Park City Municipal Corporation
Noxious Weed Management Plan 2015

Prepared for:

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I. Executive Summary

Park City is a world renowned recreation destination that balances the human experience with environmental conservation. Awards such as "Best Town Ever" (Outside Magazine 2013) gold level riding center designation and silver level bicycle friendly community (International Mountain Biking Association 2008, 2015; League of American Bicyclists 2009), illustrate Park City's strong commitment to preserving natural lands and the associated recreational opportunities.

90 % of residents use the trail system and 59 % regularly use trails to recreate with their dogs.

Residents and visitors alike are attracted to the city by the vast wildlands intermixed with recreational opportunities for cycling, mountain biking, hiking, running, equestrian use, and more. Over 400,000 tourists visit Park City in just the summer months generating over $500 million annually. The natural resources in and around Park City are highly valued by the outdoor and environmentally minded community and sustain Park City's economy. Park City has been recognized for it's strong recycling program and progressive approach to climate change adaptation. Both of these recognitions are due both to the actions of the City but also the public and local business's commitment to reducing their environmental impacts.

Along with the strong economic base natural resources provide Park City, nature is a centralizing force for the community and personal development of residents. Park City residents gather to enjoy recreational opportunities that promote a sense of community and leading to life long friendships.

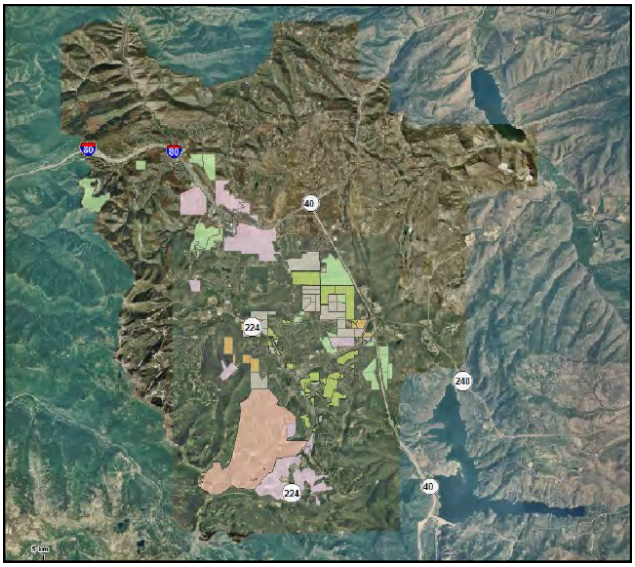
There is, growing concern regarding the impact on reduced exposure to nature has on childhood development. Park City provides the opportunity to expose children to nature that few cities can. Experience in nature develops skills and knowledge that increase confidence in children of all ages and activity levels and has been linked to reduced mental illness (Louv 2005). So concerning are statistics regarding reduced childhood exposure to nature, that the US senate passed the "No Child Left Inside Act" to increase environmental education and childhood access to the outdoors (Louv 2005). Park City exceeds the US senate expectations for the exposure of children to nature. Nature provides a base from which the community and economy of Park City thrive. Acquiring adjacent natural lands and property managing them protects the natural landscape that makes the City so unique.

Careful planning and community outreach results in successful multi-use trails that appeal to the wider community.

Park City visitors and residents have access to 400 miles of quality recreation trails in and around Park City (Mountain Trails Association 2015).

One of Utah's and Park City's greatest threats to natural/wild lands is the invasion and spread of noxious weeds (GSCD 2013). In fact, such invasive species pose one of the greatest threats to conservation of biodiversity worldwide. Nearly half of the native species now known as threatened or endangered in America are endangered because of invasive species (Simberloff 2000). Park City open space contains habitat suitable for several animals that are federally listed as at risk, threatened or endangered. For example, habitat within Park City is suitable for the highly controversial and at risk Greater Sage Grouse. Loss of a healthy plant community is one of the greatest threats to the Greater Sage Grouse, and is primarily the result of (noxious weed) invasion. Preservation of this habitat is an opportunity for Park City to contribute to urgently needed, national efforts to save the species.

The Greater Sage Grouse has experienced a habitat loss of 56% of its original range and a 38% loss in population since 1985. Due to recent public and private efforts to restore and protect habitat., the sage grouse populations are beginning to bounce back.



Park City encompasses 17.5 square miles of land and ???? % is open space.

As part of its commitment to conservation, the City has maintained a weed control program . The current program aims to comply with federal, state and county weed codes and regulations (Utah Noxious Weed Act, National Invasive Species Act; OE 13112; Federal Noxious Weed Control and Eradication Act;). Park City Municipal Corporation goes beyond regulations by monitoring and controlling new weeds not yet legally listed but known to be a threat to wildlands. Given the above mentioned annual increase in open space, the current program can no longer meet these goals. The magnitude and extent of noxious weed invasion on city property is not clear, and this information is necessary to plan and implement a successful noxious weed management program. Integration of new technology and resources along with personnel would allow Park City Municipal Corporation to

become a regional leader in noxious weed management.

The weed management program and plan in the following pages describes the current program and enhancements that would enable Park City to meet the expanding management responsibilities associated with increasing open space lands. This strategic plan also establishes a framework for implementing a multiphase approach to noxious weed management on Park City lands. A more comprehensive program that integrates cutting edge technology is essential to better protect Park City's natural, recreational and economic resources.

To facilitate improvements to this plan, it will remain a living document to be reviewed and refined as the City gains a greater understanding of the distribution of noxious weeds on open space and private lands, weed biology, method effectiveness and the unique needs of Park City. This adaptive approach to weed management allows for improvement through program evaluation and ensures increased efficacy of management actions.

Goals for this management plan:

This plan will serve as guidance for employees and contractors hired by Park City Municipal Corporation for maintenance and development of city property and management of noxious weeds on city lands. The primary objective is to develop an infrastructure and road map for a sustainable noxious weed program. The goal is to provide best management practices (BMPs) for city development and maintenance projects and for the inventory, prioritization, management, and monitoring of noxious weed species within Park City. The following pages describe a strategic program for noxious weed management in Park City.

Objectives for the noxious weed management program:

- Ensure that Park City is in compliance with federal environmental policy and laws (Endangered Species Act and Clean Water Act, National Invasive Species Act; of 1996 OE 13112 of 1999; Federal Noxious Weed Control and Eradication Act of 2004; Utah Noxious Weed Act of 1971) and Summit County amendments to the Utah Noxious Weed List.
- Make more efficient use of limited resources.
- Describe the current noxious weed program and opportunities for improvement.
- Describe BMPs and provide supporting documents to aid in ongoing planning and management actions.
- Develop and implement noxious weed prevention BMPs for all city activities including general street maintenance, building, landscaping, weed management and more…
- Identify and describe current noxious weed distributions on Park City lands, including open space, and develop a database for noxious weed data (species locations using

Spring and summer native wildflowers on Guardsman Pass draw tourists and residents to these higher elevation hiking trails.

GIS, population size, control history).

- Use inventory data and local expertise to prioritize species and particular locations for management.
- Continue to reduce known noxious weed populations and begin managing new populations as they are detected.
- Use cultural practices (revegetation) to increase native plant community resistance to invasion and promote climate change adaptation to enhance this effort long-term.
- Use monitoring data to evaluate the progress of control actions, assess the effectiveness of methods and to facilitate early detection and rapid response protocol.
- Establish partnerships with neighbors (public and private) to address shared noxious weed control goals and reduce reinvasion of Park City lands from adjacent non-city owned lands.

Key proposed enhancements to the Park City Noxious Weed Management Plan:

The success of this weed control program depends on integrating BMPs throughout Park City Municipal Corporation activities. Such BMPs can reduce long term weed management costs. For this reason, BMPs will be established and implemented in all outdoor city activities. This will include training of employees to aid in weed detection, protocol to prevent spread and procurement of equipment necessary to meet program goals. BMPs for management of weeds on open space will also be addressed. Control of noxious weed species on open space differs greatly from control in city parks, gardens and roadways.

Portable vehicle cleaning stations prevent transportation of noxious weed seed to new location.

Open space lands are more complex ecological systems that require greater resources and planning. The current noxious weed program was developed to meet weed management goals in city parks, green ways and roads where ready access and visibility aid in detecting and controlling new weed populations. Open space requires greater labor hours to access and navigate sites far from roads and greater efforts to ensure minimal impact to the natural ecosystem while crews are inventorying, managing and monitoring weeds. Therefore, the approach to noxious weed control on Park City open space lands requires modifications to the current management program.

The Proposed Enhancements:

- Establishment of a full time position focused on the coordination of weed management and development of weed management

partnerships.

- Sufficiently fund and maintain internal staff and seasonal contractors for weed control, as well as, obtain equipment, resources and training necessary to implement the program.
- Expansion of the noxious weed inventory program.
- Development of a noxious weed database for strategic management planning.
- Use of a more integrated management approach to mix management methods for more effective weed control and to increase native plant community resistance to invasion and re-invasion following weed control.
- Development of a monitoring program to track weed management program progress and detect new noxious weed populations.
- Foster partnerships with other land managing agencies and organizations to meet shared noxious weed control goals.
- Increase public education regarding noxious weed species and the part the public can play in reducing them on city lands. Also facilitate the public in meeting their legal responsibility to control weeds on their private lands with the end goal of reducing re-invasion of city lands from noxious weed populations on private lands.

Photo: M. Barndt


Photo: M. Barndt

II. Introduction

The introduction of noxious weeds results in control cost of more than $20 billion annually in the United States (Belliston et al 2009). Non-native weeds currently invade 4,600 acres a day (CSU 2000; Dewey et al 2001; Belliston et al 2009). Many of these species were brought to the United States and thus Utah unintentionally through agriculture, ranching (livestock and livestock feed), and horticultural. Others were introduced intentionally for grazing purposes and through the horticultural industry for landscaping. Human activities have resulted in the rapid spread of many weeds by unintentional transport of seed on vehicles, clothes, equipment, livestock and pets. Human disturbance of intact natural lands, which provides an opportunity for weeds to establish where they formerly could not, has resulted in invasions of natural/wild lands (Cal-IPC 2011).

Noxious weeds are the greatest threat to Utah's natural resources and costs the state hundreds of thousands of dollars annually (Merritt 2004; GSCD 2013). Noxious weeds impact the economy in two ways, losses in valued resources and direct costs. Losses can be in the form of degraded habitat, reduced aesthetics of natural lands, reduced agricultural and ranchland productivity and livestock poisoning. Losses to aesthetics can be hard to quantify, but are important due to the perception of lost value of property or human experience. A loss in value to the human experience may come as a decrease in environmental beauty or health related depending on the noxious weed (Bridges 1994). For communities reliant on recreational generated revenue, such as Park City, loss in aesthetics can have an important, negative economic impact. The presence of noxious weeds can reduce property value by 7-90% depending on the noxious weed species, size of the population and the planned use of the land (nrs.fs.fed.us; se-eppc.org; Bridges 1994; Pimentel 1999). The presence of noxious weeds has a dramatic impact on rangeland productivity. The Bureau of Land Management estimates that species such as Dyers Woad can decrease grazing by 38%, Spotted Knapweed by 80% and Medusahead by 90% (Whitesides 2004). The United States experienced $25 billion losses as a result of noxious weeds in 1999.

Noxious weeds:

- Displace native species
- Reduce habitat and forage for native wildlife
- Cause injury to wildlife, livestock and pets
- Reduce agricultural productivity
- Use already limited water supply
- Increase erosion and stream/river sedimentation
- Clog water way and increase flood severity
- Reduce recreational land value
- Increase the frequency and size of fires

(Belliston et al 2009; Division of Plant Industry 2000)

Impacts related to costs are the actual dollar amounts spent on the management of weeds (Bridges 1994). In 2015, Park City Municipal Corporation spent $120,000 on control of noxious weeds. Impacts in the form of costs for control have been estimated to be $9 - 20 billion annually in the United States alone (Bridges 1994, Pimentel 1999).

Cost of habitat loss as a result of noxious weeds can be difficult to quantify, but clear examples of such losses exist. The Great Basin has experienced substantial loss as a result of cheat

Consumption of some noxious weeds can lead to poisoning and even death in animals. Above are examples of the symptoms of photosensitivity in Cattle and Horses after eating Houndstongue.

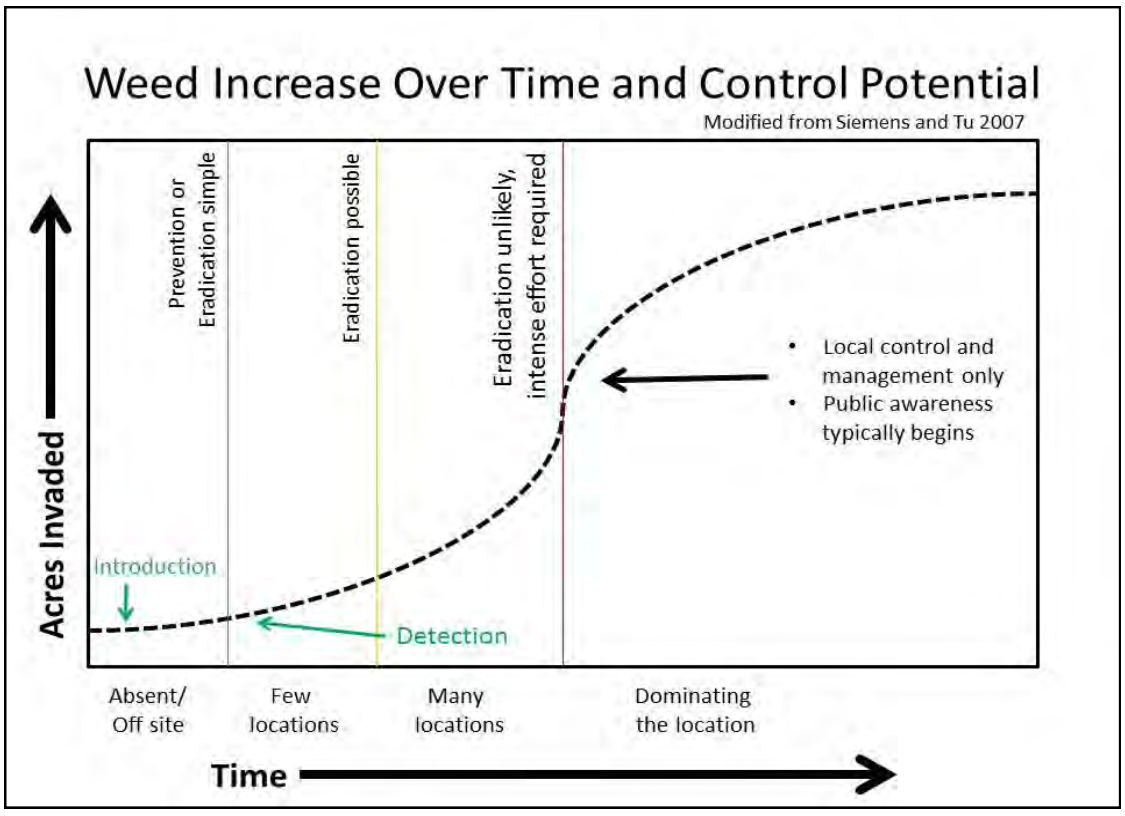
Cheat grass has substantially increase fire risk across the Great Basin.

grass invasion. Cheat Grass invasion has increased both the frequency and size of fires on sage brush habitat (Whisenant 1998; Mosely et al 1999, Merritt 2004; Division of Plant Industry 2000; Whitesides 2004). The flammable leaves of this grass fill the spaces that would naturally occur between shrubs creating connectivity that carries fire farther than would naturally occur.

In much of the Western US, Spotted Knapweed has also caused habitat damage. Infestations have been found to reduce habitat use by elks by 98% (Hakim 1979) and infestations near streams can increase runoff by 56% increasing sediment deposition in streams by 192% (Lacy et al 1989).

Noxious weed management is essential to preserve the natural environment and support the quality recreational experience provided by Park City. The best method of noxious weed control is always prevention, followed by Early Detection and Rapid Response (EDRR) (Cal-IPC 2011). EDRR is a national strategy for monitoring lands regularly to detect new noxious weed populations and rapidly eradicate them before they fully establish.

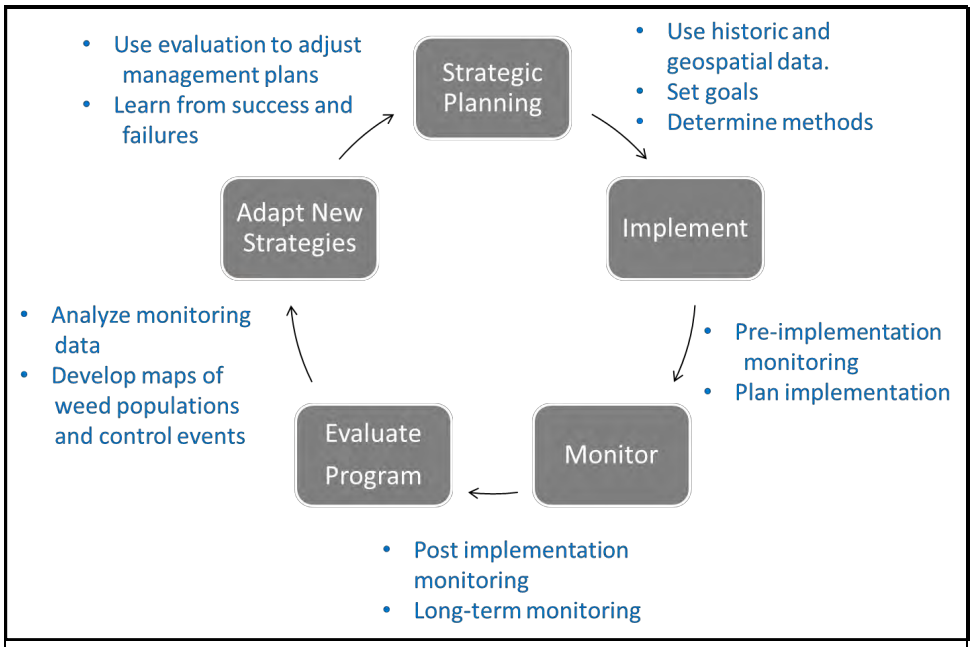
The cost of control exponentially increases while the likelihood of eradication declines as the



Without regular monitoring and prevention, noxious weed population will establish and rapidly grow to sizes that require increasing large costs to control. By the time the public typically becomes aware a weed is a problem, it is too late to eradicate and containment of the weed becomes the goal.

size of a weed population increases (Siemens and Tu 2007). Once populations reach greater than 2.5 acres, eradication is unlikely and management often needs to focus on containment and control (Rejamnek and Pitcairn 2002). For this reason, regular monitoring of lands is critical to ensure new weeds are identified rapidly when still "easily" controlled.

Noxious weed control is usually a long-term and complex endeavor, thus goals for weed control need to be realistic and strategic. One approach is to prioritize noxious weed species or populations for eradication, control or containment based on the species potential for negative impacts and likelihood of successful treatment. Eradication is the complete removal of all individual plants and seeds from a site. Once a plant is eradicated, it does not come back without reintroduction. Control aims to reduce the population size with the hope that eradication may eventually be possible. When populations are too large to control, management focuses on containment. This approach treats the edges of weed populations to prevent expansion (Zavaleta et al. 2001).Prioritiztion reduces long-term control costs by removing controllable populations while preventing increased damage by existing, larger populations.



Adaptive management strategically plans management using current information and evaluates management effects over time to inform improvements to management plans over time.

Once noxious weeds are established, the most effective weed management strategy is an integrated approach where multiple control methods are used together to increase the overall effect of noxious weed control (Division of Plant Industry 2000; GSCD 2013). An integrated weed management program combines methods such as: inventory/mapping, herbicide, mechanical controls, biological agents, re-vegetation with competitive native species, long-term monitoring, equipment inspections and cleaning for work crews and more. Incorporating a variety of methods in a management plan not only increases likelihood of success, it lends itself to an adaptive management approach where progress is monitored and evaluated to determine if new techniques are needed at a particular location (GSCD 2013).

Adaptive management allows for increased efficiency and effectiveness. It also allows the integration of new environmental components, such as human land uses and impacts of climate change ,while managing the weeds for today and future generations of Park City residents and visitors (Sale Lake City Weed Management Plan, State Plan, County plan, Division of Plant Industry 2000). One adaptive approach is to use seeding or planting of natives or non-invasive non-natives to manage natural plant communities to discourage

invasion or reinvasion of noxious weeds following weed control. Noxious weeds are opportunistic in that they will quickly establish in newly exposed bare ground. Seeding with a native or short lived non-native plant that does not compete with natives will cover bare ground and aid in prevention of noxious weed invasion. Naturally, some plants die over time so monitoring is needed to know when new actions are necessary to continue to support a plant community that resists invasion.

Noxious weeds clearly pose a substantial threat to conservation and the economy; therefor, it is no surprise the federal government initiated a national weed control policy in 1996 and later expanded the policy in 1999 and 2004 to incorporate wildland weeds. The 1999 Presidential Executive Order 13112 called for the formation of a Federal Invasive Species Council to render the federal response to introduced species more effective, and to foster cooperation among federal agencies, state agencies, and other stakeholders such as conservation organizations and private landowners (Simberloff 2000). Federal noxious weed regulations aim to prevent importation and the crossing of state borders by new potential weed species. It is at the state, county and city level that control of federally and state listed species is regulated (EPA 2006).


