suite of invasive plants and geographic distribution of invasive organisms evident across the county parks, a coordinated response effort will need to be undertaken. As resources for invasive control have been severely limited, a significant management backlog exists across a wide range of park areas. In order to gain an understanding of the potential size of this work backlog, an extrapolation was performed based upon the project team's field observations and professional experience in invasive suppression across the United States. These projections are detailed below and represent a realistic idea of the work effort that would be required to fully address the NNIs problem currently present in the parks.

Dealing with this invasive backlog will require an integrated intervention program that is based upon the prioritization model and integrates the full range of resources available to the Park Authority; contractual labor, in-house skills, and volunteer efforts. Each one of these talent pools has an important contribution to make. Unfortunately, no published time or efficiency studies are available that clearly examine the production rates of these work force elements with respect to invasive management. As such, for the purposes of this project, determinations as to relative efficiencies between the various labor types were estimated based upon land manager feedback and the professional experience of project team members in training and managing invasive plant crews.

Given the diverse forest cover type and species richness that occurs within the parks, remedial treatment of invasive vegetation will need to rely heavily upon the selective, and appropriate, application of herbicidal materials. With the exception of the City of Seattle, a jurisdiction that heavily discourages chemical intervention, no invasive plant suppression program on a landscape comparable in scale to Fairfax could be found that did not primarily rely on chemical treatment. As such, the need for certified, professional applicators renders volunteer labor inappropriate for the initial wave of intervention efforts.

Contract Crews

While the initial cost/acre for professional crews invariably will appear greater than for in-house labor, the enhanced productivity and reduced operational oversight often make contract crews an attractive option. The enhanced skill set, ability to mobilize specialty labor and equipment, and the knowledge of successful intervention programs in other regions, make contract labor a logical choice for addressing large areas of deferred invasive suppression.

Contract crews however, lack the landscape familiarity of in-house staff. This necessitates that at least one professional park staff member be assigned to contract oversight and orientation for each task order. Careful site characterization and project scope construction prior to the issuance of an RFP can reduce the need for intensive contract management. Multi-year contract awards offer another opportunity to reduce administrative expenses and allow for the selected vendor to develop an intimate knowledge of the park system landscape.

In-house Staff

Producing an accurate comparison of the relative advantages vs. disadvantages of utilizing contract labor as opposed to in-house staff to address invasive plant control is a difficult undertaking. As a relatively minor niche market, time comparisons and cost-benefit analyses of this issue are non-existent. Compounding the comparison difficulty is the inherent site-specific variations that occur in invasive infestation levels and required control interventions. A review of the programs associated with other jurisdictions indicates that in-house staff is typically used as an ancillary to contract labor. The primary focus of this staff tends to be to address smaller, confined areas of infestation. In-house staff are also frequently used to perform follow-up maintenance subsequent to the initial contractor control efforts. As in-house staff frequently have a greater level of intimacy with the landscape and a more flexible response time, they are well-suited to early detection and rapid response.

Several operational issues impact the costs associated with internal staff. In addition to the direct wage and benefits costs there are overhead and administrative expenditures associated with labor management. Recruitment and training can also significantly impact expenses as invasive control is a labor-intensive endeavor that is preferably performed by field personnel with a strong botanical skill set. Unfortunately, these same individuals tend to pursue a more aggressive career track causing a relatively high turnover rate. Based upon the professional experience of the Biohabitats team, green employees within the invasive control industry tend to be only a third as productive as seasoned employees for at least six months to a year (.33 full-time equivalent–FTE 1st year). This, of course, assumes that the employee is dedicated to invasive field work full time. If other job responsibilities detract from the amount of practical field experience time available for training this period would be extended.

It is estimated that the current Fairfax County Park Authority invasive program consists of a cumulative total of approximately 2.15 FTE. It would be unrealistic for the Fairfax County Park Authority to expect to recruit seasoned field invasive personnel during the initial start-up period of an internal program. The small scale of the industry results in a correspondingly small labor pool of qualified candidates. An extended period of reduced productivity and training development should be anticipated for any potential candidates. Recruitment salary on a regional level for a candidate with an appropriate level of education (college level botany or forestry) typically ranges from $44,802 to $51,338. It should be noted that this figure is based upon salary only and does not include the cost of benefits and associated labor expenses. It should also be noted that, in a higher cost-of-living area such as Fairfax County this recruitment wage rate may prove inadequate. It is strongly advised that the Park Authority avoid manual labor lacking the appropriate educational prerequisites. While this model is not unusual in high-volume vegetation management work such as general landscaping and utility ROW maintenance, it is ill-advised for the botanical and ecological complexity of restoration ecology. It would also skew any meaningful examination of the differences between contractual vs. in-house resources and result in an "apples to oranges' comparison.

In addition to labor costs there are issues of equipment purchase and maintenance. At a minimum, each field employee will need to be outfitted with the following:

EMPLOYEE EQUIPMENT NEEDS (BASIC)

Chainsaw	**$500**
Brushcutter	**$350**
Backpack Sprayer	***$130***
Personal Protective Equip	**$150**
Misc (hand sprayer, fuel bottles, etc.)	**$200**
TOTAL	*$1,330 MINIMUM / FIELD EMPLOYEE / YEAR*

Full utilization of this equipment will necessitate frequent and routine maintenance. In particular, the use of chainsaws and brushcutters in close proximity to ground level, as is common in invasive suppression, will shorten the useful service life of these items. It is suggested that field crews maintain back-up equipment in user-ready condition to avoid excessive delays in the time-sensitive performance of invasive control.

It is also important to recognize that opportunities exist to maximize both equipment and manpower utilization through the broadening of job responsibilities. Vehicles required to transport crews and materials to work locations are unlikely to serve exclusively on invasive projects and have potential value in multiple capacities outside of invasive suppression. The purchase cost of these units should not be applied in full to the invasive budget if it is anticipated that they will serve additional roles.

In addition, due to the inherent seasonal nature of invasive plant control, along with the impact of weather conditions, it is unlikely that a given employee will be able to perform interventions on a year-round basis. Broadening of job responsibilities to include other complementary services such as general horticultural duties will aid both in employee retention and workforce efficiency. Cross training can improve not only the flexibility of the general workforce but also the motivation of the individual employee.

Volunteer Labor

While intervention programs across the country may differ in terms of funding levels, the majority of jurisdictions contract out areas of management backlog and herbicide application. Monitoring and follow-up work is then delegated to volunteers or in-house personnel when available. The Seattle program deviates significantly from this model in that it relies heavily upon volunteer labor. Although they acknowledge that the volunteer work force is perhaps only 40 to 50% as efficient as outside labor, the restrictions on herbicide use and the reliance on manual control make this labor force a competitive option in this unique circumstance.

In Fairfax County it is estimated that volunteers contributed a total of 3,701 hours during 2007 towards invasive control. The program funds volunteer work at the.9 FTE level. This volunteer program focuses in on 40 identified Invasive Management Areas (IMA). IMA sites are selected based upon a variety of criteria, not the least of which is the proximity of the site to the interested volunteer. IMA is an important addition to the Fairfax invasive strategy as it mobilizes and educates a key stakeholder group. However, the IMA program should not be construed as a systematic methodology for addressing invasive suppression. The IMA program falls outside of the scope of the invasive prioritization model as it is primarily an outreach effort not an intervention strategy.

Integration of the volunteer labor force with the main invasive suppression effort in the Fairfax County parks system offers an ideal opportunity to leverage both the low cost and high enthusiasm of this stakeholder group. The volunteer model being pursued by the Cleveland Metro Parks system (21,000 acres) offers an interesting template for the Fairfax program. Cleveland Metro Parks has a labor pool of 1,000 volunteers and is developing a volunteer inventory and assessment program consisting of several "Recon Teams". These teams will be equipped with low-cost GPS units and vested with the responsibility for a systematic surveying of the park landscape for invasive populations. Invasive locations will be mapped and the species of concern identified. This rudimentary database will then be utilized to determine the proper allocation of limited invasive suppression resources.

Instituting a similar program in Fairfax would help address one of the main limitations of the current budget projections – the lack of a comprehensive inventory of park conditions. It would also allow select volunteers to make a vital contribution to the suppression program without needing to undertake exhaustive manual labor.

Recommended Labor Division

Based upon the Biohabitats team experience with both the Fairfax County parks system and the programs of land management entities across the United States the following labor allocation matrix is recommended:

Strategy Definitions

- Site Assessment – identification and prioritization of field conditions utilizing Level One Scoresheet
- Rapid Response – quick and timely control interventions on isolated populations of newly identified species of concern (example – Kudzu)
- Management backlog – herbicidal suppression effort on previously untreated areas for invasive species known to be widespread and established in the county park system.
- Routine Suppression – maintenance applications to areas previously treated for invasive suppression
- Monitoring – systematic data collection on species succession and site performance for areas previously treated for invasive suppression.

3.3 Budget Recommendations

Site Assessment

While the initial motivation for the development of the prioritization model was to provide a tool to compensate for the lack of a complete park inventory, the desirability and benefits associated with a proper comprehensive assessment of the park system should not be underestimated. The current expectation is that the prioritization of sites will occur on a primarily ad-hoc basis with the field locations chosen in response to service requests. As such, it would be advantageous to apply the protocols developed in the Level One score sheet to a systematic landscape inspection effort. The Level One score sheet is an effective rapid assessment tool that would greatly increase the speed and efficiency by which a database could be established. As mentioned in the previous section, this information could potentially be collected by trained volunteers equipped with relatively low-cost GPS units.

STRATEGY	CONTRACT LABOR	IN HOUSE LABOR	VOLUNTEER LABOR
Site Assessment		■	■
Rapid Response		■	
Management backlog (year one)	■		
Management backlog (year two)	■		
Routine Suppression		■	
Monitoring			■

Research from Amherst on the accuracy of vegetation inventories performed by professionals as opposed to volunteers indicates that, depending upon the type of data required, accuracy levels are comparable. As a point of comparison, the Biohabitats team solicited input from professional forestry consulting firms as to the potential cost to perform an inventory of the Fairfax park system utilizing a framework similar to the prioritization model. Preliminary estimates indicate that this operation could potentially cost $150,000 for the entire park system. Should the Fairfax Park Authority elect to pursue this recommendation using volunteers, the Biohabitats team suggests the Park Authority budget for 1 FTE to oversee crew training, logistical coordination, data conversion, and data analysis. It would be advisable to have a project supervisor who is also comfortable utilizing GIS.

The GPS units suggested for this invasive strategy should cost $200 to $300 as an accuracy level of several meters is adequate for the purposes of this effort. It is also advised that crews operate in two person teams to assure individual bias is kept to a minimum. Potential ancillary expenses would include transportation and miscellaneous supplies.

Rapid Response & Routine Suppression

The use of in-house crews to respond to new outbreaks of potentially problematic NNIs and to perform routine maintenance of acreage brought under control following contractor treatment is a potentially valuable utilization of local expertise. Internal staff will tend to possess a greater level of landscape intimacy and knowledge that will facilitate scheduling and prioritization of treatment areas. As mentioned previously, the development, training, and retention of quality intervention personnel can be a challenging effort, particularly in an urban environment characterized by higher cost-of-living expenses. A rough estimate is that the cost of maintaining a crew member with the proper equipment would be approximately $90,000 per year. There is the potential to significantly reduce this rate through the hiring of individuals without the prerequisite educational background, however the Biohabitats team does not support this strategy. As it is anticipated that most of the areas these individuals will be working on will have been pre-treated by professional contractors, the cover levels of invasive plants should be low. This will greatly enhance the daily per acre productivity of crews. As a point of comparison, the anticipated average productivity of two-person invasive field crews using backpack foliar techniques should fall within the following ranges:

INVASIVE COVER LEVEL	TWO PERSON CREW PRODUCTIVITY
low	4 acres per day
medium	2 acres per day
high	1 acre per day

Assuming that the Park Authority decides to address 10% of the parkland each year over a period of ten years, this could potentially require the investment in at least two crews of two members each for the first treatment year. This would be required in order to complete treatments within the 12 week seasonal timeframe when the majority of invasive foliar application occurs. Subsequent years would require the addition of multiple crews as the maintenance acreage increased. However, it is anticipated that a large proportion of the treated acreage will eventually require no active treatment for extended periods of time as native plant communities and limitations on site disturbance reduce new infestations to a minimum. It should be recognized that retention of trained employees, given the limited field application window, will require the broadening of job responsibilities beyond invasive treatment.

Trails & Stiltgrass

Although actually a subset of routine suppression, the extensive, high-value trail system in the Fairfax parks system and the unique role it plays in vectoring Japanese stiltgrass warrant a separate recommendation category. It is the professional opinion of the Biohabitats team that effective control of the trailside stiltgrass problem should be a priority goal for the Fairfax parks system. Within a period of three years, effective suppression of Japanese stiltgrass can be achieved along the Fairfax county parks trail system. In order to achieve this objective, it is recommended that the Park Authority utilize in-house personnel applying a pre-emergent herbicide in the early spring period. The application of a pre-emergent will retard the germination of annual plants such as stiltgrass while avoiding adverse impacts to adjacent perennial vegetation. As with all herbicide and pesticide materials, label directions must be followed and the supervision of a certified applicator is required.

Production rates and equipment and labor needs are projected to be as follows:

- Treatment area – approximately 200 linear miles
- Treatment rate – maximum 11 miles per day
- Treatment time – approximately 20 days in early spring
- Personnel – approximately 160 to 200 hours for first three years
- Treatment methodology – RTV with 100 gallon tank and boon sprayer covering a 16' swath on either side (estimated equipment, including chemical materials, $12,000)

Within a period of three years, effective suppression of Japanese stiltgrass can be achieved along the Fairfax county parks trail system.

The nature of this operation and the limited botanical skill set required make it an appropriate operation to conduct with internal staff. As the population of trailside stiltgrass declines over the first three years, the need for annual treatment over large areas of the trail system will decline. Routine spot treatment will need to continue however as a regular function of trailside maintenance.

Management Backlog

Ideally, budgetary estimates and recommendations should be based upon a quantitative inventory of infrastructure conditions and maintenance requirements. In the case of the Fairfax County parks system this information is currently unavailable. However, a professional opinion as to the current extent and severity of the invasive situation on Fairfax county parkland has been developed by the Biohabitats team. This estimate is grounded in the qualitative assessment of field conditions that was performed during the course of this project. While the total parkland acreage is over 24,000, a GIS analysis indicates that only approximately 20,400 acres are occupied by forest cover. The remainder of the area is mainly occupied by manicured landscape, hardscape elements, or water bodies. The invasive recommendations have thus been based upon a potential treatment area of 20,400 acres.

As the infestation analysis resulted in a range of values for the expected variability in invasive levels, the Biohabitats team created both a high and a low range of potential cover values. This information was used to create two potential treatment scenarios for the entire forested park area. Realistic per acre contract treatment costs were then integrated into each scenario based upon professional experience on the labor inputs that are required to address the various cover levels of invasives in each scenario. The intent of this computation was to produce an overview of the resource allocation that would be required to address the entire deferred invasive suppression in the Fairfax park system over a period of two years. If properly implemented, a two year time frame should result in a cover percentage reduction of the target invasive species of at least 98%. The budget projections and assumptions are detailed in Appendix G.

POTENTIAL CONTRACT TREATMENT COSTS
ENTIRE PARK SYSTEM

INFESTATION LEVEL	1ST YEAR	2ND YEAR
low	$33,789,376.00	$16,894,688.00
high	$39,750,409.00	$19,875,204.00

Based upon this projection, organizational goals can be determined that provide for a realistic timeframe for addressing differed maintenance. For instance, a goal of addressing the current invasive backlog over 10 years would involve treatment of 10% of the acreage each year. The first year's allocation would be approximately $3.7 million for contractual labor (average of high and low predictions). The second year's allocation would potentially be $5.55 million ($3.7 million for the next 10% of the park system + $1.85 million for the second treatment of the first area). It should be understood that this figure addresses the current backlog only. Invasive conditions are in a constantly evolving mosaic of change as plants mature and disturbance patterns shift. The budgetary projections are for informational purposes only and should not be construed as firm treatment costs.

Monitoring

Monitoring is a critical, yet often neglected aspect of invasive suppression. Even the best programs reviewed across the country typically failed to dedicate adequate resources to this aspect of a control program. Without routine monitoring of the changes in plant composition on a treatment site it is impossible to determine if the ultimate goal of a desirable complex of native plants has been achieved.

A monitoring program need not be a labor intensive undertaking as the information recorded should not exceed the data collected during the initial site prioritization effort. In fact, it could be as simple as a visual estimate the invasive plant species present and their respective abundance as a percentage of the vegetative cover. This effort is well-suited to the use of volunteer participants as it does not require manual labor or the use of specialized equipment. The ultimate level of monitoring required will increase each year depending upon the extent of the previously treated area. Utilizing the 10% treatment scenario as a guide, it is recommended that the Fairfax County Park Authority allocate 1 FTE to the oversight of this initiative. Crews will need to be trained and outfitted with GPS units. Production capacity is ultimately a function of the geographic distribution of previous treatment and subsequent monitoring sites although a rate of 16 monitoring plots per day is a reasonable expectation.

