



City of Austin Invasive Species Management Plan



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Executive Summary

Austin, Texas is well known for its parks, natural areas and beautiful scenery. From the rich Blackland prairie in the east to the rolling hills of the Edward's plateau in the west, Austin's diverse geography is home to thousands of plant and animal species. Unfortunately, not all of these organisms are beneficial; Austin's natural resources and economy are being degraded by invasive species. These unwanted invaders are often unintentionally introduced through the everyday activities of citizens. Sometimes they are deliberately introduced as ornamental or agricultural species. However they arrive, once invasive species are established, they have the potential to change Austin forever. These undesirable species have significant negative impacts including but not limited to:

- Reduction of native biodiversity;
- Interference with ecosystem functions like fire, nutrient flow and flooding;
- Reduction of the value of streams, lakes and reservoirs, for recreation, wildlife and public water supply;
- Reduction of the recreational value of natural areas, parks and other areas.

In response to these impacts, citizens volunteer their time and the City and other organizations spend hundreds of thousands of dollars to prevent, eradicate and control invasive species each year. At the same time, the city is lacking essential components among its departments to develop a comprehensive response to the threat posed by invasive species. Clearly, a coordinated and process-oriented approach to invasive species management is needed in Austin.

To address these concerns, the Austin City Council passed a resolution on April 8, 2010 directing the City Manager to develop an Invasive Species Management Plan to guide efforts to minimize the harmful environmental and economic impacts of invasive plant species on city-managed properties. Subsequent to that resolution an agreement with the Lady Bird Johnson Wildflower Center led to creation of a working group with representatives from several City departments, Austin Parks Foundation, Keep Austin Beautiful, Texas Parks and Wildlife and the Austin Invasive Species Coalition. Over the course of ten consensus-based meetings, the Working Group developed strategic five-year goals based on a central framework of prevention, early detection-rapid response and long-term control at prioritized sites. The plan also includes recommendations for implementation including staffing, funding sources, centralized mapping and monitoring, and education and outreach. To improve the plan's success, the working group has developed a preliminary list of priority invasive species and an invasive species resource manual with identification fact sheets and best management practices to control priority species.

This plan outlines goals and actions critical to protecting Austin's natural resources. Although it may not be possible to prevent every invasive species from entering the city or to eradicate all those already present, this plan will aid Austin in preserving the unique features that make Austin...Austin.



Chapter 1 Introduction

1.1 What is an invasive species?

The National Invasive Species Council, established by Executive Order 13112 in 1999, defines invasive species as species that are:

“...nonnative (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.”

A “non-native” (or “alien”, “exotic” or “nonindigenous”) species is one that has been introduced by human action, intentionally or accidentally, into an ecosystem in which it did not previously occur. Introductions occur along a variety of pathways, or vectors, such as through commercial trade of a species or by accidental means. Invasive species can be plants, animals and other organisms (e.g., fungi).

An invasive species grows, reproduces and spreads rapidly, establishes over large areas and persists. In general, species that become invasive succeed due to favorable environmental conditions and an ability to grow and reproduce rapidly where resource availability is high (Daehler 2003). As invasive species spread and dominate ecosystems, they decrease biodiversity by displacing native plants and animals (Texas Invasives.org).

Thus, the definition of invasive used here has two components: 1) nonnative status and 2) the ability or potential to cause harm. It is important to note that not all nonnative species are considered invasive because many do not, or are not likely to, cause economic or environmental harm or harm to human health (Williamson 1996). Many non-native species support human livelihoods or a preferred quality of life. Examples include most crops and a number of exotic ornamentals (IASC 2006). Conversely, in some situations native species can cause economic or environmental harm or harm to human health. Examples include the economic impact of mesquite (*Prosopis glandulosa var. glandulosa*) spreading through a Texas rangeland, Ashe juniper (*Juniperus ashei*) altering the hydrology of the Hill Country or a painful rash caused by poison ivy (*Toxicodendron radicans*) growing along Lady Bird Lake. While these species can cause problems, and do require management, they are not considered invasive because they are native to these particular ecosystems.

1.2 Why do we care? Why are invasive species a problem?

Invasive plants can create challenges for natural resource managers. Assessments of endangered species found that 49% were negatively impacted by invasive species through competition or predation, ranking second only to direct habitat destruction. Invasive species were found to affect higher proportions of imperiled plants than animals (Wilcove et al. 1998). The following sections will further explore the economic and ecological impacts of invasive species.

1.2.1 Case Study, Mayfield Nature Preserve

This case study highlights an inventory of current invasive woody vegetation, volunteer contributions and future control costs of the Mayfield Park Preserve. The study’s intent was to help land managers and volunteers make informed management decisions pertaining to the natural area.

The overall distribution of woody plants at Mayfield was 77% native species and 19% invasive. Notable invasive plants mentioned in the study are sacred bamboo (*Nandina domestica*) and Chinese pistache (*Pistacia chinensis*).



Since 2008, over 3,800 volunteer hours and \$25,000 have gone towards the elimination of sacred bamboo and other invasive species at Mayfield. Grants include \$12,500 from Austin Parks Foundation, \$9,830 from the Urban Forestry Program, and several mini-grants from Austin Parks Foundation (<http://mayfieldpark.org/>). Although this work was reported to have largely removed these problem species, current data estimates that there are a total of 5,536 sacred bamboo and 4,734 Chinese pistache individuals still growing at the site.

Overall, the remaining 14,480 invasive plants projected to remain in the preserve will require a total of 300 to over 416 hours to remove. Assigning a labor monetary value of \$21.36/hour, the expense of labor alone totals approximately \$6,408 to \$8,885. These figures do not include the expense required to process or dispose of the debris, nor the expense of labor and materials required to treat the stumps with herbicide.

In order to realistically reduce and control the remaining populations of invasives at Mayfield, large amounts of additional time and labor will be required (Murray 2011).

1.2.2 Economic Impact

The annual economic costs of invasive species to the US economy, from damages to managed and natural ecosystems to costs of control, are estimated at \$120 billion (Pimentel et al. 2005). In 2000, the US federal government spending on invasive species management was \$556 million (Lovell and Stone 2005). The California Invasive Plant Council estimated annual expenditures of \$82 million on control, monitoring and outreach. In Nevada, it is estimated that invasive plants, such as Malta-star thistle (*Centaurea melitensis*), reduce wildlife-related recreation between \$6 million and \$12 million annually (Eiswerth et al. 2005). More specifically, in 1993, the Office of Technology Assessment of the US Congress stated that the State of Florida spends approximately \$14.5 million annually on hydrilla (*Hydrilla verticillata*) control. Regionally, the Lower Colorado River Authority spends \$100,000 annually on invasive aquatic species control, excluding losses due to power shutdowns, obstructions to hydrogeneration units, turbine damage and maintenance water drawdowns (TWCA 2010). In 2010, a roadside installation and maintenance study in Williamson County (0.64 miles) found potential savings of \$3,820-69,750 over 20 years when altering right-of-way maintenance and using strict native seed mixes versus standard Texas Department of Transportation Urban and Rural Specs containing non-native species including Bermudagrass (*Cynodon dactylon*) (TBG and LBJWC 2010). Locally, the Austin Energy Decker Creek Power Station continues to experience impairment in reservoir uses (cooling water withdrawal, shoreline use and boat-ramp access) from hydrilla and algae, jeopardizing facility operations and annual direct expenditures of \$318,539 by anglers (Austin Energy 2010).

1.2.3 Environmental Impact

Soil Health

Invasive plants frequently initiate a multitude of impacts on community soil chemistry and ecosystem function. All plants modify the soil environment through plant-soil feedback interactions, but some negative consequences such as introduced pathogens and allelopathy (one plant produces chemicals that inhibit the growth of other species) can be exacerbated by invasive species (Inderjit 2010). Root exudates and plant litter affect soil structure, modify soil nutrient pools and alter nutrient cycling of plant communities, including hydrology of the soil (Weidenhamer 2010). One example is Johnson grass (*Sorghum halepense*), which is capable of growing in nutrient-poor soils (i.e. native prairie soils) interacts with N-fixing bacteria which alter soil chemistry elevating nitrogen and other soil nutrients. While some native prairie species can fix nitrogen, most are adapted to nutrient-poor soils and do not perform well in soils with elevated nitrogen. At the same time, these conditions enhance Johnson grass growth. Thus,

the ability of Johnson grass to alter soil biogeochemistry enhances its ability to invade and create near-monocultures in soils that once supported diverse plant communities (Rout 2008).

Tree Cover

Invasive, non-indigenous tree and shrub species represent a significant problem to natural vegetative communities within the state and local area. It is widely agreed that invasive species degrade natural communities by dominating forest canopies, altering soil chemistry and hydrologic characteristics, displacing native species, interfering with successional patterns and degrading biodiversity (Pase 2005, Swearingen et al. 2002). More specifically, in conditions where invasive plants dominate canopy cover, the native woodland community can be adversely affected. For example, Texas red oak (*Quercus buckleyi*) becomes light-limited when ambient light transmission is less than 40% (White, pers. comm.). The endangered golden-cheeked warbler (*Dendroica chrysoparia*) requires diverse juniper-oak woodland (BCPP 2007, Magness 2006, Kroll 1980). Below 40% light transmission, red oak regeneration declines and, over time, golden-cheeked warbler habitat is degraded (BCPP 2007, Kroll 1980).

Hydrology and Water Yield

A significant amount of city property is managed to maintain and improve the quantity and quality of the city's water supply. Woodlands, both native and non-native, typically exhibit greater rainfall interception, higher net evapotranspiration, lower water tables and less stormwater runoff than grasslands. Vegetation types differ in rates of evapotranspiration, rainfall interception, surface flow and ability to access water (McCaw 2009).

Invasive plant species, with evapotranspiration rates higher relative to native flora, can alter hydrological regimes and lower water tables (Gordon 1998). In New Zealand, invasive woody afforestation reduced annual water yield by 30-80% during low flow conditions (Davie 2005). In South Africa, exotic woody plants reduced surface flows approximately 7% (Le Maitre et al. 2001). In South Texas, evidence suggests that giant reed (*Arundo donax*) exhibits greater water use in riparian areas than other riparian reeds, resulting from increased transpiration rates and higher leaf area (Moore 2011). Such hydrological changes will likely influence frequency, duration and scale of ecosystem-level disturbances (e.g., floods, fire, etc.) (Gordon 2010).

Regionally, significant reductions in water yield can occur when grasslands are converted to woodlands. Hydrologic modeling of plant communities indicates an inverse relationship between canopy cover and water yield (ie. higher groundwater recharge and streamflow at lower canopy cover). Reduction of woody canopy cover, via grassland restoration and management, is necessary to restore and maintain higher water yields (Conrad et al. 2006, Wu et al. 2001).

Biodiversity and Avian Communities

In 1996, the U.S. Fish & Wildlife Service tasked the City of Austin and Travis County to create a preserve system to conserve and improve habitat for eight endangered species, including two avian species. Following the completion of the Balcones Canyonlands Conservation Plan, the City of Austin acquired new properties and dedicated several existing parks and preserves for the formation of the Balcones Canyonlands Preserve which protects and restores endangered species habitat through land acquisition and ecological management (BCP, <http://www.ci.austin.tx.us/water/wildland/bcphistory.htm>). In Austin, the presence of invasive plant species influences avian fauna, contributing to the decline in avian diversity near the wildland-urban interface. At uninvaded sites, avian abundance (number of individuals) and species richness were positively correlated to the volume of native plants and the structure those plants provide (Kalmbach 2006).



Invasive plants reduce the abundance and diversity of native wildlife by displacing native plant communities. Substantial displacement of native plants occurs near urban and suburban development, leading to habitat fragmentation and unsuitable habitat for native animals. Resulting habitat changes lead to the decline and potential loss of wildlife species dependent on native flora for survival. Diverse plant communities provide a variety of food sources, vertical structure and cover, nesting sites and thermal cover, creating more niches for a broader animal community to reside (Kalmbach 2006). Conversely, invasive plant monocultures provide quality habitat for fewer species overall and may favor non-native wildlife.

Invasive plants have a significant influence on avian populations with native bird diversity and density often falling as the cover of invasive plants increases. A South Texas study found that overall bird abundance was 32% greater on native-grass sites than on exotic-grass sites (Flanders et al. 2006). In Arizona, bird diversity and richness (number of species) are lower in degraded native plant communities than in non-degraded plant communities (Germaine et al. 1998).

1.3 How did invasive plants get here?

When a species is transported to and establishes in a new ecosystem, it is considered “introduced”. Although wind and water are common mechanisms of dispersal, humans introduce invasive species to new ecosystems, intentionally or unintentionally. Invasive species may first be introduced as garden ornamentals, range forage plants for livestock, plants used for erosion control or as biocontrol agents (particularly in agriculture) (Simberloff & Stiling 1996).

Other species are introduced accidentally on imported nursery stock, on or in fruits and vegetables, in ship ballast waters, on vehicles, in packing materials and shipping containers, through shipping channels, and from human travel and land management practices. Dumping exotic fish and plants from aquaria into natural waters are other common ways invasive species spread (Texas Invasives.org, Walter et al. 2009).