Dalmatian Toadflax

The state of Utah passed the Utah Noxious Weed Act, Title 4 chapter 17 in 1971. The Act and supporting documents (regulation 68) provide guidance for listing and controlling noxious weed species from the Department of Agriculture and Food. The Act calls for the State and local county officials to develop and implement noxious weed control programs. This includes the enforcement of noxious weed codes to support state wide goals of controlling current noxious weeds and preventing spread of these and other noxious weeds (Utah Noxious Weed Act 1971; Whitesides 2004). Regulations specify that control of noxious weeds is required on public and private lands. Weed laws give the authority to and requires local government to inform private land owners when their lands contain noxious weeds and to give the land owner the opportunity to control the species. In the case that the property owner fails to control weeds following notification, the local government should control the weeds at the expense of the property owner.

> ***Weed*** – a plant out of place, unwanted.
>
> ***Noxious Weed*** - a weed that has negative impacts on the natural lands, waters, native plants and animals and may affect human health and economics (Utah Noxious Weed Act 1971; Whitesides 2004).

Weed control is considered a "good neighbor" practice because weeds spread quickly making weeds everyone's problem (Division of Plant Industry 2000). All 29 counties within Utah are invaded by at least one of these state designated noxious weeds and noxious weeds are estimated to be increasing by 14% annually in Utah alone (Whitesides 2004). Noxious weeds do not respect jurisdictional and ownership boundaries, which means successful state wide management will require cross boundary partnerships and data sharing. Standardizing data across agencies, organizations and other entities goes a long way towards reaching state and regional goals. Cross boundary partnerships can also facilitate strategic use of multi-partner

Common Name	Scientific Name
Utah State Class 1A	
African Rue	*Peganum harmala*
Common Crupina	*Crupina vulgaris*
Malta Thistle	*Centaurea melitensis*
Mediteranian Sage	*Salvia aethiopis L.*
North African Grass	*Ventenata dubia*
Plumeless Thistle	*Carduus acanthiodes*
Small Bugloss	*Anchusa arvensis*
Spring Millet	*Milium vernale*
Syrian Beancaper	*Zygophyllum fabago*
Utah State Class 1B	
African Mustard	*Brassica tournefortii*
Camelthorn	*Alhagi maurorum*
Common St. Johnswort	*Hypericum perforatum*
Cutleaf Vipergrass	*Scorzonera laciniata*
Elongated Mustard	*Brassica elongata*
Garlic Mustard	*Alliaria petiloata*
Giant Reed	*Arundo donax*
Goatsrue	*Galega officinalis*
Oxeye Daisy	*Chrysanthemum leucanthemum*
Purple Starthistle	*Centaurea calcitrapa*
Japanese Knotweed	*Polygonum cuspidatum*
Viper's Bugloss	*Echium vulgare*
Utah State Class 2	
Black Henbane	*Hyoscyamus niger*
Dalmatian Toadflax	*Linaria dalmatica*
Diffuse Knapweed	*Centaurea diffusa*
Dyer's Woad	*Isatis tinctoria*
Leafy Spurge	*Euphorbia esula*
Medusahead	*Taeniatherum caput-medusae*
Purple Loosestrife	Lythrum *salicaria*
Rush Skeletonweed	Chondrilla juncea
Spotted Knapweed	*Centaurea maculosa*
Squarrose Knapweed	*Centaurea virgata* (*Centaurea squarrosa*)
Yellow Starthistle	*Centaurea solstitialis*
Yellow Toadflax	*Linaria vulgaris*

Common Name	Scientific Name
Utah State Class 3	
Bermudagrass	*Cynodon dactylon*
Canada Thistle	*Cirsium arvense*
Common Reed	*Phragmites australis ssp.*
Field Bindweed	*Convolvulus arvensis*
Hoary Cress	*Lepidium draba*
Houndstongue	*Cynoglossum officinale*
Johnsongrass	*Sorghum halepense*
Jointed Goatgrass	*Aegilops cylindrica*
Musk Thistle	Carduus *nutans*
Perennial Pepperweed	*Lepidium latifolium*
Poison Hemlock	Conium *maculatum*
Puncturevine	Tribulus terrestris
Quackgrass	*Elytrigia repens*
Russian Knapweed	*Acroptilon repens*
Saltcedar/ Tamarisk	*Tamarix chinensis*
Scotch Thistle	*Onoprodum acanthium*
Sorghum Almum	Sorghum almum, A, parodi
Utah State Class 4	
Congagrass	*Imperata cylindrica*
Dame's Rocket	*Hesperis matronalis*
Myrtle Spurge	*Euphorbia myrsinites*
Russian Olive	*Elaeagnus angustifolia*
Scotch Broom	Cytisus scoparius
Summit County Class A - addition to State	
Viper's Bugloss	*Echium vulgare*
Summit County Class B - addition to State	
Common Burdock	*Arctium minus*
Corn Chamomile	*Anthemis arvensis*
Mayweed Chamomile	*Anthemis cotula*
Scentless Chamomile	*Tripleurospermum perforatum*
Summit County Class C - addition to State	
Bull Thistle	*Cirsium vulgare*
Park City Municipal Corporation - addition to State	
Cheat Grass	*Bromus tectorum*

Fifty six noxious weed species are designated at the state level, 6 additional species at the county level and 1 additional species at the level of Park City Municipal Corporation. Designation varies by county and city as a result of which noxious weed species have reached each county and city.

resources to meet a shared goal. Funding for weed control is commonly inadequate. For that reason, it is essential to assess the current noxious weed distribution, prioritize control efforts, and work towards partnerships to increase the impact of a limited weed control effort.

In the case of the Park City Municipal Corporation, the weed control program was established for city parks and green areas along right of ways that are typically associated with Parks Departments. Park City and its residents put a high value on environmental conservation and close proximity of natural lands. As such, Park City Municipal Corporation continues to acquire open space lands and with this increase in lands, the Park City weed program must also expand to

meet the increased management needs. These enhancements to the program would not only support the environmental culture of Park City, but work towards greater regulatory compliance.

Park city Municipal Corporation Program Noxious Weed Control Goals:

The Park City Municipal Corporation noxious weed management goals have been to prevent further noxious weed invasion and control current weed populations. Moving forward, that goal is being expanded to include the preservation of open space through the control of noxious weed species and enhancement of native, plant community resistance to invasion and re-invasion of noxious weeds following weed control. The enhancements to the noxious weed control program will promote implementation of an ecologically based, integrated, pest management program. Additionally, it establishes guideline for its employee and consultants to ensure compliance with federal, state and county weed regulations (Utah Weed Act 1971; US Government 1972, 1988). These goals are to be reached through education and research, mapping and monitoring, prevention (EDRR), integrated weed management (Division of Plant Industry 2000), restoration, regulation and enforcement and the funding of such actions (Whitesides 2004, Utah Weed Act 1971Noxious).

Houndstongue

Short-term goals

- Establish a full-time weed management coordination position to facilitate compliance with federal, state and county laws/policies and meet the goals of the Park City Municipal Corporation Noxious Weed Management Program.
- Reduce or eradicate the few known populations of species with limited distribution. e.g. Garlic Mustard and Poison Hemlock
- Continue to contain and reduce other known, more common species and larger populations.
- Increase inventory efforts for open space lands to describe the current extent of noxious weed invasion.
- Develop a noxious weed distribution database for planning, prioritization, management and evaluation of the program.
- Develop weed inventory, management and monitoring guidelines for city employees and contractors to prevent new invasion and assist in control of known populations. Standardized methods and data reporting ensures quality data capable of demonstrating weed control progress.

Long-term goals

- A complete inventory of all Park City lands (current and future).
- Continue to reduce noxious weed populations and noxious weed seed banks.
- Develop a monitoring program to assess program effectiveness and detect new populations and species.

- Use inventory and monitoring data to identify new weed species so they may be evaluated for inclusion on the city noxious weed list.
- Integrate revegetation into weed control to increase plant community resistance to invasion preventing future control costs.
- Maintain current and develop new partnerships in weed control to increase cross jurisdictional efforts.
- Develop and implement a public outreach program to increase awareness and partnerships.
- Improve the Park City Municipal Corporation Noxious Weed Management Program through regular review and integration of new information, BMPs and cutting edge technology.

Bull Thistle (Cirsium vulgare)	Mayweed Chamomile (Anthemis cotula)
Canada Thistle (Cirsium arvense)	Musk Thistle (Carduus nutans)
Cheat Grass (Bromus tectorum)	Myrtle Spurge (Euphorbia myrsinites)
Common Burdock (Arctium minus)	Oxeye Daisy (Chrysanthemum leucanthemum)
Dalmatian Toadflax (Linaria dalmatica)	Perennial Pepperweed (Lepidium latifolium)
Diffuse Knapweed (centaurea diffusa)	Poison Hemlock (Conium maculatum)
Dyer's Woad (Isatis tinctoria)	Scotch Thistle (Onoprodum acanthium)
Field Bindweed (convolvulus arvensis)	Spotted Knapweed (centaurea maculosa)
Garlic Mustard (Alliaria petiloata)	Yellow Star-Thistle (Centaurea solstitialis)
Hoary Cress (Lepidium draba)	Yellow Toadflax (Linaria vulgaris)
Houndstongue (Cynoglossum officinale)	

Twenty one noxious weeds currently known to be present on Park City lands and adjacent private property.

Thistle species are common along waterways where their light, wind spread seeds can spread even further on the current of a stream.

III. Current Park City Municipal Corporation Noxious Weed Management Program

Existing Conditions

Park City encompasses a number of ecosystems including: mountain sage brush, oak scrub brush, mountain mahogany, pine forest, aspen groves, wetlands and meadows. These systems commonly support moose, deer, elk, mountain lion, bear, coyote, migratory and predatory birds and more. In addition, these systems support a few rare and endangered species and species of concern, including the Yellow-billed Cuckoo, June Sucker, Ute Ladies'-tresses, Canada Lynx and Greater Prairie Sage Grouse. Preservation of the habitat of these latter species is especially critical to prevent irreversible losses and to comply with the Endangered Species Act (US Government 1988). Because Park City is a semi-arid climate, preservation of the associated watersheds and wetlands, ponds and lakes is especially critical. Healthy plant communities aid in this effort by preventing erosion and sedimentation of waterways and filtering water as it seeps into the ground.

Current estimates of weed invasion in Park City are based primarily on city parks and roads data, limited reports from weed control contractors and developing weed inventory program.

Greater than 70 are known to be invaded by one or more noxious weed species. With recent

increases in city owned open space, this is likely a substantial under estimate of invaded invasion. Twenty one noxious weed species have been identified with varying population distributions and densities within Park City Open Space Lands. Of these species, Musk Thistle, Dyer's Woad, Canada Thistle and Houndstongue are most common. Four other species are of great concern due to their potential for spread and impact to natural lands: Garlic Mustard, Diffuse Knapweed, Spotted Knapweed and Yellow Star-Thistle. An increase in resources to support weed inventory is critical to obtain an accurate estimate of invaded acreage and to enable development of strategic management plans. Given that noxious weeds can increase population size by 14 % annually, undetected populations on Park City lands could quickly become long-term, costly investments.

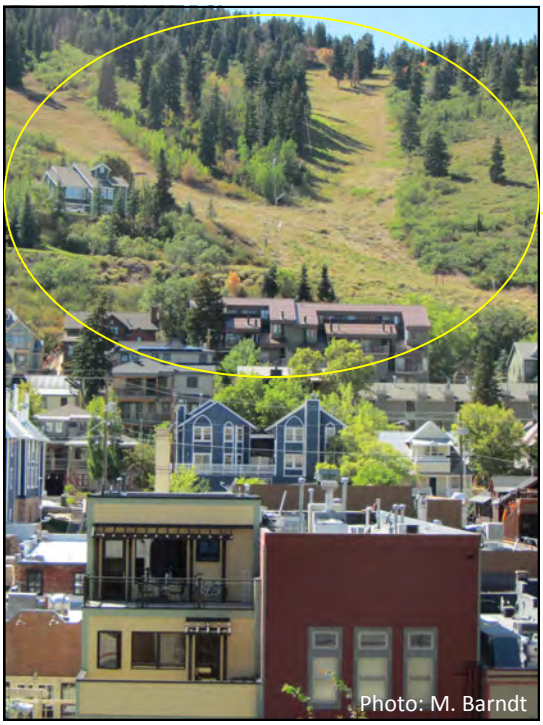
Garlic Mustard

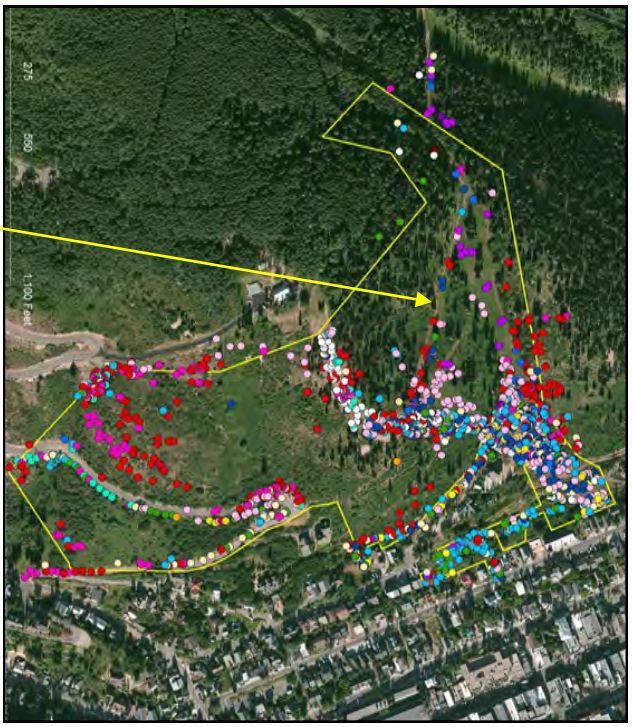
Spotted Knapweed

Current Program

The current weed management program is administered by the Parks Department which was originally established to manage green areas and roadways within the city proper. The city has been acquiring open space and put it under the jurisdiction of the Parks Department. However, management resources have not increased to meet the demands associated with managing these new lands.

The current program is managed by four Parks Department employees, Maria Barndt, Clint Dayley, Scott Simmons, and one Sustainability





From a distance it is difficult to see that Treasure Hill is has large populations of several noxious weed species including some concerning species such as Spotted and Diffuse Knapweed and Garlic Mustard. Each colored circle on the above map represents a noxious weed population. Without inventory, these populations would have gone uncontrolled.

Department employee, Heinrich Deter, who also hold other positions in their department. Current annual management plans have been based on previous year's treatment and scouting, in addition to reporting of weed populations from employees, public and contractors. The Department responds to reports with control actions as quickly as possible.

The Parks Department has contracted the inventory of specific parcels of open space at different times in the past. In 2006, the Summit County Cooperative Management Area (CWMA) inventoried 1,645 acres (2.5 square miles) including areas in Round Valley, around water tanks and the Flagstaff area. At that time, 50 of those acres (0.08 square miles) were invaded and this was considered a conservative estimate. The CWMA voiced concerns at that time that greater levels of invasion of several species including Knapweeds were present on private property adjacent to city lands. These populations are of high concern as they are a seed source for spread into city lands and will lead to future control costs to the city. In 2015, additional inventories were contracted through Ecology Bridge and again weed populations on private land were a concern with some having begun to move onto city land. As of the end of the 2015 season over 2000 acres have been specifically inventoried for noxious weeds.

Multiple methods of control have been used by the Parks Department including, but not limited to: hand pulling, mowing, grazing, biological control agents and herbicide. Like many successful programs, the Parks Department aims to control species before the plants produce seed To do this, they prioritize species over the duration of a season based on noxious weed phenology (life stage). Control initially focuses on all species equally and shifts focus as each species goes to flower. This protocol allows for rapid response to noxious weed growth rates and minimizes seed set that would supply the next season's weed population. An estimated 430 acres of land have been treated annually for noxious weeds with select locations treated 2-3 times in a single year. Treatments have occurred primarily through contractors and through city employee contributions when possible. In 2015, eight weed control contractors were hired and these eight companies were unable to treat all locations targeted by the Parks Department. There is an urgent need for more contractors and an increase in contract value limits to allow for greater acres treated with less contract management costs per year (CWMA 2006; Dickens 2015 a,b)

The Department employs one herbicide applicator who primarily concentrates on greenways, roads and green/irrigated parks and gardens. Given any additional time, this staff member assists with open space; however, this time is usually very limited. In general, the program thus far has been effective at controlling weeds within the primary jurisdiction of the Parks Department and have dedicated what resources and time they could to the newer open space lands.


Photo: M. Barndt

The Parks Department uses grassroots/ volunteers when possible to offset some costs of weed control, but also as an opportunity to educate the public regarding the importance and difficulties of weed control. There is a desire to increase this public education; however, it will need to be done strategically as many citizens do not hold a favorable opinion of herbicide use. Greater collaboration with other departments and

organizations may facilitate a more active public outreach program in the future.

Currently there are no protocol for general city employees outside of the weed control program to assist in prevention of weed spread. Most weed species are facilitated by ground disturbance and the highest levels of noxious weed invasion occur on lands that have been recently disturbed (Whitesides 2004; Cal-IPC 2011; GSCD 2013). Activities such as road maintenance, building and repairing facilities and general outdoor property maintenance have the possibility of spreading noxious weed seed if proper protocol are not in place. Noxious weed invasions are common in areas of Park City that have recently experienced construction and maintenance.

Given that management of open space is very different from the green spaces within the city proper along with current, limited resources, the Parks Department has made commendable strides towards noxious weed management goals and compliance with state regulation. The number of acres inventoried continues to increase and posting of signs to notify the public of planned herbicide treatments is now standard. These are strategies to improve weed management outcomes and public relations. That said, the program could be considerably more successful with an increase in resources and addition of personnel whose primary focus is to coordinate weed management.

Those within the Parks Department currently responsible for weed management typically dedicate 25% of their time to noxious weed control and are often pulled away from weed management actions to address other time sensitive Parks Department matters. While their attention is diverted from weed control, weed populations they had begun controlling can rebound and even expand to levels that are nearly uncontrollable. The Parks Department doesn't have a person responsible for weed management planning year round, which results in delayed contractor agreements and late weed control start dates. This prevents contractors from treating weeds in the spring while weeds are most vulnerable (seedling and small rosettes). There is a consensus among the top Parks Department employees that these interruptions in weed control focus and the absence of a monitoring program, along with, late starts of contracted weed controllers have limited their ability to make greater headway.

This year, for the first time, the most problematic weed sites were treated in the fall when perennial weeds are again more susceptible to control. The anticipated results are reduced second season plants (perennial and biannual weeds flower and seed in the second growing season) and seed production next year. The Parks department had not been able to conduct such fall treatments in previous years, but hope to continue this approach going forward.

Thistle Rosette

Program Needs

To successfully implement weed management within Park City, substantial updates to the noxious weed management program are necessary. The first of which is the development of a full time weed management coordinator to focus solely on weed management on Park City lands. A coordinator would increase contract efficiency and could increase public education to

support more positive interactions and enforcement of weed laws in partnership with the enforcement office. A partnership with the enforcement office, along with a protocol, is needed to ensure timely notification and enforcement of weed laws on private lands. In the past, this has been an area that has lacked action out of the lack of a protocol and availability of the enforcement officer.

In addition to a coordinator, the program needs to integrate available technology, such as GIS, to support full inventory of open space lands for informed management planning. Development of prioritization criteria are needed to guide annual program plans and BMPs are needed for city employees and contractors hired by Park City Municipal Corporation.

Establishment of contracts with contractors earlier in the year (before March 15th) is critical to ensure management begins at the start of the season, as well as, in the fall when weeds are most susceptible to control methods. To meet the growing need for weed control contractors, the program will need to solicit new contractors from the surrounding area. Additionally, there is a need to increase weed contract value limits from $14,500 to $24,500 to allow the Parks Department to treat more land with fewer contractors and dedicate fewer coordinator hours towards soliciting contractors, arranging contracts and evaluating contractors.

Garlic Mustard

Increased grant writing to support specific control projects would be a better use of coordinator time than managing a greater number of contactors under the $14,500 contract value limit. Beginning in 2014, the Parks department partnered with several local organizations on a Garlic Mustard control program. This program received grant funding that allowed the Parks Department to address a particularly problematic weed with almost no cost to the city. Other such grant and partnering opportunities exist, however, there currently isn't personnel available to find and take advantage of them.

Along with changes to the above administrative tasks, the program needs to develop a monitoring and evaluation program to track success of the program and inform management in the future. Reduction of noxious weed spread requires development of protocols for city employees and contractors that work on city lands. Training of these employees and contractors should be provided for the noxious weed prevention protocol, as well as, general noxious weed identification. Lastly, there is a need to increase partnerships with neighbors for collaborative efforts particularly with adjacent land owners to prevent invasion of Park City lands from private lands or those managed by other organizations and agencies.

IV. Revised Park City Municipal Corporation Noxious Weed Management Plan

Program Leadership

It is proposed that a new, full time position responsible for weed management in Park City Municipal Corporation space lands be created. This person should maintain regular communication with the Summit County weed supervisor to maintain awareness of new weed concerns and potential for collaborative projects and funding opportunities.

The new position would also be responsible for:

- Developing resources and infrastructure to support the revised Park City Municipal Corporation Noxious Weed Management Program.
- Ensuring the develop of a database of weed control contractors and manage contracts prior to and throughout the season to ensure treatment occurs when most effective. (This includes soliciting new contractors)
- Administering the Park City Municipal Corporation Noxious Weed Management Plan (Inventory, Planning, Weed Control, Monitoring and Public Outreach).
- Coordinating with neighboring entities for cross boundary management planning.
- Serving on the Summit County CWMA.
- Continually assessing mechanisms of noxious weed invasion and modifying the prevention protocol accordingly.
- Providing weed training to City Employees.
- Maintaining a noxious weed database and preparing annual progress reports .
- Evaluating contractors and the Park City Municipal Corporation Noxious Weed Control Program annually to assess program efficiency and identify on-going program needs.