4.0 Action Thresholds

Utilizing the overarching principle of "protect the best first" the determination of where along the site prioritization ranking score actions should occur is ultimately a function of the budgetary resources available for addressing the management backlog. It should be clearly understood that there are many elements of the Fairfax County Park Authority invasive program that fall outside of the ranking model. These include the application of best management practices, the IMA program, early detection and rapid response, and routine suppression. The ranking model has been developed to assist in the determination and justification of intervention treatments in areas of untreated, yet established, invasive species presence. Confusion as the proper application of this tool should be avoided.

Given that the current invasive levels within the park are not known in absolute terms, the projected percentages of acres in each cover level were estimated during the field reconnaissance phase. The following low and high projections were developed for the entire park system:

LOW ESTIMATE OF ACRES
IN EACH INVASIVE COVER CLASS

COVER CLASS	% TOTAL ACRES
1 (81% - 100%)	**0.05**
2 (61 - 80%)	**0.1**
3 (41 - 60%)	**0.45**
4 (21 - 40%)	**0.25**
5 (1 - 20%)	**0.15**

HIGH ESTIMATE OF ACRES
IN EACH INVASIVE COVER CLASS

COVER CLASS	% TOTAL ACRES
1 (81% - 100%)	0.1
2 (61 - 80%)	0.2
3 (41 - 60%)	0.4
4 (21 - 40%)	0.2
5 (1 - 20%)	0.1

AVERAGE ESTIMATE OF ACRES
IN EACH INVASIVE COVER CLASS

COVER CLASS	% TOTAL ACRES
1 (81% - 100%)	0.075
2 (61 - 80%)	.15
3 (41 - 60%)	.425
4 (21 - 40%)	.225
5 (1 - 20%)	.125

Based upon the projected cost structure to treat the entire park system, a total first year contractual expenditure of $33,789,376 for the low range and $39,750,409 for the high range would be required. Averaging these estimates produces an anticipated first year expenditure of approximately $36,971,141 to address the current infestation levels across the entire park system.

The relative estimated acreage for each cover class and associated cost is:

ACRES	PROJECTED COST
1 (1,530 acres)	$5,364,929
2 (3,060 acres)	$8,345,446
3 (8,670 acres)	$16,889,593
4 (4,590 acres)	$5,364,929
5 (2,550 acres)	$1,062,242

Under the Level One scoring sheet a maximum of 16 points can be awarded to each site. A minimum score of three is possible. This creates a range of 14 possible rankings for a prospective treatment site. Creating five bucket groupings of the possible site score rankings and matching this against the increased funding levels required to address the five cover types allows for the creation of relative action thresholds.

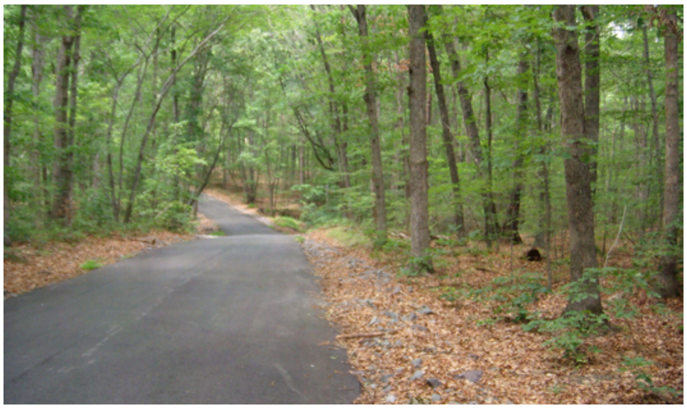
In order for management backlog resources to be utilized on lower scoring sites, budgetary allocations must be beyond the minimum thresholds for each bucket grouping. For instance, on the chart below the first $1,062,242.00 of suppression money would be spent on sites that scored at a 14 or better ranking. If suppression resources move above $1,062,243 then sites rated between levels 13 – 11 would become eligible for treatment. At $6,427,172 locations that ranked between 10 – 8 would begin to be targeted. The utilization of this budgetary gradient allows for a defensible rationale in the allocation of limited suppression resources.

It should be understood that the threshold levels displayed are based upon the first year expenditures only. Future threshold levels will change based upon the acreage that begins to fall outside of the management backlog program and into the routine monitoring and suppression category.

ACTION THRESHOLDS

LEVEL ONE RANKING	COST THRESHOLD
16 - 14	$1 - $1,062,243
13 - 11	> $1,062,243
10 - 8	> $6,427,172
7 - 5	> $23,316,765
4 - 3	> $31,662,210

5.0 Conclusion



Addressing the threat of invasive plants in a systematic and ecologically defensible manner offers the greatest potential return on limited suppression dollars. "Protecting the best, first" is an operational principle that is uniformly followed by the most progressive invasive control programs in the country. The Fairfax County Park Authority has distinguished itself as a leader in meeting the challenges posed by non-native invasive plants by recognizing the need for a comprehensive, multi-faceted invasive strategy. Implementation of the principles and tools developed during this project effort will help protect the values and assets that are central to the mission of the Fairfax County park system.

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Appendix A

Phase I - Parks Assessed

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Note: multiple locations were sampled in several larger parks. GPS coordinates not available for all sampled locations.

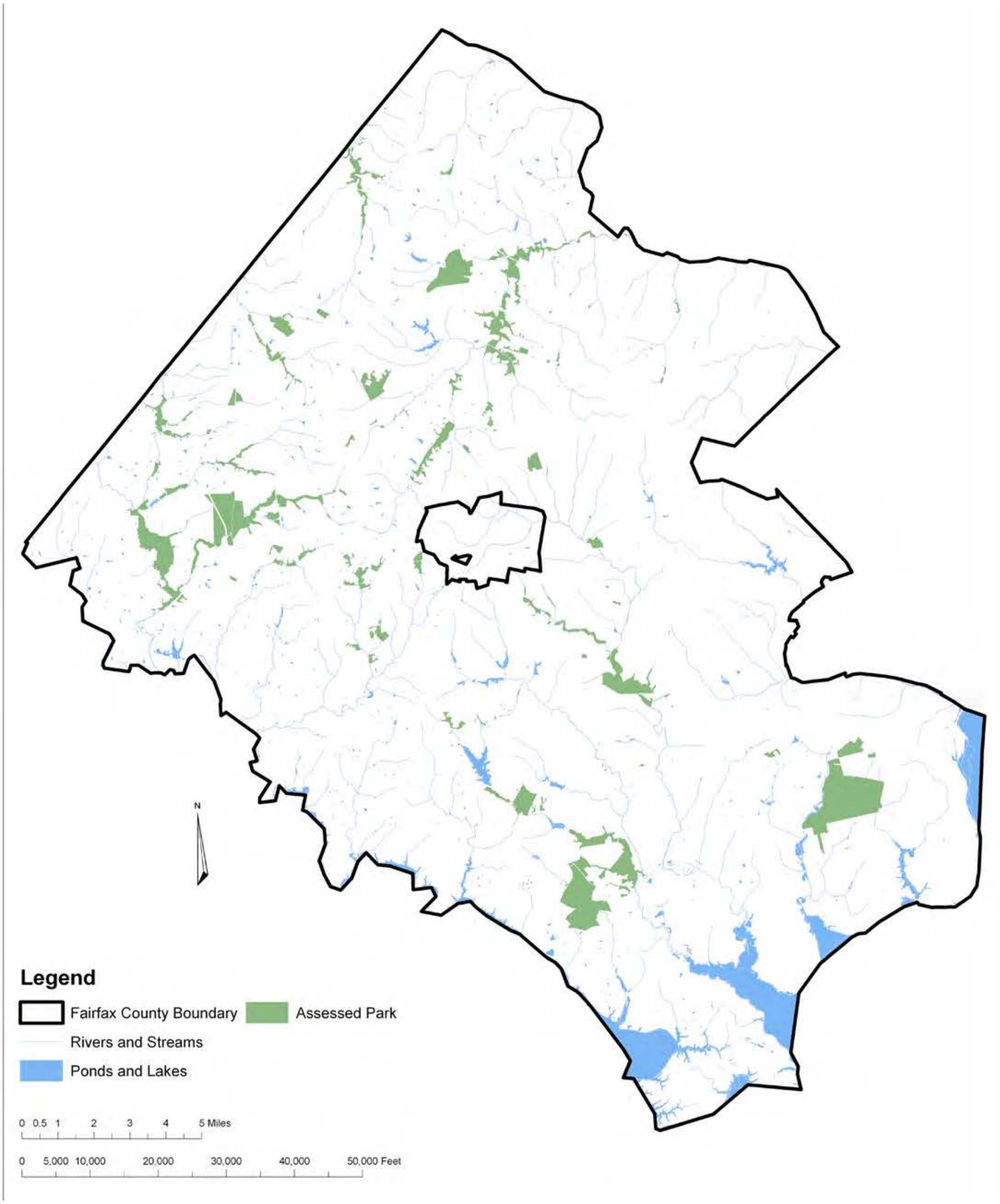
= parks sampled with x & y coordinates of location(s)

Accotink Stream Valley
Alabama Drive
Amberleigh
Americana
Annandale
Armistead
ARROWHEAD
X - 11804045.3273
Y - 7050228.43691
Ashford East
Ashgrove Historic Site
ASHLAWN
Azalea
Backlick
Backlick Run
Backlick Stream Valley
Bailey's
Bailey's Elementary School Site
Barcroft Knolls
Baron Cameron School Site
Bel Air
Belle Haven
Belvedere
Beulah
Blake Lane School Site
Borge Street
Bos Transfer 13 (Bull Run)
Boyd A And Charlotte M Hogge
Braddock
Bren Mar
Brentwood
Briarcliff
Briarwood
Brimstone
Brookfield
Broyhill
Broyhill Crest
Bruin
Bryn Mawr
Bucknell Manor
Bull Neck Stream Valley
Burgundy
Burke Lake & Golf Course
Burke Ridge
Burke Station
Bush Hill
Byron Avenue
Camelot School Site
Canterbury Woods
Cardinal Forest
Carl Sandburg School Site
Carney Park
Carrleigh Parkway
Centre Ridge
Centre Ridge North
Chalet Woods
Chandon
Chantilly
Chantilly Library Site
Chapel Acres
Chapel Road
Cherry Run
Chesterbrook School Site
Churchill Road
Clark House At Barcroft Mews
Clarke's Landing
CLARKS CROSSING
Clemyjontri Park
Clermont
Collingwood
COLVIN RUN MILL
Colvin Run Stream Valley
Confederate Fortifications Historic Site
Cooper Intermediate School Site
Coppermine Crossing Ss
Country Club View
Creighton Square
Crooked Creek
Cub Run Recenter
CUB RUN STREAM VALLEY
X - 11776324.312
Y - 7005160.67336
Cunningham
Dead Run Stream Valley
Deerlick
Devonshire
DIFFICULT RUN STREAM VALLEY
X - 11819285.6882
Y - 7017323.20694
DIFFICULT RUN STREAM VALLEY
X - 11828710.0184
Y - 7037883.0293
DIFFICULT RUN STREAM VALLEY
X - 11826658.986
Y - 7037257.14748
DIFFICULT RUN STREAM VALLEY
X - 11828065.2222
Y - 7022707.11854
Dixie Hill
Dogue Creek Stream Valley
Dolley Madison Estates
Dowden Terrace
Dranesville Tavern
Dulles Corner
Dunn Loring
Eagle
Eakin (Mantua Section)
EAKIN COMMUNITY
X - 11841163.2421
Y - 6995758.53963
East Blake Lane
Edsall
ELLANOR C. LAWRENCE
X - 11789074.4797
Y - 6998296.32621
ELLANOR C. LAWRENCE
X - 11787497.4227
Y - 6997634.03654
Eudora
Fair Oaks
FAIR RIDGE
X - 11803824.2014
Y - 7002101.53879
Fair Woods
Fairfax Hills
Fairfax Park School Site
FAIRFAX VILLA
Falstaff
Farrington
Fisher
Fitzhugh
Flag Run
Flatlick
FLATLICK RUN STREAM VALLEY
X - 11778379.4108
Y - 7001146.65426
Floris School Site
Folly Lick Stream Valley
Fort Hunt
Fort Willard Circle
Fox Hunters
Fox Valley

Foxstone
Foxvale
Franconia
Franconia Forest
Franklin Farm
Franklin Glen
Franklin Oaks
Franklin Woods
FRED CRABTREE (FORMERLY FOX MILL DISTRICT)
X - 11807560.1276
Y - 7018523.70459
Freedom Hill
FROG BRANCH STREAM VALLEY
X - 11785434.6823
Y - 7005746.43157
FRYING PAN FARM
X - 11793931.2142
Y - 7027051.2055
Frying Pan Stream Valley
Gabrielson Gardens
Garnchayne
George Mason
George Washington
Glasgow
Glen Hills
Grand Hamptons
Great Falls Grange
Great Falls Nike
Green Spring Gardens
GREENBRIAR
Greenbriar Commons
Greendale Golf Course
Greenfield
Greentree Village
Greenway Heights
Griffith
Grist Mill
Groveton Heights
Haycock-longfellow
Hayfield
Heritage Hill
Heritage Resource
Herzell Woods
Heywood Glen
Hidden Pond
Hideaway
Historic Huntley
Hollin Hall
Hollin Meadows
Holly Knoll
Hollywood Road
Holmes Run Stream Valley
Hooes Road
Hooes Road School Site
Horne
HORSEPEN RUN STREAM VALLEY
X - 11792329.3603
Y - 7022508.08978
Howery Field
Hunter Village
Huntington
HUNTLEY MEADOWS
X - 11879224.7998
Y - 6959672.11748
Huntsman
Hutchison School Site
Hybla Valley
Idylwood
Indian Run Stream Valley
Island Creek
J.e.b Stuart
James Lee School Site
Jefferson District
Jefferson Manor
Jefferson Village
John C. & Margaret K. White
John Mastenbrook - Greenway Downs
Johnny Moore Stream Valley
Joseph F. Barnes Battery
KEMPER
X - 11824495.1632
Y - 7016023.36675
Kendale Woods
Kent Gardens
Kent Gardens Greenway Stream Valley
KINGS PARK
X - 11839880.7305
Y - 6979487.60973
Kings Park West
Kingstowne
Kirby
Kirk
LAHEY LOST VALLEY
LAKE ACCOTINK
X - 11844323.142
Y - 6975887.0309
Lake Braddock School Site
LAKE FAIRFAX
X - 11819146.5716
Y - 7034952.90859
Lake Mercer
Lakeside
Lamond
Lane's Mill
Langley Fork
Langley Oaks
Larchmont
Larry Graves (Whittier Ss)
LAUREL HILL
LAUREL HILL SS
X - 11841554.9998
Y - 6949388.14364
Lawyers Road School Site
LEE DISTRICT
X - 11879308.5401
Y - 6967484.34532
Lee High
Lee Landing
Leewood
Lemon Road
Lenclair
Levelle W. Dupell
Lewinsville
Lewinsville Center
Lexington Estates
Lillian Carey
Lincoln Lewis-vannoy
Lincolnia
Linway Terrace
Lisle
Little Difficult Run Stream Valley
Little Hunting Creek
Little Pimmit Run Stream Valley
Little Rocky Run Sv
Lockmeade
Loftridge
Loisdale
Long Branch Falls
LONG BRANCH STREAM VALLEY
X - 11839402.644
Y - 6983366.83236
Longfellow Ss
Lorton
Lorton West
Lower Potomac
Luria

Lynbrook
Manassas Gap Railroad
MANCHESTER LAKES
X - 11868092.3414
Y - 6966525.68868
Marie Butler Leven Preserve
Mark Twain
Martin Luther King Jr.
Mason District
Mason Neck West
Masonville
Mclean Central
Mclean Hamlet
Mclean High
Mclean Hunt Estates
Mclean Knolls
Mcnaughton Fields
Merrilee
Merrybrook Run Sv
Middle Run Stream Valley
Middleridge
Military Railroad
Monticello
Monticello Woods
Mosby Woods
Mount Air Historic Site
Mount Eagle
Mount Gilead
Mount Royal
Mount Vernon District
Mount Vernon Manor
Mount Vernon Woods
Mount Zephyr
Muddy Hole Farm
Munson Hill
Navy Vale
Newgate
Newington Commons
Newington Heights
North Springfield
NOTTOWAY
X - 11831221.8174
Y - 7007773.8208
Oak Hill Historic Site
Oak Marr
Oakborough Square
Oakton Community (Formerly Corbalis)
Olander And Margaret Banks, Sr.
OLD CENTREVILLE ROAD
X - 11787995.3577
Y - 6988725.57193
Old Colchester Preserve And Park
Old Courthouse Spring Branch
Old Dominion School Site
Olde Forge
Olney
Orange Hunt Estates
Ossian Hall
OX HILL BATTLEFIELD
X - 11804655.0013
Y - 6999830.68539
Parklawn
Pathfinder
Patriot (Formerly Popes Head Estates)
Paul Springs Stream Valley
Peterson Lane
Pimmit Barn
Pimmit Hills
Pimmit Run Stream Valley
Pimmit View
Pine Ridge
Pine Spring
Pinecrest Golf Course
PINEY BRANCH STREAM VALLEY
X - 11808920.5867
Y - 6977620.45763
Pleasant Hill
Poburn Woods
Poe Terrace
Pohick Estates
Pohick Stream Valley
Pole Road
POPES HEAD
Popes Head Stream Valley
POPLAR TREE
X - 11794243.3376
Y - 6998464.52544
Potomac Hills
Providence Recreation Center
Quinn Farm Park (Formerly Hamovit)
Raglan Road
Random Hills
Red Fox Forest
Reston North
Reston Town Green
Richard W. Jones
Ridgeview
Riverbend
ROCKY RUN STREAM VALLEY
X - 11793640.3543
Y - 7001044.48173
ROLLING FOREST
X - 11849003.9346
Y - 6963779.05904
Rolling Valley West
Rolling Wood School Site
Rolling Woods Estates
Rose Lane
Roundtree
Royal Lake
Royal Ridge
Rutherford
Sandy Run Stream Valley
Saratoga
Scotts Run Nature Preserve
SCOTTS RUN STREAM VALLEY
X - 11851816.1497
Y - 7030520.85085
Shaker Woods
Shannon Station
Silas Burke
Silverbrook
Skyline
Sleepy Hollow
Smokewood
South Kings Forest
South Lakes Drive
South Railroad Street
SOUTH RUN DISTRICT
X - 11831719.567
Y - 6958122.3264
SOUTH RUN STREAM VALLEY
Southgate
Spring Hill
Spring Lane
Springfield Forest
Springvale
Stanton
Stephen S. Foster Intermediate School Site
Stone Crossing
STONEYBROOKE
X - 11882839.2882
Y - 6966623.41977
Stratford Landing

