

Integrated Weed Management Plan Comstock Project



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LIST OF ABBREVIATIONS

ai/A	Active ingredient per acre
BLM	U.S. Bureau of Land Management
BMP	Best Management Practice
CWMA	Cooperative Weed Management Area
EDRR	Early Detection, Rapid Response
ESA	Environmental Science Associates
GIS	Geographical Information System
GPS	Global Positioning System
HUC	Hydrological Unit Code
IWM	Integrated Weed Management
IWMP	Integrated Weed Management Plan
JBR	JBR Environmental Consultants, Inc.
NAD	North American Datum
NDEP	Nevada Division of Environmental Protection
NDOA	Nevada Department of Agriculture
NRCS	Natural Resource Conservation Service
NRS	Nevada Revised Statute
PPE	Personal Protection Equipment
UNCE	University of Nevada Cooperative Extension
UTM	Universal Transmercator Metric

INTEGRATED WEED MANAGEMENT PLAN COMSTOCK PROJECT

1.0 INTRODUCTION

The infestation of noxious and invasive weeds on agricultural lands and rangeland is a serious problem in Nevada and other western states. Noxious weeds, according to the U.S. Bureau of Land Management (BLM), have invaded about 17 million acres of public rangelands with management costs in the hundreds of millions of dollars. Weed infestation can result in numerous negative impacts that are extensive and often irreversible.

Comstock Mining, LLC (Comstock) is currently operating and conducting exploration drilling near the towns of Virginia City and Gold Hill in Storey and Lyon Counties, Nevada. Vegetation surveys conducted in 2011 have identified several noxious and invasive weed species within the project area. It is the desire of Comstock to prevent the spread of these weeds, to eradicate existing weeds where possible, and to prevent new infestations. To assist with this effort, Comstock contracted JBR Environmental Consultants, Inc. (JBR) to develop an Integrated Weed Management Plan (IWMP) that provides strategies for weed prevention and management.

An integrated weed management (IWM) approach is the basis for this plan. IWM is a process of selecting and applying a combination of management techniques (biological, chemical, mechanical, and cultural) that, together, will control a particular weed species or infestation efficiently and effectively, with minimal adverse impacts to non-target organisms. Early Detection and Rapid Response strategies aimed at identifying those weeds that have not yet been discovered in an area, but have been found in surrounding areas are also incorporated into this IWMP to assist Comstock with prevention and early eradication strategies.

The objectives of this IWMP are the following:

- Prevent the introduction, establishment and spread of invasive plants;
- Reduce the extent and density of established invasive plants;
- Protect and maintain desired plant communities from weed invasion;
- Implement economical, practical and effective weed control methods for target species;
- Rehabilitate priority areas after treatment to reduce the susceptibility of re-invasion;
- Provide education about weed management and weed identification;
- Discuss methods to control any noxious weeds that be discovered in the future (early detection, rapid response);
- Establish a monitoring protocol for evaluating the success/failure of the prescribed treatments; and
- Provide contacts and resources for effective and coordinated weed management.

2.0 OVERVIEW OF APPROACH TO WEED MANAGEMENT

Most invasive weeds were introduced accidentally or purposefully from other places, most notably Eurasia. Weed seeds have arrived to the U.S. in multiple ways including contaminated soil used as ballast for shipping vessels, shipments of crop seed or hay, and by way of imported animals that can carry weed seeds in their coat or manure. Some species, such as saltcedar, were cultivated for use as erosion control. Many species such as perennial pepperweed, or tall whitetop, were most likely imported for ornamental uses. When settlers began moving west, and with the arrival of the railroad, weeds easily found their way to western rangelands.

Weed species excel at adaptation to their environment, often outcompeting and replacing the native species. They can spread in different ways including by wind, water, animals and humans. Wind easily blows seeds from a plant to new locations. Surface water flow has been shown to carry many kinds of seeds into range and croplands. A study conducted in western Nebraska showed that up to 77 different kinds of weed seeds and approximate 38,000 seeds per acre were contained in surface irrigation water during each irrigation season (Donaldson, 2011). Flooding of rivers, creeks and streams has great potential for carrying weed seeds. Humans carry seeds on shoes, bike and vehicle tires, construction and farm equipment, plus many other methods. Fill dirt and gravel are common sources of weed infestations; therefore it is critical to use only weed-free resources. Animals and birds can spread seed through attachment to fur and feathers, hoofs, plus seed can pass through digestive tracts and remain viable.

Prevention of weed infestation is the least expensive and most effective way to stop the spread of weeds. Preventing the establishment of weeds relies upon (UNCE, 2003):

- Educating workers about the importance of managing weeds on an ongoing basis;
- Properly identifying weed species;
- Avoiding or treating existing weed populations; and
- Incorporating measures into projects that prevent weed seeds or other plant parts from establishing new or bigger populations.

2.1 NOXIOUS SPECIES

It is not only good management practice to control and treat weeds, there are federal and state laws that require landowners to manage noxious weeds. The Integrated Nevada Weed Management Plan (NWAC, 2000) states:

Impacts of Weed Invasion

(Donaldson, 2011*)

1. Native Plants are displaced.
2. Plant biodiversity is reduced.
3. Invasive weeds affect threatened and endangered species.
4. Normal ecological processes, including nutrient and water cycling, are altered.
5. Wildlife habitat is reduced, and forage is lost.
6. Recreational values and uses are affected.
7. Soil erosion and stream sedimentation are increased.
8. Forage production for livestock is reduced.
9. Crop production is impacted, and yields lowered.
10. Land values are reduced.
11. Invasive weeds impact the economy and may cause job losses.
12. Maintenance costs are increased.
13. Weeds may affect human and animal health, and may harbor vermin.
14. Weeds may cause structural damage to buildings and roads.

**Excerpted directly from UNCE Weed Warriors Manual*

“The Nevada Legislature has declared that it is the obligation and responsibility of the owners or occupiers of land in Nevada to control all weeds designated as noxious by the Nevada Department of Agriculture (NDOA). This applies to private-landowners, cities, counties, ditch companies, railroads, federal and state agencies, etc. If the owner or occupier of land fails or neglects to control noxious weeds, enforcement action can be taken by the NDOA. The NDOA can contact the owner or occupier and advise them of the actions they must take to address their noxious weed problem. If the owner-occupier fails to take action, the NDOA is authorized to notify the county commissioners of the county in which the land is located. The county commissioners shall then perform the control actions required, paying for them out of county funds. The county can then bill the owner or occupier for the cost of performing the work.”

Noxious Weed Act of 1974, as amended (7 U.S.C. 2801 et seq.)

Requires cooperation with state, local, and other federal agencies in the application and enforcement of all laws and regulations relating to the management and control of noxious weeds.

Nevada Noxious Weed State Law (NRS 555.005, NAC 555.010)

Recognizing the substantial economic losses caused by noxious weeds, the State of Nevada has enacted laws requiring control of noxious weeds (NRS 555.005, NAC 555.010), which defines noxious weeds as:

“Any species of plant which is, or is likely to be, detrimental or destructive and difficult to control or eradicate.”

When Nevada law defines a weed as “noxious,” its distribution in commerce is prohibited and its control or management is mandated (UNCE, 2003). State of Nevada noxious weed definitions are as follows:

- Category A: Weeds not found or limited in distribution throughout the State; actively excluded from the State and actively eradicated wherever found; actively eradicated from nursery stock dealer premises; control required by the State in all infestations.
- Category B: Weeds established in scattered populations in some counties of the state; actively excluded where possible, actively eradicated from nursery stock dealer premises; control required by the State in areas where populations are not well established or previously unknown to occur.
- Category C: Weeds currently established and generally widespread in many counties of the State; actively eradicated from nursery stock dealer premises; abatement at the discretion of the state quarantine officer.

Nevada Noxious Weed Law is included in Appendix A along with the most current list of Nevada Noxious Weeds.

2.2 INVASIVE SPECIES

Invasive species are those species that are not native to the ecosystem being considered, and the negative impacts caused by the species outweigh the positive benefits it provides. All noxious weeds are invasive,

but not all invasive species are considered noxious. Due to the potential economic or environmental harm caused by these species federal regulations and guidelines have been developed.

Executive Order 13112: Invasive Species

Federal Executive Order 13112 defines an invasive species as an alien (non-native) species whose introduction does or is likely to cause economic or environmental harm or harm to human health. The order directs all federal agencies to prevent and control introductions of invasive nonnative species in a cost-effective and environmentally sound manner to minimize their economic, ecological, and human health impacts.

3.0 PROJECT LOCATION AND DESCRIPTION

The Comstock Project, located in the historic Comstock Mining District, encompasses approximately 2,433 acres within Storey and Lyon Counties, Nevada in the Virginia Mountain Range (Figure 1). The project area is located within portions of Sections 5, 6, 7, 8, 9, 16, 17, 20-22 and 27-29, of Township 16 North (T16N), Range 21 East (R21E), and Sections 1-12, Township 16 North (T16N), Range 20 East (R20E). The site is located in the Dayton Valley watershed, which is located within the Middle Carson watershed (HUC #16050202). The project site encompasses both private lands, and public lands administered by the BLM.

Elevations in the project area range from approximately 4,500 feet to 6,100 feet above mean sea level. The terrain is gentle to moderately steep throughout most of the area, with four named drainages passing through: Gold Canyon, American Ravine, Amazon Gulch, and Daney Canyon. American Ravine connects to Gold Canyon, which in turn connects to the Carson River, a Waters of the U.S. navigable water body (JBR, 2011).

The climate in the survey area is typical for the high desert of northern Nevada. Annual averaged climate data for 1981 through 2010 at Virginia City, Nevada (WRCC, 2012) indicates that the project area averages 12.94 inches of precipitation per year, usually occurring in late fall through spring as snow, with occasional summer thunderstorms. Average temperatures range from 24.5 Fahrenheit (°F) in the winter to 83°F in the summer.

Soils within the survey area have been mapped by the Natural Resources Conservation Service (NRCS) and are described in the *Soil Survey of Storey County Area, Nevada* and *Soil Survey of Lyon County Area, Nevada* (NRCS, 1997).

Environmental Science Associates (ESA) conducted a floristic pedestrian survey in May and June of 2011. ESA's surveyed vegetation communities and habitat are provided in Table 1 and displayed in Figure 2.

Table 1 Vegetation Communities/Habitats for Comstock Project Site

Habitat Type	Acres in Lyon County	Acres in Storey County
Low Sagebrush	232.4	67.7
Mixed Low Sagebrush/Wyoming Sagebrush	32.2	NA
Mountain Sagebrush	148.1	367.4
Basin Big Sagebrush	30.6	4.7
Rubber Rabbitbrush	4.1	NA
Mixed Basin Big Sagebrush/Rubber Rabbitbrush	4.2	NA
Desert Scrub	41.4	111.2
Pinyon-Juniper	34.5	46.0
Riparian	2.8	11.3
Wet Meadow	NA	6.3
Dry Meadow	NA	7.3
Seep	0.1	NA
Rock Outcrop	3.3	3.2
Disturbed	127.5	99.7
Mosaic Disturbed/Sagebrush	59.3	NA

Source: ESA 2011a and 2011b

4.0 WEED SPECIES IN THE PROJECT AREA

Noxious and invasive weed surveys were conducted in 2011 by ESA for the proposed project area. Numerous weed species were identified as shown in Figure 3. The weed types include state-designated “noxious” weeds and several invasive weeds. Table 2 provides the Nevada listed noxious weeds found in the project area.

Table 2 Nevada Listed Noxious Weeds Found at Comstock Project Area

Common Name	Scientific Name	Nevada Weed Category
Tall whitetop or Perennial pepperweed	<i>Lepidium latifolium</i>	List C
Hoary cress or short whitetop	<i>Cardaria draba</i>	List C
Diffuse knapweed*	<i>Centaurea diffusa</i>	List B
Russian knapweed*	<i>Acroptilon repens</i>	List B
Scotch thistle*	<i>Onopordum acanthium</i>	List B
Musk thistle	<i>Carduus nutans</i>	List B
Poison hemlock	<i>Conium maculatum</i>	List C
Salt cedar	<i>Tamarix</i> sp.	List C

Source: ESA 2011a and 2011b

*Although not found within the project area, these species were found nearby so are a potential threat to the project site and should be considered in weed treatment and monitoring.

In addition to State of Nevada noxious weed species, several species considered potentially invasive found at the project site include the following:

- Hairy whitetop (*Cargaria pubsecens*)
- Bull thistle (*Cirsium vulgare*)
- Medusahead (*Elymus caput-medusae*)

Appendix B contains fact sheets for each of these species listed above.

4.1 GENERAL OBSERVATIONS

Noxious and invasive weed species were recorded during vegetation and Waters of the U.S. Surveys conducted within the project boundaries in 2011 by ESA. Noxious and invasive weeds were mapped and recorded with a hand-held global positioning system (GPS) unit. These locations were recorded in North American Datum (NAD) 83 and Universal Transmercator Metric (UTM) units to facilitate transferal to BLM database.

The diversity and density of weed infestations within the project site appears to be highly correlated with ground disturbance and human use. Disturbed habitats are generally the first areas to be colonized by annual, highly competitive species. These areas include old and current road cuts and shoulders, railroad grade and right of way, historic mine works and tailings, and berms. Areas that are frequently disturbed are more susceptible to noxious weed infestation by virtue of animals and people supplying seed sources to these areas in conjunction with surface disturbance. Special care should be taken to inventory, treat and monitor disturbed areas prior to beginning work. Embankments of streams, ponds, and other water bodies are also prime locations for weed infestations as the water transports the seed, and the moist conditions are ideal for weed establishment.

5.0 PRIORITIES FOR WEED TREATMENTS

This section provides strategies for prevention of weed infestations, best management practices, and for setting priorities for treatment of existing infestations.

5.1 PREVENTION

Noxious and invasive plant seeds and other reproductive plant parts can be inadvertently transported by equipment, vehicles, people and animals. Vegetation and soil disturbance during mining operations and construction related activities can also create suitable conditions for the establishment of invasive plants. Once noxious and invasive plants establish populations, these areas can become sources of seeds that facilitate further spread. Noxious and invasive plant spread can be greatly reduced if best management practices (BMPs) such as cleaning equipment and using weed-free materials are implemented. BMPs are discussed in detail in Section 5.2.

Preventing weeds from establishing in the first place is the most important weed management tool!

Overall Prevention Principles (Cal-IPC 2012)

- **Take time to plan.** Proper planning can reduce future maintenance costs by reducing the potential for noxious and invasive plant introduction and spread. Prior to beginning work in a new area it is important to conduct a pre-activity assessment of the work area to determine which, if any, noxious and invasive weeds are in the area, which activities could spread weeds, and which BMPs are applicable.
- **Stop movement of invasive plant materials and seeds.** Workers, materials and equipment can carry weeds between sites. Identify and implement BMPs (see Section 5.2) to eliminate the seed sources or minimize their effects.
- **Minimize soil and vegetation disturbance.** Disturbance can allow opportunities for noxious and invasive plants to colonize a new area. Disturbance should be minimized, and when it is unavoidable, managers should conduct follow-up monitoring to ensure early detection of any noxious and invasive plants that may have been introduced.
- **Maintain desired plant communities.** Resistance to invasive plant establishment is greatly increased by a healthy plant community with native and desirable species.
- **Practice Early Detection and Rapid Response (EDRR).** To prevent the spread of weeds and reduce management costs the early detection and eradication of small populations is crucial. Regular monitoring of project areas to detect new infestations increases the chances of success.

5.2 BEST MANAGEMENT PRACTICES (BMPs)

BMPs are defined as methods or techniques found to be the most effective and practical in achieving an objective, such as preventing or minimizing invasive plant spread, while making optimal use of resources.

Prevention BMPs that minimize noxious and invasive plant spread in mining and construction activities include (Cal-IPC 2012):

- Reduce future maintenance needs and costs;
- Reduce fire hazards;
- Reduce herbicide use;
- Enhance visibility, access and safety;
- Limit liability for lessee and land managers;
- Maintain good public relations; and
- Protect existing wildlife habitat, native plant populations and beneficial insects, as well as threatened and endangered species.

BMPs that can be implemented by Comstock for weed management are discussed below:

5.2.1 Educational BMPs

Personnel Training

Provide training to personnel on weed identification and ways to prevent infestation. Training can be obtained through the University of Nevada Cooperative Extension (UNCE) Weed Warriors Program. See Appendix H for contact information. Comstock may also want to consider offering an employee workshop on weed management specific for the mine site. JBR can assist with organizing the workshop.

Educational Materials

Provide educational materials on invasive weeds at highly visible locations. Materials should include photographs of known weed species in the area and prevention tips. The fact sheets provided in Appendix B could be posted on employee bulletin boards or other locations. JBR will also provide Comstock with a copy of the *Nevada Noxious Weed Field Guide*.

Coordination with Local Cooperative Weed Management Area (CWMA) Groups

These groups include representatives from local organizations such as conservation districts, federal, state and local agencies, landowners, and members of the general public. CWMA's have broad awareness of the infestations in the region and have experienced personnel and weed specialist involvement. Cooperative weed management can result in the expansion of resources such as labor and funding, and increase the effective of regional weed treatment and prevention. CWMA's in the area of the project site are the West Lyon County Weed Management Group, Truckee Meadows Weed Management Council, and the Carson City Weed Council. Contact information for these groups is provided in Appendix H.

5.2.2 Work Areas BMPs

By implementing BMPs prior to and during work activities the risk of new infestations and the spread of existing infestations will be greatly reduced. Appendix C provides a checklist for work areas that should be used when operations move to new areas.

Invasive Weed Surveys

Prior to beginning work in a new area, noxious and invasive species surveys should be conducted. Ideally, these surveys should encompass the entire area but if this is not practical, surveys will concentrate on areas most susceptible to infestation (i.e. high-risk areas). In addition, all personnel should be instructed to be observant when performing routine work. Survey notes should include observations about the geographic location of the site, the weed species present/absent in the area, the date the observation was made, and any additional information that distinguishes the site from other areas. If GPS receivers are available, location data should be recorded and entered into a global information system (GIS) database. Your local CWMA can assist with this. A sample weed inventory form is provided in

Appendix D. Any suspicious plants should be collected or photographed and should be reported to a knowledgeable authority for identification such as the NDOA, UNCE, or the NRCS. Agency contact information is provided in Appendix H.

Schedule activities to minimize potential for introduction or spread of invasive weeds

When possible schedule land disturbing activities to occur before noxious and invasive plants set seed. Seeds can also be found in the soil, so soil from areas that are known to contain invasive species should not be used in stockpiles or for any remediation activities.

Coordinate the timing of maintenance and weed control activities when feasible

To maximize the effectiveness of treatments proper timing is important. For example, delay blading roads until two weeks after herbicide application and delay spraying after blading until vegetative regrowth has occurred.

Control existing weed infestations before ground disturbing activities begin:

- Treat roads and staging areas before allowing equipment movement in the area.
- Before removing weeds from drainage ditches, treat the entire infestation to ensure that no plant parts or seeds will spread to adjacent or downstream areas.
- In infested areas avoid piling of plant materials on sides of trenches or roadways, instead stockpile contaminated materials in one area that can be monitored and properly disposed of.
- Before scraping road shoulders, treat noxious and invasive plants with the appropriate control measure or herbicide to render plants nonviable. This will help prevent the plants from spreading to adjacent areas by water, wind, equipment, or vehicles.

Designate specific areas for cleaning of equipment, materials, clothing and gear

- Select an area that is already infested with noxious and invasive plants (with the assumption that you will leave the area clean)
 - Accessible for monitoring and control
 - Located away from waterways, wetlands, and storm water or detention basins
- Select an area that is sealed or has paved surface to avoid soil contamination
- Install silt fence or berm around the cleaning site to prevent the spread of contaminated materials
- Dispose of any water that may be contaminated with noxious and invasive plant seed or other plant parts at a waste management facility or incinerator, not through a wastewater treatment plant.



Equipment cleaning

Construction equipment brought to the project area from off-site has the potential to introduce weed plant fragments and seeds that are trapped in the equipment or in adhering mud or dirt. Require that construction equipment be thoroughly cleaned by personnel and contractors to remove weed contamination prior to being brought to the site. See Inspection and Cleaning Checklist in Appendix C.

Designate waste disposal areas and implement proper disposal techniques:

- If using on-site disposal, render noxious and invasive plants nonviable through treatment methods described in Section 6.1
- If using off-site disposal, contain noxious and invasive plant material in heavy-duty (3-mm or thicker, contractor quality plastic) garbage bags. Securely tie the bags and transport under tarps or in an enclosed truck to an appropriate disposal area.
- Locate debris burn piles in areas that minimize the possibility of noxious and invasive plant establishment.
- Do not dispose of viable noxious and invasive plant material that has the ability to resprout or spread at a facility that produces mulch, spreadable sewage sludge, or chipped products.
- Do not dispose of soil, seeds, or plant material down a storm drain. This action may promote the spread of noxious and invasive plants downstream.
- Clean vehicles after transporting noxious and invasive plant material. See Inspection & Cleaning Checklist in Appendix C.
- Limit the number of roads traveled to during disposal activities to minimize soil disturbance and the risk of unintentionally transporting noxious and invasive plant parts and seeds into un-infested areas.

Plan travel routes to avoid infested areas when possible:

- If off-road travel is required, avoid any areas known to have weed infestation.
- If travel in an infested area is required, treat the area before hand if possible, properly clean vehicle and equipment before leaving the infested area, restrict the travel to periods when plants are not in seed production, and avoid during wet periods.
- Avoid utilizing infested areas as routine travel routes or staging areas.
- Avoid parking in areas with infestation.

Clean footwear, clothing and gear before leaving an infested area:

- Inform all personnel and contractors about the potential for clothing, footwear and gear to transport weed seeds and the critical need to perform a check before leaving an infested area.
- Materials such as brushed cotton, Velcro, and knits such as fleece and wool are especially prone to attract seed and plant parts.
- When working in infested areas, carry appropriate equipment to remove seed, soil and plant parts, such as wire brush, small screwdriver, boot brush, and bags for collecting plant parts.



5.2.3 Area Remediation BMPs

Use only weed-free materials

Use only certified weed-free materials such as straw bales, seed, mulch, and fill material. A list of Nevada certified weed free materials resources and contacts can be found in Appendix H.

Establish competing vegetation

Re-vegetate treated and disturbed areas as soon as possible in order to provide competition for weeds and reduce the likelihood that they will become established. This step is critical in preventing or minimizing

the reestablishment of weeds in a treated area. Seed mixes appropriate for the project site should be found in the Nevada Division of Environmental Protection (NDEP) approved remediation plan. Example seed mixes can be found in Appendix F. Local contacts for obtaining seed mixes can be found in Appendix H.

Monitoring

To ensure that any noxious and invasive plants are controlled and detected early; treated and re-vegetated areas should be monitored during multiple growing seasons, especially at times of germination and flowering. Typically a minimum of three years of monitoring is required. If three years is not sufficient, then treatment and monitoring should continue until confidence that the area has been controlled is achieved.

5.3 EXISTING INFESTATIONS PRIORITIES

In general, the largest existing weed infestations occur within the current mine site footprint. Perennial pepperweed and hoary cress were observed throughout the project boundaries, particularly on disturbed areas and along the drainage pathways (Figure 3). Weed infestations of poison hemlock, saltcedar and perennial pepperweed are found along the American Ravine stream (JBR, 2011). The stormwater retention basin adjacent to the intersection of State Route 341 and State Route 342 contains salt cedar and perennial pepperweed. Of particular concern is the identified patch of medusahead located along a dirt road on the northwestern portion of the project boundaries.

Prioritizing the treatment of weeds helps to decide where to focus immediate and long-term attention. It is important to set realistic goals based on available resources. Do not expect to eliminate weed infestations after one year of treatment, even if the initial results are very effective. The sites will need to be monitored and inventoried each year following the initial inventory and subsequent treatments.

5.3.1 First Priority

Small infestations

Areas that have a small density of plants (i.e. less than 20) should always be treated as soon as possible to prevent expansion of the infested area. As the plants establish deeper roots, produce more seed, and displace competing vegetation, the difficulty of control significantly increases, as does the risk of infestation to surrounding lands.

High-risk areas that contain the highest density of the most aggressive weeds (i.e. monocultures of noxious weeds)

State listed noxious weeds are most aggressive and should be treated first before treating invasive weeds that have no regulatory status.

High traffic areas.

Other areas to treat are high-risk areas where activity enables weed seeds to be brought in, causes disturbance where weeds can establish, and/or provides a mechanism for dispersal. Examples of high-risk areas include:

- Active mining and construction areas
- Parking areas



- Access, haul, and other mining related roads
- High use visitor areas

Stockpiles

When noxious or invasive weeds are stripped with topsoil and stockpiled it is highly likely that the weeds will infest the stockpile. When an infested stockpile is redistributed, what originally may have been a small, localized problem becomes a more widespread problem. It is best to dispose of any known contaminated materials.

5.3.2 Second Priority

Riparian Areas

Surface water carries weed seeds and the moist environment makes an ideal site for weed infestations. When using chemical treatments around any water body or wetland area it is required that water-approved herbicides be used.

Ditches and Pond Embankments

These areas should be considered priority treatment areas to prevent offsite contamination by water-transported seed. Only water-approved herbicides should be used in these areas.

5.3.3 Third Priority

Surrounding Areas

Increasing native plant and animal biodiversity in the surrounding area, and to prevent re-infestation of the project site may require effective weed control beyond the identified project site boundaries. ESA surveys have identified numerous small infestations outside of the project boundary but within close enough proximity to project site that would allow for the spread of seed into the site creating potential for infestation.

6.0 WEED MANAGEMENT ACTIONS

In order to properly treat and control weed species it is important to understand the growth habitats and life cycles. There are two types of weedy plants, dicots and monocots. Dicots (dicotyledonous) are broadleaf plants that have two seed leaves in each seed, have broad leaves, and may have woody stems. However, most dicot weeds have little or no woody tissue, and are herbaceous. Monocots (monocotyledons) are plants that have a single leaf and are characterized by long, narrow leaves with parallel veins and fibrous root system. Some monocots produce underground stems called rhizomes or above ground runners called stolons, while other plants produce both.

Each weed species has adapted to live and reproduce in varying, often harsh environments. Some produce seeds in winter while others prefer the warmth of summer. The type of weed (monocot or dicot) and the reproduction cycle will help determine the most appropriate treatment actions. Most weed species will fall into one of these categories (Donaldson, 2011). The weed matrix developed for the project site (Appendix E) identifies which categories apply to the identified weed species.

Winter Annual Weeds

These weeds germinate from seed in the fall to late winter. In spring they mature and produce seeds, and then die in summer. Seeds can remain dormant during the late spring and summer to germinate the following winter. Examples include cheatgrass, medusahead, and tumble mustard.

Summer Annual Weeds

The majority of annual weeds are this type. These species grow each spring or summer from seed. In one growing season they will mature, produce seeds, and die. Seeds generally are dormant during winter. Examples include prostrate spurge and ragweed.

Biennial Weeds

These weeds can germinate at any time during the growing season. Usually they produce a radial cluster, or rosette, of leaves close to the soil during the first season. In the second year they will produce flower stalks, produce seeds, and die. Examples include bull and musk thistle.

Perennial Weeds

These weed species will live for three or more years. The first year some species may not flower and others may produce seeds that do not germinate. Some species will spread primarily through seed production, while others spread by seed and through pieces of the rhizomes, stolons, or stem nodes that touch the soil and grow new roots. It is important to refrain from cultivating and hand pulling areas with perennial weeds to prevent broken pieces from starting new growth. Examples include perennial pepperweed (top whitetop), hoary cress, dandelion, common milkweed, and purple loosestrife.

6.1 TREATMENTS AND CONTROL METHODS

Several treatment methods are available for control and eradication of weed infestations. These methods include: mechanical methods such as physically pulling the weeds (including the entire root), tilling or mowing, biological controls, and chemical methods. Treatments may involve two or more methods in order to be effective. Species-specific recommended treatment methods are described in detail in Section 6.2 and are provided in the weed matrix located in Appendix E. A treatment calendar has been developed for Comstock and is included in Appendix I.

6.1.1 Cultural

Cultural controls refer to methods that encourage desirable plant growth. Fertilization, irrigation, and planting appropriate species at optimum densities are methods that help desirable plants out-compete weeds. Common cultural methods include planting appropriate competitive native or non-native species, good seed-bed preparation, cultivation to reduce weed competition before planting, seeding rate and date of application, and water and nutrient management (optimal water and fertilizer application).

Cultural controls are best used for large projects sites that contain few desirable plants. Important points to consider for this method include:

- Cultivating is often necessary to reduce the number of weed seeds in the soil before planting desirable plant species. Cultivating for a year prior to reseeding can reduce the bank of weed seeds.
- Cultivation is not recommended for natural areas major disruption of established plant communities and extensive soil disturbance can occur, rendering the area susceptible to weed infestation. *Cultivation is also not recommended for areas infested with weeds that reproduce from root and plant fragments, such as perennial pepperweed.*
- Re-vegetation of disturbed or depleted areas with desirable plants can prevent or reduce weed infestation. Disturbed areas such as active mine site, parking areas, haul and access roads, staging areas, leach pads, and any other areas that have been disturbed during the mining operations need to be re-seeded as soon as possible once the work is completed and monitored for at least three growing seasons.

Considerations and limitations of cultural controls include:

- Treatment cost.
- Cultivating is only appropriate for drastically disturbed sites, and not normally suitable for natural communities.
- Cultivation may result in increased establishment of weed species if not adequately followed-up with aggressive weed control.
- Lack of seeds from locally adapted plants, especially forbs and shrubs.
- Promoting weed growth by adding unneeded nitrogen fertilizers. Native plant communities are often adapted to low-nitrogen conditions, while weed species are adapted to high-nitrogen conditions. Only apply nitrogen fertilizers if tests show that soil nitrogen levels are insufficient to support native communities.

6.1.2 Chemical

There are many different kinds of chemical treatments available for weed control. These chemicals are usually described by their mode of action. Chemical treatments include growth regulators, amino acid inhibitors, grass meristem destroyers, cell membrane destroyers, root and shoot inhibitors, and amino acid derivatives, which interfere with plant metabolism in a variety of ways (Donaldson, 2011).

The choice of what chemical treatment is best for a particular situation depends on the target weed species, the presence of desirable plant species, soil texture, depth and distance to water, and environmental conditions (wind and/or rain). Species-specific recommended herbicides are provided in Section 6.2 and in the weed management matrix provided in Appendix E.