Methods of Planning

To reach the weed management goals of Park City Municipal Corporation, three types of planning will be important: planning to meet regulatory goals, prioritization planning to strategically use resources and integrated weed management planning for effective, long term control.

Planning to meet regulatory standards

Utah Weed Act 1971:

Integration of this noxious weed management plan will ensure Park City Municipal Corporation is in compliance with federal regulations and the Utah Noxious Weed Act. The Act calls for the control of noxious weeds on public and private lands. It further requires the mapping of noxious weeds on public lands. It promotes collaboration with the city code enforcement office to enforce the Act on private lands. It additionally, aims to engage the public through outreach that may lead to voluntarily compliance.

Endangered Species Act:

Identification of endangered species and their habitat prior to disturbance of public lands is essential to meeting the regulations of

Yellow Billed Cuckoo

the Endangered Species Act. For that reason, the weed coordinator will obtain up to date endangered species information from the United States Fish and Wildlife office and categorize weed control areas as, containing, bordering or absent endangered species and their critical habitat. This will allow for more ecologically based management strategies on a site by site basis.

Clean Water Act:

Identification of all bodies of water, wetlands, and streams/rivers followed by site specific planning will ensure no contamination of water resources. Contractors will be required to follow all herbicide labels with special care when treating areas near wetlands and waterways. When grazing is used, care will be taken to minimize grazer access to rivers and streams by providing other sources of water.


Photo: M. Barndt

Prioritization Planning

Noxious weed management is costly and there is rarely adequate resources available to control every noxious weed populations across a given landscape at one time. Prioritization of species and sites allows for organized and rapid implementation of annual management plans and adaptive management when new populations of priority or new species are detected. Development of a formal prioritization strategy will need to be a phase one priority for this new weed management plan. The CWMA 2006 survey resulted in a prioritization scheme that can, with the Utah Noxious Weed Control Act, be a starting point for city wide planning.


Houndstongue: Class C now Class 3

The state of Utah Noxious Weed Act (1971) prioritizes noxious weeds according to classes A, B, and C (Utah Noxious Weed Act 1971). Starting in 2016 these classes have been redefined and added 28 new species.

Original Classification Categories

Class A Species:

Noxious weed species not native to the state of Utah that pose a serious threat to the state. These species should be of highest priority and are suitable for the Early Detection Rapid Response (EDRR) program.

Class B Species:

Noxious weeds not native to the state of Utah, that pose a threat to the state but are beyond the point of EDRR. These species are suitable for active control and may still be eradicated.

Class C Species:

Noxious weeds not native to the state of Utah that are widely spread but pose a threat. These species/ populations, have reached a population size or distribution that makes eradication unlikely, therefore, containment of populations should be the goal for management.


Musk Thistle: Class C now Class 3

New 2016 Class Categories

Class 1A Species:

Noxious weed species not native to the state of Utah that are present in adjacent states, but are either not present in Utah or exist in only a few locations. These species are of the highest concern and are suitable for the Early Detection Rapid Response (EDRR) program.

Malta Thistle (left) is a newly designated Class 1A species similar in appearance to the previously designated species, Yellow Starthistle (right) which is now a Class 2 species. Yellow Starthistle thorns are yellow to tan, stiffer and twice as long as the reddish thorns of Malta Thistle

Class 1B Species:

Noxious weed species not native to the state of Utah that are present in adjacent states, but are either not present in Utah or exist in only a few locations. These species are also high concern and suitable for the Early Detection Rapid Response (EDRR) program.

Class 2 Species:

Noxious weeds not native to the state of Utah, that pose a threat to the state but are beyond the point of EDRR. These species are suitable for active control and may still be eradicated.

Class 3 Species:

Noxious weeds not native to the state of Utah that are widely spread but pose a threat. These species/ populations, have reached a population size or distribution that makes eradication unlikely, therefore, containment of populations should be the goal for management.

Class 4 Species

Non-native plants that have been declared noxious weeds because they pose a threat to the state through retail sale of propagation in the nursery or greenhouse industry. These species are known to be detrimental to human or animal health, the environment, public roads, crops, livestock or other property.

These classes are policy guidelines based on the likelihood of eradication, potential for impact and the present, estimated distribution in the state. However, the Utah Noxious Weed Act empowers counties to add species to the list and re-prioritize species based on county wide distributions. Park City will follow the guidance of Summit County using their expanded list. The particular species Park City deals with match that of the state and county, but the species that are most problematic varies. The most problematic species in Park City include the thistles (Musk, Canada, and Scotch), Dyer's Woad, Garlic Mustard and Houndstongue. Poison Hemlock and the knapweeds have been growing in distribution and should be a priority for 2016.

<u>High priority weeds and populations include:</u>

- New species or species not yet common.
- Small populations, particularly if the species is highly invasive.
- Populations adjacent to intact habitat and to areas of high seed spread potential (roads, trails, waterways).
- The edges of larger populations too big to eradicate – controlling the edge will contain the population.

Low priority weeds and populations include:

- Large populations beyond capacity for eradication (containment is the suggested strategy for these species and populations.)
- Weeds that are less invasive or dependent on disturbance for establishment.

Not all noxious weeds are equal from both the stand point of their impact and the resources required to control them. Some species, such as Yellow Starthistle ,are known to spread more rapidly and be more persistent than other species, such as Bull Thistle. In general, annuals and biennials are easier to control than perennials that commonly have well developed root systems from which they recover when damaged aboveground. The biology of the species is a strong determinant of the appropriate control method, but environmental context and season will also be important considerations.

Noxious Weed Prioritization by the CWMA 2006

Common Name	Scientific Name
High Priority: Goal is Eradication	
Diffuse Knapweed	*Centaurea diffusa*
Garlic Mustard	*Alliaria petiloata*
Scotch Thistle	*Onoprodum acanthium*
Yellow Starthistle	*Centaurea solstitialis*
Medium Priority: Goal Control	
Bull Thistle	*Cirsium vulgare*
Canada Thistle	*Cirsium arvense*
Cheat Grass	*Bromus tectorum*
Common Burdock	*Arctium minus*
Dalmatian Toadflax	*Linaria dalmatica*
Houndstongue	*Cynoglossum officinale*
Musk Thistle	Carduus *nutans*
Oxeye Daisy	*Chrysanthemum leucanthemum*
Perennial Pepperweed	*Lepidium latifolium*
Lower Priority (but important): Goal Containment and Control	
Dyer's Woad	*Isatis tinctoria*
Hoary Cress	*Lepidium draba*
Scentless Chamomile	*Tripleurospermum perforatum*
Spotted Knapweed	*Centaurea maculosa*
Yellow Toadflax	*Linaria vulgaris*

Yellow Starthistle currently covers 19,760 acres of US lands. It is one of the Western United States worst weeds due to the rapid rate at which it spreads, the difficulty in killing it and the harm it causes to wildlife (http://www.fs.fed.us/database/feis/plants/forb/censol/all.html).

Noxious Weed Prevention Plan

Prevention is the most cost effective method of noxious weed control. Too often management of noxious weeds does not begin until the population has reached a size that will be costly to control and require long-term commitment. Once a species is established, the cost of control grows exponentially as the population size increases (Siemens & Tu). The first step in prevention is to ensure an inventory and monitoring program is established and maintained. This program should be supported by a geospatial database to track weed populations and control efforts over time.

Identifying mechanisms by which weeds are reaching Park City lands and developing BMPs around interrupting these mechanisms is integral to a prevention plan (Simberloff et al. 2013; Sheley et al. 2015). These mechanisms commonly include city land management

Burs from Houndstongue (above) and common burdock regularly become tangled in the fur of livestock, pets and wildlife.

practices, so it is important to assess all city activities for their potential contribution to weed spread and develop BMPs to prevent future spread. Seed or plant material can travel on: clothing, boots/shoes, vehicles/recreational equipment, animals, tools and imported soils and plants (Cal-IPC 2011).

In 2006, an inventory conducted by the CWMA indicated that most populations of weeds detected in that inventory were associated with

recent "earth moving activities". This was likely due to a combination of increased bare ground, disturbed ground, seed contamination from equipment, clothing and fill material, along with, the lack of or unsuccessful post disturbance revegetation (CWMA 2006). Protocol for identification of and removing mechanisms of noxious weed spread is essential to prevention.

During the planning phase of all outdoor maintenance and building projects, planners should contact the Parks Department to determine if there are any known noxious weed species at the project site. It is advised that planners either have the Parks Department visit the site or hire a contractor to assess the site for noxious weeds. The coordinator or weed contractor will provide site specific recommendations for weed prevention. Such recommendations would identify the preferred locations for parking vehicles, areas for cleaning vehicles, equipment and clothing and areas where it is particularly important to limit traffic and soil disturbance.

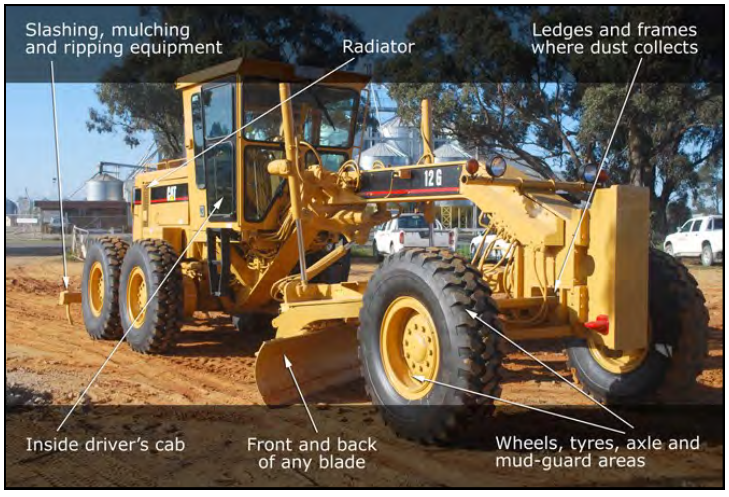
Recommendations may also include descriptions of how to properly revegetate or provide ground cover after project completion. The costs of this assessment and development of recommendations will be written into project budgets to ensure adequate funding to address noxious weed concerns. Planners will also use weed free materials (soils, gravels, mulch, hay and seed mixes) whenever possible to prevent introduction of new weeds to the project area.

Prior to breaking ground on a new project, city employees will have obtained proper weed seed cleaning equipment or

know where this equipment is, as well as, receive training on how to use it. Employees and contractors will receive training on noxious weed identification and prevention of weed spread each season and tailgate training at the start of any new project. The expense for this training will be the

responsibility of contractors when work is being completed by contractors for the city. Contractors will be required to submit evidence that such training has occurred. The city will provide trainings to employees at least once annually and provide supporting training materials funded by the noxious weed program budget.

During the implementation of a project, all vehicles and equipment will be cleaned prior to traveling to the site. Designated parking, equipment storage, equipment cleaning areas and areas to avoid will be clearly marked on a project site map and communicated to all employees. At the end of each work day, equipment will be inspected for the presence of seeds and cleaned. This includes vehicles (when possible), tools and clothing. Once a project has been completed, a map of where activities, vehicle storage and designated cleaning sites occurred will be provided to the Parks Department to assist in strategic post project monitoring. The site will be monitored for new weeds for 2 to 3 years and weed populations managed. Costs associated with these post monitoring events will be integrated in the project budget.



Action Items:

- Identify mechanisms of introduction and dispersal to aid in prioritizing monitoring programs and guide policy for reducing introduction where possible.
- Develop a regular monitoring schedule to detect new species and populations.
- Develop BMPs for soil disturbance and post noxious weed control revegetation (e.g. weed free materials).
- Develop and implement a strategy or mechanism for reporting new invasions (EDDMAPS?)
- Develop checklists to aid in field compliance to the weed management program.
- Implement a requirement that funding be set aside for noxious weed monitoring and training for all development and maintenance contracts.
- Develop trainings (or contract out) and training materials. Use these materials to train all city field employees to aid in the detection of noxious weed populations and in proper clothing, equipment and vehicle management on site and cleaning on and off site.
- Identify intact plant communities/weed free zones and prioritize these areas for monitoring and EDRR. These areas may also act to inform revegetation plans as they may be representatives of a community that is more resistant to invasion.
- Public education – see the section on Public Outreach and Education on page 26.

Initial Best Management Practices (BMPs)

- Maintain a monitoring program for all city

lands.

- Inspect and clean seed and soil from clothing, boots, equipment and vehicles between sites for all city sponsored activities.
- Locate working bases and park vehicles in weed free areas of the site whenever possible to reduce seed spread.
- Minimize disturbance of native plant communities and soils.
- Procure cleaning equipment to support the practice of vehicle and equipment cleaning between sites.
- Require weed free materials as much as possible.
- Inspect new development/project areas for 2-3 years following completion to monitor for and control disturbance facilitated weeds, especially when soils have been brought in from off site.

Inventory

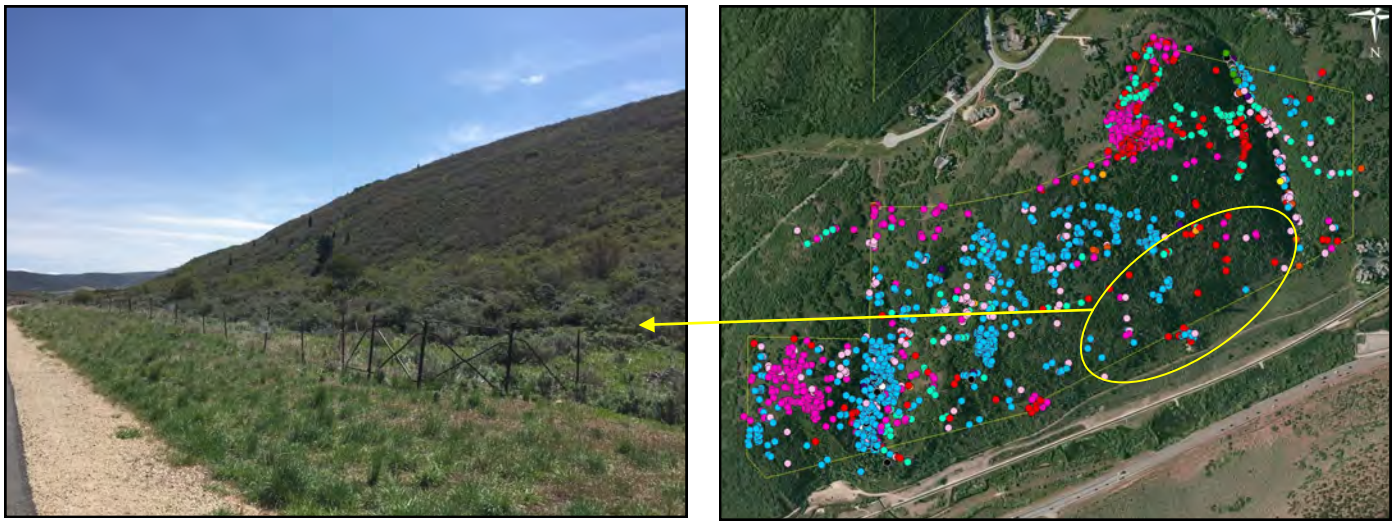
Inventorying of lands for noxious weeds is essential to identifying and describing the extent of noxious weed infestations to inform management planning and budgeting. Inventory establishes a baseline, where as, monitoring tracks changes in current weed populations over time and program effectiveness. Both inventory and monitoring are necessary to inform management planning and plan improvements (Division of Plant Industry 2000; Whitesides 2004).

Inventory Objectives:

- Identify and map the extent of noxious weed populations on Park City Lands.
- Provide an accurate and up-to-date estimate of acres invaded.
- Identify weed free zones to be protected from invasion
- Establish a complete database of noxious weeds on Park City lands for the purpose of annual, strategic management planning.
- Establish a standardized method for data collection to allow tracking of success over time and facilitate data sharing with partners .

Inventory Methods

To comply with state recommended guidelines, the Park City Municipal Corporation Noxious Weed Control Program will follow a modified version of the North American Invasive Species Management Association (NAISMA)



Of the 85 acre slopes above Prospector Park, Park City, approximately 10% is invaded by one or more noxious weed species. Colored dots ion the map (right) represent different noxious weed species.

Inventory protocol.

Park City Municipal Corporation will provide contractors with a list of data fields (which includes GIS data) to be populated/ collected (data dictionaries) to ensure data is standardized and complete. This also reduces post data processing once data is provided to the city offices.

The definition of a single patch or population of a particular species will vary based on the weed and how wide spread it is. For wide spread weeds, fine scale mapping is not efficient. Instead, populations should either be quickly recorded using a GPS to record a polygon around the full population or the population hand drawn on a map and later input into a GIS program. When using this coarse scale approach, it is imperative that polygons of weed populations are accompanied by an estimate of the percentage of that polygon occupied by the weed species.

This Spotted Knapweed population stretches over 25 feet long near the base of Treasure Hill. This size population is best mapped using a single polygon outlining the edges of the full population.

A more medium scale approach can be used for species that are common, but not wide spread. A patch or population can be defined by setting a minimum distance between patches/ populations. Commonly this distance is defined based on species visibility and logistics. For species that are in open habitat, it is common to use a minimum distance of approximately 10 meters. When in ecosystems that are difficult to see through, such as under dense shrublands, a shorter distance may be needed to ensure all populations can be located by weed control crews using the inventory maps. For all minimum distances, it is critical that the distance chosen is included in meta-data for the inventory dataset. For small populations, a single GPS point location will be assigned to each population and an estimate of the weeds percent cover and the area of the patch provided. For larger populations, polygons of the patch should be provided along with an estimate of the weeds percent cover within that polygon.

In addition to population percent cover and area, several other characteristics of the weed population and its environment should be recorded. These characteristics include, but may not be limited to:

- The dominant plant growth stage for the target noxious weed population
- Percent bare ground
- Presence of and description of any disturbance
- Key dominant native plant species
- Non-native or weedy species other than noxious weeds
- Presence of roads, trails, buildings and waterways/ bodies

Native Gamble Oak

Because noxious weed species do not share the same penology, multiple mapping visits may be necessary to ensure surveys occur when weeds are in flower (Division of Plant Industry 2000). Sites will therefore be visited twice when there is

concern that species may have been missed during initial visits. Questionable identification should be keyed out or brought to a local herbarium for verification. Additionally, new species to an area should have voucher specimens collected and submitted to the herbarium.

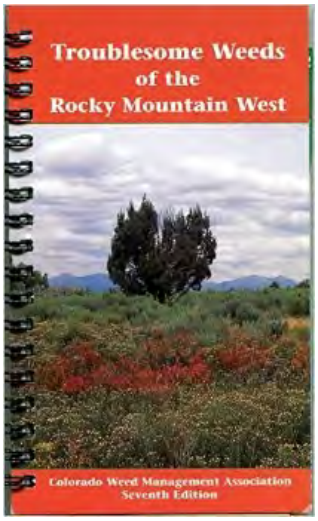
Digital photos can be used to provide a means for visual comparison of weed population size and density overtime. As helpful as they are, photos are not a replacement for plant species data such as percent cover. Photo points can be established using a land mark or by placing a permanent/semi-permanent marker into the soil (i.e. rebar). Take photos from this point in all cardinal directions. For each photo and photo point, collect GPS coordinates and relevant field notes such as: the number of the photo on the camera, name of the photographer, weed identification, site conditions (disturbed/natural), plant community composition and any additional information that would help to describe why a site is invaded. Photos should be downloaded and organized into files based on site using the following formula:

Species_Site_MMDDYY.

For example, a photo of a Starthistle at Round Valley taken March 7, 2015 would be saved as Starthistle_RoundValley_05072015.

Equipment needed to support program:

The weed coordinator will require a desk top or lap top computer with the capacity to run and store large geospatial data files. For the purpose of mapping and map generation, the coordinator will need ArcMap, a GPS (Trimble is the preferred standard with Pathfinder and TerraSync for data transfer and data dictionary development) and a printer or access to printer for maps and field notes. To support monitoring, the coordinator will need field notebooks, a digital camera, field guides ("Weeds of the West" by the Western Society of Weed Science; "Troublesome weeds of the Rocky Mountain West"; by the Colorado Weed Management Association; "Utah Flora "by Welch, Atwood, Goodrich and Higgins), a vehicle (with fire extinguisher and shovel for field safety), access to vehicle cleaning equipment; a backpack, measuring tape. The equipment list will change as the needs of Park City Municipal Corporation weed control become increasingly clear.



Integrated Weed Management Planning

The order in which the following noxious weed control methods are presented here is in no way an indication of the preference for the use of each. By far, prevention is the most effective and preferred method of control, however, when a species does become established, the best approach is an integrated approach that considers all methods of control and their potential impacts and gains. The end goal is always to reduce noxious weed populations strategically and to prevent unintended impacts on non-targeted species, the environment, and public health.

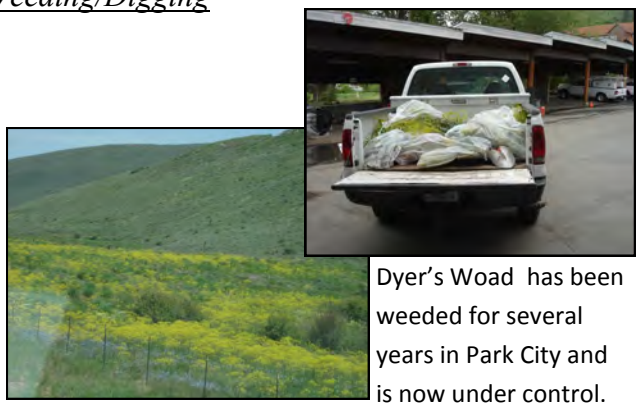
Noxious Weed Management Methods

Mechanical Control

Mechanical control aims to physically destroy the plant either aboveground or both above and below ground. There are several mechanical

methods and each is used under specific conditions.