STRATTON WOODS
X - 11798952.5218
Y - 7028490.90955
Stuart Road
SUGARLAND RUN STREAM VALLEY
X - 11804045.3273
Y - 7050228.43691
SULLY HISTORIC
X - 11787621.8235
Y - 7015123.4685
Sully Woodlands Assemblage
Summers Cemetery
Surrey Square
Symphony Hills
TAMARACK
Tara Village
Tattersall
The Turner Farm
The Wakefield Chapel
Timberly
Tollbrook Ridge
Towers
Trailside
Turkeycock Run Stream Valley
Twin Lakes Golf Course
Twinbrook Road
Tyler
Tysons Pimmit
Tysons Woods
University
Valley Crest
Vernon Heights
Villa D'este
Villa Lee
Virginia Hills School Site
Wakefield
WAKEFIELD CHAPEL
X - 11844919.4475
Y - 6987273.08612
Walnut Hill Ss
Walt Whitman School Site
Waples Mill
Washington Mill
Waverly
Wayland Street
West Springfield
West Springfield Village
Westfields Ss
Westgate
Westgrove
Westlawn School Site
White Oaks
Wickford
Wilburdale
Williamsburg Manor
WILLOW POND
Willow Woods
Wilton Woods School Site
WINDERMERE
X - 11817125.9611
Y - 7049457.3574
Winterset Varsity
Wolf Trails
WOLFTRAP STREAM VALLEY
X - 11828370.8314
Y - 7031796.82813
Woodburn School Site
Woodglen Lake
Woodlawn
Woodley Hills


N
Legend
Fairfax County Boundary
Assessed Park
Rivers and Streams
Ponds and Lakes
0 0.5 1 2 3 4 5 Miles
0 5,000 10,000 20,000 30,000 40,000 50,000 Feet

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Appendix B

Fairfax County Park Units - Fragstats Scoring Values

PARK NAME	AREA (ACRES)	TOTAL FOREST CORE AREA (ACRES)	MEAN FOREST PATCH CORE AREA (ACRES)	CORE RANK	EDGE CONTRAST INDEX	EDGE CONTRAST RANK
ACCOTINK STREAM VALLEY	787.84	243.419	2.012	Low	44.938	Med-High
ALABAMA DRIVE	11.11	0	0	Low	80	Low
AMBERLEIGH	17.74	9.559	4.779	Low	50.980	Med
AMERICANA	3.89	13.116	6.558	Med-Low	25.735	High
ANNANDALE	51.89	15.116	2.519	Low	51.765	Med
ARMISTEAD	10.62	0	0	Low	58	Med-Low
ARROWHEAD	28.49	0	0	Low	68.906	Med-Low
ASHFORD EAST	3.83	0	0	Low	50	Med
ASHGROVE HISTORIC SITE	14.19	0	0	Low	47.245	Med
ASHLAWN	16.38	1.778	0.889	Low	58.833	Med-Low
AZALEA	1.21	0	0	Low	44	Med-High
BACKLICK	8.53	0	0	Low	60	Med-Low
BACKLICK RUN	8.57	0	0	Low	60	Med-Low
BACKLICK STREAM VALLEY	34.03	8.225	0.457	Low	37.848	Med-High
BAILEY'S	2.23	0	0	Low	54.286	Med
BAILEY'S ELEMENTARY SCHOOL SITE	1.84	0	0	Low	80	Low
BARCROFT KNOLLS	0.46	0	0	Low	47.619	Med
BARON CAMERON SCHOOL SITE	59.57	2.668	0.267	Low	48.875	Med
BEL AIR	1.50	0	0	Low	60.952	Med-Low
BELLE HAVEN	16.04	0	0	Low	63.651	Med-Low
BELVEDERE	1.90	0	0	Low	51.5	Med
BEULAH	10.62	0	0	Low	55.333	Med
BLAKE LANE SCHOOL SITE	10.27	0	0	Low	70.526	Low
BORGE STREET	3.56	0	0	Low	77.273	Low
BOS TRANSFER 13 (BULL RUN)	119.41	40.681	2.543	Low	26.199	High
BOYD A AND CHARLOTTE M HOGGE	6.33	0	0	Low	77.895	Low
BRADDOCK	56.80	0	0	Low	74.872	Low
BREN MAR	31.71	0.667	0.133	Low	60.476	Med-Low
BRENTWOOD	9.84	6.891	6.891	Med-Low	39.231	Med-High
BRIARCLIFF	5.28	0	0	Low	63.75	Med-Low
BRIARWOOD	2.69	1.112	1.112	Low	49.048	Med
BRIMSTONE	4.94	7.114	3.557	Low	35	Med-High
BROOKFIELD	25.65	0.889	0.222	Low	60.755	Med-Low
BROYHILL	4.46	0	0	Low	60.926	Med-Low
BROYHILL CREST	3.96	0	0	Low	49.556	Med
BRUIN	8.12	0	0	Low	65.238	Med-Low
BRYN MAWR	5.13	0	0	Low	60.345	Med-Low
BUCKNELL MANOR	4.93	0	0		0	N/A
BULL NECK STREAM VALLEY	15.60	29.344	14.672	Med-Low	29.252	High
BURGUNDY	7.76	0	0	Low	51.290	Med

PARK NAME	AREA (ACRES)	TOTAL FOREST CORE AREA (ACRES)	MEAN FOREST PATCH CORE AREA (ACRES)	CORE RANK	EDGE CONTRAST INDEX	EDGE CONTRAST RANK
BURKE LAKE & GOLF COURSE	597.40	421.703	60.243	Med-High	40.309	Med-High
BURKE RIDGE	3.83	0	0	Low	63.846	Med-Low
BURKE STATION	18.22	5.113	2.556	Low	38.824	Med-High
BUSH HILL	5.30	0	0	Low	70.4	Low
BYRON AVENUE	5.64	0	0	Low	59.737	Med-Low
CAMELOT SCHOOL SITE	4.36	0	0	Low	54.091	Med
CANTERBURY WOODS	5.71	0.222	0.044	Low	44.167	Med-High
CARDINAL FOREST	15.51	0	0	Low	69.375	Low
CARL SANDBURG SCHOOL SITE	2.68	0	0	Low	44.286	Med-High
CARNEY PARK	40.57	3.779	1.260	Low	63.301	Med-Low
CARRLEIGH PARKWAY	10.11	11.115	5.558	Low	36	Med-High
CENTRE RIDGE	10.25	0	0	Low	53.889	Med
CENTRE RIDGE NORTH	8.91	0	0	Low	65.790	Med-Low
CHALET WOODS	10.76	8.892	4.446	Low	42.439	Med-High
CHANDON	8.03	0	0		0	N/A
CHANTILLY	5.98	0	0	Low	72	Low
CHANTILLY LIBRARY SITE	8.62	0	0	Low	64.762	Med-Low
CHAPEL ACRES	0.87	0	0	Low	50	Med
CHAPEL ROAD	25.30	28.677	28.677	Med	16.383	High
CHERRY RUN	3.91	6.891	3.446	Low	33.514	Med-High
CHESTERBROOK SCHOOL SITE	9.95	3.112	1.556	Low	39.444	Med-High
CHURCHILL ROAD	12.24	0	0	Low	53.878	Med
CLARK HOUSE AT BARCROFT MEWS	0.83	0	0	Low	51.429	Med
CLARKE'S LANDING	13.32	0.222	0.074	Low	62.188	Med-Low
CLARKS CROSSING	143.82	62.244	3.458	Low	41.447	Med-High
CLEMYJONTRI PARK	18.72	0.889	0.445	Low	47.5	Med
CLERMONT	40.85	19.340	9.670	Med-Low	47.547	Med
COLLINGWOOD	11.99	0	0	Low	75.385	Low
COLVIN RUN MILL	38.17	8.225	1.371	Low	44.303	Med-High
COLVIN RUN STREAM VALLEY	74.45	25.565	2.130	Low	44.028	Med-High
CONFEDERATE FORTIFICATIONS HISTORIC SITE	161.71	128.712	21.452	Med	49.354	Med
COOPER INTERMEDIATE SCHOOL SITE	0.63	0	0		0	N/A
COPPERMINE CROSSING SS	14.57	0	0	Low	57.949	Med-Low
COUNTRY CLUB VIEW	39.09	4.446	0.889	Low	67.527	Med-Low
CREIGHTON SQUARE	0.68	0	0	Low	36	Med-High
CROOKED CREEK	12.25	2.890	2.890	Low	52	Med
CUB RUN RECENTER	36.95	20.452	6.817	Med-Low	31.778	Med-High
CUB RUN STREAM VALLEY	894.44	293.436	4.380	Low	46.898	Med
CUNNINGHAM	11.27	0	0	Low	62.037	Med-Low

PARK NAME	AREA (ACRES)	TOTAL FOREST CORE AREA (ACRES)	MEAN FOREST PATCH CORE AREA (ACRES)	CORE RANK	EDGE CONTRAST INDEX	EDGE CONTRAST RANK
DEAD RUN STREAM VALLEY	10.16	6.447	2.149	Low	40.833	Med-High
DEERLICK	19.31	0	0	Low	65.397	Med-Low
DEVONSHIRE	3.40	0	0	Low	55.429	Med
DIFFICULT RUN STREAM VALLEY	884.18	460.606	3.489	Low	37.411	Med-High
DIXIE HILL	3.43	0	0	Low	55.909	Med
DOGUE CREEK STREAM VALLEY	82.09	39.125	1.630	Low	46.702	Med
DOLLEY MADISON ESTATES	3.63	1.334	0.667	Low	48.421	Med
DOWDEN TERRACE	8.57	0	0	Low	47.895	Med
DRANESVILLE TAVERN	14.56	0	0	Low	66.923	Med-Low
DULLES CORNER	7.04	0.222	0.056	Low	56.667	Med
DUNN LORING	15.41	1.334	0.445	Low	61.191	Med-Low
EAGLE	97.61	55.130	18.377	Med	46.067	Med
EAKIN (MANTUA SECTION)	76.01	44.682	3.724	Low	20.898	High
EAKIN COMMUNITY	57.40	24.453	4.076	Low	32.222	Med-High
EAST BLAKE LANE	17.37	0	0	Low	68.065	Med-Low
EDSALL	3.36	0	0	Low	80	Low
ELLANOR C. LAWRENCE	662.75	368.573	24.572	Med	60.497	Med-Low
EUDORA	14.16	11.115	11.115	Med-Low	41.111	Med-High
FAIR OAKS	3.62	0	0	Low	60.741	Med-Low
FAIR RIDGE	8.75	1.112	1.112	Low	56.296	Med
FAIR WOODS	14.15	0	0	Low	64.857	Med-Low
FAIRFAX HILLS	5.99	9.337	9.337	Med-Low	22.879	High
FAIRFAX PARK SCHOOL SITE	13.24	3.779	3.779	Low	54.359	Med
FAIRFAX VILLA	59.28	60.243	30.122	Med	38.427	Med-High
FALSTAFF	3.65	2.223	0.741	Low	43.333	Med-High
FARRINGTON	0.13	0	0		0	N/A
FISHER	0.49	0	0	Low	61.818	Med-Low
FITZHUGH	10.67	0	0	Low	66.286	Med-Low
FLAG RUN	8.65	0	0	Low	70.313	Low
FLATLICK	17.59	1.778	1.778	Low	44.412	Med-High
FLATLICK RUN STREAM VALLEY	93.87	12.004	0.800	Low	54.644	Med
FLORIS SCHOOL SITE	5.22	0	0	Low	80	Low
FOLLY LICK STREAM VALLEY	42.62	0.445	0.056	Low	59.928	Med-Low
FORT HUNT	19.15	0.667	0.083	Low	46.364	Med
FORT WILLARD CIRCLE	1.63	0	0	Low	57.778	Med-Low
FOX HUNTERS	0.97	2.890	2.890	Low	36.522	Med-High
FOX VALLEY	10.89	0	0	Low	44.688	Med-High
FOXSTONE	14.54	0.445	0.056	Low	44.925	Med-High
FOXVALE	24.60	12.671	4.224	Low	51.111	Med
FRANCONIA	63.67	4.668	0.519	Low	58.913	Med-Low
FRANCONIA FOREST	6.66	0	0	Low	48.333	Med

PARK NAME	AREA (ACRES)	TOTAL FOREST CORE AREA (ACRES)	MEAN FOREST PATCH CORE AREA (ACRES)	CORE RANK	EDGE CONTRAST INDEX	EDGE CONTRAST RANK
FRANKLIN FARM	7.90	0	0	Low	65.714	Med-Low
FRANKLIN GLEN	3.76	0	0	Low	36.923	Med-High
FRANKLIN OAKS	5.96	0	0	Low	61.25	Med-Low
FRANKLIN WOODS	1.45	4.891	4.891	Low	22.4	High
FRED CRABTREE (FORMERLY FOX MILL DISTRICT)	208.36	131.379	21.897	Med	46.242	Med
FREEDOM HILL	7.83	0	0	Low	64.103	Med-Low
FROG BRANCH STREAM VALLEY	75.42	1.778	0.162	Low	67.749	Med-Low
FRYING PAN FARM	135.60	2.223	0.159	Low	67.118	Med-Low
FRYING PAN STREAM VALLEY	28.75	0.222	0.019	Low	63.359	Med-Low
GABRIELSON GARDENS	12.01	20.674	5.168	Low	18.431	High
GARNCHAYNE	21.25	12.004	2.001	Low	46	Med
GEORGE MASON	7.98	0	0	Low	68.372	Med-Low
GEORGE WASHINGTON	17.71	0	0	Low	53.103	Med
GLASGOW	3.40	0	0	Low	55.333	Med
GLEN HILLS	2.51	0	0	Low	62.857	Med-Low
GRAND HAMPTONS	5.01	0	0	Low	60.455	Med-Low
GREAT FALLS GRANGE	8.91	0	0	Low	60.943	Med-Low
GREAT FALLS NIKE	45.70	0.445	0.063	Low	55.926	Med
GREEN SPRING GARDENS	28.00	0.667	0.222	Low	59.057	Med-Low
GREENBRIAR	36.59	0	0	Low	61.867	Med-Low
GREENBRIAR COMMONS	4.12	1.556	1.556	Low	30.588	Med-High
GREENDALE GOLF COURSE	147.27	0.222	0.013	Low	65.467	Med-Low
GREENFIELD	4.92	0	0	Low	68.571	Med-Low
GREENTREE VILLAGE	19.33	0.222	0.111	Low	66.207	Med-Low
GREENWAY HEIGHTS	39.27	6.002	0.546	Low	51.225	Med
GRIFFITH	1.10	0	0	Low	53.810	Med
GRIST MILL	75.05	3.112	0.148	Low	40.790	Med-High
GROVETON HEIGHTS	15.76	0.222	0.111	Low	71.026	Low
HAYCOCK-LONGFELLOW	24.42	10.004	5.002	Low	49.524	Med
HAYFIELD	2.01	0	0		0	N/A
HERITAGE HILL	2.22	0	0	Low	45.714	Med
HERITAGE RESOURCE	1.85	0	0	Low	54.546	Med
HERZELL WOODS	2.92	0	0	Low	75.385	Low
HEYWOOD GLEN	4.18	0	0	Low	59.143	Med-Low
HIDDEN POND	25.38	4.224	2.112	Low	53.382	Med
HIDEAWAY	6.40	5.113	5.113	Low	39.667	Med-High
HISTORIC HUNTLEY	2.90	0	0	Low	48.333	Med
HOLLIN HALL	4.04	0	0	Low	80	Low
HOLLIN MEADOWS	5.43	1.112	0.278	Low	44.783	Med-High
HOLLY KNOLL	5.85	0	0	Low	55.385	Med
HOLLYWOOD ROAD	5.01	0	0	Low	80	Low

