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**parks & recreation**

# **Invasive Plant Species Management Plan**



**Submitted By**

**Mark A Patterson**

**Oregon State University  
College of Forestry**

**Natural Resources, Forest  
Ecosystems & Society**

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## EXECUTIVE SUMMARY

Invasive species are one of the most significant threats to native ecosystems in the nation (Mooney, 2001). As defined by Federal Executive Order 13112, a species is considered invasive if it is not native to the ecosystem under consideration, and its establishment causes or is likely to cause economic, environmental or human harm (Exec. Order No. 13112, 3 C.F.R. (1999)).

Since its inception in 1987, Gwinnett County Parks and Recreation has been trying to curb the exponential growth of invasive species within its park borders (Horne, 2015). In recognition of the impacts to the natural, cultural, fiscal, and overall health from invasive species, Gwinnett County Parks and Recreation has authorized the development of the GCPR Invasive Plant Species Management Plan. The GCPR IPSMP was developed for the purpose of coordinating the goals of invasive species control, eradication, and prevention within the parks system.

The plan, provides broad strategies and recommendations for invasive species survey and detection, control and prevention. It also addresses appropriate habitat restoration, staff training, and public outreach and education. It is expected that this Capstone Project will be the cornerstone towards the department's vision for invasive species management for the future. The realization of this document would not have been arrived at without the support from the Oregon State University school of Forestry and the Gwinnett County Parks and Recreation Division.

### **Major goals of the plan are to:**

- Characterize invasive plant species issues and current control efforts on GCPR lands and adjacent public and private lands
- Ascertain potentially new invasive plant species infestations and develop remediation control plans
- Prevent and control invasive plant species, and restore native species in applicable habitats through park by park systematic action plans
- Comply with all legal expectations provided under land purchase parameters and conservation easement dictates as written in land parcel purchases
- Align GCPR with the Georgia state-level invasive species initiatives and management plan
- Foster partnerships and volunteerism within the parks towards invasive species management

- Develop budgetary needs and potential outside funding opportunities
- Raise awareness among GCPR staff and the general public about invasive species and their impacts
- Provide background information for establishing policies, and addressing invasive plant species through GCPR management plans, technical assistance, and grant programs
- Promote the use of invasive plant species management and habitat restoration techniques on GCPR lands and adjacent landholders properties
- Incorporate invasive plant species management efforts into existing development planning and design standards for all new park property development
- Develop a consistent quantifiable measure for progress towards individual site action plans
- Compile a year end summery for current year's action plans, on an annual basis, to provide an assessment list of current success/failure for each site's progress

## CHAPTER I - INTRODUCTION

### Ecology of Gwinnett County

Invasive species has been identified as one of the most significant threats to native ecosystems in the nation (Mooney, 2001). Introduction of these species is one of the most unrecoverable and permanent injuries to native biodiversity and the integrity of ecosystem processes. Once established, invasive species are extremely difficult to remove. When removal is possible, it comes at a high cost financially and ecologically. Even after successful recovery, the intricacies of the original ecosystem are often lost indefinitely (Perrings et al. 2000).

Invasive species however are not a new phenomenon. Since the inception of recorded history, more than 50,000 nonnative species have been introduced into North America alone (Eiswerth et al. 2002). This staggering number has risen dramatically over the last few hundred years with the settlements established by European explorers (Eiswerth et al. 2002). Many of these species, such as wheat, rice, cattle, and poultry were introduced as sources of food and now provide more than 98 percent of the U.S. food system valued at approximately \$800 billion per year (Pimentel et al. 2005). Other exotic species were introduced for landscape restoration, biological pest- control, sport, or pets (Dorcas, 2012).

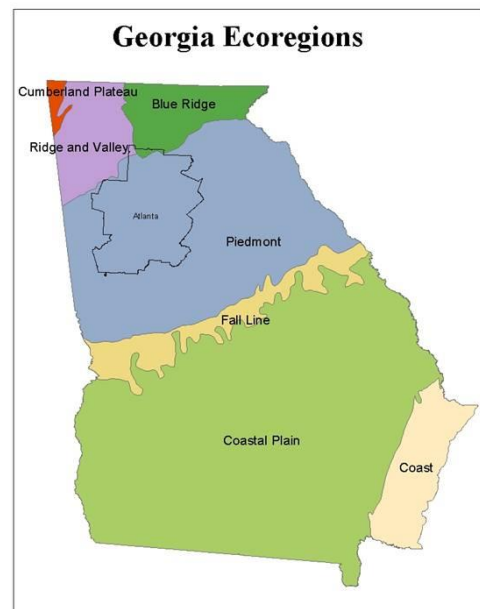


Gwinnett County, GA

Gwinnett County GIS Department

The introduction of nonnative plant species has a long history in Georgia. Much of this history follows true in Gwinnett County where early settlers found nonnative peach trees growing wild and in Native American orchards. This is probably because Spanish or French colonists had introduced peaches into Florida in the sixteenth century. From there, Native Americans spread peaches northward where they eventually became naturalized (Crosby 2004). Over time, more nonnative species were introduced into the state. For example in South Georgia, Benjamin Franklin sent upland rice and Chinese tallow tree seeds to Georgia in 1772. While attempts were made to cultivate these rice grains, upland rice was not grown with any great success in Georgia until it was reintroduced by Thomas Jefferson twenty years later (Bell 1966).

Founded in 1818, Gwinnett County, GA is located within the Piedmont ecoregion of the state. Its proximity provides for a wide assemblage of plants and animals to thrive (Griffith et al, 2001). Much of what contributes to the advantageous ecology for invasive



species can first be discovered from the geology of the county. Gwinnett County covers an area of 430 sq. miles (USA Census, 2010). Within its borders, complex structures formed largely on the edges of steeply upturned and altered rocks can be found. Topographically, the ecoregion is made up of low hills and narrow valleys (Piedmont Region, 2015).

A thick pile of metamorphosed sedimentary rocks from the late Precambrian Period to early Paleozoic Period encapsulates the basement rocks of the Piedmont. Several episodes of volcanism have occurred, and the sedimentary rocks have been intruded by magma from deeper layers of the Earth, forming dikes and plutons of granitic rocks and carrying important metals and minerals toward the surface (Piedmont Region, 2015).

Much of the rock structure of Gwinnett County is comprised of a thick layer of decomposed rock called saprolite. This is what is known locally as “Georgia Red Clay” (Worthy, 2004).



Saprolite Cross-Section  
Photo Courtesy of  
<http://geosciblog2.blogspot.com>

Saprolite is an incorporation of clay minerals rich in silicon, aluminum, and some other elements, plus more or less pigmentary iron oxides for color and resistant minerals such as quartz. Saprolite becomes a highly erodible material if the vegetation cover of oak and hickory trees is removed. When the Piedmont was settled by Europeans, the removal of the mature forest and replacement of the vegetation with tobacco or cotton crops resulted in rapid erosion of the soil followed by reduction in yield of the crops. Forests dominated by pine trees, today used for paper products, later regrew on these sites (Piedmont Region, 2015).

It should be noted that invasive species have historically played an important role in Gwinnett County. During the early 20<sup>th</sup> century, planting of kudzu (*Pueraria montana*) for soil stabilization by members of the Civilian Conservation Corp was common. In many homes the use of the ubiquitous privet (*Ligustrum sinense*) hedge, made famous by the University of Georgia, to establish borders was all too easily utilized. Today we know the harms that these two and several other plants have done to our counties land holdings (Introduction to Invasive Species, 2015). Over the last twenty years, these land purchases by Gwinnett County have seen a decrease in botanical diversity due to the overgrowth of these invasive species (Horne, 2015). The volume of available open space in these same land tracts have become filled with invasive plant material; that subsequently has prevented native plant material to expand its land coverage (Horne, 2015).

Generally speaking, invasive species have greater success at developing into problematic plant species when placed in similar geographic and temperate zones as the areas from whence they came (Allendorf and Lundquist 2003). Gwinnett County is located in North Georgia just south of the Blue Ridge Mountains and is listed as a humid sub-tropical climate due to its

location (Times Atlas, 2002). The mountains form a partial barrier to potential cold air masses moving eastward across the US, and as a result, there are minimal during the winter season when the temperature falls below 32° F. On average, the highs in the summer are in the high 80's°F with lows remaining in the uppers 60's°F (Gwinnetteeconomicdevelopment.com 2015).



## Purpose of the Plan

The GCPR Invasive Plant Species Management Plan was developed as a tool for use by the Natural Resource Management Unit of the Department. The GCPR IPSMP was developed to define issues related to invasive species in the Gwinnett County parks system, and to guide control efforts on all GCPR lands and county recreation set-asides. This strategic effort addresses, through a coherent agency-wide approach, the invasive plant species problems faced by the departments land manager and staff. It is meant to act as a template for individualized action plans specific to park sites. Each of these sites presents its own unique issues, infestation and limitations regarding management techniques that can be deployed.

## Definition of Invasive

Federal Executive Order 13112 of 1999 defined an “invasive species” as a species that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. This definition covers all organisms, including vascular plants, animals (including invertebrates), fungi, bacteria and viruses. Executive Order 13112 established the National Invasive Species Council, which developed a National Invasive Species Management Plan. That plan focuses on non-native species that cause significant negative impacts without providing an equivalent benefit to society (Exec. Order No. 13112, 3 C.F.R. 1999).

## What Invasive Plant Species are currently documented in Gwinnett County?

Currently Gwinnett County has identified 43 plants found in Gwinnett County that are considered invasive species by definition. While it should be noted that not all of the species listed may not be a problem in Gwinnett County, Georgia, they are however exotic to the U.S. and listed as a problem elsewhere in the U.S. (Invasive Species: State Resources – Georgia, 2015).

The majority of these plants found on this list originate from the eastern region of the continent of Asia. These plants are found inhabiting similar temperate zones as that found in Gwinnett County (Walther, 2009). In most cases these “plants have been used in the nursery industry for over 100 years and thus have become firmly entrenched in our horticultural palate” (Horne, 2015, p.1). A greater concern that adds to this growing commonality is the preponderance of landscape architects that utilize many of these plants for their design elements in park settings (Schuder, 2015)

## Current Listing of Invasive Plant Species Found In Gwinnett County, GA

| Common Name        | Scientific Name                    |  | Common Name          | Scientific Name          |
|--------------------|------------------------------------|--|----------------------|--------------------------|
| Creeping Bentgrass | <i>Agrostis stolonifera</i>        |  | Yellow Toadflax      | <i>Linaria vulgaris</i>  |
| Tree-Of-Heaven     | <i>Ailanthus altissima</i>         |  | Perennial Ryegrass   | <i>Lolium perenne</i>    |
| Mimosa             | <i>Albizia julibrissin</i>         |  | Japanese Honeysuckle | <i>Lonicera japonica</i> |
| Alligatorweed      | <i>Alternanthera philoxeroides</i> |  | Leatherleaf Mahonia  | <i>Mahonia bealei</i>    |

|                     |   |  |   |
|---------------------|---|--|---|
| Canada Thistle      | <i>Cirsium arvense</i>                            | Chinaberry   | <i>Melia azedarach</i>                        |
| Trifoliolate Orange | <i>Citrus trifoliata</i>                          | Japanese Stiltgrass                                  | <i>Microstegium vimineum</i>                  |
| Asiatic Dayflower   | <i>Commelina communis</i>                         | Sacred Bamboo  | <i>Nandina domestica</i>                      |
| Bermudagrass        | <i>Cynodon dactylon</i>                           | Princesstree   | <i>Paulownia tomentosa</i>                    |
| Orchardgrass        | <i>Dactylis glomerata</i>                         | Annual Bluegrass                                     | <i>Poa annua</i>                              |
| Deptford Pink       | <i>Dianthus armeria</i>                           | Kudzu  | <i>Pueraria montana</i>                       |
| Russian Olive       | <i>Elaeagnus angustifolia</i>                     | Kudzu  | <i>Pueraria montana</i><br>var. <i>lobata</i> |
| Thorny Olive        | <i>Elaeagnus pungens</i>                          | Callery Pear (Bradford Pear)                         | <i>Pyrus calleryana</i>                       |
| Autumn Olive        | <i>Elaeagnus umbellata</i>                        | Bristly Locust                                       | <i>Robinia hispida</i>                        |
| Autumn Olive        | <i>Elaeagnus umbellata</i> var. <i>parvifolia</i> | Multiflora Rose                                      | <i>Rosa multiflora</i>                        |
| Mulberryweed        | <i>Fatoua villosa</i>                             | Giant Salvinia                                       | <i>Salvinia molesta</i>                       |
| English Ivy         | <i>Hedera helix</i>                               | Johnsongrass   | <i>Sorghum halepense</i>                      |
| Tawny Daylily       | <i>Hemerocallis fulva</i>                         | Field Pennycress                                     | <i>Thlaspi arvense</i>                        |
| Field Pepperweed    | <i>Lepidium campestre</i>                         | Alsike Clover  | <i>Trifolium hybridum</i>                     |
| Shrubby Lespedeza   | <i>Lespedeza bicolor</i>                          | Big Periwinkle                                       | <i>Vinca major</i>                            |
| Sericea Lespedeza   | <i>Lespedeza cuneata</i>                          | Chinese Wisteria                                     | <i>Wisteria sinensis</i>                      |
| Chinese Privet      | <i>Ligustrum sinense</i>                          | Wisterias  | <i>Wisteria</i> spp.                          |
| Privet Sp.          | <i>Ligustrum</i> spp.                             | ( Invasive Species: State Resources – Georgia, 2015) |   |

Of the aforementioned plants, it was determined during internal parks management staff discussions that the list of county plants exceeded the list of known species to inhabit the Gwinnett County Parks (Horne, 2015). In an effort to develop a plant list that would target what was known while allowing for further investigation to that which is yet to be documented, the GCPR IPSMP Team has established the following list of target species.