1.4 Integrated Pest Management Principles, Control and Herbicide Use

Integrated Pest Management is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. Integrated Pest Management programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage in a manner that is both economical and minimizes the potential for harm to people, property, and the environment. The Integrated Pest Management approach can be applied to both agricultural and non-agricultural settings, such as the home, garden and workplace. Integrated Pest Management takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides (U.S. EPA, <http://www.epa.gov/opp00001/factsheets/ipm.htm>).

Integrated Pest Management is not a single pest control method but, rather, a series of pest management evaluations, decisions and controls. In practice, land managers follow a four-tiered approach.

- Integrated Pest Management first sets an action threshold, a point at which pest populations or environmental conditions indicate that pest control action must be taken. The level at which pests will either become an environmental or economic threat is critical to guiding future pest control decisions.
- Integrated Pest Management programs work to monitor for pests and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds. This monitoring and identification removes the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used.



- As a first line of pest control, Integrated Pest Management programs work to prevent pests from becoming a significant problem. In natural areas, this involves using sound land management to minimize soil damage and to encourage native diversity and ecosystem health. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment.
- Once monitoring, identification and action thresholds indicate that pest control is required; Integrated Pest Management programs then evaluate potential control methods for both effectiveness and risk. “Control” means eradicating, suppressing, reducing or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and communities to reduce the effects of invasive species and to prevent further invasions (Executive Order 13112). Pest controls which are both effective and present minimal risk to people, property or the environment - such as manual and certain mechanical control methods - are considered first. If further control is required, then additional pest control methods, such as individual plant treatment with herbicide, are employed. Pesticides are used when necessary, but only in a way that minimizes potential harm to people, property and the environment.

1.4.1 Current Departmental Management Plans

The following list reflects the current departmental Integrated Pest Management and land management plans that are in use during the creation of this citywide plan. It is recommended that the individual departmental plans be updated annually.

Austin Energy: Aquatic Vegetation Management, Decker Creek Power Plant.

Austin Energy: Transmission Right-of-Way Maintenance, Integrated Vegetation Management.

Austin Water Utility: Balcones Canyonlands Preserve. Land Management Plan, Tier II A, Chapter IV, Vegetation Management.

Austin Water Utility: Water Quality Protection Lands Program. Integrated Pest Management Plan.

Parks and Recreation Department: Integrated Pest Management Program.

Watershed Protection Department: Stormwater Pond Dam Safety Program.

1.5 City of Austin Resolution (20100408-030)

In order to address the significant economic, ecological and health impacts of invasive species in Austin, and to encourage community collaboration and innovation, the City Council approved a resolution on April 8, 2010 calling for the development of a city wide plan for invasive species management (Appendix D). The resolution focused on invasive aquatic, riparian and terrestrial species that influence the productivity, value and management of land and water resources on city-managed property. The City Council directed the City Manager to develop an Invasive Species Management Plan, henceforth known as the Plan, for the control and/or eradication of invasive species in order to protect and restore the city’s natural resources and report back to Council on or before June 5, 2010. Additionally, a multi-departmental (six departments) team was organized to determine the proposed management plan scope, completion time, budget and estimated staff resources required for implementation.

The “significant negative impacts” which the Resolution sought to address include: reduction in biodiversity, altered ecosystem energy flow, degraded aquatic systems, reduction in riparian and lake quality, habitat losses, alteration of regional flora and fauna, loss in value of area open spaces, adverse impacts on human health and property value and loss of native seed bank.

To address these impacts, the City will: (1) develop an Invasive Species Management Plan for the control and/or eradication of undesirable aquatic and terrestrial species; (2) estimate the annual costs of invasive species removal/control which should include volunteer efforts; (3) consider education and public awareness as a major component of the plan that will document, map and monitor invasive



species; and, (4) consider creating an inter-departmental working group to facilitate plan development, incorporating inventory, prevention, early detection/rapid response, control, management and restoration techniques.

1.6 Scope, Purpose and Goals

The scope of this plan includes all invasive aquatic, riparian and terrestrial species within City of Austin-owned or -managed property. Currently, the plan focuses on plant species, but other taxa could be integrated in the future (see City Memorandum, Appendix D). The goal is to reduce the cover and expansion of, and where possible, eradicate invasive species on city-managed properties through a coordinated plan that facilitates interdepartmental coordination, city-wide monitoring and coordination of volunteer efforts and establishes a set of minimum standards for all city departments involved in vegetation management. Individual departments are charged with developing site-specific management plans.

The Plan includes development of recommended methodology for establishment of baseline plots and consistent adaptive management for all properties in all departments. The Plan follows the National Invasive Species Council guidelines for invasive species management (prevention, early detection and rapid response, control and management, restoration, organizational collaboration and education/outreach). The Plan identifies current threats and management strategies and provides a decision making process for new threats to be identified and addressed.

While the Plan directly influences only City of Austin-owned or -managed property (Texas Agriculture Code, Chapter 71, Subchapter D, Section 71.153), we are hopeful that, through education and outreach, the Plan will influence outside groups such as state entities, homeowners and businesses, especially those operating within the City of Austin. The City wishes to extend the reach of the Plan by: developing and advancing innovative ways to protect the environment; conducting research and planning; establishing education and public awareness campaigns; and collaborating and coordinating with local, regional and state partners to prevent new introductions and manage existing populations.

1.7 Plan Development Process

On June 3, 2010, following the passage of Resolution 20100408-030, city memorandum CUIR #304 (Appendix D) established an inter-departmental executive committee to develop the scope of the Plan (Figure 1.8.1). Subsequent to that memo, an agreement with the Lady Bird Johnson Wildflower Center, at the University of Texas, to facilitate the plan's development led to creation of a stakeholder group, called the Working Group, made up of representatives from within the City of Austin and outside stakeholders (Appendix A). The City of Austin departments represented were Austin Energy, Austin Water Utility, Parks and Recreation Department, Planning and Development Review, Public Works Department and the Watershed Protection Department. The outside stakeholder groups were the Austin Parks Foundation, Keep Austin Beautiful, Texas Parks and Wildlife and the Austin Invasive Species Coalition. The group, charged with the primary development of the plan, used a consensus-based process to develop an initial draft, which was then reviewed by an Advisory Group of local, regional and state organizations.

Over the course of six meetings, the Working Group used a consensus-based process to make key decisions about the determination and definition of invasive plant species for the plan, reviewed existing invasive plant management projects, assessed current procedures and Best Management Practices (BMPs), defined project goals, and identified resources and constraints. A second series of consensus-based meetings were held to address feedback from the Advisory Group and general public and to refine the plan.



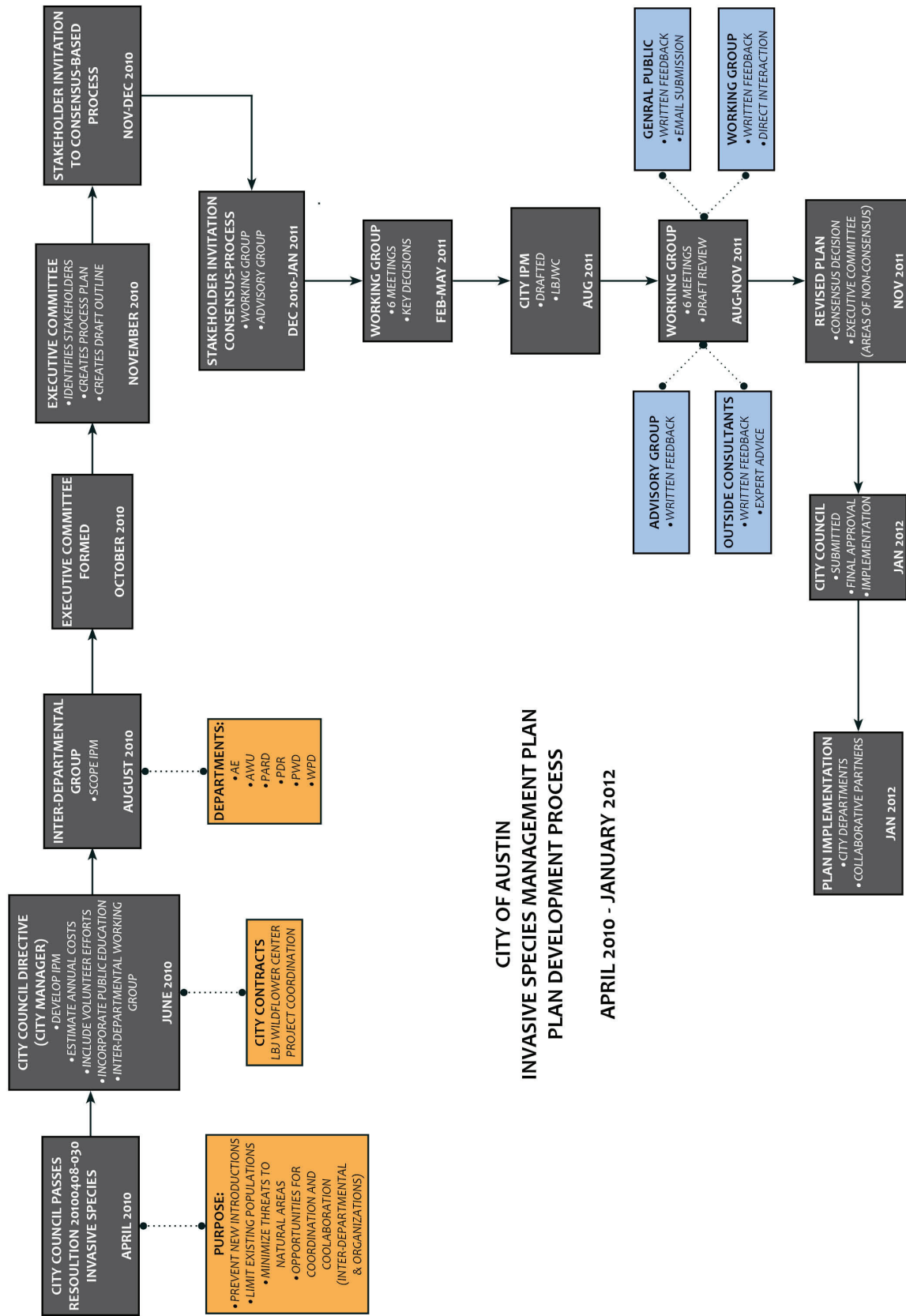


Figure 1.8.1. Plan development process.

Following final approval by the Working Group and departmental Boards and Commissions, the revised plan followed City protocols for internal and public review, and was ultimately submitted to the City Council for final approval, implementation and public distribution.

1.8 Plan Structure

The contents of the plan are set out in six chapters to provide an insight into the management process and the range of information that has been collated and assessed to establish the proposed management strategy and activities.

The plan contains background chapters on local and regional programs, and the environmental and economic impacts on the community. It describes current and past programs, coordination and collaborative opportunities and the contribution of countless volunteers towards invasive species removal. Subsequent chapters explain how invasive species will be managed on a citywide scale and the goals that provide directives to those management strategies. In addition, estimated costs and opportunities for funding sources are provided for the citywide management of invasive species.

In addition, a field resources section (Book 2) provides species-specific management guidance for 24 invasive species identified as problematic in Austin as well as a species prioritization system. Further information on the plan development process and supporting documentation can be found in a series of Appendices (Book 3).



Chapter 2 Existing City Programs

2.1 Overview

The City of Austin currently spends \$2,004,958 yearly on invasive species management. Projects are organized, funded and tracked at the departmental level and, at present, no system for citywide project coordination or monitoring is in place. Departments vary in their level of invasive management expertise, established treatment protocols and monitoring activities (Table 2.1). Resource sharing between departments can be difficult and, more importantly, the lack of inter-departmental coordination means that opportunities to increase citywide effectiveness can be missed. Simple ways to increase overall effectiveness, without significantly increasing cost, include coordinating the timing of treatment efforts in areas of overlapping, or adjacent, jurisdiction and layering invasive species management efforts on other activities when possible. For example—Austin Energy could remove invasive species rather than cutting them back in power line rights-of-way. Austin Energy benefits because the same plants do not have to be trimmed again the following cycle, and surrounding properties benefit because power line rights-of-way would no longer serve as a seed source for invasive species. If the surrounding property is a city park or wildland, that park could then time its invasive management activities near the power line to build off the work Austin Energy had begun. This type of cooperation has occurred in the past, with programs such as Nature Wise, in which the Parks and Recreation Department partnered with Solid Waste Services to mulch invasive brush removed from parks along with yard trimmings. One of the goals of a citywide plan is to facilitate this type of coordination.

At the present time, mapping of existing infestations and monitoring of treated areas is handled within departments with differing levels of precision. The creation of an easy-to-use city wide tracking system will make prioritizing treatment strategies easier and will help managers detect and respond to new infestations before they can become a serious problem.

Volunteers are a significant resource in invasive species management, both in tracking and treatment activities. Currently the training requirements and the activities volunteers are allowed to perform vary across departments. It is complicated for volunteers to provide service to more than one department and for managers to confirm a volunteer's level of skill and training. A standardized system for training and certifying volunteers for different tasks would simplify this process and maximize returns on the city's investment in volunteer training.