Chemical treatments are best used for:

- Pure stands of a single weed species where desirable, non-target plants are scarce or absent.
- Rhizomatous weed species that are unpalatable to livestock, require repeated pulling or cutting for control, or are located in remote areas where pulling or cutting are not feasible.
- Small patches of weeds where hand pulling or cutting is not effective or feasible.
- Use in conjunction with other control methods. For example, Canada thistle can be controlled by repeated cutting during the growing season followed by treatment with clopyralid. Tamarisk and Russian olive can be controlled very effectively by cutting stems very close to the ground in the fall and then immediately (within 30 seconds) spraying or painting the cut stems with triclopyr or other herbicides.

Considerations and limitations of chemical treatments include:

- You must possess the proper equipment and knowledge to apply the chemicals safely.
- The applicator must be extremely careful to not apply herbicides on desirable species that may be inter-dispersed throughout the treatment area. This may be accomplished with the use of a backpack sprayer or by using a wick.
- Applicator must be careful to check weather conditions prior to spraying in order to prevent over-spray onto desirable plants. If there has been rain within 24 hours of treatment the herbicide function can be affected, so be sure to check the label for specific instructions. Wind conditions should always be checked before spraying. Winds can cause drift spray that could adversely affect desired species or neighboring properties (for which you could be held liable). Wind conditions of less than 5 miles per hour are considered good for spraying. Wind speed meters are inexpensive and readily available.
- Certain chemical treatments exhibit varying toxicity to human health. The more toxic herbicides are classified as “restricted use herbicides,” and are to be applied in accordance with federal and state law. These herbicides are available only at licensed outlets or through reputable distributors, and require proof of certification status to purchase.
- Personnel Safety and Training. Herbicides are dangerous and should be treated with extreme care. Safety procedures and equipment is discussed below. Applicator training is available and there are many certified sprayers available for hire. Resources are provided in Appendix H.

Herbicide Application Methods

Methods used to apply herbicide include the following:

Wick/Swiper: Used mainly for sensitive areas where weeds are mixed in with desired vegetation. This method results in no drift or drip. Herbicide is basically painted directly onto the plant stem after the plant has been cut. Sponges and small paintbrushes are tools that are frequently used for this application.

Backpack/hand sprayer: This method is the most commonly used method. Backpack sprayer are readily available at home supply and hardware stores. It is very useful for remote or sensitive areas where motorized vehicles are not practical or allowed, and for specific spot spraying. Some herbicide drift may occur with this method so care must be taken. It is important that the sprayers are calibrated accurately in order to ensure that the proper volume of chemical is administered. Calibration instructions should be included with the sprayer. Assistance with calibration is available through local conservation districts, CWMAs or the NDOA.



Backpack Sprayer/Protective Suit
Photo: G. Azad

Broadcast sprayers: Broadcast spraying typically involves pick up trucks, ATVs or tractors with mounted or tow-behind boom sprayers. This method is useful in areas that are easily accessible, less sensitive, along right-of-ways and roads, and in areas where the weeds are the dominant plants. Special care must be taken while using this method, as target and non-target species in the area will receive the herbicide. It is important to calibrate the sprayer properly according to the manufacturer instructions.

Mixing and Disposing of Herbicides

- Do not mix within 50 feet of any well or open water source.
- Establish a safe site that will be used exclusively for mixing and storing herbicides.
- Be certain to mark jugs for mixing, one for clean water and one for chemical.
- Always wear safety glasses and gloves when handling herbicides or weed treatment equipment.
- Rinse mixing cups and triple-rinse all containers and bottles; return rinsate to the spray tanks and apply according to the label.
- If an herbicide spill does occur, either dilute with water, or shovel the exposed soil into a plastic bag and dispose of properly.
- Do not dispose of unused herbicide in a municipal landfill, use only county approved hazardous waste disposal programs, or contact the NDOA Pesticide Waste Disposal Program at (775) 688-1180.

Important Notes About Herbicide Use

Remember that herbicides must be applied in conformance with the label. With herbicides, the label is the law. **Applying herbicides beyond the bounds specified on the label is illegal.** Do not increase the concentration of an herbicide beyond the limits set by the manufacturer. **More is NOT necessarily better**, and higher herbicide concentrations can damage animals and non-target plants. The presumed safety of a chemical is based on the manufacturer's recommended concentrations only.

*When using herbicides,
remember:
The Label is the Law!*

Personal Protection Equipment (PPE) and Safety Rules

Herbicides are hazardous chemicals and need to be treated as such to avoid injury. Specific safety information is provided on the labels and should always be read and followed. Suggestions for safe application include:

- Provide a first aid kit and store where it is readily available (i.e. in spray vehicle, chemical storage area). This kit should contain eyewash solution, hand cleaner, clean water, change of clothes, towel, dust mask or respirator, safety glasses, and any other materials that are required or recommended on the herbicide label.
- Applicators should always wear a long-sleeve shirt, long pants, waterproof gloves, shoes/boots with socks that cover ankles, and protective eyewear. Any clothing worn during herbicide applications should be washed after use, separate from other laundry. If clothing should become heavily saturated with herbicide this clothing should be disposed of.
- Hazardous materials (PPE) suits are available and are the preferred clothing for herbicide treatments. They are available at local supply stores or can be ordered on-line.
- Wash hands thoroughly after any treatments and before eating, drinking, chewing gum, using tobacco or using the toilet.

6.1.3 Mechanical Methods

Mechanical methods include activities such as hand-pulling, tilling, mowing and cutting. Using mechanical methods in combination with chemical methods has proven to be very effective.

Hand-Pulling

Pulling the weeds by hand can normally be implemented without much risk of adverse environmental effects and is a good easy choice in a number of situations. Hand pulling is best used for:

- Small infestations of weeds that can be pulled one patch at a time.
- Annual and biennial plants (although seed banks will remain for some time).
- Shallow-rooted plant species that do not resprout from any residual roots or other plant parts.
- Plants growing on sandy or gravelly soils. If possible, concentrate pulling when the soil is moist and soft; for example, after a heavy, soaking rain.
- Situations where chemicals, motorized equipment or livestock cannot be used or are undesirable.
- Reducing seed production and preventing seed banks from increasing.

Noxious and invasive weeds that are good candidates for pulling include: Bull thistle, Cheatgrass, Musk thistle, and Russian thistle. Be sure to use gloves when pulling thistle to avoid personnel injury.

Please note that pulling of perennial pepperweed, or tall whitetop, is NOT recommended and if performed may increase the potential for infestation.

Considerations and limitations of pulling include:

- Pulling generally does not remove the entire weed root system, even under the most favorable conditions. Thus, pulling is often ineffective for killing rhizomatous weed species even if used in conjunction with other techniques.
- If pulled weeds contain seeds, they should be removed from the site and burned or disposed of in a landfill. Do not compost this material!
- Soil disturbance that stimulates germination of weed seeds in soil.

Mowing and Cutting

Mowing and cutting involves the use of mechanical or hand tools to sever the aboveground portion of a plant from its root system. With effects similar to pulling, mowing and cutting are only suitable for certain situations.

Mowing and cutting are best used for:

- Large, relatively flat and dry areas that can be mowed with few safety or equipment concerns.
- Preventing tall, erect biennial weed species from setting seed when other control techniques are not feasible.
- Cutting down dead and decadent plant materials to expose new growth and enhance chemical treatments. Be sure to remove the cut materials and dispose of properly.
- Weakening weed plants by depleting root and rhizome reserves through repeated mowing, in cases where such mowing can be conducted efficiently.
- Combining with other control methods, such as chemical treatments. Cutting can be extremely effective for killing certain tree and shrub species if it is combined with herbicide treatment of the cut stump. As noted above, cutting the stems as close to the ground as possible in the fall and immediately applying (within 30 seconds) triclopyr or imazapyr herbicide kills tamarisk and Russian olive. Mowing is also very effective for the control of perennial pepperweed.
- Small infestations of fleshy-stemmed biennial thistles, such as musk thistle and bull thistles, are easy to cut with a sharp machete.

Considerations and limitations of mowing/cutting include:

- Sites that are inaccessible or too rocky cannot be mowed, although weed whips and machetes can be effective in such situations.
- You must remove and dispose of cut plant materials that contain seeds and other plant parts.
- Spreading weed seeds from mowing equipment to areas previously free of infestations. Clean equipment used in weed-infested areas before moving it to another area. Make sure that borrowed or rented equipment is free of weed seeds by inspecting the equipment before it enters the project area and before it is returned.

Livestock Grazing

Horses, cattle, sheep, and goats can be used to selectively overgraze certain weed species, thereby weakening them and making herbicide treatments more effective. There are local companies that can provide grazing animals, watchdogs, electric fencing, and trained personnel. Contacts are provided in Appendix H. Livestock grazing is best used for:

- Weeds, which are palatable (at least at some point during the year) and non-toxic to livestock. Weeds vary greatly in their palatability to different types of livestock. Generally speaking, the preference for grasses declines from horses to cattle to sheep to goats. Furthermore, goats and sheep are more likely than horses to or cattle to relish broadleaf weeds (forbs).
- Low-level, widespread weed infestations where other control techniques are not cost-effective. Grazing can be very effective on large infestations of perennial pepperweed or Canada thistle. Follow-up herbicide treatments are necessary.

Considerations and limitations of livestock grazing include:

- Need for water, fencing and/or herding to control livestock movements.
- Frequent monitoring to manage the intensity and duration of livestock grazing carefully to avoid overgrazing, and allow desirable species to recover from grazing impacts.
- Predators such as coyotes, mountain lions, and bears may kill grazing animals, especially sheep and goats, so it is critical to conduct grazing in a safe area, or have guard animals available.
- Using the proper kind of animal to manage the weeds on your property.
- Need for someone with knowledge of animal husbandry to manage the animals.

6.1.4 Biological Methods

Biological control agents are organisms (usually insects) that are deliberately introduced to an area to control weeds. The aim of biological control is not eradication, but rather to exert enough pressure on a weed population to reduce its abundance to acceptable measures, or weaken the population to the point where it can be controlled using another weed management strategy (Donaldson, 2011).

Biological controls are best used for:

- Reducing seed production or weakening plants.
- Large, dense infestations where other control methods are not cost-effective.
- A situation where a reduced but effectively permanent presence of a noxious weeds species is acceptable.

Considerations and limitations of biological controls include:

- Failing to eradicate the target plant species. Do not use biocontrol agents where you seek to eradicate a weed population.
- Lack of effective biological control agents for most noxious weed species.
- Feasible for only a handful of weed species due to the high cost of finding, screening, and testing of potential control organisms. Biological controls have a mixed record with some tremendous successes, but also with many failures.
- Necessity of having a reservoir of host weeds to support biological agents over the long term. Thus, it may be necessary to leave some weeds to support populations of control organisms. This may be unpopular with neighbors or the public.
- Insects attacking beneficial, non-target plants. For example, the seed weevil *Rhinocyllus conicus* that has been used to control musk thistle also attacks native thistles. The weevil *Larinus planus*, introduced for control of Canada thistle, has been reported to attack native thistle species as well (Donaldson, 2011).

6.2 RECOMMENDED WEED TREATMENTS

A successful IWM program must be tailor-made for each situation. There is no cookbook solution that will work everywhere. However, certain combinations of control actions have been successful and are worthy of consideration:

- Mowing or cutting plus herbicide application;

- Spraying with herbicide followed by reseeding with competitive plant species followed by hand pulling of residual weed plants;
- Altering grazing regimes plus introducing biological control insects;
- Cutting woody plants followed by herbicide application;
- Grazing with sheep or goats plus reseeding with competitive plant species plus introducing biological control insects;
- Introducing biological control insects with periodic herbicide application;
- Spraying with herbicide followed with re-seeding with competitive perennial grasses; and
- Re-seeding with competitive grasses followed by altered livestock grazing regime.

IWM prescriptions potentially include the full range of control actions discussed in this section, including pulling, mowing and cutting, livestock, cultural controls, herbicides and biological controls. The IWM approach contrasts with the traditional approach of using a single control action; such as applying herbicides to treat all weed problems. Herbicides are one useful technique but they are not the only method of controlling weeds, and may not always be the most effective. Establishing competitive vegetation is an integral part of IWM and should be performed in conjunction with all weed management techniques.

An overview of recommended treatments for the noxious and invasive weeds (UNCE Weed Warriors, no date) that have been identified in the project area are outlined below and are provided in the weed management matrix found in Appendix E. The matrix can be provided to personnel who will be conducting weed treatments. Fact sheets providing more detailed information on each of the identified weed species are provided in Appendix B. A monthly treatment calendar is included in Appendix I and is also provided in a poster form.

Perennial Pepperweed or Tall Whitetop



Photo: USDA NRCS Plant Gallery

Perennial pepperweed is the most widespread of noxious weed infestations in Western Nevada. Prevention is key and control is critical. A combination of methods will be most effective. Mowing prevents seed production, but cultivation must be avoided. Tilling encourages resprouting from rhizomes. The effective herbicide application is dependent upon the type of land use being administered on the treatment area. 2,4-D Amine formulations such as Weeder 64® are used on wet sites, and LV Ester formulations are used on dry sites at 4lb/A (repeat applications are essential). Metsulfuron (Escort ®) at 0.6 to 1.2 oz ai/A (active ingredient per acre) is used for control in pastures, rangelands, and non-crop areas since it does not injure grasses. Chlorsulfuron (Telar ®) at 0.75 to 1.125 oz ai/A is used on non-crop sites only, but is not as safe on grasses. Imazapyr (Arsenal®, Renovate®) provides bare ground control. Herbicides are most effective on perennial pepperweed if applied to the younger green leaves. This may require mowing, grazing or burning to remove older woody material remaining from previous years' growth. Tall wheatgrass, creeping wildrye and saltgrass can compete with perennial pepperweed and should be seeded following control treatment.

Repeated episodes of mowing is encouraged but it will need to be performed multiple times throughout the growing season (spring and summer) in order to prevent seed production due to regrowth of flowering stalks. Mowing may also be accomplished through repeated grazing by goats, sheep, or cattle. Keep in

mind that grazing by livestock is not effective if more palatable forage or browse is available in the same area. After plants have been continually stressed throughout the growing season, apply herbicide to the basal leaves.

Hoary Cress (Short Whitetop) and Hairy Whitetop

Cultivate every 21 days beginning in the spring to prevent seed production. There are many effective herbicides against hoary cress, including 2,4-D products and glyphosate (Roundup®). Apply 2,4-D Amine or LV Ester during the early stages of growth, up until the “broccoli head” stage. Apply chlorsulfuron (Telar®) or metsulfuron (Escort®) during the pre-bloom to bloom stage or on rosettes during the fall. Note that chlorsulfuron and metsulfuron persist in alkaline soils for many years, and can affect revegetation efforts.



Good results have been achieved with application of glyphosate followed by seeding of the treated area with a mixture of competitive vegetation. Hoary cress contains glucosinolate, an alkaloid toxic to cattle. Control of hoary cress by grazing is therefore not an option.

Diffuse Knapweed

This species can grow one to three feet tall with flowers that are almost white in color but can be a pink-purple color. Black spots are often found on flower bracts. Preventing seed production is critical and can be accomplished by mowing, cutting or hand pulling when the flowers first appear and before seed set. Reseeding with competitive grass species is beneficial. Numerous insects are available as biological controls and include gall flies, moth, and weevil. Early grazing by livestock is recommended. Chemical treatments include: picloram (Tordon®, restricted use) which will provide long-term (3-year) residual control; clopyralid (Stinger®; Transline®, Curail®) works well during flowering. Treat rosette or other stages prior to flowering with 2,4-D, and glyphosate. Combining with cultural practices may also be effective.



Russian Knapweed

This plant can grow 18 to 36 inches tall and has flowers that are pink, lavender, or white that are produced from June to September. Control methods include mowing in combination with herbicide treatments. It can be hand pulled but be certain to wear gloves to avoid injury. Reseed with competitive grasses. Biological controls include the Russian knapweed gall nematode. Chemical controls include using picloram (Tordon®, restricted use) after the first killing frost. In spring till to remove leaves, then treat again with picloram.



Control can be achieved in 2 to 4 years. Clopyralid (Stinger®; Transline®, Curtail®) works well during flowering stage. The use of 2,4D has been found to not be very effective. Russian knapweed is toxic to horses and can result in irreversible damage. It does not appear to affect cattle or sheep.

Scotch Thistle

Growing up to 8 feet tall, this plant is very aggressive and will form dense patches that are impenetrable to humans, wildlife and livestock. Control rosettes in the first season by digging out at least two inches of the root.



Photo: Gary A. Monroe, USDA NRCS Plant Gallery

Scotch Thistle was often used around castles to keep intruders from approaching at night!

Cut or chopped plants may still flower and set seed. Mowing will help limit seed production but will not kill the plant.

Planting of competitive native species such as perennial grasses is essential. Currently there are no known biological controls. Chemical controls include: Clopyralid; picloram (Tordon®) in fall before plant bolts; Apply 2,4D in spring or fall; dicamba (Banvel®) before the flower stalk grows or in fall to control rosettes.

Musk Thistle

Grows up to 7 feet tall with freely branched stems and purplish nodding flowers. Control rosettes in the first season by digging out at least the first 2 inches of root. Cut or chopped plants may still flower and produce seed. Mowing will help limit seed production but will not kill the plant. Several biological control agents exist and include thistle crown fly, thistle head weevil, thistle crown weevil, and a rust. However, these controls have not been found to be effective in Nevada. Chemical treatments include apply 2,4-D amine or LV ester during rosette stage. 2,4D can also be used in the fall if the soil moisture is sufficient and air temperatures are over 50°F.



Photo: Gary A. Monroe, USDA NRCS Plant Gallery

Chlorsulfuron (Telar®) can be used in the spring from rosette to pre-bloom stages. Clopyralid (Stinger®; Transline®, Curtail®) are also effective.

Poison Hemlock



Photo: Gary A. Monroe, USDA NRCS Plant Gallery

This is a tap-rooted plant with stout hollow stems that are marked with a distinctive purplish splotch. The leaves are somewhat fern-like and tiny white flowers from an umbel. Poison hemlock is best controlled by mowing prior to seed production, if possible. It can be hand-pulled but be extremely careful. ***Be sure to wear good leather gloves when working around poison hemlock as all plant parts are highly poisonous.*** Prevent reestablishment by maintaining desirable plant communities. Biological controls include a hemlock moth that defoliates the plant. This control has been found to provide good control but is inconsistent. For chemical control use a broadleaf weed killer such as 2,4-D

(Weedar 64) to protect bank-stabilizing grasses. Hemlock is most often found in aquatic environments so be certain to use a chemical that is labeled for use around water.

Salt Cedar

In addition to its invasive characteristics, tamarisk uses more water than native willows and cottonwoods, and concentrates salt in its leaves. Dropped leaves accumulate under the plant, inhibiting the growth of other species, including potential competitors. Tamarisk is best eradicated by cutting the stump as close to the ground as possible, followed immediately by an application of undiluted glyphosate (Roundup®). Apply imazapyr (Arsenal®) late in the season at a 1 to 2 percent solution, or use a 1:1 mixture of imazapyr and glyphosate for a similar effectiveness at a lower cost. Repeated treatments and successful establishment of competitive species is necessary.



Photo: Gary A. Monroe, USDA NRCS Plant Gallery

Bull Thistle



Since bull thistles are incapable of reproducing from the root system, mechanical methods that sever the root below the soil surface are highly recommended. This should be done before the reproductive growth stage to avoid seed production and dispersal. Use gloves when hand pulling to avoid injury. Herbicides such as 2,4-D, clopyralid, clopyralid plus triclopyr, picloram, dicamba and glyphosate can also help control the plant. Herbicides should be applied in late fall or early spring when thistles are in the seedling to rosette stage. Over-seed the treated area with a mixture of competitive vegetation. Grasses are recommended as a competitor for bull thistle. Heavy grazing should be avoided, as this is reported to facilitate bull thistle establishment. A seedhead fly is reported to provide biological good control of bull thistle in Oregon.

Medusahead

Medusahead is a highly aggressive winter annual fibrous weed that is an extreme fire hazard. It has been known to outcompete even cheatgrass. Prevention and early detection, rapid response is extremely important. Foxtail barley or squirreltail (a nuisance weed) is often mistaken for medusahead. One can tell the difference by pulling the head of the plant. If it easily comes off then it is most likely not medusahead, however if in doubt consult with the UNCE or NDOA. Medusahead is a grass species that can grow 6 to 24 inches tall and is slightly hairy. Flowers are produced in May or June and persist through the winter. Control methods include mowing, disk or plowing before seed set. Grazing can be used early in the growing season. The crown foot fungus has been found to be somewhat effective as a biological control. Chemical treatments include glyphosate (Roundup®) on early growth (can be expensive for rangeland application) and sulfometuron (Oust) at 1/3 ounce per acre. This will also kill other grasses so is recommended only for use in non-crop lands or firebreaks.



Weeds to Watch For

Noxious and invasive weeds seem to always be increasing in numbers and diversity. It is important to be aware of other species that are of particular concern due to their ability to spread rapidly and their

difficulty in controlling. The UNCE has developed the *Weeds to Watch For* list for Carson City and Storey Counties. This information is provided in Appendix G.

Nuisance Weeds

There are a number of weed species that are found throughout Nevada rangelands that can be invasive in nature, and can be mistaken for noxious, invasive weeds. These include chicory, common mallow, common mullein, common purslane, curlycup gumweed, field bindweed, foxtail barley (often mistaken for medusahead), kochia, redroot pighead, and Russian thistle.

6.3 SEEDING

Reseeding of treated areas is essential for effective weed management. Sample weed mixes are provided in Appendix F, however the preferred seed mix for the project site should be included in the approved NDEP remediation permit. Local sources for obtaining seed mixes are included in Appendix H.

The fall seeding window is generally August 15 to November 15 and is preferred over spring seeding. Fall seeding and planting allow seeds and plants to take advantage of peak soil moisture conditions available in spring for rapid growth when soil temperatures are warming. For large areas, drill seeding is the preferred method of seed planting because seed is placed in the ground, giving more protection and soil contact. Less seed is necessary for germination and production of good perennial grass stands.

Broadcast seeding is a method used on remote or inaccessible sites. The method still requires soil preparation in order to provide a good seedbed, by raking, chaining, harrowing. Broadcast seeding normally requires higher seeding rates and results in less efficient use of the seed. Safe seed sites must be provided and seeds must be covered for protection prior to germination.

6.4 MONITORING

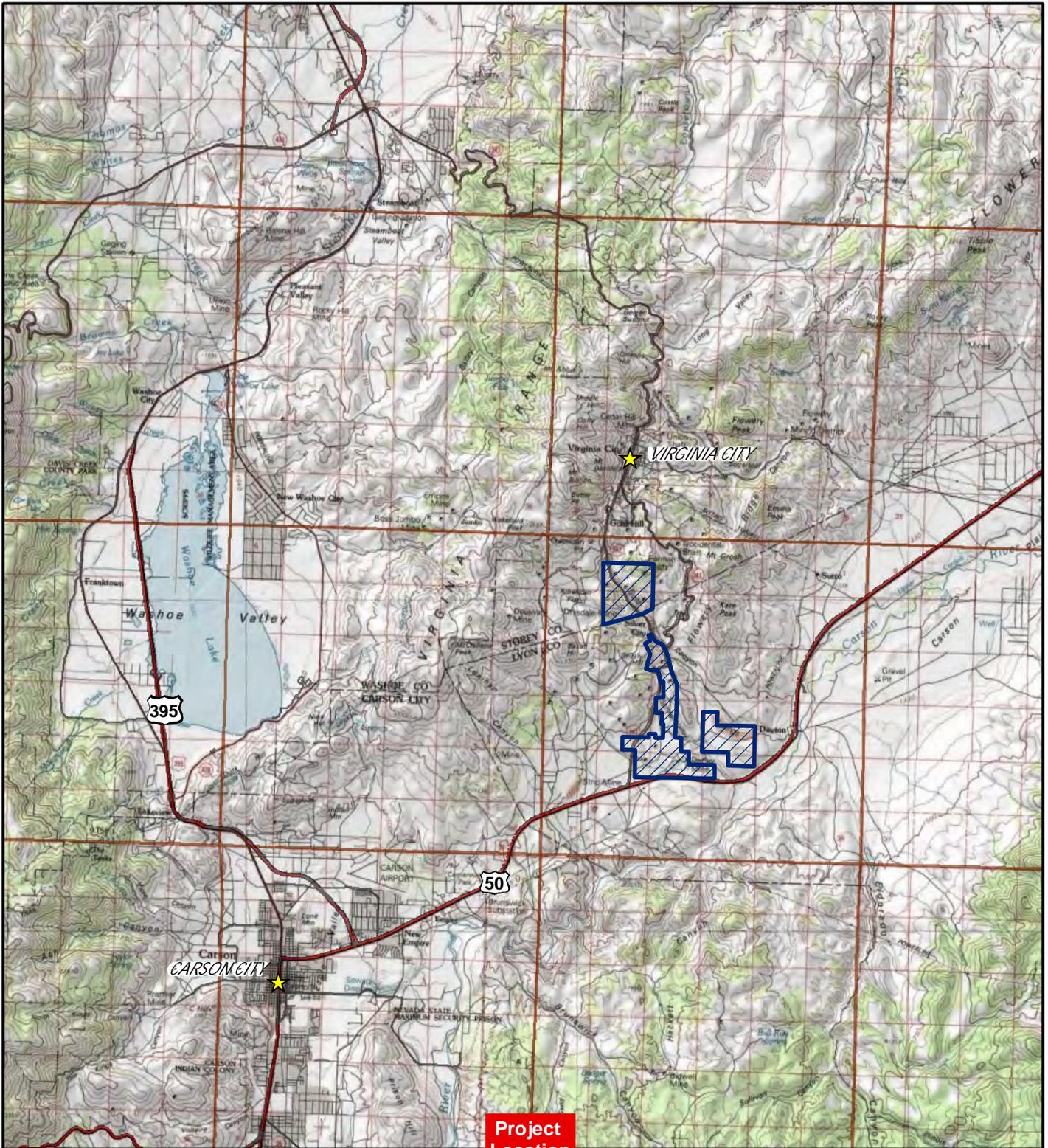
Monitoring is an essential component for IWM. Monitoring refers to the collection and analysis of information to evaluate progress in meeting the resource management objectives. Periodic observation of weeds being managed is vital to evaluate the effectiveness of the weed management program. If management objectives are not being met, weed control actions need to be modified and implemented. Without some type of monitoring, there is no way of knowing whether control actions are contributing to the fulfillment of management objectives. A sample weed monitoring form is provided in Appendix D.