PARK NAME	AREA (ACRES)	TOTAL FOREST CORE AREA (ACRES)	MEAN FOREST PATCH CORE AREA (ACRES)	CORE RANK	EDGE CONTRAST INDEX	EDGE CONTRAST RANK
HOLMES RUN STREAM VALLEY	131.94	37.124	0.977	Low	45.168	Med-High
HOOES ROAD	20.81	0	0	Low	57.75	Med-Low
HOOES ROAD SCHOOL SITE	10.14	0.222	0.056	Low	26.154	High
HORNE	238.00	52.685	2.107	Low	42.759	Med-High
HORSEPEN RUN STREAM VALLEY	127.25	4.001	0.174	Low	61.525	Med-Low
HOWERY FIELD	7.65	0	0	Low	57	Med
HUNTER VILLAGE	19.80	3.779	0.945	Low	43.108	Med-High
HUNTINGTON	16.69	0.222	0.022	Low	36.563	Med-High
HUNTLEY MEADOWS	1475.42	871.638	13.410	Med-Low	30.303	High
HUNTSMAN	105.42	17.784	1.778	Low	57.167	Med-Low
HUTCHISON SCHOOL SITE	28.38	0	0	Low	70.588	Low
HYBLA VALLEY	2.29	0.445	0.445	Low	45.333	Med
IDYLWOOD	13.40	0	0	Low	66.905	Med-Low
INDIAN RUN STREAM VALLEY	56.82	7.336	0.815	Low	44.134	Med-High
ISLAND CREEK	95.70	45.127	15.042	Med-Low	50.633	Med
J.E.B STUART	17.09	0	0	Low	66.923	Med-Low
JAMES LEE SCHOOL SITE	12.44	0	0	Low	76.364	Low
JEFFERSON DISTRICT	61.13	0	0	Low	62.903	Med-Low
JEFFERSON MANOR	14.39	0	0	Low	64	Med-Low
JEFFERSON VILLAGE	3.97	0	0		0	N/A
JOHN C. & MARGARET K. WHITE	13.78	0.222	0.111	Low	53.607	Med
JOHN MASTENBROOK - GREENWAY DOWNS	3.45	1.112	0.371	Low	42.281	Med-High
JOHNNY MOORE STREAM VALLEY	355.36	312.554	34.728	Med	43.702	Med-High
JOSEPH F. BARNES BATTERY	4.10	4.224	2.112	Low	37.037	Med-High
KEMPER	26.91	30.677	15.339	Med-Low	43.333	Med-High
KENDALE WOODS	2.40	0.222	0.074	Low	40.238	Med-High
KENT GARDENS	26.32	2.890	0.361	Low	47.5	Med
KENT GARDENS GREENWAY STREAM VALLEY	21.32	0.889	0.074	Low	57.913	Med-Low
KINGS PARK	9.24	0	0	Low	67.027	Med-Low
KINGS PARK WEST	31.07	6.002	0.667	Low	53.774	Med
KINGSTOWNE	75.31	2.890	0.482	Low	56.118	Med
KIRBY	2.96	0	0	Low	56.4	Med
KIRK	13.63	0.222	0.025	Low	38.485	Med-High
LAHEY LOST VALLEY	23.52	13.338	3.335	Low	50.581	Med
LAKE ACCOTINK	481.74	171.838	4.773	Low	47.806	Med
LAKE BRADDOCK SCHOOL SITE	13.04	0	0	Low	72.5	Low
LAKE FAIRFAX	476.64	204.294	12.768	Med-Low	45.042	Med-High
LAKE MERCER	194.71	41.348	4.135	Low	50.528	Med
LAKESIDE	21.05	0	0	Low	47.229	Med

PARK NAME	AREA (ACRES)	TOTAL FOREST CORE AREA (ACRES)	MEAN FOREST PATCH CORE AREA (ACRES)	CORE RANK	EDGE CONTRAST INDEX	EDGE CONTRAST RANK
LAMOND	17.95	2.001	0.400	Low	43.380	Med-High
LANE'S MILL	8.06	5.335	5.335	Low	38.511	Med-High
LANGLEY FORK	53.56	20.229	10.115	Med-Low	43.146	Med-High
LANGLEY OAKS	101.67	125.600	31.400	Med	37.793	Med-High
LARCHMONT	2.45	0	0	Low	53.636	Med
LARRY GRAVES (WHITTIER SS)	6.89	0	0	Low	80	Low
LAUREL HILL	1184.66	274.096	3.150	Low	45.831	Med
LAUREL HILL SS	39.44	0	0	Low	47.742	Med
LAWYERS ROAD SCHOOL SITE	13.62	1.334	0.333	Low	55.536	Med
LEE DISTRICT	137.61	19.340	2.149	Low	63.057	Med-Low
LEE HIGH	24.58	0	0	Low	66.944	Med-Low
LEE LANDING	0.52	0	0	Low	70	Low
LEEWOOD	9.25	0.889	0.296	Low	62.326	Med-Low
LEMON ROAD	10.05	1.334	0.445	Low	59.592	Med-Low
LENCLAIR	7.69	0	0	Low	60	Med-Low
LEVELLE W. DUPELL	28.02	18.229	6.076	Med-Low	46.610	Med
LEWINSVILLE	37.75	0	0	Low	69.697	Low
LEWINSVILLE CENTER	8.67	0	0	Low	47.5	Med
LEXINGTON ESTATES	15.11	16.006	16.006	Med-Low	39.571	Med-High
LILLIAN CAREY	58.37	13.560	3.390	Low	64.207	Med-Low
LINCOLN LEWIS-VANNOY	48.28	0	0	Low	66	Med-Low
LINCOLNIA	4.66	0	0	Low	62.381	Med-Low
LINWAY TERRACE	10.73	0	0	Low	57.143	Med
LISLE	0.91	0	0	Low	40	Med-High
LITTLE DIFFICULT RUN STREAM VALLEY	383.82	402.141	17.484	Med-Low	32.679	Med-High
LITTLE HUNTING CREEK	70.69	0.667	0.026	Low	41.560	Med-High
LITTLE PIMMIT RUN STREAM VALLEY	16.23	1.112	0.111	Low	51.960	Med
LITTLE ROCKY RUN SV	15.84	0	0	Low	76.724	Low
LOCKMEADE	5.15	0	0	Low	56	Med
LOFTRIDGE	48.58	33.345	11.115	Med-Low	34.337	Med-High
LOISDALE	8.64	0.667	0.667	Low	58.824	Med-Low
LONG BRANCH FALLS	5.14	0	0	Low	53.611	Med
LONG BRANCH STREAM VALLEY	156.00	13.783	0.459	Low	55.612	Med
LONGFELLOW SS	1.03	0	0	Low	32.941	Med-High
LORTON	4.39	0	0		0	N/A
LORTON WEST	116.36	16.450	1.265	Low	42.04	Med-High
LOWER POTOMAC	27.90	2.001	0.286	Low	37.632	Med-High
LURIA	5.39	8.225	1.645	Low	19.25	High
LYNBROOK	0.58	0	0	Low	71.111	Low
MANASSAS GAP RAILROAD	13.24	1.334	0.445	Low	51.370	Med

PARK NAME	AREA (ACRES)	TOTAL FOREST CORE AREA (ACRES)	MEAN FOREST PATCH CORE AREA (ACRES)	CORE RANK	EDGE CONTRAST INDEX	EDGE CONTRAST RANK
MANCHESTER LAKES	27.40	0	0	Low	64.444	Med-Low
MARIE BUTLER LEVEN PRESERVE	19.54	0	0	Low	64.167	Med-Low
MARK TWAIN	9.95	0	0	Low	57.813	Med-Low
MARTIN LUTHER KING JR.	22.85	0.445	0.063	Low	44.063	Med-High
MASON DISTRICT	120.18	37.791	12.597	Med-Low	56.783	Med
MASON NECK WEST	43.89	1.556	0.111	Low	35.060	Med-High
MASONVILLE	0.69	0	0	Low	60	Med-Low
MCLEAN CENTRAL	25.77	2.223	0.741	Low	62.333	Med-Low
MCLEAN HAMLET	18.07	2.445	2.445	Low	66.327	Med-Low
MCLEAN HIGH	9.63	0	0	Low	63.714	Med-Low
MCLEAN HUNT ESTATES	10.58	2.890	0.963	Low	52.857	Med
MCLEAN KNOLLS	2.97	0	0	Low	56.364	Med
MCNAUGHTON FIELDS	10.11	0	0	Low	80	Low
MERRILEE	1.12	0	0		0	N/A
MERRYBROOK RUN SV	16.70	0.222	0.032	Low	53.082	Med
MIDDLE RUN STREAM VALLEY	209.07	33.567	1.199	Low	58.379	Med-Low
MIDDLERIDGE	7.85	0	0	Low	66.667	Med-Low
MILITARY RAILROAD	1.22	0	0	Low	42	Med-High
MONTICELLO	8.79	0	0	Low	65.6	Med-Low
MONTICELLO WOODS	13.76	0	0	Low	66.842	Med-Low
MOSBY WOODS	6.91	0	0	Low	62.727	Med-Low
MOUNT AIR HISTORIC SITE	32.24	15.561	7.781	Med-Low	47.927	Med
MOUNT EAGLE	12.98	0	0	Low	60.323	Med-Low
MOUNT GILEAD	6.87	0	0	Low	64.348	Med-Low
MOUNT ROYAL	3.01	0	0	Low	51.786	Med
MOUNT VERNON DISTRICT	87.54	27.343	6.836	Med-Low	60.521	Med-Low
MOUNT VERNON MANOR	13.83	0	0	Low	62.895	Med-Low
MOUNT VERNON WOODS	7.97	0	0	Low	45	Med-High
MOUNT ZEPHYR	1.88	1.112	0.185	Low	39	Med-High
MUDDY HOLE FARM	13.60	0	0	Low	48.182	Med
MUNSON HILL	2.17	0	0	Low	68.571	Med-Low
NAVY VALE	1.17	0	0	Low	42.143	Med-High
NEWGATE	3.68	0	0	Low	80	Low
NEWINGTON COMMONS	8.54	0	0	Low	64.706	Med-Low
NEWINGTON HEIGHTS	69.71	31.567	6.313	Med-Low	52.165	Med
NORTH SPRINGFIELD	5.06	0	0	Low	51.191	Med
NOTTOWAY	90.47	4.001	1.334	Low	66.755	Med-Low
OAK HILL HISTORIC SITE	10.43	0	0	Low	63.261	Med-Low
OAK MARR	135.80	52.463	5.246	Low	49.075	Med
OAKBOROUGH SQUARE	7.56	3.779	3.779	Low	44.25	Med-High
OAKTON COMMUNITY (FORMERLY CORBALIS)	10.12	0	0	Low	64.348	Med-Low

PARK NAME	AREA (ACRES)	TOTAL FOREST CORE AREA (ACRES)	MEAN FOREST PATCH CORE AREA (ACRES)	CORE RANK	EDGE CONTRAST INDEX	EDGE CONTRAST RANK
OLANDER AND MARGARET BANKS, SR.	9.96	0	0	Low	55.833	Med
OLD CENTREVILLE ROAD	9.42	0	0	Low	59.130	Med-Low
OLD COLCHESTER PRESERVE AND PARK	137.65	65.356	8.170	Med-Low	44.886	Med-High
OLD COURTHOUSE SPRING BRANCH	33.07	4.001	0.667	Low	40.396	Med-High
OLD DOMINION SCHOOL SITE	13.71	2.890	1.445	Low	49.836	Med
OLDE FORGE	6.36	0	0	Low	70.270	Low
OLNEY	17.27	0	0	Low	69.351	Low
ORANGE HUNT ESTATES	8.07	6.002	2.001	Low	27.941	High
OSSIAN HALL	22.64	1.778	0.593	Low	62.549	Med-Low
OX HILL BATTLEFIELD	4.61	0	0	Low	80	Low
PARKLAWN	3.84	0	0	Low	64	Med-Low
PATHFINDER	0.61	0	0	Low	46.471	Med
PATRIOT (FORMERLY POPES HEAD ESTATES)	96.07	77.138	12.856	Med-Low	45.961	Med
PAUL SPRINGS STREAM VALLEY	17.13	0.445	0.017	Low	42.941	Med-High
PETERSON LANE	5.52	0	0	Low	62.051	Med-Low
PIMMIT BARN	0.59	0	0		0	N/A
PIMMIT HILLS	1.04	0	0	Low	50.667	Med
PIMMIT RUN STREAM VALLEY	70.52	22.675	1.194	Low	53.194	Med
PIMMIT VIEW	5.19	0	0	Low	64.889	Med-Low
PINE RIDGE	41.63	0.889	0.111	Low	61.839	Med-Low
PINE SPRING	5.54	0	0	Low	68.889	Med-Low
PINECREST GOLF COURSE	52.27	0.667	0.056	Low	53.621	Med
PINEY BRANCH STREAM VALLEY	189.46	166.725	9.807	Med-Low	40.273	Med-High
PLEASANT HILL	11.47	1.112	0.371	Low	59.575	Med-Low
POBURN WOODS	11.02	10.004	3.335	Low	48.8	Med
POE TERRACE	3.41	0	0	Low	53.810	Med
POHICK ESTATES	15.81	0	0	Low	57.097	Med
POHICK STREAM VALLEY	809.54	132.269	1.740	Low	52.566	Med
POLE ROAD	48.85	1.334	0.063	Low	35.976	Med-High
POPES HEAD	74.70	8.225	1.371	Low	58.098	Med-Low
POPES HEAD STREAM VALLEY	20.19	58.465	29.232	Med	11.619	High
POPLAR TREE	48.68	0	0	Low	69.608	Low
POTOMAC HILLS	9.59	18.229	9.114	Med-Low	34.085	Med-High
PROVIDENCE RECREATION CENTER	13.31	0.445	0.222	Low	53.243	Med
QUINN FARM PARK (FORMERLY HAMOVIT)	168.62	50.462	3.154	Low	36.745	Med-High
RAGLAN ROAD	10.55	4.446	1.112	Low	56.271	Med
RANDOM HILLS	11.28	0.445	0.222	Low	68.065	Med-Low

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RED FOX FOREST	7.23	0.445	0.445	Low	45.902	Med
RESTON NORTH	9.54	0	0	Low	66.667	Med-Low
RESTON TOWN GREEN	5.00	0	0	Low	80	Low
RICHARD W. JONES	246.88	11.782	0.785	Low	50.903	Med
RIDGEVIEW	24.98	0	0	Low	69.091	Med-Low
RIVERBEND	406.46	398.139	49.768	Med-High	20.125	High
ROCKY RUN STREAM VALLEY	313.30	60.466	1.440	Low	55.140	Med
ROLLING FOREST	3.95	0	0	Low	64.516	Med-Low
ROLLING VALLEY WEST	20.41	0	0	Low	65.217	Med-Low
ROLLING WOOD SCHOOL SITE	13.01	0	0	Low	60.476	Med-Low
ROLLING WOODS ESTATES	3.42	0	0	Low	56.667	Med
ROSE LANE	1.71	0	0	Low	45.278	Med-High
ROUNDTREE	73.54	21.119	2.347	Low	44.645	Med-High
ROYAL LAKE	58.49	5.558	0.618	Low	41.985	Med-High
ROYAL RIDGE	12.37	0	0	Low	78.621	Low
RUTHERFORD	23.88	0.222	0.111	Low	63.258	Med-Low
SANDY RUN STREAM VALLEY	38.83	31.789	6.358	Med-Low	37.266	Med-High
SARATOGA	7.30	0	0	Low	59.111	Med-Low
SCOTTS RUN NATURE PRESERVE	384.07	339.230	84.807	Med-High	36.860	Med-High
SCOTTS RUN STREAM VALLEY	23.25	27.788	5.558	Low	41.211	Med-High
SHAKER WOODS	13.67	3.335	3.335	Low	49.778	Med
SHANNON STATION	13.63	5.558	0.926	Low	37.377	Med-High
SILAS BURKE	10.34	0	0	Low	63.922	Med-Low
SILVERBROOK	10.68	0	0	Low	66.286	Med-Low
SKYLINE	3.92	0	0	Low	25	High
SLEEPY HOLLOW	13.20	8.670	1.734	Low	39.762	Med-High
SMOKEWOOD	13.66	1.778	0.593	Low	60	Med-Low
SOUTH KINGS FOREST	3.51	0	0	Low	50	Med
SOUTH LAKES DRIVE	13.94	0	0	Low	65.6	Med-Low
SOUTH RAILROAD STREET	2.04	0	0	Low	62.564	Med-Low
SOUTH RUN DISTRICT	191.28	47.350	2.785	Low	49.170	Med
SOUTH RUN STREAM VALLEY	362.06	198.069	7.074	Med-Low	48.169	Med
SOUTHGATE	2.78	0	0	Low	61.818	Med-Low
SPRING HILL	45.85	4.224	0.422	Low	48.214	Med
SPRING LANE	5.23	0	0	Low	65	Med-Low
SPRINGFIELD FOREST	10.52	0	0	Low	69	Med-Low
SPRINGVALE	8.78	0	0	Low	65.918	Med-Low
STANTON	9.62	2.001	0.667	Low	49.444	Med
STEPHEN S. FOSTER INTERMEDIATE SCHOOL SITE	1.50	0	0	Low	80	Low
STONE CROSSING	9.61	0	0	Low	74.167	Low