### Current List of Invasive Plant Species Targets in the Gwinnett County Parks

| Common Name       | Scientific Name                                   | Common Name          | Scientific Name              |
|-------------------|---|----------------------|------------------------------|
| Mimosa            | <i>Albizia julibrissin</i>                        | Japanese Honeysuckle | <i>Lonicera japonica</i>     |
| Canada Thistle    | <i>Cirsium arvense</i>                            | Leatherleaf Mahonia  | <i>Mahonia bealei</i>        |
| Russian Olive     | <i>Elaeagnus angustifolia</i>                     | Chinaberry           | <i>Melia azedarach</i>       |
| Thorny Olive      | <i>Elaeagnus pungens</i>                          | Japanese Stiltgrass  | <i>Microstegium vimineum</i> |
| Autumn Olive      | <i>Elaeagnus umbellata</i>                        | Sacred Bamboo        | <i>Nandina domestica</i>     |
| Autumn Olive      | <i>Elaeagnus umbellata</i> var. <i>parvifolia</i> | Princesstree         | <i>Paulownia tomentosa</i>   |
| English Ivy       | <i>Hedera helix</i>                               | Annual Bluegrass     | <i>Poa annua</i>             |
| Shrubby Lespedeza | <i>Lespedeza bicolor</i>                          | Kudzu                | <i>Pueraria montana</i>      |

|                   |                          |                              |                          |
|-------------------|--------------------------|------------------------------|--------------------------|
| Sericea Lespedeza | <i>Lespedeza cuneata</i> | Callery Pear (Bradford Pear) | <i>Pyrus calleryana</i>  |
| Chinese Privet    | <i>Ligustrum sinense</i> | Multiflora Rose              | <i>Rosa multiflora</i>   |
| Privet            | <i>Ligustrum spp.</i>    | Johnsongrass                 | <i>Sorghum halepense</i> |
|                   |                          | Wisterias                    | <i>Wisteria spp.</i>     |

## Why is GCPR Addressing Invasive Plant Species?

While most introduced species pose little threat to the environment, there are those that do constitute a significant risk. Invasive species rank second only to habitat destruction as a threat to biodiversity. Almost half of the species in the U.S. that are at risk of extinction are negatively impacted by invasive species. Invasive species threaten biodiversity in several ways. They may cause or spread diseases, for example, or act as predators or parasites of native species (Invasive Species, 2015). Invasive species are known to alter nutrient cycling, hydrology, fire regimes, light penetration levels, regeneration of native species populations and physical habitat structure throughout once healthy ecosystems (Mummy, 2006). The long-term effects of these changes are unknown, but their rate of occurrence raises concern about the ability of native species to adapt, particularly in the face of reducing habitat (Strayer, 2006).

“The introduction of nonnative species poses a profound threat to the state’s biodiversity. Georgia ranks sixth in the nation for overall biological diversity (4,004 species) and twelfth for number of endemic species (58 species). Nationally, Georgia ranks second in amphibian diversity (77 species), third in freshwater fish diversity (268 species), fifth in reptile diversity (83), seventh in vascular plant diversity (2,986 species), seventeenth in bird diversity (328), and eighteenth in mammal diversity (91)” (Invasive Species Management-Georgia DNR, 2015, p.10).

Unfortunately, Georgia also ranks eighth nationally in the number of imperiled species (533 species), and fourth in number of known or suspected extinctions (24 species), due in part to the introduction and spread of nonnative species (Stein et al. 2000). Georgia currently has 239 native species that are in danger of immediate or foreseeable extinction in all or a significant portion of their range. Seventy-three additional native species occur rarely enough to need protection because of their scarcity (GA DNR 2007, O.C.G.A. §27-3-130) (Introduction to Invasive Species - Georgia Invasive Species Task Force, 2015)

In addition to environmental harm, invasive species can have large economic impacts in the areas where they have become established. The costs associated with fire ants in the U.S., for example, have been estimated at \$1 billion/year. In Texas, the agricultural economic losses caused by this ant are an estimated \$90 million annually, and Texas spent at least \$580 million in 2000 to control this insect (About Invasive Species, 2015). Nationally, invasive plant species cause a 12 percent reduction in agricultural crop yields, costing the industry \$24 billion in lost crop production annually. In addition, about \$3 billion a year in herbicides are used to protect

U.S. crops from invasive plants (Pimentel et al. 2005)( Introduction to Invasive Species - GISTF, 2015).

One recent study placed the U.S. benefit of controlling invasive aquatic plant species alone as being in the billions of dollars (Rockwell 2003). In some instances the introduction of invasive plant species has a peripheral impact beyond the economic losses due to direct cost of combating and mitigating the impacts of the species (e.g., clogged waterways). Hydrilla, for example, blocks irrigation and drainage canals, enhances sedimentation in flood control reservoirs, interferes with public water supplies, impedes navigation, and generally restricts public water uses (Invasive Species Management-Georgia DNR, 2015).

At this time it is uncertain as to the overall potential economic costs of invasive species in Gwinnett County. Studies have yet to be initiated that look at this county on an individual basis. However, if trends on a national level are to be assumed to filter down towards the local areas such as the Gwinnett ecoregion, there is no doubt that an increase in economic losses can be assumed for the county.

Recent advances of invasive species issues such as the Emerald Ash Borer will increase losses to forest and local landscapes as the impact from its presence is just now beginning to be felt (Kovacks, 2010). Early detection of this species and many others are a critical stage in the fight to combat these species. GIS technologies such as those used in remote sensing will play a vital role in detection, assessment and eventual follow-up on the success of management strategies (Pontius, et al. 2008).

The need however to address the issue of invasive species within the county goes beyond the economic and environmental obligation the department has as public land stewards. There is a legal mandate that we must comply with to remove all invasive species found within properties designated within a conservation easement category. These properties are to be maintained with the intent to control invasive species through the use of management techniques for the purpose of eradication (Schuder, 2015).

## Goals and Objectives of the GCPR IPSMP

**Goal 1:** To identify the invasive species issues and ongoing control efforts currently enacted on all GCPR lands and align strategies with current state management plans.

### Objectives:

- Assess identified issues, needs, and past remediation efforts with pertinent GCPR staff members
- Utilize GIS based technologies and proven botanical field survey inventory practices to assess the percentage of invasive plant species on a park by park analysis
- Ascertain potentially new invasive plant species infestations and develop remediation control plans
- Prevent and control invasive plant species, and restore native species in applicable habitats through park by park systematic action plans
- Comply with all legal expectations provided under land purchase parameters and conservation easement dictates on GCPR lands
- Align GCPR with the Georgia state-level invasive species initiatives and Management Plan

### Milestone I:

- Utilizing remote sensing capabilities to establish a case study for the determination of success in the identification of an invasive plant species within a specific park. **Timeline:** Complete case study by November 2015

### Milestone II:

- Utilizing remote sensing capabilities to establish full park assessments for the identification of target invasive plant species within each Gwinnett County park. **Timeline:** Complete full park analysis by Summer 2016

**Goal 2: Develop a comprehensive training program for field staff for the implementation of the GCPR IPSMP.**

### Objectives:

- Assess current available training programs focused on Georgia Species
- Compile available educational materials and instructional media pertaining to the identification, management strategies and techniques, remediation of sites for dissemination to park staff

- Coordinate possible intranet viewed webinars for staff training with IT Division
- Develop train the trainer program for parks foremen to utilize with subordinate staff training
- Raise awareness among GCPR staff and the general public about invasive species and their effects through the use of signage, publications, and public presentations in the parks
- Promote the use of invasive plant species management and habitat restoration techniques on GCPR lands and adjacent landholders properties through available media outlets

**Milestone I:**

- Develop an invasive plant species training manual for staff use.  
**Timeline:** Complete by Summer 2016

**Milestone II:**

- Present first field methods training class to park staff.  
**Timeline:** Complete by Summer 2015

**Milestone III:**

- Complete the train the trainer program for parks supervisory staff to integrate into use with their future staff training.  
**Timeline:** Complete by Fall 2015

**Goal 3:      Develop a strategic plan for year to year implementation of the GCPR IPSMP to include budget needs and align these items to the internal Gwinnett County Balanced Scorecard System.**

**Objectives:**

- Develop budgetary needs and potential outside funding opportunities
- Foster partnerships and volunteerism within the parks towards invasive species management

**Milestone I:**

- Develop line item budget for the 2017-2021 operational years.  
**Timeline:** Complete by Spring 2016

**Milestone II:**

- Create a volunteer job notice for invasive plant removal crews for use by the departmental Volunteer Services Section.  
**Timeline:** Complete by Summer 2016

**Goal 4:** Promote the use of invasive plant species management and habitat restoration techniques on GCPR lands and adjacent landholder properties through adopted standards.

**Objectives:**

- Develop native plant standards to be adopted by the Parks Development Team in new park construction and older park renovations
- Incorporate invasive plant species management efforts into existing development planning and design standards for all new park property development

**Milestone I:**

- Develop acceptable plantings list for staff use. **Timeline:** Complete by Spring 2016

**Goal 5:** Develop a consistent quantifiable measure for progress towards individual site action plans.

**Objectives:**

- Compile a year end summery for all IPSMP action plans on an annual basis to develop a list that provides historic success/failure on each sites progress.
- Integrate each years plans into that current years Balanced Scorecard Operators System

**Milestone I:**

- Compile quarterly and year-end reports each subsequent year for recap of fiscal allowances and man-hour studies. **Timeline:** Complete by year-end 2016

## **CHAPTER 2 - SURVEY and DETECTION**

### **Purpose and Goals for Doing Survey and Detection**

“Despite the ubiquity of invasive plant species and their often deleterious effects on native flora and fauna, the consequences of biological invasions for human health and the ecological mechanisms through which they occur are rarely considered” (Allen, 2010, p.2). It should be noted that there is an increasingly large amount of information that points to invasive plant species increasing the probability for peripheral issues such as disease vectors gaining greater access to the populace as the crowd over vegetated areas with thick mats of plant material (Allen, 2010).

Invasive plants are often more vigorous in their introduced ranges than in their native ranges. This may reflect an innate superiority of plants from some habitats or an escape from their enemies. Another hypothesis proposes that invasive plants evolve increased competitive ability in their introduced range. Post-introduction adaptation by introduced plants may contribute to their invasive success and make it difficult to predict problem species. (Siemans, 2001).

The success shown by invasive species in these studies provides a basis for the need to detect invasive plant species at their early stages of inhabitation before the potential genetic divergence can occur and allow for more robust plants to become entrenched in their new habitat. (Siemans, 2001).

Gwinnett County Parks and Recreation recognizes the need to establish an early warning and detection capability to prevent the spread of invasive species. Its methodologies towards the detection of invasive plant species shall include:

- A. - Inventory the distribution and abundance of invasive species already present to help establish management priorities through ground-truthing and geospatial technologies; and
- B. – Initiate early detection of new invasive species to prevent establishment and eradicate the population through the use of field surveys, citizen scientist volunteers and geospatial technologies.

To that end, the following goals are present to provide for a survey and detection program for invasive species:

- Goal 1: Identify and prioritize invasive plant species that present the greatest risk to the parks system. This will be done in consultation both state and federal Invasive Species Task Groups
- Goal 2: Identify and prioritize areas of greatest risk due to ecological or historical significance or proximity to a disturbed area or a habitat already containing invasive species. Protecting non-infested areas is of highest priority and is the basis for proactive management



- Goal 3: Identify surveys conducted by other agencies, including the use of EDDMAPS® and share data collected by GCPR with other institutions
- Goal 4: Maintain awareness of current invasive species research in order to develop and adapt monitoring and management options. This will be done through membership with statewide Task Force Groups and ongoing external training
- Goal 5: Collect data consistently and in a spatially explicit manner (i.e. using GIS mapping through the EDDMAPS ® system)

From the previous chart listing Gwinnett Parks Invasive Plant Species, found on pages 9-10, the following plant species are priority target species the Gwinnett County Parks system. These are known through ground-truthing to be high in percentage coverage in low areas within several parks. However, much of this information is not quantitative to date and there is currently no overall percent coverage estimates compiled.

These plants that should be surveyed by park staff, MRM personal, and trained citizen conservation corps members include:



Hydrilla (*Hydrilla verticillata*)  
<http://www.eddmaps.org/Species/>

them can be difficult. *Ligustrum sinense* can tolerate a wide range of conditions. Plants form dense thickets, invading fields, fencerows, roadsides, forest understories, and riparian sites. They can shade out and exclude native understory species, perhaps even reducing tree recruitment. Native to Europe and Asia, *Ligustrum sinense* was introduced in the United States in 1852 as an ornamental plant. It is commonly used as an ornamental shrub and for hedgerows

### Hydrilla

*Hydrilla verticillata* forms dense mats at the surface of the water. The dense mats can restrict native vegetation, irrigation practices, recreation, hydroelectric production, and water flow. It can invade most slow-moving or still water systems. This plant is believed to be native to Asia or Africa, although it is widely spread across the globe. It was first introduced into North America as an aquarium plant in the 1950s.