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FIGURES



BASE MAP: U.S. Topographic Map accessed at ArcGISOnline.com

Project Location

 Project Site



0 0.75 1.5 3
Miles

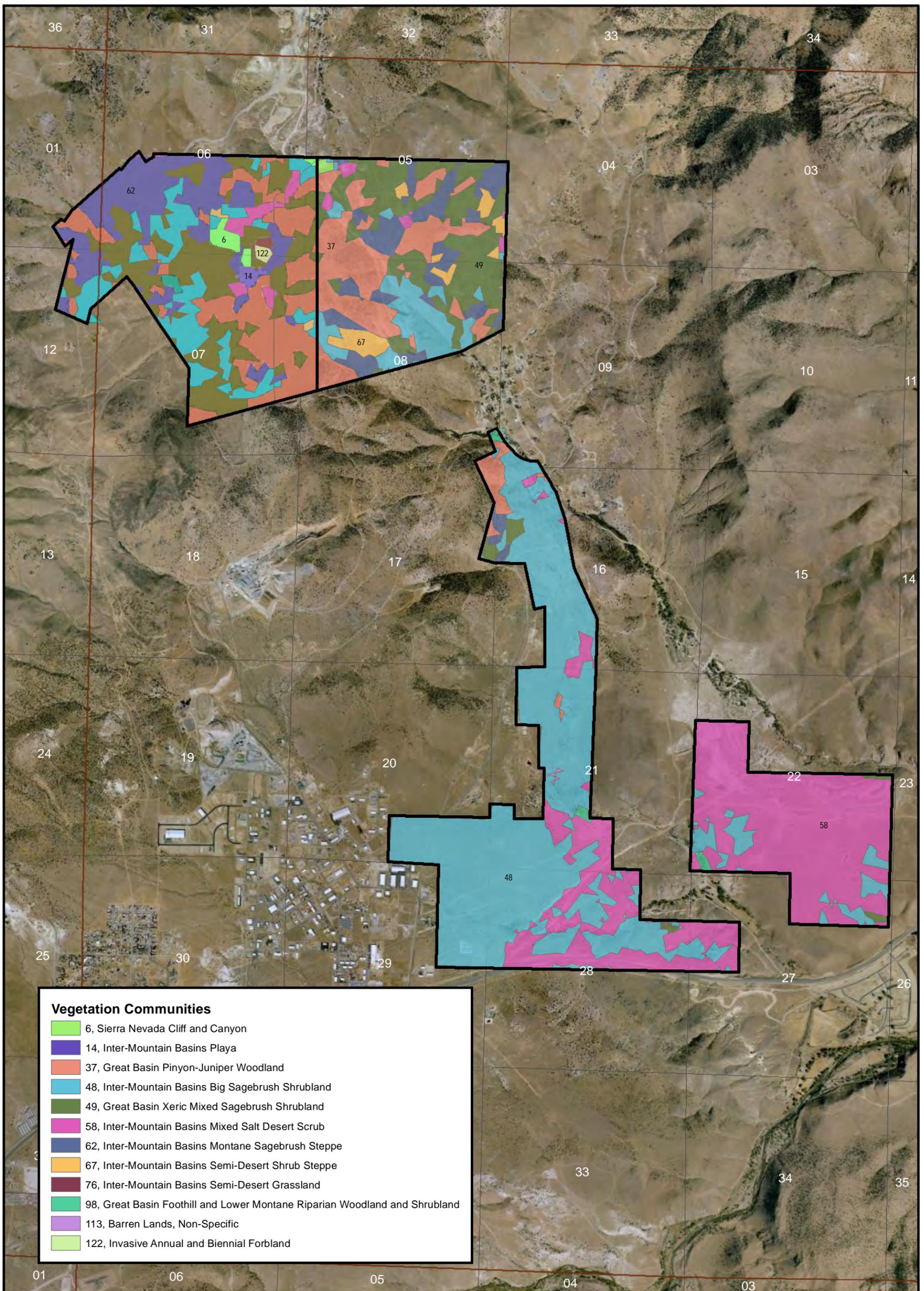
COMSTOCK MINING, INC. COMSTOCK PROJECT

FIGURE 1
PROJECT LOCATION



DRAWN BY	CHJ	DATE DRAWN	3/2/2012
SCALE	1 in = 3 miles		

Path: M:\STATES\WV\clients\Comstock\Plum_Mine_Environmental_Assistance_B-A12059.00\MXDs\Noxious_Weeds\Figure_2_Vegetation_Communities.mxd



Vegetation Communities

- 6, Sierra Nevada Cliff and Canyon
- 14, Inter-Mountain Basins Playa
- 37, Great Basin Pinyon-Juniper Woodland
- 48, Inter-Mountain Basins Big Sagebrush Shrubland
- 49, Great Basin Xeric Mixed Sagebrush Shrubland
- 58, Inter-Mountain Basins Mixed Salt Desert Scrub
- 62, Inter-Mountain Basins Montane Sagebrush Steppe
- 67, Inter-Mountain Basins Semi-Desert Shrub Steppe
- 76, Inter-Mountain Basins Semi-Desert Grassland
- 98, Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
- 113, Barren Lands, Non-Specific
- 122, Invasive Annual and Biennial Forbland

BASE MAP: BING Imagery, 2010

 Project Site



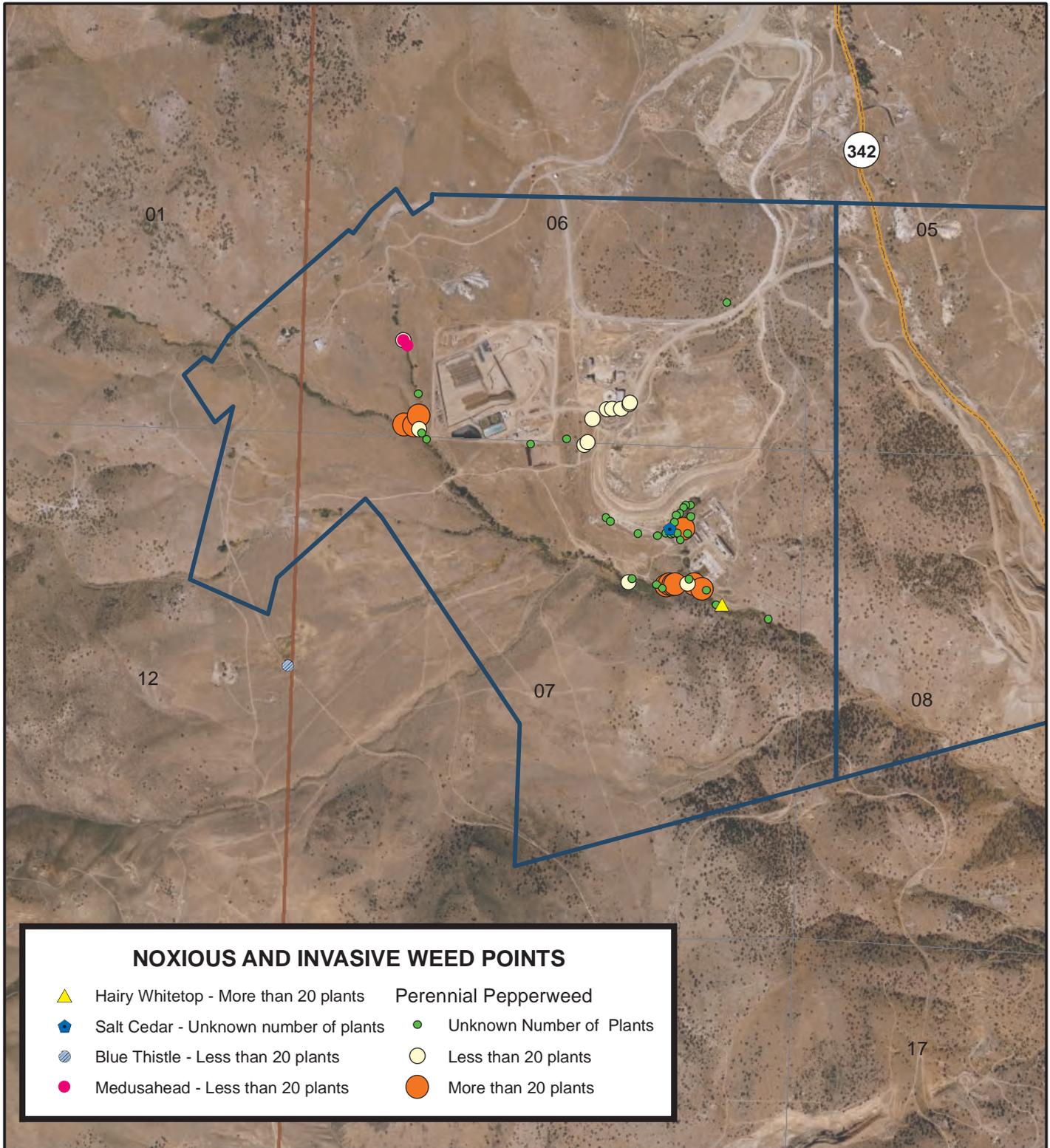
**COMSTOCK MINING, INC.
COMSTOCK PROJECT**

**FIGURE 2
VEGETATION HABITAT COMMUNITIES**



DRAWN BY	CHJ	DATE DRAWN	5/21/2012
SCALE	1 in = 2,400 feet		

This document is for reference purposes only and should not be used as a legal document. JBR makes no guarantees to the accuracy of the data contained herein or any loss resulting therefrom.



NOXIOUS AND INVASIVE WEED POINTS

▲ Hairy Whitetop - More than 20 plants	● Perennial Pepperweed
◆ Salt Cedar - Unknown number of plants	● Unknown Number of Plants
● Blue Thistle - Less than 20 plants	● Less than 20 plants
● Medusahead - Less than 20 plants	● More than 20 plants

BASE MAP: BING Imagery, 2010

Project Site

**COMSTOCK MINING, INC.
COMSTOCK PROJECT**

**FIGURE 3
SURVEYED NOXIOUS AND INVASIVE WEEDS**



DRAWN BY	CHJ	DATE DRAWN	5/18/2012
SCALE	1 in = 1,500 feet		

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Appendix A

State of Nevada Noxious Weed Law
Nevada Noxious Weed List

Nevada Revised Statutes

(see <http://www.leg.state.nv.us/NRS/NRS-555.html> for full text)

CHAPTER 555

CONTROL OF INSECTS, PESTS AND NOXIOUS WEEDS

GENERAL PROVISIONS (this excerpt includes sections on noxious weeds)

<u>NRS 555.005</u>	Definitions.
<u>NRS 555.010</u>	Director authorized to investigate and control pests of plants and animals, plant diseases and disorders, and noxious weeds.
<u>NRS 555.021</u>	Director: Cooperation for suppression of vertebrate pests.
<u>NRS 555.031</u>	Weed control analyst: Creation; appointment.
<u>NRS 555.033</u>	Duties of weed control analyst.
<u>NRS 555.100</u>	Department: Inspections; notice to control, treat or eradicate diseases, insects, weeds or other pests.
<u>NRS 555.110</u>	Infected or infested premises: Declaration as public nuisance; abatement by department.
<u>NRS 555.120</u>	Expenses for abatement of nuisance become lien against property; notice of lien; action to foreclose lien; sales.
<u>NRS 555.125</u>	Regulation of host plants in infested areas: Hearing; order; enforcement; penalty.
INSPECTION AND DESTRUCTION OF NOXIOUS WEEDS	
<u>NRS 555.130</u>	Designation of noxious weeds.
<u>NRS 555.140</u>	General powers and duties of state quarantine officer; use of funds received for purpose of control or eradication of noxious weeds.
<u>NRS 555.150</u>	Eradication of noxious weeds by owner or occupant of land.
<u>NRS 555.160</u>	State quarantine officer to investigate noxious weeds; notice to owner or occupant of land where noxious weeds are found.
<u>NRS 555.170</u>	Neglect of owner or occupant to eradicate weeds after notice; action by county commissioners; payment of costs by county.
<u>NRS 555.180</u>	County treasurer to mail itemized statement of costs to owner or occupant; objections and hearing; costs constitute lien on land.
<u>NRS 555.190</u>	Incorporated city to pay county for any expense incurred by county to eradicate noxious weeds within city.
<u>NRS 555.200</u>	Removal of noxious weeds from public domain; reimbursement by Federal Government.
<u>NRS 555.201</u>	Penalty.
WEED CONTROL DISTRICTS	
<u>NRS 555.202</u>	Legislative declaration.
<u>NRS 555.203</u>	Creation of district: Initiation by board of county commissioners or petition; hearing; exclusion of land; addition of power to control and eradicate noxious weeds.
<u>NRS 555.205</u>	Board of directors: Number; qualifications; appointment; terms; vacancies.
<u>NRS 555.207</u>	Board of directors: Powers.
<u>NRS 555.208</u>	Review of action of board of county commissioners or board of directors by state board of agriculture; notice and hearing; judicial review.
<u>NRS 555.209</u>	Regulations.
<u>NRS 555.210</u>	Performance of necessary work by weed control officer on failure by landowner; charges as lien.
<u>NRS 555.215</u>	Assessments of real property in district; medium-term obligations.
<u>NRS 555.217</u>	Change of boundaries: Petition; notice and hearing; resolution; ratification by board of county commissioners.
<u>NRS 555.220</u>	Penalty.

NRS 555.005 Definitions. As used in this chapter, unless the context requires otherwise:

1. "Department" means the state department of agriculture.
2. "Director" means the director of the department.

3. "Noxious weed" means any species of plant which is, or is likely to be, detrimental or destructive and difficult to control or eradicate.

(Added to NRS by 1961, 512; A 1975, 555; 1993, 1709; 1997, 479; 1999, 3640)

NRS 555.010 Director authorized to investigate and control pests of plants and animals, plant diseases and disorders, and noxious weeds. Within the limits of any appropriation made by law, the director may:

1. Investigate the prevalence of; and
2. Take the necessary action to control,

vertebrate and invertebrate pests of plants and animals, plant diseases, physiological plant disorders and noxious weeds for the protection of the crops, livestock, public health, wildlife, water quality and beneficial uses of land in the State of Nevada.

[1:53:1941; 1931 NCL § 373.01] + [1:108:1943] + [1:179:1945] + [1:217:1947; 1943 NCL § 373.04]—(NRS A 1959, 245; 1961, 521; 1967, 316; 1975, 555; 1993, 1709; 1997, 479; 1999, 3640)

NRS 555.031 Weed control analyst: Creation; appointment.

1. The position of weed control analyst is hereby created in the department.
2. The director shall appoint the weed control analyst. The person so appointed:
 - (a) Is in the classified service of the state;
 - (b) Must be a scientist who possesses a master's degree in one of the biological sciences from an accredited college or university; and
 - (c) Must be selected on the basis of his training, experience, capability and interest in biological methods of controlling noxious weeds.

(Added to NRS by 1999, 2849)

NRS 555.033 Duties of weed control analyst. The weed control analyst shall:

1. Research biological methods of controlling noxious weeds in this state;
2. Document the effectiveness of those methods in controlling noxious weeds;
3. Develop strategies for managing noxious weeds in this state; and
4. Perform such other duties as requested by the director.

(Added to NRS by 1999, 2849)

NRS 555.100 Department: Inspections; notice to control, treat or eradicate diseases, insects, weeds or other pests.

1. The department shall, if necessary or if a complaint is made to the department, cause an inspection to be conducted of any premises, land, means of conveyance or article of any person in this state, and if found infested with an infectious disease, insect, plant, weed or other pest that is injurious to:

- (a) The public health or quality of any water in this state; or
- (b) Any wildlife, beneficial use of land or agriculture in this state,

the department may provide a written notice of its findings to the owner or occupant of the premises, land, means of conveyance or article and require him to control, treat or eradicate the disease, insect, weed or other pest in the manner and within the period specified in the notice.

2. A notice issued pursuant to the provisions of subsection 1:

- (a) May be served upon the owner or occupant by an officer or employee of the department; and
- (b) Must be served in writing, by certified mail or personally, with receipt given therefor.

[Part 1:56:1917; 1919 RL p. 2628; NCL § 449]—(NRS A 1961, 522; 1993, 1710; 1999, 3640; 2001, 699)

NRS 555.110 Infected or infested premises: Declaration as public nuisance; abatement by department.

1. All such premises so infected or infested are hereby adjudged and declared to be a public nuisance, and if any such nuisance exists at any place within the jurisdiction of the department and the owner or occupant thereof, after notification, refuses or neglects to abate the nuisance within the period specified, the department shall cause the nuisance to be abated at once by eradicating or controlling those diseases, insects, weeds or other pests in a manner to be determined by the department.

2. The expense thereof must be paid from any money made available to the department by direct legislative appropriation or otherwise.

[Part 1:56:1917; 1919 RL p. 2628; NCL § 449]—(NRS A 1961, 522; 1993, 1710; 1999, 3641)

NRS 555.120 Expenses for abatement of nuisance become lien against property; notice of lien; action to foreclose lien; sales.

1. All sums paid by the department constitute a lien on the property and premises from which the nuisance has been removed or abated pursuant to NRS 555.100 and 555.110, and may be recovered by an action against that property and premises.

2. A notice of lien must be filed and recorded in the office of the county recorder of the county in which the property and premises are situated within 30 days after the right to liens has accrued.

3. An action to foreclose a lien may be commenced at any time within 1 year after the filing and recording of the notice of lien, which action must be brought in the proper court by the district attorney of the county in the name and for the benefit of the department.

4. If the property is sold, enough of the proceeds must be paid to the department to satisfy the lien and costs, and the overplus, if any, must be paid to the owner of the property if he is known, and if not, into the court for his use when ascertained. All sales under the provisions of this section and NRS 555.100 and 555.110 must be made in the same manner and upon the same notice as sales of real property under execution from a justice's court.

[Part 1:56:1917; 1919 RL p. 2628; NCL § 449]—(NRS A 1961, 523; 1993, 1710; 1999, 3641)

NRS 555.125 Regulation of host plants in infested areas: Hearing; order; enforcement; penalty.

1. If it appears that an area has or is likely to become infested with a pest which cannot be practically eradicated or controlled except by the means provided in this section, the department shall hold a public hearing to determine the necessity of declaring a time during which or an area in which plants capable of acting as hosts for the pest may not be planted, grown, cultivated, maintained or allowed to exist.

2. Notice of the hearing must be given to all growers of the host plants within the area and must specify:

- (a) The time and place of the hearing.
- (b) The host plant.
- (c) The pest.
- (d) The purpose of the hearing.

3. If, after the hearing, the department determines that the pest cannot otherwise be practically eradicated or controlled, the department shall issue an order prescribing a time during which or an area in which the host plants may not be planted, grown, cultivated, maintained or allowed to exist, and requiring owners or occupiers of property upon which the host plants exist to eradicate the plants.

4. If the owner or occupant neglects or refuses to eradicate the plants, the department may do so in the manner prescribed by NRS 555.110.

5. Any person violating such an order is guilty of a misdemeanor.

(Added to NRS by 1967, 418; A 1993, 1711; 1999, 3641)

INSPECTION AND DESTRUCTION OF NOXIOUS WEEDS

NRS 555.130 Designation of noxious weeds. The state quarantine officer may declare by regulation the weeds of the state that are noxious weeds, but a weed must not be designated as noxious which is already introduced and established in the state to such an extent as to make its control or eradication impracticable in the judgment of the state quarantine officer.

[Part 1:174:1929; NCL § 414]—(NRS A 1997, 479)

NRS 555.140 General powers and duties of state quarantine officer; use of funds received for purpose of control or eradication of noxious weeds.

1. The state quarantine officer shall carry out and enforce the provisions of NRS 555.130 to 555.220, inclusive.

2. To secure information better to carry out the provisions of NRS 555.130 to 555.220, inclusive, the state quarantine officer may conduct reasonably limited trials of various methods of controlling or eradicating noxious or potentially noxious weeds under practical Nevada conditions.

3. The state quarantine officer may provide supervision and technical advice in connection with any project approved by him for the control or eradication of any noxious weed or weeds in this state.

4. All funds appropriated for, or received incident to, the control or eradication of any noxious weeds must be available for carrying out the provisions of NRS 555.130 to 555.220, inclusive.

[2:174:1929; A 1941, 377; 1931 NCL § 415]—(NRS A 1961, 523; 1997, 479)

NRS 555.150 Eradication of noxious weeds by owner or occupant of land. Every railroad, canal, ditch or water company, and every person owning, controlling or occupying lands in this state, and every county, incorporated city or district having the supervision and control over streets, alleys, lanes, rights of way, or other lands, shall cut, destroy or eradicate all weeds declared and designated as noxious as provided in NRS 555.130, before such weeds propagate and spread, and whenever required by the state quarantine officer.

[Part 1:174:1929; NCL § 414]—(NRS A 1961, 524; 1987, 1728; 1997, 480)

NRS 555.160 State quarantine officer to investigate noxious weeds; notice to owner or occupant of land where noxious weeds are found.

1. The state quarantine officer shall make or cause to be made a careful examination and investigation of the spread, development and growth of noxious weeds in this state. Upon the discovery of those weeds he shall ascertain the name of the owner or occupant of the land and the description of the land where the weeds are found. The state quarantine officer may serve notice in writing upon the owner or occupant of the land to cut, eradicate or destroy the weeds within such time and in such manner as designated and described in the notice. One such notice shall be deemed sufficient for the entire season of weed growth during that year.

2. Notices may be served upon the owner or occupant by an officer or employee of the department, and must be served in writing, personally or by certified mail, with receipt given therefor.

[3:174:1929; NCL § 416]—(NRS A 1961, 524; 1993, 1711; 1997, 480; 1999, 3642)

NRS 555.170 Neglect of owner or occupant to eradicate weeds after notice; action by county commissioners; payment of costs by county.

1. If any owner or occupant of the lands described in the notice served, as provided in NRS 555.160, shall fail, neglect or refuse to cut, destroy or eradicate the weeds designated, upon the land described, in accordance with the requirements of the notice, the state quarantine officer may notify the board of county commissioners of the county or counties in which the land is located of such failure, neglect or refusal.

2. Upon notice as provided in subsection 1, the board of county commissioners concerned shall proceed to have cut, destroyed or eradicated the weeds in question in accordance with the requirements of the notice served upon the owner or occupant of the land in question, paying for such cutting, destruction or eradication out of county funds.

3. Upon the completion of such work of cutting, destruction or eradication of such weeds, the board of county commissioners shall prepare in triplicate itemized statements of all expenses incurred in the cutting, destruction or eradication of the weeds involved, and shall deliver the three copies of the statements to the county treasurer within 10 days of the date of the completion of the work involved.

[4:174:1929; NCL § 417]—(NRS A 1961, 524)

NRS 555.180 County treasurer to mail itemized statement of costs to owner or occupant; objections and hearing; costs constitute lien on land.

1. Upon receipt of the itemized statements of the cost of cutting, destroying or eradication of such weeds, the county treasurer shall forthwith mail one copy to the owner or occupant of the land on which the weeds were cut, destroyed or eradicated, together with a statement that objections may be made to the whole or any part of the statement so filed to the board of county commissioners within 30 days. A hearing may be had upon any objections made.

2. If any objections to any statement are filed with the board of county commissioners, the board shall set a date for a hearing, giving due notice thereof, and upon the hearing fix and determine the actual cost of cutting, destroying or eradicating the weeds and report its findings to the county treasurer.

3. If no objections to the items of the accounts so filed are made within 30 days of the date of mailing the itemized statement, the county treasurer shall enter the amount of such statement upon his tax roll in a column prepared for that purpose; and within 10 days from the date of the action of the board of county commissioners upon objections filed, the county treasurer shall enter the amount found by the board of county commissioners as the actual cost of cutting, destroying or eradicating the weeds in the prepared column upon the tax roll.

4. If current tax notices have been mailed, the costs may be carried over on the rolls to the year following. The costs incurred shall be a lien upon the land from which the weeds were cut, destroyed or eradicated, and shall be collected as provided by law for the collection of other liens.

[5:174:1929; NCL § 418]—(NRS A 1961, 525)

NRS 555.190 Incorporated city to pay county for any expense incurred by county to eradicate noxious weeds within city. Any expense incurred by any county in the cutting, destroying or eradicating of noxious weeds

from any street, lane, alley or other property owned or controlled by an incorporated city in that city, in accordance with the provisions of NRS 555.170, must be repaid to the county from the general fund of the incorporated city, upon presentation to the governing body of the incorporated city of an itemized statement of the expense so incurred.

[6:174:1929; NCL § 419]—(NRS A 1987, 1728; 1997, 480)

NRS 555.200 Removal of noxious weeds from public domain; reimbursement by Federal Government.

1. Whenever a noxious weed is found growing upon the public domain or any other lands in this state owned by the Federal Government, the state quarantine officer may serve notice, as provided in NRS 555.160, upon the person within the county or this state who is in charge of the activities of the federal agency having control or jurisdiction of the land.

2. If the agency described in the notice fails or refuses to comply with the notice, the state quarantine officer may provide for the cutting, destruction or eradication of the weeds in any manner permitted by federal law. The state quarantine officer or the political subdivision shall seek reimbursement from the Federal Government for any expense incurred by the state or the political subdivision pursuant to this section.

[7:174:1929; NCL § 420]—(NRS A 1961, 525; 1979, 292; 1997, 480)

NRS 555.201 Penalty. Any person violating any of the provisions of NRS 555.130 to 555.200, inclusive, or failing, refusing or neglecting to perform or observe any conditions or regulations prescribed by the state quarantine officer, in accordance with the provisions of NRS 555.130 to 555.200, inclusive, is guilty of a misdemeanor.

[Part 9:174:1929; NCL § 422]—(NRS A 1969, 518)

WEED CONTROL DISTRICTS

NRS 555.202 Legislative declaration. The legislature declares that it is primarily the responsibility of each owner or occupier of land in this state to control weeds on his own land, but finds that in certain areas this responsibility can best be discharged through control by organized districts.

(Added to NRS by 1969, 516)

NRS 555.203 Creation of district: Initiation by board of county commissioners or petition; hearing; exclusion of land; addition of power to control and eradicate noxious weeds.

1. The board of county commissioners of any county may, in accordance with chapter 308 of NRS, create one or more weed control districts in that portion of the county which lies outside any incorporated city. Creation of such a district may be initiated by the board of county commissioners or by a petition which:

(a) Designates the area to be included in the weed control district, either as the entire unincorporated area of the county or by sections or parts of sections with appropriate township and range references; and

(b) Is signed by an owner of land within the proposed weed control district.

2. Lands proposed for inclusion in a weed control district need not be contiguous.

3. Before creating a weed control district, the board of county commissioners shall:

(a) Hold at least one public hearing pursuant to NRS 308.070. At this hearing, the board of county commissioners shall entertain applications for the exclusion of lands, designated by sections or parts of sections as prescribed in subsection 1, from the proposed district, if any such application is made. The board of county commissioners shall exclude any such lands as to which it is shown to their satisfaction that any weeds which exist on that land do not render substantially more difficult the control of weeds on other lands in the proposed district.

(b) Provide for the hearing of protests against the establishment of the district in the manner set forth in NRS 318.065 and 318.070.

4. The board of trustees of a general improvement district may, in accordance with NRS 318.077, add to the basic powers of the district the control and eradication of noxious weeds.

(Added to NRS by 1969, 516; A 1981, 1641; 1987, 1728; 1997, 481)

NRS 555.205 Board of directors: Number; qualifications; appointment; terms; vacancies.

1. The board of county commissioners of any county in which a weed control district has been created shall appoint a board of directors of the district composed of three persons who:

(a) Are landowners in the district, whether or not they signed the petition for its creation. For the purpose of this paragraph, if any corporation or partnership owns land in the district, a partner or a director, officer or beneficial owner of 10 percent or more of the stock of the corporation shall be deemed a landowner.

(b) Fairly represent the agricultural economy of the district.

2. If the district includes lands situated in more than one county, the board of county commissioners shall appoint at least one member of the board of directors from each county in which one-third or more of the lands are situated.

3. The initial appointments to the board of directors shall be for terms of 1, 2 and 3 years respectively. Each subsequent appointment shall be for a term of 3 years. Any vacancy shall be filled by appointment for the unexpired term.

4. In addition to other causes provided by law, a vacancy is created on the board if any director:

(a) Ceases to be a landowner in the district.

(b) Is absent, unless excused, from three meetings of the board.

5. If, as a result of a change in the boundaries of the district, a county becomes entitled to a new member of the board of directors pursuant to subsection 2, the board of county commissioners shall make the new appointment upon the first expiration of the term of a current member thereafter.

(Added to NRS by 1969, 517; A 1981, 1642)

NRS 555.207 Board of directors: Powers. The board of directors of a weed control district may:

1. With the approval of the state quarantine officer, appoint a weed control officer.

2. Receive and expend any moneys provided by assessment, voluntary contribution or otherwise for the control of weeds in the district.

3. Exercise any other power necessary or proper to effectuate the purposes for which the district exists.

4. Elect a chairman from among its members, and secretary who may or may not be a member.

(Added to NRS by 1969, 517)

NRS 555.208 Review of action of board of county commissioners or board of directors by state board of agriculture; notice and hearing; judicial review.

1. The board of directors of a weed control district or the board of county commissioners of any county having lands situated in a weed control district or proposed for inclusion in such a district may request that the state board of agriculture review any action taken by the board of county commissioners of a county, or the board of directors of the district, in connection with the creation of the district or a change in the boundaries of the district.

2. Upon receiving such a request the state board of agriculture shall, after notice and opportunity for a hearing, affirm or reverse the action. The decision of the state board of agriculture is a final decision for purposes of judicial review.

3. This section does not limit the right of any landowner to seek judicial review of actions taken by a board of directors or a board of county commissioners in connection with the creation of a district or a change in the boundaries of a district.

(Added to NRS by 1981, 1641)

NRS 555.209 Regulations.

1. The board of directors shall prepare regulations for the weed control district, which shall include but are not limited to:

(a) The species of weeds to be controlled in the district.

(b) The means of direct control by spray, cultivation or otherwise.

(c) The means of indirect control, including the movement from, to and within the district of agricultural machinery, agricultural products, livestock and other vectors capable of spreading the weeds designated for control.

2. One copy of the proposed regulations must be delivered to the state quarantine officer, and at least two copies made available for public inspection in the office of the district secretary or the county clerk, as the board may by resolution prescribe.

3. The state quarantine officer shall then hold a public hearing in the county in which is located the larger or largest proportion of the area of the district, to consider the proposed regulations, of which he shall give notice by publication, in a newspaper of general circulation in each county having lands situated in the district, of at least one notice published not less than 10 days before the hearing. At this hearing, the state quarantine officer shall entertain written suggestions for the modification of the regulations.

4. After the hearing, and any additional time which the state quarantine officer may allow for the submission of additional facts or proposals, he shall approve, modify or disapprove the proposed regulations. If the board of directors of the district does not concur in the action of the state quarantine officer, the state board of agriculture shall establish the regulations.

(Added to NRS by 1969, 517; A 1981, 1643)

NRS 555.210 Performance of necessary work by weed control officer on failure by landowner; charges as lien. If any landowner fails to carry out a plan of weed control for his land in compliance with the regulations of the district, the weed control officer may enter upon the land affected, perform any work necessary to carry out the plan, and charge such work against the landowner. Any such charge, until paid, is a lien against the land affected coequal with a lien for unpaid general taxes, and may be enforced in the same manner.

[2.5:174:1929; added 1949, 560; 1943 NCL § 415.01]—(NRS A 1969, 518)

NRS 555.215 Assessments of real property in district; medium-term obligations.

1. Upon the preparation and approval of a budget in the manner required by the Local Government Budget and Finance Act, the board of county commissioners of each county having lands situated in the district shall, by resolution, levy an assessment upon all real property in the county which is in the weed control district.

2. Every assessment so levied is a lien against the property assessed.

3. Amounts collected in counties other than the county having the larger or largest proportion of the area of the district must be paid over to the board of county commissioners of that county for the use of the district.

4. The county commissioners of that county may obtain medium-term obligations pursuant to NRS 350.087 to 350.095, inclusive, of an amount of money not to exceed the total amount of the assessment, to pay the expenses of controlling the weeds in the weed control district. The loans may be made only after the assessments are levied.

(Added to NRS by 1959, 391; A 1969, 518; 1981, 1643; 1995, 1829; 1999, 278; 2001, 1827, 2336)

NRS 555.217 Change of boundaries: Petition; notice and hearing; resolution; ratification by board of county commissioners.

1. The boundaries of a weed control district may be changed in the manner prescribed in this section or in subsection 3 of NRS 308.080, but the change of boundaries of the district does not:

(a) Impair or affect its organization or its rights in or to property, or any of its rights or privileges whatsoever.

(b) Affect or impair or discharge any contract, obligation, lien or charge for or upon which it or the owners of property in the district might be liable or chargeable had the change of boundaries not been made.

2. The owners of lands may file with the board of directors a petition in writing praying that those lands be included in or excluded from the district. The petition must describe the tracts or body of land owned by the petitioners, and the petition shall be deemed to give the consent of the petitioners to the inclusion in or the exclusion from the district of the lands described in the petition. The petition must be acknowledged in the same manner that conveyances of land are required to be acknowledged.

3. The board of directors of the district may, on its own motion or upon petition of any person other than the owner, initiate proceedings for the inclusion of land in the district. A petition filed with the board of directors for this purpose must be in writing and must describe the tracts or body of land proposed to be included, allege that the lands described contain certain weeds that are harmful to owners of land in the district and request that the lands be included in the district.

4. Areas proposed for inclusion in a weed control district need not be located in the same county as other portions of the district and need not be contiguous to other portions of the district.

5. The secretary of the board shall give notice of filing of the petition, or initiation of proceedings by the board, to the owner or owners of the lands described in the petition or motion of the board and shall cause notice to be published in a newspaper of general circulation in the county in which the lands described are situated. The notices must require all persons interested to appear at the office of the board at the time specified in the notice and show cause in writing why the request should not be granted.

6. The board shall at the time specified in the notice, or at the time or times to which the hearing may be adjourned, proceed to hear the request and all written objections presented to show cause why the request should not be granted. The failure of any person interested to show cause in writing must be considered an approval by that person of the inclusion in or the exclusion from the district of the lands as requested.

7. Upon conclusion of the hearing the board by resolution shall approve the request, subject to ratification by the board of county commissioners of the county in which the lands are situated if the request is for the inclusion of

lands, or deny the request. In the case of proceedings initiated pursuant to subsection 3, the board may approve the inclusion in the district of the described lands only if it determines that the lands contain weeds that are harmful to owners of land in the district. The board may defer adoption of the resolution to a special meeting or its first regular meeting after conclusion of the hearing, whichever is sooner.

8. A copy of the resolution, adopted pursuant to subsection 7, must be filed with the board of county commissioners of each county in which all or a part of the district is located.

9. No action of the board of directors approving the inclusion of lands within the district becomes effective unless it is ratified by the board of county commissioners of the county in which the lands are situated. The board of county commissioners may ratify the action at any time after the filing of the resolution, but if the board has neither ratified the action nor denied ratification within 90 days after the date the resolution was filed pursuant to subsection 8, the action of the board of directors shall be deemed ratified.

(Added to NRS by 1973, 1076; A 1981, 1643; 1997, 482)

NRS 555.220 Penalty. Any person violating any of the provisions of NRS 555.202 to 555.210, inclusive, or failing, refusing or neglecting to perform or observe any conditions or regulations prescribed by the state quarantine officer, in accordance with the provisions of NRS 555.202 to 555.210, inclusive, is guilty of a misdemeanor.

[Part 9:174:1929; NCL § 422]—(NRS A 1969, 518)

**POLICY STATEMENT REGARDING
NOXIOUS WEED ABATEMENT STATUTES
NRS 555.005-201**

March, 2005, Nevada Dept. of Agriculture

A noxious weed is a plant that has been defined as a pest by law or regulation. Both Nevada and the U.S government maintain lists of plants that are considered threats to the well being of the state or the country. The two lists differ significantly.

In Nevada, The Nevada Department of Agriculture (hereinafter referred to as "the Department") will recommend plants for listing after consultation with outside experts and a panel composed of Nevada Weed Action Committee members. If a plant is found to probably be "detrimental or destructive and difficult to control or eradicate" (Nevada Revised Statute 555.005), the Department, with approval of the Board of Agriculture, will designate the plant as a noxious weed.

Chapter 555 sections .005-.217 of the Nevada Revised Statutes authorize the Department to investigate noxious weeds and require land owners or occupants to control such weeds. This statutory duty requires a noxious weed policy which recognizes that weeds vary as to their potential and actual harm to Nevada's agriculture and environment. Overall noxious weed significance is the basis for determining what prevention or control activities are appropriate, at what level, and when and where those activities should be conducted.

- A. Noxious weed ratings are intended to be used as aids to inform land owners and managers and other interested persons as to a particular noxious weed's environmental, agricultural and biological significance, as well as its importance to the general public, and the action recommended by the Department to deal with the pest.
- B. Each pest rating represents the **Department's** view of the **statewide** importance of the noxious weed to the crops, livestock, public health, wildlife, water quality and beneficial uses of land in Nevada. **Local conditions may dictate more stringent action against a pest than recommended at a state level.**
- C. It is the Department's policy to use the "Noxious Weed Tier System" to determine what action is to be taken consistent with existing statutes which include authority for: the promulgation of quarantine, abatement for eradication and/or control; holding and inspecting; establishing weed control districts; and for other regulatory activities.

At the time that the Department lists a species, it will also give a rating of A, B, or C. These ratings reflect the **Department's view of the statewide importance of the noxious weed, the likelihood that eradication or control efforts would be successful, and the present distribution of noxious weeds within the state.** These lists will be in the Nevada Administrative Code (NAC 555.010).

DEFINITIONS

"A" Weeds normally limited in distribution throughout the state; actively excluded from the state and actively eradicated wherever found; actively eradicated from nursery stock dealer premises; control required by the state

"B" Weeds more widespread throughout the state; actively excluded where possible, actively eradicated from nursery stock dealer premises; control required by the state in areas where populations are not well established or previously unknown to occur

"C" Weeds generally widespread throughout the state; actively eradicated from nursery stock dealer premises; abatement at the discretion of the state quarantine officer

Nevada Administrative Code

NAC CHAPTER 555 - CONTROL OF INSECTS, PESTS AND NOXIOUS WEEDS

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<u>555.070</u>	Douglas County Weed Control District: Weeds subject to control; methods of control; inspections; legal proceedings; cooperation with subdivision outside of District.
<u>555.075</u>	Goose Creek Weed Control District: Weeds subject to control; methods of control; inspections; legal proceedings; cooperation with subdivision outside of District.
<u>555.080</u>	Lovelock Valley Weed Control District: Weeds subject to control; methods of control; legal proceedings; inspections; limitation of terms and recall of director of District.
<u>555.090</u>	Walker River Weed Control District: Weeds subject to control; methods of control; legal proceedings.
<u>555.095</u>	Lamoille Weed Control District: Weeds subject to control; methods of control; inspections; legal proceedings; cooperation with subdivision outside of District.

GENERAL PROVISIONS

NAC 555.005 Definitions. As used in this chapter, unless the context otherwise requires:

1. "Department" means the State Department of Agriculture.
2. "Director" means the Director of the Department.

(Supplied in codification)

CLASSIFICATION OF WEEDS

NAC 555.010 (Amendment was officially filed March 24, 2005)

DEFINITIONS

Category A weeds are weeds that are generally not found or that are limited in distribution throughout the State. Such weeds are subject to:

- (a) Active exclusion from the State and active eradication wherever found.
- (b) Active eradication from the premises of a dealer of nursery stock.

Category B weeds are weeds that are generally established in scattered populations in some counties of the state. Such weeds are subject to:

- (c) Active exclusion where possible.
- (d) Active eradication from the premises of a dealer of nursery stock.

Category C weeds are weeds that are generally established and generally widespread in many counties of the state. Such weeds are subject to active eradication from the premises of a dealer of nursery stock.

**Nevada Administrative Code
(effective 2006)**

555.10 1. The following weeds are designated noxious weeds:

(a) Category A Weeds:

- | | |
|----------------------------|---|
| (1) African rue | (<i>Peganum harmala</i>) |
| (2) Austrian fieldcress | (<i>Rorippa austriaca</i>) |
| (3) Austrian peaweed | (<i>Sphaerophysa salsula</i>) |
| (4) Camelthorn | (<i>Alhagi pseudalhagi</i>) |
| (5) Common crupina | (<i>Crupina vulgaris</i>) |
| (6) Dalmatian toadflax | (<i>Linaria dalmatica</i>) |
| (7) Dyer's woad | (<i>Isatis tinctoria</i>) |
| (8) Eurasian water-milfoil | (<i>Myriophyllum spicatum</i>) |
| (9) Giant reed | (<i>Arundo donax</i>) |
| (10) Giant salvinia | (<i>Salvinia molesta</i>) |
| (11) Goats rue | (<i>Galega officinalis</i>) |
| (12) Houndstongue | (<i>Cynoglossum officinale</i>) |
| (13) Hydrilla | (<i>Hydrilla verticillata</i>) |
| (14) Iberian starthistle | (<i>Centaurea iberica</i>) |
| (15) Klamath weed | (<i>Hypericum perforatum</i>) |
| (16) Leafy spurge | (<i>Euphorbia esula</i>) |
| (17) Malta star thistle | (<i>Centaurea melitensis</i>) |
| (18) Mayweed chamomile | (<i>Anthemis cotula</i>) |
| (19) Mediterranean sage | (<i>Salvia aethiopis</i>) |
| (20) Purple loosestrife | (<i>Lythrum salicaria</i> , <i>Lythrum virgatum</i> and their cultivars) |
| (21) Purple star thistle | (<i>Centaurea calcitrapa</i>) |
| (22) Rush skeletonweed | (<i>Chondrilla juncea</i>) |
| (23) Sow thistle | (<i>Sonchus arvensis</i>) |
| (24) Spotted knapweed | (<i>Centaurea maculosa</i>) |
| (25) Squarrose knapweed | (<i>Centaurea virgata</i>) |
| (26) Sulfur cinquefoil | (<i>Potentilla recta</i>) |
| (27) Syrian bean caper | (<i>Zygophyllum fabago</i>) |
| (28) Yellow starthistle | (<i>Centaurea solstitialis</i>) |
| (29) Yellow toadflax | (<i>Linaria vulgaris</i>) |

(b) Category B Weeds:

- | | |
|---------------------------|---------------------------------------|
| (1) Carolina horse-nettle | (<i>Solanum carolinense</i>) |
| (2) Diffuse knapweed | (<i>Centaurea diffusa</i>) |
| (3) Medusahead | (<i>Taeniatherum caput-medusae</i>) |
| (4) Musk thistle | (<i>Carduus nutans</i>) |
| (5) Russian knapweed | (<i>Acroptilon repens</i>) |
| (6) Sahara mustard | (<i>Brassica tournefortii</i>) |
| (7) Scotch thistle | (<i>Onopordum acanthium</i>) |
| (8) White horse-nettle | (<i>Solanum elaeagnifolium</i>) |

(c) Category C Weeds:

- | | |
|---------------------------|--------------------------------|
| (1) Black henbane | (<i>Hyoscyamus niger</i>) |
| (2) Canada thistle | (<i>Cirsium arvense</i>) |
| (3) Green fountain grass | (<i>Pennisetum setaceum</i>) |
| (4) Hoary cress | (<i>Cardaria draba</i>) |
| (5) Johnson grass | (<i>Sorghum halepense</i>) |
| (6) Perennial pepperweed | (<i>Lepidium latifolium</i>) |
| (7) Poison hemlock | (<i>Conium maculatum</i>) |
| (8) Puncture vine | (<i>Tribulus terrestris</i>) |
| (9) Salt cedar (tamarisk) | (<i>Tamarix</i> spp.) |
| (10) Water hemlock | (<i>Cicuta maculata</i>) |

WEED CONTROL DISTRICTS

NAC 555.070 Douglas County Weed Control District: Weeds subject to control; methods of control; inspections; legal proceedings; cooperation with subdivision outside of District. (NRS 555.130, 555.209)

1. The following weeds are subject to control within the Douglas County Weed Control District:

- (a) Canada thistle (*Cirsium* spp.);
- (b) Puncture vine (*Tribulus* spp.);
- (c) Russian knapweed (*Centaurea* spp.);
- (d) Whitetop (*Cardaria* spp., *Lepidium* spp.);
- (e) Yellow star thistle (*Centaurea* spp.); and
- (f) Diffuse knapweed (*Centaurea diffusa*).

2. The control of any designated weed by the application of a chemical (herbicide) must be in accordance with the latest recommendations issued cooperatively by the University of Nevada, Reno, and the Department.

3. When chemical control is not feasible, mechanical methods to prevent seeding or storage of food may be used under the direction of the Weed Control Officer.

4. Any medium used in agricultural production moving from, to or within the District which is capable of spreading weeds designated for control by the District is subject to inspection by a director or the Weed Control Officer. If it is found infested with viable reproductive parts of a designated weed, a director or the Weed Control Officer may order the medium treated or cleaned by using methods and procedures approved by the director or Weed Control Officer.

5. If any person refuses to allow the District to control designated weeds on his land or refuses to perform the necessary control measures himself in a manner acceptable to the District, the district Board of Directors may request the initiation of legal action by the Director of the Department as provided by law.

6. The District may cooperate financially or otherwise with any owner of land or political subdivision outside of the District infested with a weed subject to control within the District if the infestation renders a potential problem to the control of weeds within the District.

[Dep't of Agriculture, eff. 2-27-70]—(NAC A by St. Quarantine Officer, 7-14-92)

NAC 555.080 Lovelock Valley Weed Control District: Weeds subject to control; methods of control; legal proceedings; inspections; limitation of terms and recall of director of District. (NRS 555.209)

1. The following weeds are subject to control within the Lovelock Valley Weed Control District:

- (a) Whitetop (*Cardaria* spp., *Lepidium* spp.);
- (b) Knapweed (*Centaurea* spp.);
- (c) Puncture vine (*Tribulus* spp.); and
- (d) Licorice (*Glycyrrhiza* spp.).

2. The control of any designated weed by the application of a chemical (herbicide) must be in accordance with the latest recommendations issued cooperatively by the University of Nevada, Reno, and the Department. In areas where chemical control is not feasible, other methods of weed control approved by the directors of the District must be used.

3. If a farmer or landowner refuses to allow the District to control designated weeds on his land, or refuses to perform the necessary control measures himself in a manner acceptable to the District, the directors may request the initiation of legal action by the Director of the Department as provided by law.

4. Any medium used in agricultural production moving from, to and within the District that is capable of spreading weeds designated for control by the District is subject to inspection by a district director or Weed Control Officer. If it is found infested with viable reproductive parts of a designated weed, the director or the Weed Control Officer may order the item treated or cleaned.

5. Any livestock originating outside of the District must be penned on the owner's property or in other suitable corrals for not less than 36 hours immediately upon arrival in the District.

6. All seed to be planted within the Lovelock Valley Weed Control District is subject to inspection by the District or a Weed Control Officer. Seed must be free from the designated weeds within the District.

7. All incoming forage and feed grain is subject to inspection by the District or a Weed Control Officer unless such forage and feed grain is destined to a mill approved by the District. The District shall adopt standards for controlling the dissemination of weed seeds in and around mills.

8. A director is limited to two successive terms. Recall procedures must be initiated by the county commissioners upon receiving a petition signed by 51 percent of the landowners or tenants within the District.

[Dep't of Agriculture, eff. 5-12-70]

NAC 555.090 Walker River Weed Control District: Weeds subject to control; methods of control; legal proceedings. (NRS 555.130, 555.209)

1. The Walker River Weed Control District is created for the control of designated noxious weeds within the prescribed boundaries.

2. Weeds to be controlled are limited to the following:

- (a) Whitetop (*Cardaria* spp., *Lepidium* spp.);
- (b) Knapweed (*Centaurea* spp.);
- (c) Canada thistle (*Cirsium* spp.);
- (d) Musk thistle (*Carduus* spp.);
- (e) Scotch thistle (*Onopordum* spp.);
- (f) Yellow star thistle (*Centaurea* spp.);
- (g) Puncture vine (*Tribulus* spp.); and
- (h) Licorice (*Glycyrrhiza* spp.).

3. The control of any designated weed by the application of a chemical (herbicide) must be in accordance with the latest recommendations issued cooperatively by the University of Nevada, Reno, and the Department. In areas where chemical control is not feasible, other approved methods of weed control must be used.

4. A diligent effort must be made to conduct control measures against every infestation of these weeds within the District at no direct charge to the landowner regardless of size or location of the infestation.

5. The District shall make no separate charge or assessment to any person for weed control on his property except by agreement made before the work is started.

6. The District shall have no regulation for the indirect control of noxious weeds by regulation of possible carriers.

7. If a farmer or landowner refuses to allow the District to control designated noxious weeds on his land, or refuses to perform the necessary control measures himself in a manner acceptable to the District, the director may request the initiation of legal action by the Director of the Department as provided by law.

[Dep't of Agriculture, eff. 2-25-70]—(NAC A by St. Quarantine Officer by R148-98, 12-14-98)

Designated Nevada Noxious Weeds (2005; NRS 555.010)

	COMMON NAME	CATEGORY	SCIENTIFIC NAME
1	African rue	A	<i>Peganum harmala</i>
2	Austrian fieldcress	A	<i>Rorippa austriaca</i>
3	Austrian peaweed	A	<i>Sphaerophysa salsula / Swainsona salsula</i>
4	Black henbane	C	<i>Hyoscyamus niger</i>
5	Camelthorn	A	<i>Alhagi pseudalhagi</i>
6	Common crupina	A	<i>Crupina vulgaris</i>
7	Dyer's woad	A	<i>Isatis tinctoria</i>
8	Eurasian water-milfoil	A	<i>Myriophyllum spicatum</i>
9	Giant reed	A	<i>Arundo donax</i>
10	Giant salvinia	A	<i>Salvinia molesta</i>
11	Goats rue	A	<i>Galega officinalis</i>
12	Green fountain grass	C	<i>Pennisetum setaceum</i>
13	Hemlock, poison	C	<i>Conium maculatum</i>
14	Hemlock, water	C	<i>Cicuta maculata</i>
15	Hoary cress	C	<i>Cardaria draba</i>
16	Horse-nettle, Carolina	B	<i>Solanum carolinense</i>
17	Horse-nettle, white	B	<i>Solanum elaeagnifolium</i>
18	Houndstongue	A	<i>Cynoglossum officinale</i>
19	Hydrilla	A	<i>Hydrilla verticillata</i>
20	Klamath weed	A	<i>Hypericum perforatum</i>
21	Knapweed, diffuse	B	<i>Centaurea diffusa</i>
22	Knapweed, Russian	B	<i>Acroptilon repens</i>
23	Knapweed, spotted	A	<i>Centaurea maculosa</i>
24	Knapweed, squarrose	A	<i>Centaurea virgata Lam. Var. squarrose</i>
25	Leafy spurge	A	<i>Euphorbia esula</i>
26	Mayweed chamomile	A	<i>Anthemis cotula</i>
27	Mediterranean sage	A	<i>Salvia aethiopis</i>
28	Medusahead	B	<i>Taeniatherum caput-medusae</i>
29	Perennial pepperweed	C	<i>Lepidium latifolium</i>
30	Puncturevine	C	<i>Tribulus terrestris</i>
31	Purple loosestrife	A	<i>Lythrum salicaria, L. virgatum & cultivars</i>
32	Rush skeletonweed	A	<i>Chondrilla juncea</i>
33	Sahara mustard	B	<i>Brassica tournefortii</i>
34	Saltcedar (tamarisk)	C	<i>Tamarix ramosissima, T. parviflora</i>
35	Johnson grass	C	<i>Sorghum halepense</i>
36	Sowthistle	A	<i>Sonchus arvensis</i>
37	Starthistle, Iberian	A	<i>Centaurea iberica</i>
38	Starthistle, Malta	A	<i>Centaurea melitensis</i>
39	Starthistle, purple	A	<i>Centaurea calcitrapa</i>
40	Starthistle, yellow	A	<i>Centaurea solstitialis</i>
41	Sulfur cinquefoil	A	<i>Potentilla recta</i>
42	Syrian bean caper	A	<i>Zygophyllum fabago</i>
43	Thistle, Canada	C	<i>Cirsium arvense</i>
44	Thistle, musk	B	<i>Carduus nutans</i>
45	Thistle, Scotch	B	<i>Onopordum acanthium</i>
46	Toadflax, Dalmatian	A	<i>Linaria dalmatica</i>
47	Toadflax, yellow	A	<i>Linaria vulgaris</i>

Appendix B

Weed Species Fact Sheets



COOPERATIVE EXTENSION

Bringing the University to You

Fact Sheet-05-03

Identification and Management of Bull Thistle

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Bull thistle, also called spear thistle, Fuller's thistle, and lance-leaved thistle, is a biennial in the sunflower (Asteraceae) family. A native of Eurasia, it is widely established in North America after continuously being introduced as a seed contaminant. Bull thistle has been found in all Nevada counties.

Identification

In the first year of growth, bull thistle (*Cirsium vulgare*) forms a rosette of leaves (Fig. 1) and develops its short, fleshy taproot. It overwinters as a rosette and then grows erect, spiny-winged stems. The stems grow two to five feet tall and have many spreading branches. They are sparsely hairy.

The stem leaves are pinnately lobed and three to six inches long. The top of the leaves are prickly and hairy, but the undersides are cottony and woolly. The lobes have stout, needle-like spines at the tips.

The fragrant flowers are one to two inches long and shaped like a gumdrop (Fig. 2). They grow singly at the ends of shoots and branches (Fig. 3) from July through September. They are usually pinkish purple but can be white. The narrow bracts at the base of the flower (involucre) are covered with spines.



Figure 3. Bull thistle flowers grow at the ends of shoots and branches.



Figure 1. The young leaves have a fringe fringe of spines (left).



Figure 2. Bull thistle flowers are pinkish-purple.

The involucre (bracts) is covered with spines (right).

Bull thistle does not reproduce vegetatively, but rather by seed. The light-colored, oblong seeds have dark brown to black longitudinal stripes. They are one-sixteenth inch long and somewhat flattened with white, plume-like hairs (pappus) that readily detach at maturity. A healthy plant produces about 5,000 seeds, but

extremely vigorous plants may produce up to 50,000 seeds.

Bull thistle may be mistaken for Canada thistle (*Cirsium avense*), but there are many ways to tell these plants apart. First, bull thistle is a biennial and Canada thistle is perennial. Unlike bull thistle, the leaves of Canada thistle are not hairy on top and the flower bracts (involucre) do not have spines. In addition, Canada thistle has a rhizomatous root system, while bull thistle has a short taproot that does not creep or spread.

Habitat

In the western United States, bull thistle is the most widespread of the pasture and rangeland thistles. Plants are found in disturbed areas such as roadsides, fence rows, overgrazed pastures and rangeland, eroded gullies, ditch banks, and vacant lots.

Bull thistle grows best on soils that are rich in nitrogen, have a neutral pH, and retain moderate soil

moisture. It is rarely found on sand or pure clay soils. It does not grow well in shade or under droughty conditions.

Impact

Bull thistle rapidly colonizes disturbed areas and prospers in pastures that are heavily grazed and receive nitrogen fertilization. The number of rosettes and amount of seed production is significantly higher in grazed pastures compared to ungrazed pastures.

Bull thistle reproduces only by seed. The seeds of bull thistle are easily dispersed by water, animals, human activities, and wind. The most common way large amounts of the weed are spread is through transportation of contaminated agricultural products, such as hay. Once established, bull thistle successfully out competes native plant species, depriving them of water and nutrients. Bull thistle's sharp spines deter livestock and wildlife from grazing them and nearby plants.

Management

Prevention: Since bull thistle reproduces only from seeds, preventing seed production will successfully decrease its spread. Be sure to clean any equipment or vehicles after operating in an infested area. Use clean, certified seed. If a bull thistle plant is found, take action immediately so as to prevent seed production and establishment of a stand.

Mechanical Control: To kill bull thistle till, hoe or hand pull it. Seeds will likely be left in the soil, so revegetate the site with desirable plants that will be able to compete with bull thistle and prevent reinvasion. These methods are most effective when done before bull thistle flowers.

Mowing bull thistle will not eradicate the weed, but it can be used to limit the spread of seed if timed properly. Mow once after the plants produce a flower stalk (bolt) but before they flower, and then again about a month later. Mowing will be more effective if used in combination with other management techniques.

Cultural Control: Re-establishment of desirable vegetation is needed in order to successfully manage bull thistle. Perennial grasses will be the most effective. Good grazing management will encourage grass growth and keep pastures and rangeland healthy. Avoid heavy grazing because it facilitates bull thistle establishment.

Biological Control: The seedhead fly (*Urophora stylata*) was released in the United States in 1983 and successfully established for biological control of bull thistle in Colorado, Maryland, Washington, California, Montana, and Oregon. It is reportedly providing good control of bull thistle in Oregon, where both are widespread. The larvae feed on developing bull thistle seeds in the flowerheads. The feeding can decrease seed production up to 65 percent.

The weevil, *Trichosirocalus horridus*, was released on bull thistle in Wyoming, but establishment has not been confirmed.

Chemical Control: When bull thistle plants are in the rosette growth state, clopyralid, dicamba, MCPA, 2,4-D, or picloram can be used in pastures, rangeland, and non-crop areas. Clopyralid should be applied to rosettes in spring or fall at a rate of 0.13 to 0.5 pound active ingredient per acre (ai/A). Applying 0.2 to 0.3 pound ai/A of clopyralid plus one to 1.5 pounds ai/A of 2,4-D will also be effective. Dicamba at a rate of 0.5 to one pound ai/A can be applied to rosettes in the spring or fall, but will only be effective if good growing conditions exist. Applying 1.5 to two pounds ai/A of 2,4-D to rosettes in the spring should provide control. Using only one pound ai/A of 2,4-D while adding 0.5 pound ai/A of dicamba should also be effective. Apply picloram at a rate of 0.13 to 0.25 pound ai/A to rosettes in the spring or fall.

For plants that are in the bolting to bud stages, use metsulfuron or chlorsulfuron. Apply 0.3 ounce ai/A of metsulfuron or 0.75 ounce ai/A of chlorsulfuron. The use of a nonionic surfactant increases the effectiveness of herbicide applications.

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Photographs are courtesy of *Weeds of the West*.

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Managing Hoary Cress

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Hoary cress or heart-podded whitetop (*Cardaria draba*) (Fig. 1) and whitetop or globe-podded whitetop (*Cardaria pubescens*) are growing in all 17 counties in Nevada. Lens-podded whitetop (*Cardaria chalepensis*) has been reported in Washoe, Elko, Lyon, Eureka and Lincoln Counties. These three exotics look alike, invade the same sites and are equally difficult to control. Members of the mustard family (*Brassicaceae*), they are long-lived rhizomatous perennials that were introduced into the United States in the late 1800's, most likely via contaminated alfalfa seed. Today they have spread all over the world. Their seeds have been used to make pepper, and honey bees make high quality honey from their flowers.

Habitat

The whitetops grow well in many environments, but they commonly grow in disturbed, alkaline soils with moderate moisture. They do particularly well in sub-irrigated pastures, hay fields (especially alfalfa), and rangeland meadows. The whitetops also grow in acidic soils with limited moisture. They do well along roadsides, ditch banks, and in many other unshaded disturbed areas. They are aggressive invaders in much of Nevada because their seeds germinate and the plants grow in moderately salty soils.

Identification

The whitetops have leaves at the base of their stems as well as along their stems. Their basal leaves are short-stalked and emerge from the crown. Stem leaves clasp the stem at their base,



Figure 1. Hoary cress (*Cardaria draba*) in flower.

are grayish green and arrowhead shaped. Their grayish green appearance comes from the fine soft white hairs that cover the leaves and stem.

White flowers are borne in clusters at the top of slender stalks that grow from 10 to 24 inches tall. Individual flowers are less than ¼ inch wide. They have four petals and six stamens. The flat-topped flower clusters may be several inches wide (Fig. 2).

The shape of the seedpods can be used to identify the three cardarias. Hoary cress has a heart-shaped, broad, flat seedpod, lens-podded whitetop's pod is flat and round, and *Cardaria pubescens* has a small, purplish, globe-shaped pod. In general, all are tipped with a small beak, are reddish brown and about ½ inch long. They

have two to four seeds each. These plants are prolific seed producers; they produce up to 850 seeds per stem and 4,800 seeds per plant. Over a long season, such as in southern Nevada, the whitetops may produce seed twice.

The seeds spread by wind, animals, vehicles, and water. They are often a contaminant in crop seed. Whitetop seeds can germinate within three weeks of being dispersed from the plant.



Figure 2. Whitetop flower cluster and seedpods.

The seeds can remain viable in the soil for up to three years. Seed longevity impacts the management strategies used; follow up treatments over several years will be necessary.

Whitetop seeds usually germinate in the fall, but some germinate in spring. In as little as three weeks, a seedling can become a rosette (a plant with leaves radiating from the crown (center) close to the ground and without flower stalks) and establish lateral roots. The plant continues to grow both above and below ground until the first frost. The lateral roots grow widely; up to 12 feet the first season and two to five feet each season thereafter. The lateral roots may turn down and grow several feet deep. They may produce rhizomes (horizontal underground stems) that sprout additional plants. A single whitetop plant can produce 450 new shoots in a single growing season. With competition, they produce fewer new plants.

The first year, whitetop normally grows and over winters as a rosette. In the spring, it emerges before other plants. This makes it a competitor of desirable spring vegetation since it uses moisture and other resources first. It

eventually crowds out other vegetation, forms an infestation of only whitetop (monoculture) and devastates the site.

Impacts of Whitetop

An infestation of whitetop:

- Reduces biodiversity by displacing plants from plant communities and eventually the animals that are dependant upon those plants for food and habitat.
- Reduces forage quality and quantity.
- Reduces crop, pasture, and rangeland productivity.
- Forms a dense stand of only whitetop.
- Replaces forage for wildlife and livestock. Contains glucosinolates that are toxic to cattle.
- Reduces available soil moisture and nutrients early in the season.
- Devalues the land, making land sales difficult.
- Increases operating costs of private and public lands.

Weed Management Options

Prevention is the most cost reducing and time effective weed management strategy.

Prevent whitetop establishment by:

- Cleaning clothing, vehicles and other equipment before entering an uninfested area.
- Ensuring that workers, recreationists, and the public refrain from entering infested lands and, if entering the area is necessary, that they remove seed and plant debris from their clothing, vehicles, and equipment before leaving the area.
- Not grazing plants with seed and holding livestock for 10 to 14 days if they have grazed infested areas.
- Grazing appropriately to maintain competitive forage by rotating livestock to allow desirable plants to recover and altering seasonal use.
- Limiting seed dispersal by cutting the flower heads before they produce seed. Although this prevents dispersal of seed, it usually stimulates more vegetative reproduction from the roots.

- Keeping banks of waterways free of whitetop and screening irrigation water to remove seed and plant fragments before irrigating non-infested land.
- Not grading roadsides with established stands until the whitetop is eradicated.
- Sowing certified weed-free seed in croplands and rangeland revegetation.

If whitetop does become established, it should be contained as soon as possible.

Containment can be achieved by managing the outside perimeter to prevent the spread of whitetop. Continue using prevention techniques for the uninfested area and apply integrated management options to the infested area using a combination of the following.

Mechanical control in fall or early spring is appropriate for small seedling stands. When pulling, hoeing or tilling the seedlings, make sure to get the lateral and vertical roots. If fragments of the root remain, new plants will develop. This practice is effective in riparian areas and around the home. Pulling and cultivation must be done on a regular basis, sometimes several times a season. For example, tilling whitetop must be repeated every 10 to 21 days until no seedlings emerge. Do not till or mow an established stand; this stimulates the rhizomes to grow new plants.

Cultural control options are limited because of whitetop's dominant invasive nature. Planting legumes that compete with whitetop for soil moisture can aid control.

Flooding is effective on heavy soils, but the complete submersion of whitetop for several weeks is required to kill it and flooding usually kills any desirable vegetation that is present. Flooding can also reduce land fertility as a result of leaching or erosion of the soil.

Unfortunately there are no successful **biological controls** available in the United States for whitetop. Cattle will not eat whitetop unless there is nothing else to eat. They should be kept away from whitetop; it contains glucosinolate, an alkaloid toxic to cattle. Sheep will graze whitetop in the rosette stage. Grazing, like mowing, stimulates the vegetative growth and spread of whitetop if it is grazed later in the season.

Chemical control is difficult because whitetop establishes itself in crops and on rangeland where desirable broad-leaved plants, many of which are legumes, are present. Legumes are sensitive to herbicides and will be lost if sprayed. Crops such as alfalfa, peas, onions, and sugar beets are damaged or killed by pre-emergent and post-emergent herbicides that effectively kill whitetop. There are no registered herbicides for these crops that will kill whitetop and not kill the crop.

Managers should treat whitetop in the fall after the crop has been harvested to ensure that future crops are not lost to the herbicide or to whitetop infestations.

In Nevada, land managers have few chemicals to use against whitetop. If used correctly, 2, 4-D can provide fair to good control. Chlorsulfuron (Telar[®]) and metsulfuron (Escort[®]) can be used on non-cropland. Caution: chlorsulfuron and metsulfuron persist in alkaline soils (high pH) for several years. The soil residual may kill or damage crops, forage, and plants used in rangeland revegetation if planted too soon following treatment. Because desirable species cannot grow, a new infestation of whitetop or other noxious weed may invade the area.

Small infestations in cropland may be controlled by application of foliar active products such as glyphosate. Dicamba can extend the window of control without creating long soil residuals.

Once the weed is eradicated, it is very important to **revegetate** the land. Planting desirable forage or crops that emerge all season long will increase competition with whitetop. Also, crop and grazing rotations should be implemented to maintain healthy and productive stands of forage.

Not only are the whitetops great seed producers, but they also spread from roots and rhizomes increasing control costs and limiting viable management options. Following any treatment, the treated area must be monitored and spot treatments applied to prevent re-establishment of the whitetop. This may include pulling, tilling, or herbicide treatment of the new plants. It is not known how long the rhizome can remain viable in the soil, but seeds can remain viable for three years. Therefore, monitoring and spot treatments must continue for

several years until new plants do not emerge or seeds do not germinate.

An active, cooperative **Weed Management Strategy** among local landowners and land managers is the best defense against invasive weeds, especially whitetop. Prevention, early detection and eradication (when possible) or containment, consistent monitoring, control and revegetation with competitive grasses and legumes are all components of an effective strategy. No one element of the strategy is successful alone.

Persistence and vigilance at every step of the weed management strategy are keys to ensuring success. Constant monitoring for new and returning weeds, follow-up treatments, and revegetation may need to be repeated several times to restore a healthy, productive environment. Healthy pastures, crops, ditches, riverbanks, and rangeland act as a natural barrier to weed invasion. Not only do they reduce the ability for invasive weeds to establish, they provide forage for livestock and wildlife, compliment native habitats, increase plant and animal diversity, improve aesthetics of the landscape, control erosion, and create more opportunities for recreation.

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Medusahead: Economic Impact and Control in Nevada

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Medusahead (*Taeniatherum caput-medusae*), is an aggressive, winter annual weed that is changing the ecology of western rangelands. It was first discovered growing in Oregon in 1887 by Thomas Howell (1903). Since then, medusahead has invaded millions of acres in the Pacific Northwest, California, Utah and Nevada. Native habitat has been lost and many native species displaced. Medusahead is extremely competitive, especially on heavier soils, and has crowded out cheatgrass (*Bromus tectorum*) in areas of Idaho (Miller et al., 1999). Medusahead reduces the forage productivity of rangelands, while enhancing the ignition and spread of wildland fires (Young 1992). Rangeland fire not only kills desirable vegetation, but it produces disturbed land that is easily infested with more medusahead. Such unnatural fire decreases species diversity of plant and animal communities.

In Nevada, medusahead infestations occur in Carson City, Douglas, Elko, Humboldt, Pershing and Washoe counties. Prevention, control of small infestations, and containment of larger ones is imperative, otherwise the future environmental and economic impacts will be devastating.

Medusahead germinates mostly in the fall, although winter and spring germination occurs with favorable environmental conditions. Medusahead roots grow during the winter and early spring. Because they develop early and deeply, medusahead outcompetes native plants for soil moisture. It flowers in early spring and seeds mature in late June or early July (Fig. 1). The seeds are covered with spiny barbs. They are dispersed by becoming attached to animals, humans or vehicles as they pass by. As medusahead grows it accumulates silica which makes the plant unpalatable to

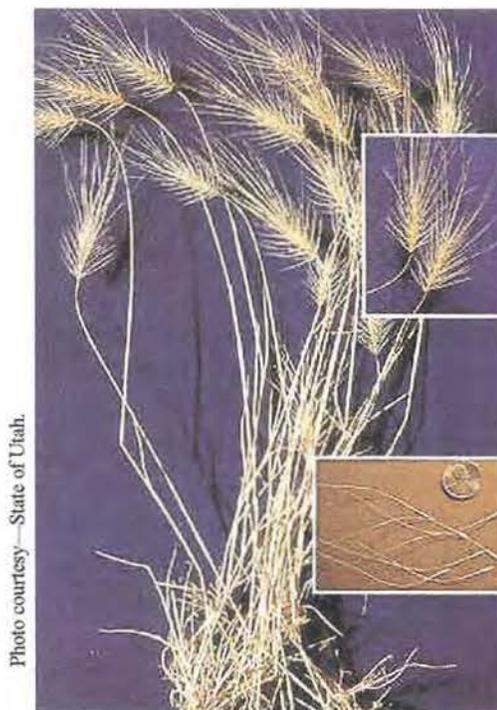


Photo courtesy—State of Utah.

Figure 1. “[Medusahead]...is probably the greatest threat to the biodiversity of the natural vegetation that has yet been accidentally introduced into the Great Basin.” (Jim Young, ARS 1992)

livestock, except when the plant is very young. Medusahead creates a dense layer of litter that decomposes slower than other plants because of its high content of silica. After several years of accumulation, it creates an enormous load of fuel. It also suppresses native plant growth while promoting the germination of its own seed.

The density of medusahead stands varies from several hundred plants per square foot to 2,000 plants per square foot. This depends largely on annual precipitation, soil type, and adjacent vegetation. Young

(1992) reports that medusahead is highly adaptable and can produce more seeds at one plant per square foot than at 1,000 plants per square foot. Due to its late maturation, medusahead is bright green when all other annuals are brown, which makes it easy to identify. As the weed matures, it turns purple and eventually tan. Medusahead ranges in height from six to 24 inches. The seedhead produces persistent awns with spiny bristles (Fig. 2) (View with a 10X hand lens or feel the bristles by running the awns between your thumb and finger). The seed is grain-like and may remain viable for many years.

Economic analysis of invasive weed management allows the land manager to evaluate potential costs and benefits of weed control schemes. Good economic analyses must illustrate both direct and indirect costs that are associated with invasive weed infestations in order for the land manager to make correct decisions. Direct costs are labor, chemicals and equipment. Indirect costs can include, the cost of reduced grazing acreage, decreased recreational activity/revenue, increased fire hazard and/or lost wildlife diversity. Cattle ranchers lose productive grazing acres that cannot be substituted easily; some invasive weeds can be injurious or poisonous to livestock and wildlife. Farmers risk contaminating their crops, which lowers the market price for those crops, if they can even be sold. Nevada's agricultural reputation and future agricultural sales are also at risk if contaminated hay is not discovered before it is sold. Government agencies may lose revenues on contaminated rangelands that lack wildlife diversity caused by invasive weeds.

Photo courtesy—University of California, Davis.



Figure 2. Medusahead seedhead with its persistent awns.

These situations are occurring because of invasive weeds, including medusahead. In order to stop medusahead, control strategies must be an economically sound and include cooperative effort among federal, state, and county agencies and private citizens. Invasive weeds lay waste to natural resources and consume valuable time and financial resources. Learn to prevent invasive weeds from entering an area and report any sightings to the land manager or your local Cooperative Extension Educator.

Several control methods reduce medusahead infestations and used in combination can eradicate it. The following methods are used by weed scientists and land managers for medusahead control. Not every method will be a perfect solution for your medusahead infestation. Adjustments must be made for climatic factors (annual precipitation, average temperature, etc.), soil type and native plants present or desired. Land management objectives must also be considered (grazing, harvesting, wildlife conservation, etc.).

Mechanical control of medusahead involves the use of prescribed fire and/or spring plowing or disking (Fig. 3). Prescribed fire is effective in controlling medusahead if the seeds are not mature and have not disseminated. The burn should occur when the seed is in the soft dough stage (when the seeds exude a milky substance if squeezed) in late spring (McKell et al. 1962). Burning also stops the accumulation of a litter layer, which increases available space and light promoting the growth of desirable species. Removing the litter layer also improves the effectiveness of mechanical and chemical control (Harris and Goebel 1976). Use caution when burning to prevent wildfire. Always obtain permission from local firefighting and quality management agencies.

Plowing and disking effectively control medusahead infestations. Plowing reduces infestations by 65% to 95% the next growing season (Harwood 1960). Followed by chemical spot treatment and revegetation, prescribed fire or plowing (disking) can control, even eradicate, medusahead. Eradication using mechanical control by itself is nearly impossible.

Biological control uses natural enemies to control medusahead's growth and seed pro-



Figure 3. Prescribed fire being used to reduce the competition medusahead and favor the growth of desirable species in southern Cache county Utah.

duction. Grazing, with sheep or cattle, has been moderately effective in the control of medusahead, and is best utilized as part of an integrated control program. Livestock will graze the plant early in the spring when it is green. Overgrazing must be avoided, otherwise medusahead will reinfest the area (Fig 4). A crown rot fungus is moderately effective in controlling medusahead, and research is being carried out on possible root pathogens in the Great Basin (Sheley 1995). No insects are used in medusahead management.

Chemical control is effective when used in combination with other control methods. Glyphosate applied at .375 lbs/acre in early spring before seed production gives good results. This also limits the damage incurred by desirable species that develop later (Sheley 1995). Research suggests that burning the area before herbicide application is more effective than only applying the chemical.

Read the label to ensure that the chemical used will not harm desirable plants growing in the infested area. Initial monitoring should include a description of all species including other weed species. Exercise caution when working with any chemical herbicide, mechanical equipment and fire. Always read and follow safety guidelines.

Revegetation should be part of any medusahead management plan. Seeding a medusahead infested area with a desirable plant will be unsuccessful without first controlling the medusahead.

This requires controlling both the existing medusahead, especially not allowing it to produce seed, and reducing the seed bank in the soil, which usually takes two or three years, depending upon soil moisture and growing conditions. After this, seedlings of desirable plants will become established. Combining a tillage treatment followed by herbicide treatment is most effective in controlling the weed and promoting desirable plant growth (Torell and Erickson 1976). When using herbicides before seeding with desirable species, the herbicide residue in the soil must be at a level where it will not damage the seeded species. Check the herbicide label for its soil persistence. Squirreltail, bluebunch wheatgrass, crested wheatgrass, intermediate wheatgrass, orchardgrass, Thurber needlegrass, needle-and-thread grass, Indian ricegrass, Sandberg bluegrass and sheep fescue, are all competitive grasses that work well when renovating previously infested medusahead stands in the western United States.

Integrated control methods work best for managing medusahead infestations on rangelands. Livestock grazing is a highly efficient tool to use as part of an integrated program when the timing and duration are managed correctly. For example, grazing in conjunction with revegetation must occur after the desirable species has become established, otherwise revegetation will not work. Winter and early spring grazing works well where desirable species have completed their life cycle. Medusahead may also be grazed by animals during that time because it is a winter annual. Late spring, summer and fall grazing is not recommend as it gives medusahead a competitive advantage. Livestock used to graze mature medusahead must be moved to a



Figure 4. Close-up of a medusahead infestation in a perennial grass stand.

holding area for 10 to 14 days and fed weed-free feed before they can be moved to weed-free areas.

Recognize that not every control option will work on all infested sites. Monitoring the progress of a management strategy and making the necessary adjustments year to year is the only way to successfully eradicate medusahead. For further assistance, or to report an infestation, contact Dr. Wayne S Johnson at (775) 784-1931. Contact your local extension educators; they can also help you with invasive weed management (sidebar).

Medusahead must be reported, mapped, controlled and monitored in order to protect Nevada's wilderness and rangelands.

Internet Invasive Weed Resources

University of Montana: <http://invader.dbs.umt.edu/>
Western Society of Weed Science: www.wsweedscience.org/
California Weed Science Society: www.cwss.org/
Colorado State University: www.arapcsuext.org/agri/noxious2.htm
Bureau of Land Management: <http://www.blm.gov/weeds/>

Precaution: Pesticides have both benefits and risks. Maximize the benefits and minimize the risks by following the label. Labeled information contains both instructions and limitations. Pesticide labels are legal documents and it is a violation of both federal and state laws to use a pesticide in a manner inconsistent with its labeling. The pesticide applicator is legally responsible for the proper use of a pesticide. Always read and follow the label! The use or nonuse of chemical names does not constitute an endorsement nor criticism of a product containing the chemical.

Editing: Christie South & Sue Strom

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Managing Musk Thistle

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Musk or nodding thistle (*Carduus nutans*) is a native of Europe and Western Asia. It has been in the United States since the late 1800's. It was accidentally introduced and has spread rapidly in North America. It is a prolific seed producer and, as an alien species, it lacks natural enemies.

It is important to identify and eradicate musk thistle as soon as it is found. It is a noxious weed in Nevada and many other states because it reduces forage yield and quality, makes recreation areas impassable, and degrades wildlife habitats.

Identification

Musk thistle is a biennial. In its first year, it grows as a basal rosette (a plant with leaves radiating from the crown (center) close to the ground and without flower stalks) (Fig.1). The rosette may grow two feet in diameter. Its waxy leaves appear pale blue-green because they are covered with whitish hairs.



Figure 1. Musk thistle rosette.

During its second growing season, musk thistle can grow to nine feet tall. It has large, coarse stems that are covered with dense, short hairs. The leaves are three to six inches long and

alternate. They are spiny, deeply lobed, long and narrow. Musk thistle has a single, deep taproot that does not spread laterally. The root is hollow at the top and has a corky texture throughout.

During the second year, approximately 45 to 55 days after bolting (producing a flower stalk), musk thistles produce seeds. Fortunately, musk thistle only reproduces by seed; unfortunately, it is very prolific, producing a few thousand to 100,000 seeds per plant. On average, a plant produces 10,000 seeds. Each seed has a bristle or pappus (stiff hairs) that aids in seed dispersal; however, animals, wind, birds, and water do not generally spread the seeds; but they may. The majority falls close to the plant, resulting in thousands of new seedlings in the immediate area. Musk thistle seeds may remain viable for more than 10 years in the soil.

Musk thistle produces terminal flower heads from June through October (Fig.2). It may also



Figure 2. Musk thistle flower.

produce secondary heads that develop lower on the main branches. All the flower heads (terminal and secondary) can emerge over nine

weeks. In as little as seven days after the first bloom, and for a period of up to two months, seeds can be shed. The flowers are one to three inches in diameter and deep rose to violet or purple colored; very rarely a white flower is produced. Each flower has spine-tipped bracts (reduced leaf or leaf-like structure at the base of the flower) surrounding it. The flower heads often droop or nod, giving the musk thistle its common name, nodding thistle (Fig. 3).



Figure 3. Musk thistle on rangeland.

Habitat

Musk thistle is found in temperate climate zones and only occasionally in the tropics. It can occupy saline soils in low valleys, as well as acidic soils at 10,000 feet. Its seeds germinate in various ranges of environmental conditions. It grows in 40 states, including arid Nevada and the moist climates of the East Coast. Moisture and sunlight favor its establishment. Pastures, construction sites, roadsides, ditches, gullies, and rangeland, particularly areas covered by snowdrifts, are ideal sites for musk thistle.

Musk thistle does not become well established in vegetated sites where competition is great. Healthy, dense pasture and rangeland vegetation prevents musk thistle from establishing. However, competitive vegetation does not guarantee a musk thistle-free area, but it

does reduce musk thistle establishment and dominance.

Impact of Musk Thistle

Coming in contact with musk thistle is very unpleasant. A dense stand of musk thistle can act as a natural fence line or barrier on the range because of its spiny leaves. Animals avoid musk thistle. In pastures and rangeland, valuable forage is lost due to the presence of musk thistle. Livestock will not graze musk thistle nor near it. Sheep may graze it in its rosette stage, but only if there is nothing else to eat. Similarly, musk thistle does not provide good forage for wildlife, thus reducing wildlife habitat value. Wildlife may move to a new location if a significant portion of their habitat is infested with musk and other thistles. A dense stand can make waterways inaccessible to wildlife, livestock, and recreationists.

The quality of recreation is diminished when musk thistle invades trails and scenic areas. Trails become inaccessible, native vegetation is displaced (changing the natural landscape), and opportunities for wildlife viewing diminish as wildlife relocates.

Management of Musk Thistle

Because musk thistle is a biennial that reproduces only by seeds, it is more manageable than many invasive species. Prevention is the key to controlling musk thistle. Complete exclusion of the thistle is the most cost effective method of control. If musk thistle does establish, prevention of seed production and dispersal is most important for a successful management program. By combining several management techniques, musk thistle may be eradicated or controlled.

Prevention

Prevention is the most time and cost effective of all the available techniques and must come first.

Buy and plant certified weed-free seed to keep musk thistle out of new plantings. When feeding livestock, make sure the feed, hay or grain, is certified weed free.

Ensure equipment and vehicles are cleaned before leaving contaminated areas.

On rangeland and in pastures, have a grazing management plan that allows desirable

vegetation to recover from grazing. To prevent musk thistle incursion, do not over graze a healthy pasture or rangeland. A site with forage under stress and with open, disturbed patches allows musk thistle to establish.

Monitor your property and adjacent lands for musk thistle and eradicate new plants whenever they appear. Preventing seed production and dispersal is paramount. Kill existing rosettes wherever they are found by tilling, cultivating or herbicide application. Mow second year plants after the flower stalk is in the bud stage. Earlier mowing may cause the plant architecture to change to a prostrate (laying flat on the ground) plant capable of producing flowers and seeds. Eradicating a small infestation of any weed is more cost effective and consumes less time than trying to control and eradicate a large stand.

▪ **Cultural Control**

Cultural control of musk thistle is limited. Good forage management practices that establish competitive desirable forage, maintain soil fertility, and prevent erosion will help combat musk thistle. Perennial grasses are most competitive with broadleaf weeds in the western United States (Sheley and Petroff 1999). Research shows that musk thistle has declined over the years when perennial grasses are present.

▪ **Mechanical Control**

Mechanical control is effective on musk thistle. Tilling, hoeing, and hand pulling must be completed either in the rosette stage or early after the flower stalk grows (bolts), but before the plant flowers and produces seed. Hand pulling and hoeing are only an option for small stands. To be effective, a successful revegetation program must follow tilling. If this is not done, reinfestation of musk thistle is inevitable.

Mowing is an option, but it can allow some musk thistle plants to recover and possibly sow seeds. Mowing does reduce seed production, but should not be the single means of control in a management program. It is most effective at the flower bud stage. Mowing combined with an herbicide is more effective.

Mechanical control is very effective in ditches, yards, construction sites and pastures. However, it may be difficult or uneconomical to use this method on rangelands.

▪ **Biological Control**

Grazing just to control musk thistle is not recommended. However, using good grazing techniques will stimulate growth of native grasses and keep pastures healthy. Since cattle will not graze musk thistle and sheep will only eat it in its rosette stage, it is difficult to maintain healthy pasturelands once they have been infested with musk thistle.



Photos courtesy of Oregon Department of Agriculture.

Figure 4. *Rhinocyllus conicus* adult laying eggs (left). *Rhinocyllus conicus* larval-damaged seed (right).

There are four insects in the United States that attack musk thistle. *Rhinocyllus conicus* (Fig. 4) is a seed weevil that reduces seed production. *Trichosirocalus horridus*, a beetle, eats the crown of the thistle, kills the apical (top or terminal bud of a stem) meristem (actively dividing tissues at the growing tips of shoots and roots), and reduces flowering. The leaf feeding tortoise beetle, *Cassida rubiginosa*, feeds on the leaves, skeletonizing them. This complements the damage of *Rhinocyllus conicus* and *Trichosirocalus horridus*. *Cheilosia corydon*, a leaf and shoot miner, deposits its eggs in young leaves and shoots. The larvae feed on the inner part of the leaves and shoots. Hollowed out, they dry and break. However, *Rhinocyllus conicus* is not host specific. It has been released in Nevada near Verdi and is well established in the areas of Austin, Big Creek, and Grove's Lake. It will eat other thistles including native species, some of which may be endangered.

▪ **Chemical Control**

Numerous chemicals kill musk thistle. clopyralid, dicamba, MCPA, picloram, metsulfuron, chlorsulfuron, and 2,4-D have proven to be effective. Which chemical to use and at what application rate depend on the

location, environmental conditions, growth stage of the musk thistle, weather, associated species, soil-type, stand density, county or state regulations, and what is to be grown in the area in the future.

In the rosette stage, clopyralid, dicamba, MCPA, picloram, and 2,4-D provide good control. Application of these chemicals is usually suggested for the fall of the first year (rosette stage). After the musk thistle bolts, metsulfuron and chlorsulfuron are effective. These two products reduce the amount of seed produced after application. Clopyralid, dicamba, MCPA, picloram, and 2,4-D do not appear to reduce seed production after application if the plant has bolted. Apply metsulfuron and chlorsulfuron in the spring, during bolting. If the season is long and the musk thistles bolt the first year, apply metsulfuron and chlorsulfuron in the fall. This same treatment can be used on bull and scotch thistle as well. Always follow labeled directions; it's the law!

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Identification and Management of Perennial Pepperweed (Tall Whitetop)

Susan Donaldson, Water Quality Education Specialist

Perennial pepperweed (*Lepidium latifolium* L.), often called tall whitetop, is one of the most troublesome noxious weeds in Nevada. It grows in all 17 counties, and despite many efforts to control it, populations continue to expand.

A native of southeastern Europe and southwestern Asia, it may have come into the United States as a contaminant in sugar beet seed in about 1900.

What does it look like?

A member of the mustard family (*Brassicaceae*), perennial pepperweed commonly grows 2 to 4 feet tall, but may reach 8 feet in wet or shady areas. Growth from buds on the root crown and/or roots begins in spring, forming a rosette. Plants bolt in May and bloom most often in June or July. Mature plants have the following characteristics:

Roots: Roots are large, coarse and brittle. Shallow roots extend laterally close to the soil surface for long distances. These creeping underground roots grow 3 to 10 or more feet long, and send up shoots to form new plants. Deep roots allow plants access to moisture deep in the ground. Plants can grow from root parts as small as one-tenth of an inch in thickness. Creeping roots are the most important method of reproduction for this weed.

Stems: Stems are somewhat woody, waxy and smooth. Multiple stems can grow from the root crown. Branching occurs at the leaf axils.

Leaves: Leaves are alternate, lance-shaped to ovate, green to grayish green, smooth and waxy. The leaf margins can be smooth or toothed, and the edges

are sometimes curled. The leaves at the base of the plant are 4 to 11 inches long and have stalks. Leaves decrease in size toward the top of the plant, and stalks vanish, but leaves do not clasp the stem.

Flowers: Flowers are small, white and have four petals and six stamens. The flowers are arranged in 6 to 8 tight ball-like clusters at the ends of the stems in racemes. The flowers do **not** at any time form “down” that might blow in the wind, similar to thistles. Regrowth will bloom in fall if conditions are right.

Seeds: Seeds are produced in small hairy pods. The seeds are tiny and reddish-brown in color. Perennial pepperweed is a prolific seed-producer.



Perennial pepperweed is most recognizable when blooming.

Mature stands can produce more than 6 billion seeds per acre. Although most are shed in the fall, some seeds remain on the plant through winter.

Young seedlings of perennial pepperweed can be difficult to recognize, as they look like seedlings of other mustards. While many seeds are produced, it's unusual to find many seedling plants in the field. In most cases, new plants develop from buds on the creeping perennial roots. When moist conditions persist after spring floods or reservoir drawdowns, abundant seedlings have been observed.

Perennial pepperweed can be differentiated from the noxious weed hoary cress, often called "whitetop" (*Cardaria draba* L.), by its taller size and later bloom period. Also, the base of hoary cress leaves clasp (wrap around) the stem, and the stems only branch in the flowerheads.

Where does it grow?

Perennial pepperweed first infests moist or wet sites along streams, rivers, lakes and wetlands. It grows in riparian areas throughout the western United States and in several midwestern and eastern states.

Perennial pepperweed tolerates salty soil and adapts well to many sites under adverse conditions. It grows in native hay meadows, abandoned agricultural lands, pastures, hayfields, residential areas and along roadsides. Given sufficient moisture in the first year of growth, plants will continue to grow in very dry sites in subsequent years, especially where the groundwater table is close to the land surface.

How is it spread?

Both perennial pepperweed seeds and roots from eroded banks can travel long distances in rivers and irrigation ditches to infest new areas. Flood irrigation carries perennial pepperweed seeds into and throughout native hay meadows, pastures and other irrigated lands.

Perennial pepperweed seeds and perennial roots are also spread in contaminated fill dirt or so-called "top soil" during construction and landscaping. They can



Rosette



Stem leaf



Flowering stem



Infestations along rivers and lakes result in increased erosion and water quality impairment.

be picked up and distributed to uninfested areas on tires and all types of equipment used in haying, shipping of hay and farm products, construction, utility line maintenance, road maintenance, hunting, four-wheeling and other recreational activities. Contaminated straw used in erosion-control projects also moves this weed. Additionally, live seed is spread over long distances in dried flower arrangements. Livestock and several wildlife species may also disperse seed.

Why should we be concerned?

No benefit has yet been found for perennial pepperweed, and it has many bad aspects. This weed is a very competitive plant. It crowds out desirable vegetation, adversely impacts wildlife habitat, impairs scenic values and decreases biodiversity. In riparian areas, it interferes with the regeneration of willows and cottonwoods, reducing the cover and food available for birds, especially nesting waterfowl.

Perennial pepperweed lowers the quality of livestock feed from pastures and hay fields it infests. It reduces both protein content and digestibility, devaluing the hay nutritionally and economically. The accumulation of dead, woody stems inhibits grazing.

Left untreated, small infestations expand throughout pasture and hay land in just a few years. The weed interferes with production of weed-free forage and decreases the value and sellability of cropland.



Infestations take over pastures and hay land, reducing their value.

Perennial pepperweed is a nuisance on golf courses and in parks and increases weed control costs.

What can we do to control this weed?

Perennial pepperweed is difficult to control due to its competitive nature and extensive, rapidly spreading root system. Because it has invaded many sites throughout the West, its eradication (complete elimination) would be very expensive and is thus unlikely. Instead, the goal is to control its spread using integrated weed management (IWM) practices. IWM uses prevention techniques and appropriate cultural, mechanical, biological and chemical weed control methods in a planned approach to maximize the effectiveness of the overall control effort.

Before getting started with control projects, first consider the eventual use of the site. For example, roadsides will be managed differently than pastures, riparian areas, alfalfa fields or gardens. Once you've determined your management goals for the site, you can select the appropriate tools to achieve those goals. Simply killing the perennial pepperweed and leaving a site unvegetated invites future infestation by other weeds. Revegetation with competitive species is key to the long-term control of any weed.

Also consider the size of the infestation, and how many years perennial pepperweed has been growing at the site. For large infestations that established many years ago, the initial goal should focus on



Effective control of perennial pepperweed requires killing the below-ground root mass.

containing the existing population and preventing the spread of seed and roots to new areas. In infested waterways, find the uppermost location at which perennial pepperweed occurs and work downstream with control efforts.

Prevention: Since it is unlikely that we'll be able to eradicate perennial pepperweed, efforts often focus on excluding it from uninfested areas. Surveys and monitoring help find the first perennial pepperweed plants in previously weed-free areas so they can be controlled during the first growing season. Always control infestations when they are first noticed, before entire fields or yards are engulfed. Seedlings are easier to kill than mature, established plants.

When working at sites that are infested with perennial pepperweed, continually monitor earth-moving equipment for seed or rootstock contamination, which can be carried to weed-free areas. Likewise, never use fill dirt from infested areas that may contain seed or perennial roots.

Seed sources should be certified free of perennial pepperweed seed, and infested hay should not be sold or transported through uninfested areas. Contact the Nevada Department of Agriculture, <http://agri.state.nv.us>, for information on hay and seed certification programs.

Cultural control: Vigorous plant communities will best withstand invasion by perennial pepperweed. Maintain healthy stands of desirable plants with appropriate species selection and irrigation. Long-term flooding has also been used to control perennial pepperweed. Plants must be inundated by several inches of water throughout the growing season for one or more years to kill them.

Mechanical control: Mechanical controls, including digging, mowing or tilling, are generally ineffective. These methods encourage plants to sprout from their crowns and perennial roots, and are not recommended except as part of an integrated approach using multiple tools. Shading or smothering with thick mulches is also ineffective.

Hand pulling or digging has been used in situations where only a few plants are present or in riparian areas where herbicides cannot be used due to the proximity of water or other management concerns. It is most effective in moist, loose soils where a slow and steady pulling action will remove 6 to 8 inches or more of the root. New plants readily sprout from root fragments, so hand-pulled areas must be monitored frequently and new growth pulled as soon as it appears. Pull or dig repeatedly at frequent intervals during the growing season for a number of years. This is a labor-intensive method that is only appropriate in limited circumstances where herbicides are not an option.

Tilling cuts roots into fragments, each of which can grow into a new plant, increasing the density of infestation. Repeated tilling or disking is not effective in controlling perennial pepperweed. Also, small root fragments are more likely to move offsite than are large root systems.

Mowing plants or cutting stems can be used to remove plant material or delay the onset of flowering and seed production. These treatments do not kill the plants and may even result in root expansion. Research has shown that pretreatment mowing can be useful to enhance the effectiveness of subsequent herbicide applications on regrowth.

However, soil moisture must be sufficient for regrowth to occur through the flowering stage.

Burning is often used to remove the accumulated dead material prior to herbicide application, but does not kill the roots. The dead material is sometimes difficult to burn due to a lack of fine fuels.

Biological control: Livestock grazing can be used as a tool in an integrated management approach, but grazing alone does not provide long-term control of perennial pepperweed. Sheep and goats especially will graze perennial pepperweed at any point up to the flowering stage. Carefully managed intensive grazing by sheep or goats can help decrease stem densities and suppress the weed, allowing desirable vegetation to thrive. Grazing also helps remove mature vegetation from sites, allowing more effective follow-up treatment with herbicides after plants have regrown. A heavy concentration of grazing animals may also break up the litter layer and stimulate the germination of desirable species.

When using grazing as an IWM tactic for controlling perennial pepperweed, be careful to quarantine animals for at least five days before moving them to weed-free areas. Studies have shown enhanced germination of seeds that have passed through livestock digestive tracts.

Currently, no insects or diseases are available to kill or debilitate the plant. An *Albugo* rust has been identified on the leaves of perennial pepperweed plants, especially during wet years, but the effects of the rust do not appear to provide control. Extreme care is needed to avoid introduction of an insect or disease that could affect a valuable crop species. Likewise, care must be taken to ensure the biological control will not infest native perennial *Lepidium* species. Two species within the genus *Lepidium* are listed as federal endangered species. The influence of a potential biological control organism on these closely related species must be clearly established before its use will be allowed by regulatory agencies.



Goats will graze enthusiastically on perennial pepperweed, but grazing does not kill plants.

Chemical control: In most cases, herbicides are needed to provide effective control of perennial pepperweed. However, chemical control is made more difficult by the robust root system. Prior to herbicide application, the site often must be pretreated to reduce the large amounts of semi-woody growth produced by perennial pepperweed during previous years. This thick residue makes it difficult to spray new growth because the herbicide becomes trapped on the dead overgrowth before it can reach the green leaves of the target plants. Sites with this dense residual vegetation are also difficult to walk through and move equipment across. Remove thatch prior to herbicide application by burning, raking, mowing, grazing, brush beating or other methods.

Many of the recommended herbicides are most effective when applied at bud to early bloom stage of plant growth (see Table 1), preventing seed set. A second application to any regrowth in the fall enhances control. Follow all label directions with care, do not spray during windy weather and never apply chemicals to open water—ponds, ditches, streams or wetlands—unless the herbicide is labeled for aquatic use. When possible, focus herbicide applications on the large lower leaves, not the upper leaves or flowers. This increases the amount of herbicide that is absorbed and increases the likelihood of killing more of the roots. It may take

Table 1. Chemical Controls for Perennial Pepperweed

Active				
Chlorsulfuron	Telar®, others	Broadleaf-selective herbicide; do not apply directly to water or to areas where surface water is present; provides good control in dry sites; has residual effects that can interfere with reseeding for one or more years	0.75 – 1.5 oz a.i./A; add a nonionic surfactant per label instructions	Apply at bud to early flowering stages; can apply in the fall if green tissue is present
Imazapyr⁺	Habitat®, Arsenal®, others	Broad-spectrum herbicide that may also harm grasses. Habitat® is approved for use in and around standing and flowing water. Do not apply Arsenal® directly to water or areas where surface water is present.	2 – 6 oz a.e./A	Can apply at any time; best control when applied at bud to early flowering stages
Glyphosate⁺	Roundup®, Rodeo®, Aquamaster®; many others	Nonselective herbicide; generally provides fair to poor control of perennial pepperweed; formulations available for use in and around aquatic sites. Not persistent in soil.	3-4 lbs a.e./A; check product label	Mow plants prior to flowering and apply to plants after they regrow

*Various other products containing mixtures of several active ingredients are also available. The information given herein is supplied with the understanding that no discrimination is intended and no endorsement by Cooperative Extension is implied.

⁺Available in formulations that can be used in aquatic and riparian habitats.

[†]Always read and follow all label directions when using herbicides. Check rates before mixing. Abbreviations: a.e. = acid equivalents; a.i. = active ingredient; A = acre; MSO = methylated seed oil.

two or more weeks following application for plants to show signs of death. When using pesticides near wet areas, be careful to avoid contaminating waterways. In sensitive sites, rather than using a spray applicator and risking herbicide drift into the water, consider applying the chemicals with a wipe or wick applicator. This device contains a sealed reservoir of herbicide and a porous wicking applicator at one end. The chemical is wiped or painted onto individual plants. While wipe applicators minimize risk to adjacent vegetation or sensitive resources, it is difficult to get an even application on plants and the technique is very labor-intensive. This method is typically recommended for small sites and not for ordinary use.

Chlorsulfuron (Telar[®], others) and metsulfuron-methyl (Escort[®], others), two sulfonylurea compounds, are very effective in controlling perennial pepperweed. They are not registered for use in wet areas, but can be used in range, pasture, noncrop and roadside applications. Add a nonionic surfactant per label directions to aid in spreading and uptake by the waxy leaves. These two chemicals, which are broadleaf weed killers, do not kill most established grass and grass-like species. Check current product labels for possible grazing restrictions. Both herbicides are available in formulations that can be applied to pasturelands. Repeated use of these compounds may suppress germination of grass seeds, so they should be used with care. Both have a residual effect that may last more than one year in alkaline soils, and for several years or longer in broadleaf crops such as alfalfa.

Unfortunately, both chlorsulfuron and metsulfuron are more expensive than many other common herbicides, kill most broadleaf plants, and may injure or kill native shrubs and trees as well as crops if not applied with care. Both herbicides also have some pre-emergent activity that may adversely affect the survival of seedlings from broadleaf plants, making it difficult to revegetate a site. However, if perennial pepperweed can be controlled with only one or two applications of chlorsulfuron or metsulfuron-methyl,



In sensitive sites, use wipe applicators to avoid spray drift.

the overall cost may be lower than other alternatives that require repeated applications over several years.

Another effective herbicide is imazapyr (Arsenal[®], Habitat[®], others), a nonselective pesticide that kills all vegetation indiscriminately, providing bare ground control. Imazapyr is labeled for use on noncroplands, such as road and utility rights-of-way. It is most effective when applied to actively growing foliage. Imazapyr is available in formulations registered for aquatic or riparian use (Habitat[®], others).

Imazapic (Plateau[®], Panoramic[®]) is also effective in controlling perennial pepperweed as well as many other broadleaf and grass species. It can be used in pastures, rangelands and many noncropland sites, including rights of way, turf areas, nonagricultural fence rows and nonirrigation ditch banks. It is effective on plants during the post-flowering stage, allowing applications to be delayed when needed to meet site objectives. While no grazing restrictions exist, hay cannot be harvested for at least 7 days following application. When using on sites that will be revegetated, see product labels for a list of tolerant species.

The phenoxy herbicides (variants of 2,4-D) result in death of perennial pepperweed shoots, but some roots and crown buds may rapidly sprout and grow. Repeated applications may therefore be required for up to five years or more to starve out the root system. Formulations of 2,4-D amine salts are available that can be used in water bodies or on ditch

banks. Check label directions when selecting a product.

Glyphosate (Roundup®) is less effective than 2,4-D in controlling perennial pepperweed and is not generally recommended. Since glyphosate is a nonselective herbicide, all vegetation to which it is applied will be killed or injured.

Researchers at the University of California, Davis have studied the effectiveness of mowing followed by herbicide application. If plants are mowed at the bud to early bloom stage and allowed to regrow to the same stage before treatment with herbicides, control was improved, especially with glyphosate application.

Site-specific chemical control recommendations are given in Table 1. Research is continuing on the control of this weed, and new methods and products continually being studied.

Revegetation of infested sites

To successfully manage perennial pepperweed, immediately after control, any residual perennial pepperweed thatch must be removed and desirable competitive vegetation established. Species that are highly competitive and spread by creeping perennial roots, such as tall wheatgrass (*Thinopyrum ponticum*), creeping wildrye (*Leymus triticoides*) and saltgrass (*Distichlis spicata*) may be successful. By selecting grasses, broadleaf-selective herbicides can continue to be used to control regrowth of perennial pepperweed. Sod-forming perennial grasses that grow a thick mat of vegetation compete best with the weed.

Results of a study by Wilson et al. (2008) showed that successful control and revegetation of dense infestations of perennial pepperweed took at least three years of IWM efforts, including removal of thatch, application of herbicides and reseeding. Spot treatment with herbicides was necessary in

succeeding years. The same study found that burning, disking or mowing alone were not effective in controlling the weed. Successful revegetation with native grasses required use of mechanical controls in combination with herbicides.

Monitoring

Perennial pepperweed is very difficult to control, and sites must be monitored for up to five or more years and retreated when needed. Absence of plants one year after treatment should not be interpreted as success. New shoots from deep roots that survive an initial growing season after treatment may emerge during a subsequent growing season.

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Managing Poison and Western Water Hemlocks

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Poison hemlock (*Conium maculatum*) was first introduced to North America from Europe as an ornamental. This poisonous plant has since established in almost every state in the United States. Western water hemlock (*Cicuta douglasii*) is a wetland plant that is native to the intermountain region. It may be confused with poison hemlock, but causes a different type of poisoning and is considered one of the most poisonous plants in North America.

Identification

Poison hemlock, of the *Apiaceae* (parsley) family, is a biennial that usually grows 6 to 8 feet tall. Its extensively branched stems are smooth, erect, and solid, with distinct ridges. Distinctive purple spots are visible on the lower portions of the stems (Fig. 1). The fleshy white taproot is long and has a smell close to that of carrots or parsnips.

Shiny, green leaves are triangular shaped, arranged alternately on the stem, and divided 3 or 4 times (Fig. 2). Each leaf has several pairs of leaflets that grow from opposite sides of the stalk. The numerous leaflets are 1/8 to 1/4 inch long and segmented, with veins that run to the tips of the lobes. The lower leaves are on long



Figure 1. Poison hemlock stems have purple spots.

stalks and clasp the stem, while the upper leaves are on short stalks. The foliage has a strong, musty odor.

The white flowers bloom from June to August. They are stalkless with five petals, and develop in numerous umbrella-shaped clusters, each supported by a stalk. The inconspicuous bracts beneath the flowers are 1/4 inch long with a green center and whitish edges. The fruits are small, grayish-brown with prominent, wavy, longitudinal ribs. Two light brown, 1/8 inch long seeds are enclosed in each fruit. They are paired, ribbed, and concave.

Poison hemlock can be distinguished from



Figure 2. Poison hemlock leaves appear fern-like (top). Western water hemlock leaves have veins that terminate in the bottom of serrations (bottom).

wild carrot by its hairless leaves and stems. Poison hemlock is also commonly mistaken for cow parsnip, which differs in that it has palmately (fan-shaped) compound leaves rather than pinnately compound like poison hemlock.

Western water hemlock, also of the parsley family, is a highly poisonous perennial often confused with poison hemlock. Its stems are erect, 3 to 7 feet tall, and usually enlarged at the base. The alternate, pinnate leaves have a toothed margin (Fig. 2). A distinguishing characteristic is the leaf veins that terminate at the bottom of leaf serrations, and not at the tips.

Like poison hemlock, western water hemlock's flowers are white and grouped in umbrella-shaped clusters (Fig. 3). Likewise, each flower is two-seeded. The tea-colored seeds are somewhat kidney-shaped with corky ridges.

The most recognizable feature of western water hemlock is its thick, tuberous rootstalk that contains many small chambers (Fig. 4). These chambers hold a highly poisonous brown or straw-colored liquid that is released when the stem is broken or cut. Thick, fleshy tubers and slender individual roots grow from the bottom of the main rootstalk.



Figure 3. Western water hemlock has umbrella-shaped clusters of white flowers.

Western waterhemlock is often confused for the edible water parsnip. The easiest way to distinguish between these species is by western waterhemlock's distinct root system. In addition, the leaves of water parsnip end at the leaf tips, and its flowers have bracts.



Figure 4. The roots of western water hemlock are the most poisonous part of the plant.

Habitat

Poison hemlock is commonly found at lower elevations along roadsides, ditch and stream banks, creek beds, fence-lines, waste places, and in or on the edge of cultivated fields where there is sufficient soil moisture. It can also invade native plant communities in riparian woodlands and flood plains where natural aquatic systems dominate. It can survive in dry sites with poorly drained soils, but is most competitive under wetter soil conditions.

Western water hemlock is a wetland plant especially common on pastures or tilled areas. It can also be found along streams and irrigation canals. Its establishment on rangeland is limited due to its high water requirement. This plant occurs in wet, fertile soils at the edge of waters. It is most common in deep loam, clay loam, or clay soils.

Impact

Poison hemlock can invade perennial crops and grain fields, but it more commonly invades grazing areas such as pastures and meadows. It crowds out more desirable forage species, and its toxicity causes considerable livestock losses.

Mistaking poison hemlock for another member of the carrot family, such as parsley,

can have deadly consequences. This plant is toxic to humans, but livestock poisonings are much more common. All classes of livestock and wildlife are susceptible to poisoning, with cattle, goats, and horses being the most sensitive. Animals tend to avoid this plant when other forage is available, but they will consume it when not much other vegetation is present, or when greenchop, silage, or hay is contaminated with it.

All parts of poison hemlock are poisonous, but the lower sections of the stem and root are the most deadly. Symptoms of poisoning include: nervousness, trembling, knuckling at the fetlock joints, ataxia, dilation of the pupils, a weak and slow heartbeat, coma, and ultimately death from respiratory paralysis. Fetal deformation may occur if a pregnant animal eats poison hemlock. The plant's toxins may pass into an animal's milk and affect the offspring. It can also have an effect on the safety of milk that humans drink from dairy cattle.

Western water hemlock is deemed the most violently toxic plant in North America. Only a small amount of the toxic substance is needed to cause poisoning in livestock and humans. The toxic substance in the plant is cicutoxin, an



Figure 5. Poison hemlock grows 6 to 8 feet tall.

unsaturated alcohol that has a strong carrot-like odor. The roots are the most toxic part. The leaves and stems are poisonous in the early stages of growth, but lose much of their toxicity when mature. The green seed heads are also highly poisonous. Sheep that consume it do not seem to be as affected as cattle.

Signs of poisoning can occur 15 minutes to 6 hours after the plant is consumed. Symptoms include: muscle twitch, rapid pulse, rapid breathing, tremors, convulsions, excessive salivation or frothing at the mouth, and dilation of the pupils. Animals will eat western water hemlock in the spring and graze on the green seed heads later in the season.

Weed Management Options

Prevention: It is important to prevent small infestations of these hemlocks from becoming larger. Inspect the land for newly invading plants. Identify the plant and then remove it by hand pulling, hoeing, or applying a spot herbicide treatment. Wear gloves and protective clothing when handling these plants. To avoid spread of the seed, minimize soil disturbance by abstaining from driving machinery and vehicles through infested areas, and limiting livestock use in the area. Preventing small infestations of the plants from producing seed is vital. Control and avoidance of western water hemlock are the only ways to prevent livestock loss from poisoning.

Mechanical Control: Plowing or repeated cultivation will prevent poison hemlock from establishing. If cultivation is not possible, mow the plants after they have bolted. Unfortunately, a single mowing will not provide complete control. Repeated mowing will reduce its competitive ability, deplete carbohydrate energy reserves in the taproot, and prevent seed production. Mowing close to the ground will also reduce the amount of leaf material available for livestock grazing. Burning is not considered a useful method for poison hemlock control, as this plant grows in wet sites and remains green all season long.

Hand grubbing is a very effective method of removing western water hemlock. The roots must be entirely removed because they are attractive to grazing livestock and highly poisonous. This plant is easily removed when

the ground is moist. Gather all the plant pieces after removal and burn them.

Cultural Control: Western water hemlock grows where water is abundant, which is usually areas that receive heavy grazing pressure. Animals are attracted to it because it emerges early in the spring, its green, and it has an attractive smell. Western water hemlock is pulled out of the ground very easily in areas where the ground is moist and soft, thus animals are likely to eat the entire plant. This increases the chances of livestock poisoning. Grazing should be postponed until the ground is dry and the plant is harder to remove. Controlling the access of animals to habitats where western water hemlock grows may reduce the risk of poisoning.

Biological Control: It is unknown how the European Palearctic moth (*Agonopterix alstroemeriana*) was initially introduced into the United States, but it has rapidly moved throughout and colonized the western states, including Nevada, demonstrating success in poison hemlock control. The larvae live in conspicuous leaf rolls, and feed on foliage, buds, and flowers in the spring and early summer.

There are currently no commercial biological control methods available for western water hemlock.

Chemical Control: The herbicide tebuthiuron provides pre-emergence control of **poison hemlock** plants, as does chlorsulfuron and a combination of chlorsulfuron and metsulfuron. The pre-emergence photosynthetic inhibitors hexazinone, metribuzin, and terbacil also provide great control of poison hemlock.

Post-emergence application of phenoxy herbicides or glyphosate can be effective, with best results when applied in early spring. Treating poison hemlock with herbicides may entail repeated applications for a couple of years.

For **western water hemlock**, application of chemicals is most effective when done in late spring or early summer. Glyphosate, 2,4-D, and picloram will all provide excellent control of western water hemlock. Apply 2,4-D or MCPA to western waterhemlock at a rate of 2 lb ae/A in the early bolting stage of growth. Chemical

application is an effective means of control, but there is some evidence that the toxicity of the plant increases after spraying until the plant dies. Most animal losses take place in the spring or after the plants were sprayed with chemicals. Therefore, keep animals away from treated plants for 3 weeks after spraying. Repeat herbicide application until eradication is accomplished.

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Managing Russian Knapweed

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Russian knapweed (*Acroptilon repens*) is a nonnative, noxious and invasive weed that is extremely difficult and expensive to control once it becomes established. It is found in almost every county in Nevada. From a survey in 2000, it was estimated that Russian knapweed had infested 75,000 acres in Nevada.

Identification

Russian knapweed, a member of the Asteraceae (Aster) family, is native to Eurasia. It is a perennial herb with erect stems that grow 18 to 36 inches tall with many branches. The rosette leaves are narrow at the base and widen toward the tip (Fig.1). The lower leaves on the stems are two to four inches long, toothed, and deeply lobed. The smaller, upper leaves usually have smooth margins, and are attached to the stem without a stalk at their base. The stems and leaves are covered with fine, gray hairs.

Flowers are urn-shaped and occur singly on shoot tips from June to September. They are about ¼ to ½ inch in diameter, and pink to

purple in color (Fig. 2). Surrounding the base of the flower are green bracts that have light, thin hairs. Each bract has a papery tip. These characteristics of the bracts help distinguish Russian knapweed from the other knapweeds generally found in the Western United States.



Figure 2. Russian knapweed flowers are pinkish purple, and the bracts have papery tips.

The flat Russian knapweed seed is a smooth, ivory-colored achene. The seeds develop in late summer and are viable in the soil for at least two to three years. Russian knapweed does not produce as many seeds as most other invasive weeds, but it readily reproduces vegetatively.

Russian knapweed produces extensive vertical and horizontal roots. The roots penetrate the soil several meters deep. Its scaly, black to brown, underground stems (rhizomes) have buds that develop into new shoots and quickly colonize nearby areas. Small root pieces created by plowing, rototilling, or other soil disturbances can generate new shoots and spread this weed.



Figure 1. Leaves of newly emerging plants are toothed and covered with fine hair.

Habitat

Russian knapweed is widely established in the western United States. Highly adaptable, it occurs in most soil types. Abundant in both moist and arid climates, Russian knapweed only becomes established in moist soils in arid areas and not in upland sites where water tables are deep. It is a strong competitor and forms dense colonies, even monocultures, especially in disturbed areas, such as roadsides, riverbanks, pastures, and cropland.

In Nevada, Russian knapweed is a problem in crop and rangelands. In addition, it is often found around old buildings and growing on disturbed ground. This weed prefers moist but not wet sites, such as drainages, riparian zones that are not excessively wet including ephemeral stream and pond bottoms, irrigated fields, and runoff areas that periodically dry down. Once established, Russian knapweed is very tolerant of drought conditions and is a great competitor because its deep, extensive roots draw moisture from a greater volume of soil compared to shallow rooted species. Its deep rootedness allows it to survive dry surface soils for long periods.



Figure 3. This perennial weed has erect stems that can grow 18 to 36 inches tall.

Threat

Russian knapweed is a designated noxious weed in Nevada. When established, it forms dense, single-species stands because its roots exude substances that reduce or prevent the growth of nearby plants (allelopathy). This eliminates desirable plants, including natives, and greatly reduces crop production.

Russian knapweed seeds are small and difficult to separate from most small crop seeds. Consequently, it is frequently spread as a contaminant of crop seed and hay. Being a nutritionally poor feed and toxic to horses, its presence in hay decreases the hay's value and thus, its market price.

Dispersal of Russian knapweed today occurs from seed and roots. Seed is spread mostly through contaminated hay, farm machinery and all types of vehicles, including recreational vehicles. At one time, it was recommended for seeding to control erosion, which allowed it to become widespread. Seed production distributes Russian knapweed into new areas, but its vegetative reproduction allows it to thrive and continue to spread. Russian knapweed root growth continues year-long. Plants emerge earlier than other plants, giving this species a competitive advantage over spring-planted and low-growing crops and many native species that begin growing late in the spring.

Plants consumed by horses asq fresh or dry feed causes the irreversible, often fatal neurological "chewing disease." This disease, which only affects horses, occurs quickly and destroys the animal's ability to take in and chew food. There is no effective treatment available.

Weed Management Options

Prevention: Russian knapweed's extensive root system makes it very difficult to eradicate. Therefore, action to prevent establishment must occur when the weed first appears.

A healthy plant community is a great defense against a Russian knapweed invasion. Areas susceptible to the establishment of Russian knapweed should be monitored regularly in the spring, summer, and fall. All Russian knapweed plants that are found

should be immediately removed. Revisit the removal sites several times over the next few weeks and months to make sure there are no resprouts. If Russian knapweed plants produce seed, the site must be monitored for several years.

Growers should use certified weed-free crop seed to prevent the spread of Russian knapweed. Equipment should be thoroughly cleaned after working in or near infested areas. Driving vehicles or equipment through mature patches of Russian knapweed will aid its spread over long distances if seed heads become attached.

Be aware, seed from large infestations may produce small, nearby satellite colonies that will coalesce into an even larger infestation in just a few years. If resources are limited, control the satellite infestations and the perimeter of the large infestation first.

Mechanical Control: Hand pulling Russian knapweed is very difficult, but may be effective for small infestations during the establishment year only. Always wear gloves. For best results, pull the plants when the soil is wet and before seeds are formed. A majority of the root system must be removed to effectively eliminate the plant. Plants with seeds should be bagged and burned or buried in a landfill.

Cultivation of Russian knapweed produces broken root fragments that spread quickly and regrow into plants. Mowing or disking several times a year is expensive and only controls top growth. However, if done frequently, the new growth will be less vigorous. It is conceivable that the plants' ability to regenerate could be exhausted. In combination with an application of proper herbicides, control may be achieved. Mowing or disking at two to three week intervals during the growing season followed by an herbicide application in the fall may be effective. Mowing performed before seed set will reduce, but not completely eliminate, seed production. The plant usually produces new seed-bearing, prostrate stems below the height of the mower blade.

Burning the plants is not recommended and will not provide long-term control because the rootstocks will produce new plants.

Cultural Control: Cultural control of Russian knapweed by manipulating soil moisture and fertility, grazing, or sowing

competitive species is very difficult. The idea is to stress the weed sufficiently to cause it to use up the nutrients stored in its root system and then plant competitive, perennial grass species in its place. However, this allelopathic weed is often too competitive and forms monocultures by eliminating surrounding plants. Where control is successful, plant desirable species; do not leave bare ground or this or other weeds will become established.

Livestock (cattle, sheep, goats) will graze Russian knapweed, effectively removing all above-ground portions of the plants. This has only negligible effect on the vigor and viability of the root system unless the grazing is repeated whenever green leaves emerge. Desirable plants will become stressed if grazing is heavy or overgrazing occurs. This will give Russian knapweed an even greater competitive advantage, so caution must be taken to avoid overgrazing desirable plants while removing the Russian knapweed.

Biological Control: A gall-forming nematode (*Subanguina picridis*) was introduced to the United States in 1984 for Russian knapweed control, and has since been successfully established in Washington, Colorado, Montana, Oregon, Utah, and Wyoming. This nematode forms galls on the stems, leaves, and root crowns of Russian knapweed and weakens, but does not kill, the plant. It has not been found to readily spread long distances without assistance.

Continued research is being done to determine whether a gall-forming wasp (*Aulacida acroptilonica*) and a rust fungus (*Puccinia acroptili*) can be used effectively as biological control agents. There are currently no insects approved for management of Russian knapweed.

Chemical Control: The use of an herbicide alone without establishment of competitive vegetation will not effectively control Russian knapweed. To be most successful, chemical applications should be combined with mechanical or cultural controls and revegetation with competitive plants, including grasses and forbs. Avoid using herbicides that will injure desirable vegetation needed to provide competition. Remember to always carefully read the label before using herbicides.

In areas of Nevada that experience cold temperatures, the most effective treatment has been found to be the use of Tordon[®] (picloram) at a rate of 1 pint/A in the fall following the first heavy frost. This is followed by cultivation to bury alleopathic leaf material for decomposition and seeding with plants that tolerate picloram (such as grasses). Follow-up annual fall post-frost treatment with picloram is necessary to control any remaining or newly germinating Russian knapweed plants. Tordon[®] may also be applied to Russian knapweed at a rate of 1 lb ae/A in late spring before or during flower stem elongation. A selective treatment at this rate will not damage perennial grasses. Tordon[®] applied in fall immediately after a killing frost is very effective. Competition from crops or grasses following treatments is important to sustain any effective herbicide treatment. Tordon[®] is a restricted-use herbicide, which by law must be applied, or its application supervised by, a certified applicator. Do not contaminate water or use Tordon[®] in diversified crop areas.

Applying 2,4-D at the lawful allowable rate of 2 lb ae/A per year will not control Russian knapweed plants.

The non-crop herbicide Telar[®] (chlorsulfuron) may be used at a rate of 1.5 oz of product/A in the plant's pre-bloom to bloom and fall rosette stage. A nonionic surfactant should be added to the spray mixture. Do not use Telar[®] near sensitive crops or on soils with pH ranges above 7.5. This product has an extended soil residual in alkaline soil and will interfere with the establishment of broadleaf crops, forbs, and some grasses sown several months, and sometimes more than a year, after its application. Read and follow the label.

For control of Russian Knapweed in pasture and rangeland, Curtail[®] (clopyralid + 2,4-D) may be applied at a rate of 3 to 4 quarts of product/A when weeds are young and actively growing. Do not plant grasses for 30 days after application.

Imazapic[®] applied at 12 oz/A gives excellent control of mature Russian knapweed, especially when the area is planted with competitive vegetation.

Repeated and spot herbicide applications may be necessary to obtain adequate Russian knapweed control. Herbicides must be used in

combination with other control methods and revegetation to achieve the best results.

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Managing Saltcedar

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Saltcedars (*Tamarix chinensis*, *T. ramosissima*, and *T. parvifolia*) are invasive, shrubby trees that are rapidly colonizing riparian areas in Nevada. *Tamarix ramosissima* is the principle invader. They were introduced into the United States in the early 1800's as ornamentals and to prevent soil erosion along streams. These trees have escaped cultivation and are spreading rapidly throughout the desert southwest, Rocky Mountains and Great Basin. A fourth species, Athel (*T. aphylla*) is a very tall single-trunked, evergreen that is invasive in Southern Nevada. Less hardy than the others, it grows in Clark and southern Nye Counties.

In Nevada, saltcedar occupies Baltic rush meadows along the Walker River, saltgrass communities or former croplands at Stillwater and the Humboldt Sink, and arroyos in the upper pinyon/juniper zone of the Stillwater Range at Fence Maker Pass. The Colorado, Muddy and Virgin Rivers are heavily infested in southern Nevada. Native plant communities surrounding springs, seeps, streams and lakes are also threatened. Even isolated arroyos are being occupied by saltcedar throughout Nevada.

DESCRIPTION AND HABITAT

Saltcedar (*T. ramosissima*) is a deciduous shrub or small tree that grows 20 to 25 feet tall. Its gray-green leaves and wispy limbs give it a feathery appearance. The striking, small, pink to white flowers cover the upper branches in spring with occasional sparse flowering over the season (Fig. 1). It profusely produces tiny seeds each year that are spread by wind, water and animals.

Unlike native willows and cottonwoods that produce seeds for a short period in the spring, saltcedar



Figure 1. Wispy saltcedar limbs in bloom.

produces seeds over the entire summer as long as soil moisture is available. Spring-produced saltcedar seed has near 100 percent germination over a wide range of constant or alternating temperatures. Seed produced later has less viability. Each plant can produce 500,000 or more seeds. One hundred seeds per square inch have been produced within a saltcedar forest. Once wetted, embedded in soil or not, saltcedar seeds germinate in 24 hours. If the soil dries rapidly, the seedlings die. For establishment, the soil must dry slowly enough for the roots to grow into moisture deeper in the soil profile.

Saltcedar also reproduces vegetatively from the stems, crown and roots. New growth occurs readily when young plants are grazed or mowed, or the trunk or shoots are removed or killed by fire or severe drought.

Saltcedar uses more water than native cottonwoods, poplars and willows. It grows best in riparian sites such as stream banks, saline meadows, seasonally saturated washes, and lands that have seasonally high

water tables. It is classified as a phreatophyte, meaning it uses very large amounts of groundwater. Therefore, it lowers the water table that supplies springs and shallow wells. Dried up springs in Nevada have recovered after the surrounding saltcedar has been removed.

Saltcedar is able to use salty water. It does this by absorbing the salts through cell membranes. It avoids the toxic effects by using special glands to excrete the salts and by dropping salt-filled leaves. The leaves dropped each fall accumulate to a considerable depth under the canopy. Through this process, saltcedar acts as a salt pump concentrating salts from deep in the ground onto the soil surface. Over time, salts in the mulch layer kill existing plants and prevent others, especially desirable forage species, from becoming established. As a result, the ground under a saltcedar or within a saltcedar boscage is void of plants except, on occasion, another salt tolerant species.

SALTCEDAR ASSOCIATED PROBLEMS

Studies in New Mexico and Utah show saltcedar uses four to thirteen acre-feet of water a year; much more water than native trees and shrubs. It has an extensive, deep root system that absorbs water from the surrounding soil lowering the water table and killing most native plants. Competition for water resources in the west is growing yearly, especially where large saltcedar communities exist.

A normally functioning, healthy river (Fig. 2) has a



Figure 2. A variety of plants contribute to a healthy, functioning, beautiful river or stream.

narrow, deep, meandering flow. Saltcedar reduces a river's flow of water. It uses soil moisture that would usually contribute to the stream and traps sediment along the banks and in the river. This increases the size of the flood plain spreading water over a larger area, which increases evaporation and water use by plants (often extensive saltcedar woods). When infested with saltcedar, a healthy river becomes an impenetrable, unproductive saltcedar forest that may use one third more water from the river than a similar

stand of native trees (Fig. 3). A saltcedar-dominated stream functions poorly, is unattractive, changes native habitats, supports less wildlife, spoils recreational uses and affects water quality.

Cattle, sheep and goats will graze saltcedar but it is nutritionally poor forage for both livestock and wildlife. They prefer not to eat it and only do so when little else is available. Cattle eat only the young sprouts early in the year. Aggressive grazing by sheep may provide some control, but overgrazing stimulates suckering and speeds the area's conversion to a pure saltcedar stand.

Saltcedar provides cover for wildlife, but animal and plant diversity is reduced. The impenetrable stands make recreational access almost impossible on foot, horse or vehicle. Hunting and fishing are greatly restricted. Rounding up livestock hiding in a thicket is a chore.

CONTROL STRATEGIES

Effective management requires determination and a



Figure 3. Saltcedar stands along the Muddy River at Glendale, NV prevent fishing.

multi-year commitment. Efforts should be taken to prevent site disturbances by fire, overgrazing, and mechanical damage, that leave the site open for saltcedar invasion. Elimination of upstream infestations is required to effectively control saltcedar in a watershed. Eradication of the plant immediately after discovery is best before saltcedar becomes well established. After saltcedar is removed, it is requisite that a competitive stand of desirable plants be established to prevent reinvasion of the area by saltcedar.

BIOLOGICAL CONTROL

Biological control applies natural enemies to weeds. Insects, disease causing organisms, and livestock have all been used in successful biological control efforts on a variety of invasive weeds.

Two insects, a mealy bug (*Trabutina mannipara*) and leaf beetle (*Diorhabda elongata*), have been released in the United States to attack saltcedar. The

mealy bug is not adapted to colder, drier environments and was released outside Nevada. The leaf beetle was released at Schurz, Stillwater, and Lovelock, Nevada after it was established that it eats only saltcedar and not valuable natives, ornamentals or crops. Research continues on its adaptability, reproductive ecology and predation of saltcedar in Nevada.

MECHANICAL CONTROL

Plowing, cutting, mowing, chaining and burning have been attempted to control saltcedar. All have failed on large-scale projects because saltcedar resprouts profusely following mechanical treatments. Success has been achieved after a fire when the root crowns are removed before the next growing season and all new growth is removed as it occurs.

Flooding saltcedar for one or two years is effective. Small plants, if completely covered, easily succumb. The root crown and most of the shoots must be covered completely for months to successfully kill larger plants.

CHEMICAL CONTROL

Only two herbicides effectively control saltcedar, triclopyr (Garlon 4) and imazapyr (Arsenal). After applying either product, do not disturb the saltcedar for two years. This allows the herbicide time to move throughout the entire plant, especially the root system, and kill it. Applying 2,4-D, picloram, or glyphosate to saltcedar does not control it.

Saltcedar usually produces a multi-stemmed shrubby tree. In the Walker River Delta, there are 60,000 stems per acre, many of them less than one inch in diameter. This makes navigating the area and applying chemicals difficult, even hazardous. Exercise care in handling herbicides while moving among the stems to avoid spilling it on yourself, others, or contaminating the area.

Cut saltcedar stems off at ground level and immediately paint the cut surface with full strength Garlon 4, the ester formulation of triclopyr. (Specific instructions limit the use of triclopyr near water and in wetlands.) Apply the herbicide with a brush within ten minutes, sooner is better. Triclopyr can also be applied as a basal stem treatment mixed with metylated seed oil as a carrier (see the label for directions on mixing the two). Stems must be treated all the way around, which can be difficult in heavy stands. Stem treatments can be used on stems up to three inches in diameter. This requires less labor than painting the cut surface of stems. Both applications use large amounts of herbicide per acre, are labor intensive, and time consuming.

The only effective foliar-applied herbicide for saltcedar is imazapyr. Follow the label instructions regarding application rates, use of an oil carrier, and

the types of application equipment to use. Again, do not disturb saltcedar treated with imazapyr for two years or burn the treated stand after it has dried. For additional insights see Table 1.

When applying herbicides, always follow the directions on the label. Failure to do so violates the law. Following the instructions protects the applicator, other workers, non-target plants and animals, and our environment. It also reduces liability for any damages incurred.

SUSTAINABLE MANAGEMENT

Treated areas should be revegetated and properly managed. Successful saltcedar control and revegetation is difficult for these reasons:

- The accumulation of salt on the soil's surface hinders the establishment of desirable plants.
- The understory species in many saltcedar infestations is desert saltgrass, which is damaged or killed by imazapyr. The area has to be tilled to break up the saltgrass sod and turn the salts under before seed of other species can be broadcast or drilled.
- Removal of the limbs and roots of saltcedar is difficult and expensive. If the trees are large, chainsaws and a caterpillar are used to remove the biomass and deep rip the roots.
- Burning the treated area results in sprouting from the roots. Two growing seasons must elapse for the herbicide to kill the roots so that the saltcedar will not regrow when the shots are removed or burned.

Other aspects must be considered when controlling and removing saltcedar. The plant plays an important part in bank stabilization on Nevada's desert river systems. Loss of stabilization must be compensated for in any control program. Control of saltcedar in the Walker River Delta and the Virgin River Valley may result in additional erosion of highly salt-affected soils, increasing the salt content of nearby waters.

Along the Carson, Humboldt, Muddy, Truckee, Walker and Virgin Rivers or other riparian communities where saltcedar is established, selective control is necessary. Reestablishment of native woody vegetation may prove difficult requiring changes in management of the riparian woodlands to prevent pollution of nearby waters and re-establishment of saltcedar.

Table 1. Considerations for effective chemical treatments to control saltcedar.

Considerations	Treatment Methods		
	Cut-stump Surface	Basal Bark	Foliar Spray
Plant Stage	All stages, triclopyr in summer and fall.	All stages, but most effective applied to stems less than 3" in diameter treated when dormant compared to spring or summer applications.	Best results occur with an aerial application of imazapyr in the late summer to early fall (August – September). Stop when fall dormancy begins.
Treatment Process	Paint the cut stumps immediately with triclopyr; within 10 minutes, sooner is better. Use a water-soluble dye to track the treated plants.	Spray the lower uncut 15" of the plant with triclopyr in an oil carrier. Be sure to spray the entire bark surface of the stem.	Herbicide and wetting agent are applied via spray devices. Ground based sprayers (ATV's or trucks) and aircraft are effective.
Herbicide Application	Thoroughly treat each stump, especially the cambium layer just inside the bark. Stumps must be wetted completely for good control.	Low-volume application: mix 25 to 30 gallons Garlon 4* with oil to make a 100-gallon mixture. Apply to plants with stems less than 3" in diameter. Inconsistent results.	Apply Arsenal* (Imazapyr) with the proper surfactant until the saltcedar is wet, but not dripping. Do not disturb the crown and roots of large trees for 2 years to allow imazapyr to move throughout the tree to prevent re-sprouting from the roots.
Effectiveness	Most popular and effective in areas unsuitable for aerial or ground rig applications. Use near water to avoid drift and contamination of water.	Retreatment of the stems that were not killed is difficult compared with the cut stump treatment. Use where it is very rocky or labor is not available for treating cut stumps.	Effective on large stands with few non-target plants growing among the saltcedar. The shoots normally die within one year, the roots within two years.
Retreatment	Is necessary to clean up missed stumps.	May need to retreat the following year.	If necessary.

*Trade or common names have been used to simplify information; no endorsement by the University of Nevada Cooperative Extension is intended nor implied. Likewise criticism of products not listed is neither implied nor intended.

Be cautious when using chemicals. Be careful not to treat irrigation ditches, non-target plants, or surface waters. For more information contact your local University of Nevada Cooperative Extension office.

BENEFITS OF SALT CEDAR CONTROL

Controlling saltcedar and revegetating the land improves riparian habitats and increases biodiversity. Using the woody biomass of saltcedar for value added manufacturing in rural Nevada may be a viable option. Conversion of saltcedar woodlands to more water efficient plants allows water in a watershed to be utilized for more beneficial uses. Until alternative vegetation becomes established on the infested land, actual measurements cannot be taken to determine whether or not water is conserved and available. Control of saltcedar also improves grazing, wildlife habitat, and recreational uses along waterways.

ADDITIONAL RESOURCES

- 1) Ball, D., P.J.S. Hutchinson, T.L. Miller, D.W. Morishita, R. Parker, R.D. William and J.P. Yenish. 2001 Pacific Northwest Weed Management Handbook. Oregon State University. Corvallis, OR. pp. 184-203.
- 2) Bussan, A.J., S.A. Dewey, W.E. Dyer, M.A. Ferrell, S.D. Miller, J. Mickelson, B. Mullin, R. Sheley, R. Stougaard, M.A. Trainor, T.D. Whitson and D. Wichman. 2001-2002 Weed Management Book. Montana, Utah and Wyoming Cooperative Extension Services. pp. 222, 224, 273.

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Fact Sheet 98-75

WANTED— Dead, Not Alive!

This outlaw weed is hiding out! Find it. Eradicate it.

Scotch Thistle

Alias: *Onopordum acanthium*

Scotch thistle is a naturalized plant from Europe and eastern Asia that is aggressive, often forming dense stands impenetrable to people, wildlife, and livestock. In Nevada, it grows along roadsides, fencelines, ditchbanks, open dry areas, and in pastures. It is rarely found in gardens and areas cultivated yearly. This thistle is a biennial that grows leaves in a rosette the first year. The stalk, more leaves, flowers, and seeds appear the second year. Scotch thistle is listed as a noxious weed by Nevada Administrative Code.



Do not let this attractive perennial fool you! It impedes water flow, crowds out native vegetation, and destroys wildlife habitat!

Distinguishing features:

- ◆ Grows up to 8 feet tall.
- ◆ During the first year, a rosette forms which can have leaves 2 feet long and 1 foot wide.
- ◆ Second year leaves are large, hairy, coarsely lobed, and have a velvet-grey appearance. They are spiny-edged and form leaf wings around the stalk.
- ◆ Flowers are globe shaped, upright, spiny, and purple to violet in color. They are borne singly on branch tips, but there are many branches.

Take action:

- ◆ Report its location to the land owner, gardener, manager or park ranger.
- ◆ Avoid walking on, driving on, or camping in infested areas. Remove all weed seeds from your clothing, shoes, pets, camping gear, vehicle, and tire treads before moving out of an infested area.
- ◆ Mechanically remove the thistle. Herbicides may also be available that effectively control the thistles in the rosette stage.

Your reward:

A cleaner, healthier environment and the satisfaction that you have helped make the difference!

For more information about controlling this and other invasive weeds, contact:

Nevada Cooperative Extension
775-784-1334;

Nevada Division of Agriculture
Bureau of Plant Industry,
775-688-1180; or

Your local Weed District manager or
Conservation District:

Knapweed Fact Sheet

Spotted and Diffuse Knapweed

Asteraceae Family

Cindy Roche, Bugwood.org



Spotted knapweed
Centaurea maculosa

Richard Old, XID Services, Inc., Bugwood.org



Diffuse knapweed
C. diffusa



L.L. Berry, Bugwood.org

Distinguishing Features:

❶ Flowers:

- Spotted knapweed: Flowers are pink or purple colored. Bract tips have black triangular spots.
- Diffuse knapweed: Flowers are predominantly white, occasionally pink-purple. Bracts end in sharp, rigid spines with the terminal spine being distinctly longer. *Sometimes can have black spots, but will always have a terminal spine.*

❷ **Seeds:** Preventing seed production is imperative to control of all knapweeds! Typically, seeds can remain viable up to eight years. Seeds below depths of one and a half inches will not germinate until the soil is disturbed.

❸ **Leaves:** Leaves are blue-green, deeply lobed, and sparsely arranged along the stem.

❹ **Flowering Time:** June to October.

❺ **Life cycle/ other:** *Both can germinate in the spring and fall.*

- Spotted knapweed: Biennial or short lived perennial.
- Diffuse knapweed: Biennial or short lived perennial. Occasionally an annual.



Both pics by Richard Old, XID Services, Inc., Bugwood.org

Diffuse knapweed rosette (top) and mature flowering plant (bottom).

Impacts:

- Knapweeds are highly competitive plants that can exclude more desirable plants and form large, dense

infestations.

- Spotted knapweed threatens wildlife habitat and pastures because of its ability to quickly move from disturbed sites into relatively undisturbed, beneficial plant communities.
- During the winter, knapweed plants will break off at the base of the stem and form tumbleweeds. These tumbleweeds are blown around by the wind therefore spreading seed to un-infested areas.
- Knapweed invasions cause losses averaging up to 63 percent of available grazing forage.

Control:

- Diffuse and spotted knapweed can be managed similarly. They are readily controlled with herbicides. **However, the weeds will reinvade unless cultural techniques are used!**
- **For small sites** with limited distribution, pull or dig up plants and remove as much root as possible so the plant will not re-sprout. Roots tend to break off four to six inches beneath the ground.
- Carefully monitor sites throughout the growing season to remove missed plants. Expect the level of control work to be intensive for the first several years due to seed banks and the soil disturbance that occurs when pulling or digging.
- **Larger infestations** can be treated with an appropriate herbicide for the site. Monitor the site throughout the growing season to catch any missed plants.
- Weed scientists at both Montana State University and Colorado State University indicate that 1 pt/A of Tordon (0.25 lb) controls spotted knapweed for two to three years, but the weed will reinvade the area unless other management techniques are used.
- Irrigation (where possible) may help stimulate grass competition. Diffuse knapweed will not tolerate flooding and shade.
- Livestock (sheep, goats, cattle) will eat diffuse and spotted knapweed. Recent research completed by Colorado State University shows that cattle grazing diffuse knapweed twice in spring decreased seed set by 50 percent.
- Mowing alone is *not recommended* for control. Since the plant has the ability to flower below the mower height, mowing alone will not prevent seed production.



Marisa Williams, University of Arkansas, Fayetteville, Bugwood.org

Spotted knapweed flowering.



Steve Dewey, Utah State University, Bugwood.org

Spotted knapweed will infest dry and arid lands, like this Utah interstate right-of-way.

	Salt Lake County Weed Control Program www.weeds.slco.org 801-562-6466 weeds@slco.org
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Appendix C

Weed Management Check Lists

New Work Area Checklist

(Source: Cal-IPC 2012)

	Completed	Comments
Provide prevention and weed species identification training to staff and contractors		
Adopt official policy to prevent invasive plant spread		
Coordinate with local CWMA and conservation district		
Inventory work site for noxious and invasive plants		
Refer to plan maps and inventory sheets for locations of invasive plant infestations before carrying out field activities		
Plan treatment methods and designate responsible personnel		
Flag all weed infested areas that are to be avoided		
Order any necessary supplies and chemicals		
Protect likely invasive plant introduction sites such as parking lots, roads, and staging areas		
Clean and inspect all equipment, vehicles, tools, and gear for weed seed and other plant parts before entering work site		
Designate staging area outside of weed-infested areas		
Designate specific areas for cleaning equipment and tools for weed seeds and other plant parts		
Designate waste disposal areas for invasive plant materials		
Develop mowing policy to minimize introduction and spread of invasive plants		
Plan travel routes to avoid infested areas		
Use weed-free sources for materials from local sources		
Minimize soil disturbance and transport		
Implement erosion control practices		
Render invasive plant material nonviable when disposing of materials on-site.		
Monitor work site for infestations and treatment effectiveness		
Re-vegetate and/or mulch disturbed areas as soon as possible		
Schedule activities to minimize potential for introduction and spread of invasive plants		
Prevent invasive plant contamination of project materials when stockpiling and during transport		
Minimize contact with roadside sources of weed seed that could be transported to other areas		
Keep active work areas that are relatively weed-free closed to vehicles that are not involved in the work site		
Quickly treat small infestations before they become established, produce seed or are able to spread		

Large Equipment Inspection and Cleaning Checklist

(Source: Cal-IPC 2012)

Check for soil, seeds, and plant material	Inspected	Cleaned
Truck Bed		
Exhaust system		
Vent openings		
Grills: Front and back		
Tray under radiator		
Top of transmission		
Stabilizer bar		
Shock absorber joint with axles		
Front and rear axles		
To of front suspension units		
Wheel well/quarter panels		
Ledges under bumper (front & rear)		
Tire rims and treads		
Between rear wheel brake drums and the rim of the wheel		
At the bend in the fuel inlet tube		
Spare tire and mounting area		
Under the flood mat inside cab		
Under the seat inside cab		
Upholstery in cab		
Beneath foot pedals in cab		
Gear shift cover folks in cab		

Appendix D

Weed Inventory/Monitoring Form

Comstock Project
Invasive Plant Field Survey Form

General Information

Site Number/Name: _____ Collection Date: _____

Surveyor Name: _____

Location Information

Datum: _____ UTM: _____ Zone: _____ Year: _____

Decimal Degrees:

Latitude: N _____

Easting: _____

Longitude: W _____

Northing: _____

Plant Information

Genus _____ Species _____

Common Name _____

Infested Area Size _____ Unit of Measure _____

Estimated number of plants _____

Gross Area _____ Unit of Measure _____

Approximate distance to work area _____

Approximate distance to water body _____

Is infestation in already disturbed area? _____

Has this area been treated for invasive plants before? _____

Surveyor comments: _____

Appendix E

Weed Management Treatment Matrix

Common Name	Biological Name	Description	Current Distribution	Classification	Reproduction	# Seeds/Plant	Treatment Types			Additional Information	
							Mechanical	Cultural	Biological		Chemical
*Spotted and Diffuse Knapweed	<i>Centaurea maculosa</i>	Growing up to 3-4 feet in height, the basal leaves are deeply lobed and arranged in a rosette. The slender, hairy stems grow in an erect and branched arrangement. Single thistle-like, pinkish-purple flower heads reach 3/4 inches in diameter and occur at the tips of terminal or axillary stems from late June through August.	Found in dry prairie sites, oak and pine barrens, and on lake dunes and sandy ridges. It seems to be especially problematic in the central sands, northern Wisconsin, and near the Great Lakes.	Perennial	Seed	1,000	Small populations can be removed by digging or pulling. This is best done when the soil is moist. The entire root should be removed. Mowing has not been successful--plants merely reflower at a lower height.	Eliminate small satellite populations immediately. Use herbicide followed by seeding with a mixture of competitive grasses.	A few agents exist including the weevil <i>Larinus minutus</i> , the fruit fly <i>Urophora affinis</i> , and the seedhead gall fly <i>Urophora quadrifasciata</i> . Also, the larvae of the knapweed peacock weevil and the broad-nosed seedhead weevil may consume up to 95% of seeds being produced by the knapweed.	There are many effective herbicides including 2, 4-D Amine and glyphosate (Roundup®). Use with caution near water. 2,4-D LV Ester or Amine applied during early growth to "broccoli head" stage gives fair control. Apply chlorsulfuron (Telar®) or metsulfuron (Accurate®). Once competitive grasses have been established and if repeated treatment is necessary, apply either 2,4 D Amine, chlorsulfuron, metsulfuron.	
*Musk Thistle	<i>Carduus nutans</i>	Up to seven feet tall with freely branched stems and purplish nodding flowers. Leaves are dark green with large midrib veins and spines. Similar to Scotch thistle, but musk thistle has dropping flower heads. Look for a single large flower head at the end of a stem.	Found in rangelands, pastures, non-crop lands and irrigated areas throughout the U.S. and Canada.	Biennial	Seed	20,000	Control rosettes in the first season. Dig out at least 2 inches of root. Cut or chopped plants may still flower or set seed. Mowing does not kill the plant, but does help limit seed production.	Encourage perennial vegetation, and control while in rosette stage.	Several agents exist including thistle crown fly, thistle head weevil, thistle crown weevil, and rust, but they have not been effective in Nevada.	Apply 2,4-D Amine at 1.5 to 2.0 lb/A during rosette stage of growth. 2,4-D Amine can be used in the fall if the soil moisture is sufficient and air temperatures exceed 50 degree F. Apply chlorsulfuron 0.75 oz ai/A (Telar®) in the spring from rosette to pre-bloom stage of growth. Follow label directions and precautions. Clopyralid at 0.09 to 0.375 lb ai/A (check label for rate based on acreage)(Stinger®, Transline®, Curtail® (includes 2,4-D), is also effective; glyphosate may provide control. If repeated treatment is necessary, use any herbicide recommended here, except glyphosate, as it will kill desirable grasses.	It is easiest to control this weed when in rosette stage.
*Perennial Pepperweed, tall whitetop	<i>Lepidium latifolium</i>	Two to six feet tall with lanceolate, bright green to grayish leaves with entire to toothed margins. Basal leaves are larger than the upper leaves, which occur on flower stalks. Individual white flowers are small and clustered at the ends of the branched flower stalks.	Has naturalized to many areas of the U.S. Commonly inhibits water ways, ditch banks and wet meadows. Adapted to saline soils.	Perennial	Rhizomes and seeds	10,000/stem	Mowing prevents seed production and depletes food production in plant, but does not kill it. Avoid Cultivation! Tilling encourages resprouting from rhizomes.	Eliminate small satellite populations immediately. Use herbicide followed by seeding with a competitive crop or rhizomatous grass.	No insect or diseases have been found so far, but many agents are being examined. There are concerns on biocontrol on mustard due to potential for crop damage grazing may be useful to decrease stem densities and biomass, especially prior to herbicide application. Grazing will not kill the plant.	Many being tried. 2,4-D amine formulations such as Weedar 64® on wet sites, and ester formulations on dry sites at 4lb/A (repeat applications essential). Metsulfuron at 0.6 to 1.2 oz ai/A (Escort®) is used for control in pasture, rangeland, and non-crop areas, since it does not injure grasses. Chlorsulfuron at 0.75 to 1.125 oz ai/A(Telar®) is used on non-crop sites only, but is not as safe on grasses. Imazapyr (Arsenal®, Renovate®) (water labeled) gives bare-ground control. Read label for grazing restrictions. Once competitive grasses have been established and if repeated treatment is necessary, apply metsulfuron.	
Bull thistle	<i>Cirsium vulgare</i>	Grows 2 to 5 feet tall with numerous spreading branches. Stems of the plant are sparsely hairy, irregularly and spiny winged, green or brownish in color with purple veins. Flower heads are usually solitary on the end of each stem, gumdrop-shaped, one to two inches tall with long, stiff, yellow tipped spines. Flowers are generally bright purple but sometimes white in color.	The plant thrives in moist soils and is less common on sand and pure clay soils. Typical habitats include disturbed or degraded land, such as roadsides, fence rows, overgrazed pastures and rangelands, eroded gullies, ditch banks and vacant lots.	Biennial	Seed	5,000 - 50,000	Severing the root below the soil surface will kill bull thistles. Repeated hand pulling, hoeing, tillage, and mowing can be utilized. This should be done before the reproductive growth stage to prevent seed production and distribution.	Plant competitive grasses, especially tall grasses as bull thistle seedlings cannot tolerate shade.	The seedhead fly, <i>Urophora stylata</i> , has reportedly provided good control in Oregon by reducing seed production by up to 65%.	Dicamba, triclopyr, aminopyralid or 2,4-D work best when applied in the spring before stem elongation and again in the fall to control rosettes. Metsulfuron can be applied anytime plants are actively growing and clopyralid can be applied up to the bud stage. Once competitive grasses are established, if treatment is still necessary apply metsulfuron.	
*Hoary Cress	<i>Cardaria draba</i>	Grows 1 to 2 feet tall. Leaves are 1 to 1-1/2 inches long, blue-green, waxy, and lanceolate. Lower leaves are stalked, while upper leaves are stalkless and have two lobes that clasp the stem. Flowers are produced in clusters with four white petals that give the plant a white flat top.	Grows on abandoned fields, roadways, ditchbanks, and disturbed sites with alkaline soils. Prefers 12 to 16 inches annual precipitation.	Spring-flowering perennial.	Rhizomes and seeds	4,800	Prevent seed production. Cultivate every 21 days beginning in the spring until no additional shoots or seedlings appear. Try repeat disking.	Plant competitive vegetation.	At this time, there are no known successful biological control agents in the United States for hoary cress.	There are many effective herbicides including 2, 4-D amine and glyphosate (Roundup®). Use with caution near water. 2,4-D LV ester or amine applied during early growth to "broccoli head" stage gives fair control. Apply chlorsulfuron (Telar®) or metsulfuron (Escort®) prebloom to bloom stage, or onto rosettes in the fall. Use of surfactant will increase the effectiveness. Good results have been achieved with application of glyphosate followed by grass seeding into the treated area. Once competitive grasses are established, use metsulfuron if repeated treatment is necessary.	There are three types of <i>Cardaria</i> (heart, globe, and lens poded). The seed life in the soil is 3 to 6 years. This plant is often confused with perennial pepperweed (<i>Lepidium latifolium</i>).

Source: Weed Warriors, Sue Donaldson, University of Nevada Cooperative Extension

*Priority Species
ai = active ingredient
lb = Pounds
oz = ounces
A = Acres

Common Name	Biological Name	Description	Current Distribution	Classification	Reproduction	# Seeds/Plant	Treatment Types				Additional Information
							Mechanical	Cultural	Biological	Chemical	
*Canada Thistle	<i>Cirsium arvense</i>	Deeply lobed leaves are spiny, with small bristly clusters of purple to whitish flowers produced mid-June through September.	Deep, loose, cool soils. Found throughout U.S. except Alaska. Also through S. Canada.	Creeping perennial emerging mid to late spring.	Vegetative buds on the root system, creeping roots, and seeds.	680 to 1500 /stem; surviving 21 years in the soil.	Continually stress the plant by mowing several times/ year over many growing seasons. Mow every 3 to 4 weeks from June through September. Disking and plowing spread this weed.	Rotate crops, for example, to annual cereals planted early, with tillage in the fall.	Stem weevil, Canada thistle bud weevil, stem gall fly.	Clopyralid (Stinger®; Transline®; Curtail® (includes 2,4-D) works well at any time of the year. Aminopyralid (Milestone®), picloram (Tordon®, restricted use), imazapic (Plateau); clopyralid +triclopyr (Redeem®); clopyralid + 2,4-D (Curtail®), imazapyr (Arsenal®) and glyphosate (Roundup®)may also be used. Once competitive grasses are established, apply aminopyralid if repeated treatment is necessary.	
Russian Olive**	<i>Elaeagnus angustifolia</i>	Russian olive is a fast-growing tree of moderate size that can reach heights from 10 to 25 feet. The trunks and branches of the tree are armed with 1 to 2 inch woody thorns. Leaves are simple, alternate, lanceolate to oblong, entire, and 1 1/2 to 3 inches in length. The upper surfaces of the leaves are light green and covered with silvery star-shaped hairs.	Central and western United States	Woody shrub to small tree. Perennial.	Primarily by seed production, but may establish from underground rootstalks as well.	Seed/fruit production is proportional to the size of the tree, ranging from several hundred to several thousand per tree.	Saplings can be controlled through repeated cutting, and large trees can be cut but will resprout from the stump. Herbicide must be applied to the cut stump to be effective.	Establish native vegetation such as willows and cottonwoods to displace Russian olive.	Research is still being performed to determine the effectiveness of several biological control agents in controlling Russian olive.	Immediate herbicide application to cut stumps is the most common method. Triclopyr (Garlon®, Renovate®) is used for cut stumps at basal growth. Use glyphosate (Roundup®) undiluted as a cut stump treatment, as it is not take up by the leaves. Apply imazapyr (Arsenal®) late in the season at a 1 to 2 % solution. A 1:1 mixture of imazapyr and glyphosate can be used for similar effectiveness at a lower cost.	
Russian Knapweed	<i>Acrotilon repens</i>	Grows 18 to 36" tall. Has deeply lobed leaves that are 2 to 4" long with gray pubescence. Flowers are pink, lavender, or white, and are produced from June to September. Upper part of the taproot is a blackish color. Rosettes have toothed leaves that are covered in fine hair.	Found in most western states in disturbed sites, cultivated fields, pastures, along roadways, and dry rangelands.	Perennial, emerges in early spring.	Seed and rhizomes	50 to 500 per shoot	Use a combination of mowing and herbicide treatments. Wear gloves to hand pull.	Seed with competitive perennial grasses after treatments. Use proper irrigation and fertilization.	Russian knapweed gall nematode.	Apply picloram (Tordon®, restricted use) after first killing frost. Till the following spring and then treat again. Control can be achieved in 2 to 4 years. Clopyralid (Stinger®; Transline®; Curtail®) workd well during flowering. Can use 2,4D but it is not very effective.	Toxic to horses, with irreversible damage resulting in the inability of the horse to pick up and chew food. Is okay for cattle and sheep.
Russian thistle**	<i>Tribulus terrestris</i>	Prostrate plant with a simple taproot, and pinnately compound leaves. Small yellow flowers produce spiked seeds or bus.	Throughout the U.S. except the northern tier from Montana to Maine.	Warm season annual	Seed	up to 250,000	Use cultivation when small. If plants have produced seed, harvest seed into bags or hole-free containers and burn or send to local land fill. Establish a management plan for the following year.	Mulch area 4 inches deep	Poncturvine seed and stem weevile. Only successful in areas with mild winters.	Herbicides are used before seed production and subsequently for 2 to 3 years to eliminate the seed source. Apply 2, 4-D amine or LV ester every three weeks during germination or when new seedlings appear, and repeat if necessary. Glyphosate and preemergents may be helpful.	Probably came over from the Mediterranean on contaminated wool, spreading to the midwest. First reported in California in 1903. Seeds will remain dormant in the soil for 4-5 years, making eradication difficult.
*Tamarisk, salt cedar	<i>Tamarix ramosissima</i>	Five to 20-foot-tall tree or shrub with reddish-brown bark, turning fissured gray with age. Pale, bluish-green leaves are small and scale-like, with smooth entire margins. Flowers are small, pink to white, five leaved, delicate and showy. Has a deep primary root. Deep adventitious roots are produced at nodes from buried stems.	Naturalized throughout the southwestern desert.	Woody shrub to small tree. Flowers from early spring to late summer.	Seed. Roots spread if disturbed or fragmented.	500,000/plant per year	Burning followed by herbicide; bulldozing; pulling of roots. Will resprout after cutting or burning. Grazing by sheep or goats can be used to remove understory prior to herbicide application.	Extended flooding and hand removal of small seedlings.	A leaf-eating beetle, <i>Diorrhhabda elongata</i> , was released in NV in 2001, and sufficiently defoliated trees in the Lovelock area. There are concerns with the use of biological agents due to potential impacts on the habitat of the endangered southwestern willow fly catcher.	Immediate herbicide application to cut stumps is the most common method. Triclopyr (Garlon®, Renovate®) is used for cut stumps at basal growth. Use glyphosate (Roundup®) undiluted as a cut stump treatment, as it is not take up by the leaves. Apply imazapyr (Arsenal®) late in the season at a 1 to 2 % solution. A 1:1 mixture of imazapyr and glyphosate can be used for similar effectiveness at a lower cost.	Originally introduced to the U.S. as a streambank stabilizer. Well adapted to heat, cold, alkaline and salty soils, wind and flooding. Can grow several feet per season. It is no longer legally sold in NV. Can use 200-300 gallons of water per mature plant per day.
Poison Hemlock	<i>Conium maculatum</i>	Tap-rooted plant with stout hollow stems marked by distinctive purplish splotches. The dark leaves are fern-like in appearance. Has tiny white flowers that form an umbel. This plant is very toxic, handle with care and always wear gloves.	Grows along streams and ditches throughout the U.S.	Biennial	Seed	8,000/plant per year	Mow prior to seed production. Handle with gloves. Can hand pull with caution and good leather gloves. Bag and dispose of plant parts.	Plant desirable plant communities to prevent establishment.	Hemlock moth which is a defoliating moth that provides inconsistent, but sometimes good control.	Use a broadleaf weed killer such as 2,4D that is approved for use around water. Can try triclopyr.	Often mistaken for parsley. All parts of the plant are highly poisonous, including the large white taproot.