Finally, the use of integrated pest management varies with department and property. Some departments have written plans, some follow an integrated pest management approach but lack a written plan and, in some cases, integrated pest management is not followed. This plan provides a set of minimum standards for all departments to follow an IPM approach.



Table 2.1. Departmental involvement in invasive species management.

Department	Management	
	Yes	No
Austin Energy	x	
Austin Police Department		x
Austin Public Library		x
Austin Water Utility-Wildland Conservation Division		
Balcones Canyonlands Preserve	x	
Water Quality Protection Lands	x	
Community Court		x
EMS		x
Fire		x
Parks and Recreation Department (PARC)		
Parks and Preserves	x	
Urban Forestry	x	
Golf	x	
Planning and Development Review	x	
Solid Waste Services	x	
Watershed Protection Department	x	

2.2 Summary of current activities

Five city departments are involved in invasive species management: Planning and Development Review, Parks and Recreation, Austin Water Utility, Watershed Protection Department and Austin Energy (Table 2.2). This section provides a summary of the types of activities performed by these departments.

Planning and Development Review deals with invasive species indirectly through the permitting process. Development submittals include tree surveys which cover both native and non-native trees on-site. This department is in a position to encourage invasive species removal as part of the application approval process. Currently, mitigation (i.e. replacement trees) is not required for removal of invasive trees specified in the Environmental Criteria Manual (ECM) section 3.5.4. Land Use Review also encourages invasive species removal. Land Use Review has revised the regulatory tree survey, preservation and mitigation list, ECM Appendix F: Descriptive Categories of Tree Species, to ensure that no invasive plants are on the list. The list now only includes trees native to either the Texas Blackland Prairie or the Edwards Plateau.

The *Parks and Recreation Department* is involved in management through the urban forestry, parks and golf programs. Urban forestry is involved in citywide efforts focused on woody invasive species. An integrated pest management approach is used and a monitoring protocol is in place. An integrated pest management plan has been developed, providing policy and guidance for all parks. The plan is updated annually as new information within the industry is developed to provide best practices in park settings. At this time, invasive species management is *ad hoc*. Most treatment activities are accomplished by contractors and volunteers. Some parks, such as Zilker Nature Preserve, have written integrated pest management plans and formal monitoring protocols while other parks and preserves take a more informal approach. Invasive species management is more limited within the golf courses than within parks and preserves. A golf integrated pest management plan exists, but in practice invasive species are addressed primarily when they pose a safety issue or interfere with integrity of the golf course.





Department	Project/Location	Annual Direct Cost (\$)	Annual Volunteer Contributions (\$) ^a	Written IPM	IPM Approach	Mapping	Post-treatment Monitoring
Austin Energy ¹	Decker Lake Hydrilla Removal / Transmission ROW	1,362,624	-	x		x	x
Austin Water Utility-Wildland Conservation Division	Balcones Canyonlands / Water Quality Protection Lands	12,477	15,129	x	x	x	x
Parks and Recreation Department	Preserves / Urban Forestry	543,195	157,756	x		x	x
Watershed Protection Department	Stormwater Ponds / Waterways	86,662	769	x	x	x	x
Total		2,004,958	173,654				

^a Annual Direct Volunteer In-kind Contribution valued at \$21.35/hr

¹ **Annual Direct Costs apply to all vegetation management on transmission corridors, including invasive species**

Table 2.2. Summary of current invasive species management.

The *Watershed Protection Department* integrates invasive species management into stormwater treatment and riparian and stream restoration activities. The primary targets are hydrilla and species that threaten stream and riparian health.

The *Austin Water Utility Wildland Conservation Division*, which manages Austin’s contribution to the Balcones Canyonlands Preserve and the Water Quality Protection Lands, integrate invasive species management into day-to-day operations. Land management, and thus invasive species management, is part of the core missions of these programs. Monitoring, management and restoration protocols are well established. Treatment activities within the Water Quality Protection Lands are guided by a written integrated pest management plan and land management plan, and activities within the Balcones Canyonlands Preserve are guided by an integrated pest management approach and a written land management plan.

Austin Energy controls hydrilla when necessary to protect intake screens on Decker Lake and performs vegetation maintenance under power line rights-of-way as necessary to protect integrity of, and access to, power lines.

2.3 Sustainable Integrated Land Management

The draft Imagine Austin Comprehensive Plan includes a recommendation that the City “develop and implement unified, comprehensive land management of all City of Austin lands.” In keeping with this goal, the City recognizes that a coordinated effort to manage invasive plants on municipal properties is, among other things (e.g., maintenance, riparian restoration, etc.), a key element of a comprehensive approach to land management. As this plan neared completion, discussions were underway between the Parks and Recreation (PAR) and Watershed Protection (WPD) departments and the Office of Sustainability regarding the establishment of an inter-departmental initiative on sustainable integrated land management. It is anticipated that this initiative, if launched, would include participation of each of the city departments previously identified as potential members of a standing working group on invasive species management.



Chapter 3 Regional Programs

It is important that the City of Austin be aware of other invasive species management efforts, particularly those that could support or enhance the effectiveness of the COA plan. To that end, this chapter lists some of the best examples of local, regional and national programs to prevent and control invasive species.

3.1 Local and Municipal Programs

Austin Invasive Species Coalition (AISC) - <http://www.austininvasives.org/>

A centralized website for Austin-area events and education related to preserving plant biodiversity through invasive removal and education.

Austin Parks Foundation - <http://www.austinparks.org/restoration.html>

Since 1992, Austin Parks Foundation has initiated, promoted and facilitated physical improvements, new programming, and greater community involvement for Austin's parks.

COA Grow Green - <http://www.ci.austin.tx.us/growgreen>

Grow Green is a water quality education program that promotes least-toxic solutions to gardening problems. See Invasive Plant Field Guide (<http://www.ci.austin.tx.us/growgreen/downloads/invasiveplants.pdf>) and Invasive Plants to Avoid – (http://www.ci.austin.tx.us/growgreen/downloads/pg_invasive.pdf).

EcoTexas - <http://ecotx.org/>

EcoTexas is a nonprofit organization that encourages the public to take action to reduce the threat of invasive species through workdays and education.

Keep Austin Beautiful (KAB) - <http://www.KeepAustinBeautiful.org>

KAB provides resources and education to inspire individuals and the Austin community toward greater environmental stewardship.

City of Portland Invasive Species Program - <http://www.portlandonline.com/bes/index.cfm?c=45696>

The City of Portland has taken significant steps to limit the negative effects of invasive species. In November 2005, the Portland City Council adopted Order 36360 which required the city to develop a three-year work plan and ten year goals to integrate invasive plant management into existing city programs and reduce invasive plant coverage in Portland.

3.2 State Programs

Texas Invasive Plant and Pest Council (TIPPC) - <http://www.texasinvasives.org>

The Texas Invasive Plant and Pest Council (TIPPC) is a 501C non-profit organization representing stakeholders from state and federal agencies, conservation organizations, academia, green industry and the public sector.

Texas Invasive Species Coordinating Committee (TISCC) - <http://www.tiscc.texas.gov/>

This committee includes the following agencies: The Texas State Soil and Water Conservation Board, Texas Department of Agriculture, Texas AgriLife Extension Service, Texas Parks and Wildlife, Texas Forest Service and the Texas Water Development Board.



Texas Parks and Wildlife Department - <http://www.tpwd.state.tx.us/>

The Texas Parks and Wildlife Department provides outdoor recreational opportunities by managing and protecting fish and wildlife and their habitat and by acquiring and managing parks, historic sites and wildlife areas. Its mission is to manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.

Texas Forest Service - <http://texasforests.tamu.edu>

The Texas Forest Service was created in 1915 as an integral part of The Texas A&M University System. Its mission is to provide statewide leadership and professional assistance to assure that the state's forest, trees and related natural resources are widely used, nurtured, protected and perpetuated for the benefit of all.

Texas AgriLife Extension - <http://agrilifeextension.tamu.edu>

Working hand-in-hand with its Texas A&M System partners, the state legislature and the communities it serves, the mission of the Texas AgriLife Extension Service to serve Texans through community-based education has remained unchanged for almost a century.

3.3 Regional Programs

California Invasive Plant Council - <http://www.cal-ipc.org/>

Research, restoration, and education on California's fight against wildland plant invaders.

Invasive Plant Atlas of New England - <http://nbii-nin.ciesin.columbia.edu/ipane/>

Database of invasive and potentially invasive plants in New England.

Mid-Atlantic Exotic Pest Plant Council - <http://www.ma-eppc.org/>

A one-stop shop for information regarding invasive plants of the Mid-Atlantic region.

Midwest Invasive Plant Network - <http://mipn.org>

MIPN's mission is to reduce the impact of invasive plant species in the Midwest.

Southeast Exotic Pest Plant Council - <http://www.se-eppc.org/>

A forum for the exchange of scientific, educational and technical information in the southeastern U.S.

3.4 National Programs

National Invasive Species Council (NISC) - <http://www.invasivespecies.gov/>

Established by Executive Order (EO) 13112 to ensure that Federal programs and activities to prevent and control invasive species are coordinated, effective and efficient.

USDA Animal and Plant Health Inspection Service (APHIS) - <http://www.aphis.usda.gov/>

APHIS provides leadership in ensuring the health and care of animals and plants. The agency improves agricultural productivity and competitiveness and contributes to the national economy and the public health.

Lady Bird Johnson Wildflower Center - <http://www.wildflower.org/>

The mission of the Lady Bird Johnson Wildflower Center is to increase the sustainable use and conservation of native wildflowers, plants and landscapes. As an experienced educational organization, the Wildflower Center specializes in building partnerships between likeminded organizations and in the dissemination of information to the public.



USDA Forest Service Forest Health Protection - <http://www.fs.fed.us/foresthealth/>

Since its beginnings over a half-century ago, the Department of Agriculture (USDA) Forest Service Forest Health Protection (FHP) program has built an organization of specialists trained to provide technical assistance on forest health-related matters. The mission of FHP is to protect and improve the health of America's forests.

National Association of Exotic Pest Plant Councils - <http://www.naeppc.org/>

The National Association of Exotic Pest Plant Councils (NAEPPC) was established in October 1995 by the signature of representatives of the first four state and regional Exotic Pest Plant Councils. NAEPPC was established because the Exotic Pest Plant Councils recognized the value of cooperation through a national association of organizations that share common goals.

National Institute of Invasive Species Science - <http://www.niiss.org>

The National Institute of Invasive Species Science is a consortium of government and non-government organizations formed to develop cooperative approaches for invasive species science that meet the urgent needs of land managers and the public. Administratively housed at the U.S. Geological Survey Fort Collins Science Center in Colorado, the National Institute of Invasive Species Science provides a hub for invasive species science collaboration, coordination and integration across agencies and disciplines.

Sustainable Sites Initiative - <http://www.sustainablesites.org/>

The Sustainable Sites Initiative is a voluntary rating system that encourages sustainable landscape design, construction and maintenance. Prerequisite 4.1 requires control and management of known invasive species found on site.



Chapter 4 Management

4.1 Prevention

Often the most cost-effective approach to combating invasive species is to keep them from establishing in the first place. Prevention is the first line of defense against invasive species and should be a primary focus of the City of Austin.

Actions such as management plans, standard operating procedures and education and outreach efforts are all important tools that can be applied within a comprehensive strategy to prevent the establishment of invasive species. Prevention efforts must have the coordinated support of the City of Austin as well as other interested parties.

The following are recommended preventative measures (BCPP 2007).

- Adjacent landowners should be encouraged to use native plants (or non-invasive exotics) in place of invasive species.
- Local nurseries should be educated about invasive species
- Soil disturbance should be limited
- Recently exposed or disturbed areas should be quickly revegetated with native species.
- When feasible, seeds used in restoration projects should be collected near the area to be restored and should be free of weed seeds.
- Managers should be careful of introducing problem weed seeds in purchased soils and other materials for projects such as trail maintenance, erosion control or landscaping. Equipment should be cleaned before bringing onto a property to prevent bringing in problem species.
- Managers should monitor areas during and after work has been done to ensure that problem weeds were not introduced. Follow-up monitoring may need to continue for several years.
- Managers should give control efforts along roads and utility corridors high priority, as they can provide a conduit for invasive seed as well as a favorable growing environment for many invasive species.
- When new construction or invasive removal is planned, soil disturbance should be minimized and disturbed areas should be monitored, revegetate with native species and treat invasives as necessary, follow an integrated pest management process. Stockpiled soil should be protected from invasive seed. A simple way to accomplish this is by covering the pile with mulch.
- Departments should develop and periodically update a “watchlist” of species to be on alert for. Land management staff should be trained to recognize highly invasive plants such as buffelgrass and kudzu.
- Managers should monitor for the introduction and spread of invasive species.
- Managers should develop methods to avoid spreading non-native plants to other areas especially when conducting active removal of invasives species and when conducting work along utility corridors. Special attention and procedures should be applied to cleaning boots, hand tools, construction and maintenance machinery.
- Managers should use care when using so-called “native” seed mixes which may contain non-native and invasive species. Managers should always verify the species composition of seed mixes before purchasing.