Weeding/Digging



Dyer's Woad has been weeded for several years in Park City and is now under control.

Weeding and digging up of noxious weeds are used in sensitive areas and when it is more logistically feasible (steep terrain and backcountry) or ecologically relevant (wetlands). Hand pulling and digging up of plants will also be used most often in mid-summer when plants begin to flower. The goal here is to remove flowering individuals to prevent them from producing seed. This method is most cost effective for small populations, annuals and biennials, shallow rooted species and in loose soils such as sand and gravel. These methods are often used to reduce seed production, particularly at the end of the season when flowers are present and herbicide alone may no longer prevent seed development. These methods are also used in highly visible areas to reduce resident's discomfort over herbicide use. This particular method can use Parks Department staff when hours are available and is a safe option for volunteer groups.

Mowing

Mowing is primarily used to kill aboveground portions of the plant, control the amount of plant material (thickness of vegetation) and prevent flowering or seeding. Mowing can also be used as a pre-treatment for herbicide application to improve chemical contact with lower growing plants/rosettes. Without follow up control such as herbicide or hand removal, mowed plants will grow back and likely flower. Repeated mowing can cause the plant to use up its below ground resources making it more susceptible to stress such as herbicide. Mowing can be relatively inexpensive, however, may become costly overtime if unable to reduce the population. It is not practice for steep or rocky terrain of in the backcountry.

Hand Cutting

Much like weeding, hand cutting is labor intensive and thus expensive. Hand cutting of weeds has similar benefits and limitations as mowing, however; is suitable for backcountry locations. It can be especially effective for fall weed control using a cut and paint method. The plant's main stem is cut and then immediately painted (or sprayed) with herbicide. This causes the herbicide to be pulled deeper into the plant where it can do more damage.

Tilling

Tilling damages the plants root system leading to dehydration and death. Tilling can also kill noxious weeds by burying the aboveground portion of the plant if the plant isn't well established (SWCA 2013;). Tilling is not suitable for all species. Be sure that the species you are controlling cannot resprout from root fragments. Tilling is most effective on seedlings and newer plants and in dryer climates where plants already

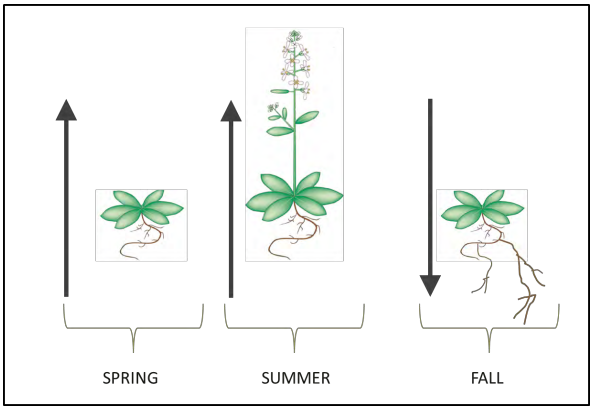
experience moisture imitation.

Disking

Disking is similar to tilling, but effects shallower soil depths. It is therefore effective for controlling shallow rooted weeds such as most annuals, but may trigger excessive resprouting in perennials. Disking of perennials can create denser and larger populations.

Chemical

Chemical control, while not the preferred method, is often the most effective and least costly method. Herbicides can penetrate into plant roots and will kill species no other management method can. Herbicides are especially effective when combined with other methods. Environmental impacts can be associated with herbicide, but following BMPs can limit and prevent impacts while meeting noxious weed control objectives. Pesticide application regulations require notification 24 hours prior to application of herbicide to public lands. This can be accomplished by posting signs 24 hours in advance of treatment.



In spring, young plants are fragile and susceptible to herbicide. By fall, plants that live multiple season will be pulling nutrients back down into the roots. Herbicide applied in fall will be carried into the roots with nutrients. The arrows in the diagram represent the direction nutrients each season.

Chemical methods will be primarily used in the spring and fall. In the spring, plants are more sensitive to herbicides and are low to the ground making application of herbicide easier and more complete.

Rosettes are low to the ground and therefore easier to evenly spray with herbicide.

By fall, flowering individuals have died off, but individuals of some weed species will be in rosette form (flat to the ground with no flowering stems) preparing to go dormant for the season. Plants that are going into dormancy pull nutrients and other resources from the leaves above ground to the roots for storage. Herbicide sprayed at this point will be pulled into the roots with these nutrients and resources resulting in a stronger impact .

While there are a number of herbicides available to treat noxious weeds, it is important to choose the chemical most appropriate for the species being controlled. Biology and environmental context will be considered as different species will respond differently to different control methods and under different environmental conditions. The control method will also change according to the life stage of the plant, as many plants are more susceptible to control at differing life stages, such as seedlings or when going into dormancy. Soil texture and proximity to water or depth to water table are key site characteristics determining herbicide safety for environmental reasons (prevention of water

pollution); therefore such site characteristics will also be important in determining herbicide type.

Herbicides are categorized by their mode of action which includes: growth regulators, amino acid inhibitors, grass meristem destroyers, cell membrane destroyers, root/shoot inhibitors, and plant metabolism interference. At present and initially, chemicals are determined by the contractors, but will be reviewed by the weed management coordinator prior to contract implementation.

Common Application Methods

- *Spot treatments* – Herbicide is applied directly to the individual plant without spraying adjacent vegetation or the ground.

- *Broadcast spraying* – Herbicide is applied to an area such that the full area receives an equal quantitiy of herbicide. This type of herbicide application is commonly used for dense patches of noxious weeds where few or no non -target plant species are present.
- *Cut-paint* – The individual plant is cut and herbicide is applied immediately to the cut stump.
- *Grow Kill Cycles* - Multiple applications of herbicide are applied overtime to deplete the noxious weed soil seed bank. Herbicide is applied as each new noxious weed crop emerges until no new noxious weed seedlings emerge.

Biological

Rhinocyllus conicus is a biological control beetle used on Musk thistle. It has been used to reduce thistle density in Summit County.

Biological control uses the natural biological enemies of a noxious weed species to reduce the population to more a manageable size. Biological control agents reduce seed production and plant vigor. Biological controls are effective, but often slow to establish. There are many noxious weed species for which biocontrols have been identified and tested, however, the effectiveness of a biological control varies by climate, habitat and weed density (Dewey et al. 2001). In the right climate, they are especially appropriate for dense, large populations were other methods are not logistically feasible and where low levels of a weed can be tolerated. Park City Municipal Corporation will use biological agents when appropriate, available and affordable. Information regarding the use of control agents and to obtain biocontrol agents is available from the Animal and Plant Health Inspection Services (APHIS). Biological agents are available

Biological Control bug release on Park City lands

free of charge, however, availability of an agent varies. There are commercial resources and their prices vary by species and quantity ordered. To contact APHIS: (435)830-4146 or www.bio-control.com

Cultural

Cultural control methods focus on using natural means of control such as fire, grazing and strengthening the native plant community to reduce invasion or invasion potential.

Prescribed burns

Prescribed burns are commonly used to reduce noxious weed density and competition with natives. These burns can have a side benefit of stimulating native plant germination and regrowth, returning nutrients to the soils and enhancing wildlife habitat. Successful prescribed burns are conducted under specific weather and fuel conditions to ensure the burn is complete but not at risk of spreading out of control areas. Burns can be conducted as one large unit or as spot treatments for smaller populations.

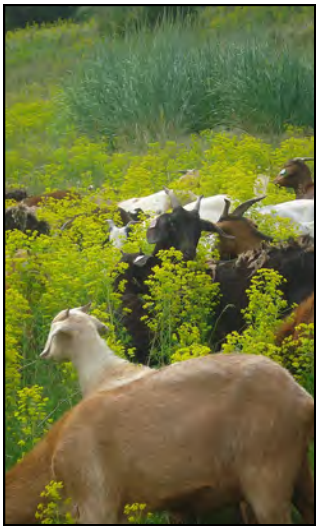
A prescribed fire is carefully coordinated to effect targeted plants while protecting non-target plants and protecting the surrounding lands. This grassland, prescribed fire is being used to control the noxious grasses that dominated the site.

Prescribed burns remove the above ground parts of noxious weeds and can kill several species completely. Burns are especially effective on annual plants and can be used to destroy seeds of weeds in the fall months. Burns in noxious, annual grass dominated grasslands are conducted when the seed is still on the plant, but the plants have dried out. Burns at this life stage can reduce the annual seed rain by 98% substantially limiting the size of the population the following season. Not all species can be controlled by fire and often burns must be repeated to deplete the weed seedbank.

While prescribed burns can be incredibly effective, they are dangerous and therefore should be conducted by trained professionals. Additionally, burns are not advised in areas of healthy native plant communities.

Grazing

Grazing is a natural control method best for containment of larger noxious weed populations and assistance in the control of such populations. The key to successful grazing is timing, matching the grazing intensity (number of animals in the herd and the duration over which the herd grazes) to the level of weed invasion and choosing the proper grazer. Sheep, goats, horses and cattle are most commonly used. Each grazer type is suited to different habitats and weed species. Sheep and goats can be trained to eat most, non-toxic noxious weeds bur show preference towards forbs (broadleaf). Cattle and horses have a more limited pallet. Additionally, their larger hooves make them more suitable for some types of wetland



Animal	Digestive system	Feeding behaviour	Classification
Cattle	Large rumens adapted to fiberous material	Prefer grasses, but will graze forbs at bolting stage.	Grass and roughage eaters
Sheep	Large rumens adapted to fiberous material	Can selectively graze and tolerate high fiber content, diet is dominated by forbs	Forb and roughage eaters, easily managed by human herders, used for stretegic grazing.
Goats	Large liver mass that allows processing less digestible or more toxic plants than other greazers	Mouths are designed to strip leaves from woody plants and chew branches, willtolerate spiney plants.	Browsers used often to control woody species

Modified from Frost and Launchbaugh 2003 Di'Tomaso 2006

grazing than the other species. The small hooves of sheep and goats penetrate further into the wetland soils and cause greater damage/tillage.

Grazing can be logistically challenging to implement. It is critical to release grazers at the time they will be most effective and do the least harm. This timing varies by noxious weed species and weather. There is the added challenge of providing water for the herd and fencing to control herd movement for the duration of the treatment. Lastly, for all grazing programs, the grazers must be held in a corral prior to and after grazing for a period of time (10-14 days) to allow any consumed seed to be passed and removal of seed from fur and hooves completed. Livestock are effective seed dispersers and for that reason, quarantine periods are necessary to prevent infesting other lands.

Revegetation

Noxious weed control in isolation can lead to unintended results such as reinvasion by new weed species, failure to control the targeted weed, damage to natives and negative impacts to wildlife dependent on vegetation for food and shelter. It is common for a new weed species to replace the controlled weed if post weed control actions are not taken to reduce bare ground. When a noxious weed has been present for a long period of time, it may have altered the environment. So even if it is controlled, natives cannot establish. In cases where the noxious weed dominates the site, rapid removal with no effort to support native plant recovery leaves disturbed, bare ground that is more suitable for weeds than natives. In such, cases revegetation is advised to increase native plant community resistance to invasion and resilience to reinvasion (Zevaleta et al. 2001)

Native shrub: Rosa woodsii

This area was dominated by Garlic Mustard (left) until volunteers and city employees hand pulled every plant. Unfortunately, the City was unable to reseed it before Hoary Cress invaded (right) Photos: Maria Barndt.

The State Weed Management plan emphasizes the important role establishing resilience of ecosystems to invasion through revegetation or restoration of natives plays in long-term noxious weed control (Whitesides 2004). Park City Municipal Corporation can incorporate this management practice as a method to follow larger weed treatments or areas of high disturbance or invasion potential. A key


Rocky Mountain Penstomen

first step will be to identify areas most likely to be successfully restored and develop site specific plans to be ready for implementation when funding and resources become available. A common approach uses seeding (and sometimes planting) of native species and limited non-native species that can compete with the noxious weeds, but will eventually die off as they are replaced with natives. Seeding and or planting costs should be included in project budgets (construction, roadway work/repairs, facility improvements, weed control in highly disturbed areas) to ensure revegetation occurs. Costs for revegetation can range depending on the species in the mix and seeding rates, but trend towards $10-$150 per acre. Compare this to costs of herbicide treatment at $50 to $200 per acre or mechanical at $136 to $167 per acre which often need repeat treatments within a single season and annually (Doran Technical Report; CWMA 2006). Once new native vegetation establishes, cultural method costs reduce and in the end can be far less than on going weed control. Such revegetation is also considered a method for global change adaptation by supporting healthy vegetation systems that buffer the effects of global change in general and specifically on wildlife and water quality (IPCC 2014).


Seed mixes can be developed to include species common to habitat adjacent to project sites.

Action Steps

- Develop a plan for revegetation including site preparation and seeding and planting palettes (similar or the same mixes as used for cultural methods).
- Develop criteria for when planting should be implemented.
- Develop base species pallets for various habitats and environmental conditions.
- Gather ecological and historic information about the site to be revegetated.
- Gather a list of potential climate change adaptation techniques suitable for the Park City area habitats and species.
- Develop follow up plans to adapt management to recovery of seeded and planted species.
- Monitor yearly to evaluate success and establish a database of successful and unsuccessful projects from which to draw for future planning.
- All new construction must include plans and funding for post construction revegetation and monitoring. While it increases construction costs up front, it reduces weed management costs through creating resilient native


Native grass: Poa alpina

communities and ensures new noxious weed populations resulting from construction related disturbance are detected and controlled.

Final planting and seeding palettes should be carefully planned and reviewed by trusted biologists/ecologists.

Seed can also be applied in a slurry with fertilizer and mulch to aid in native establishment while preventing erosion and weed growth.

Mulching

Mulching is commonly used to prevent weed germination in areas of bareground and where irrigation is used to aid in native plant establishment. This method is especially useful when ground cover will not be placed immediately. Mulch can include the following materials: wood, straw, rubber, rock and others, but it is important that it be weed seed free material. For erosion control and weed competition, use a sterile wheat/rye hybrid or fast germinating native grass (Bennet 2006).

The Utah Department of agriculture maintains a list of weed free hay producers to aid in prevention of weed spread. www.ag.state.ut.us/plantid/WeedFreeList.pdf

Post Weed Control Management

Monitoring and Evaluation

Monitoring consists of collecting standardized data using the same protocol over time to allow for analysis of changes in plant populations. Monitoring data are integral to evaluating program progress towards organization goals and objectives (Division of Plant Industry 2000; Elzinga et al 1998). A common challenge in weed control is that replacement of the controlled weed by a new weed. Monitoring ensures the new species is detected and controlled . Evaluation also enables the identification of methods that are not effective so methods can be improved upon or replaced (Zavaleta et al. 2001). The key to successful monitoring programs is the establishment of an easily executed protocol that can be repeated and does not require much time to complete. The current understanding of eradication and control success is limited by low availability of monitoring data nationwide. Implementing a consistent monitoring program in Park City would guide Park City Municipal Corporation management decisions, but could also aid the national community through adding to the currently limited data that is needed to establish cutting edge management techniques and technology.

Objectives:

- Assess changes in plant community composition overtime to identify areas of risk, success, improvements, and provide information for climate change adaptation planning (climate change adaptation is becoming a more common requirement by external funders and federal agencies).

- Annual review of management effectiveness to inform future planning .
- Identify any unintentional effects of management on the ecosystem and non-targeted species
- Detect new weed species and weed populations in weed free zones.
- Determine rates of weed spread.
- Compile biological data to inform predications as to where noxious weeds are most likely to spread in the future.

Action Step:

Develop monitoring protocol based on the NAISMA mapping standards and that merge seamlessly with the inventory protocol.

Additional considerations for weed control monitoring

Areas within a site that should be more thoroughly surveyed include:

- Areas of disturbance such as: roads, railways, trails, gravel pits, new developments, utility land easements and waterways.
- Project/Site/Parcel boundaries – notes regarding any noxious weeds present on the adjacent land should be recorded.

Additional consideration for cultural control and reclamation monitoring

- Evaluate the success of seeded species to aid in adaptive management in the future (which do best where and which keep weeds out?).
- Monitor two times a season in the first 2 years and once in the next 3 years.
- Expect that grasses and forbs will take 3-5 years to establish.

Evaluation Criteria for weed treatment sites

- Was the population reduced?
- Was the intended method used and if not, why?
- What was the effect on target, noxious weed species?
- Were there unintentional effects on non-target species and the ecosystem?
- Is a repeat or modified treatment needed?
- Have new weed species invaded and if so, what species?

Development of Partnerships

"Noxious weed management is a good neighbor policy." (K George Beck -Division of Plant Industry 2000). Noxious weeds do not respect jurisdictional boundaries, therefore, it is essential that collaborative efforts between regional entities be established and fostered around the common goal of noxious weed control. Weed management actions of Park City Municipal Corporation can be rendered ineffective at jurisdictional boundaries if adjacent lands contain noxious weed populations that disperse seed onto Park City lands. Collaborative planning can lead to lasting weed control and shared resources.

Collaboration can also provide opportunities for grant funded projects and wise use of volunteers. This is particularly true when collaborating with land conservancies. Often conservancies manage land easements on Park City Municipal Corporation lands and have access to volunteer groups the City may not. For example, establishing a handful of preplanned projects suited for volunteers with methods desired and guidelines for when the projects are best implemented could aid in meeting the goals of both the conservancy and the City.

A commitment to maintain representation on the Summit County Weed Management Area plays an important role in fostering partnerships and collaborative efforts. Summit County is an important partner and should be engaged regularly by the weed coordinator.

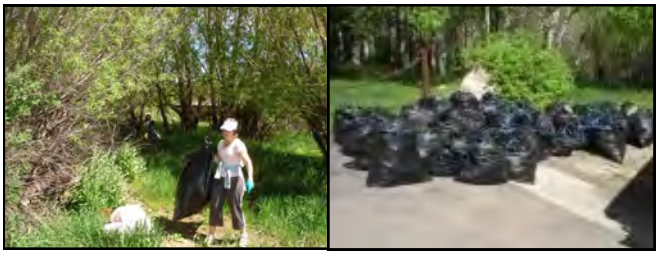
Summit County Department of Weed Control
Contact: Dave Bingham, 435-336-3979

Partnerships will not be limited to other agencies and organizations charged with noxious weed management, but also local volunteer groups and the court system to utilize community service worker hours. Additionally, Park City Municipal Corporation will explore the possibility of using prisoner crews for hand pulling of weeds to reduce per acre management costs.

Public outreach/ education

The Utah Weed Act specifically states that increasing public awareness of noxious weeds and the public's responsibility to control weeds on their lands is an essential priority for weed management in Utah (Whitesides 2004). The 2006 CWMA and 2015 Park City Municipal Corporation noxious weed inventories reported high levels of noxious weed invasion on private property, with particular concern for those adjacent to city open space. A protocol for collaborating with the city enforcement office to notify land owners of weed populations will be critical. It is important that landowners be educated about their legal responsibility and given an opportunity to comply. Very often, land owners are unaware of this responsibility and may also be unaware of noxious weeds on their lands.

Public participation in weed management can take many forms from single day weed pulls to long-term citizen science programs. Participation commonly varies due to the individual's availability, the accessibility of the program/project for participants and commitment to the particular concern. Simple participation projects could include weed awareness signs with a container attached for people to remove seeds from their clothing and equipment and safely dispose of at popular trail heads. This helps reduce seed spread, but even more so, helps to educate and empower the community.



Volunteer Garlic Mustard weed pull conducted in Park City 2015. Photos: Maria Barndt

Development of a core group of volunteers could lead to more than increased awareness, it

can aid to reduce time before discovery of new weed populations, increase public trust and reduce weed control costs per acre (Jordan et al. 2012).Continuity of staff and program events will be key to long-term participation along with rapid results or a least measurable results that are shared with participants in a timely manner (Havens et al. 2012; Jordan et al. 2012)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Benefits:

- An educated public can alert the City of new weed populations.
- Educated public is more likely to control weeds on their own lands which reduces invasion in adjacent city lands.
- Ensures public understands control methods – impacts and benefits.
- Facilitates new partnerships with residents and local organizations/businesses and fosters trust.

Challenges to address:

Some citizens may be opposed to the use of herbicides so education related to herbicide use should be approached carefully and with citable facts.

Potential Outreach and Education Methods:

- Develop brochures, articles, factsheets…. to be placed in public locations within the city.
- Presentations can be given at volunteer events in partnership with other organizations , e.g. Mountain Trails volunteer trail days.
- Post signs at trail heads, and, for some, include containers for people to safely place seeds removed from their cloths and pet's fur. This also educates and empowers the community and visitors to aid in protecting the natural lands they so enjoy.
- Develop citizen science projects (e.g. the Weed Watchers of King County California – citizen scientists adopt an area of land to monitor and report new weeds.) to increase the number of eyes on the land and public interest and trust.

VI. Plan Implementation and Evaluation

The above proposed changes to the Park City Municipal Corporation Noxious Weed Management Program will be implemented in phases to build a firm foundation from which the program can grow in effectiveness. Weed management planning will be of an adaptive nature applying lessons from past and current years to the following year. Contractors will be used to support the Park City Municipal Corporation noxious weed control program and coordinator in reaching Park City Municipal Corporation weed control and open space conservation goals. Noxious weed control and inventories have been contracted out in past years.


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Contracting out these tasks will continue along with other tasks such as database development, data analysis for evaluation of the program and project monitoring as needed.

Phase 1 – Expansion of infrastructure

- Hire a full time weed coordinator (prior to the 2016 season to provide adequate time for the new coordinator to establish a management plan for 2016).
- Develop a weed control contractor data base and solicit new contractors.
- Increase the contract value limit to $24,500 annually.
- Develop a weed management database using current weed data and employee/contractor reports (including geospatial data).
- Develop weed management areas for ease of communication to contractors and data management.
- Develop a city employee education program to assist in the identification of weed populations and prevention of weed spread.