### Privet

Several privet species occur, and distinguishing among



Chinese Privet (*Ligustrum sinense*)  
<http://www.eddmaps.org/Species/>



Japanese stiltgrass (*Microstegium vimineum*)  
<http://www.eddmaps.org/Species/>

### Nepalese Browntop

Most commonly an invader of forested floodplains, *Microstegium vimineum* is also found in ditches, forest edges, fields, and trails. It is very shade tolerant and can completely displace native vegetation. It is native to Asia and was accidentally introduced into North America sometime around 1920. It has previously been used as packing material for porcelain, possibly explaining its accidental introduction.

### Princess Tree

*Paulownia tomentosa* is an aggressive tree that invades disturbed natural areas including forests, roadsides, and stream banks. It is native to China and was first introduced into the United States as an ornamental in 1840. Preferred habitat includes open, disturbed areas such as roadsides, right-of-ways, forest edges, and old fields.



Princess Tree *Paulownia tomentosa*  
<http://www.eddmaps.org/Species/>



Kudzu (*Pueraria montana*)  
<http://www.eddmaps.org/Species/>

### Kudzu

*Pueraria montana* var. *lobata* often grows over, shades out and kills all other vegetation, including trees. It is native to Asia and was first introduced into the United States in 1876 at the Philadelphia Centennial Exposition. It was widely planted throughout the eastern United States in an attempt to control erosion.

## **Survey and Detection Recommendations**

The following directives are recommended for the ability to accomplish the goals listed in this document.

- Recommendation I- Create dedicated positions towards natural resource management within the department. These positions will be utilized as part of the Invasive Species Task Force Team
- Recommendation II- Include standardized survey protocols for invasive species in GCPR Park Properties by utilizing the template provided under the EDDMAPS System®
- Recommendation III- Train GCPR Park staff employees in survey and detection methods at yearly training day function
- Recommendation IV- Initiate park system-wide monitoring programs utilizing geospatial technologies and field observations for early detection and removal of invasive species on an annual basis
- Recommendation V- Develop a quality assurance program for survey data through training regimes and integrate survey data into the EDDMAPS® system
- Recommendation VI- Enlist volunteers for survey and detection of invasive species. Establish this corps of volunteers under the GCPR Conservation Corps Volunteer Program
- Recommendation VII- Establish partnerships with local college GIS programs to establish an increased geospatial team for the use of technologies in detection and project follow-up
- Recommendation VIII- Continue to evaluate GCPR IPSMP on a yearly basis against statewide management programs to continue continuity of goals, protocols, management techniques and remediation plans

## **CHAPTER 3 - CONTROLLING INVASIVES and RESTORING HABITAT**

### **Purpose of Controlling Invasive Plant Species**

GCPR has both a legal and ethical obligation towards the control of invasive plant species on its lands (Schuder, 2015). The inability to control and reduce the impacts of invasive plant species on these lands could allow for widespread repercussions in the realms of biodiversity, recreation, economic growth, public health and safety, historic preservation, eco-tourism, and wildlife management (PDCNR, 2015).

Current and future GCPR management decisions on invasive species management are likely to be one of the most important factors by which future generations will judge our resource stewardship. The ability to protect these resources will foster greater support for other future funding initiatives towards parks resource management (Patterson, 2015)

The invasion of certain species creates a significant increase in maintenance costs for the Department and other land managers. Invasive aquatic plants must be chemically treated or mechanically removed to sustain open waterways for boating. Chemical, mechanical, and biological control treatments are frequently required to control invasive species in GCPR park land management operations. (Horne, 2015).

Managing invasive species for GCPR is not optional, although the timing and method of approach may vary by site, the need to address these issues is now. Natural resources must be managed in order to maintain recreational, conservation settings, protect public health, functional ecosystems, and the survival of species of special concern (PDCNR, 2015).

GCPR should proactively maintain and improve the level of ecological integrity inherited from previous historic land holders or invasive species may permanently alter ecosystems, transform our historic landscapes and entirely eliminate multiple native species (PDCNR, 2015).

### **Planning to Control Invasive Plant Species**

In an effort to maximize funding capabilities with staffing and current available peripheral resources, prioritizing areas and species before starting control efforts is important for selecting the most appropriate methods for the target species within a park site. Steps involved in developing a simple, brief site plan include:

#### **Step I: Establish Management Goals and Objectives for the Site**

This should include determining the “Stewardship Value” of a land management area. A “Stewardship Value” is based on an area’s uniqueness and degree of disturbance. Areas that harbor rare or threatened flora or fauna, a rare or threatened plant community or an unusually pristine plant community would be high priorities. Area utilized for heavy active recreation would be considered low priorities due to the existing land use and disturbance. The value of this land is therefore high for recreational value, but lowered for its ability to

harbor species of conservation concern. Typically these high recreational use areas include sports fields, picnic areas, and intensive passive recreational use.

**Step 2: Determine which species or populations, if any, block or have potential to block attainment of the management goals and objectives**

This determination should account for both the potential impact of the species in the site it is found and the extent the species has invaded that site. The more drastically an invasive species could change the current plant community or visitor use of the site, the more severe the impact. A low impact invasive species could co-exist on the site without changing the plant communities or use. Evaluating the extent to which a species occupies a site is necessary to prevent the establishment of high impact invasive species, eliminate small, rapidly expanding infestations and prevent further spread of established species.

**Step 3: Determine which methods are available to control the invasive plant species**

This accounts for the resistance from an infestation to control techniques currently available to GCPR. In any attempt to transition from an extensive infestation to a sustainable desired plant community, the outcomes preferred may not be achievable with the resources available. It is equally possible that certain species are just so prevalent in Georgia that eradication is impossible (for example privet) (Invasive Species Management-Georgia DNR, 2015).

Remediation of a site and its designation for control of an invasive plant species should be driven by the following categories:

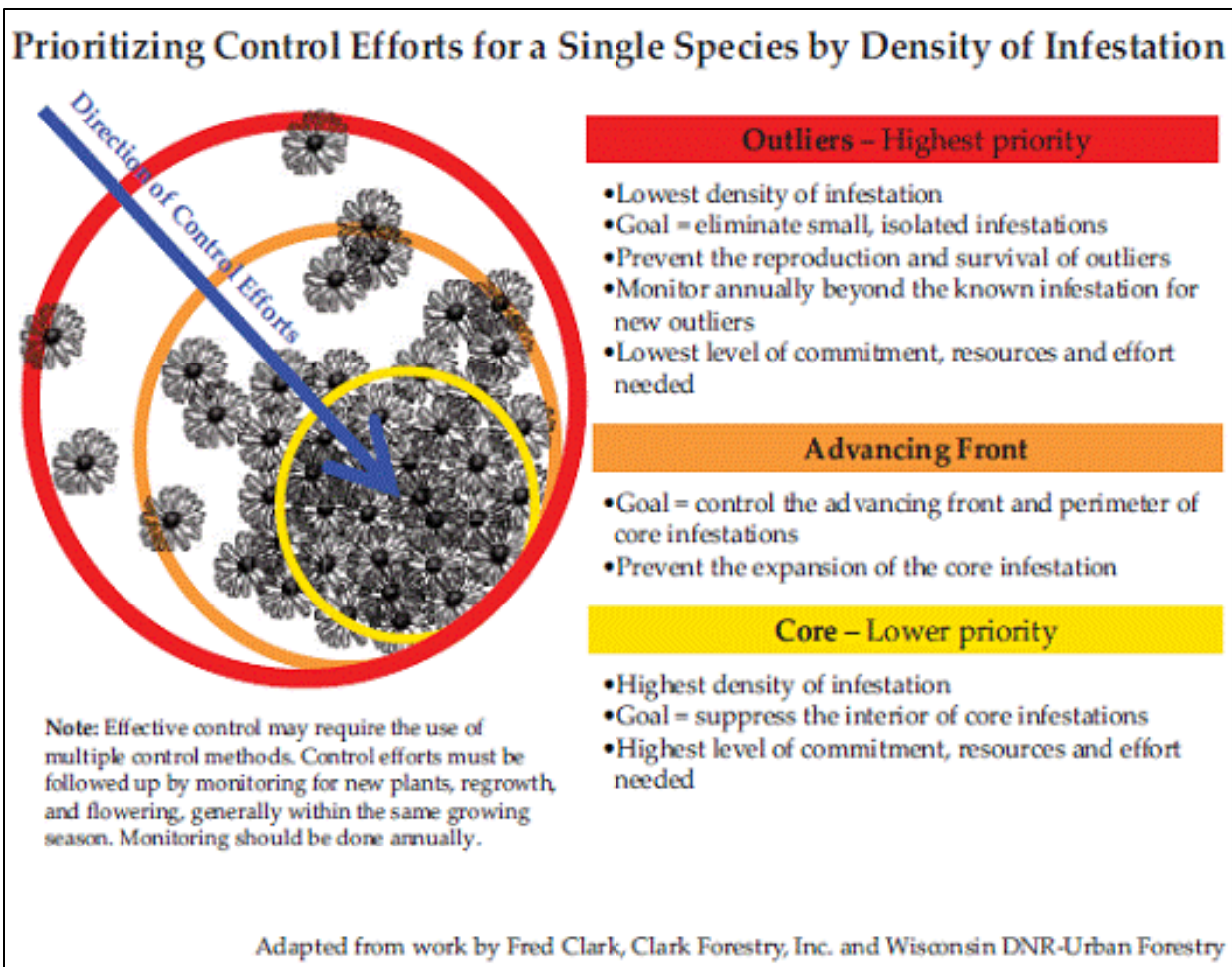
- A) The invasive species can be selectively removed at the site, leaving a relatively intact native plant community.
- B) The invasive species can be selectively removed at the site, and desirable native vegetation will reclaim the site by keeping the invasive species suppressed.
- C) The invasive species can be selectively removed at the site, but the area will require planting or seeding of desirable species after suppression of the invasive species.

**Step 4: Develop a site management plan designed to move conditions toward management goals as they pertained to the sites recreation designation**

**Step 5: Monitor the impacts of management actions in terms of their effectiveness in moving conditions toward these goals and objectives**

**Step 6: Reevaluate, modify, and start the process again on an annual cycle (PDCNR, 2015)**





One method to utilize in certain instances can be seen in the image above.

In this system, the species targeted with the highest priority are those that are found on the front edges of the highest impact zones. This method can be highly effective when resources towards the management of the site is limited. This method requires long-term management of a site, but affords the department the ability to focus its resources on high priority areas. It is recommended that this particular method of management best be utilized in recreation set-asides only.

### Control Methods on GCPR Lands

A variety of methods can be used to control invasive species on GCPR parklands. The prevention of an introduction of invasive species is less costly over time than trying to manage those (Pimentel et al. 2005). This approach requires a concerted effort to either prevent the initial introduction of the species or the ability to recognize and contend with populations as soon as they appear. Control methods should depend on the species being controlled and the characteristics of the site being treated (Invasive Species Management-Georgia DNR, 2015).

The department's priority target species must be identified in individual park sites, conservation easements and rec-set-asides.

Control methods utilized within each sites invasive plant management plan should consider the potential consequences against the benefits towards successful suppression. These controls could include biological control, synthetic pesticide application, and mechanical control. In each case, the management strategy deployed should consider the particular site for its sensitivity to a particular methodology.

#### Biological Control

Typically biological control uses an organism that is a natural enemy of the pest in its home range. In GCPR lands this would be the deployment of farm goats or other indiscriminate ungulates. Given the legal parameters of utilizing released biological specimens such as insects on targeted plant species and the regulations and permitting required, it would be in the best interest of GCPR to refrain from utilizing this methodology. If biological methods are determined to be the best operational standard for a particular site, additional permitting, funding, and acquisition of source materials would be necessitated.



Goats eating invasive plants on a shoreline  
Photo courtesy of  
<http://www.timesunion.com>

#### Mechanical Control

Mechanical methods deployed by GCPR can be one of two methods. Method one is the utilization of hand tools for the manual elimination of targeted invasive plant species. The second method is through the use of machinery. This method requires the use of mowers, forestry mulchers and mechanized hand tools. Mechanical control of invasive species can be effective when terrain permits and the loss of other vegetation on the site is not a concern. Through mechanical control method, biomass can be reduced which will allow for a more judicious pesticide application to eliminate re-sprouting. Volunteers can assist with hand removal, although this requires time, correct plant identification and removal, without unnecessary site disturbance (Kohler, 2001).



Bobcat® Forestry Cutter  
[www.bobcat.com](http://www.bobcat.com)

#### Chemical Control

Through the use of pesticides, GCPR can realize effective control of invasive species under many different environmental conditions, but the application methods may be challenging and expensive. Staff training and certification is a must and following federal, state and local regulations regarding their use in sensitive areas must be adhered to. Additionally it is common to see herbicide use raise concerns about effects on non-target species, water

quality, and residual chemicals in the environment and associated health hazards (PDCNR, 2015)( Invasive Plant Management: Control Methods, 2015).

### **Control of Invasive Plant Species on Private Lands Adjacent to Parks**

It will be critical for GCPR to remain vigilant also to not only control invasive plant species on park lands, but monitor the possible encroachment of invasive plant species from adjacent private lands. Efforts to offer assistance to these landowners in control should be considered along with intensive public education regarding the need to control these species. Yearly annual assessment along with controlled management of property lines should be utilized. Providing distinctive land cleared buffers along these public/private landowner corridors will eliminate chance growth and provide clear defined land ownership lines to both parties (Siemans, 2001).