4.2 Early Detection and Rapid Response

While prevention is the first line of defense, even the best prevention efforts will not stop all invasive species. Once a species becomes widely established, control efforts become costly and eradication is unlikely, therefore early detection and rapid response efforts increase the likelihood that invasions will

be halted and eradicated.

It is recommended that the City of Austin follow the National Invasive Species Council approved *General Guidelines for the Establishment and Evaluation of Invasive Species Early Detection and Rapid Response Systems* (Appendix G).

Early Detection and Rapid Response actions are grouped into three (3) main categories:

1. Early Detection

Early detection provides initial evidence of an invasive species. Early detection can be achieved by “active detection networks”, comprised of individuals that have specific job training and responsibility to find invasive species. They typically focus on species of concern, high-risk pathways and locations. The identification of species is essential to early detection efforts.

2. Rapid Assessment

The detection of an invasive species initiates the Rapid Assessment process. Rapid assessment may recommend that a response be initiated. In addition, assessments of potential invasions can be conducted in advance of their detection. The rapid assessment process is an essential aspect of timely Early Detection and Rapid Response.

3. Rapid Response

Rapid response efforts contain and, where possible, eradicate populations of invasive species. Because even localized populations can cross jurisdictional boundaries, interdepartmental cooperation is essential for success. To be effective, response efforts often need partners from both the private and public sectors.

Validation

Several resources in the Austin area are available to assist city staff and volunteers with plant identification:

1. The University of Texas Plant Resource Center
2. Texas Parks and Wildlife Department State Botanist
3. The Nature Conservancy of Texas Botanists
4. The Lady Bird Johnson Wildflower Center

4.3 Control Measures and Management Overview

Some invasive species may be too widespread to fully eradicate. However, control and management efforts can slow and/or reduce their impacts. It is recommended that the City of Austin follow the National Invasive Species Council approved *Guidelines for Ranking Invasive Species Control Projects* (Appendix G).

The working group has developed a list of the most common and/or problematic invasive plant species of concern for the City of Austin (Book 2, Field Resources) using the Texas Invasive Plant and Pest Council Plant Assessment Form adapted from *Criteria for Categorizing Invasive Non-native Plants that Threaten Wildlands* (Warner et al 2003). Each department should prioritize this list according to their mission. If an alert is triggered for any species, departments should work together to develop effective interdepartmental control and management strategies for that species. After a comprehensive distribution map of invasive plant species is completed, the list should be reevaluated and updated. The list should be reevaluated and updated every 5 years.

Managers should utilize employees, contractors and volunteers to implement Integrated Pest



Management strategies. Following the Integrated Pest Management framework the City of Austin will always use the least toxic, effective and economical approach first. When using herbicide, the City of Austin will use the least toxic and effective herbicide (White 2007) and follow all state and federal laws pertaining to herbicide use (Appendix L, Texas Administrative Code & Appendix N, The Pesticide Label). Control and management of invasive species is accomplished using modern resource management methods. Several complementary methods may be implemented in an overall strategy to protect ecosystems and aid in their recovery.

Strategies should be analyzed and adjusted as needed and work (including follow-up and monitoring) should be conducted for many years. Control efforts reduce invasive species to more acceptable levels and management prevents spread and re-emergence.

City of Austin departments should develop control plans for individual invasive species or for certain areas within their jurisdiction following their rules and regulations. This document contains sample control and management practices for 24 common non-native invasive plants found in Austin (Book 2, Field Resources).

Soil protection is an important consideration during all invasive management activities. Bare soil tends to erode and can be reinvaded. Potential damage to soil should be weighed against the benefits of invasive species removal. The potential for soil damage extensive enough to necessitate active soil restoration (deep ripping, amending) is an indication that other methods should be considered. Alternatively, a phased approach, wherein invasive species removal is conducted incrementally, may also be an effective strategy for minimizing soil damage.

4.4 Restoration and Rehabilitation

In some cases, once invasive species are removed, native communities can recover without further intervention, provided best management practices prevent re-invasion. However, in cases of severe degradation, natural recovery processes can be overwhelmed by invasive species and active restoration is required. Although restoration efforts have common elements, each area is unique. Work must be guided by site-specific considerations and analysis. However, some generalizations can be made. When soil is disturbed, and especially if it is left bare, it must be revegetated with appropriate species to prevent soil loss and re-invasion.

The goal of restoration is to restore ecosystem process, not simply to replace components. Ecosystem processes allow natural systems to repair themselves and to remain relatively stable. In practice, the assessment and repair of natural processes begins with the soil. In the process of treating and removing invasive species, the soil may be disturbed and left bare. In some cases, compaction reduction activities and organic soil amendments may be needed to restore soil health. Soil disturbance should be addressed and the area should be revegetated with appropriate native species as soon as possible. When immediate revegetation is not possible, temporary soil protection measures such as mulch may be needed. However, mulch suppresses all germination, which can complicate later revegetation efforts.

Generalized revegetation protocols can be found in the City of Austin Environmental Criteria Manual.

4.5 Prioritization

Before management techniques can efficiently be implemented, invasive species of concern must first be prioritized. To this end, the working group established a list of 24 species that all departments were currently targeting. Each species was initially assessed using an adapted version of the *Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands* (Criteria). These criteria have



been designed to support categorized lists of invasive plants by ranking each plant's level of threat to the ecological health of wildlands through evaluation of its ecological impact, ability to invade natural vegetation communities and current extent of its invasion. Evaluators use an associated "Plant Assessment Form" to score species using the criteria and to document supporting evidence. Developed by the California Invasive Plant and Pest Council (Cal-IPPC), for use in California, Arizona and Nevada, these criteria can be adapted for use in other states or regions by substituting appropriate ecological types for that state or region (Warner et al. 2003). In 2009, the Texas Invasive Plant Council adapted these criteria to fit ecological types in Texas. It is important to note that the assessment of invasiveness occurs at the species level and does not automatically apply to subspecies, hybrids, cultivars or varieties of that species.

These adapted Criteria will be used to standardize the addition of new species, prioritize future introductions and act as a tool to remove species from the priority list. These Criteria can act as a working method of adding and removing invasive plants to the City's top priority species list, but at minimum should be evaluated every 5 years by resource managers educated in local invasive species issues. The top 24 species, along with a summary of the results of the California Invasive Plant and Pest Council assessment, can be found in Table 4.5.2. The complete assessments can be found in Appendix 3, Weed Risk Assessments.

The working group chose not to prioritize species within the top 24 list, in part because data are not uniformly robust and distribution estimates are not specific to Austin. Each department should set priorities within the list in accordance with its mission and management goals. But, when an alert is triggered using the Criteria, that species should be deemed high priority citywide.

In addition to prioritization by species, projects should be prioritized based on the site's restoration potential, ecological and community value and the invasive species present. Restoration potential takes into consideration the current ecological state of the site and the level of difficulty in reaching desired restoration goals. The potential for reinvasion is also a consideration. Reinvasion potential is influenced by such factors as degree of fragmentation, proximity to invasive seed sources and use policy. The threat of invasive species to rare, threatened or endangered plant and animal species and to sensitive or valuable landscapes should be an important consideration when prioritizing sites. In addition, the site's ecological, social and educational value should be considered.

Resource availability and the potential for follow-up monitoring and treatment are important considerations when prioritizing projects. Projects with potential for collaboration and resource sharing with other departments and community groups should be given higher priority than projects lacking these opportunities. An invasive species coordinator would be instrumental in helping departments identify opportunities for collaboration and volunteer coordination, as well as potential outside funding sources.

Lastly, the particular invasive species present, the degree of invasion and the negative impact of the particular invasive species should be considered when assigning management priorities. How severe are the potential environmental impacts of the species? Are there reasons to delay treatment on particular individuals because of community attachment to them? Would complete removal significantly damage the soil or leave large areas bare, thus necessitating intensive restoration efforts? If so, a phased approach, in which areas are treated and restored incrementally, may be indicated.



Species	Common Name	Overall	Alert	Impact	Invasiveness	Distribution	Documentation
<i>Arundo donax</i>	Giant reed	High	no	A	B	A	3.84
<i>Eichhornia crassipes</i>	Common water hyacinth	High	no	A	A	A	3.3
<i>Hydrilla verticillata</i>	Hydrilla	High	no	A	A	A	3.38
<i>Ligustrum lucidum</i>	Glossy privet	High	no	A	A	A	3.41
<i>Melia azedarach</i>	Chinaberry tree	High	no	A	B	A	2.69
<i>Phyllostachys aurea</i>	Golden bamboo	High	no	A	B	A	2.61
<i>Pueraria montana var. lobata</i>	Kudzu	High	no*	A	B	A	2.8
<i>Rapistrum rugosum</i>	Bastard cabbage	High	no	A	B	A	2.92
<i>Sorghum halepense</i>	Johnson grass	High	no	A	A	A	3
<i>Tamarix ramosissima</i>	Salt cedar	High	no	A	B	A	3.15
<i>Allianthus altissima</i>	Tree of heaven	Moderate	no	B	B	A	3.08
<i>Broussonetia papyrifera</i>	Paper mulberry	Moderate	no	B	B	A	2.16
<i>Centaurea melitensis</i>	Malta star-thistle	Moderate	no	B	A	A	3.15
<i>Colocasia esculenta</i>	Elephant ears	Moderate	no	B	A	A	2.5
<i>Cynodon dactylon</i>	Bermudagrass	Moderate ¹	no	B	B	A	2.7
<i>Firmiana simplex</i>	Chinese parasoltree	Moderate	no	B	B	A	2
<i>Lonicera japonica</i>	Japanese honeysuckle	Moderate	no	B	B	A	3
<i>Macfadyena unguis-cati</i>	Catlawvine	Moderate	no	B	A	A	2.15
<i>Nandina domestica</i>	Sacred bamboo	Moderate	no	C	A	A	2.8
<i>Pistacia chinensis</i>	Chinese pistache	Moderate	no	B	B	A	1.6
<i>Pyracantha coccinea</i>	Scarlet firethorn	Moderate	no	C	B	A	2.15
<i>Triadica sebifera</i>	Chinese tallow	Moderate	no	B	B	A	3.15
<i>Cyrtomium falcatum</i>	Japanese netvein hollyfern	Low*	no	B	C	A	1.14
<i>Bothriochloa ischaemum</i>	Bluestem, King Ranch	Unknown	no	B	B	U	2

^{1, *} see notes section for description

Table 4.5.2. Top invasive species in Austin and summary of Weed Risk Assessments.

Table 4.5.2. Continued (Warner et al. 2003).

Rating

1. High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
2. Moderate – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
3. Low – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.
4. Unknown - Evaluated but lack sufficient information to assign a rating or the available information indicates that the species does not have significant impacts at the present time.

Alert

Specific combinations of section scores that indicate significant potential for invading new ecosystems triggers an Alert designation so that land managers may watch for range expansions. Y = Yes, N = No

Impact

The Impact section assess the cumulative impact (e.g., over a period of several decades) of the species on the wildlands where it typically occurs in Texas or other places with similar environmental conditions. The assessment applies to impacts within the area currently occupied by the species within Texas (to the extent that this area is known). This section is arranged hierarchically: species that significantly alter ecosystem processes and system-wide parameters (Q1.1) almost always have significant impacts on plant community composition, structure, and interactions (Q1.2), and higher trophic levels and interactions (Q1.3).

Invasiveness

The Invasiveness assessment rates a species’ potential to establish, spread, and increase in abundance in wildlands.

Distribution

The Ecological Amplitude section rates the number and proportion of different ecological types invaded. The “ecological amplitude” of the species indicates the diversity of ecological types invaded. The “distribution” addresses the extent of infestation in any given ecological type. This is a percentage of the



Table 4.5.2. Continued (Warner et al. 2003).

ecological type's total number of occurrences (frequency) that has been invaded, not as an estimate of the average percent cover occupied by the species within each ecological type.

Documentation

Assessed as highest level of documentation for each criterion.

4 = Reviewed scientific publications

3 = Other published material (reports or other non-peer-reviewed documents)

2 = Observational (unpublished information confirmed by a professional in the field)

1 = Anecdotal (unconfirmed information)

0 = No information

Notes

¹While Bermudagrass has an overall rating of being moderately invasive, it is recognized that Bermudagrass is useful in certain applications as a turf grass for ball fields and high traffic areas. It is recommended that improved hybrids of Bermuda grass such as Tifgreen, Tifdwarf, Tifway and Santa Ana be used in those applications as these hybrid varieties do not produce seed, whereas common bermudagrass produces seeds that remain viable in soil for at least 2 years.

*See weed risk assessment notes



4.6 Standardization of Operating Procedures

In order to streamline detection, treatment and monitoring activities, the working group recommends that a set of minimum standards for control, monitoring and training be established that all departments will meet. Each department is encouraged to write their own land management and integrated pest management plans, in keeping with departmental missions that will meet minimum standards. A full set of standard operating procedures will need to be developed once the plan is adopted. However, the working group has laid out the following actions and guidelines to be adopted as soon as possible.