Construction is a common city activity known to introduce conditions that favor weed growth.

- Increase cooperation with neighboring entities.
- Monitor areas treated for noxious weeds to evaluate treatment success. And contractor quality assessment

Phase 2 – Strategic planning and maintenance of past management efforts

- Evaluate management effectiveness with monitoring
- Develop cultural control protocol and implement
- Revise Noxious Weed Management Plan to incorporate new data and information.
- Develop an education program for the general public to assist in weed identification and facilitate their taking responsibility of noxious weeds on their lands.

Phase 3 – Strategic planning for long-term noxious weed management

- Analyze weed database to identify at risk habitats and prioritize sites (for control, containment, monitoring, inventory) and weeds for the 2017 season.
- Inventory current Park City lands, and new lands as they are acquired, for noxious weeds based on a prioritized strategic plan.
- Continue to contain and control known noxious weed populations (primarily through use of weed control contractors).

Plan Evaluation:

The effectiveness of this new noxious weed management plan will be determined, initially, based on the following criteria:

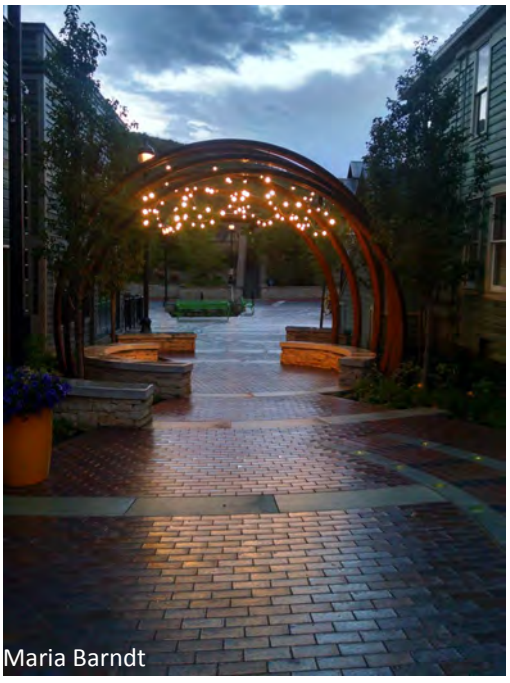
- Filling of the full time weed coordinator position.
- Development of the noxious weed database for city lands.
- Percent of completion of the weed control contractor database and degree to which enough new contractors have been added to address the demand.
- Percent of open space that has been inventoried compared to previous years and the total open space needing inventory.

- Percent of known noxious weed populations treated and/or monitored?
- Quantification of the changes in treated noxious weed population size and/or density (with the understanding that change may be a slow process depending on the noxious weed species, the invasion history, and the initial size and density of the population).

Success criteria may change to reflect new information gained from the management program and as management needs change. Different weed species require different management approaches which may require success criteria to be altered to accurately detect and reflect progress.

VI. Conclusions

Park City Municipal Corporation aims to not only comply with federal, state and county laws and regulations, but to preserve the natural lands that make Park City unique. The current weed management program has performed well over the years, but now requires increased resources and up to date technology to meet the growing demands of newly acquired open space lands. This management plan provides guidance to city employees and contractors regarding the goals and protocol of the Park City Municipal Corporation Noxious Weed Management Program and BMPs. This plan also remains a living document to allow for integration of knew knowledge, experience and technology to be used to continually increase efficiency and effectiveness of noxious weed management by the Park City Municipal Corporation.



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Appendix A: Utah Noxious Weed Act

R68. Agriculture and Food, Plant Industry.
R68-9. Utah Noxious Weed Act.
R68-9-1. Authority.

Promulgated under authority of 4-2-2 and 4-17-3.

R68-9-2. Designation and Publication of State Noxious Weeds.

A. The following weeds are hereby officially designated and published as noxious for the State of Utah, as per the authority vested in the Commissioner of Agriculture and Food under Section 4-17-3:

There are hereby designated three classes of noxious weeds in the state: Class A (EDRR) Class B (Control) and Class C (Containment).

TABLE

Class A: Early Detection Rapid Response (EDRR) Declared noxious weeds not native to the sate of Utah that pose a serious threat to the state and should be considered as a very high priority.

Blackhenbane	Hyoseyamus niger (L.)
Diffuse Knapweed	Centaurea diffusa (Lam.)
Leafy Spurge	Euphorbia esula L.
Medusahead	Taeniatherum caput-medusae
Oxeye daisy	Chrysanthemum leucanthemum L.
Perennial Sorghum spp.	including but not limited to Johnson Grass (Sorghum halepense (L.) Pers.and Sorghum Almum (Sorghum Almum,Parodi).
Purple Loosestrife	Lythrum salicaria L.
Spotted Knapweed	Centaurea maculosa Lam.
St. Johnsworts	Hypericum perforatum L.
Sulfur cinquefoil	Potentilla recta L.
Yellow Starthistle	Centaurea solstitialis L.
Yellow Toadflax	Linaria vulgaris Mill.

Class B: (Control) Declared noxious weeds not native to the state of Utah, that pose a threat to the state and should be considered a high priority for control.

Bermudagrass	Cynodon dactylon (L.) Pers.
Broad-leaved Peppergrass (Tall Whitetop)	Lepidium latifolium L.
Dalmation Toadflax	Linaria dalmatica (L.) Mill
Dyers Woad	Isatis tinctoria L.
Hoary cress	Cardaria spp.
Musk Thistle	Carduus nutans L.
Poison Hemlock	Conium maculatum L.
Russian Knapweed	Centaurea repens L.
Scotch Thistle	Onopordium acanthium L.

(Cotton Thistle)	
Squarrose Knapweed	Centaurea virgata Lam. ssp

Squarrosa

Class C: (Containment) Declared noxious weeds not native to the sate of Utah that are widely spread but pose a threat to the agricultural industry and agricultural products with a focus on stopping expansion.

Field Bindweed (Wild Morning-glory)	Convolvulus spp.
Canada Thistle	Cirsium arvense (L.) Scop.
Houndstounge	Cynoglossum officianale L.
Saltcedar	Tamarix ramosissima Ledeb.
Quackgrass	Agropyron repens (L.) Beauv.

* Bermudagrass (Cynodon dactylon) shall not be a noxious weed in Washington County and shall not be subject to provisions of the Utah Noxious Weed Law within the boundaries of that county. It shall be a noxious weed throughout all other areas of the State of Utah and shall be subject to the laws therein.

R68-9-3. Designations and Publication of Articles Capable of Disseminating Noxious Weeds.

A. As provided in Section 4-17-3, the following articles are designated and published by the Commissioner as capable of disseminating noxious weeds:

1. Machinery and equipment, particularly combines and hay balers.
2. Farm trucks and common carriers.
3. Seed.
4. Screenings sold for livestock feed.
5. Livestock feed material.
6. Hay, straw, or other material of similar nature.
7. Manure.
8. Soil, sod and nursery stock.
9. Noxious weeds distributed or sold for any purpose.
10. Livestock.

R68-9-4. Prescribed Treatment for Articles.

A. As provided in Section 4-17-3, the Commissioner has determined that the following treatments shall be considered minimum to prevent dissemination of noxious weed seeds or such parts of noxious weed plants that could cause new growth by contaminated articles:

1. Machinery and Equipment.

a. It shall be unlawful for any person, company or corporation to

(1) bring any harvesting or threshing machinery, portable feed grinders, portable seed cleaners or other farm vehicles or machinery into the state without first cleaning such equipment free from all noxious weed seed and plant parts; or

(2) move any harvesting or threshing machinery, portable feed grinders or portable seed cleaners from any farm infested

with any noxious weed without first cleaning such equipment free from all noxious weed seed and plant parts.

(a) Immediately after completing the threshing of grain or seed which is contaminated with noxious weeds, such machine is to be cleaned by:

(1) removing all loose material from the top and side of the machine by sweeping with a blower

(2) opening the lower end of elevator, return and measuring device and removing infested material from shakers, sieves, and other places of lodgement;

(3) running the machine empty for not less than five minutes, alternately increasing and retarding the speed; and

(4) following the manufacturer's detailed suggestions for cleaning the machine.

2. Farm Trucks and Common Carriers.

It shall be unlawful for any person, company or corporation to transport seed, screenings or feed of any kind containing noxious weed seed over or along any highway in this State or on any railroad operating in this State unless the same is carried or transported in such vehicles or containers which will prevent the leaking or scattering thereof. All common carriers shall thoroughly clean and destroy any noxious weed seeds or plant parts in cars, trucks, vehicles or other receptacles used by them after each load shall have been delivered to consignee before again placing such car, truck, vehicle or receptacle into service.

3. Seed.

a. It shall be unlawful for any person, firm or corporation to sell, offer or expose for sale or distribute in Utah any agricultural, vegetable, flower or tree and shrub seeds for seeding purposes which contain any seeds of those weeds declared noxious by the Commissioner of Agriculture and Food.

b. It shall be the duty of the State Agricultural Inspector to remove from sale any lots of seeds offered for sale which are found to contain noxious weed seeds. Such seed may be recleaned under the supervision of the inspector and, if found to be free from noxious weed seeds, the same may be released for sale or distribution; otherwise, such seed shall be returned to point of origin, shipped to another state where such weed shall be returned to point of origin, shipped to another state where such weed seed is not noxious, or destroyed or processed in such a manner as to destroy viability of the weed seeds.

4. Screenings Sold for Livestock Feed.

a. All screenings or by-products of cleaning grains or other seeds containing noxious weed seeds, when used in commercial feed or sold as such to the ultimate consumer, shall be ground fine enough or otherwise treated to destroy such weed seeds so that the finished product contains not more than six whole noxious weed seeds per pound.

b. All mills and plants cleaning or processing any grains or other seeds shall be required to grind or otherwise treat all screenings containing noxious weed seeds so as to destroy such weed seeds to the extent that the above stated tolerance is not exceeded before allowing the same to be removed from the mill or plant. Such screenings may be moved to another plant for grinding

and treatment; provided that: each container or shipment is labeled with the words "screenings for processing - not for seeding or feeding" and with the name and address of the consignor and the consignee.

5. Livestock Feed Material.

a. It shall be unlawful for any person, company or corporation to sell or offer for sale, barter or give away to the ultimate consumer any livestock feed material, including whole grains, which contain more than six whole noxious weed seeds per pound. Whole feed grain which exceeds this tolerance of noxious weed seeds may be sold to commercial processors or commercial feed mixers where the manner of processing will reduce the number of whole noxious weed seed to no more than six per pound.

6. Hay, Straw or Other Material of Similar Nature.

a. It shall be unlawful for any person, company or corporation to sell or offer for sale, barter or give away any hay, straw, or other material of similar nature, which is contaminated with mature noxious weed seeds or such parts of noxious weed plants which could cause new growth, or to alter, change or falsify in anyway information contained on a phytosanitary certificate.

7. Manure.

a. Manure produced from grain, hay, or other forage infested with noxious weeds shall not be applied or dumped elsewhere than upon the premises of the owner thereof.

8. Soil, Sod and Nursery Stock.

a. No soil, sod or nursery stock which contains or is contaminated with noxious weed seeds, or such parts of the plant that could cause new growth, shall be removed from the premises upon which it is located until cleaned of such weed seed or plant parts, except that such contaminated soil may be used for restrictive non-planting purposes upon permission and under direction of the county weed supervisor or a representative of the Utah Department of Agriculture and Food.

9. Noxious Weeds Distributed or Sold for Any Purpose.

a. It shall be unlawful for any person, company or corporation to sell, barter or give away any noxious weed plants or seeds for any purpose.

10. Livestock.

a. No livestock to which grain, hay, or other forage containing noxious weed seeds has been fed shall be permitted to range or graze upon fields other than those upon which they have been so fed for a period of 72 hours following such feeding. During such period, they shall be fed materials which are not contaminated with noxious weed seeds.

R68-9-5. Reports From Counties.

A. The Board of County Commissioners of each county, with the aid of their county Weed Board and their County Weed Supervisor, shall submit an "Annual Progress Report of County Noxious Weed Control Program" to the Commissioner of Agriculture and Food by January 15 of each year, covering the activities of the previous calendar year. A prescribed form for this report shall be supplied by the Commissioner.

R68-9-6. Notices.

A. General and individual notices pertaining to the control and prevention of noxious weeds shall be substantially of the types prescribed herein; namely, General Notice to Control Noxious Weeds, Individual Notice to Control Noxious Weeds, and Notification of Noxious Weed Lien Assessment.

1. General Notice To Control Noxious Weeds.

A general public notice shall be posted by the County Weed Board in at least three public places within the county and be published in one or more newspapers of general circulation throughout the county, on or before May 1 of each year and at any other times the County Weed Board determines. Such public notice shall state that it is the duty of every property owner to control and prevent the spread of noxious weeds on any land in his possession, or under his control, and shall serve as a warning that if he fails to comply with this notice, enforced weed control measures may be imposed at the direction of county authorities. Such general notice shall also include a list of weeds declared noxious for the State of Utah and for said county, if any.

2. Individual Notice to Control Noxious Weeds.

Following publication of a general notice, if a County Weed Board determines that definite weed control measures are required to control noxious weeds on a particular property, the Board shall cause an individual notice to be served upon the owner or the person in possession of said property, giving specific instructions concerning when and how the noxious weeds are to be controlled within a specified period of time. The individual notice shall also inform the property owner or operator of legal action which may be taken against him if he fails to comply with said notice.

3. Notification of Noxious Weed Lien Assessment.

If it is deemed advisable, the Board of County Commissioners may cause noxious weeds to be controlled on a particular property and any expenses incurred by the county shall be paid by the owner of record or the person in possession of the property. A notice shall be provided such person, showing an itemized cost statement of the labor and materials necessarily used in the work of said control measures. This notice shall also state that the expense constitutes a lien against the property and shall be added to the general taxes unless payment is made to the County Treasurer within 90 days.

KEY: weed control
Date of Enactment or Last Substantive Amendment: July 2, 2008
Notice of Continuation: June 9, 2008
Authorizing, and Implemented or Interpreted Law: 4-2-2; 4-17-3

Appendix B: J. Merritt Official Letter from the Utah Weed Control Association

Utah Weed Control Association
4820 Old Main Hill
Logan, Utah 84323-4820

2 June 2004

Noxious Weeds are the largest environmental concern to Utah. Infestations of noxious weeds crowd out native vegetation, increase erosion, use precious water, and decrease the forage production that is used by domestic and wild animals. Noxious weeds are not just an agricultural problem. They are everyone's problem.

The Utah Strategic Plan for Managing Noxious and Invasive Weeds is the result of many hours of meetings and deliberations by a number of concerned citizens who represent a variety of organizations. These individuals have worked hard to develop a plan that has the clear goal of stopping the spread of noxious weeds and reducing the present population of those weeds that currently exist in Utah.

I would encourage everyone to read the plan and assist in completing the goals of the plan.

Everyone in Utah should:

1. Learn to identify the major noxious weeds.
2. Manage noxious weeds on the property they own or manage.
3. Support private and governmental efforts to manage the noxious weed population.
4. Be able to explain the impacts of noxious weeds to others.

The people of Utah now have the opportunity to reduce the infestations of noxious weeds. We also have the opportunity to believe that noxious weeds will not affect us or that the problem is someone else's problem. The Utah Strategic Plan for Managing Noxious and Invasive Weeds provides us with a plan and a goal to combat this environmental problem. If the plan is to succeed, all Utahans must join the battle.

The members of the Utah Weed Control Association are ready and willing to assist in the completion of the goals and objective of the Utah Strategic Plan for Managing Noxious and Invasive Weeds.

Sincerely,

Joel Merritt

Joel Merritt
President, Utah Weed Control Association

Appendix D
Noxious Weed Species Descriptions

Information for these descriptions come from several texts and documents including : Brown, L. (1979) Grasses: An Identification Guide, Houghton Mifflin Company, New York, NY.; Whitson, T.D., L.C. Burrill, S.A. Dewey, D.W. Cudney, B.E. Nelson, R.D. Lee, and R. Parker (2001)Weeds of the West. 9th ed., Grand Teton Lithography, Jackson, WY.; DiTomaso J.M., G.B. Kyser and M.J. Pitcairn (2006)Yellowstarthistle Management Guide, Cal-IPC Publication 2006-03, California Invasive Plant Council, Berkeley CA; Belliston, N, R Whitesides, S Dewwy, J Merrit and S Burningham (2009)Noxious Weed Guide for Utah, 3rd Edition, Utah State University Cooperative Extension, Utah, USA; R.L. Sheley and J.K. Petroff (1999)Biology and Management of Noxious Rangeland Weeds. Oregon State University Press, Corvallis, OR.

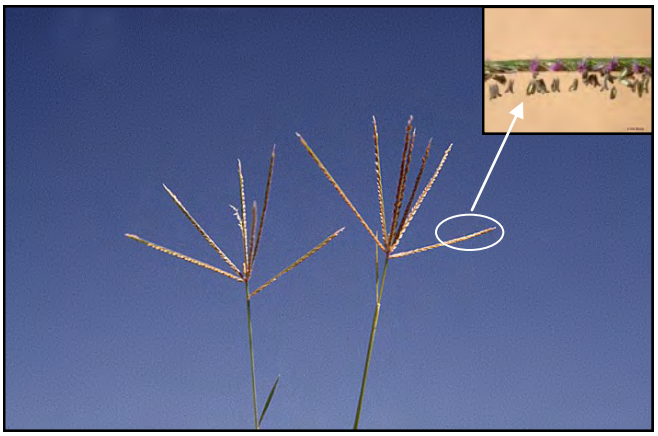
Bermuda grass (Cynodon dactylon)

How to Identify:

Bermuda grass creeps along the soil surface resprouting from rhizomes below the soil and stolon's above ground. Leaves can appear green-grey in color, are smooth and have a ring of white hair at the sheath and blade junction. There are also papery sheaths at each node of the lateral stems. Flowers develop at the end of the stem and have 3 to 7 branches that look like fingers of a hand. Spikeles are 1-2 inches long with 2 rows of sessile spikelets on just one side of the stem. Stem appears somewhat flattened. Bermuda grass commonly forms mats.

Impacts:

This grass is a competitive problem in croplands and turf management and is known to invade adjacent wildlands. It can push out native plants and its pollen is an allergen for many people.



How to control:

DO NOT TILL OR DISK ! Tilling will not control this species and may instead increase the number of plants from root fragments. Shading can help reduce cover and density. Planting of trees and shrubs can provide this shade. Solarization and covering with dark plastic or plywood can also be effective.

Fire is not effective for Bermuda grass control.

Herbicides are effective, but need to be timed carefully. Grass selective herbicides should be applied in the spring. Non-selective herbicides should be applied late summer to fall.

Look-a-likes:

Large Crabgrass (Digitara sanguinalis) can look similar to Bermuda grass, but Crabgrass spikelets are attached by a short pedicel. Also, Crabgrass is ad annual and therefore not likely to form mats.

Flowering spikelets of Crabgrass come out from the main flowering stem at many locations (left) while spikelets of Bermuda Grass come from a central point (pedicle at the end of the stem.

Noxious Weed Class C

Family: .....Poaceae

Region of Origin: .....Africa

Life Form: .....Perennial

Reproduction Method: .....Seed, rhizome and stolon

Height Range: .....Up to 1 foot

Flowering Period: .....April

Flower Color: ..... Tan and purple

Black Henbane (Hyoscyamus niger)

Additional Common Names: Hog's bean

How to Identify:

Black Henbane has a foul odor. Leaves are coarsely toothed to lobed, have pointed tips and are hairy and grey-green in appearance. Flowers are on a raceme and axillary to leaves on the upper stem.

Impacts:

This plant is toxic to humans and animals due to the hyoscyamine and other alkaloid chemicals it produces.

How to control:

Digging up plants can reduce population, but herbicide is more effective for larger populations. Herbicide will be most effective when applied at the rosette stage up to blooming.

DO NOT GRAZE THIS SPECIES!! This plant is toxic to livestock. Prevention is the best method for this species and can be done by eliminating or reducing bare ground (e.g. mulching, straw, native plantings…). Once established, it's seeds can remain viable in the soil for 5 years; so , long-term efforts will be required to deplete the seedbank.

Noxious Weed Class .....B

Family: .....Solanaceae

Region of Origin: .....Europe

Life Form: .....Annual to biennial

Reproduction Method: ..... Seed (10,000-50,000/plant)

Height Range: .....Up to 4 feet

Flowering Period: .....Late spring

Flower Color: .....Brownish to yellow with purple centers and veins

Bull Thistle (Cirsium vulgare)

How to Identify:

The tap root of Bull Thistle is relatively short and fleshy. The Stem is a dark green, darker than other thistles with leaves that come to a narrow, knife shape with long, sharp spines. The whole plant appears covered in hairs and thorns and the stem can appear winged. Leaves are pinnately lobed and dark green and prickly on top and cottony on the underside. During the first year of growth, the plant forms a rosette and in the second year a main stem forms to support flowing stems. Flowers are 1.5-2 inches in width and primarily clustered at the ends of stems. Flowers have sharp, spiny involucres.

Impacts:

Bull Thistle is a competitive plant that can encroach on native plant habitats. When it forms dense patches, it can prevent wildlife and livestock from accessing habitat and water sources. Most cattle will not eat Bull Thistle but some will eat the flowers when they are still fleshy. This can reduce rangeland productivity.

How to control:

Because Bull Thistle is a biennial it is essential that seed input is controlled so the seedbank can deplete itself. It can be controlled by digging up the plant or mowing just before flower development. Sheep and goat grazing can be effective for both control and over time killing the population. There are several broadleaf herbicides effective on Bull Thistle.