PARK NAME	AREA (ACRES)	TOTAL FOREST CORE AREA (ACRES)	MEAN FOREST PATCH CORE AREA (ACRES)	CORE RANK	EDGE CONTRAST INDEX	EDGE CONTRAST RANK
STONEYBROOKE	14.26	0	0	Low	68.333	Med-Low
STRATFORD LANDING	8.29	0	0	Low	51.515	Med
STRATTON WOODS	29.98	0	0	Low	64.921	Med-Low
STUART ROAD	6.46	0	0	Low	54.75	Med
SUGARLAND RUN STREAM VALLEY	222.63	16.450	0.914	Low	58.696	Med-Low
SULLY HISTORIC	60.51	13.338	1.905	Low	52.353	Med
SULLY WOODLANDS ASSEMBLAGE	208.82	353.457	353.457	High	10.694	High
SULLY WOODLANDS ASSEMBLAGE	201.19	120.931	10.078	Med-Low	35.969	Med-High
SULLY WOODLANDS ASSEMBLAGE	155.08	116.930	11.693	Med-Low	36.555	Med-High
SULLY WOODLANDS ASSEMBLAGE	35.21	21.119	2.112	Low	29.796	High
SULLY WOODLANDS ASSEMBLAGE	1.00	5.558	5.558	Low	20	High
SULLY WOODLANDS ASSEMBLAGE	588.57	372.575	31.048	Med	28.513	High
SULLY WOODLANDS ASSEMBLAGE	402.48	513.291	513.291	High	12.437	High
SUMMERS CEMETERY	0.20	0	0	Low	64	Med-Low
SURREY SQUARE	9.37	0	0	Low	64.727	Med-Low
SYMPHONY HILLS	5.97	0	0	Low	62.826	Med-Low
TAMARACK	20.63	2.001	0.500	Low	44.321	Med-High
TARA VILLAGE	4.41	0	0	Low	80	Low
TATTERSALL	35.49	41.126	41.126	Med	33.333	Med-High
THE TURNER FARM	52.64	0	0	Low	68.130	Med-Low
THE WAKEFIELD CHAPEL	1.50	0	0	Low	80	Low
TIMBERLY	22.82	5.113	1.278	Low	50.580	Med
TOLLBROOK RIDGE	4.62	23.119	23.119	Med	4	High
TOWERS	16.07	2.668	1.334	Low	59.474	Med-Low
TRAILSIDE	6.75	0	0	Low	60	Med-Low
TURKEYCOCK RUN STREAM VALLEY	64.58	7.781	0.707	Low	50.039	Med
TWIN LAKES GOLF COURSE	357.22	3.557	0.083	Low	66.431	Med-Low
TWINBROOK ROAD	4.41	1.112	0.556	Low	51.724	Med
TYLER	2.35	0	0	Low	62.857	Med-Low
TYSONS PIMMIT	6.87	0	0	Low	80	Low
TYSONS WOODS	4.82	0.889	0.889	Low	51.579	Med
UNIVERSITY	9.42	0.445	0.148	Low	60.909	Med-Low
VALLEY CREST	6.76	10.893	2.179	Low	33.973	Med-High
VERNON HEIGHTS	2.89	0	0	Low	73.333	Low
VILLA D'ESTE	8.99	0	0	Low	63.056	Med-Low

PARK NAME	AREA (ACRES)	TOTAL FOREST CORE AREA (ACRES)	MEAN FOREST PATCH CORE AREA (ACRES)	CORE RANK	EDGE CONTRAST INDEX	EDGE CONTRAST RANK
VILLA LEE	5.36	0.445	0.111	Low	46.111	Med
VIRGINIA HILLS SCHOOL SITE	6.01	0	0	Low	59	Med-Low
WAKEFIELD	287.90	35.346	1.683	Low	54.791	Med
WAKEFIELD CHAPEL	7.72	0	0	Low	65.714	Med-Low
WALNUT HILL SS	3.53	0	0	Low	65.455	Med-Low
WALT WHITMAN SCHOOL SITE	21.08	0	0	Low	59.474	Med-Low
WAPLES MILL	37.52	34.457	17.228	Med-Low	32.615	Med-High
WASHINGTON MILL	10.09	0	0	Low	42.222	Med-High
WAVERLY	16.87	1.334	0.222	Low	50.571	Med
WAYLAND STREET	16.47	14.672	14.672	Med-Low	39.861	Med-High
WEST SPRINGFIELD	7.97	0	0	Low	71.515	Low
WEST SPRINGFIELD VILLAGE	10.27	2.445	2.445	Low	53.818	Med
WESTFIELDS SS	16.88	11.560	3.853	Low	37.705	Med-High
WESTGATE	12.31	0	0	Low	66.333	Med-Low
WESTGROVE	20.51	0.889	0.178	Low	36.056	Med-High
WESTLAWN SCHOOL SITE	4.34	0	0	Low	55.385	Med
WHITE OAKS	10.11	0	0	Low	53.6	Med
WICKFORD	7.58	3.779	3.779	Low	34.103	Med-High
WILBURDALE	8.12	5.780	2.890	Low	34.444	Med-High
WILLIAMSBURG MANOR	27.73	0.222	0.028	Low	44.507	Med-High
WILLOW POND	36.68	1.778	0.127	Low	62.190	Med-Low
WILLOW WOODS	12.45	0.222	0.028	Low	58	Med-Low
WILTON WOODS SCHOOL SITE	4.74	0	0		0	N/A
WINDERMERE	24.08	12.227	3.057	Low	46.582	Med
WINTERSET VARSITY	4.69	0	0	Low	50	Med
WOLF TRAILS	11.07	0.222	0.032	Low	46.066	Med
WOLFTRAP STREAM VALLEY	41.35	24.453	2.223	Low	35.455	Med-High
WOODBURN SCHOOL SITE	8.35	1.112	0.556	Low	47.778	Med
WOODGLEN LAKE	63.72	10.226	2.045	Low	55.094	Med
WOODLAWN	11.60	0	0	Low	46.053	Med
WOODLEY HILLS	7.80	0.222	0.074	Low	53.684	Med

Appendix C

Best Management Practices Manual

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Fairfax County Park Authority
Best Management Practices

To assist in the Prevention, Control, and Eradication of Non-native Invasive Plant Species

Biohabitats ISM
INVASIVE SPECIES MANAGEMENT

Fairfax County
VIRGINIA

Section One
General Principles

BMP 1: Minimize the area and intensity of ground disturbance associated with construction and/or maintenance activities.

Rationale: Disturbance of the soil facilitates the establishment of invasive plants. For example, stiltgrass can become established along trails following their construction then spread into adjacent forest land. Minimizing such disturbance will help minimize the area susceptible to establishment of invasive plants. Ground disturbance can be minimized during the project planning process by clearly delineating zones in which heavy equipment can operate. Language can be incorporated in contracts that establishes penalties for contractors that operate heavy equipment outside of permitted zones.

BMP 2: Control invasive plant species in areas to be disturbed prior to disturbance.

Rationale: During construction and maintenance activities, seeds and fragments of invasive plants can be spread throughout the disturbed site. The disturbance also facilitates the establishment of invasive plants through processes such as increasing soil seed contact, increasing light availability, and reducing competition. Pre-construction or pre-maintenance invasive plant control is especially important in situations where only a few invasive plants are already present, because these can be killed prior to disturbance or when an invasive plant species that is a high-priority for control is present. Pre-construction or maintenance plant control would likely employ herbicides. Control should occur early enough such that the invasive plants are dead when construction or maintenance begins and should be part of the project budget.

BMP 3: Inspect and clean plant materials from all pieces of heavy construction equipment (e.g., loaders, graders, backhoes, bulldozers) prior to their entry on parklands.

BMP 3.1: Clean maintenance equipment prior to operating in areas currently uninvaded by NNI species.

BMP 3.2: Schedule daily operations in areas of low NNI infestation first in order to reduce the need for multiple vehicle cleanings during the work day.

Rationale: Seeds or living fragments of invasive plant species that are capable of establishing new plants can lodge in the tracks, wheels, or undercarriages of heavy equipment[1]. Such seeds and plant fragments can be transported from one location to another on the equipment. Inspecting and removing plant fragments will reduce the likelihood of introducing invasive plants to new locations. Water from high-pressure hoses or leaf blowers is particularly effective in dislodging seeds and plant fragments from heavy equipment. Language can be incorporated in contracts that require contractors to clean heavy equipment prior to working on parklands.

BMP 4: Promptly revegetate all significant disturbances resulting from construction and/or maintenance activities.

Rationale: Minimizing the time that disturbed soil remains bare will help minimize the likelihood that non-native invasive plants will be able to colonize a disturbed site. Language can be incorporated in contracts that require contractors to re-seed disturbed areas within 7 days following cessation of ground-disturbing activities.

BMP 5: Re-seed disturbed areas with a diverse mixture of desirable native plant species suitable to the disturbed site.

Rationale: Re-seeding is important because it speeds the rate at which disturbed areas are revegetated and helps suppress invasive plant species. We recommend that the County specify seed mixes for different environmental conditions and require contractors to use one (or more if appropriate) of the approved seed mixes.

BMP 5.1: Seed and establish native warm season grass communities on open reforestation sites.

Rationale: Reforestation sites are often only planted with woody plants. However, until woody plants get tall enough and the canopy closes, there will be a great deal of light and intense competition from non-woody plants. By establishing a healthy community of native warm season grasses and forbs, non-native invasive plant occurrence can be minimized and the wildlife benefit greatly increased. This will mimic an old field habitat until the woody plants mature. A certified weed free compost blanket, such as Soilmate compost, may additionally speed up natural system recovery.

BMP 6: Utilize weed-free straw/mulch on construction and/or maintenance projects where mulch is specified.

Rationale: Straw is commonly used as mulch to promote plant establishment. However, straw and other mulches can harbor seeds of non-native invasive plants. Where mulch is specified it shall be free of NNI plant seeds and propagules. North American Weed Management Association standards for weed free forage and mulch will be followed where possible.

BMP 7: Use native plant species and non-invasive introduced plant species for landscaping parklands.

Rationale: It is counter productive to use invasive plants for landscaping or wildlife habitat purposes regardless of any aesthetic value that they may have. Examples of such invasive plant species include Amur Honeysuckle, Russian olive, and Bradford pear. The Park Authority could create a list of approved landscaping plant species for parklands like the one currently in draft form.

BMP 8: Monitor areas disturbed during new construction or maintenance activities for at least two growing seasons and control any high-priority invasive plant species that appear.

Rationale: In spite of preventative measures used during and after construction, invasive plants may appear in disturbed areas. It will be much more cost-effective in the long run to control high-priority invasive species as soon as they do appear rather than waiting until they become firmly established. Depending on the presence of invasive species in adjacent and nearby areas, it may not be reasonable to control all invasive plant species in disturbed areas. Hence, we recommend focusing management actions on high-priority invasive plant species.

BMP 9: Preserve existing canopy cover during park infrastructure modifications.

Rationale: Early successional invasive plant species have a competitive advantage in canopy gaps that increase light levels on the forest floor. Tree conservation during park renovations or improvements will minimize changes in ambient light levels.

BMP 10: Preserve existing hydrologic regime during park infrastructure modifications.

Rationale: Changes in surface flow and soil moisture levels can result in increased opportunities for invasive plant activity due to both a decline in the tree canopy on a given site and the transportation of undesirable plant propagules.

BMP 10.1: Restore hydrology where appropriate and feasible.

Rationale: Many floodplains in suburban parks have been cut off from their streams through channel incision. The result is a drier condition with periodic scour and human disturbance that is often favorable to non-native invasive species. By reconnecting the floodplain with the stream, increased overall moisture combined with lower levels of human disturbance and lower relative scour during flood events may favor native wetland and or facultative species and help restore wetland communities.

BMP 11: Reduce vectoring of NNI species onto park lands from neighboring properties

Rationale: NNI species do not recognize legal property boundaries. Undesirable vegetation on lands adjacent to park boundaries can act as a potential seed and vegetative propagule source resulting in infiltration of NNI species onto park property. In addition, encroachment onto park property through the direct disposal of yard waste can introduce NNI species. Monitoring park boundaries and targeting adjacent residential areas for education and partnership offers a low cost intervention tactic that can potentially reduce vectoring and increase community involvement in local parks.

BMP 12: Minimize site disturbance and vectoring of NNI species associated with park visitation

Rationale: Concentrated impacts of park visitation and/or the direct, unintentional introduction of invasive propagules by park patrons can create new opportunities for NNI species establishment within park boundaries. Identification of these pathways, along with monitoring and public education can assist in reducing the impact of this vectoring mechanism.

Section Two
Specific BMP Recommendations

Where possible and feasible, as funding allows, the following examples show where and how the above BMPs may be used:

Section 2A - Trails

Relevant BMPs - 1, 2, 3.5, 4, 9, 10, 10.1

The network of pedestrian trails with the Fairfax County Park Authority is a major asset that is enjoyed by a significant number of park visitors, supplemented by social and deer trails that are unmaintained. Unfortunately, trail construction and/or maintenance has been identified as one of the leading vectoring mechanisms encouraging the intrusion and establishment of non-native invasive species[2]. Without careful consideration of trail placement and management, these pathways can undermine and destroy the very resource they were designed to celebrate. Fortunately the implementation of sound best management practices can dramatically reduce the disturbance associated with trails without dramatically increasing costs.

The following trail BMPs are recommended by the Fairfax Park Authority -

Tree Canopy Preservation – As identified in the Fairfax County Tree Action Plan (December 2006), protecting trees along trails is a core level goal (section 2.9). While trees provide a number of functional benefits, minimizing tree loss during trail construction directly impacts invasive plant populations. Canopy gaps from tree loss results in additional light reaching the forest floor. Invasive plants are typically early successional species that respond rapidly to this change and will proliferate accordingly. Careful attention to tree conservation during trail construction will reduce disturbance and the corresponding competitive advantage of invasive plant species.

- All proposed new trails and routing modifications to existing trails will require an approved tree conservation plan prepared by a qualified certified arborist or suitable equivalent. Plan will include map locations of all canopy level trees whose critical root zone is intersected at a level of greater than 20% by the proposed trail footprint.
- Critical root zone will be defined as an area surrounding the tree stem such that the radius of the critical root zone is equal to one foot for each inch of tree diameter (measured at 4.5 feet above grade)
- Tree conservation plans will include detailed critical root zone protection strategies for all plants meeting the above criteria.
- Tree removal required to meet project designs or for site safety shall be conducted in a manner to minimize damage to desirable vegetation.
- Where feasible, large woody debris (greater than 4 inches in diameter) generated during tree removal operations shall be left on site in long long lengths (greater than 6') to minimize soil exposure and create micro-habitat on the forest floor.
- Woody debris left on site from tree removal must have significant surface area in contact with the forest floor and shall not exceed 2 feet in height above ground level.
- Areas of tree removal will be monitored for NNI species and treated for a minimum of two growing years post removal.

Protection of Surface Hydrology – Changes in stormwater flow patterns on the forest floor can result in major incursions of invasive vegetation, in particular the invasive grass Microstegium. Concentration of propagules trailside and the subsequent dispersal into the adjacent forest has been identified as a significant risk factor within the park system[3].

- All proposed new trails will be designed to minimize disruption of existing surface drainage patterns.

Maintenance – Disturbance of trail shoulders as a result of maintenance activities (primarily mowing) is currently a significant source of invasive plant dispersal along the county trail system. Modifications to trail maintenance practices offer tremendous preventative cost savings.

- Maintenance equipment shall be stored in an area free of NNIS.
- Maintenance equipment will be inspected and cleaned of weed seed, mud, and soil particles immediately following use in an area of NNIS infestation.
- In order to reduce equipment cleaning time, where possible trail maintenance activities shall begin in an area free of invasive plant infestation.
- Mowing shall not be preformed in areas of NNIS infestation following emergence of seed heads and fruiting structures.
- Soil disturbance during maintenance activities shall be minimized.
- Soil and vegetative debris shall not be relocated or transferred from areas of known NNIS infestation to unifested areas.
- Blading and drainage ditch clearing shall not be conducted between areas of infestation and non-infested areas.

Design – Once constructed, trail location is a fixed variable that can adversely impact the understory and regenerative potential of a forest stand. Modifications to design at this phase of the construction process can prevent unnecessary disruption of ecological processes and the subsequent increase in maintenance costs.

- All proposed trail locations shall be inspected for pre-existing invasive plant activity and ecological integrity using the Fairfax Park site prioritization model.
- Spatial data on invasive plant populations along all proposed trail routes shall be compiled prior to final determination of trail position.
- Proposed trail locations shall undergo a minimum of one year's invasive plant suppression action prior to construction.

Section 2B - Construction and Maintenance

Relevant BMPs - 1, 2, 5, 6, 8

Modifications to any park infrastructure, by definition, will result in site disturbance. As disturbance is a primary driver of invasive infestation it is of critical importance that careful attention be given to reducing opportunities for invasive establishment.