Cleared land borders between  
public/private lands  
<http://www.olsonfencingllc.com/>



### **Restoration of GCPR Lands**

An invasive plant species ability to establish themselves within new areas can be greatly reduced when a large land disturbance such as park land development activities occur. GCPR should attempt to establish these park development practices with the thought of targeting all potential invasive plant species areas within the disturbance zone to be eradicated. This will reduce the possibility of new infestations in the future within these same areas.

Land disturbance practices and for that matter invasive plant species removal projects on any scale provides the backdrop for a restoration project to take place. However those same land changes can make restoration more difficult because some of our native species may no longer be able to live under the new land conditions (Introduction to Invasive Species - GISTF, 2015).

Creating a restoration plan that takes into consideration those potential changes before a disturbance occurs is ideal and provides the opportunity to reduce the potential for invasive species establishment. Restoration plans should include a determination of which native species may thrive in, or at a minimum tolerate, future climate conditions and avoid those species that may not be suited for the area if the climate should change (Introduction to Invasive Species - GISTF, 2015).

Restoring areas affected by even minor soil disturbance may unintentionally provide ideal conditions for invasive seed germination enhanced by overuse of fertilizer, lime, and cover crops containing uncertified seed. Uncertified seed mixtures may contain undesirable species that quickly establish and dominate the site. The selection of native plant species for all restoration activities is imperative (PDCNR, 2015).



Reclaiming sites not impacted by direct soil disturbance (fires, insect, and disease outbreaks) also requires a restoration plan. These changes in light intensity touching the forest floor provide ample opportunities for invasive plant establishment if these areas go without an annual evaluation. Given the actions of the GCPR active park areas, it would be unlikely to maintain practices that include minimizing soil disturbance, reducing fertilizer and lime use and water consumptive use. However, these areas are normally void of large scale intrusions of invasive species due to the desire to establish more manicured landscapes over those found in the conservation park properties of the department's holdings (Patterson, 2015).

In any attempt to establish a restoration project within a given park site, it will be prudent to ascertain that the selection of native plant species to be used are suitable for the soils and light intensity for that site. Equally important is that any restored sites must be monitored frequently, and any invasive species populations that appear be managed immediately after initial detection, for most effective control.

## **Recommendations for Restoration of Disturbed Lands**

The following recommendations are set forth to provide guidelines for the restoration of GCPR park lands after land disturbance practices have occurred. These recommendations are meant to act as a template for restoration projects within the parks system, but can be adopted for countywide for agency use.

- Integrate the use of the Society for Ecological Restoration's restoration guidelines, as applicable within park restoration sites (see Appendix C). Although these guidelines are intended for large comprehensive restoration projects, they make be scaled down to be suitable for parkland use.
- Develop and implement restoration plans for disturbed areas that advocate practices to reduce potential invasive species establishment.
- Explore and develop short- and long-term budgetary funding for invasive species control both on parks and recreation set-aside lands.
- Explore tools, opportunities, and partnerships to expand opportunities for citizen involvement through voluntary events.
- Establish a section within the GCPR staff hierarchy that will coordinate control efforts, facilitate communications and develop all phases of the invasive plant species remediation plan.
- Establish plans for invasive species control to be included in park land development and renovation projects.
- Establish additional staff and resources to implement these recommendations.

The following recommendations were adopted from the Pennsylvania Department of Conservation and Natural Resources ISMP and the Georgia DNR Invasive Management Task Force recommendations (PDCNR, 2015)(Invasive Species Management-Georgia DNR, 2015).

## **CHAPTER 4 – PREVENTION OF A REOCCURANCE**

### **Purpose of Prevention**

The most effective, economical, and ecologically sound approach to managing invasive plants is to prevent them from invading in the first place (Pimentel, 2005). While natural resource managers often concentrate on fighting well-established infestations, at which point management is expensive and eradication is unlikely. Yet controlling established invasive plant species is costly and difficult, and complete eradication is extremely difficult (Introduction to Invasive Species - GISTF, 2015). Prevention can avoid the potentially permanent species losses that may result from a pest invasion. Infestations must be managed to limit the spread of invasive plants, but weed management that controls existing infestations while focusing on prevention and early detection of new invasions can be far more cost-effective (Pimentel, 2005).

According to reports by several federal and state agencies, invasive plant prevention depends on the following

- Limiting the introduction of invasive plant seeds
- Early detection and eradication of small patches of invasive plants
- Minimizing the disturbance of desirable plants along trails, roads, and waterways
- Maintaining desired plant communities through good management
- Monitoring high-risk areas such as transportation corridors and bare ground
- Revegetating disturbed sites with desired plants
- Evaluating the effectiveness of prevention efforts and adapting plans for the following year.

(Introduction to Invasive Species - GISTF 2015, PDCNR 2015, Invasive Species Management-Georgia DNR 2015).

### **Preventing Introduction and Spread on GCPR Lands**

The ability to prevent the establishment of invasive plant species on GCPR lands is possible and the specific invasive species management techniques used by GCPR may serve as models for the implementation on other agency and private lands within Gwinnett County. To that end GCPR field staff must become well versed in the identification of the invasive plant species found within the county.

In instances along properties adjacent to county parks where heavy infestations on private lands are known to occur, GCPR staff should monitor property borders and work with private landowners to educate and assist in the control of these invasive plant to ensure that the invasive plants do not spread into county held park lands.

Vector sources for the intrusion of invasive plant species can include areas such as natural pathways. These pathways provide avenues for the introduction and dispersal of pests through

wind, water or animal transmission. Additionally, areas disturbed by both natural and human causes (roadsides, trails, log landings, energy transmission rights-of-way and construction zones) are particularly susceptible to invasion and should be targeted for prevention and monitoring efforts (interpretive signs, educational programming, equipment washing), as these are likely sources of seed or propagules for the translocation of invasive species.

Given the abundance of natural surface trails and the user groups, both equestrian and mountain bike community, the ability to transport invasive seed stock into the GCPR park lands is present (Lynne, 2003). Hikers, bikers, and horses disturb soils and transport seeds of invasive plants into recreational areas, providing optimum conditions for invasive plants to become established. Along the waterways of the parks system the potential for unclean watercrafts and angling equipment which can transfer aquatic organisms between water bodies is present (Invasive Species Management-Georgia DNR, 2015).

Special attention is needed on newly acquired park properties with varied land use histories. These sites typically were utilized as agricultural lands that over time became fallow and allowed to succumb to pressures from invasive plant species introduction. Many of these sites that undergo these land use change or disturbance, such as agricultural fields that are allowed to naturally revert to other vegetation communities, are especially susceptible to invasive species establishment (Schuder, 2015).

### **To Prevent the Introduction and Spread of Invasive Plant Species in the GCPR Parks System**

In an effort to prevent the introduction or spread of invasive species within a GCPR park site, the following recommendations made by the Society for Ecological Restoration should be followed:

- Minimize disturbance of natural areas where invasive plant species do not occur when possible, and restore damage caused by unavoidable disturbances with suitable plant species.
  - Projects planned in relatively intact habitat areas are susceptible to invasive species introductions through disturbance.
  - Project review must include consideration for the likelihood of facilitating invasions. Placing unnecessary trails and roadways in large, un-fragmented tracts should be avoided in order to maintain ecosystem integrity. Construction rights-of-way should be minimized to further reduce susceptibility.
  - Cover, mulch, seed or plant the disturbed area to prevent establishment of unwanted plants. Establishing native seed cover is preferred, when appropriate.
  - Monitor the site and control unwanted plants that may appear.
- Reclaim/restore recently altered or newly acquired areas.
  - Heavily disturbed areas require immediate reclamation of these sites by planting non-invasive plant species.

- Establishing native species in restoration activities will help create a desired vegetation cover.
- Newly acquired land should be scouted for invasive species and, if necessary, quickly treated.
- Make sure any equipment was not used previously in heavily infested areas and is clean of mud, seeds, and other propagules.
- Discourage the use of known or potentially invasive plant species
  - Plants that are native to a site should be selected for use in landscaping, whenever feasible. (An exception may be in landscaping an existing structure to represent historical accuracy. In that case, species intended for use should be carefully screened to ensure that known invasive species are not introduced).
- Use reputable nurseries and seed sources
  - Ask vendors if they are aware of restricted species. Check for “hitch-hikers” in nursery stock, packing materials, and associated locations. Use only certified seed, where feasible.
- Protect native plant communities
  - A key to controlling invasive plants is to protect native plant communities. Protecting native plant communities from disturbance, wildlife browse, and other threats will strengthen their ability to resist invasion.
- Develop invasive species expertise
  - In an effort to prevent further invasions, GCPR staff must be trained in invasive species identification, inventory and control methods. Training must be annually accomplished as new species are discovered and control techniques change.
- Inspect annually for invasive species
  - Effective scouting on GCPR Park land sites and adjacent private lands will allow staff to identify invasive species before populations increase exponentially and reach levels difficult to control.
- Carefully consider location when disposing of mechanically removed invasive plant species
  - Reproductive parts of many invasive plants can withstand seasonal cycles, including drying and freezing, therefore composting invasive species residue is not recommended.
  - Seeds and roots/rhizomes, especially, should be destroyed or carefully collected and discarded with trash to prevent reestablishment.
  - If chemical treatments are considered post removal, applicable laws and regulations should be followed before the site treatment takes place.

- Review contracts for opportunities to strengthen prevention measures with contractors whose work involves land disturbance in a Gwinnett County Park Site
  - Added language to existing contracts with contractors may include equipment-cleaning requirements, avoiding the use of equipment that has been recently used in infested areas, liability for new invasive species introductions, disturbed habitat remediation guidelines and other appropriate preventive activities.
- Consider invasive species when making trail decisions and designations
  - Consider the need for preventing invasive species introduction when establishing trails and roadways, as there is potential for horses, motorized transportation devices and even hikers to act as pathways of invasion.
  - Avoid the construction of trails through known infestations (SER, 2015).

### **Preventing Introduction of Species Not Yet in Gwinnett County**

The goal of preventing new infestations into the county and specifically the parks system should be a priority for the departmental staff assigned to the GCPR IPSMP. Staff should maintain up-to date training with state and federal agencies dedicated to invasive species management and stay alert of trends or growth of new invasive plant species encroaching upon Gwinnett County. Annual training of staff and surveying of current scientific publications for these trends will greatly reduce oversight of a particular species arrival to the GCPR park lands.

### **Recommendations**

The following recommendations for the prevention of new and increased spread of invasive species into the Gwinnett Park system are as follows:

- Require contractors to share the responsibility of preventing the introduction of invasive plant species into construction zones where they disturb land within a GCPR park site
- Include invasive species prevention methods for private landowners in publications concerning countywide natural resource management. GCPR staff should take the lead on addressing these issues and act as the point consul for private citizens and other county agencies to contact
- Continue to incorporate invasive species prevention sections and method into all GCPR park site resource management plans
- Increase the visibility of the GCPR IPSMP within all GCPR media outlets. Flyers, web presence, and social media avenues should be considered.

## **CHAPTER 5 - EDUCATION, TRAINING, and PUBLIC OUTREACH**

### **Introduction**

The greatest instrument in the prevention and control of invasive species is education. To improve GCPR staff's ability to identify invasive plant species, it is vital that an adequate educational training program be established. This program can serve both staff, volunteers, and the general public. Currently there is in place, a public waterfowl management program where the public is advised to refrain from feeding waterfowl in the parks. This same template can be utilized to improve the public's awareness towards resource management strategies and current projects associated with the removal and remediation of invasive plant species. Education that promotes understanding of invasive species issues is a vital basis for partnerships between landowners, managers, and the public. Shared knowledge includes recognition of problem species, habitat and land management practices that foster species establishment, and the ecological changes caused by populations (PDCNR, 2011).

### **Identification of Educational Resources**

A survey of existing programs on both a state and federal level have created a wealth of background information, sources and data for the utilization of training of staff in invasive plant species management. The sources are found in Appendix D.

### **Development of the Invasive Species Education and Training Programs**

Materials that support sustainable resource management techniques and the identification of invasive plant species should be developed into a comprehensive source for staff to utilize as a stand-alone training program. This task should be a priority for the designated GCPR Section office. These tools should be developed for internal staff training and the volunteer program. It should be a consideration that the current Park Coordinators, and their respective Senior Foreman, be trained on the use of these materials to then provide GCPR district level parks staff training. These materials should include the following aspects related to the success of other state agency training programs.

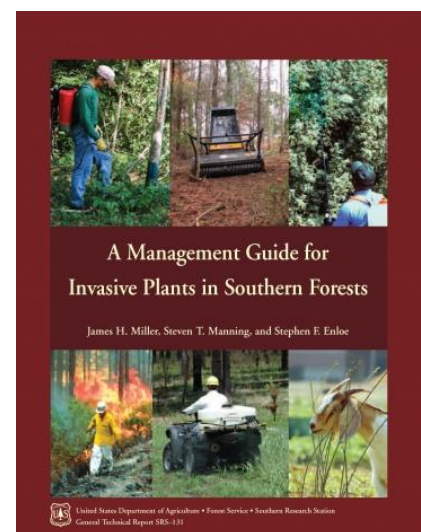
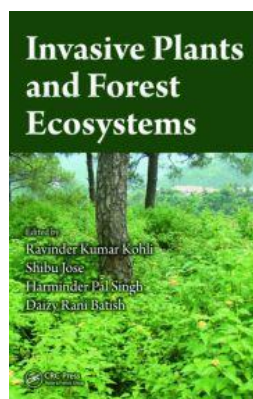
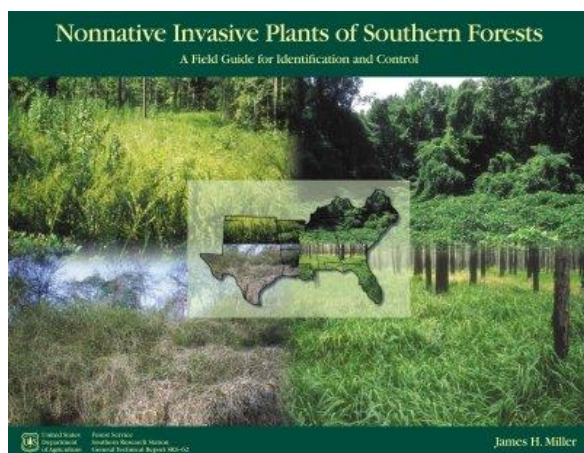
- Target audiences
  - Each education or training program will have its own unique audience(s). The training materials need to provide the user the ability to convey the goals, tasks, and recommendations of the GCPR IPSMP
  - Potential target groups include: GCPR staff, other Gwinnett County agency staff, partners/cooperators, volunteers, and the general public
- Tools and methods should be appropriate for each audience
  - Training tools must be sustainable, interesting and applicable to the audience being targeted
  - Existing tools should be used where available

- Trainers and educators should identify additional tools that need to be refined or developed.
- Volunteer training
  - Training programs specifically directed at volunteers should be included, as they can effectively assist in all phases of identifying and controlling invasive species.
- Evaluating the program
  - An evaluative component must be included in the overall program, in order to examine the success of training and education, thereby providing appropriate guidance for changing needs and directions in the future.

## Implementation of the Invasive Species Education and Training Programs

Initially the training offered in this program should target the staff most associated with the identification and implementation of prescribed invasive plant management plans. This training should begin by the Spring 2016 quarter to allow for staff knowledge and comfort level grow through the year until actual “boots–on-the-ground” projects commence in the Fall of 2016

## Recommended publications to be utilized in staff training programs



These images represent several publications that are recommended for GCPR to integrate into its staff training and resource library. Each of these publications provide clear management tools and strategies for the management of invasive plant species that are found within the county parks system..



## **CHAPTER 6 - OVERALL RECOMMENDATIONS**

### **Introduction**

Managing natural resources is not an easy task. Additionally, management of invasive plant species can be a stand-alone job for most departments. The GCPR staff inventory at this time does not allow for a dedicated staff to combat invasive plant species nor its subsequent identification and site management plan development. Given the shortages of staff it will be crucial to utilize the available resources given and target those areas that are at greatest threat and potential loss (Patterson, 2015).

The environment is constantly changing, resources such as funding and staff time are stretched over many priorities, and technologies come and go. It would be wise to invest in the necessary tools and manpower needed to thwart invasive species in our parks. The stewardship of GCPR park lands has become a higher priority than seen in the departments twenty-eight year history. This scrutiny can be utilized to support changing the current departmental business model and develop a further reaching structured system (Horne, 2015).

### **Existing and New Problems**

Since its inception 28 years ago, GCPR has been able to address the invasive plant species problem on a case by case basis. This was often driven by the need to curtail intrusions into adjacent private lands or high recreational value usage areas. Due to a lack of capital and support for action, many of the GCPR park lands have been allowed to increase their invasive plant species density over the last twenty-eight years. The need to control and begin to restore these areas to their natural native state is more important today due to public change in expectations for land stewardship. As the GCPR parks system continues to grow and funds made available through the SPLOST program, it is prudent to show an investment in the sustainable management and control of our natural areas (Horne, 2015).

Over the next decade, Gwinnett County will see its population grow to over one-million residents (Gwinnetteeconomicdevelopment.com 2015). This increase in population will drive expectations higher for the lands that are protected as parks. It is prudent to establish a true program for the management on invasive plant species now (Schuder, 2015). This need will require an expanded scope of operations and business plan for the parks sections of GCPR. This change in operational efficiency should lead to better management of GCPR park land resources and provide improved efficiency in addressing ecological issues including invasive plant management.

### **Opportunities and Partnerships**

Currently there is a business model proposed that allows for the creation of a stand-alone unit that will address the natural resource issues of the GCPR park lands. It is recommended

that this plan be approved and initiated to establish the ability to integrate the GCPR IPSMP into full effect.

Additionally, given the need for public support and compete buy-in on the IPSMP it is advisable that a strong volunteer driven program be enacted to provide augmented workforce for the management of invasive plants. It is suggested that GCPR staff develop partnerships with local plant groups such as the Georgia Native Plant Society ® or the local universities for student assistance in documenting, removal and remediation of invasive plant species sites.

## **Staff Structure**

As mentioned before, it is a recommendation that GCPR establish a stand-alone natural resource management section whose purpose will be to establish sustainable management plans for the natural resources found within the GCPR system. This would include the adoption and integration of this plan.

To that end the following expectations for this staff structure should include:

- Define standards for the operational maintenance levels of conservation stewardship areas within all GCPR parks. These standards will address mowing rates, integrated management strategies, and action plan for the removal of all invasive species found within these zones
- Develop a Comprehensive Management Strategy based upon these standards that outline management levels for each park site. This strategy will include a timeline that addresses each sites needs versus actualities
- Identify needs, shape short and long term projects, and associated budgeted requests and staffing needs that will increase the overall success of the GCPR IPSMP
- Define a system wide expectation for our parklands as related to natural areas and their sustainability and the control on invasive plant species
- Develop a comprehensive in-house training program for staff on the management of invasive plant species in GCPR park holdings
- Develop a training program for the Gwinnett County Correction Department officers to allow them to assist in the removal of invasive plant species in the parks and recreation set-aside areas
- Assess the feasibility of out-sourced contract labor solutions to certain invasive plant species mitigation plans

- Identify any available outside funding sources to assist in funding deficiencies. This should include the use of volunteers and federal programs such as Americorps® and SCA® programs
- Establish a volunteer driven citizen scientist program for the purpose of data collection and project driven workdays that benefit the parks system natural resource areas
- Develop a comprehensive list of requisite plant materials to be utilized as park standards in the development and re-master planning of park lands. The focus of this initiative is to define ecologically sustainable plant species that are native and allow for the mission of the section to be met while reducing the potential introduction of new non-native and potentially invasive plant species

## **Funding**

It is critical that GCPR staff investigate alternative sources for funding. The current prognosis and evaluation of invasive plant species in the parks is not positive and the funding needs for remediation exceeds that which is currently budgeted. It is a recommendation that a line item within the operational budget of the recommended Natural Resource Management Unit include funds specific to Invasive Species Management and restoration in the GCPR parks. Additional outside funding sources should be evaluated and applications for applicable grants should be made

## **Measuring Progress**

Measuring progress and for that matter more, success, will be an ongoing evolution of perceptions. The initial shift in support for land stewardship has provided the ability for GCPR to invest resources towards the sustainable actions against invasive plants species in the GCPR park lands.

Program monitoring and evaluation is vitally important. It will enable GCPR to determine the effectiveness of its overall objectives and actions identified in this management plan at stopping the introduction and spread of invasive species. Well-timed oversight of program objectives will permit corrections as additional information becomes available. Overall program progress will involve two components: evaluation and dissemination of information.

Evaluation: Progress toward meeting program objectives is one element of the evaluation to be undertaken by GCPR staff. More importantly, GCPR staff must place special weight on the procurement and task of funding necessary to meet tasks identified in each specific site plan. Evaluation should also include participation from outside partners who participated in the particular site plan.

Dissemination: GCPR staff will prepare quarterly reports highlighting progress toward meeting the management site and overall plans, goals and objectives. These reports will be made available to the county decision makers via the Internal Balanced Scorecard System.

## CHAPTER 7 - CASE STUDY- SETTLES BRIDGE PARK

In an effort to verify the in-house capabilities for staff to assess invasive plant species existence within a Gwinnett County Park utilizing geospatial technologies, the Settles Bridge Park case study was initiated.

### Hypothesis:

Can high-spatial resolution multispectral aerial photographic imagery compiled by the Gwinnett County GIS Department be utilized with existing software platforms in the GCPR technology inventory to detect invasive species and its density within a county park to at least an 80% accuracy rate?

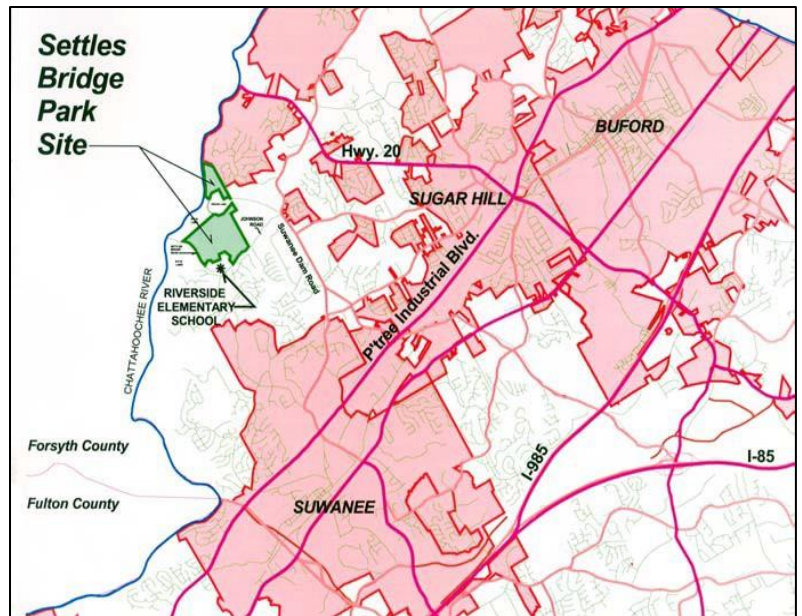
### Background

GCPR staff have been using the ESRI® software platform ArcGIS for the last ten years in departmental development and mapping of assets. Additionally, in 2015, Gwinnett County purchased the remote sensing software platform, IMAGINE®, produced by the software designer Hexagon Geospatial. This move was accomplished with the goal of developing the ability to utilize the photographic imagery compiled each year by the county for investigating land cover classifications and coverages within the parks. In addition, it was thought this same software would enable staff to discern potential archaeological stone mound sites that are not easily accessible by department staff.

Chinese Privet (*Privet Ligustrum sp.*) was chosen for this project because it is a noxious and highly aggressive invasive shrub that outcompetes potential native flora for habitat. Chinese Privet is also believed to be the dominant invasive plant species found in any Gwinnett County Park. Because Chinese Privet is extremely hardy, shade tolerant and grows fast in low wetland areas and river systems it is found throughout the state of Georgia. In some areas, it actually accounts for more than 50% of the total vegetation cover. A 2005 published report stated that invasive plants pose a serious threat to threatened and endangered plant communities with an estimated annual economic loss of over \$137 billion dollars per year in damages and control methods (Pimentel et al. 2005).

Previous studies (Salajanu 2009, Resasco 2007) relied upon the use of LandSat TM and MODIS imagery. There is a shortage of published data where aerial imagery has been utilized to extract invasive species prevalence and to date, none specifically related to the Gwinnett County Parks System.

To test my procedures, I chose a mid-sized park parcel as the test site. This site, known as Settles Bridge Park, lies adjacent to a major water source for drinking water and boundary line for the states of Georgia and Alabama. Settles Bridge Park is a 268-acre park found within the confines of the 12,000+-acre Gwinnett County Parks System. Gwinnett County is a large metropolitan county in the northeast corner of the Greater Metro-Atlanta Georgia Region.



Adjacent to Settles Bridge Park is the Chattahoochee River and subsequent state and federal lands controlled by the National Parks Service (NPS), the Georgia Department of Natural Resources (GADNR), and the Army Corps of Engineers (ACE).

Prior to the parks opening in 2009, Settles Bridge Park was a large land tract that was historically agricultural during the 1800's and up to the early 1940's. The land returned to a fallow state during the last 60 years until its development into a park in late 2008.

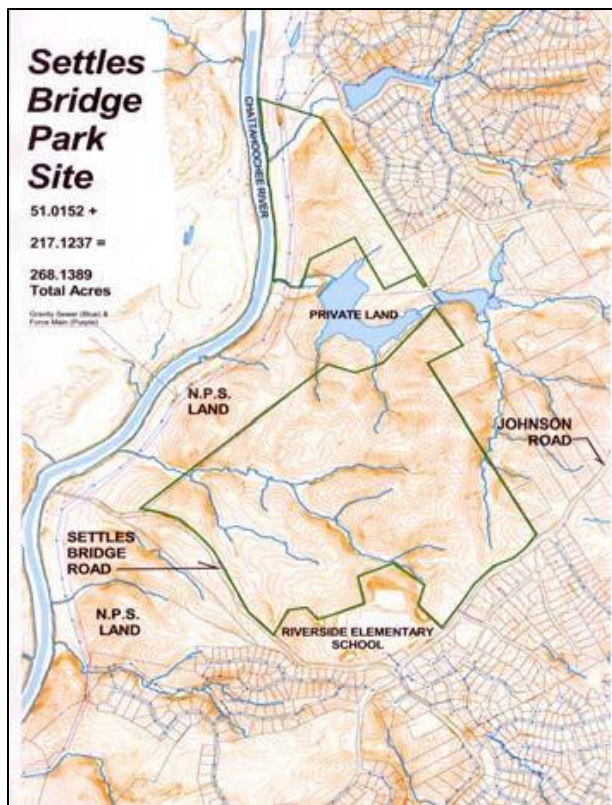
True to most of the agricultural lands of the S. Piedmont region, the park shows the man-made terraces often associated with farming practices of the mid-19th century. This fracturing of native plant communities, the manipulation of the area's hydrology, and the flood prone areas of the park afforded an open invitation to any hardy invasive shrub.

This case study is intended to establish a baseline template that would afford a more streamlined capability for future invasive plant species investigations using geospatial technologies.

## Introduction

Chinese privet (*Privet Ligustrum* sp.) is an invasive species introduced into the United States during the mid-1850 as an ornamental plant. Its small young sprouts provide a food source for deer and other small rodents, but as the plant matures and the stalks become hardened, little wildlife will consume the shrub. Considered to be a minor food source to a variety of migratory birds, the same birds often drop the seeds along flight paths. It is for this reason that many scientists surmise its bountiful spread into sparsely populated areas. Throughout the southeast along wetland margins and river systems, privet plants thrive and force into submission the native ground flora of the area. Today, these plants are still purchased at local nurseries by landowners looking for a fast growing hedge (Miller, 2010).

The total acreage for the Settles Bridge Park Site is 268-acres. The park consist of two parcels, 51 acres and 217 acres, linked by a National Park Service (NPS) land parcel. The 51-acre park parcel is bounded on the north and south sides by NPS land, on the west by the Chattahoochee River, on the east by the Wild Timber subdivision and on the southeast by residential tracts. The southern 217-acre parcel is bounded on the north by private residential property, on the south by Settles Bridge Road, on the west by NPS land, on the east by Johnson Road and on the southeast by the Riverside Elementary School. The NPS lands do not comprise the park acreage that is under control by the Gwinnett County Parks system. At this time, the NPS land is held in a natural state with no current recreational uses. It is considered a parcel within the Chattahoochee National Recreation Area but acts only as a buffer for the river's protection.

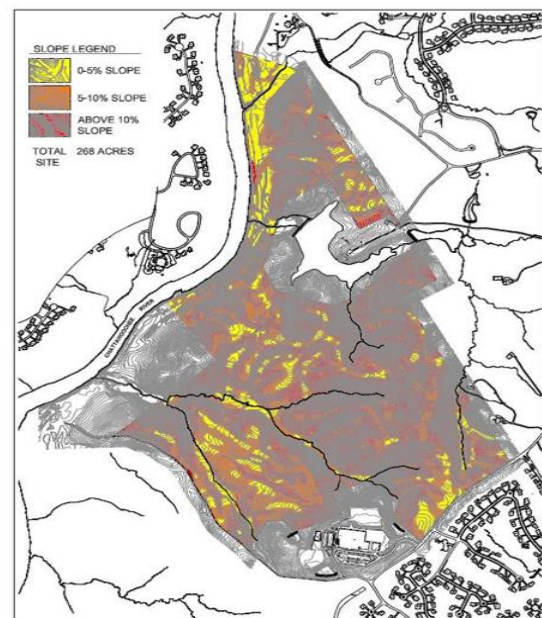


The 217-acre parcel was purchased by Gwinnett County for the purpose of a park and subsequently the additional 51-acre parcel was leased by the county from The Department of Natural Resources (DNR). Portions of the Settles Bridge Park site are currently accessed for passive recreation, primarily hiking, jogging and biking, via old roadbeds and unpaved trails that community members maintain with their own resources.

The 217-acre parcel has been identified to

possess significant natural, scenic, aesthetic and open space features and ecological values worthy of preservation and conservation. In December of 2004 this property was placed under a Conservation Easement for GCPR Park lands. This easement calls for the long-term management of the parks natural, cultural and historical areas. This includes the management for the removal of invasive plant species.

### Ecological Background on the Site



2014 Slope Analysis of  
Settles Bridge Park

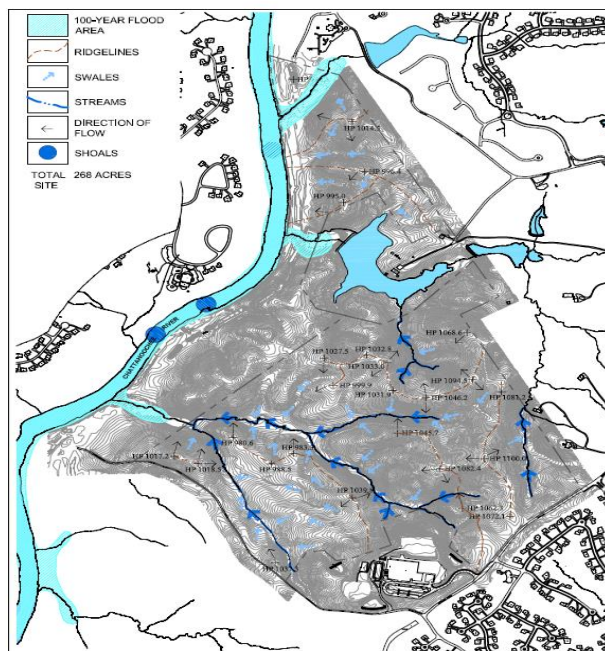


## Slope Analysis

Topographic information for the park site was obtained from the county GIS system and included data at a two-foot contour interval. A majority of the site is fairly steep and is divided by several flowing streams. The property has a net 194-foot grade change with elevations ranging from the highest of 1098 feet to the lowest of 903 feet. A majority of the site is over a 15% grade, with some areas terraced from former agricultural occupation. A few acres of level ground are associated with the flat-topped ridges on the southwestern side of the property.

## Hydrology of Settles Bridge Park

The Upper Chattahoochee River Watershed is part of the larger Apalachicola-Chattahoochee-Flint River Basin. The Chattahoochee River is sourced from the North Georgia Mountains, through Lake Sydney Lanier and many other tributaries north of the park site. The only significant tributary between the site and Buford Dam to the north is Richland Creek. For a more complete identification of tributaries see Gwinnett County Flood Insurance Maps.



2014 Hydrology Analysis of  
Settles Bridge Park

The entire Settles Bridge Park Site is within the Upper Chattahoochee River Watershed. Nearly all storm water drains into the Chattahoochee through a well-defined series of unnamed tributaries and intermittent swales. Some swales remain dry except during rain events while others have some water in them at all times. During rain events the water level of the river can rise dramatically.

## Soil Analysis

Soils at the Settles Bridge Park Site are distributed relative to the topography. Clay loams and sandy clay loams are generally found along the hilltops. Floodplain soils consisting of alluvial sand, silt, and clay are deposited in narrow flats along the Chattahoochee River in the northwest section of the site. Local

alluvial soils along smaller streams in the southern section of the site have been washed down from the uplands.

## Vegetation Analysis



Settles Bridge Park is situated on the upper banks of the Chattahoochee River in the Upper Piedmont of Georgia. The site has a history of farming practices and is now primarily successional forest with concentrations of pine stands, many of which have died from southern pine beetle (*Dendroctonus frontalis*) damage. Mature specimen trees and a greater diversity of native understory shrub layers and ground cover occur in stream corridor ravines that were spared from clearing during agricultural occupation. The following is a breakdown of identified categories of vegetation:

### **Oak-Hickory Forest**

These areas are primarily located on the drier high points and most inland portions of the park parcels (away from the river). Southern red oak, white oak, chestnut oak, hickory, wild cherry, slippery elm, sourwood, and dogwood comprise the hardwood canopy. Some residual dead pine trees occur on the ridges. Understory plants are sparse, consisting of a few lowbush blueberry shrubs and sporadic muscadine grape vines. At the highest points, red maple, beech and sassafras are more dominant. A slightly younger forest also occurs on the low points of these areas, including tulip poplar, beech, red cedar, sourwood and a few living pines. Understory shrubs include sparkleberry and blueberry (Edwards, 2013).



### **Pine Forest**

Aerial photography taken during the winter of 2009 clearly shows concentrations of pine trees. Most of these areas are hilltops that contained greater than sixty percent mature pine trees, which have recently succumbed to pine beetle infestation. Most of the dead trees are still standing, but many have toppled over. The result has allowed more daylight in and has made these areas seem more meadow-like in character. Grasses, blackberry patches, and sumac stands have taken hold. In some places younger pine trees are trying to reestablish, including loblolly and short needle pines. Smaller understory deciduous species such as red maple, scrub oak, hawthorn, sourwood, dogwood, and wild cherry are prevalent on the slopes adjacent to the hilltops. Larger tree species establishing include tulip poplar, and sweetgum. In the wooded areas understory shrubs include blueberry, sparkleberry, and honeysuckle. Ground cover is sparse, consisting of a few ferns and some muscadine grape vines (Edwards, 2013).



### **Bluff Slope Ravine Forest**

Due to steep sided banks and active waterways, these areas were spared from disturbance of agricultural practices, making this vegetation category the most diverse and pristine. Large native azaleas, pawpaw, and a variety



Doll's Eyes Plant  
*Actaea pachypoda*

of ferns, including: cinnamon, lady, royal, and Christmas, are prevalent along the streams banks. Running ground cedar forms a lush carpet and other native ground cover that you would expect to find on a forest floor are also present such as mayapple and



Running Ground Cedar  
*Lycopodium digitatum*

doll's eyes. Several specimen of beech, hickory and cherry trees are also present (Edwards, 2013).

### **Bottomland/Floodplain Forest**

These areas are flat, boggy grasslands adjacent to stream channels. Trees include water oak, tulip poplar, red maple, and willow. Sparkleberry, ferns and running ground cedar are present close to the stream banks (Edwards, 2013).

### **Successional Forest**



These areas contain a high percentage of young pine trees, most of which have also been devastated by pine beetle damage. Many of the dead trees have fallen, knocking over other trees in their paths. Smaller deciduous understory trees are thriving in close proximity to each other, making these areas visually impenetrable. Tree species include sourwood, dogwood, emergent oak, tulip poplar, sweet gum, and several varieties of hawthorn. Highbush and

lowbush blueberries comprise the shrub layer. Running ground cedar and pipsissewa in shaded areas and lichens in more open areas are some of the typical ground covers (Edwards, 2013).

### **Erosion Gully**

The gullies are a result of the former agricultural practices, but remained more protected than the hillsides. Mature beech, sweetgum, northern red oak, dogwood, and pawpaw comprise the canopy layer. High and lowbush blueberry dominate the shrub layer. Concentrations of leucothoe occur along the waterways. Poison ivy and smilax vines are growing on some of the trees. The groundcover layer is more diverse due to the availability of water and includes some species of plants that are not found anywhere else on the site. Pink lady slipper orchids, rattlesnake plantain, pipsissiwa, and ferns make up the predominant species on the ground (Edwards, 2013).



## Invasive Exotics

These plants are concentrated in the sewer easement clearing along the Chattahoochee River, which is also the area of greatest disturbance.

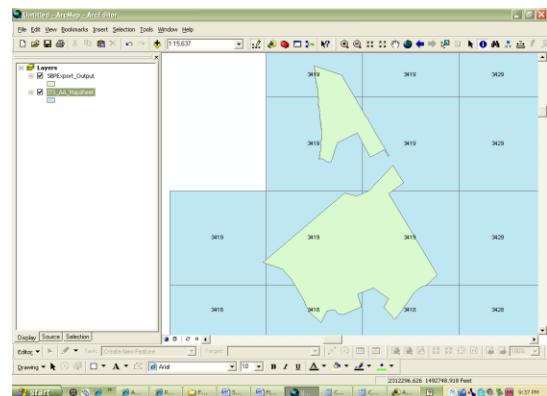
## METHODOLOGY

### DATA ACQUISITION

Data utilized in this project were acquired from the Gwinnett County Government GIS office. The data set was comprised from the 2015 Aerial Imagery Dataset Collection Survey. This survey data included 4-band Hyper-multispectral imagery and was flown at a scale to allow the image to represent the following: 1" = 500' for the areas that would be mapped at a scale of 1" = 100'. The data utilized were collected in the early winter of 2014 (Stevenson, 2015).

### DATA PROCESSING

All data used in this project was first imported into ArcGIS to clip and mosaic the targeted land parcels that were designated as Settles Bridge Park lands. Upon successful clipping of the AOI (Area of Interest), the new data set was then imported into Erdas Imagine 9.3 for unsupervised classification. Unsupervised classification provides the software system the ability to detect and assign land-cover classes to the imagery surveyed. The classification schemes can be broken down into as many or as few classes as the investigator wished to use.



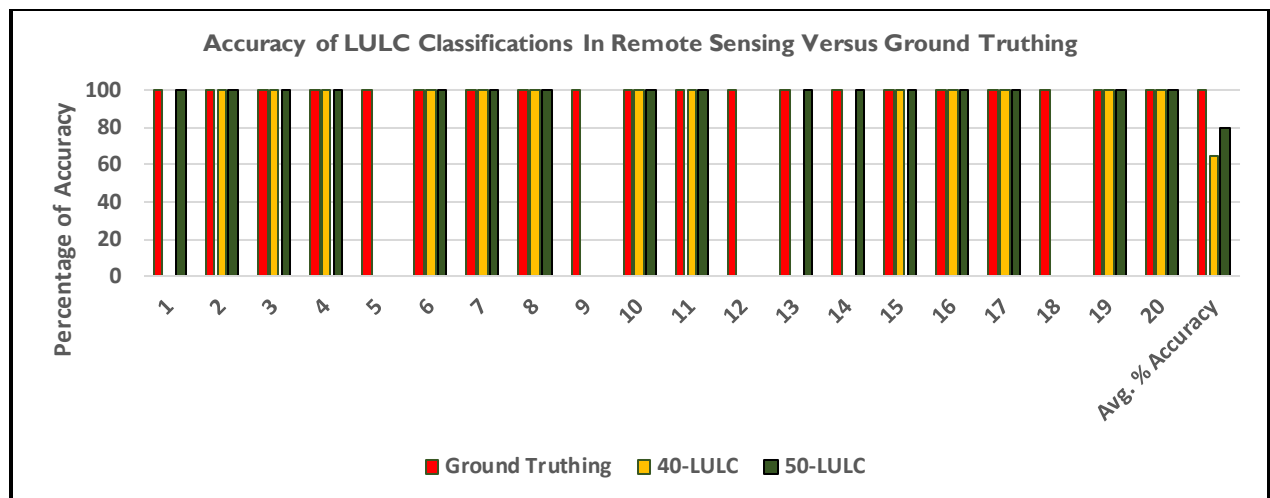
Erdas 9.3 is the current working version GCPR utilizes for its remote sensing needs. The department has recently upgraded the software package in late 2015 and training on the new upgrades of the remote sensing software package have been initiated.

The imagery was imported into Erdas 9.3 for classification. An unsupervised classification scheme set for 40-LULC Land-Use, Land-Cover was utilized for the initial test. This was done to first establish an opening trial to determine the probability of extracting the targeted plant species from the imagery. The preliminary data set provided a composite image of areas that were potential invasive species sites and known sites of native flora. This was confirmed with ground-truthing (Patterson, 2015).

Upon examination of the data and assessing its accuracy via ground-truthing of 20 plotted sites within the park, the accuracy of this attempt fell in at a 65% accuracy rating (Table 1). In this first trial, the plots numbered 1, 5, 9, 12, 13, 14, and 18 failed to show detected Chinese Privet within their borders. Because this trial's results were did not meet the goal of extracting a minimum of 80% accuracy, a second broader trail was initiated. The next step was to

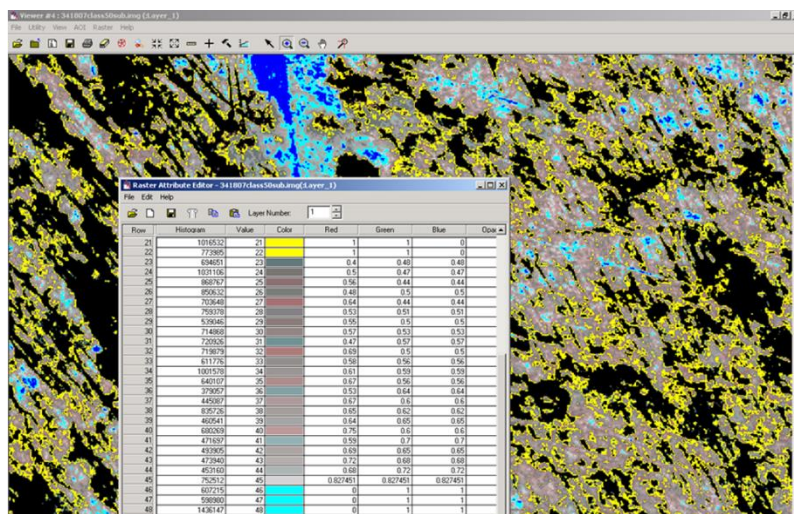


increase the classes utilized to address the low accuracy rating to determine if the percentage could be increased.



(Table I)

Upon a second trial utilizing a classification scheme of 50 LULC unsupervised classes, the accuracy improved to a percentage total of 80%. The second trial provided accurate data readings that matched the ground-truthing with the exception of plots 5, 9, 12, 18. (Table I). After processing the image in the 50 LULC class scheme, adjustments to the “Raster Attribute Editor” were completed to change the colors on several known pixel images (Fig. I); this included water and the previously mentioned ground-truthed privet complex.



**Fig. 1. Digitizing the Privet features of the data set in yellow.**  
**Notice its proximity to bodies of water**

All imported and derived datasets were defined as NAD 1983 State Plane Georgia West FIPS 1002 Feet.

This defined data set was completed at the request of GCPR Management staff who intend to utilize this project as a foundation for future funding request. This standard is the countywide standard used for the sharing of data and maps through intra-agency agreements.

## ANALYSIS

Visual inspection of the initial results did not provide for an adequate percentage level to accurately assess the overall confirmation of the hypothesis. A resulting second iteration utilizing a 50 LULC scheme was done to further enhance the probability for extracting only the targeted species from the data sets. The second iteration of 50-LULC provided the minimum acceptable level of confirmation. The use of 20 geo-referenced check-points in ground-truthing the software generated data enabled an accurate assessment of the unsupervised classification scheme. This was done to verify the results received from the remote sensing calculations.

## RESULTS

Table 2. Showing the actual total acreage of privet detected via the 50LULC unsupervised classification process.

| Classification #        | Pixel Count | Converted Acreage |
|-------------------------|-------------|-------------------|
| 17                      | 664963      | 15.27 acres       |
| 18                      | 822601      | 18.88 acres       |
| 19                      | 792031      | 18.18 acres       |
| 20                      | 896561      | 20.58 acres       |
| 21                      | 1016532     | 23.34 acres       |
| 22                      | 773985      | 17.77 acres       |
| TOTAL ACREAGE IN PRIVET |             | 114.02 acres      |

The resulting data collected from the unsupervised classification of land-cover types found in this land parcel determined that a total of 114.02 acres of privet existed within its borders (Table 2.).

This total was arrived at by multiplying the total number of pixels (x) that were classified as possessing privet by the equation:  $x * (0.00002296368369) = \text{total acres}$ .

Where 0.00002296368369 represents acres per pixel.

## SOURCES OF ERROR

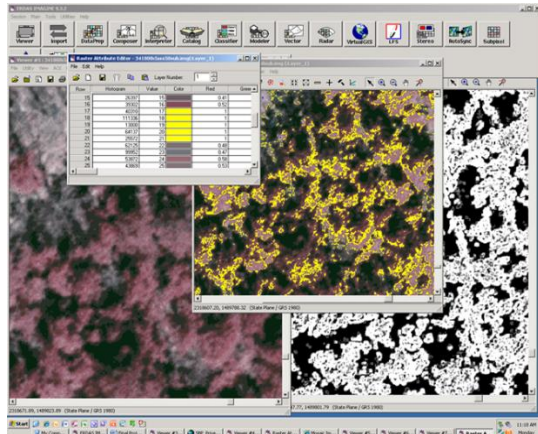
There are several factors that come into play in assessing whether any errors were present in this experiment. First an error could have been generated at the time of collection. It is possible that the instrument used to collect the imagery for Gwinnett County had a discrepancy that had not been calibrated for since its last certification. A review of the specifications put out by the county's GIS department shows that the GIS department requires that the camera(s) used must meet the following conditions "An U.S. Geological Survey (USGS) camera calibration report no more than three (3) years old is required for each camera used to obtain aerial photography"(Gwinnett GIS, 2014).

Additionally, error may have been introduced at further steps in the process, including imagery processing by the contractor who was responsible for post-processing the data set, data import and processing techniques used in this study, and methods of data analysis.

While the data collection by the contractor has to be completed during specified time and weather conditions: 10am-2:30pm EST, or "when the ground is not obscured by snow, haze, fog, or dust; when streams are not within their normal banks; or when the clouds or cloud shadows will appear on more than five percent (5%) of the area in any one photograph" (Gwinnett GIS, 2011). It is possible that a contractor trying to accomplish multiple projects within a deadline could vary from these specific specifications.

Further complicating matters is the large body of water, the Chattahoochee River, that runs North to West-South-West alongside the park boundary. Given that passes from the aircraft used to collect the imagery data flew over this river, these datasets may contain some returns from water thus causing further errors (Jensen, 1987).

## DISCUSSION



**Fig. 2**  
Comparison of classified image against  
the same unclassified IR Image.

The primary intent of this study was to determine if a faster method of analyzing privet stands could be determined via remote sensing technologies and aerial mapping versus the current use of collecting data in the field. Using the approach in this study, the associated data sets provided a rough estimation of the total land cover containing this noxious plant. Cross-referencing the classified data set against the same unclassified data set (Fig. 2.), and ground-truthing the data in the field provided clear evidence that the use of aerial imagery in extracting invasive species is a plausible alternative to labor intensive field collection. This methodology accounted for a time savings of potentially weeks in the field to

collect the same data that was analyzed and classified in a matter of a few days.

It should be understood, that this project developed only a partial indication of invasive plant species coverage in a park setting. It cannot be overlooked that this focused on only one of over 40 invasive plant species known to reside in Gwinnett County and as such, it is possible that the overall density and land cover of invasive plant species in this park is much higher than the indicated results from this case study. Furthermore, there should be the inclusion of budgetary acquisition of field spectrometer equipment to better define the spectral signature of these species. This could be a case study where the use of supervised classification can be utilized and produce much more accurate data sets.

## CONCLUSIONS

While this project makes use of basic rudimentary classification schemes in the treating of data, it did provide a gateway for further work and refining of these techniques. The data created would undoubtedly become more accurate if the classification scheme was increased to 60 or even 70 classes. At some point however, the increase in classification will begin to drop pixels that are themselves a targeted area.

Additionally the concept of using a supervised classification procedure would further the ability to raise the accuracy of the data sets from the 80% seen in this project. While it is obvious that  $20\% \pm$  is a large number and would have amounted to an error of up to 22

acres, the technique used in this project provide a starting point for agencies who need to evaluate the extent of invasive plant coverage on their lands. As the need to decrease cost in land management activities rises, the functionality of alternative and expedient methods must be explored and developed further.

## **Recommendations**

Given the early success of this method of utilizing technology against field work for initial estimations of a parks coverage on an invasive plant species, it is the recommendation of this report to follow through on the following:

- Develop a cost estimate for the removal of the identified privet assemblages within this park setting. This must take into consideration the aforementioned practices for the particular site and its suitability for the use of chemical and/or mechanical removal
- Given the large amount of material to be removed (+100 acres), it is recommended that GCPR identify a range of suitable riparian plant species that are native to this area to re-vegetate the large tracts of lands that will become void of plant life past the removal of the situated invasive plant species. This is critical given the proximity to a large river and potential for erosion due to land disturbance
- Identify a reasonable timeline for the recommended action plan to allow for weather, staffing, and equipment availability

## **Recommendations for Privet Removal for Settles Bridge Park**

### **Management strategies:**

- Remove all prior Chinese Privet (*Ligustrum sinense* sp.) plantings, and control sprouts and seedlings.
- Bag and dispose of all fruit from Chinese Privet (*Ligustrum sinense* sp.) removed into a dumpster or burn.
- Minimize disturbance within miles of where Chinese Privet (*Ligustrum sinense* sp.) plants occur, and anticipate wider occupation if plants are present before disturbance
- Treat new Chinese Privet (*Ligustrum sinense* sp.) plants when young to prevent seed formation. Only cut and bulldoze with a forestry mulcher when fruit are not present on live plants.
- Manually pull new seedlings and tree wrench saplings when soil is moist, ensuring removal of all roots.
- When prescribed burns are applied, only burn Chinese Privet (*Ligustrum sinense* sp.) when live to top-kill small to medium-sized specimens.
- If biological control is to be utilized, Chinese Privet (*Ligustrum sinense* sp.) is readily eaten by goats and sheep.

## Recommended control procedures

- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant: a glyphosate herbicide as a 3-percent solution (12 ounces per 3-gallon mix) when safety to surrounding vegetation is desired, or elsewhere, Arsenal AC\* as a 1-percent solution (4 ounces per 3-gallon mix).
- Backpack mist blowers can broadcast glyphosate as a 3-percent solution (12 ounces per 3-gallon mix) or Escort XP\* at 1 ounce per acre (0.2 dry ounces per 3-gallon mix and 10 gallons per acre) during winter for safety to dormant hardwoods. Summer applications of glyphosate may not be as effective as other times and require a higher percent solution. The best time period for Arsenal AC\* and Escort XP\* is summer to fall.
- For stems too tall for foliar sprays and when safety to surrounding vegetation is desired, apply a basal spray of Garlon 4 as a 20-percent solution (5 pints per 3-gallon mix) in a labeled basal oil product, vegetable oil or mineral oil with a penetrant, or fuel oil or diesel fuel (where permitted); or undiluted Pathfinder II. Elsewhere, apply Stalker\* as a 6- to 9-percent solution (1.5 to 2 pints per 3-gallon mix) in a labeled basal oil product, vegetable oil or mineral oil with a penetrant, or fuel oil or diesel fuel (where permitted) to young bark as a basal spray making certain to treat all stems in a clump; or cut and immediately treat the stump tops with Arsenal AC\* as a 5-percent solution (20 ounces per 3-gallon mix) or Velpar L\* as a 10-percent solution in water (1 quart per 3-gallon mix) with a surfactant. When safety to surrounding vegetation is desired, immediately treat stump tops and sides with Garlon 3A or with a glyphosate herbicide as a 20-percent solution (5 pints per 3-gallon mix) in water with a surfactant. ORTHO Brush-B-Gon, Enforcer Brush Killer, and Vine-X are effective undiluted for treating cut-stumps and available in retail garden stores (safe to surrounding plants).
- For large stems, make stem injections using Arsenal AC\* when safety to surrounding vegetation is desired, Garlon 3A or a glyphosate herbicide using dilutions and cut-spacings specified on the herbicide label (anytime except March and April). An EZ-Ject tree injector can help to reach the lower part of the main stem; otherwise, every branching trunk must be hack-and-squirt injected (Miller, et al. 2010)

\* *Nontarget plants may be killed or injured by root uptake.*



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## **Appendix A**

### **List of Abbreviations**

|            |  |
|------------|--|
| APHIS-PPQ  | Animal and Plant Health Inspection Service – Plant Protection and Quarantine |
| CAES       | University of Georgia College of Agricultural and Environmental Sciences     |
| CDCP       | Centers for Disease Control and Prevention                                   |
| CISEH      | Center for Invasive Species and Environmental Health                         |
| CRD        | Georgia Department of Natural Resources – Coastal Resources Division         |
| CSW        | Community Service Worker-GCPR  |
| DPH        | Georgia Department of Human Resources – Division of Public Health            |
| EDD Maps   | Early Detection and Distribution Maps  |
| EPD        | Georgia Department of Natural Resources – Environmental Protection Division  |
| GCPR       | Gwinnett County Parks and Recreation   |
| GCPR IPSMP | Gwinnett County Parks and Recreation Invasive Plant Species Management Plan  |
| GDA        | Georgia Department of Agriculture  |
| GDA-PPD    | Georgia Department of Agriculture-Plant Protection Division                  |
| GA DNR     | Georgia Department of Natural Resources                                      |
| GDOT       | Georgia Department of Transportation   |
| GFA        | Georgia Forestry Association   |
| GFC        | Georgia Forestry Commission  |
| GGIA       | Georgia Green Industry Association   |
| GIS        | Geographic Information System  |
| GISTF      | Georgia Invasive Species Task Force  |
| GNPS       | Georgia Native Society   |
| GWF        | Georgia Wildlife Federation  |
| ISSG       | Invasive Species Specialists Group   |
| MAREX      | University of Georgia Marine Extension Service                               |
| NISC       | National Invasive Species Council  |
| NOAA       | National Oceanic and Atmospheric Administration                              |

|        |   |
|--------|---|
| NPS    | National Park Service   |
| NRCS   | Natural Resources Conservation Service  |
| OTA    | Office of Technology Assessment   |
| PRHSD  | Georgia Department of Natural Resources – Parks, Recreation and Historic Sites Division |
| SARP   | Southeast Aquatic Resources Partnership   |
| SEAFWA | Southeastern Association of Fish and Wildlife Agencies                                  |
| SPLOST | Special Purpose Local Options Sales Tax   |
| TNC    | The Nature Conservancy  |
| UGA    | University of Georgia   |
| UNG    | University of North Georgia   |
| USCG   | United States Coast Guard   |
| USDA   | United States Department of Agriculture   |
| USFS   | United States Forest Service  |
| USFWS  | United States Fish and Wildlife Service   |
| USGS   | United States Geological Survey   |
| WRD    | Georgia Department of Natural Resources – Wildlife Resources Division                   |

## Appendix B

### GA Laws Pertaining To Invasive Plant Species

**Georgia Environmental Policy Act (O.C.G.A. §12-16-1):** The Georgia Environmental Policy Act (GEPA) requires that all state agencies and activities prepare an Environmental Impact Report (EIR) as part of the decision-making process for all activities that may have an impact on the environment. Alternatives to the proposed project or activity must be considered as part of the report. The Act states that any proposed governmental action which may “significantly adversely affect the quality of the environment” including the state’s air, water, land, plants, and animals, requires an Environmental Effects Report. As outlined in the Act, an EIR describes the environmental impact and any adverse environmental effects of the action, alternative actions, mitigation, and measures proposed to avoid or minimize impact, and other effects of the action. The government agency responsible for the action authors the report and provides it to the director of the Environmental Protection Division (EPD) in the GA DNR. A notice that the report has been prepared is to be published in the legal organ of each county in which the action is to take place, which may lead to a public hearing regarding the action. The Act requires the EPD director to issue guidelines to assist government agencies in the preparation of environmental effects reports.

**Georgia Seed Law (O.C.G.A. §2-11-1):** This Act makes it illegal to sell, offer for sale, expose for sale, or transport for sale any agricultural, vegetable, flower, tree, or shrub seed within Georgia that consists of or contains prohibited noxious weed seeds, or restricted noxious weed seeds per pound in excess of the prescribed number or the number declared on the seed container label or associated with the seed (O.C.G.A. §2-11-23(a)(4)(5)). Prohibited noxious weed seeds are weed seeds that are highly destructive and difficult to control by good cultural practices and the use of herbicides (O.C.G.A. §2-11-21(17)(A)). Restricted noxious weed seeds are those weed seeds that are very objectionable in fields, lawns, and gardens but can be controlled by good cultural practice (O.C.G.A. §2-11-21(17)(B)).

It is unlawful to sell, offer for sale, or expose for sale, any agricultural or vegetable seed for planting purposes in Georgia if the noxious weed seeds per pound of pure seed is in excess of the following limitations (GA Rules 40-12-4-.01):

**Tropical Soda Apple Rules (GA Rules 40-4-22):** The Georgia Department of Agriculture has declared tropical soda apple to be a public nuisance to the agricultural and horticultural interests of the State (GA Rules 40-4-22-.01). Any location in Georgia containing tropical soda apple plants, fruits, or seeds is subject to regulation (GA Rules 40-4-22-.03). All plants with fruit must be removed and buried or incinerated (GA Rules 40-4-22-.04(1)(a)). All plants without fruit must either be: mowed once a month to a stubble height of no more than three inches, or treated with an herbicide at the highest recommended label rate and at the shortest treatment intervals (GA Rules 40-4-22-.04(b)). Livestock may not be moved from a regulated property unless held in a tropical soda apple free holding area for at least seven days after their last exposure to the plant’s fruit (GA Rules 40-4-22-.04(4)). Manure may not be moved from a regulated property unless it is composted for at least six months and the property owner monitors the compost pile

monthly (GA Rules 40-4-22-.04(5)). Soil may not be moved from a regulated property unless it is steam sterilized (GA Rules 40-4-22-.04(6)), and hay may not be removed from a regulated property at all (GA Rules 40-4-22-.04(8)).

**Wildflower Preservation Act of 1973** (O.C.G.A. §12-6-170): This legislation provides for the designation of officially protected plants and authorizes rules for the collection, transport, sale, and listing of these plants. Under this Act, the GA DNR has the authority to list as protected any plants meeting the requirements approved by the Board of Natural Resources. Protected plants must not be collected on public lands unless authorized by the GA DNR. The sale of protected plants is prohibited unless grown on private land and sold by the landowner or with the permission of the landowner. Protected plants must not be transported unless permission has been granted by the landowner as evidenced by the presence of an affixed tag from the department and a written document detailing such permission. This Act also authorizes the enforcement of these policies through prosecution of any violations of the Act.



## **Appendix C**

### **Society for Ecological Restoration's Invasive Species Restoration**

*Society for Ecological Restoration International (SER): Guidelines for Developing and Managing Ecological Restoration Projects, 2nd Edition*

By Andre Clewell [1], John Rieger [2] and John Munro [3] Last Revised: December 2005

### **CONCEPTUAL PLANNING**

Conceptual planning identifies the restoration project site, specifies restoration goals, and provides relevant background information. Conceptual planning is conducted when restoration appears to be a feasible option but before a decision has been made to exercise that option. The written conceptual plan captures the essence and character of the potential restoration.

- Identify the project site location and its boundaries.
- Identify ownership.
- Identify the need for ecological restoration.
- Identify the kind of ecosystem to be restored.
- Identify restoration goals.
- Identify physical site conditions in need of repair.
- Identify stressors in need of regulation or re-initiation.
- Identify and list the kinds of biotic interventions that are needed.
- Identify landscape restrictions.
- Identify project-funding sources.
- Identify labor sources and equipment needs.
- Identify biotic resource needs and sources.
- Identify the need for securing permits required by government agencies.
- Identify permit specifications, deed restrictions, and other legal constraints.
- Identify project duration.
- Identify strategies for long-term protection and management.

### **PRELIMINARY TASKS**

Preliminary tasks are those upon which project planning depends. These tasks form the foundation for well- conceived restoration designs. Preliminary tasks are fulfilled after conceptual planning results in the decision to proceed with the restoration project.

- Appoint a restoration practitioner who is in charge of all technical aspects of restoration.
- Appoint the restoration team.
- Prepare a budget to accommodate the completion of preliminary tasks.
- Document existing project site conditions and describe the biota.
- Document the project site history that led to the need for restoration.
- Conduct pre-project monitoring as needed.
- Establish the reference ecosystem or “reference.”
- Gather pertinent autecological information for key species.

- Conduct investigations as needed to assess the effectiveness of restoration methods and strategies.
- Decide whether ecosystem goals are realistic or whether they need modification.
- Prepare a list of objectives designed to achieve restoration goals.
- Secure permits required by regulatory and zoning authorities.
- Establish liaison with interested public agencies.
- Establish liaison with the public and publicize the project.
- Arrange for public participation in project planning and implementation to fulfill cultural goals.
- Install roads and other infrastructure needed to facilitate project implementation.
- Engage and train personnel who will supervise and conduct project implementation tasks.

## **IMPLEMENTATION PLANNING**

Implementation plans describe the tasks that will be performed to realize project objectives. These tasks collectively comprise the project design. The care and thoroughness with which implementation planning is conducted will be reflected by how aptly implementation tasks are executed.

- Describe the interventions that will be implemented to attain each objective.
- Acknowledge the role of passive restoration.
- Prepare performance standards and monitoring protocols to measure the attainment of each objective.
- Schedule the tasks needed to fulfill each objective.
- Obtain equipment, supplies, and biotic resources.
- Prepare a budget for implementation tasks, maintenance events, and contingencies.

## **IMPLEMENTATION TASKS**

Project implementation fulfills implementation plans. If planning was thorough and supervision is adequate, implementation can proceed smoothly and within budget.

- Mark boundaries and work areas.
- Install permanent monitoring fixtures.
- Implement restoration tasks.

## **POST-IMPLEMENTATION TASKS**

The attainment of objectives may depend as much on follow-up activities as it does to the care given to the execution of implementation tasks. The importance of post-implementation work cannot be overemphasized.

- Protect the project site against vandals and herbivory.
- Perform post-implementation maintenance.
- Reconnoiter the project site regularly to identify needs for mid-course corrections.

- Perform monitoring as required to document the attainment of performance standards.
- Implement adaptive management procedures as needed.

## **EVALUATION AND PUBLICITY**

Assessments are conducted to ensure the satisfaction of project objectives and goals. The project is publicized for public and technical consumption.

- Assess monitoring data to determine whether performance standards are met and project objectives are attained.
- Conduct an ecological evaluation of the newly completed project.
- Determine whether cultural project goals were met.
- Publicize and prepare written accounts of the completed restoration project.

## **Appendix D**

### **Resource List of Invasive Species Training Materials and Resources**

Georgia Native Plant Society, <http://gnps.org/>

Center for Invasive Plant Management, <http://www.weedcenter.org/>

Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW)  
<http://ficmnew.fws.gov>

Forest Service Remote Sensing and Geospatial Technologies with Invasive Species -  
<http://www.fs.fed.us/eng/rsac/invasivespecies/>

Hazard Analysis and Critical Control Point (HACCP) Planning, [www.haccp-nrm.org/](http://www.haccp-nrm.org/)

Invasive Plants Field Guide and Reference: An Ecological Perspective of Plant Invaders of Forests and Woodlands- <http://www.fs.fed.us/ne/morgantown/4557/cindy/InvasiveSpeciesFieldGuide.pdf>

The National Biological Information Infrastructure, USGS <http://invasivespecies.nbii.gov>

The Nature Conservancy, Invasive Species Initiative, <http://tncweeds.ucdavis.edu/>

Natural Areas Association [www.naturalarea.org](http://www.naturalarea.org)

Nonnative Invasive plants of Southern Forests: A field Guide for identification and control,  
[http://www.srs.fs.usda.gov/pubs/gtr/gtr\\_srs062/](http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs062/)

Plant Conservation Alliance, Alien Plant Working Group, [www.nps.gov/plants/alien](http://www.nps.gov/plants/alien)

The Source for Information and Images of Invasive & Exotic Species-[www.invasive.org/](http://www.invasive.org/)

USDA APHIS, <http://www.aphis.usda.gov/oa/invasive/invasive.html>

U.S. Fish and Wildlife Service, National Wildlife Refuge System. Invasive Species Program-  
<http://invasives.fws.gov/> and <http://contaminants.fws.gov>

U.S. Geological Survey <http://biology.usgs.gov/invasive>

US Geological Survey: Non-indigenous Aquatic Species (NAS) This serves as a central repository for spatially referenced, bio-geographic data - <http://nas.er.usgs.gov>

US Environmental Protection Agency: Office of Oceans, Wetlands, and Watersheds  
[www.epa.gov/owow/invasive\\_species/links.html](http://www.epa.gov/owow/invasive_species/links.html)