Look-a-likes:

Bull Thistle leaves are hairy and spiny. They are also darker in color.

Musk Thistle has smooth almost shiny leaves.

Canada Thistle has narrower, less divided and smoother leaves.

Noxious Weed Class	County
Family:	Asteraceae
Region of Origin:	Eurasia
Life Form:	Biennial
Reproduction Method:	Seed
Height Range:	4 feet
Flowering Period:	July – Sept
Flower Color:	Deep Pink to purple

Canada Thistle (Cirsium arvense)

Identify:

Canada Thistle has slender stems that branch only at the top. Flowers form in clusters at the branch tips. Bracts found just under the flower petals are spineless. Leaves are lance to narrowly oval shaped with smooth to spiny edges. Hairs may or may not be present, but are usually on the underside of the leaf. This thistle is known to form dense stands.

Impacts:

Canada Thistle grows clonally through its root system which allows it to form dense patches rapidly. This growth habit also allows it to competitively exclude desirable native plant species and prevent wildlife from accessing waterways. It is not very palatable to livestock and most wildlife so can decrease rangeland productivity and wildlife habitat. In addition to the impacts on wildlife, it reduces the quality of recreational lands due to the spiny leaves.

Control:

This slender thistle is difficult to control because it stores large amounts of resources for regrowth in it's root mass. The key to killing it is to wear out these stored resources by stressing the plant repeatedly over many years. Hand pulling, mowing, covering plants with dark tarps or sheets of metal or wood is an effective way to stress the plant out.

DO NOT DISK OR TILL THIS SPECIES!!

Root fragments can grow into full plants leading to an increased number of plants.

Herbicide is often the most effective control method for Canada Thistle. There are biological controls available, which have varied effectiveness depending on climate and plant density.

Look-a-likes:

Musk Thistle has flower heads three to four times the size of Canada Thistle and large bracts on the lower portion of the flower head.

Bull Thistle is much darker and covered in spines so thick it can look like Velcro.

Noxious Weed Class …….… A

Family: ……..….. Asteraceae

Region of Origin: ……...…Eurasia

Life Form: ……...….Perennial

Reproduction Method: ……...Seed and roots

Height Range: ……..…2-5 feet

Flowering Period: ……..…..June-August

Flower Color: ……. purple to pink, sometimes white

Cheat Grass (Bromus tectorum)

Additional Common Names: Downy Brome

How to Identify:

The stems of Cheat Grass are erect or spreading though primarily erect. Leaves are covered with soft hairs and the ligules are short, paper thin and ragged at the edges. Inflorescence are 2-6 inches long, dense with flowers and often drooping or nodding. Spiklets are nodding and slender reaching 3/8-3/4 inch long. Awns are 3/8-5/8 of an inch long and turn wine red/purple as seeds reach maturity.

How to control:

Cheat grass infected with a fungal rust.

Once Cheat grass has established, eradication is unlikely unless populations are small and new. Containment and control are logical for long established and larger populations. The species only reproduces by seed and is an annual, so prevention of seed production will deplete the seedbank overtime. Prescribed burns, mowing, weeding and herbicide are all effective but differ in logistical and financial feasibility.

Look-a-likes:

ID by photo order :Smooth Brome (B. inermis), Ripgut Brome (B. diandrus), Red Brome (B. rubus) , Japanese Brome (Bromus japonicas:)

In general, Cheat grass has much hairier blades and sheaths than other similar grasses, particularly at germination.

Impacts:

Cheat grass is a very competitive species and is known to out compete natives for early season moisture. It is known to increase wildfire frequency and size. In shrublands that are not adapted to frequent fire, Cheat Grass has caused habitat conversion from shrubland to weedy grasslands. In rangelands, it can substantially reduce productivity due to lower nutrient content. In recreational areas, the seeds can attach to clothes and pets fur. They then dig into the skin and may lead to infections in pets.

Noxious Weed Class ……City

Family: ……...Poaceae

Region of Origin: ……..……Mediterranean

Life Form: …….Annual

Reproduction Method: …..…..Seed

Height Range: ……..…4-30 inches

Flowering Period: …….. Mid-Summer

Flower Color: ……...Starts green, becomes tan as seeds develop and wine-red to purple at maturity

Common Burdock (Arctium minus)

Additional Common Names: bardane, beggar's button, common burdock, lesser burdock. wild burdock. wild rhubarb

How to Identify:

Common Burdock grows from a large taproot. The leaves form a rosette the first year and a flowering stalk the second year. The stem branches frequently and is hairy and grooved or angled. The leaves are large, heart shaped and also covered in hairs.

How to control:

Mowing and cutting of Common Burdock can control the plants. Pulling can be difficult due to an extremely thick and deep tab root. Herbicides are also effective and there are many that will work to control Common Burdock.

Look-a-likes:

Wild Rhubarb

Impacts:

Burdock will establish in intact plant communities and disturbed soils. Common Burdock is commonly host to powdery mildew and root rot which increases the likelihood of other surrounding and more sensitive plants becoming infected. It alters the taste of milk when cattle graze it making milk less valuable. Due to the bur like form of the seed heads, it readily attaches to wildlife, livestock and pets. Sheep wool value is substantially reduced once Common Burdock burs embed themselves in the wool.

Noxious Weed Class…… A

Family: ……..Asteraceae

Region of Origin: ……Europe and Asia

Life Form: ……..…..Biennial

Reproduction Method: ……..Seed only

Height Range: ……...3-6 feet

Flowering Period: ……Late Summer

Flower Color: ……...….Red/violet disk flowers and green bracts

Corn Chamomile (Anthemis arvensis)

How to Identify:

Corn Chamomile is a bushy plant with a short taproot. The stem is densely branched and slender. Leaves are several times divided and fine. Leaves are light green and lightly hairy in younger stems and smooth in older stems. Flowers look similar to daisies only much smaller.

How to control:

Herbicide is the best form of control and is most effective when applied prior to flowering.

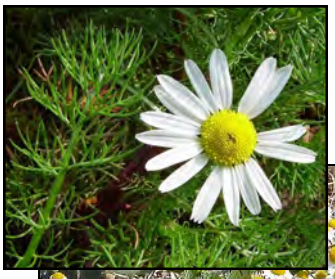
Look a-likes:

Mayweed: smells when flowers or leaves are crushed.

Scentless Chamomile:

Impacts:

Corn Chamomile is a competitive annual that can form large and dense patches. It is most commonly considered a crop pest, but has been moving into the wildland especially in disturbed areas.



Noxious Weed Class ……..	A
Family: …….	Asteraceae
Region of Origin: ……	Europe
Life Form: ……...	Annual
Reproduction Method: ……...	Seed only
Height Range: ……	1/5 to 2 feet
Flowering Period: ……..	May to October
Flower Color: ……..…	White ray flowers around a center of yellow disk flowers

Dalmatian Toadflax (Linaria dalmatica)

How to Identify:

Dalmatian toadflax is a fleshy broadleaved plant that can become somewhat woody in nature. Leaves of Dalmatian Toadflax are alternate, entire and clasp the stem. Flowers are axillary and in the uppermost leaves. The whole plant is waxy giving it a bluish –green color. Flowers are yellow with an orange and yellow beard.

Impacts:

Dalmatian Toadflax is a competitive species that is known to out compete many native plants. When Dalmatian Toadflax replaces grassland species, erosion, surface run-off and sedimentation of streams can increase. Few species of wildlife are able to use this plant so infestations can greatly reduce habitat quality. Cattle tend to avoid Dalmatian Toadflax, but in cases where they do eat it, toxicity has been observed. In rangelands, it is estimated to cost $40 per acre to control.

How to control:

Toadflax species are highly variable in their response to management so it is best to use multiple methods on any given population. Grazing is limited to grazers that are not sensitive to plant toxins. Sheep grazing can be an effective containment and control method. They appear unaffected by the toxins in the plant and will selectively graze it.

Hand pulling can be effective in loose soils where the roots will come up fairly easily. This method is feasible for small populations.

Planting competitive native species can help to reduce Dalmatian Toadflax density and overall population size.

Several biological control agents have been effective in both the United States and Canada. As with any biological control, effectiveness varies with population size and climate.

The waxy leaves of Dalmatian Toadflax makes the plant hard to control with herbicides. Genetic variability in toadflax species can make herbicide selection difficult, however, fall applications are often most effective regardless of the herbicide used.

Look a-likes:

Several Snapdragons

Yellow Toadflax has much narrower leaves.

Noxious Weed Class …..……	A
Family: ……...….....	Schrophulariaceae
Region of Origin:……	Europe
Life Form: ……......	Perennial
Reproduction Method: ……...	Seed and root stalk
Height Range: ……	Up to 3 Feet
Flowering Period: ….…….....	Mid-summer to fall
Flower Color: ……...….	Yellow with orange bearded throat

Diffuse Knapweed (Centaurea diffusa)

How to Identify:

Stems are erect and rough to the touch. Leaves are pinnately divided. Bracts of the flower head are tipped with tan spines and distinctive teeth like involucres. The whole plant appears greyish/bluish green in color. The root is a deep taproot, making it difficult to pull by hand. The plant has a roundish appearance similar to tumble weed and if broken from its base can blow around like traditional tumble weeds.

Impacts:

This is a very competitive species that spreads rapidly and displaces native plants. It has the potential to increase soil erosion as it replaces natives that normally stabilize the soil through fibrous roots. Additionally, it is low in nutrients making it a poor quality forage for livestock. Diffuse Knapweed can substantially reduce property value through losses in forage and costs associated with long-term control.

How to control:

This species is commonly found as a contaminant in soils and gravel used for construction and road maintenance. Diffuse Knapweed is difficult to control once established and will require a combination of methods. Grazing, weeding, mowing, herbicide and biological control agents are effective when used in combination of two or more. Weeding is appropriate for small populations or as follow up after herbicide treatment. Mowing will not kill Knapweed, but can contain and control populations too large to weed and be a pre-herbicide treatment. There are several herbicides and biological controls effective on Knapweed. Each should be selected on a site by site basis for best results.

Look a-likes:

Spotted Knapweed has dark spots on the bracts of the flower head and the spines of the bract are short.

Noxious Weed Class …… A

Family: ……...Asteracea

Region of Origin: ……..…Eurasia

Life Form: ……Annual to short lived perennial

Reproduction Method: ……...…..Seed

Height Range: ……..……1 – 2 feet

Flowering Period: ……..….. June-September

Flower Color: ……..……White or pink to purple.

Dyer's Woad (Isatis tinctoria)

How to Identify:

Dyers Woad grows from a 3 to 5 foot long taproot. The basal leaves are a radiating cluster at the stem base, bluish green, somewhat hairy and up to 7 inches long. Stem leaves are lance shaped and alternate. All leaves have a cream-colored mid vein and appear somewhat waxy. The fruit is a flattened seed pod (silicle), 3/8" long and 1/4" wide, winged and slightly pear shaped. Seeds hang from a small stalk and are purple/ brown at maturity. The flowers are cross-shaped with 4 sepals, 4 petals and 6 stamens. Flowers are found in terminal clusters on the branch

How to control:

Cultivation of the rosettes prior to bolting and flowering can eliminate newly established populations. Mowing is less effective due to its woody nature. Hand pulling and digging may be the most practical form of control for hard to reach, difficult terrain. Hand pulling is the recommended control option after the plant bolts, and before seed production. Sheep will not voluntarily graze the plant.

A native rust pathogen Puccinia thlaspeos is effective in preventing seed or fruit production. However symptoms are rarely obvious until the second year.

Herbicide is effective if applied at the bolt to bud stage of growth in the spring and early summer.

Impacts:

Dyer's Woad impacts the natural plant communities by outcompeting native plants. It causes a loss of wildlife and livestock forage by displacing native grasses and other native species. It is unpalatable to livestock, but not toxic. Plants can produce 100,000 seeds per year. Dyer's Woad can invade intact native plant communities with or without disturbance.

Look-a-Likes:

Other mustards such as Black Mustard. However, Black Mustard has large, dark green dissected leaves. Leaves are also hairy.

Noxious Weed Class ……B

Family: ……..Brassicaceae

Region of Origin: ……Europe

Life Form:……..Winter annual, biennial and short-lived perennial

Reproduction Method: ……..Seed

Height Range: ……1 – 4 feet

Flowering Period: ……..Late spring

Flower Color: ……Yellow

Field Bindweed (Convolvulus arvensis)

Additional Common Names: Morning glory, bindweed, wild morning-glory

How to Identify:

Field Bindweed has an extensive root system and spreading stems. Roots can reach depths of 20-30 feet and stems can develop adventitious roots along the creeping stems. The plant is vine like and will climb objects and other plants. Leaves are alternate and arrow like in shape. Flowers are about an inch in diameter and trumpet shaped.

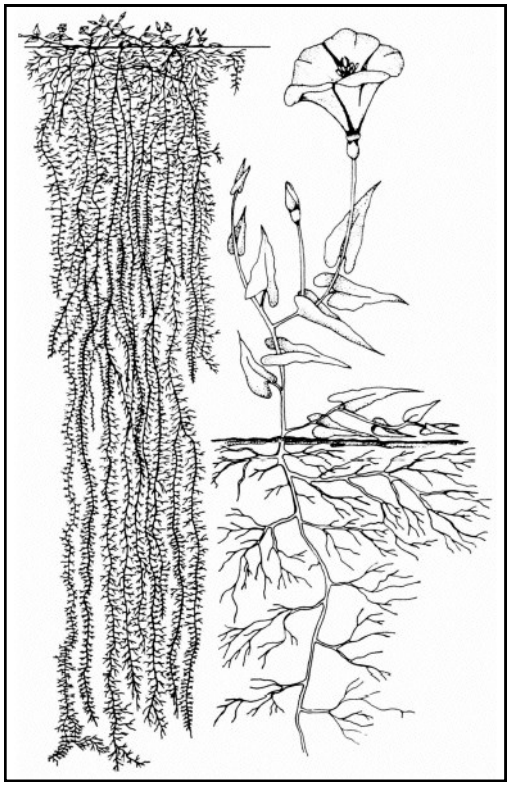
Impacts:

Field Bindweed has invaded most states in the US except the most southern states. Unlike many noxious weeds, it is capable of establishing in intact plant communities and without disturbance.

How to control:

Seeds of Field Bindweed can be viable in the soil for 50 years, which means control is a long-term commitment and prevention of seed production is a key component of control. Herbicide can be effective at reducing Field Bindweed at all stages of growth, but no herbicides can eradicate this plant when used alone or in a single treatment.

Solarization can be effective at nearly eradicating Field Bindweed populations. Herbicide treatments following solarization can treat any remaining individuals.



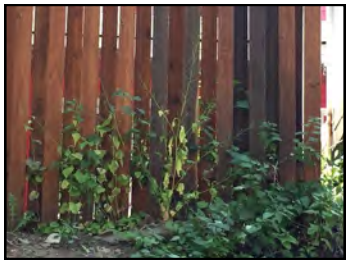
Noxious Weed Class	C
Family:	Convolvulaceae
Region of Origin:	Europe
Life Form:	Perennial
Reproduction Method:	Seed and root
Height Range:	1-6 feet long
Flowering Period:	June to September
Flower Color:	White and pink

Garlic Mustard (Alliaria petiloata)

Additional Common Names: Hedge garlic, sauce-alone, jack-by-the-hedge, poor man's mustard, jack-in-the-bush, garlic root, garlic wort, mustard root

How to Identify:

In the first year, Garlic Mustard forms rosettes and a flowering stalk the second. Leaves of rosettes are rounded, kidney-shaped with toothed edges and no hairs Upper leaves on mature plants are more triangular and smaller. Garlic Mustard has small, white 4-petaled flowers in clusters at the top of the stem. Plants usually smell like garlic, especially younger leaves and when leaves are crushed.



How to control:

Garlic Mustard is difficult to control once established. Hand-pulling individual plants is effective if the entire root is remove. This is only feasible for smaller populations. For larger populations, herbicide will be necessary. Herbicide should be applied to spring seedlings or fall plants. After pulling or spraying larger patches, covering the area with mulch can help reduce seed germination.

Look a-likes:

Sweet cicely (Osmorhiza claytonia and O. longistylis)

Early saxifrage (Saxifraga virginica)

Canadian white violet (Viola Canadensis)

Impacts:

Garlic Mustard is not used by wildlife or insects and out competes native plants by producing a chemical that inhibits their growth. It can grow in dense shade or full sun. The fact that it is self-fertile means that one plant can occupy a site and produce a seed bank. Plant stands can produce more than 62,000 seeds per square meter to quickly out compete local plants.

Noxious Weed Class ..... A

Family: .....Brassicaceae

Region of Origin: .....Eurasia and Africa

Life Form: .....Biennial

Reproduction Method: .....Seed

Height Range: .....3 – 6 feet

Flowering Period: .....April - August

Flower Color: .....White

Hoary Cress (Cadaria draba-formerly Lepidium draba)

Additional Common Names: Whitetop, Small Whitetop

How to Identify:

Hoary cress is a perennial that grows up to 3 feet though 1 foot is more common. Roots are known to reach depths of 10 feet. The stem is erect and branches very little until the top of the plant where it is densely branched. Stems are covered with little hairs. Leaves are grayish-green, clasping, lightly pubescent and are up to 4 inches long. Flowers are white with 4 petals occur in dense flower clusters These clusters give the weed a flat-topped appearance early in the season. Two small, flat, reddish-brown seeds are contained in each of the heart-shaped seed pods.

Impacts:

Hoary Cress is a very competitive species known to crowd out native species and reduce crop yields. The weed contains glucosinolates that can be toxic to cattle (McInnis et al. 1993). Dense patches may form quickly and reduce habitat and rangeland quality.

How to control:

This species is especially common in disturbed soils so the best form of control for Hoary Cress is reducing soil disturbance. Monitoring newly disturbed soils to detect plants and control them before they establish is key. This species is very difficult to control once established so early detection is priority. DO NOT DISK OR TILL THIS SPECIES!! It can reproduce from root fragments so chopping up roots can lead to an increase in the number of plants.

Herbicides are most effective when applied to rosettes or young plants prior to blooming.

Look-a-likes:

Lens-podded Whitetop (C. chalepensis) and Hairy Whitetop (C. pubescens) look similar to Hoary Crest, however they differ in seed capsules and fruits.

Hoary Cress

Lens pod

Hairy Whitetop

Noxious Weed Class ……County
Family: ……..Brassicaceae
Region of Origin: ……Europe
Life Form: ……Perennial
Reproduction Method: ……Seed and root stock
Height Range: ……up to 2 feet
Flowering Period: …….. Late Spring
Flower Color: ……White

Houndstongue (Cynoglossum officinale)

How to Identify:

Leaves of Houndstongue form a rosette the first year and then grow a flowering stem in the second year. Leaves are alternate, 1-12 inches long and 1-3 inches wide, entire and hairy. Upper leaves are narrower (about an inch wide) than lower leaves. Leaves may appear whitish-green, particularly basal leaves. Flowers grow in nodding stems and initially appear bell shaped until the flower fully opens into 5 distinct petals. The fruit is composed of prickly nutlets.

How to control:

Hand removal or removal using a shovel is effective for small patches, but it is important to cut the taproot two inches or more below the soil surface. This method is also most effective between the rosette and blooming stages. Houndstongue spreads only by seed and seed remain viable for only 3 years, so preventing seed production is important.

Larger infestations can be managed with herbicides. Rosettes can be controlled using 2,4-D amine. Metsulfuron can be used in rangeland, pastures and disturbed areas and should be applied in mid-June when plants are actively growing. Annual applications may be needed for several years until the seedbank is no longer viable.

Impacts:

Houndstongue can produce 50-2,000 seeds per plant and impacts wildlands by displacing native plants and rangeland by degrading forage quality. Houndstongue contains pyrrolizidine alkaloids which are toxic to cattle, horses, sheep and goats and chemicals that prevent other plants from germinating. Houndstongue is shade and drought tolerant making it capable of forming dense patched even where other weeds are commonly unable to grow.

The nutlet fruits of this plant are prickly like Velcro and readily attach to clothing and fur.

Look-a-likes:

Houndstongue

False Forget-me-not

Noxious Weed Class	B
Family:	Boraginaceae
Region of Origin:	Europe
Life Form:	Biennial
Reproduction Method:	Seed and Root
Height Range:	1-4 feet
Flowering Period:	Early summer
Flower Color:	Reddish-purple

Johnsongrass (Sorghum halepense)

How to Identify:

Primarily a warm season grass, however Johnson Grass has been observed to span colder season. It is typically a clumped grass and is coarse to the touch. Stems are erect and have prominent nodes. Leafe blades are flat with obvious ligules. Ligules are short and membranous with fringed ends. Flowers develop on a large, open panicle and are awn tipped. Awns are bent and needle like and can be reddish to purple. Seed heads are reddish to purple in color.

Sheath collar and ligule

How to control:

Herbicide is effective for controlling Johnsongrass.

Mowing prior to herbicide application may provide more complete coverage and thus greater control success.

Look-a-likes:

Sudan Grass

Impacts:

Johnsongrass can be toxic to livestock when it is under cold or water stress. It is also known to be a competitive grass which has a history of crop invasion. It can reduce corn and soybean crops by 40%.