- All proposed construction locations shall be inspected for pre-existing invasive plant activity and ecological integrity using the Fairfax Park site prioritization model.
- In order to reduce invasive propagule movement and diminish the invasive seedbank in the soil all proposed construction sites shall undergo a minimum of one year's invasive plant suppression action prior to construction.
- Soil disturbance shall be minimized and desirable vegetation maintained at project site to the fullest extent possible.
- Staging areas shall be selected that are free of invasive plant populations wherever possible.
- Construction equipment will be inspected and cleaned of weed seed, mud, and soil particles immediately following use in an area of NNI infestation.
- Fill material brought to site shall be free of NNI propagules.
- Borrow pit areas shall be inspected for NNI presence prior to soil, gravel, or rock extraction
- Construction sites shall have an approved invasive plant monitoring and treatment program conducted for a minimum of two growing seasons following project completion.
- Funds to support the above outlined activities shall be included in the project budget in the scoping phase.

Section 2C - Landscaping

Relevant BMPs - 2, 4, 5, 6, 7

Horticultural plantings and maintenance activities constitute a major vectoring mechanism for new invasive plant infestation. In addition to the direct introduction of invasive propagules, landscape introductions of exotic earthworms and nitrogen fertilization can indirectly promote NNIS establishment. Earthworms reduce the forest duff layer and have been positively correlated with invasive plant colonization. Artificial enhancement of soil nitrogen (fertilization) enhances the growth of NNI in formally nitrogen limited forest environments. Careful attention to selection and use of appropriate landscape materials can help assure a frictionless transition between the manicured and natural area park environments.

- Revegetation of disturbed sites will occur in the first planting season feasible following construction.
- Landscape staging areas shall be selected that are free of invasive plant populations wherever possible.
- Landscape equipment will be inspected and cleaned of weed seed, mud, and soil particles immediately following use in an area of NNI infestation.
- Weed-free straw & mulch shall be used on all Park Authority landscaping or maintenance projects.
- Certified weed-free seed shall be used on all Park Authority landscaping or maintenance projects.
- Landscaping stock, products, soil, and mulch shall be free of earthworms when material is to be placed within 100 feet of undisturbed forest
- Vegetation native to the region shall be preferred for all park landscaping projects.
- Non-native invasive species are not to be used in park landscaping projects
- Areas identified as potential landscape installation sites will be inspected for NNI and undergo a suppression program for a minimum of one year prior to landscape installation if NNI are present.
- Landscape installations shall be monitored and treated for NNI for a minimum of two growing seasons following project completion.
- Landscape fertilization shall only be conducted in conjunction with a documented nutrient deficiency as identified by a soil test.

Section 2D - Visitation Impact Management

Relevant BMPs - 11, 12

Damage to desirable vegetation and the exposure of mineral soil by concentrated visitor activities can increase the risk of NNI species establishment. In addition, the potential exists for direct introduction of undesirable plants onto park property via weed seeds and propagules adhering to visitor clothing and equipment. Enhanced public awareness of invasive species issues coupled with focused efforts to reduce localized site disturbances associated with visitor activities can help reduce new infestation sites.

- Areas of park vegetation identified as negatively impacted by visitation activities will be targeted for restoration and/or managed in order to reduce additional spread of invasive species.
- Activities of potential high-impact to desirable vegetation will be sited and directed to areas of low ecological value whenever possible.
- Public outreach and education activities will be focused and targeted to the needs and concerns of specific park user groups.

BMP References

1 Lonsdale, W.M. and A.M. Lane. 1994. Tourist vehicles as vectors of weed seeds in Kakadu National Park, Northern Australia. Biological Conservation, vol. 69, pp. 277-283.

2 Biohabitats, 2009 Fairfax County Non-Native Invasive Plants Assessment. Contract #RQ08-957860-22A, Phase I.

3 Personnel Communication. Gary Fleming, Vegetation Ecologist, Virginia Department of Conservation & Recreation, 2009.

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Appendix D

Overview of Invasive Programs in Select Park Jurisdictions

Task 2.2 Operational Review
Invasive Plant Budget Recommendations

It is difficult to put a static cost on an invasive plant project due to several inter-related variables. Hydrology (presence of water), topography, endangered/sensitive species, citizen concerns, and others tend to affect pricing. The following matrixes are designed as a guide for budgeting invasive plant programs. They are categorized by vegetation-type which includes trees, shrubs, vines, and herbs (grass & forbs). There are five distinct cover-classes and differing methodologies for each vegetation-type.

*Methods are discussed in Task 2.3 – Recommended Control Strategies

TREE COST PER ACRE SCHEDULE

% COVER	BASAL BARK	F/T (BACKPACK)	HACK/SQUIRT	GIRDLE	CUT/TREAT
1 (81 - 100%)	$2500-$2001	$1300-$1041	$3120-$2497	$5200-$4161	$5200-$4161
2 (61 - 80%)	$2000-$1501	$1040-$781	$2406-$1872	$4160-$3121	$4160-$3121
3 (41 - 60%)	$1500-$1001	$780-$521	$1871-$1249	$3120-$2081	$3120-$2081
4 (21 - 40%)	$1000-$501	$520-$261	$1248-$625	$2080-$1041	$2080-$1041
5 (1 - 20%)	$500-$10	$260-$10	$624-$10	$1040-$10	$1040-$10

SHRUB COST PER ACRE SCHEDULE

% COVER	BASAL BARK	F/T (BACKPACK)	F/T (ATV)	CUT/TREAT	GRUB
1 (81 - 100%)	$2500-$2001	$1300-$1041	$600-$481	$5200-$4161	$10,400-$8321
2 (61 - 80%)	$2000-$1501	$1040-$781	$480-$361	$4160-$3121	$8320-$6241
3 (41 - 60%)	$1500-$1001	$780-$521	$360-$241	$3120-$2081	$6240-$4161
4 (21 - 40%)	$1000-$501	$520-$261	$240-$121	$2080-$1041	$4160-$2081
5 (1 - 20%)	$500-$10	$260-$10	$120-$10	$1040-$10	$2080-$10

VINE COST PER ACRE SCHEDULE

% COVER	BASAL BARK	F/T (BACKPACK)	HACK/SQUIRT	GIRDLE	CUT/TREAT
1 (81 - 100%)	$2500-$2001	$1300-$1041	$3120-$2497	$5200-$4161	$5200-$4161
2 (61 - 80%)	$2000-$1501	$1040-$781	$2406-$1872	$4160-$3121	$4160-$3121
3 (41 - 60%)	$1500-$1001	$780-$521	$1871-$1249	$3120-$2081	$3120-$2081
4 (21 - 40%)	$1000-$501	$520-$261	$1248-$625	$2080-$1041	$2080-$1041
5 (1 - 20%)	$500-$10	$260-$10	$624-$10	$1040-$10	$1040-$10

HERB COST PER ACRE SCHEDULE

% COVER	BASAL BARK	F/T (BACKPACK)	F/T (ATV)	CUT/TREAT	GRUB
1 (81 - 100%)	$2500-$2001	$1300-$1041	$600-$481	$5200-$4161	$10,400-$8321
2 (61 - 80%)	$2000-$1501	$1040-$781	$480-$361	$4160-$3121	$8320-$6241
3 (41 - 60%)	$1500-$1001	$780-$521	$360-$241	$3120-$2081	$6240-$4161
4 (21 - 40%)	$1000-$501	$520-$261	$240-$121	$2080-$1041	$4160-$2081
5 (1 - 20%)	$500-$10	$260-$10	$120-$10	$1040-$10	$2080-$10

Fairfax County Contracted Comparison Projects

Great Smoky Mountains National Park 2008 Invasive Plant Management

AGENCY CONTRACT
National Park Service

PROJECT DESCRIPTION
- Mimosa, Common Privet
- Moderate infestation
- Methodology: Cut and treat

APPROXIMATE AREA OF PROJECT
125 acres

Cost/Acre	Total Cost
$322.40	$40,300

Progress
Contracted project completed for the Great Smoky Mountains National park in the fall of 2008. Two sites were managed for a total of approximately 125 Acres. These sites included 3.5 miles of Foothills Parkway with 100 foot buffer (42 Acres), 1 Acre Privet on Foothills Pkwy along bridge site and 82 acres of privet control on Peachtree Creek Branch. Each site created unique work scenarios. The Peachtree Branch site was located on steep terrain down the side of a mountain in the dense forest canopy making access difficult. The Foothills Parkway site involved typical roadside obstacles that had to be accounted for.

INVASIVE PLANT PESTS AT GREAT SMOKY MOUNTAINS NATIONAL PARK 2008

SCIENTIFIC NAME	COMMON NAME	CUT AND TREAT	GIRDLE	FOLIAR SPRAY	GRUB	BASAL BARK
TREE SPECIES						
Ailanthus altissima	Tree of Heaven	X	X	X	X	X
Albizia julibrissin	Silk tree	X	X	X	X	X
Paulownia tomentosa	Princess tree	X	X	X	X	X
MULTISTEMMED SPECIES						
Ligustrum sinense	Privet	X		X	X	X
L. maackii	Amur honeysuckle	X		X	X	X
Rosa multiflora	Multiflora rose	X		X		X
Elaegnus fortunei	Autumn olive	X		X		X

Warner Parks (City of Nashville)

AGENCY CONTRACT
Friends of Warner Park (NGO)

PROJECT DESCRIPTION
• Bush honeysuckle
• Heavy infestation
• Methodology: Cut and treat

APPROXIMATE AREA OF PROJECT
100 acres

Cost/Acre	Total Cost
$1,300	$130,000

Progress
The 3,000 acre Warner Parks contains Oak/Hickory hardwood forests that are heavily infested with the invasives listed on the next page. The primary control interventions have been either mechanical removal or cutting and treating the multi stemmed species throughout the park.

The photo above and to the left is before cutting and treating. The photo above and to the right shows the results after a few hours of cutting and treating bush honeysuckle.

INVASIVE PLANT PESTS AT THE WARNER PARKS IN NASHVILLE, TN

SCIENTIFIC NAME	COMMON NAME	CUT AND TREAT	GIRDLE	FOLIAR SPRAY	GRUB	BASAL BARK
TREE SPECIES						
Ailanthus altissima	Tree of Heaven	X	X	X	X	X
Albizia julibrissin	Silk tree	X	X	X	X	X
Paulownia tomentosa	Princess tree	X	X	X	X	X
MULTISTEMMED SPECIES						
Berberis thunbergii	Japanese barberry	X		X		
Ligustrum sinense	Privet	X		X	X	X
L. maackii	Amur honeysuckle	X		X	X	X
Rosa multiflora	Multiflora rose	X		X		X
Elaegnus fortunei	Autumn olive	X		X		X
Euonymous alatus	Burning bush	X		X	X	X
Lespedeza bicolor	Shrub lespedeza	X		X		
Poncirus trifoliata	Trifoliate Orange	X		X	X	
HERBACIOUS SPECIES						
Microstegium vinineum	Japanese stitltgrass			X	X	
Lespedeza cuneata	Sirecea lespedeza			X		
Sorghum halepense	Johnsongrass			X		
Schedonorus phoenix	Tall fescue			X		
Cirsium arvense	Canada thistle			X		
Carduus nutans L.	Musk thisle			X		
VINE SPECIES						
Euonymus fortunei	Climbing Euonymous	X		X	X	
Lonicera japonica	Japanese honeysuckle	X		X	X	
Vinca minor	Periwinkle			X	X	
Vinca major	Large-leafed periwinkle			X	X	
Hedera helix	English ivy	X		X	X	
Wisteria spp	Chinese wisteria	X		X		
Ampelopsis brevipedicularis	Porcelain berry	X		X		

George Washington Memorial Parkway, VA

AGENCY CONTRACT
National Park Service

PROJECT DESCRIPTION
• Porcelain berry
• Moderate infestation
• Cut and treat
• 1 time treatment

APPROXIMATE AREA OF PROJECT
170 acres

2008

Cut & Treat	
Cost	*Cost/Acre*
$42,000	$247

Progress
Contracted treatment program involved cutting vines from trees, specifically Oriental bittersweet, English ivy and Japanese honeysuckle. Larger stumps were immediately treated with an approved herbicide. English ivy was treated separately with a foliar spray.

Selective application timing and materials protects desirable species in treatment zones. This fern survived a foliar application along the Parkway due to awareness by comtractor of non target species.

INVASIVE PLANT PESTS AT GEORGE WASHINGTON MEMORIAL PARKWAY, VA

SCIENTIFIC NAME	COMMON NAME	CUT AND TREAT	GIRDLE	FOLIAR SPRAY	GRUB	BASAL BARK
VINE SPECIES						
Celastrus orbiculata	**Oriental bittersweet**	X		X	X	
Lonicera japonica	**Japanese honeysuckle**	X		X	X	
Vinca minor	**Periwinkle**			X	X	
Hedera helix	**English ivy**	X		X	X	
Ampelopsis brevipedicularis	**Porcelain berry**	X		X		

2008

Rock Creek Park National Park, DC

AGENCY CONTRACT

National Park Service

PROJECT DESCRIPTION

• Lesser celandine, Wisteria, Porcelain berry, Garlic Mustard

• Heavy infestation

• Cut and treat, foliar treat

2008

Lesser Celandine (1st treatment)		
Cost	*Acres*	*Cost/Acre*
$18,096	31.4	$576.31
Lesser Celandine (2nd treatment)		
Cost	*Acres*	*Cost/Acre*
18,096	87.8	$206.10
Foliar treat (3rd treatment)		
Cost	*Acres*	*Cost/Acre*
$36,192	55.6	$650.94
Shrubs, vines, ivy (1st treatment)		
Cost	*Acres*	*Cost/Acre*
$3,981.12	1	$3,981.12
	Total cost of project	$42,000.82

Progress

Rock Creek National Park has contracted treatment for five years. First year work required high selectivity in a hardwood forest setting. Subsequent work has involved 176 acres of control in hardwood forests. On these sites a large percentage of the understory were non native invasive species. Several methodologies were utilized. Garlic mustard was hand pulled, bagged and hauled away; Oriental bittersweet was treated by cutting the larger vines <2 inches from the ground and immediately stump treated with the appropriate herbicide, followed by foliar application to all bittersweet foliage no higher than three feet. Other species that were low lying were foliar sprayed. Several tree species were also basal bark treated. Recent treatments have included management in riparian areas of Rock Creek for lesser celandine, mile a minute, Microstegium and porcelain berry.

Sandwiched between the busy streets of Washington DC, Rock Creek Park has been constantly barraged with invasive species throughout the years. Control of Chinese Wisteria was achieved using cut stump methods and foliar applications.

PLANTS MANAGED AT ROCK CREEK NATIONAL PARK

SCIENTIFIC NAME	COMMON NAME	CUT AND TREAT	GIRDLE	FOLIAR SPRAY	GRUB	BASAL BARK
TREE SPECIES						
Ailanthus altissima	Tree of Heaven	X	X	X	X	X
Albizia julibrissin	Silk tree	X	X	X	X	X
Paulownia tomentosa	Princess tree	X	X	X	X	X
Broussonetia papyrifera	Paper mulberry	X	X	X	X	X
Acer sp.	Norway and Japanese maple	X	X	X	X	X
MULTISTEMMED SPECIES						
Berberis thunbergii	Japanese barberry	X		X		
Ligustrum sinense	Privet	X		X	X	X
Lonicera fragrantissima	Fragrant honeysuckle	X		X	X	X
L. maackii	Amur honeysuckle	X		X	X	X
L. morrowii	Morrow's honeysuckle	X		X	X	X
L. tatarica	Tartarian honeysuckle	X		X	X	X
Rosa multiflora	Multiflora rose	X		X		X
Elaegnus fortunei	Autumn olive	X		X		X
Viburnum dilatatum	Linden viburnum	X		X	X	X
Viburnum plicatum	Double file viburnum	X		X	X	X
Euonymous alatus	Burning bush	X		X	X	X
HERBACIOUS SPECIES						
Alliaria petiolata	Garlic mustard			X	X	
Polygonum cuspidatum	Japanese knotweed			X	X	
Microstegium vinineum	Japanese stitltgrass			X	X	
Ranunculus ficaria L.	Lesser celandine			X	X	
VINE SPECIES						
Euonymus fortunei	Climbing Euonymous	X		X	X	
Celastrus orbiculata	Oriental bittersweet	X		X	X	
Lonicera japonica	Japanese honeysuckle	X		X	X	
Vinca minor	Periwinkle			X	X	
Vinca major	Large-leafed periwinkle			X	X	
Hedera helix	English ivy	X		X	X	
Wisteria spp.	Chinese wisteria	X		X		
Ampelopsis brevipedicularis	Porcelain berry	X		X		

Upper right photo: Porcelain berry (lower vine) intertwined with grapevine (upper vine) at Rock Creek Park. Lower right photo: Colorant dye mixed with chemical applications at Rock Creek Park. Target species - Oriental bittersweet.

Lubber Run Park

AGENCY CONTRACT

Arlington County, VA

PERIOD OF PERFORMANCE

2006 to present

PROJECT DESCRIPTION

• English ivy, Japanese knotweed, lesser celandine, kudzu
• Heavy infestation
• Cut and treat, foliar treat
• 5 years of maintenance

APPROXIMATE AREA OF PROJECT

22 acres

2006	**Cost/Acre**
$57,200	$2,600
2007	**Cost/Acre**
$29,300	$1,331.82
2008	**Cost/Acre**
$19,800	$900
2009	**Cost/Acre**
$13,500	$613.64
2010	**Cost/Acre**
$10,400	$472.73

South Laurel Highlands Plant Management Program

AGENCY CONTRACT
Fayette County Conservation District

PERIOD OF PERFORMANCE
2009

PROJECT DESCRIPTION
• Pre-emergent for Microstegium
• Heavy infestation
• Foliar treat

APPROXIMATE AREA OF PROJECT
40 acres

2008	Cost/Acre
$23,300	$582

ParkFairfax, VA

AGENCY CONTRACT

ParkFairfax Unit Owners Association

PERIOD OF PERFORMANCE

2007 - present

PROJECT DESCRIPTION

• English ivy (primary), Wisteria
• Heavy infestation
• Foliar treat
• 5 year maintenance plan

APPROXIMATE AREA OF PROJECT

6 acres

2007 (cutting vines and foliar treat)	**Cost/Acre**
$23,050	$3,841.67
2008 (year two)	**Cost/Acre**
$12,550	$2,091.67
2009 (year three)	**Cost/Acre**
$7,650	$1,275
2010 (year four)	**Cost/Acre**
$4,715	$785.83
2011 (year five)	**Cost/Acre**
$4,715	$491.67

Richmond National Battlefield

AGENCY CONTRACT
Mid-Atlantic Exotic Pest Management Team

PERIOD OF PERFORMANCE
2008

PROJECT DESCRIPTION
- Privet, tree of heaven
- Moderate infestation
- Basal bark, foliar treat
- One time treatment

APPROXIMATE AREA OF PROJECT
13 acres

2008	Cost/Acre
$58,500	$4,500

Appendix E

Level One Scoring Sheet

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INVASIVE PLANT SITE PRIORITIZATION SCORING SHEET
Fairfax County Park Authority

Fairfax County VIRGINIA

Park name

Site location

Inspector name Date

ECOSYSTEM SCORE

BIODIVERSITY LEVEL	DISTURBANCE LEVEL		
	Low	Medium	High
High	5	4	3
Medium	4	3	2
Low	3	2	1

SUBTOTAL ______

NON-NATIVE INVASIVE SPECIES SCORE

	Readily Suseptible to Control	Requires Repeated Control Efforts	Difficult/Poor Response to Control Efforts
Less than 20% of Vegetative cover	5	4	3
20% - 50% of Vegetative Cover	4	3	2
Greater than 50% of Vegetative Cover	3	2	1
	Add 1 if site was managed in the last 12 months		

SUBTOTAL ______

CULTURAL VALUE SCORE

VISITATION LEVEL	OWNERSHIP		
	Formal Volunteer Program	Informal Volunteer Program	No Apparent Public Involvement
High	5	4	3
Medium	4	3	2
Low	3	2	1

SUBTOTAL ______

TOTAL SITE SCORE ______

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Appendix F

Level Two Scoring Sheet

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INVASIVE PLANT MANAGEMENT PRIORITIZATION SCORING SHEET LEVEL 2
Fairfax County Park Authority

Fairfax County Invasive Plant Management Prioritization Model Level Two

Level Two criteria are utilized when site complexity exceeds capabilities of Level One prioritization ranking
The user assigns points to the various factors for a particular management area. The highest-priority area for management will have the highest number of points.
Factors can be ignored and assigned zero points with the effect of lowering the priority of an area for management.
Factors can also be weighted to place emphasis on environmental and ecological factors of special significance to the Fairfax Parks system.

ECOSYSTEM SCORE

Biodiversity

Landscape Context (Spatial Considerations, already rated for all Fairfax County Parks)

Core Forest Area - metric reflects the habitat and conservation value of core forest, defined as forest areas at least 100 meters from the nearest forest edge
metric is already calculated for all County parks
most management areas will have a zero score for this metric

		Range (acres)
High	**(4 points)**	84.75 - 513.47
Med - High	**(3 points)**	41.14 - 84.75
Medium	**(2 points)**	18.38 - 41.14
Med - Low	**(1 point)**	5.56 - 18.38
Low	**(0 points)**	0 - 5.56

Forest Edge Quality - this metric reflects the quality of the forest edge, greater contrast between land use patterns equates to a reduced scoring
for instance - forest abutting old field would score better than forest adjacent to development
metric is already calculated for all of the parks

		Range (index)
High	**(4 points)**	4 - 30.6
Med-High	**(3 points)**	30.6 - 45.3
Medium	**(2 points)**	45.3 - 57.2
Med-Low	**(1 point)**	57.2 - 69.4
Low	**(0 points)**	69.4 - 80.0

Forest Structure - existing desirable vegetation and habitat, capability of site to sustainably regenerate

Successional Stage - proxy for disturbance frequency, age, accrued equity, and replaceability of site

High - late successional stage characteristic for site index (example - mature canopy of oak, hickory) _ _ _ _ _ _ _ _ _ _ **(3 points)**
Med - mature canopy composed of trees characteristic of an intermediate seral stage _ _ _ _ _ _ _ _ _ _ **(2 points)**
Low - early successional stage species composition (example - canopy composed of mulberry and black locust) _ _ _ _ _ _ _ _ _ _ **(1 point)**

ECOSYSTEM SCORE (continued)

Canopy Layer - reflects both structural and species richness in forest canopy, roughly 100 x 100 ft visual sample area

High - closed canopy, uneven aged stand, greater than 5 native species represented as codominant canopy trees, greater than 5 tree over 18inches in DBH **(3 points)**
Med - closed canopy, even aged stand, 2 - 5 native species represented as codominant canopy trees, 2 or greater trees over 18 inches in DBH maximum) **(2 points)**
Low - open canopy, even aged stand, monoculture canopy, less than 2 native trees over 18 inches in diameter **(1 point)**

Shrub Layer - reflects both structural and species richness, roughly 100 x 100 ft visual sample area

High - significant cover percentage of native shrubs and vines in forest understory, high species diversity **(3 points)**
Med - moderate cover percentage of native shrubs and vines in forest understory, low species diversity **(2 points)**
Low - native shrubs and vines largely absent in forest understory **(1 point)**

Herbaceous Layer - seasonal nature of certain species should be noted in evaluating this metric

High - significant cover percentage of native forbs & grasses high level species diversity **(3 points)**
Med - moderate cover percentage of native forbs & grasses, low level of diversity **(2 points)**
Low - native forb & grass species largely absent **(1 point)**

Forest Regeneration - use 10 x 10 ft visual sample of forest understory tree species less than one inch in diameter, addresses forest sustainability and potential for native species recovery following invasive treatment

High - greater than 70% regen cover of native tree species, three (3) or more native species represented in regen **(3 points)**
Med - between 30 - 70% regen cover of native tree species, two (2) - three (3) native species represented **(2 points)**
Low - less than 30% regen cover of native tree species, no more than (1) native species present **(1 point)**

Special Environmental Features

Wetland - site includes seasonal vernal pools and/or perennial wetlands

High - wetland large in size (> 1 acre) **(3 points)**
Med - wetland small in size (< 1 acre) **(2 points)**
Low - No wetland present in area **(1 point)**

Riparian area - site located in a stream corridor or adjacent to water body

High - Riparian area large in size (> 1 acre) **(3 points)**
Med - Riparian area small in size (<1acre) **(2 points)**
Low - No riparian area present **(1 point)**

Significant Element Occurrence

High - known species occurrence (DNR/NatureServe) **(3 points)**
Med - known habitat occurrence (DNR/NatureServe) **(2 points)**

ECOSYSTEM SCORE (continued)

Disturbance Regime - incorporates the risk of new invasive plant occurrences into a management site & the potential of a site to regenerate desirable vegetation
The primary drivers for disturbance in Fairfax Parks are considered to be deer herbivory, stormwater surges, and trail impacts

Deer Herbivory - metric to be based upon twig browse, browse line, deer pellets, and visible animals

- High - visible browse line, presence of fecal pellets, absence of preferred browse species, deer frequently observed ---- **(1 point)**
- Med - preferred browse species present but damaged, presence of fecal pellets, deer occasionally observed ---- **(2 points)**
- Low - well developed native plant composition in understory, deer sign relatively absent ---- **(3 points)**

Drainage Location - metric to be based upon location of management area in watershed

- High - 1st order stream drainage ---- **(3 points)**
- Med - 2nd order stream drainage ---- **(2 points)**
- Low - 3rd order & greater stream drainage ---- **(1 point)**

Drainage Condition

- High - absence of visible erosion ---- **(3 points)**
- Med - surface rill erosion, minimal gully formation ---- **(2 points)**
- Low - concentrated flows, significant gully formation ---- **(1 point)**

Stormwater Outfalls

- High - cumulative pipe diameter 36" or greater ---- **(1 point)**
- Med - cumulative pipe diameter 6" - 36" ---- **(2 points)**
- Low - cumulative pipe diameter less than 6" ---- **(3 points)**

Trail Footprint

- High - wide paved trail present, potential vehicular access, mown shoulders, unstable location in floodplain ---- **(0 points)**
- Med - narrow paved trail or crushed stone trail, minimal shoulder maintenance, dirt trail on slope with associated erosion ---- **(1 point)**
- Low - dirt footrail, low erosion, organic trail substrate (ex-woodchips) ---- **(2 points)**
- None - no routine pedestrian or vehicular access to project site ---- **(3 points)**

NON-NATIVE INVASIVE SPECIES SCORE

Infestation Level - In general, parks with fewer, smaller occurrences and lower invasive plant cover levels are higher priorities for mg't

Number of Invasive Plant Occurrences (number of patches of invasive plants)

High - patches are highly coalesced into one another - - - **(1 point)**
Medium - invasive plant occurrences scattered and largely separated from one another - - - **(2 points)**
Low - invasive plant species isolated from other infestations - - - **(3 points)**

Cover of Invasive Plant Species

High - greater than 80 % - - - **(0 points)**
Medium High - between 60 - 80% - - - **(1 point)**
Medium - between 40 - 60 % - - - **(2 points)**
Medium Low - between 20 - 40% - - - **(3 points)**
Low - less than 20 % - - - **(4 points)**

Ecological Threat - Innate threat level posed by invasive species present due to biology of organism

High - species is a primary threat to regeneration of forest tree cover - - - **(3 points)**
Medium - species is primarily a threat to other ecological conditions (not forest regeneration) - - - **(2 points)**
Low - invasive plant species unlikely to expand range or dominate site, a limited threat - - - **(1 point)**

Control Difficulty - relative feasibility of effective suppression of population at a given site

Accessibility for control actions

High - patch located adjacent to trail, vehicle parking area and water sources - - - **(3 points)**
Medium - patch located less than 5 minute walk from parking and water sources - - - **(2 points)**
Low - difficult; located far from trail, vehicle parking area, and water sources - - - **(1 point)**

Susceptibility to control - ignores spatial and location aspects of the occurrences

High - individual plants controlled by a single application of herbicide or a single pulling or digging, non-persistent seed bank - - - **(3 points)**
Medium - species present can be controlled with multiple applications of most effective treatments) - - - **(2 points)**
Low - species present difficult to control even with herbicides; persistent seed bank - - - **(1 point)**

Treatment History -previous invasive management & suppression work on site

High - site has undergone two or more years of uninterrupted suppression treatment - - - **(3 points)**
Med - site has been treated at least once within the previous year - - - **(2 points)**
Low - site has no recent treatment history - - - **(1 point)**

CULTURAL USE LEVEL SCORE

Visitation Level - reflects site utilization and the negative impact of invasive plants on the visitor experience

Public Parking - available in or adjacent to area

High - structured parking ---------- **(3 points)**
Medium - unstructured parking ---------- **(2 points)**
Low - access limited to street parking ---------- **(1 point)**

Trail Utilization - frequency of pedestrian use of area

High - frequent trail use at various times of day ---------- **(3 points)**
Medium - daily trail use primarily during finite peak periods ---------- **(2 points)**
Low - trail use infrequent ---------- **(1 point)**
None - no defined pedestrian access ---------- **(0 points)**

Public Infrastructure - recreation facilities, interpretive signs, nature center; excludes roads & trails

High - significant facilities present ---------- **(3 points)**
Medium - moderate level of infrastructure ---------- **(2 points)**
Low - little or no investment in hardscape infrastructure in site area ---------- **(1 point)**

Ownership - reflects demand for vegetation management, previous non-invasive management, service requests

Management Context

High - Va DNR ranking ---------- **(3 points)**
Med - recent NNI management activity (riparian buffer planting, etc.) ---------- **(2 points)**
Low - no special management context ---------- **(1 point)**

Service Requests

High - multiple requests for vegetation management at site ---------- **(3 points)**
Med - single request for vegetation management at site ---------- **(2 points)**
Low - no recorded requests for vegetation management at site ---------- **(1 point)**

Park Classification

High - primary focus of park is natural resource protection, park has resource mgmt plan ---------- **(3 points)**
Med - primary focus of park is natural resource protection, park lacks resource mgmt plan ---------- **(2 points)**
Low - primary focus of park is NOT natural resource protection ---------- **(1 point)**

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Appendix G

Treatment Projections & Assumptions

SCENARIO 1 - PROJECTED LOW LEVEL OF INFESTATION
CONTRACTOR TREATMENT

COVER CLASS	% TOTAL ACRES	ACRES	FOLIAR COST/ ACRE	CUT STUMP COST/ACRE	FOLIAR PARK WIDE COSTS	CUT STUMP PARK WIDE COSTS
1 (81 - 100%)	0.05	1020	$1,170	$4,680	$1,193,400	$4,773,600
2 (61 - 80%)	0.1	2040	$910	$3,640	$1,856,400	$7,425,600
3 (41 - 60%)	0.45	9180	$650	$2,600	$5,967,000	$23,868,000
4 (21 - 40%)	0.25	5100	$390	$1,560	$1,989,000	$7,956,000
5 (1 - 20%)	0.15	2040	$135	$525	$275,400	$1,071,000
					$11,281,200	*$45,094,200*

BLENDED TREATMENT YEAR ONE	*$33,789,376*
BLENDED TREATMENT YEAR TWO	*$16,894,688*

SCENARIO 2 - PROJECTED HIGH LEVEL OF INFESTATION
CONTRACTOR TREATMENT

COVER CLASS	% TOTAL ACRES	ACRES	FOLIAR COST/ ACRE	CUT STUMP COST/ACRE	FOLIAR PARK WIDE COSTS	CUT STUMP PARK WIDE COSTS
1 (81 - 100%)	0.1	2040	$1,170	$4,680	$2,386,800	$9,547,200
2 (61 - 80%)	0.2	4080	$910	$3,640	$3,712,800	$14,851,200
3 (41 - 60%)	0.4	8160	$650	$2,600	$5,304,000	$21,216,000
4 (21 - 40%)	0.2	4080	$390	$1,560	$1,591,200	$6,364,800
5 (1 - 20%)	0.1	2040	$135	$525	$275,400	$1,071,00
					$13,270,200	*$53,050,200*

BLENDED TREATMENT YEAR ONE	*$39,750,409*
BLENDED TREATMENT YEAR TWO	*$19,875,204*

Assumptions

- % total acres = % of park land in naturalized woodland (approximately 20,400 acres) that is infested at each cover class
- Extrapolation based upon qualitative assessment of approximately 1/4 of parks
- No allowances have been made for acreage under native tree canopy that has been converted to hardscape or manicured lawn
- Treatment type costs are contractor averages for multiple species sites dominated by woody vegetation
- Foliar treatment based upon selective use of herbicides using low-pressure application equipment
- Treatment costs do not reflect brush removal and assume access within 1/4 mile from paved road
- Cost projections are for first year single treatment per site only (follow-up treatment costs should decline by approximately 1/2 each year for the first three years)
- Blended treatment assumes 1/3 of acreage will only require foliar application during 1st treatment

AVERAGE OF SCENARIO 1 & 2
CONTRACTOR TREATMENT

COVER CLASS	% TOTAL ACRES	ACRES	FOLIAR COST/ ACRE	CUT STUMP COST/ACRE	FOLIAR PARK WIDE COSTS	CUT STUMP PARK WIDE COSTS
1 (81 - 100%)	0.075	1530	$1,170	$4,680	$1,790,100	$7,160,400
2 (61 - 80%)	0.15	3060	$910	$3,640	$2,784,600	$11,138,400
3 (41 - 60%)	0.425	8670	$650	$2,600	$5,635,500	$22,542,000
4 (21 - 40%)	0.225	4590	$390	$1,560	$1,790,100	$7,160,400
5 (1 - 20%)	0.125	2550	$135	$525	$344,250	$1,338,750
					$12,344,550	*$49,339,950*