Source: Weed Warriors, Sue Donaldson, University of Nevada Cooperative Extension

*Priority Species

ai = active ingredient

lb = Pounds

oz = ounces

A = Acres

Common Name	Biological Name	Description	Current Distribution	Classification	Reproduction	# Seeds/Plant	Treatment Types				Additional Information
							Mechanical	Cultural	Biological	Chemical	
Medusahead	<i>Taeniatherum caput-medusae</i>	Grass that is 6 to 24" tall. Leaf blades are up to 1/8" wide, more or less rolled, and slightly hairy. Stems are slightly hairy and jointed. Flowers are long-awned spikes and are produced in May or June, and can last through the winter. Awns are twisted.	Found on millions of acres of semi-arid rangeland in the Pacific Northwest. Is found in Nevada rangelands.	Winter annual	Seed		Disk, plow or mow before seed sets. Hot, slow fires will reduce the weed up to 90% in the following year.	In early spring graze intensively with sheep. Fertilize with nitrogen to increase competition from other grasses and forbs.	Crown root fungus has been found to be somewhat effective.	Use glyphosate (Roundup®) on early growth, especially for small infestations. For large areas use sulfometuron (Oust) at 1/3 ounce per acre. This will also kill other grasses so use only in non-crop lands or firebreaks.	Often mistaken with squirreltail or foxtail barley. Extreme fire hazard and highly competitive.
Scotch Thistle	<i>Onopordum acanthium</i>	Grows up to eight feet tall. Rosette are very large and can be 2 feet across. Leaves are large, hairy, and have a velvet-grey look with spiny edges. Flowers are globe shaped, and purple to violet in color	Found in rangelands and other dry lands in the Western U.S.	Biennial or winter annual	Seeds; seeds can remain viable for 30+ years.		Control rosette in first season. Dig out at least 2" of root. Mowing will help limit seed production but will not kill plant.	Plant competitive grasses to inhibit establishment.	None known at present. Research is ongoing.	Clopy; picloram (Tordon®) in fall before plant bolts; apply 2,4-D in spring or fall; dicamba (Banvel®) before lengthening of flower stalk on established plants or in fall to control rosette; Curtail®.	Extremely aggressive plant which forms impenetrable patches.

Source: Weed Warriors, Sue Donaldson, University of Nevada Cooperative Extension
 *Priority Species
 ai = active ingredient
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Appendix F

Sample Seed Mixes

Example Seed Mixes

Selecting the appropriate seed mix for a particular area is highly dependent upon the hydrologic regime of that site. The local precipitation and depth to water table are both integral parts of determining what species will successfully colonize and establish a productive community. Due to this fact, the recommended seed mixes provide here are primarily based upon the topographic location of the site relative to the Carson River. The Natural Resource Conservation Service (NRCS) has developed a database, designating different ecological sites across the state. These ecological sites correspond directly to the vegetation communities described previously in this document, and will be used to indicate the appropriate seed mix for any given site.

Table 1 Seed Mix for Riparian Shrub, Old Riparian, and Mature Fremont Cottonwood Communities

Species	lbs/acre	Seeds/lb	Seed/Ft. Sq.	% Seeds
Wheatgrass Streambank	3.00	156,000.00	10.74	8.06
Wheatgrass Slender Revenue	3.00	97,000.00	6.68	5.01
Wheatgrass Siberian	3.00	170,000.00	11.71	8.78
Bluegrass Kentucky	1.00	2,177,000.00	49.98	37.48
Rush Baltic	0.15	10,930,100.00	37.64	28.23
Cereal Rye Fall	10.00	18,000.00	4.13	3.10
Wildrye Basin	3.00	130,000.00	8.95	6.71
Wildrye Creeping	3.00	51,000.00	3.51	2.63
	26.15		133.35	100%

Table 2 Seed Mix for Wetland Community

Species	lbs/acre	Seeds/lb	Seed/Ft. Sq.	% Seeds
Inland Saltgrass	1.00	520,000.00	11.94	15.00
Wildrye Basin	4.00	130,000.00	11.94	15.00
Wheatgrass Western	4.00	110,000.00	10.10	12.69
Wildrye Creeping	4.00	51,000.00	4.68	5.89
Alkali Sacaton	0.50	1,758,000.00	20.18	25.36
Sedge Nebraskensis	0.50	444,000.00	5.10	6.41
Fescue Tall Fawn	3.00	227,000.00	15.63	19.65
	17.00		79.57	100%

Table 3 **Seed Mix for Big Sagebrush Shrubland Community**

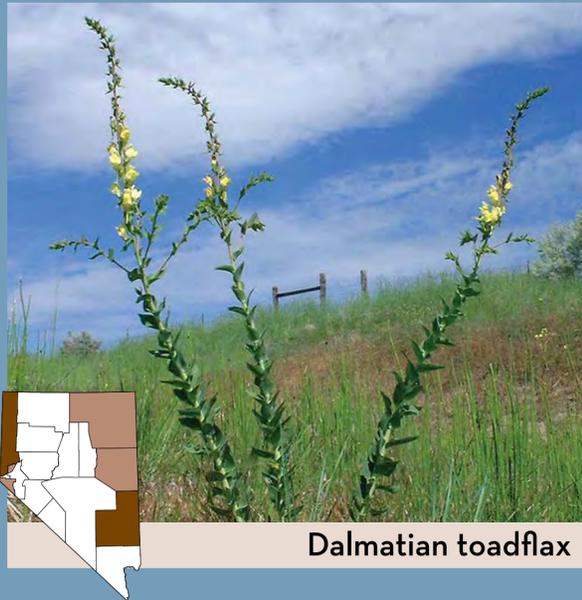
Big Sagebrush Shrubland (BSS) Seed Mix				
Species	lbs/acre	Seeds/lb	Seed/Ft. Sq.	% Seeds
Indian Ricegrass Rimrock	4.00	141,000.00	12.95	15.05
Squirrel Tail	3.00	220,000.00	15.15	17.61
Inland Saltgrass	1.00	520,000.00	11.94	13.88
Wildrye Basin	4.00	130,000.00	11.94	13.88
Alkali Sacaton	0.50	1,758,000.00	20.18	23.46
Saltbrush Quailbrush	1.00	50,000.00	11.48	13.34
Saltbrush Fourwing	2.00	52,000.00	2.39	2.78
	15.50		86.02	100%

Appendix G

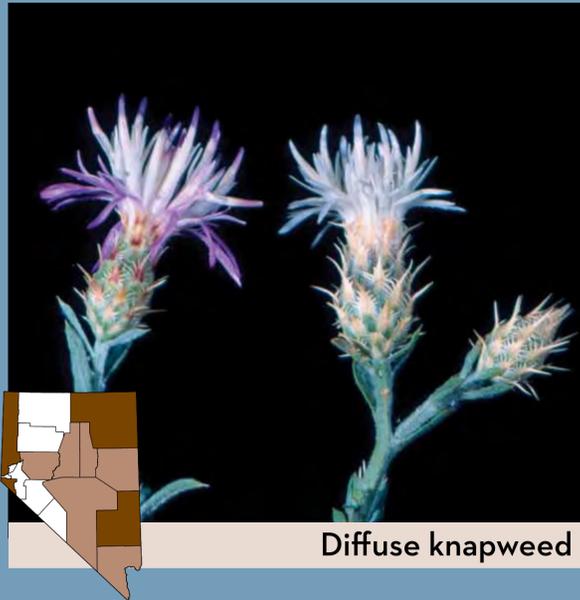
Weeds to Watch For (Poster)

WEEDS TO WATCH

New Weed Threats for Carson City and Storey Counties



Dalmatian toadflax



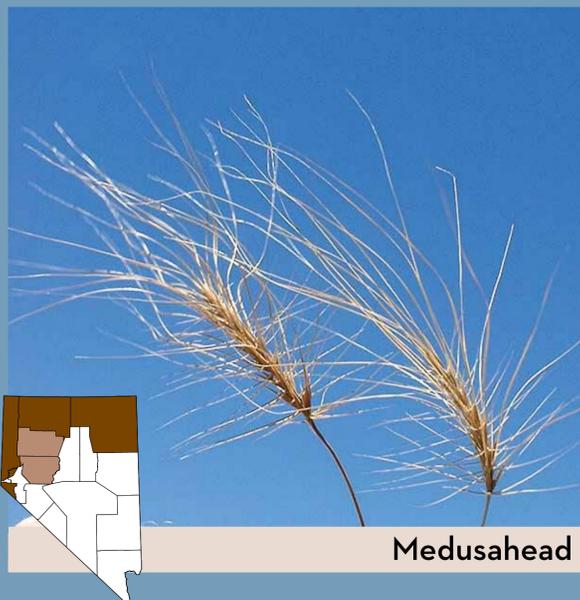
Diffuse knapweed



Leafy spurge



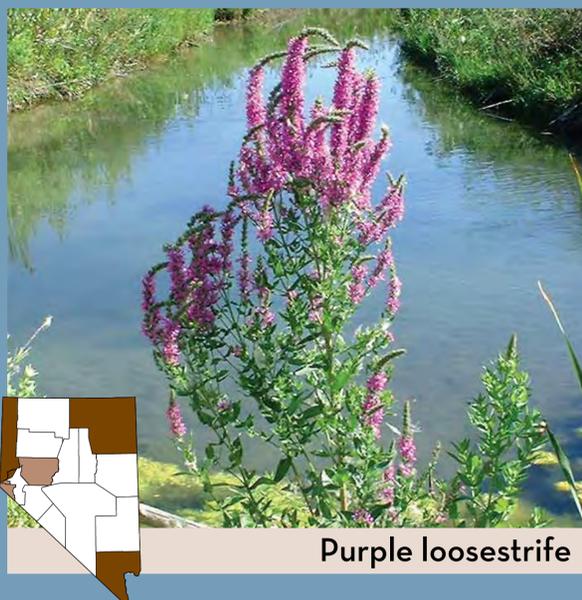
Meadow knapweed



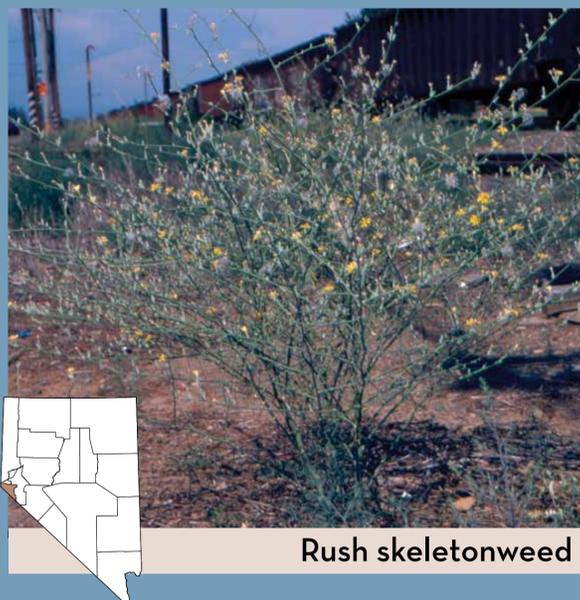
Medusahead



Musk thistle



Purple loosestrife



Rush skeletonweed

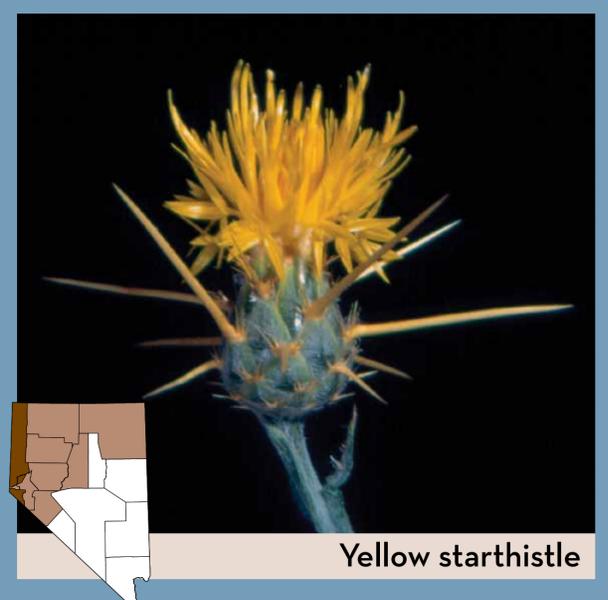


Scotch thistle

Despite all the weeds currently infesting Carson City and Storey Counties, there are literally hundreds of new weeds lurking on its borders. The weeds on this poster are of particular concern because they are known to spread rapidly, cause damage to desirable habitats and be difficult to control. The best approach for these weeds is early detection and rapid response. This involves diligent monitoring for new invasions and prompt action to eliminate them. The maps are shaded to provide current abundance information for each species: **NOT KNOWN** **RARE** **COMMON**



University of Nevada
Cooperative Extension



Yellow starthistle

Dalmatian toadflax (*Linaria dalmatica*): Perennial. **I.D.:** Up to 4 feet tall; stem and leaves smooth and waxy; leaves alternate, dense, lance- to heart-shaped, have smooth margins and are blue-green; leaves clasp the stem; flowers yellow, sometimes with an orange-bearded throat and a long spur; look like snapdragons. **Other:** Often infests rangelands, waste areas and roadsides; may be toxic to livestock if ingested in large quantities.

Diffuse knapweed (*Centaurea diffusa*): Biennial (sometimes annual or perennial). **I.D.:** Up to 2 feet tall; stem rough and covered with short, stiff hairs; leaves alternate, lower leaves pinnately divided, sometimes covered with short grayish hairs; upper leaves linear with smooth margins; flowers white or pale purple; flower base covered with yellow, comb-like bracts tipped with a narrow spine. **Other:** Often infests rangelands, waste areas and roadsides; dry, mature plants often break off and tumble in the wind to spread seed.

Leafy spurge (*Euphorbia esula*): Perennial. **I.D.:** Up to 3 feet tall; base of plant often woody; entire plant contains milky, white sap; leaves alternate, linear, with no petiole and smooth margins; flowers small, showy, green to yellow and clustered at tips of stems; bracts below flowers are heart- to kidney-shaped and have the appearance of flower petals; produces a spherical capsule with three chambers. **Other:** Often found in pastures, waste areas, rangelands, field borders and along waterways; sap can irritate skin, eyes and the digestive tracts of humans and animals (sheep and goats are immune).

Meadow knapweed (*Centaurea debeauxii*): Perennial. **I.D.:** Up to 3.5 feet tall; lower leaves larger than upper leaves; flowers pink to purplish-red; bracts are fringed and light brown to dark brown. **Other:** Often found on roadsides, in waste areas, fields and pastures.

Medusahead (*Taeniatherum caput-medusae*): Annual. **I.D.:** Grass, 0.5 to 2 feet tall; stem sometimes covered with short hairs; collar region usually has long hairs, auricles and a membranous ligule; seedhead a spike, awns are stiff, straight or twisted and barbed; spikes often remain intact on dry plants through winter. **Other:** Grows best on clay soils; primarily infests rangeland; unpalatable to grazing animals due to high levels of silica in the foliage and long, stiff awns; matures two to four weeks later than other annual grasses.

Musk thistle (*Carduus nutans*): Biennial. **I.D.:** 2 to 6 feet tall; stems winged and spiny; leaves dark green with a light green mid-vein, alternate and sometimes hairy; margins are deeply lobed and spiny; rosette leaves have pale edges; flowers large and pink to purple; head often nods or droops; stem below head usually spineless; base of flower is covered with spine-tipped bracts that are usually purple. **Other:** Often infests roadsides, over-grazed pastures and waste areas.

Purple loosestrife (*Lythrum salicaria*): Perennial. **I.D.:** Up to 6 feet tall; stem has four to five sides and is covered with short hairs; leaves mostly opposite or whorled, narrow to lance-shaped with smooth margins, smooth (hairless) to hairy with no petioles; flowers have five to seven pink to purple petals surrounding a yellow center; each petal has a dark mid-vein and appears wrinkled or crushed. **Other:** Grows best in wet areas; often found in wetlands and along the edges of ponds and waterways; historically used as an ornamental plant but has escaped cultivation.

Rush skeletonweed (*Chondrilla juncea*): Perennial. **I.D.:** Up to 4 feet tall; stems contain white, milky sap; lower portion of stem is covered with coarse, downward-pointing, reddish-brown hairs; rosette leaves resemble dandelion; stems have very few leaves; leaves narrow with smooth margins; flowers yellow. **Other:** Grows best in well-drained soils; often infests roadsides, rangelands and waste areas; very difficult to control due to lack of leaf surface.

Scotch thistle (*Onopordum acanthium*): Biennial. **I.D.:** Up to 12 feet tall; stem and leaves covered with woolly, gray hairs; winged stems; leaves alternate; oblong, margins are lobed or toothed with stiff spines; flowers white to purple; base of flower is round and covered with green, purple or yellow bracts, each tipped with a spine. **Other:** Infests pastures, rangeland, roadsides and waste areas; forms dense stands that are difficult for humans and animals to penetrate.

Yellow starthistle (*Centaurea solstitialis*): Annual. **I.D.:** 1 to 6 feet tall; stems winged; leaves blue- or gray-green and covered with fine hairs; rosette leaves are oval to linear with deeply lobed margins; stem leaves are alternate, linear to oblong with smooth to wavy margins; flowers yellow; base of flower is covered with cotton-like hairs and straw-colored spines. **Other:** Often infests rangeland, pastures, cultivated fields, waste areas and roadsides; causes “chewing disease” in horses by damaging the area of the brain that controls fine motor movements – particularly of the mouth – resulting in starvation or dehydration.

Weed Impacts

All weeds impact their environment by replacing desired vegetation and reducing forage availability and habitat quality. Impacts for specific weeds are stated when they are more severe. (e.g., they are toxic to animals).

Weed Management

Weed management decisions are dependent on habitat and surrounding vegetation, and are not listed in this publication. For those recommendations, please reference the Nevada Noxious Weed Field Guide (<http://www.unce.unr.edu/publications/files/nr/2010/sp1001.pdf>) or the Pacific Northwest Weed Management Handbook (<http://uspest.org/pnw/weeds>).

Contact

If you have seen these weeds, contact your local University of Nevada Cooperative Extension, BLM, USFS or conservation district office: <http://www.unce.unr.edu/contact/personnel>.

References:

Creech, E., Schultz, B. & Blecker, L. 2010. Nevada Noxious Weed Field Guide. University of Nevada Cooperative Extension Special Publication: SP-10-01.
Whitson, T. (ed). 2006. Weeds of the West. Las Cruces, NM: Western Society of Weed Science.

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Dalmatian toadflax, Medusahead, Purple loosestrife, Scotch thistle by Nate Belliston, Uinta County Weed Department; Diffuse knapweed, Leafy spurge, Meadow knapweed, Musk thistle, Rush skeletonweed by Joe DiTomaso, © 2008 Regents of the University of California; Yellow starthistle by Jack Kelly Clark, © 2008 Regents of the University of California.



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Appendix H

Resources and Contacts
Nevada Certified Weed Free Materials List

Weed Management Resources and Contacts

Cooperative Weed Management Areas/Groups

West Lyon County Cooperative Weed Management Area

Contact: Dayton Valley Conservation District, Rob Holley

Address: P.O. Box 3543, Carson City, NV 89702

Phone: 775-720-6898

Email: rholley.dvcd@yahoo.com

Website: <http://www.daytonvalleycd.blogspot.com/>

Truckee Meadows Weed Coordinating Group

Contact: University of Nevada Cooperative Extension, Sue Donaldson

Phone: 775-856-8401

Email: Donaldson@unce.unr.edu

Website: <http://www.washoeweeds.org/>

Carson City Weed Coalition

Contact: University of Nevada Cooperative Extension, Margie Evans

Address: 2621 Northgate Lane, Suite 15, Carson City, NV 89706

Phone: 775-887-2252

Email: evansm@unce.unr.edu

Website: <http://www.unce.unr.edu/counties/carson-storey/programs/index.asp?ID=95>

Conservation Districts

Dayton Valley Conservation District

Contact: Dayton Valley Conservation District, Richard Wilkinson

Address: P.O. Box 3543, Carson City, NV 89702

Phone: 775-883-3525

Email: richard.Wilkinson@nv.nacdnet.net

Website: <http://www.daytonvalleycd.blogspot.com/>

Washoe-Storey Conservation District

Address: 1365 Corporate Blvd., Reno, NV 89502

Phone: 775-857-8500

Email: wscd.grants@gmail.com

Website: <http://wscd.nv.gov/>

Contacts for Seed Mix

Comstock Seed

Contact: Ed Kleiner

Address: 917 Highway 88, Gardnerville, NV 89460

Phone: 775-265-0090

Email: sales@comstockseed.com

Website: www.comstockseed.com

Western Botanical Services, Inc.

Contact: Julie Etra
Address: 5859 Mt. Rose Highway, Reno, NV 89511-5001
Phone: 775-849-3223
Email: etra.Julie@gmail.com
Website: <http://wbsinc.us>

Granite Seed

Address: 1697 West 2100 North, Lehi, Utah 84043
Phone: 801-768-4422
Website: www.graniteseed.com

Kelly Erosion Control

Address: 2395 Tampa St., #B, Reno, NV 89512
Phone: 775-322-7755
Website: <http://www.kelleyerosioncontrol.com/>

Contacts for Herbicide Treatments

Dayton Valley Conservation District

Contact: Dayton Valley Conservation District, Richard Wilkinson, Rob Holley
Address: P.O. Box 3543, Carson City, NV 89702
Phone: 775-883-3525
Email: richard.Wilkinson@nv.nacdnet.net
Website: <http://www.daytonvalleycd.blogspot.com/>

Sheldon's Pest Management

Address: 3905 Reno Hwy #C, Fallon, NV 89406
Phone: 775-867-2066

Hiller Weed Management Services

Contact: Blake Hiller
Address: 420 Octavia Court, Reno, NV 89509
Phone: 775-684-9779

Great Basin Institute

Address: 16750 Mount Rose Highway, Reno, NV 89511
Phone: 775-674-5475
Website: <http://www.thegreatbasininstitute.org/>

Soil Tech

Contact: Dan Rockwell
Address: 7955 Sugar Pine Court, Suite 250, Reno, NV 89523
Phone: 775-324-5547
Email: dan@soil-tech.com
Website: <http://www.soil-tech.com>

Please see attached list for other commercial companies in the area.

State of Nevada

Nevada Department of Agriculture

<http://www.agri.state.nv.us>

Nevada Weed Management Association

<http://nvwma.org/>

Nevada Noxious Weeds Field Guide

<http://www.unce.unr.edu/publications/files/nr/2010/sp1001.pdf>

Training and Education

University of Nevada Cooperative Extension – “Weed Warriors” Program

<http://www.unce.unr.edu/programs/horticulture/index.asp?ID=141>

UNCE Weed Identification and Control Guide

<http://www.unce.unr.edu/publications/files/nr/other/EB9801.pdf>

Weed Education Clearinghouse

http://www.cdfa.ca.gov/phpps/ipc/weededucation/weed_ed_hp.htm

Weed Science Society of America

<http://www.wssa.net>

US Department of Agriculture Plants Database

<http://plants.usda.gov>

National Programs and Resources

National Invasive Species Council

<http://www.invasivespecies.gov/epmt>

U.S. Bureau of Land Management

http://www.blm.gov/nv/st/en/prog/more_programs/invasive_species.html

Center for Invasive Plant Management

<http://www.weedcenter.org>

Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW)

<http://ficomnew.fws.gov>

National Invasive Species Information Center

<http://www.invasivespeciesinfo.gov>

Commercial Weed Treatment Companies

COMPANY NAME	MAILING ADDRESS	CITY	ZIP	PHONE
AERIAL ENVIRONMENTAL ENHANCEMENT SERVICES	PO BOX 1506	FALLON	89407	775-742-3025
B'S LAWN & PEST CONTROL SERVICES	1630 HOYT ST	RENO	89509	775-828-9660
BONANZA PEST CONTROL INC	PO BOX 60506	RENO	89506	775-972-8212
CAD PEST CONTROL SERVICES INC	PO BOX 18437	RENO	89511-0437	775-853-1672
CROWN PEST CONTROL INC	PO BOX 50605	SPARKS	89435-0605	775-626-2233
DESERT BLOOM LANDSCAPE PEST MGMT SPECIALTIES	1822 HARTE RD	RENO	89521-7447	775-847-9273
FAMCO PEST CONTROL	PO BOX 21147	CARSON CITY	89721	775-882-5242
G & G NURSERY & LANDSCAPING	1425 HYMER AVE	SPARKS	89431	775-856-6800
HIGH DESERT PEST CONTROL INC	1220 E GREG ST STE 11	SPARKS	89431-6530	775-359-2088
INTEGRITY PEST MANAGEMENT LLC	PO BOX 5841	FALLON	89406	775-423-7129
LAWN DOCTOR OF SPARKS	PO BOX 51295	SPARKS	89435-1295	775-425-1197
LAWN MAGIC	PO BOX 19127	RENO	89511-0898	775-852-8952
NITRO-GREEN	PO BOX 1564	SPARKS	89432-1564	775-828-2900
PERMA-GREEN	340 WESTERN RD STE 9	RENO	89506-7616	775-329-4875
PESTMASTER SERVICES INC - RENO	PO BOX 7083	RENO	89510-7083	775-858-7378
PIED PIPER PEST CONTROL	PO BOX 71147	RENO	89570-1147	775-851-7378
PREVENTIVE CUSTOM PEST & WEED CONTROL	2171 W WILLIAMS AVE	FALLON	89406-2612	775-867-4506
SHELDON'S PEST MANAGEMENT SERVICES	PO BOX 957	FALLON	89407-0957	775-867-2066
SIERRA PEST CONTROL	PO BOX 2091	SPARKS	89432-2091	775-331-2869
SIGNATURE LANDSCAPES LLC	324 VINE ST	RENO	89503-5221	775-857-4333
THE WEED LADY LLC	PO BOX 1115	VIRGINIA CITY	89440	775-848-4877
TOWN & COUNTRY LANDSCAPE	9800 N VIRGINIA ST	RENO	89506	775-329-2904
VALLEY PEST CONTROL	PO BOX 21374	RENO	89515	775-852-7378
VITAL-N-GREEN	961 PETES WAY	SPARKS	89434-9659	775-356-7672

2011 Nevada Weed Seed Free Forage Growers
Updated 1/12/12

Source: Excerpted directly from the Nevada Department of Agriculture website: http://agri.nv.gov/nwac/PLANT_WFHProducers.htm

Name	Physical Address City	Phone	Product
Clarence Burr	1125 Hwy 88 Gardnerville	775-265-2318	Alfalfa, grass, and mix hay
Dale Borsini	Highway 208 Yerington	775-721-5778	Alfalfa
Rod Goodwin	1423 Orchard Road Gardnerville	775-781-0893	Alfalfa/Grass Mix
Nate Leising	626 Highway 88 Gardnerville	775-720-2749	Grass Mix Bales
Tom Lund	608 Fairview Gardnerville	775-450-3818	Grass Bales
John Ritter	288 Pete Hendricks Lane Yerington	775-771-8258	Straw, Alfalfa
Quint & Jill Ross	501 South Downs Lane Fallon	775-423-7370	Grass and Alfalfa Hay
James Settlemeyer	770 Highway 395 Gardnerville	775-450-6114	Alfalfa and Alfalfa/Grass
Fred Stodieck	1000 Waterloo Lane Gardnerville	775-782-2863	Alfalfa/Grass Mix
Hay U Hay Company	HC 34 Box 34153 Ely	775-238-0566	Grass Mix
Red Barn Ranch	551 Foothill Rd. Gardnerville	775-265-5557	Grass Bales
Winnemucca Farms	4100 Dutch Flat Rd. Winnemucca	775-623-4400	Straw
Six-N-Ranch	P.O. Box 49 Smith	775-465-2351	Wheat
Dave Groso	P.O. Box 123 Wellington	775-465-2378	Alfalfa/Grass Mix
Robert Smith	7250 Curry Rd. Fallon	775-426-6408	Alfalfa Hay
Whited Farms	HC Box 203 Wells	(775) 752-3949	Alfalfa/Grass Mix
Jimmie Lee	HC 33 Box 33585 Ely	(775) 591-0400	Alfalfa Hay
Williams Farms	25 East Pursel Yerington	(775) 463-4048	Grass Hay
Steven Fulstone	31 Rivers Road Smith	775-465-2341	Wheat/straw
Bernard J. Peterson – Southern Nevada Water Authority	HC 10 Box 10853 Ely	702-340-3705	Alfalfa Hay
Paul Lee	429 Cuttin' Loose Lane Gardnerville	775-813-4853	Grass Hay
Burnham Farms, LLC	HC 62 Box 62153 Eureka	775-318-0020	Straw

2011 Nevada Certified Weed Seed Free Gravel & Sand Producers
Updated 02/01/12

Name	Physical Address City	Phone	Product
Cinderlite Rock and Sand	1665 S. Sutro Terrace Carson City	775- 882-4483	Gravel materials
F.W. Carson	1064 Tahoe Blvd Incline Village	775-831-5008	Gravel materials

Source: Excerpted directly from the Nevada Department of Agriculture website: http://agri.nv.gov/nwac/PLANT_WFHProducers.htm

Appendix I

Weed Management Treatment Calendar

Comstock Project Noxious and Invasive Weed Management Maintenance Calendar

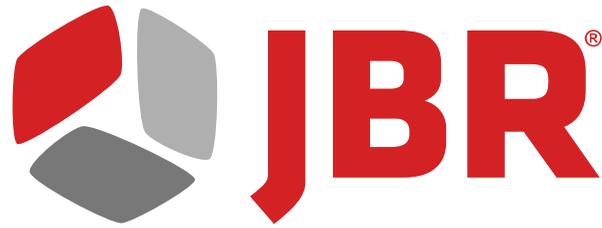
Please note: This weed maintenance calendar is meant as a summary of general guidelines to limit the impact of noxious and invasive plant species within the project area. More detail is provided in the Comstock Project Weed Management Plan. Actual plant stage is dependent upon annual precipitation and other climate factors. Adjust schedule as necessary. When using herbicides, always follow the label of the product being used. Make sure to follow all local, state or federal regulations that apply to the project site.

Common Name	Scientific Name	Treatment Type	Jan			Feb			Mar			Apr					
			1	2	3	1	2	3	1	2	3	1	2	3			
		Mechanical															
		Chemical															
		Mechanical															
		Chemical															
		Mechanical															
		Chemical															

Medusahead	<i>Taeniatherum</i>											
	Mechanical											
	Chemical											
	Mechanical											
	Chemical											
	Mechanical											
	Chemical											
	Mechanical											
	Chemical											

Equipment & Supplies												

*Whenever possible plant competitive vegetation to help control infestations from reoccurring!
Please refer to Weed Management Plan for herbicide treatment details.*



creating solutions for today's environment