Noxious Weed Class ……...…	C
Family: ……..Poaceae	
Region of Origin: ……...…Mediterranean	Region
Life Form: ……..Perennial	
Reproduction Method: ……..Seed and	rhizome
Height Range: ……2-9feet	
Flowering Period: ……May to July	
Flower Color: ……....green to	brownish-red

Leafy Spurge (Euphorbia esula)

How to Identify:

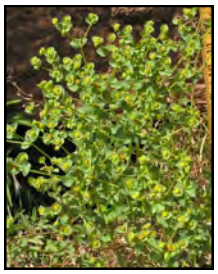
Leafy Spurge has a deep and extensive root system that can reach depths of 10 feet. Roots can become woody and have pink nodes. Stems are erect and smooth to the touch with branching. Leaves are alternate, narrow, about 1-4 inches long and often drooping. Flowers are fused into a cup like shape just above heart shaped floral bracts. Flowers are arranged in an umbel at the end of branching stems. The entire plant contains a milky, latex that bleeds out when the plant is damaged.

How to control:

Due to the extensive root system and high genetic variability of this species, it is very difficult to control once established. Grazing can be used to contain populations and stress the plant, however, herbicide is often necessary after the first 2 growing season. Mowing, weeding and burning are fairly ineffective control methods.

Several biological control agents are available including beetles, moth larva and plant disease. The most effective biological controls effect the roots of Leafy Spurge, but selection of biocontrol's should be done on a site by site basis.

Look a-likes:



Rocky MT Spurge

Cypress Spurge

Yellow toad flax pre-lowering.

Impacts:

Leafy Spurge has invaded over 2.5 million acres of land in the United States and Canada. It is very competitive species , even within 4 months of germination and often forms dense stands. The milky sap contained throughout the plant is toxic to livestock (deadly) and can irritate human skin.

Noxious Weed Class ..... A

Family: .....Euphorbiaceae

Region of Origin: .....Eurasia

Life Form: .....Perennial

Reproduction Method: .....Seed

Height Range: .....1 – 3 feet

Flowering Period: .....May to late summer

Flower Color: .....Yellow to yellowish green

Mayweed Chamomile (Anthemis cotula)

Additional Common Names: Dog Fennel

How to Identify:

Mayweed Chamomile is an ill smelling, bushy plant with a short taproot. The stem is densely branched and slender. Leaves are several times divided and very fine. Flowers look similar to daisies only much smaller.

How to control:

Hand pulling or cutting can be effective in preventing seed production when plants are treated before flowering. Herbicides are also effective.

Look a-like:

Corn Chamomile: is scentless.

Scentless Chamomile: also scentless

Pineapple Weed: lacks white petals and smells like pineapple when crushed.

Impacts:

Mayweed is a skin irritant and can cause blisters on livestock muzzles and irritate mucus membranes. Additionally, the flower can alter the flavor of milk when dairy cows consume it.

Noxious Weed Class ..... A

Family: .....Asteraceae

Region of Origin: .....Europe

Life Form: .....Annual

Reproduction Method: .....Seed only

Height Range: .....1/5 to 2 feet

Flowering Period: ..... May to October

Flower Color: .....White ray flowers around a center of yellow disk flowers

Medusahead (Taeniatherum caput-medusae)

Additional Common Names: Medusahead, medusa's head, Medusahead rye, Medusahead grass

How to Identify:

The leaves of Medusahead are erect, rolled and 1/8 of an inch wide or thinner. The inflorescence have long (1-4 inch) awns that twist at maturity. These awns are stiff and slightly barbed so feel rough and almost Velcro like to the touch.

Impacts:

Medusahead is a rapidly spreading grass that out competes natives and increases fire frequency and size. It is known to form dense mono-cultures. These mono-cultures out compete the perennials that naturally hold soils in place. Short lived roots of Medusahead do not protect soil from erosion.

This grass is not palatable to livestock once seeds begin to develop and thus can decrease foraging capacity of rangeland by 40-70%.

How to control:

Burning can be an effective method for reducing seed input by 60-90% when done while seeds are in a milky stage. There are several herbicides that are effective on Medusahead and the herbicide should be selected on a site by site basis. Herbicide is also more effective following prescribed burns. Reintroducing native, particularly perennials grasses like squirrel-tail may be important to prevent reinvasion.

Look a-likes:

Squirrel-tail Grass | Fox-tail Barely

Squirrel-tail Grass and Fox-tail Barely look similar to Medusahead, however, the awns of Medusahead are twisted and become more so as the plant ages.

Noxious Weed Class …..……...A

Family: ……...……Poaceae

Region of Origin: …...……Mediterranean

Life Form: ……..Winter annual

Reproduction Method: ……...Seed

Height Range: ……6 – 24 inches

Flowering Period: ……..May to June

Flower Color: ……Green

Musk Thistle (Carduus nutans)

Additional Common Names: Nodding Thistle

How to Identify:

Stems of Musk Thistle are multi-branched. The lower leaves of Musk Thistle have a wide, white mid-vein, whitish leaf edges, a smooth waxy surface and yellowish to white spines at the tips. Leaves and stems are painfully spiny. Flower s are larger than other thistles (2 in. diameter) and often nodding. Bracts are found under the flower on the flower head and are green to purplish green. It is important to note that this species can have a great deal of variation in its appearance.

Impacts:

Musk Thistle commonly forms dense stands that hinder livestock and wildlife access to resources such as water. This thistle is fairly unpalatable to most livestock and wildlife particularly post flower.It is also a very competitive species that can push out native plants.

How to Control:

Since Musk Thistle only reproduces by seed and is biennial, destruction of plants prior to seeding is an effective means of control. Digging up of plants or mowing before flowers form can kill the plant. All flowers and seed-heads should be thrown in the trash. Because seeds of Bull Thistle can survive in the soil for 10 years, it can take more than 15 years of control to eradicate a population. Herbicide applied on rosettes in the late fall or early spring may be more practical for large patches. There are several broadleaf specific herbicides that are effective on Musk Thistle.

Look-a-likes:

Canada thistle has finer leaves and much smaller flower heads.

Bull Thistle has darker and much spinier leaves.

Noxious Weed Class …….	A
Family: ……...	Asteraceae
Region of Origin: ……...	Eurasia
Life Form: …….	Biennial to winter annual
Reproduction Method: …….	Seed
Height Range: ……...…….	1-6 Feet
Flowering Period: …….....	May to late summer
Flower Color: …….	Pink to purple,

Myrtle Spurge (Euphorbia myrsinites)

Additional Common Names: Donkey Tail, Blue or Creeping Spurge

How to Identify:

Myrtle Spurge is a tap rooted species with creeping blue-green stems and leaves. Leaves spiral along and clasp the stem. Stem and leaves are fleshy/ succulent.

How to control:

Control is most effective in March, May, September and October. Myrtle Spurge can be controlled by pulling and digging. It is advised that you get 4 inches of the root to prevent resprouting. When doing any manual control, be sure to wear gloves, long sleeved shirt and eye protection. Grazing has also been successful with sheep and goats as has planning of competitive natives to push out Myrtle Spurge. Fall treatment of 2,4D or glyphosate is also effective. With all methods of control, it will take several years to eradicate a population of Myrtle Spurge.

Impacts:

Along with being a highly competitive plant, the white, latex milk found in all plant parts is toxic to livestock. It can also cause nausea, vomiting, diarrhea and skin irritations in humans.

Look-a-likes:

Dalmatian Toadflax prior to flowering , but lacks milky latex

Other Euphorbia species can be confused with Myrtle Spurge, but other Euphorbia will not be succulent (fleshy) like Myrtle Spurge.

Noxious Weed Class ……County

Family: …… Euphorbiaceae

Region of Origin: ……Eurasia

Life Form: ……Perennial

Reproduction Method: ……Seed and root

Height Range: ……4-6 inches (18 in wide)

Flowering Period: ……Early summer to fall

Flower Color: …… green with yellow-green bracts

Oxeye Daisy (Chrysanthemum leucanthemum)

Additional Common Names: Marguerite, Moon-daisy

How to Identify:

Oxeye Daisy has a fibrous root system. The whole plant is smooth to minimally hairy. The basal leaves are oblanceolate to narrowly ovate and 2-5 inches long. Basal roots also form in a rosette. The upper leaves are narrow and toothed. Flowers are 1 -1.5 inches in width and develop on the branched ends of the stem.

How to control:

Establishing a native cover can crowd out Oxeye Daisies. Digging up plants works for smaller populations and herbicide is effective on larger populations. 2,4-D based herbicides can be effective on Oxeye Daisy, however rates often need to be on the higher side of label recommendations.

Look a-likes:

Oxeye Daisy is commonly mistaken for other asters, but oxeye has leaves with coarse teeth margins unlike most other asters.

Eastern Daisy Fleabane

Mayweed Chamomile

Corn Chamomile

Impacts:

Oxeye Daisy can competitively exclude native plants and increase the amount of bare soil. Increases in bare soil then lead to increased erosion. Oxeye Daisy can form monocultures and cattle tend to avoid grazing the plants. This not only reduces rangeland productivity, but when cattle do graze the plant, it can change the taste of milk in dairy cows.

Noxious Weed Class …….…	B
Family: ……..	Asteraceae
Region of Origin: ……	Eurasia
Life Form: ……......	perennial
Reproduction Method: …….	Seed and rhizome
Height Range: ……	1 foot
Flowering Period: …….....	June through August
Flower Color:…….	White ray flowers around a center of yellow disc flowers.

Perennial Pepperweed (Lepidium latifolium)

Additional Common Names: Large Whitetop, Tall Whitetop, Broad-leaved Peppergrass

How to Identify:

Stems and leaves are waxy. Leaves are greyish-green, lanceolate and smooth to mildly toothed. Basal leaves are larger than those nearer the top of the stem. Flowers are small and arranged in umbels at the end of the stems. This species is commonly found in wetter soils.

Impacts:

Perennial Pepperweed had invaded thousands of acres in wetlands, croplands and rangelands of the United States. Once established, this plant quickly displaces native plants reducing habitat quality. Along streams and rivers, it increases erosion, particularly during floods. Perennial Pepper weed also extracts salts from lower in the soil and carries it to the soil surface. This increase in salt makes reintroduction of natives more difficult.

How to control:

The deep root system (10 ft.) of this plant makes control difficult. Seeds of this plant are small and both seed and root fragments are easily distributed by water. **DO NOT DISK OR TILL THIS SPECIES!!** Perennial Pepperweed can reproduce through root fragments.

The combination of mechanical control (mowing) and herbicide have proven most effective. Herbicide application alone can be effective until the plants bloom. Because this species often invades wetlands and waterways, special care must be taken to follow label recommendations of water approved herbicides.

Look a-likes:

Hoary Crest looks similar to Perennial Pepperweed, but Hoary Crest leaves are hairy

More lance shaped with sharper toothed margins.


Perennial Pepperweed


Hoary Cress

Noxious Weed Class …….….	C
Family: …….....	Brassicaceae
Region of Origin: ……	Mediterranean
Life Form: …….	Perennial
Reproduction Method: …….	Seed and root
Height Range: …..……	1-3 feet
Flowering Period: ……..……..	Early summer to fall
Flower Color: ……..…….	White

Poison Hemlock (*Conium maculatum*)

How to Identify:

Poison Hemlock forms rosettes in the first year and a flowering stem in the second year. Stems are smooth and often have purple spots along the stem and ridges. Leaves are deep green, finely, pinnately divided 3-4 times with segmented leaflets, fern or lace like in appearance. The leaves are alternate and sheathed at the base. A musty odor is common for Poison Hemlock leaves. Flowers are white, in compound umbels and have a foul odor. Often found in moist soils (streams, ditches and roadsides…).

Impacts:

All parts of the plant are poisonous. The toxicity of this plant makes it particularly troublesome in rangelands where it often forms dense stands. Poison Hemlock is also poisonous to humans though poisonings in humans are much rarer than in livestock.

How to control:

Repeated mowing can be used to reduce the competitive ability of Poison Hemlock, but is not an effective long-term control method. Herbicide is effective especially between the rosette stage and before blooming. There are both pre-emergent and post emergent herbicides available for Poison Hemlock but repeat treatment will be important to deplete the soil seedbank.

Look a-likes:

Wild Carrot

Water Hemlock

Noxious Weed Class ……	A
Family: …….	Apiaceae
Region of Origin: ……..……	Europe
Life Form: ……..….	Biennial
Reproduction Method: ……..	Seed
Height Range: ……..……	Up to 10 feet
Flowering Period: ……..…..	Late spring early summer
Flower Color: ……..…….	White

Purple Loosestrife (Lythrum salicaria)

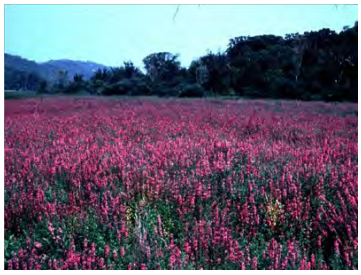
How to Identify:

Root bunches of this plant send up several stems that are 4 to eight sided. Stems can and often do become somewhat woody. Each stem is erect with opposite to whirled, lance shaped leaves with smooth edges. Flowers bloom along a spike and have 5-7 petals.

Impacts:

Purple Loosestrife is a wetland invasive that is also common along moist roadside ditches, marches, small lakes and ponds. It quickly becomes dense and pushes out native plants, while also reducing the quality of aquatic habitat for fish and wildlife. The dense monocultures can no longer provide the open sections of waterways necessary for nesting water fowls and do not provide a food source for songbirds reliant on native plants. Purple Loosestrife can completely fill in small waterways and interrupt stream flow. Stream flow interruptions during very heavy rainfall can lead to flooding.

How to control:



For small populations, Purple Loosestrife can be removed using digging, but it is important to get the entire root as remaining rhizomes will resprout. It is also important to ensure fragments of rhizome do not float away as they may sprout when they reach shore. Hand pulling is not effective for control of this species. Herbicides are very effective. Care must be taken to ensure the herbicide label indicates it is effective on Purple Loosestrife, but also labeled for the environment of the site (water ways, wetlands…). Biological control agents such as weevils and beetles, are effective. Contact APHIS for more information.

Look a-likes:

Fireweed

Blazing star

Elephant Head

Noxious Weed Class	A
Family:	Lythraceae
Region of Origin:	Eurasia
Life Form:	Perennial
Reproduction Method:	Rhizomes
Height Range:	6 – 8 feet
Flowering Period:	June through August
Flower Color:	Pink to violet or purple, rarely white

Quackgrass (Elytrigia repens)

Additional Common Names: Couch Grass , Quick Grass, Dog Grass, Witch Grass

How to Identify:

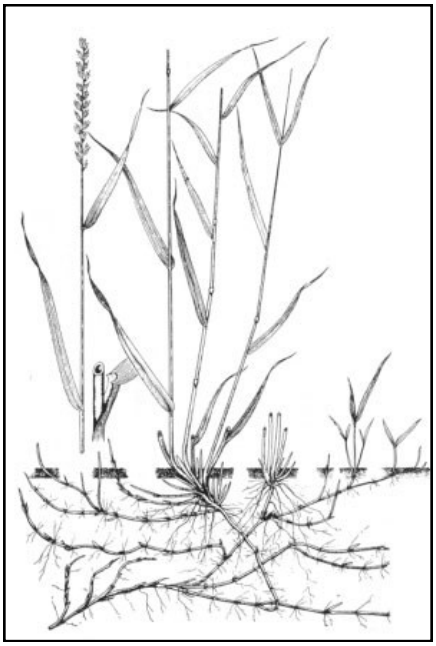
Rhizomes are yellow-white and fleshy. The stem is rarely branched. Leaf blades are ¼ to ½ an inch wide, flat, pointed with small auricles at the junction of the blade and sheath. Leaves often are constricted near the leaf tips. Spikelets are in two rows flatwise along the stem and florets are awn less or have short awns. It looks as though the flowers have turned their backs to the stem.

How to control:

DO NOT DISK OR TILL THIS SPECIES!!
Root/rhizome fragments can grow into full plants and rhizomes can live up to 2 years.

Herbicide is an effective control and is best applied early spring to winter.

Mulching around plants to prevent new sprouts can be helpful in containing Quackgrass



Impacts:

Quackgrass is known to reduce agricultural and rangeland productivity. It is also thought to be allopathic, meaning it alters the soil around it to be less suitable for other plants.

Noxious Weed Class C

Family: .....Poaceae

Region of Origin: .....Mediterranean

Life Form: .....Perennial

Reproduction Method: .....Seed and rhizome

Height Range: .....1-4 feet

Flowering Period: .....July

Flower Color: .....Green to yellow

Russian Knapweed (Acroptilon repens)

How to Identify:

Stems are very hairy, tough and may become somewhat woody. Stems may also branch frequently. Leaves are deeply lobed and hairy. Leaves of the upper stem are narrow and smooth to serrated at the margins. Flowers are ¼ to 1 inch in diameter and develop on the ends of stems one flower per stem. Bracts of the flower head have papery tips.

Impacts:

Russian Knapweed can spread at a rate of 11% annually. As it forms dense patches, it displaces natives and other quality forage for wildlife and livestock. This results in substantial property value losses and control costs. This species is toxic to horses.

How to control:

Roots of Russian Knapweed can reach depths of 8 feet and are extensive making control very difficult once the plant establishes. Because this is a perennial plant, preventing seed development will not be enough to eradicate the population. All plants must be killed. The seeds can persist in the soil for 5 years so control efforts will be long-term. Herbicide can be effective, but often it is not enough to control Russian Knapweed alone. Some success has been experienced with planting of competitive perennial grasses following herbicide applications.

Look-a-likes:

Diffuse Knapweed—has longer shaper bracts

Spotted Knapweed—has dark spots on the sharp bracts.

Squarrosa Knapweed— has longer, sharper bracts and the flower head is much narrower.

Noxious Weed Class …….	A
Family: ……...Asteraceae	
Region of Origin: ……..Eurasia	
Life Form: ……..perennial	
Reproduction Method: ……..Seed and advantious roots	
Height Range: ……..1 – 3 feet	
Flowering Period: …….June - September	
Flower Color: ……...Pink to lavender and sometimes light blue	

Saltcedar/ Tamarisk (Tamarix chinensis)

How to Identify:

This is a deciduous, evergreen shrub to small tree. Stems are reddish brown and the leaves are scale like on slender branches. Flowers are small and have 5 petals.

Impacts:

This species is an aggressive competitor that is capable of developing monocultures along streams, rivers, canals and reservoirs. It is capable of invading areas that do not have moist soils, but is most common near riparian areas. Large individual plants can use 200 gallons of water per day making them particularly concerning in arid and semi-arid environments were water is limiting. It has also been known to increase soil salinity, which can make soils less conducive to native plant growth. Development of large patches along waterways have resulted in more intense flooding during heavy rainfall events.

How to control:

Mowing, burning, chopping, chaining, and disking can be used to reduce Tamarisk, but these methods are not likely to control the population.

Several herbicides are effective and there are two biological control beetles that have been successfully used to control larger populations.

Noxious Weed Class	A
Family:	Tamariaceae
Region of Origin:	Eurasia
Life Form:	Perennial
Reproduction Method:	Seed
Height Range:	1 – 20 feet
Flowering Period:	April to August
Flower Color:	Pink to white

Scentless Chamomile
(Tripleurospermum Perfotum)

How to Identify:

Leaves are very finely divided. The plant can have a bushy appearance. Stems are branched. Flowers are solitary at the end of flowering stalks of the main stem and are 2-3 cm wide.

Impacts:

Scentless Chamomile is a poor competitor compared to other noxious weeds, however, it can rapidly expand and fill areas of bare ground.

How to control:

Hand pulling is effective for small populations. Mowing can be used on larger populations to prevent seeding. If mowing is used, the treatment will need to be repeated several times a season.

The roots of Scentless Chamomile are shallow and therefore, tilling and disking can be effective control methods. This method should be limited to areas that have already experienced soil disturbance and do not contain many natives.

There are multiple herbicides that are effective on Scentless Chamomile and all are most effective when applied early season.

Seeds can persist in the soil for 10 years . Control of Scentless Chamomile will likely be a long-term investment.

Look-a-likes:

Other chamomiles

Corn Chamomile

Mayweed

Oxeye daisy:

Noxious Weed Class ……...	County
Family: ……	Asteraceae
Region of Origin: ……	Europe
Life Form: ……	Annual, short lived perennial
Reproduction Method: …….	Seed
Height Range: ……..	2-3 feet
Flowering Period: …….....	June to late summer
Flower Color: ……	White and yellow

Scotch Thistle (Onoprodum Acanthium)

How to Identify:

Scotch Thistle has a winged stem that is densely branched. Flowers are globe shaped, 1-2 inches wide with a base covered in tiny, sharp bracts. Leaves can be 2ft. long and 1ft. wide with sharp, yellow spines. The leaves and often the whole stem can appear gray/white-green due to a thick mat of cotton-like hairs.

How to Control:

Scotch Thistle can be control by digging plants up. Mowing or grazing with goats will help prevent seed production. The thistle is an annual to biennial so individual plants will dye naturally within 2 years, so preventing seeding is important. Herbicide may be more practical for very large populations and there are several broadleaf specific herbicides available for Scotch Thistle.

Impacts:

Dense patches prevent livestock and wildlife from moving through and thus may prevent access to water. This is a competitive species that will crowd out natives and is not palatable to most wildlife. The exception may be a hand full of insects.

Look—Likes:

Flodmans thistle (Cirsium flodmanii): this species is native and has narrower leaves and smaller flower heads then Scotch thistle. In general, it is a daintier plant with a lighter colored flower.

Noxious Weed Class	A
Family:	Asteraceae
Region of Origin:	Eurasia
Life Form:	Biennial
Reproduction Method:	Seed only
Height Range:	Up to 12 feet and 6 feet wide
Flowering Period:	June - August
Flower Color:	Pink to Purple

Spotted Knapweed (Centaurea maculosa)

How to Identify:

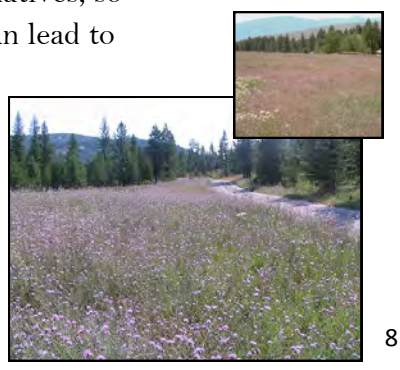
This species has a thick and deep tap root. The stems and leaves of Spotted Knapweed are hairy. Basal leaves are pinnately divided with oblanceolate ends and stem leaves are divided. Flowers develop as a single flower head at the end of branching stems and are approximately ¾ of an inch in diameter. A distinctive characteristic of Spotted Knapweed is the presence of dark (brown to black) spots on the bracts of the flower head.