BLENDED TREATMENT YEAR ONE	*$36,971,141*
BLENDED TREATMENT YEAR TWO	*$18,485,570*

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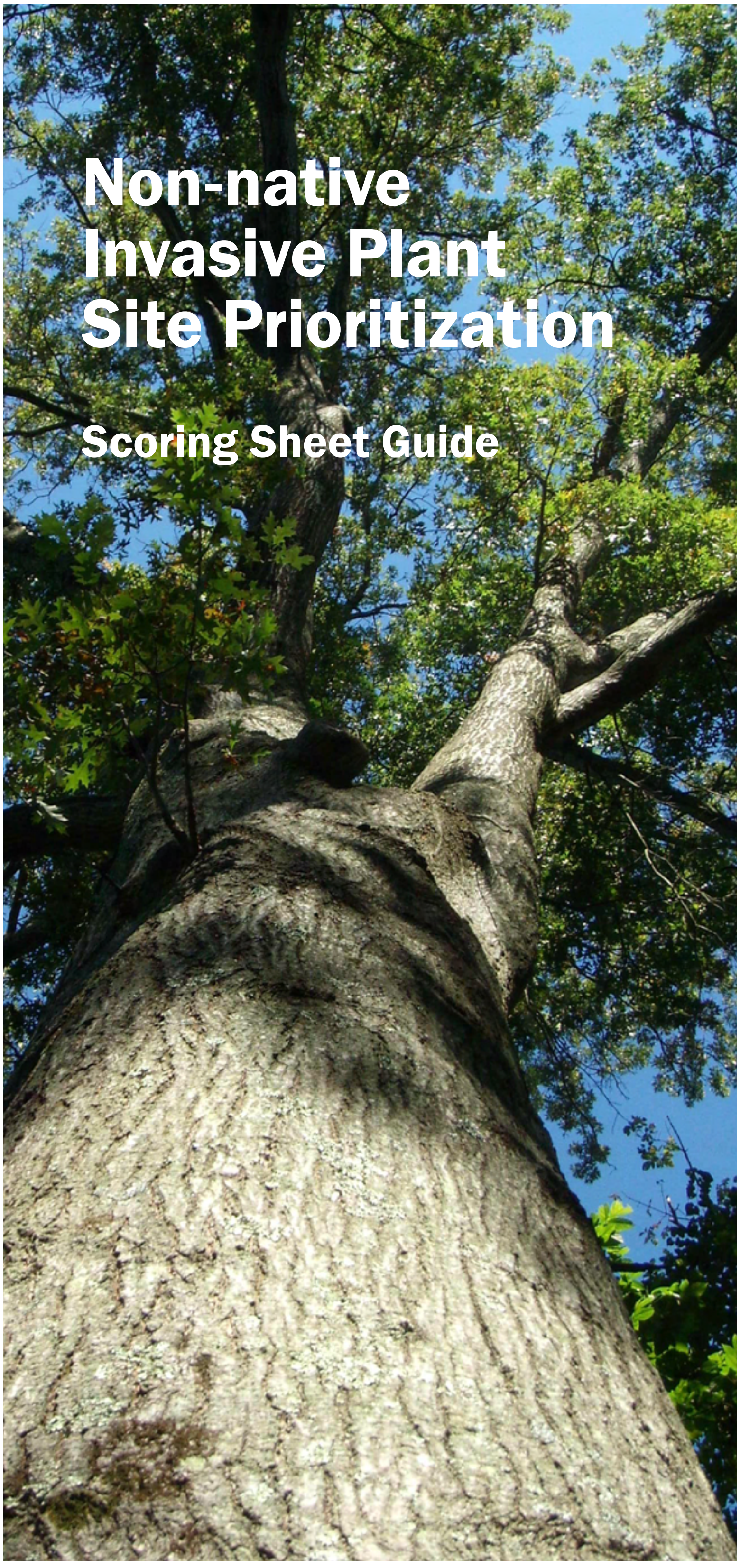
Appendix H

Scoring Sheet User Guide

Non-native Invasive Plant Site Prioritization

Scoring Sheet Guide



Filling out the Score Sheet

ALWAYS SIGN YOUR WORK

Please fill out the park name, the general location within the park that you are inspecting, your initials and the date. Note GPS coordinates (if available) under the site location.

EASY MATH

Please circle the score within each of the three domains that best exemplifies your opinion of site conditions. Scores should be subtotaled in the right hand column and a total score tabulated at the bottom. If you need to, you can use half values, but remember this is a quick assessment, and in most cases you can find the closest whole number.

TAKE A PICTURE

If you have a camera available it is always valuable to photograph existing conditions. Please try to take images towards the four cardinal directions (N, S, E, W) as this will provide a good overview for future reference. And always remember to label and link your pictures to the particular site.

TAKE NOTES

There is plenty of white space on the score sheet; write down anything you think may be important. It isn't necessary to make comments, but many people have found it useful.

What To Look For in the Field

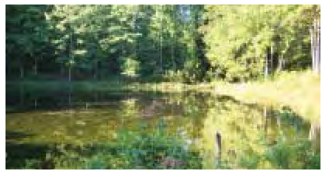
The following descriptions are intended to remind you of your training in each of the categories. These are ideas of what to watch for but are not intended to be comprehensive checklists. The more time you spend in the field using the score sheets, the greater your skill will be in identifying variations in site conditions.

ECOSYSTEM SCORE

BIODIVERSITY: This field is designed to assess the desirable natural elements of a site. How valuable, unique, and difficult to replace are the features of this location? On the scoring sheet this field can range from low to high:

High: If you're in a forest, look for large mature trees (over 18 inches in diameter) in the canopy, lots of diverse native shrubs, and a healthy forest floor dominated by native plants, new trees, leaf litter, and downed deadwood. Is the forest canopy composed of various tree species (especially oaks and hickories) and sizes? Is the site adjacent to a large wetland or stream? Are vernal pools evident? Are most of the species unusual or rare?

Medium: Look for a closed canopy that is primarily composed of trees of the same size and species (forest systems), a shrub layer with just a few native species and a ground layer with limited native species diversity. Are these few different types of species relatively common?



Low: Look for a limited level of canopy cover composed of mostly the same species. Perhaps only one or two of the trees will exceed 18 inches in diameter. Are there large gaps in the canopy? These sites will tend to lack desirable native plants in the understory and, if tree regeneration is present, it will be limited to less than a third of the available area.

DISTURBANCE: As invasive plants thrive in disturbed habitat, this metric rates the relative stability of the site. On the scoring sheet this field ranges from low to high:

Low: Evidence of deer damage and or presence is rare, evidence of erosion and flooding absent, and trails are either footpaths or not present.

Medium: Some deer browse, minor surface flooding, dirt or crushed stone trails only.

High: Visible browse line, concentrated flooding and evidence of site scouring, wide paved trails.

NON-NATIVE INVASIVE SPECIES SCORE

INFESTATION LEVEL: This metric is a visual estimation of the percent of the site that is occupied by invasive vegetation. On the scoring sheet this field has three categories based upon invasive cover percentage:

Imagine looking down from above. How much of the ground would be covered by invasive plant foliage? In your mind's eye tabulate all invasive species present in total; *e.g.* if species A is 5% and species B is 20%, then the site would be in the 20-50% cover range. Cover is based upon the species growth habit; for instance, stiltgrass cover is based on the ground level, but tree of heaven would be based on its percent of the tree canopy.

CONTROL DIFFICULTY: The feasibility of controlling an invasive plant infestation at a given site is dependent upon the biology of the plant, the location of the site, the probability of new infestation, and the control treatments available. Please consult with Natural Resource Management and Protection if you can't answer these questions.

Notes will be very useful in this section, if you don't know how to treat/control a species, at least mark down which species are present and this value can be assigned later. The following control categories will be found on the scoring sheet:

Readily susceptible to control: Single treatment will remove majority of plants, species does not have a persistent level of seed in soil, site has easy accessibility, little potential for reinfestation from adjacent areas.

Requires repeated control efforts: Multi-year program will be needed, location is within five minutes walking from vehicle, neighboring sites have low populations of target plants.

Difficult/poor response to control efforts: Site has limited potential for control, high reinfestation probability, difficult species to treat, low accessibility, large populations of invasive plants adjacent to, or upstream from, treatment location.

NOTE REGARDING PREVIOUS TREATMENT: Should a site have been treated for invasive plants within the last 12 months, please add 1 point. Check with Natural Resource Management and Protection if you're unsure of the treatment history.

CULTURAL USE SCORE

VISITATION LEVEL: This metric reflects the relative popularity of a given location. It will range from high to low on the scoring sheet:

High: Structured parking, frequent trail use, trails used by more than hikers (bikers, equestrians etc.), numerous amenities installed (benches, swings, etc.)

Medium: Unstructured parking, daily trail use during peak periods, moderate level of amenities.

Low: Access limited to street parking, infrequent trail use or trails absent, little or no infrastructure present.

OWNERSHIP: This metric captures the expressed interest in controlling invasives at a site. If you need additional information than is visible on the site visit, discuss with Natural Resource Management and Protection. Three categories of ownership are present on the scoring sheet:

Formal program: Site has a current habitat or restoration planting, multiple requests for management have been received, has a management plan and/or has a conservation designation (*e.g.*, Virginia Department of Natural Resources).

Informal program: A request for treatment has been received, has a habitat or restoration planting proposed, but lacks a management plan.

No apparent public involvement: Focus of site is not resource protection (*e.g.*, a ball field or recreational buffer area), no requests for treatment have been recorded.

Frequently Asked Questions

WHAT IS THIS THING ABOUT?

The scoring sheet is designed to be a rapid assessment tool that enables the comparative ranking of field sites for invasive treatment. It is a site ranking tool, not a species ranking tool. Scoring is undertaken in three domains: ecosystem, non-native invasive species, and cultural value. Total site scoring can range from 3 to 16 points. Sites with higher total scoring values are given priority for invasive intervention.

CAN IT WORK ANYWHERE?

The scoring system can be used on any identifiable parcel (be sure to work with Natural Resource Management and Protection to identify where and when you are using this). Should you detect an invasive species previously unknown within the county park system, please advise Natural Resource Management and Protection immediately.

CAN I USE IT?

Basic botanical skills and a familiarity with the plant communities typical in Fairfax County are required to be confident about your score. Training sessions will be offered by Natural Resource Management and Protection; attend as many as you need to be comfortable with the system.

HOW LONG DOES IT TAKE?

You should spend no more than 30 minutes per site, but many will be much quicker. No field measurements are needed. Use your eyes, ears and botanical skills. Remember, this is a rapid assessment tool, not a research study.

HOW BIG SHOULD A SITE BE?

As a visual inspection, site size may vary. Natural Resource Management and Protection will give you a map of your site(s), but things change in the field. If there is a change in landform, density of invasives or other significant factor, feel free to make new sites or combine other sites. In addition, the three domains may involve features of differing scale. Watch your time! If it is taking too long you are probably sampling too large an area.

WHAT DO I NEED?

Bring several of the scoring sheets, maps, a clipboard, writing utensil, good eyes, a digital camera and GPS. You may also want to consider bringing bug spray, sunscreen and/or a compass. Wear long pants and sleeves, and a hat.

CAN I WORK ALONE?

Working in pairs allows some discussion about the scores, which may make a better overall score sheet. Each person could complete their own score sheet, or you could work together on one. Pairs also help make the activity safer, but there is no reason why this couldn't be completed by oneself.

Fairfax County Park Authority

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Appendix I

Recommended Control Strategies

FAIRFAX COUNTY INVASIVE PLANT CONTROL METHOD CHART

INVASIVE SPECIES	PROPOSED CONTROL METHOD	PRODUCTS USED	PROTENTIAL IMPACT ON NON TARGET ORGANISMS	PERCENT (%) EFFECTIVENESS	COMMENTS
Garlic Mustard (*Ailiaria petiolata*)	Foliar treatment (FT)	2% RoundUp Pro	Non-selective...requires accurate application.	98%	Will require 5 year monitoring and maintenance to control seed bank
Japanese Stiltgrass (*Microstegium vimineum*)	Pre-emergent or Foliar treatment	4 oz./Acre Plateau or 2% RoundUp Pro	Plateau: may harm native seed germination, but very selective to grass post emergent. RoundUp Pro non-selective...requires accurate application.	Plateau: 95% Rodeo: 95%	Plateau is not aquatic safe, but if applied correctly in upland area can eliminate 3-4 years of seedbank. Used upon COR approval. Application in March. R application Sept.
Japanese Honeysuckle (*Lonicera japonica*)	Foliar treatment, cut-and-treat (CT)	2% RoundUp Pro FT and 25% CT	RoundUp Pro nonselective... requires accurate application.	90%	Apply in late fall to avoid non target damage
Mile-a-Minute (*Polygonum perfoliatum*)	Pre-emergent or Foliar treatment	6 oz./Acre Plateau or 2% RoundUp Pro	Plateau: may harm native seed germination, but very selective to grass post emergent. RoundUp Pro non-selective...requires accurate application.	Plateau: 95% Rodeo: 95%	Plateau is not aquatic safe, but if applied correctly in upland area can eliminate 3-4 years of seedbank. Used upon COR approval. Application in March. Rodeo application Sept.
Oriental Bittersweet (*Celatrus orbiculatus*)	FT, CT	2% Garlon 3A FT, 25% Garlon 3A CT	Broadleaf selective	90%	Cut ascending vines and treat stump. Treat for reprouts
Privets (*Ligustrum vulgare, L. obtusifolium, L. sinense, L. japonicum*)	FT, CT	2% RoundUp Pro FT, 25% RoundUp Pro CT	RoundUp Pro nonselective... requires accurate application. CT is 100% selective.	90%	Apply in late fall/early winter to avoid non target damage
Exotic Bush Honeysuckle (*Lonicera: L. maackii, L. morrowii, L. tatarica, L. standishii*)	FT, CT	2% RoundUp Pro FT and 25% CT	RoundUp Pro nonselective... requires accurate application. CT is 100% selective.	95%	Apply in fall to avoid non target damage
Japanese and European Barberrys (*Berberis thunbergii, Berberis vulgaris*)	FT, CT	2% RoundUp Pro	RoundUp Pro nonselective... requires accurate application.	95%	Treat in mid-Spring (early May)
Winged Euonynus (*Euonymus alata*)	FT, CT	2% RoundUp Pro FT and 25% CT	Rodeo: non-selective... requires accurate application.	95%	FT in summer/early fall, CT in mid-fall for easy id.
Multiflora Rose (*Rosa multiflora*)	FT	2% RoundUp Pro	RoundUp Pro nonselective... requires accurate application.	90-95% depending on size and age	FT in mid-spring to early summer.
Autumn and Russian Olive (*Elaeagnus umbellata and Eleaeagnus angustifolia L.*)	FT, CT	2% RoundUp Pro FT and 25% CT	RoundUp Pro nonselective... requires accurate application.	95%	
Wineberry (*Rubus phoenicolasius*)	FT	2% RoundUp Pro	RoundUp Pro nonselective... requires accurate application.	90-95%	FT in early summer.
Porcelain berry (*Amplelopsis brevipedunculata*)	FT, CT	2% Garlon 3A FT, 25% Garlon	Broadleaf selective	90%	Cut ascending vines and treat stump. Treat for reprouts

FAIRFAX COUNTY INVASIVE PLANT CONTROL METHOD CHART

INVASIVE SPECIES	PROPOSED CONTROL METHOD	PRODUCTS USED	PROTENTIAL IMPACT ON NON TARGET ORGANISMS	PERCENT (%) EFFECTIVENESS	COMMENTS
English Ivy (*Hedera helix*)	FT, CT	5% RoundUp Pro FT, 25% CT	RoundUp Pro nonselective... requires accurate application.	80%	Although SOW calls for 1.5-2.5% glyphosate, IPC research indicates 5% is more effective. Used upon COR approval
Lesser Celandine (*Ranunculus ficaria*)	FT	1.5% Rodeo	Rodeo: non-selective... requires accurate application.	98%	Rodeo is aquatic safe.
Wisteria (*Wisteria sinensis*)	FT, CT	2% Garlon 3A FT 25% Garlon 3A CT	Broadleaf selective	90%	Mid Summer Treatment
Exotic Viburnum (*V. plicatum & V. dilataum*)	FT, CT	2% RoundUp Pro FT and 25% CT	RoundUp Pro nonselective... requires accurate application.	95%	FT in summer/early fall, CT in mid-fall for easy id.
Norway Maple (*Acer platanoides*)	Basal bark (BB), FT	20% Garlon 4 BB, 2% RoundUp Pro CT	BB is selective to the treated species. RoundUp Pro is nonselective and requires accurate application.	95%	Summer/Fall Treatment
Tree-of-heaven (*Ailanthus altissima*)	Basal bark (BB), FT	20% Garlon 4 BB, 2% RoundUp Pro CT	BB is selective to the treated species. RoundUp Pro is nonselective and requires accurate application.	95%	Summer/Fall Treatment
Mimosa (*Albizia julibrissin*)	Basal bark (BB), FT	20% Garlon 4 BB, 2% RoundUp Pro CT	BB is selective to the treated species. RoundUp Pro is nonselective and requires accurate application.	95%	Summer/Fall Treatment
Kudzu (*Pueraria montana*)	FT, CT	0.5% Transline FT, 2% Garlon 3A FT	Transline is selective to most legumes and some composites. It will not affect the majority of tree species. Garlon 3A is broadleaf specific and aquatic safe. Research indicates Garlon 3A typically has better control than Transline.	85%	Late Summer Treatment
Archangel (*Lamiastrum galeobdolon*)	FT	2-5% Triclopyr	Broadleaf selective	Triclopyr: 90% Glyphosate: 75%	Archangel is a ground cover plant with a shallow root system so manual pulling could be implemented. The only downfall is that the plant will sprout from very small root fragments
Winter Creeper (*Euonymus fortunei*)	FT, CT	5% Triclopyr 25% Tricopyr	Broadleaf selective	Triclopyr: 85%	

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INVASIVE SPECIES MANAGEMENT

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