Standardized Record Keeping

The working group recommends standardizing record keeping for all departments. A centralized database has been created by City of Austin staff to facilitate interdepartmental communication, early detection, rapid response and long term monitoring. The database is adapted from the Weed Information Management System, which was developed by the Nature Conservancy to help resource managers track invasive species locations, assessments (size and status of infestation to facilitate monitoring over time), and treatments applied (<http://tncinvasives.ucdavis.edu/wims.html>). The City of Austin system will allow land managers to link coverage and treatment data to maps. Users can query the dataset to ascertain, for example, what work has been done in a particular watershed. Only city employees will be able to enter data into the system, and each department will maintain its own database, which will be incorporated into the central database automatically. Volunteer efforts will be entered by their staff contact.

An additional tool available to the city is the Eradicator Calculator. The Eradicator Calculator is an initiative of TexasInvasives.org intended to track the cost of treating invasives in Texas. The tool can be queried by city or county. Information about employee actions from the City of Austin database will be periodically exported to the calculator. Volunteer efforts are valued at \$21.35/hr, which is a standard value calculated by Independent Sector, a non-partisan coalition of charities, foundations and corporate giving programs. The value of volunteer time is based on the average hourly earnings of all production and nonsupervisory workers on private nonfarm payrolls (as determined by the Bureau of Labor Statistics). Independent Sector augments this value by 12 percent as an estimate for fringe benefits (Independent Sector 2011). This will help track direct costs to the city, the value of volunteer efforts and will place Austin's efforts within a statewide context.

Crew Implementation

Program managers should identify some implementation goals and decide where invasive species management falls among crew priorities. Each crew should have hands-on training on identifying and treating invasive species in addition to the fact sheets developed for this plan. The working group should develop a short list of talking points about the rationale for dealing with these species, what to do about them and how to flag and report what they find. Departments should have a point-of-contact between the department and volunteers to coordinate efforts and decide when and where to use crews and when to use volunteers. The appropriate activities for both groups should be clearly defined. Each crew should have at least one licensed pesticide applicator and access to treatment materials and equipment.

Herbicide/Pesticide Use

Integrated pest management should be used in all control efforts. Particular care must be taken in endangered species habitat, and documents such as *Protection Measures for Pesticide Applications* (White 2007) may provide useful information in the determination of the least toxic, effective chemical. The Nature Conservancy's *Weed Control Methods Handbook* (Tu et al. 2001) is also a useful resource. Some departments, such as Watershed Protection, have conservation, management or integrated pest management plans in place that address this issue and these department specific plans should be



adhered to when they exist.

All pesticide applicators must follow all label requirements, including dilution, application and disposal of containers. Equipment must be maintained to ensure cost effectiveness and safety.

State and federal law must be the minimum standard for all departments. See Regulatory Requirements for Herbicide Use on City Property (see below) for licensing requirements for city staff, volunteers and contractors.

Volunteers

Volunteers are a crucial asset to successful invasive species management. Properly trained volunteers can greatly increase the effectiveness of early detection/rapid response and can increase the treatable area. Effective use of volunteers requires that their efforts be coordinated with those of city employees, that volunteers receive appropriate training, that managers can reliably ascertain a volunteer's level of training and that actions that are appropriate for volunteers are clearly defined. The working group recommends the development of a consistent policy between departments on use of volunteers which, as much as possible, resolves conflicts between department policies. The steps required to allow a volunteer to perform certain tasks, such as herbicide application, should also be clearly defined. A volunteer certification process should be developed to train and certify volunteers for certain tasks such as herbicide application and chain saw operation. A common training manual should be used by all departments. Volunteers will use both standard operating procedures and site plans to guide their work. Volunteer contributions should be tracked along with city efforts.

All pesticide applicators on City property must meet the Texas Department of Agriculture requirements for herbicide application on public land, which are listed below. As stated previously, departments may develop policies that are more stringent than applicable state and federal laws and regulations.

Regulatory Requirements for Herbicide Use on City Property

The application of any pesticide, regardless of regulatory status, on public property must be made or supervised by a licensed pesticide applicator.

The City has three options for the application of pesticides on City property. City employees making or supervising pesticide applications must hold a Noncommercial Political Subdivision pesticide license. Paid pest control contractors must hold a Commercial pesticide license. Volunteers must be supervised by a City employee who holds a Noncommercial Political Subdivision pesticide license. Volunteers may not apply pesticides under a Private license, a Commercial license, or a Noncommercial license held by their employer. See Appendix L, Texas Administrative Code for certification, supervision, and record keeping requirements for pesticide application on public lands.

Further, pesticide applicators must be certified in the appropriate license use (sub) categories for each pesticide application. (See Appendix L, Texas Administrative Code for certification, supervision, and record keeping requirements for pesticide application on public lands.) For example, applicators applying pesticides or supervising the application of pesticides to turf grass must be certified in license use category 3a.

Types of Pesticide Licenses (Appendix N, Pesticide Commercial - Noncommercial Applicator License)
Commercial Applicator - A person who operates a business or is employed by a business that applies restricted-use or state-limited-use pesticides to the property of another person for hire or compensation. Commercial applicators must renew annually and obtain five CEUs each year.



Noncommercial Applicator - A person required to use restricted-use or state-limited-use pesticides but who is not a private applicator or commercial applicator. Noncommercial applicators are generally government employees who apply restricted-use or state-limited-use pesticides in the course of their employment or persons employed by businesses applying such pesticides on their own property. Noncommercial applicators must renew annually and obtain five CEU's each year.

Noncommercial Political Subdivision Applicator - A noncommercial political subdivision (NCPS) applicator is employed by a political subdivision of the state of Texas or of a federal agency operating in Texas.

Texas Administrative Code (Appendix L & Appendix N, TDA Pesticide Documents)
Applicator Certification (Title 4; Part 1; Chapter 7; Subchapter C; Rule §7.21)

(a) The department may certify applicators in the following license use categories and subcategories:

- (1) agricultural pest control:
 - (A) field crop pest control;
 - (B) fruit, nut and vegetable pest control;
 - (C) weed and brush control in pasture and rangeland;
 - (D) predatory animal control;
 - (E) farm storage pest control and fumigation;
 - (F) animal pest control;
 - (G) citrus pest control;
 - (H) livestock protection collar application; and
 - (I) M-44 (Sodium Cyanide application in accordance with §7.40 of this title (relating to M-44 Sodium Cyanide - State-Limited-Use Requirements)).
- (2) forest pest control;
- (3) ornamental plant and turf pest control (except as provided in subsection (c)(2) of this section);
 - (A) plant pest and weed control; and
 - (B) greenhouse pest control;
- (4) seed treatments;
- (5) right-of-way pest control;
- (6) aquatic pest control:
 - (A) aquatic plant and animal pest control; and
 - (B) anti-fouling paint;
- (7) demonstration and research;
- (8) regulatory pest control;
- (9) aerial application;
- (10) chemigation; and
- (11) chlorine gas.

Supervision (Title 4; Part 1; Chapter 7; Subchapter D; Rule §7.31)

(a) Licensed applicators may only supervise application of pesticides for categories or subcategories in which they are certified.

(d) A licensed applicator is not required to be physically present at the time and place of the application unless the label states the required presence of the licensed applicator. The licensed applicator must always be available and is responsible for any actions under the licensee's direct supervision.

(e) Each licensed applicator is responsible for assuring that any person working under the licensee's direct supervision is knowledgeable of label requirements governing the use of the particular pesticide.



- (f) Licensed applicators employed by political subdivisions who supervise nonlicensed employees that make any pesticide application are responsible for assuring that the following requirements are met:
- (1) nonlicensed employee must be trained in the specific use of the pesticide applied, annually.
 - (A) obtain five CEUs in accordance with the continuing education required for licensed commercial and noncommercial applicators; or
 - (B) training on the appropriate laws and regulations pertaining to pesticide use, the label information for the use of all pesticides that are applied and pesticide safety training.

Records of Application (Title 4; Part 1; Chapter 7; Subchapter D; Rule §7.33)

- (a) The following records of pesticide use shall be maintained for a period of two years:
- (1) commercial applicator or a noncommercial applicator shall maintain records of each pesticide application regardless of the use classification of the pesticide applied.
- (d) The record of each pesticide application shall be kept current and maintained at the applicator's principal place of business as designated on the applicator's application/renewal for a pesticide applicator's license.

Information Required:

1. Date and time of application
2. Person for whom application was made
3. Location of land
4. Product name
5. EPA registration number
6. Rate of product per unit
7. Total volume applied per unit
8. Pest treated
9. Site treated
10. Total acres or volume of acre treated (e.g. acre, square feet, number of head)
11. Wind direction and velocity and air temperature
12. FAA "N" number of aerial equipment; ID number of other application equipment
13. Applicator name and license number and/or person making the application

Public Perception

Brush accumulation can be perceived as a fire hazard and eye sore to the general public. To reduce these concerns, accumulated cuttings should be disposed of appropriately. Various techniques such as windrows, chipping, and complete removal of woody slash have been adopted by city departments (Appendix K). Public perception should be taken into consideration on a site by site basis when deciding on the best management practice for brush control. In addition, it is important to notify neighborhoods that may be affected by the work. When work is being done in highly visible, high profile sites, letters should be sent explaining the work to be done, schedule, revegetation plan and contact information (Appendix N, Pesticide Prior Notification for Neighbors and Their Employees). Each Department should have access to a standardized yard-sign-sized sign that can be placed in high profile work areas to educate the public. These signs should have the logo of all plan development partners, a unified "brand" such as "Least Wanted" or "Hello...Goodbye" and a place for contact information (e.g. the city department, Austin Parks Foundation or Keep Austin Beautiful).

Outreach

The impact of this plan can be extended through outreach to landowners who wish to conduct invasive



species management on their own properties. Construction of web page containing contact information and answers to frequently asked questions would be a useful first step in support this goal.

Adoption of Standardized Procedures

The following measures can be used to encourage adoption of standardized procedures. Managers should receive training on invasive standard operating procedures. Standard operating procedures should be readily available. Inspectors' site plans should include invasive management standard operating procedures. The plan and standard operating procedures should be integrated into City policy for all capital improvement projects and public development projects. In order to track the adoption of standard operating procedures, standardized trainings and people trained in each department should be tracked. Compliance can be evaluated as part of annual performance reviews.



Chapter 5 Five Year Goals

Success of this plan is defined as effective interdepartmental coordination and, ultimately, a reduction in invasive species cover on City-managed properties. In order to track progress toward these long term goals, the working group developed a set of measurable 5 year objectives. Early on, emphasis should be on implementation and shift, over time, toward measures of effectiveness. We suggest that the plan, and progress made in carrying out the plan, be evaluated every five years.

Objectives have been placed in four categories: Measurement, Control, Standard Procedures and Public Education (Figure 5.1). Unless otherwise stated, the target date for the following objectives is 2016 or five years from plan adoption, whichever comes later.

Measurement/Implementation

- Standardized, centralized digital record-keeping system for invasive species management and control used for all City managed lands.
- Each department will have implemented invasive species removal actions on at least 25% of their total acreage

Invasive Species Control

- Determine baseline data for invasive species distribution in City-managed properties.
- Each department will have implemented treatment plans for a reduction in the distribution from the baseline. Departments will set their own goals for reduction and all will meet a defined minimum standard. Volunteer efforts can be included in departmental plans.

Public Education

Public education is particularly important for the success of this plan. Actions by the public affect city properties, positively and negatively. The council resolution calls for the enlistment of the public's help and to reduce negative impacts on properties through education. Coordination and branding will be required to improve literature, media or campaigns initiated by the city. However, it is important that this plan stay within the scope of its original charge, meaning that the plan directly influences city managed properties only. Non-city managed properties will be influenced indirectly through public education and outreach.

- By January 1, 2013, the City of Austin will no longer purchase or recommend known invasive species
- Establish a baseline measure of public attitudes towards invasive species

Standard Operating Procedure

- Ensure that appropriate employees are evaluated on their performance of the standard operating procedures for invasive species as part of their annual performance evaluation process.
- Incorporate this plan and standard operating procedures in City codes for all capital improvement and public development projects.
- 100% of vegetation management employees will have received appropriate training in the standard operating procedures. These employees include field crews, inspectors, inspector supervisors, contractors and applicable review staff.
- Standardize procedures for all departments



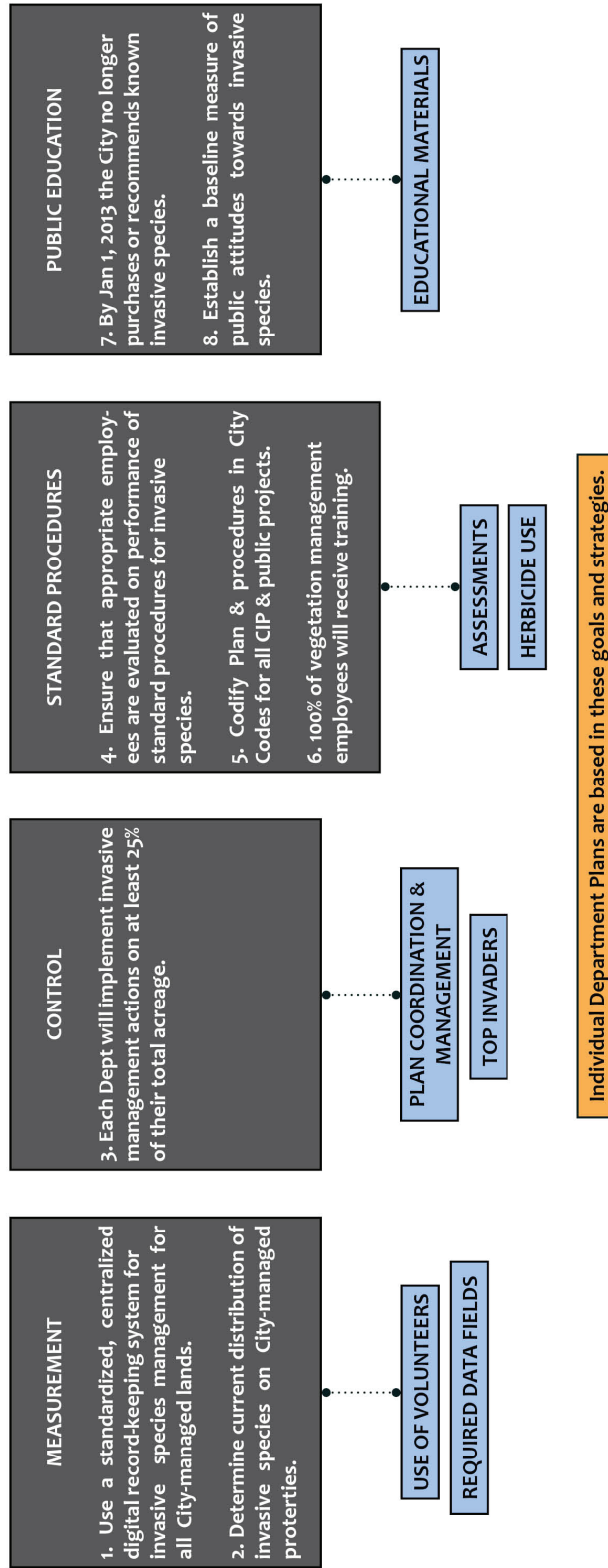


Figure 5.1. Five year goals.

Chapter 6 Costs and Funding Sources

6.1 Costs

This section provides estimates on the operating costs for staff, implementation and continuation of the Invasive Species Management Plan. In addition, this section will provide estimates on costs for control programs, revegetation and ongoing maintenance based on expenditures for control efforts. Program costs could be reduced through partnerships with local, regional, state and national organizations.

6.1.1 Staffing Costs

The Working Group recommends that two full-time equivalent positions – an Environmental Conservation Program Coordinator and a GIS Analyst - be created to manage the implementation of the Invasive Species Management Plan and to facilitate communication between city departments. The costs associated with the positions should be in addition to existing staff and budgets dedicated to invasive species management. Parks and Recreation and Watershed Protection have discussed which department would be best suited to serve as the home department for the recommended program coordination functions. Given the prospects of a relatively stable long-term funding, as well as synergies with Watershed Protection’s mission and existing staff capabilities, there is consensus that Watershed Protection should house the proposed new positions.

The Invasive Species Coordinator would work with city departments and partners to organize and catalog assessments, treatments and restoration activities among the various properties of all city departments. The Coordinator would plan and develop programs to train city staff and collaborate with internal and external agencies to meet plan goals. Additionally, the Coordinator would identify and explore funding opportunities for the overall invasive species management program as well as future salary requirements. It is also recommended that the coordinator’s activities and priorities be determined by an Invasive Species Committee comprised of representatives of the six departments involved in invasive management.

The GIS Analyst would provide support to the Coordinator by updating and maintaining the spatial database of information related to assessments, treatments, restoration and follow-up activities. With six city departments working on various invasive species projects, a centralized repository is critical for management and information sharing.

6.1.2 Implementation / Control Costs

This section outlines the cost to implement the goals, policy, and control priorities provided in Chapters 4 and 5. The cost of invasive species management on city managed lands is estimated for a one-year and five-year period based on the plan goals and estimated area treated in that time frame.

City Costs

The City of Austin - The City of Austin currently spends \$2,004,958 yearly on invasive species management. To meet the goal of invasive species management actions on 5% of departmental area each year, an additional \$255,889 would be required by the City per year, bringing the total yearly cost to approximately \$2.26 million. The Working Group estimated the cost of invasive species management, on all city managed property under the full-purpose jurisdiction, to be approximately \$9.96 million over the Five Year Goals period (Table 6.1.2.1). The cost estimate does not include the additional staff requested to provide oversight for management of the city-wide plan, nor does it include costs incurred by other city departments that are involved in land management activities. Given that the plan pertains to all city-



managed properties, all departments are expected to work toward achievement of the five-year goals, when appropriate.

Using standardized treatment pricing (Appendix H), cost estimates and volunteer contributions for implementation and control are based on annual averages that each department has incurred in recent years. Each department provided an annual average of acres treated for that same time frame. Additionally, each department reported total acres or stream miles within their full-purpose jurisdiction, depending on categories of land management types. Unit costs, price per acre or stream mile, were extrapolated for departmental monetary costs and volunteer contribution. Lastly, unit costs for each department, management type, and volunteer contribution were forecasted annually and five years in the future. The annual staff cost and volunteer contribution represents the costs to implement vegetation and invasive species management actions on 5% of departmental area each year. The five-year staff cost and volunteer contribution represents the costs to implement vegetation and invasive species management actions on 25% of departmental area, to meet the goals stated in the plan.

Table 6.1.2.1. City of Austin, Forecasted costs.

City of Austin - Forecasted Costs		
	Annual Direct Costs (5% area treated)	Total Direct Costs (25% area treated)
Austin Energy - Lake Walter E. Long ^{1,3}	\$45,000	\$225,000
Austin Energy - Transmission ROW ^{2,4,5}	\$1,317,624	\$5,251,400
Parks and Recreation - Preserves	\$316,000	\$1,579,745
Parks and Recreation - Urban Forestry	\$516,672	\$2,578,576
Water Utility - WQPL/BCP	\$11,377	\$56,885
Watershed Protection - Stormwater Ponds	\$26,487	\$131,454
Watershed Protection - Waterways	\$27,687	\$138,435
Total	\$2,260,847	\$9,961,495
Volunteer In-kind Contribution ^{6,7}	\$177,899	\$888,368

¹ Annual Treatment, 20% of area within full-purpose jurisdiction

² Annual Treatment, 25% of area within full-purpose jurisdiction

³ Five Year Treatment, 100% of area within full-purpose jurisdiction

⁴ Four Year Treatment, 100% of area within full-purpose jurisdiction

⁵ **Forecasted cost estimates apply to all vegetation management on corridors, including invasive species**

⁶ Austin Parks Foundation In-kind Contribution (3,200 hours annually; 200 hours coordination included)

⁷ Keep Austin Beautiful In-kind Contribution (3,742 hours annually; 200 hours coordination included)

Departmental Costs

Austin Energy – Analysis of vegetation management, including invasive species, for Austin Energy (Hydrilla and Transmission ROW) revealed that the department incurred an annual direct cost of \$1,317,624 to manage 138 miles of transmission corridors and \$45,000 to manage 254 acres of Lake Walter E. Long, totaling \$1,362,624. Austin Energy does not use volunteers.

Overall, the department is responsible for 550 miles of transmission corridors and 1,269 acres of Lake Walter E. Long that fall within the department’s full purpose jurisdiction. Vegetation management on transmission corridors throughout the Austin Energy system includes treatment of all vegetation, not just invasive species. A transmission corridor is typically 100 feet wide.

Currently, Austin Energy has implemented vegetation and invasive species management actions on 20-25% of utility acreage each year, meeting goal 3 of control measures within the five-year goals (Table



6.1.2.2). The target goal of Austin energy is to treat 25% of utility area each year, reaching 100% utility area every four to five years. Unit cost (acre) of treatment of hydrilla is estimated at \$177, and unit cost (mile) of treatment of transmission ROW is estimated at \$9,548.

Maintaining average unit costs for departmental direct costs, it is estimated that to meet the annual departmental goal of 25% area treated and five-year goal of 100% area treated, the department will experience an annual expense of \$1,362,624 and a total expense of \$5,476,400 at the end of five years.

Table 6.1.2.2. Austin Energy, Forecasted costs.

Austin Energy - Lake Walter E. Long			
	Unit Cost	Annual Direct Costs ^a (20% area treated)	Total Direct Costs ^b (100% area treated)
Area Equivalent ¹	acre	254 acres	1,269 acres
Staff	\$178	\$45,000	\$225,000
Total	\$178	\$45,000	\$225,000

^a One Year Goal, treatment of 5% of area within full-purpose jurisdiction

^b Five Year Goal, treatment of 25% of area within full-purpose jurisdiction

Austin Energy - Transmission ROW			
	Unit Cost ^a	Annual Direct Costs ^b (25% area treated)	Total Direct Costs ^c (100% area treated)
Area Equivalent ¹	mile	138 miles	550 miles
Staff	\$9,548	\$1,317,624	\$5,251,400
Total	\$9,548	\$1,317,624	\$5,251,400

^a **Forecasted cost estimates apply to all vegetation management on corridors, including invasive species**

^b One Year Goal, treatment of 5% of area within full-purpose jurisdiction

^c Five Year Goal, treatment of 25% of area within full-purpose jurisdiction

¹ Area Equivalent for transmission corridors is one mile length with a 100 foot width

Parks and Recreation Department – Analysis of invasive species management for Austin Parks and Recreation Department (Preserves and Urban Forestry) revealed that the department incurred an annual direct cost of \$150,000 to manage 150 acres of preserves and greenbelts, and \$393,915 to manage 330 acres of urban forest, totaling \$543,915. The annual volunteer contribution to Austin Parks and Recreation averages about 7,389 hours per year, totaling \$157,756.

Overall, the department is responsible for 6,319 acres of preserves and greenbelts and 8,624 acres of urban forest that fall within the department’s full purpose jurisdiction. Currently, Austin Parks and Recreation has implemented invasive species management actions on 2.4% of preserves and greenbelts and 3.8% of urban forestry acreage each year. Unit cost (acre) of treatment of preserves and urban forest is estimated at \$1,000 and \$1,196 per acre, respectively.

Maintaining average unit costs for departmental direct costs, it is estimated that to meet the annual departmental goal of 5% area treated and five-year goal of 25% area treated, the department will experience an annual expense of \$832,672 and a total expense of \$ 4,158,321 at the end of five years (Table 6.1.2.3). Annual volunteer contributions, at the amount of 7,657 hours per year or \$163,478, would be required to meet the five-year goal. Total contribution of volunteers over the five-year period would equal 38,285 hours or \$816,263.



Table 6.1.2.3. Parks and Recreation Department, Forecasted costs.

Parks and Recreation Department - Preserves			
	Unit Cost	Annual Direct Costs (5% area treated)	Total Direct Costs ^a (25% area treated)
Area Equivalent	acre	316 acres	1,580 acres
Staff	\$1,000	\$316,000	\$1,579,745
Total	\$1,000	\$316,000	\$1,579,745
Volunteer In-kind Contribution ¹	\$930	\$139,395	\$696,071

^a Five Year Goal, treatment of 25% of area within full-purpose jurisdiction

¹ Annual Direct Volunteer In-kind Contribution (6,529 hours annually, valued at \$21.35/hr)

Parks and Recreation Department - Urban Forestry			
	Unit Cost	Annual Direct Costs (5% area treated)	Total Direct Costs ^a (25% area treated)
Area Equivalent	acre	432 acres	2156 acres
Staff	\$1,196	\$516,672	\$2,578,576
Total	\$1,196	\$516,672	\$2,578,576
Volunteer In-kind Contribution ¹	\$56	\$24,083	\$120,192

^a Five Year Goal, treatment of 25% of area within full-purpose jurisdiction

¹ Annual Direct Volunteer In-kind Contribution (860 hours annually, valued at \$21.35/hr)

Austin Water Utility – Analysis of invasive species management for Austin Water Utility, Wildland Conservation Division (Water Quality Protection Lands and Balcones Canyonlands Preserve) revealed that the utility has incurred annual direct costs of \$12,477 and annual volunteer contributions of \$15,129 each year for the last four years.

Currently, the Wildland Conservation Division has implemented invasive species management actions on more than 5% of utility acreage each year, meeting goal 3 of control measures within the five-year goals (Table 6.1.2.4). That percentage equals to approximately 1,500 acres each year of the 22,753 acres within the full-purpose jurisdiction of the Wildland Conservation Division. Unit costs (acre) of treatment ranges from \$7.70 to \$11.80 per acre, depending on the use of prescribed fire versus alternative invasive species treatment for control. The annual direct volunteer contribution to the Wildlands Division averages 709 hours per year.

Maintaining an average unit cost of \$10 per acre for departmental direct costs, it is estimated that to meet the annual goal of 5% area treated and five-year goal of 25% area treated, the department will incur an annual expense of \$11,377 and a total expense of \$56,885 at the end of five years. Annual volunteer contributions, at the amount of 538 hours per year or \$13,652, would be required to meet the five-year goal. Total contribution of volunteers over the five-year period would equal 2,690 hours or \$68,260.

It is anticipated that the Austin Water Utility, Wildland Conservation Division properties will not require additional resources to meet this goal within the next five years. The Water Utility will require additional resources to engage in invasive species removal on urban/developed properties, such as treatment plants.



Table 6.1.2.4. Austin Water Utility, Forecasted costs.

Austin Water Utility - WQPL/BCP			
	Unit Cost ^a	Annual Direct Costs (5% area treated)	Total Direct Costs ^b (25% area treated)
Area Equivalent	acre	1,138 acres	5,689 acres
Staff	\$10	\$11,377	\$56,885
Total	\$10	\$11,377	\$56,885
Volunteer In-kind Contribution ¹	\$12	\$13,652	\$68,260

^a Unit cost dependent upon inclusion of prescribed burning versus optional treatments (\$7-12/acre)

^b Five Year Goal, treatment of 25% of area within full-purpose jurisdiction

¹ Annual Direct Volunteer In-kind Contribution (709 hours annually, valued at \$21.35/hr)

Watershed Protection Department– Analysis of invasive species management for Watershed Protection Department (Stormwater Ponds and Waterways) revealed that the department incurred an annual direct cost of \$67,060 to manage 80 miles of waterways and \$19,602 to manage 20 acres of stormwater ponds, totaling \$86,662. Overall, the department is responsible for 660 miles of waterways and 534 acres of stormwater ponds that fall within the department’s full purpose jurisdiction.

Currently, the Watershed Protection Department has implemented invasive species management actions on 12% of waterways, prioritized as the Urban Watershed Regulation Areas, and 3.7% of the total stormwater pond acreage. Unit cost (mile) of treatment of waterways and stormwater ponds is estimated at \$839 and \$981, respectively (Table 6.1.2.5). The annual direct volunteer contribution to the Watershed Protection Department averages about 36 hours per year.

Maintaining average unit costs for departmental direct costs, it is estimated that to meet the annual goal of 5% area treated and five-year goal of 25% area treated, the department will experience an annual expense of \$54,174 and a total expense of \$269,889 at the end of five years. Annual volunteer contributions, at the amount of 35 hours per year or \$769, would be required to meet the five-year goal. Total contribution of volunteers over the five-year period would equal 180 hours or \$3,845.

Table 6.1.2.5. Watershed Protection Department, Forecasted costs.

Watershed Protection Department - Stormwater Ponds			
	Unit Cost	Annual Direct Costs (5% area treated)	Total Direct Costs ^a (25% area treated)
Area Equivalent	acre	27 acres	134 acres
Staff	\$981	\$26,487	\$131,454
Total	\$981	\$26,487	\$131,454

^a Five Year Goal, treatment of 25% of area within full-purpose jurisdiction

Watershed Protection Department - Waterways			
	Unit Cost	Annual Direct Costs (5% area treated)	Total Direct Costs ^a (25% area treated)
Area Equivalent	mile	33 miles	165 miles
Staff	\$839	\$27,687	\$138,435
Total	\$839	\$27,687	\$138,435
Volunteer In-kind Contribution ¹	-	\$769	\$3,845

^a Five Year Goal, treatment of 25% of area within full-purpose jurisdiction

¹ Incomplete Data, Annual Direct Volunteer In-kind Contribution (36 hours annually, valued at \$21.35/hr)



6.2 Potential Funding Sources

A wide range of strategies and actions will be required to achieve the goals of this plan. Efforts to prevent, detect, treat and monitor invasive species are often delayed by the lack of funding. Education and outreach require funding for implementation of successful campaigns and the development and distribution of materials. The city should work with governing officials, partners, stakeholders, industry and federal entities to establish permanent funding sources for invasive species programs in the city. When applying for funding opportunities, the city should incorporate the contributions of volunteer and public sector organizations to increase the amount of matching funds from granting programs.

6.2.1 Federal Funds

Table 6.2.1. Federal Funds.

Grant Name	Grant Size	Match Required	Lead Sponsor	Proposal Due Date	Application Due Date	Eligibility
5 Star Restoration Program	\$10-40k	100%	EPA	N/A	2/14/2011	a, b, c, d, e
Source Reduction Assistance	\$10-130k	5%	EPA	6/30/2011	2/24/2011	a, b, c, d, e
Targeted Watersheds Grant Program	\$40-60k	25%	EPA	N/A	5/19/2010	a, b, c, d, e
Conservation Innovation Grant	\$75k	50%	NRCS	12/28/2010	3/4/2011	a, f, h
Conservation Reserve Program	\$50k	50%	NRCS	N/A	N/A	a, e, f
Conservation Stewardship Program	\$40k	0%	NRCS	N/A	N/A	f
Coop. Conservation Partner Initiative	\$200k	100%	NRCS	5/27/2010	N/A	a, b, c, e
Environmental Quality Incentives Prg	N/A	25%	NRCS	N/A	N/A	f, h
Grassland Reserve Program	\$50k	25%	NRCS	N/A	N/A	h
Wetland Reserve Program	\$1300/ac.	25%	NRCS	N/A	N/A	f
Wildlife Habitat Incentives Program	\$50k	25%	NRCS	N/A	N/A	b, c, f
Native Plant Conservation Initiative	\$15-75k	100%	NWFW	6/30/2011	10/15/2011	a, b, c, d, e
Pulling Together Initiative	\$15-75k	100%	NWFW	7/15/2011	10/14/2011	a, b, c, d
Urban and Community Forestry	N/A	N/A	USFS	N/A	N/A	N/A

- a. Nonprofit Organizations
- b. Local and County Government
- c. State Government
- d. Federal Government Agencies
- e. Educational Institutions
- f. Private Landowners
- g. Service Area
- h. Eligible Lands/Producer

U.S. Environmental Protection Agency

5 Star Restoration Program

The Five Star Restoration Program brings together students, conservation corps, other youth groups, citizen groups, corporations, landowners and government agencies to provide environmental education and training through projects that restore wetlands and streams. The program provides challenge grants, technical support and opportunities for information exchange to enable community-based restoration projects. At the completion of Five Star projects, each partnership will have experience and a demonstrated record of accomplishment, and will be well positioned to take on other projects. Aggregating over time and space, these grassroots efforts will make a significant contribution to our environmental landscape and to the understanding of the importance of healthy wetlands and streams in our communities.

Website: <http://www.epa.gov/owow/wetlands/restore/5star/>

Source Reduction Assistance - CFDA 66.717

EPA requires the applicant to provide a minimum 5% match, as part of the total allowable project cost, in order to receive an award. Awards are issued annually by regions. The purpose of issuing SRA awards is to support environmental projects that reduce or eliminate pollution at the source.



In fiscal year 2011 the Regions are interested in funding proposals that encourage greenhouse gas reduction, toxic and hazardous materials reduction, resource conservation, efficient business practices and P2 integration activities. Applicants are strongly encouraged to submit proposals that demonstrate new, innovative techniques, surveys, studies or use research, investigations, experiments and/or training promoting P2/source reduction efforts. Proposals that principally support recycling, clean-up, treatment, disposal or energy recovery activities will not be considered for funding.

Website: <http://www.epa.gov/p2/pubs/grants/index.htm#sra>

Targeted Watersheds Grant Program

The Targeted Watersheds Grant Program encourages watershed organizations to collaborate and implement environmental change. EPA awards cooperative agreements to assist in building the capacity of watershed organizations so that these organizations are better positioned to undertake restoration and protection efforts and produce measurable environmental results.

The objective of the capacity building component of the TWG Program is to develop the capacity of watershed organizations. The objective is two-fold: 1) to promote the organizational development and growth of local watershed partnerships and stakeholders committed to improving and maintaining the natural and economic resources of their watersheds; and 2) to provide training and technical assistance to these groups so they can better address watershed-based problems and help develop sustainable solutions.

Website: http://water.epa.gov/grants_funding/twg/initiative_index.cfm

U.S.D.A. Natural Resources Conservation Service – Texas Programs

Conservation Innovation Grant

The Conservation Innovation Grant program is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging Federal investment in environmental enhancement and protection, in conjunction with agricultural production. CIG enables NRCS to work with other public and private entities to accelerate technology transfer and adoption of promising technologies and approaches to address some of the Nation's most pressing natural resource concerns.

Website: <http://www.tx.nrcs.usda.gov/programs/CIG/index.html>

Conservation Reserve Program

The Conservation Reserve Program provides technical and financial assistance to eligible farmers and ranchers to address soil, water and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The Conservation Reserve Program reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter-strips or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices.

Website: <http://www.tx.nrcs.usda.gov/programs/crp/index.html>

Conservation Stewardship Program

The Conservation Stewardship Program is a voluntary conservation program that encourages producers to address resource concerns in a comprehensive manner by undertaking additional conservation activities and improving, maintaining and managing existing conservation activities. The program



provides equitable access to all producers, regardless of operation size, crops produced or geographic location. The resource concerns that have overarching priority in Texas are water quantity, soil erosion and plant health and condition.

Website: <http://www.tx.nrcs.usda.gov/programs/CSP/index.html>

Cooperative Conservation Partner Initiative

The Cooperative Conservation Partnership Initiative is a voluntary conservation initiative that enables the use of certain conservation programs with resources of eligible partners to provide financial and technical assistance to owners and operators of agricultural and nonindustrial private forest lands.

A primary intent is to leverage non-Federal government resources along with NRCS program resources to achieve resource conservation objectives. The purposes of the partnership agreement are to: (1) address conservation priorities involving agriculture and nonindustrial private forest land on local, State, multi-state or regional levels; (2) encourage producers to cooperate in meeting applicable Federal, State and local regulatory requirements related to production; (3) encourage producers to cooperate in the installation and maintenance of conservation practices; and (4) promote the development and demonstration of innovative conservation practices and delivery methods, including practices associated with specialty crop and organic production and precision agriculture operations.

Website: <http://www.tx.nrcs.usda.gov/programs/CCPI/index.html>

Environmental Quality Incentives Program

EQIP is a continuous sign-up program that allows landowners or operators to apply for financial and technical assistance for the application of specific conservation practices. Higher priority will be given to those applications that address national, state and local priorities and provide higher cost efficiency.

The NRCS in Texas supports the locally led process through local work groups and provides EQIP funding to every county. The State Technical Committee and Local Work Groups have concurred in the practices eligible for financial assistance to treat the identified resource concerns.

Website: http://www.tx.nrcs.usda.gov/programs/EQIP/11/counties_s_y/travis.html

Grassland Reserve Program

Assists landowners to restore and protect grassland, rangeland, pastureland, shrub land and certain other lands. It provides assistance for rehabilitating grasslands, grazing uses and related conservation values using rental contracts and permanent easements.

Applications will be rated based on ranking and selection criteria developed in the states following broad national guidelines. USDA proposes that land eligibility criteria should focus on preserving the nation's most critical grassland resources, the native and natural grasslands and shrub lands.

Participants may choose a 10, 15 or 20-year rental contract with USDA providing annual payments. Or participants may choose a permanent GRP easement held by either the United States or an eligible entity.

Expanding land eligibility criteria to include land that has been historically dominated by grassland, forbs or shrubland when it contains historical or archaeological resources or when it would address issues raised by State, regional and national conservation priorities. Implementation of GRP management plan is required.

Website: <http://www.tx.nrcs.usda.gov/programs/GRP/index.html>



Wetland Reserve Program

The Wetlands Reserve Program is a voluntary program offering landowners the opportunity to protect, restore and enhance wetlands on their property. The USDA Natural Resources Conservation Service provides technical and financial support to help landowners with their wetland restoration efforts.

WRP program objectives are to: purchase conservation easements from, or enter into cost-share agreements with willing owners of eligible land; help eligible landowners protect, restore and enhance the original hydrology, native vegetation and natural topography of eligible lands; restore and protect the functions and values of wetlands in the agricultural landscape; help achieve the national goal of no net loss of wetlands; improve the general environment of the country.

Website: <http://www.tx.nrcs.usda.gov/programs/wrp/index.html>

Wildlife Habitat Incentives Program

The Wildlife Habitat Incentives Program provides financial incentives to develop habitat for fish and wildlife on private lands. Participants agree to implement a wildlife habitat development plan and NRCS agrees to provide cost-share assistance for the initial implementation of wildlife habitat development practices. NRCS and program participants enter into a cost-share agreement for wildlife habitat development. The state objective is to restore and conserve native wildlife habitats with emphasis on prairies and savannahs, riparian zones, wetlands, forestland and woodlands and thorn shrub. Emphasis will be placed on restoring native habitats of species experiencing declines or reduced populations due to agricultural impacts. Additional consideration will be given to applications that have a high likelihood of success and that will result in a significant change in the existing habitat. Offers that provide a definite benefit to federally listed threatened or endangered species will receive extra points in the ranking. Applicants must own or be in control of the land and be in compliance with the conservation provisions of the Food Security Act of 1985 as amended regarding highly erodible land and wetlands.

Website: <http://www.tx.nrcs.usda.gov/programs/whip/index.html>

National Fish and Wildlife Foundation

Pulling Together Initiative

The Pulling Together Initiative seeks proposals that will help control invasive plant species, mostly through the work of public/private partnerships such as Cooperative Weed Management Areas. PTI applications are accepted from private non-profit (501)(c) organizations, federally recognized tribal governments, local, county, and state government agencies, and from field staff of federal government agencies. Individuals and for-profit businesses are not eligible to receive PTI grants, but are encouraged to work with eligible applicants to develop and submit applications to PTI. PTI applications must provide a 1:1 non-federal match for their grant request.

Website: http://www.nfwf.org/AM/Template.cfm?Section=Charter_Programs_List&TEMPLATE=/CM/HTMLDisplay.cfm&CONTENTID=19753

Native Plant Conservation Initiative

Supports on-the-ground conservation projects that protect, enhance and/or restore native plant communities, including pollinators, on public and private lands. Projects fall into one of six categories: conservation, education, restoration, research, sustainability and creating data linkages for native plant conservation in North America.

Eligible applicants include 501(c) non-profit organizations and local, state or federal government agencies. For-profit businesses and individuals are not eligible to apply directly to this program, but are encouraged to work with eligible applicants to develop and submit proposals. Organizations or projects that have received funding and have been successfully completed under this program are eligible and



encouraged to re-apply.

Website: http://www.nfwf.org/AM/Template.cfm?Section=Charter_Programs_List&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=20321

U.S.D.A. Forest Service - Urban and Community Forestry

Urban and Community Forestry (UCF) is a cooperative program of the US Forest Service that focuses on the stewardship of urban natural resources. UCF responds to the needs of urban areas by maintaining, restoring and improving urban forest ecosystems. Through these efforts the program encourages and promotes the creation of healthier, more livable urban environments across the nation.

UCF provides technical, financial, research and educational services to local government, non profit organizations community groups, educational institutions and tribal governments. The program is delivered through its legislative partners, the state forestry agencies. Programs will be focused on issues and landscapes of national importance and prioritized through state and regional assessments. Three national themes provide a framework for this work: conserve working forest landscapes, protect forests from harm and enhance benefits associated with trees and forests.

Website: <http://www.fs.fed.us/ucf/nucfac.html#grants>

6.2.2 State Funds

Table 6.2.2. State Funds.

Grant Name	Grant Size	Match Required	Lead Sponsor	Proposal Due Date	Application Due Date	Eligibility
319(h) Grant	\$165-870k	40%	TCEQ	6/1/2011	7/29/2011	b, c, e
State Wildlife Grants	\$50k	35%	TPWD	N/A	Oct.	a, c, e

- a. Nonprofit Organizations
- b. Local and County Government
- c. State Government
- d. Federal Government Agencies
- e. Educational Institutions
- f. Private Landowners
- g. Service Area

Texas Commission on Environmental Quality – 319(h) Grants

The Texas Commission on Environmental Quality and the Texas State Soil and Water Conservation Board administer federal grants for activities that prevent or reduce nonpoint source pollution. Grants are awarded annually and fund projects for up to three years. The grants are made available through a federal program authorized under Section 319 of the Clean Water Act.

Applicants are encouraged to partner with other local, state and federal authorities to increase the impact of their activities. Private organizations may participate in projects as partners or contractors but may not apply directly for funding.

A project must address the objectives, goals and/or priorities identified in the State of Texas Nonpoint Source Management Program or nonpoint source elements in the Texas Coastal Management Plan. Priority is given to funding development and implementation of watershed protection plans or Total Maximum Daily Load Implementation Plans.

Website: <http://www.tceq.texas.gov/waterquality/nonpoint-source/grants/grant-pgm.html>

Texas Parks and Wildlife Department - State Wildlife Grants

The State Wildlife Grants Program is a distributed conservation fund under the Wildlife and Sport Fish



Restoration Program managed by the U.S. Fish and Wildlife Service. Eligible and ineligible general actions for SWG are defined by the 2007 U.S. Fish and Wildlife Service Guidelines. Specific projects and guidance from the Action Plan are listed in the Conservation Action Priorities document for SWG and HLLP. Conservation projects should contribute to threat/impact reduction to improve the condition of species of greatest conservation need (SGCN), habitats/systems on which they depend, and/or natural processes that support habitat function, as defined by the 2005 Wildlife Action Plan. Additional priority will be given to projects that promote collaboration with partners and emphasize conservation on private lands.

Funding emphasis will be on site or field-based projects that contribute directly to conservation action and/or management of priority resources, in the following categories: Restoration and/or Management, Land and/or Water Protection, Survey, Monitoring, Capacity Building/Planning and Outreach. Website: <http://www.tpwd.state.tx.us/business/grants/wildlife/swgrants/>

6.2.3 Local Funds

Table 6.2.3. Local Funds.

Grant Name	Grant Size	Match Required	Lead Sponsor	Proposal Due Date	Application Due Date	Eligibility
Neighborhood Partnering Program	\$75-150k	25-40%	COA	N/A	N/A	a, e, g
Park Grants Program	\$50k	100%	APF	8/16/2011	9/30/2011	g
Urban Forest Grant Program	N/A	N/A	COA	N/A	N/A	a, b, e, f, g

- a. Nonprofit Organizations
- b. Local and County Government
- c. State Government
- d. Federal Government Agencies
- e. Educational Institutions
- f. Private Landowners
- g. Service Area

Austin Parks Foundation - Park Grants Program

The purpose of the Park Grants Program is to build and strengthen community support for parks, enabling neighborhood residents to make positive changes in their parks and surrounding communities. Grants support collaborative efforts that build a sense of community ownership for the park. Every year, Austin Parks Foundation offers the chance to apply for grants to improve their neighborhood parks. Grantees are required to match the grant fund with volunteer labor, community fund raising and in-kind donations.

Grants will fund community-driven initiatives that enhance public parks and green space owned and managed by the City of Austin Parks & Recreation Department. APF will place priority on projects that demonstrate active and committed community involvement, include a diversity of community partners and employ creativity and innovation in project implementation and partnerships.

Website: <http://www.austinparks.org/npg.html>

City of Austin

Neighborhood Partnering Program

Created by the Austin City Council, the Neighborhood Partnership Program provides opportunities for community and neighborhood organizations to effect public improvements by sharing in the costs of those efforts with the City of Austin government.

All projects must be done on City owned property or in City right of way. Qualified applicants include: a neighborhood association registered with the City of Austin; a neighborhood plan contact team; a



community-based organization; educational, ethnic or religious organizations.
 Website: <http://www.ci.austin.tx.us/publicworks/npprogram.htm>

Urban Forest Grant Program

The Urban Forest Grant Program was established to promote conservation and other projects that benefit Austin’s urban forest. Projects associated with tree planting and preservation, education, public service announcements, disease control and management of invasive species are eligible for funding. The grant program is designed with a diverse range of categories to encourage creative and innovative proposals. Proposals could include replanting or preservation of public and neighborhood trees lost or damaged in storms or by disease, the creation of public service announcements promoting tree conservation and preservation, or inventive education/training programs that introduce tree preservation and care to diverse audiences.

A fund created to mitigate the impact of tree removals supports the grant program. The program aims to achieve a balance between re-forestation and preservation. Public, non-profit or private entities such as, businesses, governmental agencies, academic and private institutions, homeowners or neighborhood associations, youth groups, civic groups and non-profit organizations may apply for funding.
 Website: <http://www.ci.austin.tx.us/trees/ufgp.htm>

Volunteer Organizations

- Austin Parks Foundation - <http://www.austinparks.org/>
- Keep Austin Beautiful - <http://www.keepaustinbeautiful.org/>
- Native Plant Society of Texas - <http://npsot.org/>
- Native Prairies Association of Texas - <http://www.texasprairie.org/>

6.2.4 Private Funds

Table 6.2.4. Private Funds.

Grant Name	Grant Size	Match Required	Lead Sponsor	Proposal Due Date	Application Due Date	Eligibility
Brown Foundation, Inc.	N/A	N/A	Private	N/A	N/A	a
Lee and Ramona Bass Foundation	\$350k +	0%	Private	N/A	N/A	a, e, f
Native Plant Society of Texas	\$500-2k	0%	Private	N/A	N/A	e
Xcel Energy Foundation	\$4-20k	0%	Private	N/A	N/A	a, e, f, g
Texas American Water	\$10k	0%	Private	N/A	N/A	a, b, c, e, g

- a. Nonprofit Organizations
- b. Local and County Government
- c. State Government
- d. Federal Government Agencies
- e. Educational Institutions
- f. Private Landowners
- g. Service Area

Brown Foundation, Inc.

The purpose of The Brown Foundation, Inc. is to distribute funds for public charitable purposes, principally for support, encouragement and assistance to education, the arts and community service. The Brown Foundation’s current emphasis is in the field of public education at the primary and secondary levels. The Foundation will focus on supporting non-traditional and innovative approaches, which are designed to improve public education primarily within the State of Texas.

In all program areas, the Foundation is interested in funding projects which fulfill one or more of the following criteria: addressing root causes of a concern rather than treating symptoms; serving as a



catalyst to stimulate collaborative efforts by several sectors of the community; resulting in a growing, long-lasting impact on the situation beyond the value of the grant itself; and, reflecting and encouraging sound financial planning and solid management practices in administration of the project.

Grant requests will be considered only from tax-exempt organizations described in Section 501(c)(3) of the Internal Revenue Code (the "Code") and further classified as a public charity within the meaning of Section 509(a) of the Code, or governmental units described in Section 170 of the Code.

Website: <http://www.brownfoundation.org/index.asp>

Lee and Ramona Bass Foundation

The Lee and Ramona Bass Foundation was established to support nonprofit organizations that provide important services for people, primarily within the state of Texas. The Foundation funds grants in the following categories: schools, colleges and universities within Texas, with emphasis placed upon faculty development and liberal arts programs; community programs and projects, particularly related to the arts and the environment, such as museums, zoos and educational/research institutions; national and regional conservation programs.

To be eligible for consideration by the Foundation, an organization must have received a determination letter or letters from the Internal Revenue Service indicating that it is an organization described in Section 501(c)(3) of the Internal Revenue Code of 1986 and is treated as other than a private foundation within the meaning of Section 509(a) of the code. An organization also may qualify if it falls within the terms of Section 170(c)(1) and the contribution requested is to be used exclusively for public purposes.

Website: <http://www.leeandramonabass.org/Introduction.html>

Xcel Energy- Foundation Grants

Xcel Energy Foundation strives to build partnerships, which enhance the environment and foster an ethic of conservation and preservation. In 2010, grants were awarded to environmental education, stewardship and partnerships across the service territory. The foundation prefers: environmental education, environmental awareness; and environmental partnerships (habitat and park projects, special projects/partnerships)

The following are ineligible to receive grant funding from the Xcel Energy Foundation: Organizations that are not designated 501(c)(3) by the IRS, programs outside of Xcel Energy's regulated service area, research programs or government agencies.

Website: http://www.xcelenergy.com/About_Us/Community/Foundation_Grants

Texas American Water- Environmental Grant Program

Texas American Water provides an Environmental Grant Program to support innovative, community-based environmental projects that improve, restore or protect watersheds and community drinking water supplies. The program is designed to support diverse types of activities, such as watershed cleanups, reforestation efforts, biodiversity projects, streamside buffer restoration projects, wellhead protection initiatives and hazardous waste collection efforts.

Project activities and outcomes should address a watershed or source water protection need in the local community within American Water service areas. Source water protection projects are activities that result in the protection or improvement of the community's public drinking water supplies. Watershed protection projects should focus on activities that improve, restore or protect one or more watersheds.

Website: <http://www.amwater.com/txaw/Ensuring-Water-Quality/environmental-grants-program.html>



6.2.5 Additional Websites

U.S.D.A. National Agricultural Library, National Invasive Species Information Center

Manager's Tool Kit, Grants and Funding- <http://www.invasivespeciesinfo.gov/toolkit/grants.shtml>

Center for Invasive Plant Management

Research, Grants Program - <http://www.weedcenter.org/research/grants.html>

Funding Opportunities - <http://www.weedcenter.org/funding/funding.html>

U.S.D.A. Natural Resource Conservation Service

Texas Programs- <http://www.tx.nrcs.usda.gov/programs/>

Midwest Invasive Plant Network

Grants- <http://www.mipn.org/grants.html>



Chapter 7 Conclusion

Invasive aquatic, riparian and terrestrial plant species influence the productivity, value and management of a broad range of land and water resources in the City of Austin. Each city department has addressed the invasive species issue with varying degrees of success depending on departmental expertise and available resources. At the same time, citizens' desire to protect the quality of Austin's open spaces has fostered concern regarding the threat that invasive species pose to Austin's parks, riparian areas, lakes, streams and natural areas.

The economic and environmental damage from invasive species will continue in Austin without a well-organized, cohesive and adequately-funded effort. This plan recommends that invasive species management remain the responsibility of individual departments with jurisdiction over city-owned properties; however the city should establish an invasive species coordinator who will assist each department with their invasive plant management efforts. The invasive species coordinator will lead the City in achieving the five-year goals (Chapter 5) by implementing the strategies outlined in Chapter 4.



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