Impacts:

Spotted Knapweed is known to be competitive with natives and is allelopathic (produces chemicals in the soil that make soil less conducive to native plant growth.). This species is especially problematic in dry, gravely and disturbed soils. It can be a contaminant in soils and gravel used for roads and construction backfill.

Spotted Knapweed is not a quality forage. When dense patches form, rangeland and wildlife habitat quality declines.

The root system of Knapweed is not as effective at holding soil in place as natives, so invasion of Knapweed can lead to increased soil erosion and stream sedimentation.



How to control:

Hand weeding can be effective for small populations if repeated frequently each season. However, repeated mowing can shift this species from a biennial to a perennial, so use mowing sparingly.

Herbicide is effective on Knapweed, especially in combination with prescribed burning and mowing. Grazing at high intensity can also have significant effects on Knapweed, but will not eradicate it.

Biological control agents such as: flies, weevils, moths, bacteria and fungus, can be effective . It may take 2-4 years to see substantial control, but 90% control can be obtained in the right climate.

Look a-Likes:

Diffuse Knapweed (Centaurea diffusa), lacks spots on the bracts of the flower heads and the bracts are much longer and sharper.

Noxious Weed Class …… A

Family: ……..Asteraceae

Region of Origin: ……..…Eurasia

Life Form: ……Biennial to short lived perennial

Reproduction Method: …….Seed

Height Range: ……..……1 – 3 feet

Flowering Period: …….. June - October

Flower Color: ……..Pink to purple

Squarrose Knapweed (Centaurea virgata (C. squarrosa))

How to Identify:

Squarrose Knapweed is a tap rooted species with a highly branched stem. Leaves are grey-green and alternate. Lower leaves are highly lobed and upper leaves are more bract like. Flower heads are fairly small and narrow compared to other noxious knapweed species. Flower head bracts are tan in color and curved backwards or spreading with the terminal spine being longer than those along the edges of the bracts.

Impacts:

Knapweed is highly competitive with native plant species. This species is known to produce chemicals that inhibit native plant growth (Allelopathy). It is a poor quality plant for forage, though can be grazed while still a rosette. Dense patches of Squarrose Knapweed, like other Knapweeds will substantially reduce rangeland productivity and wildlife habitat.

How to control:

Hand weeding Squarrose Knapweed is not effective as it will resprout from remaining root segments. Digging can be effective but only if a majority of the root is removed.

Herbicide is an effective method of control and there are several options for herbicide type.

Six biocontrol agents are available for this species: two small gall flies of the fruit fly family Urophora affinis Frauenfeld and U. quadrimaculatus, Tephritidae. For further information on biological controls, contact APHIS.

Look-a-likes:

Diffuse Knapweed—has longer shaper bracts

Spotted Knapweed—has dark spots on the sharp bracts.

Russian Knapweed— has papery bracts and has a much wider seed head.

Noxious Weed Class ……..…	County
Family: ……	Asteraceae
Region of Origin: ……	Eastern Mediterranean
Life Form: ……..…….	Perennial
Reproduction Method: ……..	Seed and ???
Height Range: ……	1-1.5 feet
Flowering Period: ……..	Midsummer
Flower Color: ……...…	Rose to pink

St. Johnswort (Hypericum perforatum)

Additional Common Names: Kalamath Weed

How to Identify:

Stems are erect and branch frequently. Leaves of St. Johnswort are opposite, entire and sessile. They are approximately an inch long and have distinctive transparent dots on the leaves. It looks as if the leaves have pin holes in them. There are tiny black spots around the edge of the underside of the leaves. The root of this plant is often woody and always a taproot.

How to control:

Hand pulling and digging of small populations followed by monitoring is effective. Larger populations will likely require herbicide control or biological control. Several biological controls exist, including: beetles, Midges and a moth, have been used to control St Johnswort. The effectiveness of biological controls will depend on the climate and density of plants.

Mowing will not control St Johnswort and burning can actually increase density.

Planting of competitive native plants, especially perennial grasses, can be effective to prevent invasion and reinvasion of St Johnswort. This species is not shade tolerant, so planting species that will shade St Johnswort is recommended.

Impacts:

St Johnswort quickly expands to dense patches displacing desirable native plants. It is not a good forage plant and thus can decrease rangeland property values and wildlife habitat. This species is toxic to white haired animals. It contains a chemical that makes these animals sensitive to sunlight and causes excessive weight loss. Other livestock can experience this poisoning if large quantities of the plant are consumed.

Noxious Weed Class ……	A
Family: …….	Clusiaceae/ Hypericeae
Region of Origin: ……	Europe
Life Form: ……...	Perennial
Reproduction Method: …….....	Seed and runners
Height Range: ……	1 – 3 feet
Flowering Period: ……..	Early Summer
Flower Color: …… tiny,	Yellow with pin hole, black spots on margins

Sulfur Cinquefoil (Potentilla recta)

How to Identify:

Stems are rough, erect and hairy. Leaves are palmately compound with 5 to 7 leaflets and hairy. Hairs may be up to 1/4 an inch long and are present on both the leaves and stem. The leaves are green on both upper and undersides and arranged alternatively along the stem. Leaf size decreases as you move up the stem. Flowers have 5 petals and are about 1 inch wide. Each petal is deeply notched.

How to control:

This is a disturbance follower, so should be monitored for following soil disturbing actions.

Hand digging is effective if the majority of the tap root is removed. This method is not logistically realistic for larger populations.

Mowing will not control this plant.

Herbicides are the most effective control method for Sulfur Cinquefoil.

Look a-likes:

Sulfur Cinquefoil can be distinguished from other Cinquefoils by the hairs and number of leaves. Most natives will have much shorter hairs and few stem leaves.

Prior to flowering, it may look like Marijuana due to the hairy 5 leaflet leaf structure.

Impacts:

Sulfur Cinquefoil is rarely grazed and if grazed, only flower stalks are eaten. It forms dense stands and thus substantially reduces rangeland productivity and property value.

Noxious Weed Class ……	A
Family: ……...……..	Rosaceae
Region of Origin: …….	Eurasia
Life Form: ……...…..	Perennial
Reproduction Method: ……..…...	Seed
Height Range: ……	1 – 3 feet
Flowering Period: ……..	May - July
Flower Color: …….	Light yellow darker near center

Viper's Bugloss (Echium vulgare)

Additional Common Names: Blue Weed

How to Identify:

Basal rosette leaves are lanceolate in shape and hairy. Stem leaves are also lanceolate and area arranged alternate along the stem. Hairs on the stem and leaves have a purplish base that make the stems and leaves look spotted. Flowers are arranged on cymes (spikes) and can have up to 20 flowers. Flowers are funnel shaped with five lobes. Stamens are pink to red in color. Seeds are nutlet in form.

Impacts:

Viper's Bugloss is toxic to livestock. It is also a known host to aphids that carry and spread several plant diseases native plants are susceptible to. This can significantly reduce native plant diversity. Invasion of Viper's Bugloss reduces value of rangelands and quality of wildlife habitat.

How to control:

Hand pulling (use gloves) and digging are effective if the majority of the tap root is removed. This is labor intensive and therefor, is best for small populations only. Viper's Bugloss prefers low fertility soils and bare ground, so planting of natives can aid in reducing spread and increasing control.

Herbicide is the best option for this plant in general and especially for larger populations.

Look a-likes:

Other Echium species can be confused with Viper's Bugloss, but all Echium species are exotic to the US so you are not at risk of confusing Viper's Bugloss for a native Echium.

Phacelia flowers are often confused for Viper's Bugloss, however, Phacelia flowers are symmetrical whereas, Viper's Bugloss are tubular.

Houndstounge is also confused with viper's Bugloss, but its flowers are more red in color.

Phacelia crenulata

Phacelia linearis

Houndstounge

Noxious Weed Class …… A

Family: ……..Boraginaceae

Region of Origin: ……...Europe

Life Form: ……Annual,
Biennial, Perennial

Reproduction Method: …….Seed

Height Range: ……..3 feet

Flowering Period: ……June—October

Flower Color: ……Purple to blue

Yellow Starthistle (Centaurea solstitialis)

How to Identify:

Stems of Yellow Starthistle are winged and covered with tiny hairs that give the plant a grey-green look. Basal leave are deeply lobed, whereas, leaves further up the stem are entire and pointed. Flowers are born on the end of branches with tan colored thorns ¾ an inch long.

Impacts:

Yellow Starthistle has invaded over 23 states and is considered one of the worst noxious weeds in the United States. This species causes chewing disease in horses. Chewing disease has no treatment and usually will lead to starvation or dehydration ending in death. The thorns that surround the flowers of Yellow Starthistle lodge themselves into the eyes, nose, skin and feet of animals. Yellow Starthistle also alters water cycles and reduces available soil water. Once established, this plant spreads very rapidly and is difficult to control.

How to control:

Grazing by sheep, goats and cattle can be used to contain Yellow Starthistle and prevent seeding, but must occur prior to formation of the thorns

Digging and hand pulling are effective and economically viable for small populations or after the first 3 years of management has reduced the seedbank and thus fewer plants continue to germinate. Mowing is effective when done just before flowering, but plants can recover from if done too soon.

Herbicide is the most effective method for larger populations especially in soils that are particularly fertile.

Look a-likes:

Maltese star thistle (C. melitensis): spines are much shorter.

Noxious Weed Class	A
Family:	Asteraceae
Region of Origin:	Mediterranean
Life Form:	Annual
Reproduction Method:	Seed
Height Range:	2 – 3 feet
Flowering Period:	May - September
Flower Color:	Yellow

Yellow Toadflax (Linaria vulgaris)

Additional Common Names: Butter And Eggs

How to Identify:

Stems of Yellow Toadflax are erect, densely leaved and have very few if any branches. The whole plant is smooth to the touch. Leaves are arranged alternately along the stem and are narrow, pale green and pointed at the ends. Leaves tend to be 2-2.5 inches long. Flowers form along a raceme and look similar to those of snapdragons.

Impacts:

Crowds out native plant species by forming dense patches reducing forage for both livestock and wildlife. When Yellow Toadflax replaces grassland species, erosion, surface run-off and sedimentation of streams can increase. Yellow Toadflax is also a known agricultural weed that reduces crop productivity. Cattle will typically avoid Yellow Toadflax, but rare occurrences of poisoning have occurred.

How to control:

Once established this species is difficult to control due to a deep taproot and laterally spreading roots that produce new plants and high genetic variability. Toadflax species vary in their response to management so it is best to use multiple methods on any given population. Genetic variability in toadflax species can make herbicide selection difficult, however, fall applications are often most effective regardless of the herbicide used.

Biological control agents are available, but effectiveness will vary with plant genetics , population density and climate.

Planting of deep rooted native plants will help increase plant community resistance to Yellow Toadflax. Rooting must be deeper than that of Yellow Toadflax

Look a-likes:

Yellow Paintbrush (Castilleja flava var. flava) is a native paintbrush species.

Noxious Weed Class ……. A

Family: ……..Scrophulariaceae

Region of Origin: ……..…Eurasia

Life Form: ……....Perennial

Reproduction Method: ….....Seed and root

Height Range: ……1 – 2 feet

Flowering Period: ……....July to September

Flower Color: …….Yellow to yellowish white with an orange throat.

Appendix C: Noxious Weed Species List

Weed Classifications according to the Utah Weed Control Association, Summit County Weed Department and Conversations with Park City Municipal Corporation Department of Park and Recreation (2015)

Common Name	Scientific Name	Species Abbreviation
Utah State Class 1A		
African Rue	*Peganum harmala*	*PEGHAR*
Common Crupina	*Crupina vulgaris*	*CRUVUL*
Malta Thistle	*Centaurea melitensis*	*CENMEL*
Mediteranian Sage	*Salvia aethiopis L.*	*SALAET*
North African Grass	*Ventenata dubia*	*VENDUB*
Plumeless Thistle	*Carduus acanthiodes*	*CARACA*
Small Bugloss	*Anchusa arvensis*	*ANCARV*
Spring Millet	*Milium vernale*	*MILVER*
Syrian Beancaper	*Zygophyllum fabago*	*ZYGFAB*
Utah State Class 1B		
African Mustard	*Brassica tournefortii*	*BRATOU*
Camelthorn	*Alhagi maurorum*	*ALHMAU*
Common St. Johnswort	*Hypericum perforatum*	*HYPPER*
Cutleaf Vipergrass	*Scorzonera laciniata*	*SCOLAC*
Elongated Mustard	*Brassica elongata*	*BRAELO*
Garlic Mustard	*Alliaria petiloata*	*ALLPET*
Giant Reed	*Arundo donax*	*ARUDON*
Goatsrue	*Galega officinalis*	*GALOFF*
Oxeye Daisy	*Chrysanthemum leucanthemum*	*CHRLEU*
Purple Starthistle	*Centaurea calcitrapa*	*CENCAL*
Japanese Knotweed	*Polygonum cuspidatum*	*POLCUS*
Viper's Bugloss	*Echium vulgare*	*ECHVUL*
Utah State Class 2		
Black Henbane	*Hyoscyamus niger*	*HYONIG*
Dalmatian Toadflax	*Linaria dalmatica*	*LINDAL*
Diffuse Knapweed	*Centaurea diffusa*	*CENDIF*
Dyer's Woad	*Isatis tinctoria*	*ISATIN*
Leafy Spurge	*Euphorbia esula*	*EUPESU*
Medusahead	*Taeniatherum caput-medusae*	*TEACAP*
Purple Loosestrife	Lythrum *salicaria*	LYTSAL
Rush Skeletonweed	Chondrilla juncea	*CHOJUN*
Spotted Knapweed	*Centaurea maculosa*	*CENMAC*
Squarrose Knapweed	*Centaurea virgata* (*Centaurea squarrosa*)	*CENVIR*
Yellow Starthistle	*Centaurea solstitialis*	*CENSOL*
Yellow Toadflax	*Linaria vulgaris*	*LINVUL*

Common Name	Scientific Name	Species Abbreviation
Utah State Class 3		
Bermudagrass	*Cynodon dactylon*	*CYNDAC*
Canada Thistle	*Cirsium arvense*	*CIRARV*
Common Reed	*Phragmites australis ssp.*	*PHRAUS*
Field Bindweed	*Convolvulus arvensis*	*CONARV*
Hoary Cress	*Lepidium draba*	*LEPDRA*
Houndstongue	*Cynoglossum officinale*	*CYNOFF*
Johnsongrass	*Sorghum halepense*	*SORHAL*
Jointed Goatgrass	*Aegilops cylindrica*	*AEGCYL*
Musk Thistle	Carduus *nutans*	*CARNUT*
Perennial Pepperweed	*Lepidium latifolium*	*LEPLAT*
Poison Hemlock	Conium *maculatum*	*CONMAC*
Puncturevine	Tribulus terrestris	*TRITER*
Quackgrass	*Elytrigia repens*	*ELYREP*
Russian Knapweed	*Acroptilon repens*	*ACRREP*
Saltcedar/ Tamarisk	*Tamarix chinensis*	*TAMCHI*
Scotch Thistle	*Onoprodum acanthium*	*ONOACA*
Sorghum Almum	Sorghum almum, A, parodi	*SORALM, SORPAR*
Utah State Class 4		
Congagrass	*Imperata cylindrica*	*IMPCYL*
Dame's Rocket	*Hesperis matronalis*	*HESMAT*
Myrtle Spurge	*Euphorbia myrsinites*	*EUPMYR*
Russian Olive	*Elaeagnus angustifolia*	*ELAANG*
Scotch Broom	Cytisus scoparius	*CYTSCO*
Summit County Class A - addition to State		
Viper's Bugloss	*Echium vulgare*	*ECHVUL*
Summit County Class B - addition to State		
Common Burdock	*Arctium minus*	*ARCMIN*
Corn Chamomile	*Anthemis arvensis*	*ANTARV*
Mayweed Chamomile	*Anthemis cotula*	*ANTCOT*
Scentless Chamomile	*Tripleurospermum perforatum*	*TRIPER*
Summit County Class C - addition to State		
Bull Thistle	*Cirsium vulgare*	*CIRVUL*
Park City Municipal Corporation - addition to State		
Cheat Grass	*Bromus tectorum*	*BROTEC*

Appendix E:
Park City Municipal Corporation Noxious Weed Mapping Standards

This summary contains the data fields required to meet Park City Municipal Corporation mapping standards. They have been based upon the North American Invasive Species Management Association (NAISMA) mapping standards and modified to meet the needs of Park City. These standards are intended to be considered the minimum standards and address the most basic information necessary to compare invasive species problems across lands over time. These standards should be used for both monitoring and inventory data collection.

Field Descriptions

Data Field Name: This is the name that will appear on the inventory form for a particular variable or characteristic being recorded. It provides common vocabulary for sharing information.

Definition: Provides a description and explanation of the data field.

Coding: Describes the proper way information should be entered.

Required Fields

Collection Date:
Field Name: Collection Date.
Definition: The date the weed infestation was observed in the field.
Coding: Enter the date where YYYY equals the four digits or numbers of the year (2002), mm equals the two digit representation of the month (10) and dd stands for the two digit representation for the day of the month (03). The date will be in the following format yyyymmdd.

Management Unit Name:
Field Name: Management Unit
Definition: This variable is based on city maps and may contain several subsections with in it. This is information you will need to obtain from the weed coordinator.
Coding: text and numbers depending on the name

Site Name:
Field Name: Site Name
Definition: For some sites, this may be the same as the Management Unit. Other sites will have a site name based on maps provided by the city and will be a subsection of a larger management unit.
Coding: text and numbers depending on the name.

Target Weed Name:

Field Name(s): Genus, Species

Definition: These fields will contain the scientific or species name of the weed. The scientific name consists of the genus name followed by the species name, in Latin.

Coding: Enter the Genus and species name as it appears in either your plant key

Population Size

Field Name: Population Area

Definition: This is an estimate of the area in which the noxious weed is in if you were to draw a polygon around the full population. If using GPS, ensure your data dictionary includes area in the data output. If GPS polygons are not being used, make this estimate yourself.

Coding: number in square feet or acres.

Percent of location covered by noxious weed:

Field Name: Percent cover

Definition: It is an estimate of the area within the polygon the noxious weed actually covers.

Coding: Enter the number of acres - Unit of Measure: acres.

Percent Bareground present

Field Name: Bareground

Definition: It is an estimate of the area within the polygon that is bareground if you were looking straight down from above the plant canopy.

Coding: a percentage

Dominant Plant Growth Stage of Noxious Weed

Field Name: Growth Stage

Definition: This is the growth stage that the majority of plants within the population of a noxious weed are at.

Coding: V = vegetative without signs of bolting or flowering i.e. a rosette; B = bolting; F = Flowering; S = Seeds developing or already dispersing; D = Dead

Non-target Weed Name:

Field Name(s): Genus, Species

Definition: These fields will contain the scientific or species name of the weed. The scientific name consists of the genus name followed by the species name, in Latin.

Coding: Enter the Genus and species name as it appears in either your plant key, make a new entry for each new species you record.

	Non-noxious Weeds at GPS Point #1	Non-noxious Weeds at GPS Point #2	Non-noxious Weeds at GPS Point #3	Non-noxious Weeds at GPS Point #4
Genus, Species Non-noxious Weed #1	*Dipsacus fullonum*	*Dipsacus fullonum*	*Melilotus officinalis*	
Genus, Species Non-noxious Weed #2	*Melilotus officinalis*		*Brassica nigra*	
Genus, Species Non-noxious Weed #3				
Genus, Species Non-noxious Weed #4				

Dominant Native Species:

Field Name(s): Dom Native Species

Definition: These fields will contain the scientific or species name of the most common native species. The scientific name consists of the genus name followed by the species name, in Latin. Each species name will be separated by a common as if making a list.

Coding: Enter the Genus and species name as it appears in either your plant key followed by a comma and then the next Genus and species name….

Disturbance

Field Name: Disturbance

Definition: Describe any disturbances observed at the site (recent soil movement, damaged vegetation…). Such information can help in predicting what lands are most at risk for invasion in the future.

Code: text

Adjacent Land Description

Field Name: Adjacent land use

Description: This will be a list of land use types or terrain, such as roads, trails, buildings, waterways, parks…

Code: text

Source of the Data

Field Name: Source of the Data

Definition: This field refers to the owner or manager of the data. This may be a different person or entity from the landowner or the person who collected the data. It may be an office manager or a database specialist. This entity that will be responsible for answering questions about the data or be responsible for data requests.

Coding: This field using the same coding system as for national ownership, described in a previous section.

All data will be provided as maps with a description of the location (area of city, nearest streets) or shapefiles of all GPS points and polygons.

All data will also be required to have associated meta-data:

- The date range over which the data was collected.
- The minimum distance between populations/patches used for survey.
- The make and model of the GPS units used for data collection.
- The data resolution obtained by GPS
- The System, Zone and DATUM settings used on the GPS

Appendix F: Example herbarium voucher specimen collection form

Scientific Name:
Family Name:
English Laguage Name:
Location: State: County: Local Description: Latitude: Longitude
Habitat: Collection site Biological characteristics:
Description of Plant: Life form: Hight: Flower color: Other:
Collectors name:
Collection date: