CDOT PROJECT IM 0703-294

I-70/32nd AVENUE INTERCHANGE ENVIRONMENTAL ASSESSMENT

INTEGRATED NOXIOUS WEED MANAGEMENT PLAN

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FHU Reference No. 05-154
October 2006

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LIST OF ABBREVIATIONS AND ACRONYMS

CDOT	Colorado Department of Transportation
EA	Environmental Assessment
FHU	Felsburg Holt & Ullevig
FHWA	Federal Highway Administration
I-70	Interstate Highway 70
INWMP	Integrated Noxious Weed Management Plan
LRT	Golden Light-Rail
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
NRSI	Natural Resource Services, Inc.
RTD	Regional Transportation District
SH58	State Highway 58
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

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EXECUTIVE SUMMARY

In accordance with the National Environmental Policy Act of 1969 (NEPA) and its related statutes and regulations, the Federal Highway Administration (FHWA), as the Lead Agency, in cooperation with the Colorado Department of Transportation (CDOT) as the Applicant Agency, is preparing an Environmental Assessment (EA) for proposed improvements to the Interstate 70 (I-70)/32nd Avenue Interchange (the Proposed Action). The project is proposed by the City of Wheat Ridge. Natural Resource Services, Inc. (NRSI) was contracted on August 30, 2005 by Felsburg Holt & Ullevig (FHU), acting on behalf of CDOT and the City of Wheat Ridge, to prepare an Integrated Noxious Weed Management Plan (INWMP) for the I-70/32nd Avenue Interchange EA. The field survey was completed in September 2005.

Noxious weeds are non-native invasive plant species that have been introduced into an environment with few, if any, controls and which are likely to cause economic or environmental harm or harm to human health. Because of the adverse environmental effects of weeds, both the federal and state governments have issued various orders and regulations regarding noxious weeds. FHWA Guidance on Invasive Species (August 10, 1999) requires consideration of noxious weed species in the project area. This includes mapping all existing invasive weed populations within, on or adjacent to the project site, an analysis of the potential impacts of disturbances caused by project construction and the potential spread of weeds, and a list of preventive and control measures to prevent or reduce such spread of noxious species.

The I-70/32nd Avenue interchange project is located in the western part of the Denver metropolitan area. The project area falls partially within the cities of Wheat Ridge and Lakewood and within unincorporated Jefferson County. The project area includes about two miles of I-70 from 26th Avenue to Ward Road and two miles of SH 58 from McIntyre Street to I-70. The general coordinates are 39º 46' 00" N latitude and 105º 09' 00" W longitude (UTM Zone 13 487,500E and 4,402,000N).

The project consists of the construction of new I-70/32nd Avenue Interchange hook ramps, 32nd Avenue Improvements, a new diamond SH 58/Cabela Drive interchange west of Eldridge Street and connection of Cabela Drive to this interchange, connection of Cabela Drive with 44th Avenue north of the new interchange on SH 58, improvements to the I-70/Ward Road Interchange, and bicycle/pedestrian infrastructure improvements. Several local agency projects that will be completed by the City of Wheat Ridge include the construction of the 40th Avenue underpass beneath I-70, the widening of Youngfield Street from 38th Avenue to 44th Avenue, and construction of Cabela Drive from 40th Avenue to the proposed development just north of Clear Creek.

The field survey resulted in the identification of 24 noxious weed species which are listed on the Colorado Department of Agriculture Noxious Weed Lists A, B and C (Colorado Department of Agriculture 2005). Two of these, i.e. cypress spurge and myrtle spurge, are listed on the Colorado "A" list, sixteen are listed on the Colorado "B" list, and six are listed on the Colorado "C" list.

In addition, fifteen noxious weed species listed on the Jefferson County Noxious Weed List (Jefferson County 2006) were identified on the site. Ten of these species are listed on the Jefferson County List as requiring control and three species, cypress spurge, myrtle spurge and salt cedar, are listed by Jefferson County as requiring eradication (Jefferson County 2006). Many of the identified weed species were located in sparse to dense populations distributed throughout the entire project area.

Also, fifteen of the seventeen noxious and undesirable plants listed in the City of Wheat Ridge Open Space Management Plan (City of Wheat Ridge and ERO Resources Corporation 2002) were identified within the project area. The only two weed species listed by Wheat Ridge and not identified on the site were buckthorn and purple loosestrife.

Finally, fifteen species of noxious weeds listed on the CDOT Maintenance Program Noxious Weed List (CDOT 2006) were identified within the project area.

During the proposed construction, both preventative and control measures will be employed to mitigate the spread of noxious weeds both to and from the construction site. Noxious weed preventative and control measures will include the use of weed free seed and mulch, local topsoil, Best Management Practices (BMP's), chemical control by licensed applicators following herbicide label requirements, mowing where applicable, and proper equipment inspection and maintenance.

1.0 INTRODUCTION

In accordance with the National Environmental Policy Act of 1969 (NEPA) and its related statutes and regulations, the Federal Highway Administration (FHWA) as the Lead Agency, in cooperation with the Colorado Department of Transportation (CDOT) as the Applicant Agency, is preparing an Environmental Assessment (EA) for proposed improvements to the Interstate 70 (I-70)/32nd Avenue Interchange (the Proposed Action). The project is proposed by the City of Wheat Ridge. Natural Resource Services, Inc. (NRSI) was contracted on August 30, 2005 by Felsburg Holt & Ullevig (FHU), acting on behalf of CDOT and the City of Wheat Ridge, to prepare an Integrated Noxious Weed Management Plan (INWMP) for the I-70/32nd Avenue Interchange EA. This document describes the methods employed and reports the results of the noxious weed survey. The detailed information included in this report is intended to support the EA document and is also intended to provide guidance in managing noxious weed populations within the project area during the construction of the project.

1.1 Noxious Weed Management Requirements

Noxious weeds are non-native invasive plant species that have been introduced into an environment with few, if any, controls and which are likely to cause economic or environmental harm or harm to human health. They generally have a competitive advantage in dominating and crowding out native plant species and can threaten the integrity of native plant communities. Noxious weeds are aggressive, spread rapidly, reproduce profusely, and resist control and management measures. Because of the adverse environmental effects of weeds, both the federal and state governments have issued various orders and regulations regarding noxious weeds. FHWA Guidance on Invasive Species (August 10, 1999) requires consideration of noxious weed species in the project area. This includes mapping all existing invasive weed populations within, on or adjacent to the project site, an analysis of the potential impacts of disturbances caused by project construction and the potential spread of weeds, and a list of preventive and control measures to prevent or reduce such spread of noxious species. The following are some of the regulations guiding noxious weed management.

1.1.1 Presidential Executive Order 13112 – Invasive Species

Executive Order 13112, Invasive Species, was issued on February 3, 1999 to prevent the introduction of invasive species, provide for their control, and minimize the economic, ecological, and human health impacts that result from invasive species. This order directs federal agencies to prevent the introduction of invasive species, control and monitor invasive species, and restore native species and habitats that have been invaded (Federal Register 1999).

1.1.2 Colorado Noxious Weed Act

The *Colorado Noxious Weed Act, §§ 35-5.5-101 through 119, C.R.S.* (*2003*) as amended, states that all landowners must manage noxious weeds that may be damaging to adjacent landowners. Rules pertaining to administration of the Act include three lists of noxious weed species (Colorado Department of Agriculture 2005). The ***A List*** contains 18 species of noxious weeds targeted for eradication within Colorado. If individuals or populations of ***A List*** species are found, the local governing body must provide the State Weed Coordinator with mapping that

includes information on location and density of the infestation. The ***B List*** contains 39 species that the state of Colorado has targeted for eradication, containment or suppression based upon a given local governing body's management plan. The ***C List*** contains 14 species for which the State will provide support and funding for local control efforts (see **Appendix B**).

1.1.3 Jefferson County Noxious Weed List

The *Jefferson County Noxious Weed List* (Jefferson County 2006) contains a local list of noxious weeds which have been identified by Jefferson County for eradication (8 species), control (9 species) or as weed species of special concern (3 species) (see **Appendix B**).

1.1.4 City of Wheat Ridge Noxious and Undesirable Plant List

The City of Wheat Ridge listed 17 species of noxious weeds as noxious and undesirable plants in its Open Space Management Plan completed in 2002 (City of Wheat Ridge and ERO Resources Corporation 2002). These species are targeted for control by the city (see **Appendix B**).

1.1.5 CDOT Maintenance Program Noxious Weed List

CDOT lists 30 noxious weed species which are identified for specific control as part of the agency's road maintenance program (CDOT 2006).

The necessity for a noxious weed survey and an INWMP stems from requirements incorporated into the Colorado Noxious Weed Act, § 35-5.5-101 through 119, C.R.S. (2003) and associated Colorado Department of Agriculture rules (Colorado Department of Agriculture 2005). This law charges state and local governments of Colorado with the management of noxious weeds. As part of the required management, each local government must adopt an "undesirable plant management plan" directed at controlling noxious weeds and a "designated noxious weed species list" which their plan would target. Noxious weeds, as specified in § 35-5.5-103, C.R.S. (2003) means an alien plant or parts of an alien plant that has been designated by rule as being noxious or has been declared a noxious weed by a local advisory board, and meets one or more of the following criteria:

(A) Aggressively invades or is detrimental to economic crops or native plant communities
(B) Is poisonous to livestock
(C) Is a carrier of detrimental insects, diseases, or parasites
(D) The direct or indirect effect of the presence of this plant is detrimental to the environmentally sound management of natural or agricultural ecosystems

In addition, this INWMP will comply with the following executive orders and guidance:

- *State of Colorado Executive Order D 006 00 Development and Implementation of Noxious Weed Management Programs of July 19, 1999*
- *CDOT draft guidance on Incorporating Noxious Weed Management into the NEPA analysis and Project Development Process dated 2000*

- *CDOT Draft Template and Guidance for the Preparation of an Integrated Noxious Weed Management Plan for CDOT Region 6 Planning and Environmental Unit dated February 23, 2006*

The INWMP will also comply with CDOT Standard Specifications for Road and Bridge Construction, dated 2005, specifically:

- *Section 208.04 (d) on Erosion Control/Stabilization*
- *Section 212.02 Seed, Soil Conditioners, Fertilizer and Sod – except that fertilizer shall not be used (because it can enhance noxious weed growth)*
- *Section 213.02 Mulching Materials*

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2.0 STUDY AREA

The I-70/32nd Avenue interchange project is located in the western part of the Denver metropolitan area, as shown in **Figure 2-1**. The project area falls partially within the cities of Wheat Ridge and Lakewood and within unincorporated Jefferson County. The City of Arvada is located north of the project area, and the City of Golden is located west of the project area. The site boundaries are shown in **Figure 2-2**.

2.1 Project Location

The project area is bounded on the north by Colorado State Highway 58 (SH 58) and its associated south frontage road, on the east by I-70, on the south by 32nd Avenue, and on the west by McIntyre Street. The general coordinates are 39º 46' 00" N latitude and 105º 09' 00" W longitude (UTM Zone 13 487,500E and 4,402,000N). The Project Area can be found on the USGS Golden, CO 7.5 minute topographic quadrangle at the following locations:

- SE1/4 of Section 24 in Township 3 South, Range 70 West of the 6th Prime Meridian, Golden, Colorado quadrangle
- NE1/4 of Section 25 in Township 3 South, Range 70 West of the 6th Prime Meridian, Golden, Colorado quadrangle
- S1/2 of Section 19, Township 3 South, Range 69 West of the 6th Prime Meridian, Golden, Colorado quadrangle
- NW1/4SW1/4 of Section 20, Township 3 South, Range 69 West of the 6th Prime Meridian, Golden, Colorado quadrangle
- W1/2 of Section 29, Township 3 South, Range 69 West of the 6th Prime Meridian, Golden, Colorado quadrangle
- N1/2 of Section 30, Township 3 South, Range 69 West of the 6th Prime Meridian, Golden, Colorado quadrangle
- NW1/4 of Section 32, Township 3 South, Range 69 West of the Prime Meridian, Golden, Colorado quadrangle

SH 58 is located in the northern portion of the project area and extends west from the I-70/SH 58 interchange complex. I-70 is generally oriented east-west east of SH 58 and north-south south of SH 58. Clear Creek parallels SH 58 to the south through the project area, crossing beneath I-70 south of the I-70/SH 58 interchange. The north and south boundaries of the project area are formed by 44th and 32nd Avenue, respectively. Youngfield Street parallels the east side of I-70 in a north-south direction on the east side of the project area from 44th Avenue to 26th Avenue.

2.2 Site Description

Historically, most of the site has been shaped by the deposition of sandy and gravely alluvium deposited by Clear Creek. Today, Clear Creek is highly channelized and is largely isolated from its floodplain. Only significant flood events are likely to result in flooding within the floodplain. With the exception of the Clear Creek riparian corridor, most of the project area would be classified as mesic to arid upland. Several man-made irrigation ditches, which divert water from Clear Creek, and associated stormwater drainage ditches associated with the adjacent highway corridors also exist within the site.

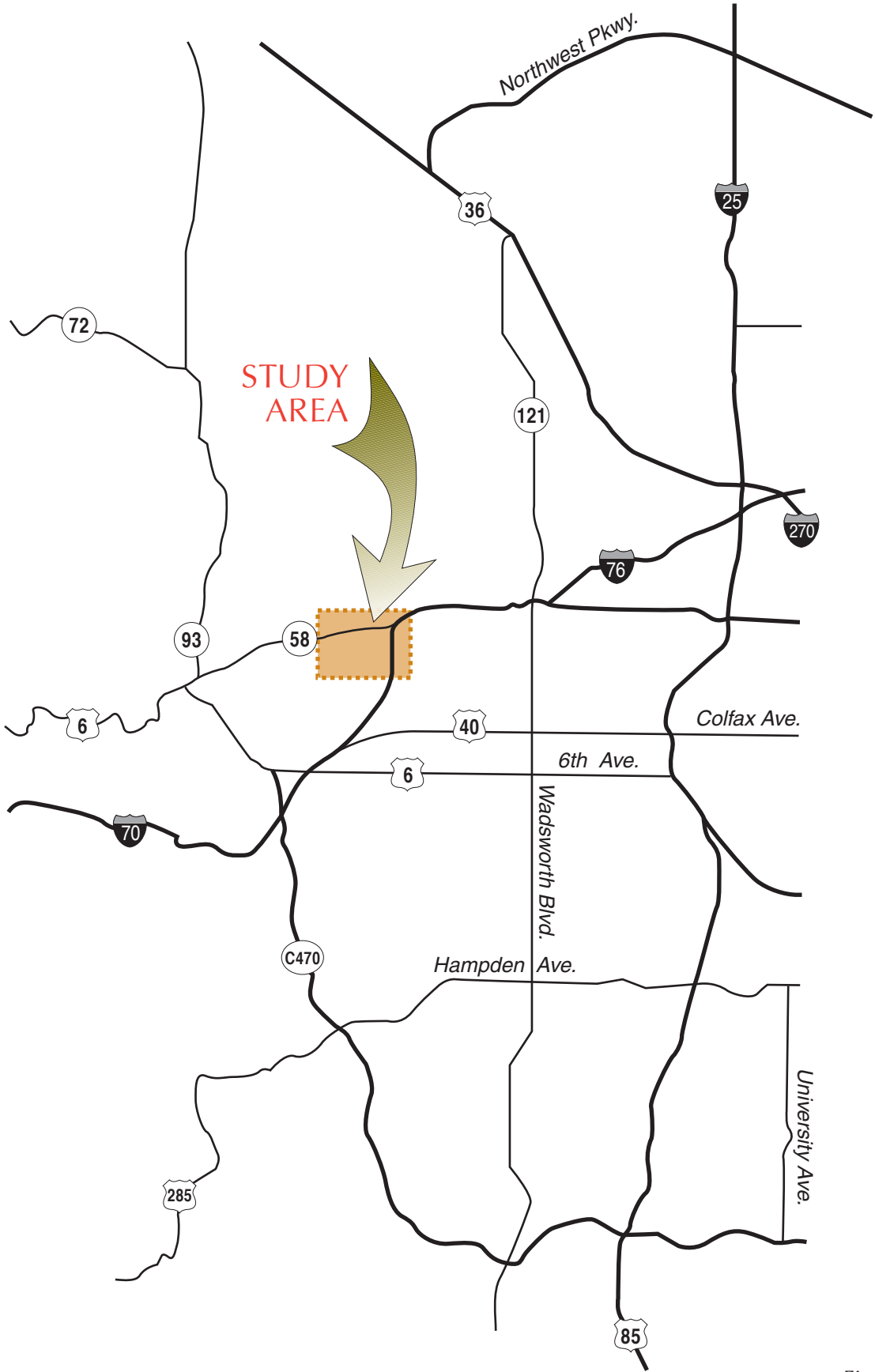


Figure 2-1

Project Location

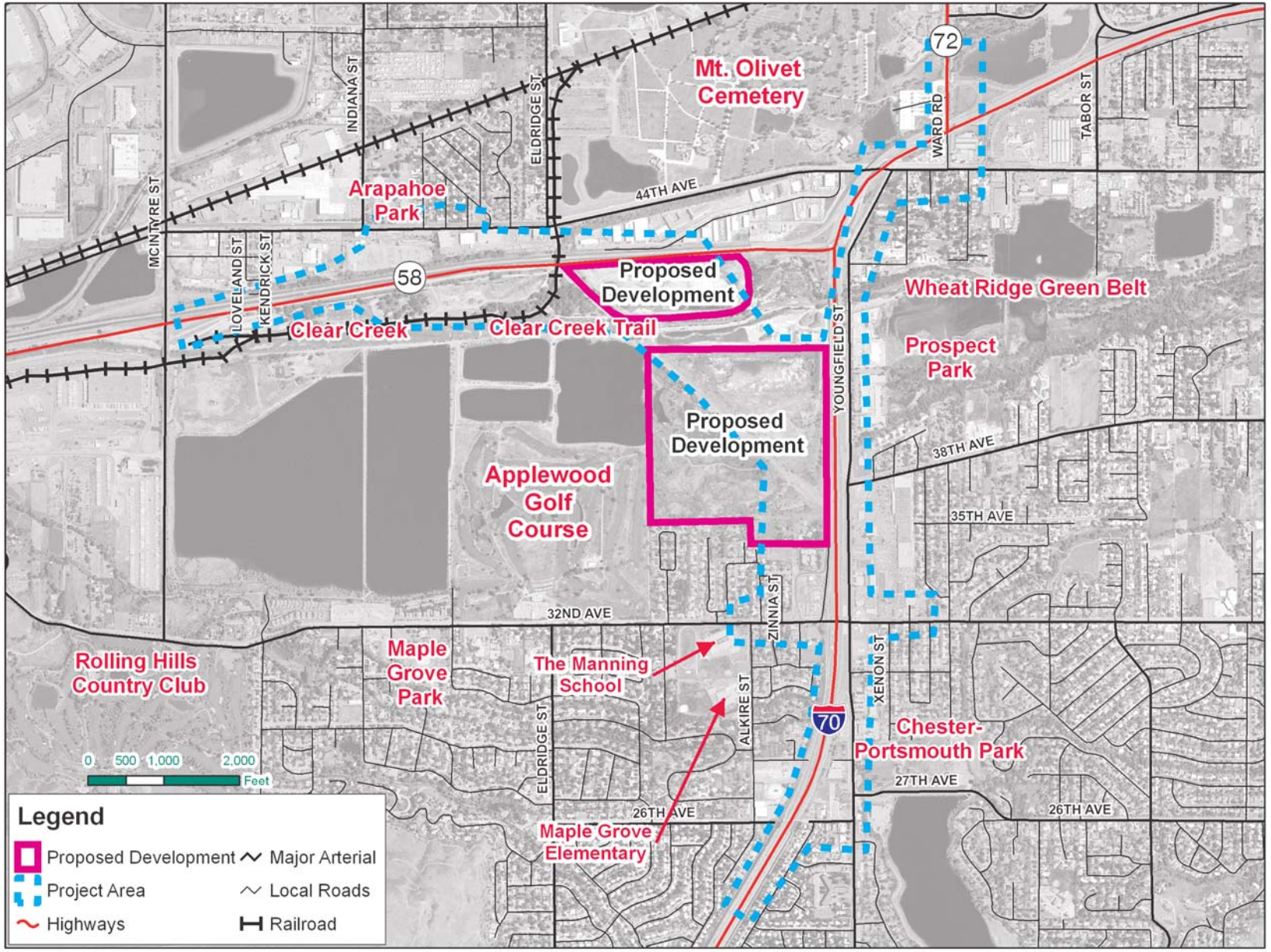


Figure 2-2

Project Area

2.2.1 Topography and Elevation

Topography within the site is characterized as primarily flat floodplain with 0 to 2 percent slopes. Considerable artificial contouring associated with mining, road and railroad construction, and other industrial uses has occurred over most of the site. No unusual features or rock outcrops are present on the site. Elevations within the project area range between 5430 and 5510 feet above mean sea level (MSL). The terrain is generally flat, sloping gently downward from west to east.

2.2.2 Hydrology

The project area is situated at the transition zone between the foothills and the eastern plains along the primary alluvial terrace of Clear Creek, an urban riparian corridor, downstream of North Table Mountain and South Table Mountain and due east of the City of Golden, Colorado.

2.2.2.1 Clear Creek

The northern third of the project area is bisected from west to east by Clear Creek, a medium sized stream with a rocky cobble bottom and steep banks up to ten feet high. Clear Creek is a tributary of the South Platte River. Much of the length of Clear Creek within the project area has been channelized in the past. Most of the banks are stabilized with large diameter granite riprap (up to 4 feet in diameter) although a few sections along both the north and south banks are not covered with riprap. A number of low check dams and diversion dams have also been built along the entire length of Clear Creek within the site. Impounded waters upstream of these checkdams have become filled with sediment and cobble over time forming low islands and terraces between the steeper rip-rapped banks. Most of these terraces are low and flat, ranging from four inches to several feet above the water level in the creek at the time of the field surveys. The majority of the terraces have the hydrology, hydric soils and facultative vegetation to be classified as wetlands.

In the extreme northeast corner of the Project Area is a system of wetlands associated with an historic oxbow of Clear Creek which apparently still carries water from the creek during high flow events. At the time of the field survey of this area on September 1, 2005, the site was occupied by several large active beaver ponds which impounded water that apparently enters the site through seepage, rainfall events and Clear Creek overflow events. No water was entering the site from the creek at the time of the site visit but a small amount of outflow from the beaver pond complex into Clear Creek was observed.

2.2.2.2 Irrigation Diversion Ditches

Two major irrigation ditches divert water from the north bank of Clear Creek to areas to the north and northeast of the project area. These are the Juchem-Reno Ditch and the Bayou (Bayau) Ditch. The Juchem-Reno Ditch also receives storm runoff and seepage water from drainage ditches associated with SH 58 to the north of the area and the SH 58 frontage road located on the south side of SH 58. A system of permanent palustrine forested and palustrine emergent wetlands were associated with the drainage ditches which empty into the Juchem Ditch, but very few wetlands were directly adjacent to the Juchem Ditch itself. Both the Juchem-Reno ditch and the Bayou ditch, within the project area, are characterized in most places as

having very steep sides and a very dense overstory of mature trees and shrubs. Water was flowing in both irrigation ditches at the time of the site visits.

2.2.2.3 Isolated Lakes and Depressional Wetlands

A number of man-made lakes, gravel pits and isolated depressional wetlands exist within the project area. Many of the lakes have resulted from historic gravel mining operations. Some of these have been modified to serve as holding ponds for Coors Brewing Company. Lakes within the area were characterized by steep banks, stabilized by riprap in many instances, with very little to no wetland vegetation along the shorelines. A few other isolated depressional wetlands were scattered throughout the northern half of the project area. These were all extremely dry at the time of the site visits and contained a very limited number of plant species. Water sources for these areas appeared to result solely from precipitation or from seepage during wet years.

2.2.3 Soils

Soils data were obtained from the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) (formerly known as the Soil Conservation Service) soil surveys (Price and Amen 1980). Specific site data were field verified by Steve Johnson of NRSI during the September site visits in 2005. Soils mapped on the site by the Soil Conservation Service in 1980 were characterized as Alda-Torrifluvents, very gravelly, nearly level, deep, somewhat excessively drained and somewhat poorly drained, loamy, very gravelly, and sandy soils that formed in mixed alluvium. Upland slopes were characterized as dominantly somewhat excessively drained and well drained, sandy and loamy soils on high terraces and hill slopes. Most soils throughout the site appeared to have been significantly disturbed in the past by aggregate mining operations and other industrial activities. Three soil types were mapped within the project area (Ibid 1980). They were:

- Torrifluvents, very gravelly, 0 to 3 percent slopes which were associated with unmined areas adjacent to the Clear Creek channel
- Alda-Niwot complex, 0 to 2 percent slopes located on upland areas north of the creek channel
- Pits, gravel occupying most of the project area south of Clear Creek

Hydric soils were evident during the September site visits within the riparian zone immediately bordering Clear Creek as well as within, and immediately adjacent to, the Juchem and Bayou Ditches and associated drainage ditches. Some hydric soils were also associated with the few isolated depressional wetlands within the project area.

2.2.4 Weather

The weather in the proposed project area is typical of the central Colorado high plains. Annual rainfall averages approximately 17 inches and temperatures range from highs of over 100 degrees Fahrenheit in July and August to lows of 0 degrees Fahrenheit and below in the winter. Average humidity generally ranges below 25 percent throughout the year.

2.2.5 Vegetation

All of the project area was farmed or ranched at some time in the past and has been disturbed by historic mining and industrial uses (Arbogast et al. 2000). Considerable disturbance of the periphery of the site has also occurred in association with the construction of the SH 58 and the I-70 highway corridors. Some disturbance has also occurred in the recent past in conjunction with the construction of the Jefferson County Open Space Clear Creek Trail.

2.2.5.1 Clear Creek Riparian Corridor

Though the riparian habitat along most of Clear Creek through the project area was dominated by dense coyote willow (*Salix exigua*) thickets, there was low structural complexity, i.e. an herbaceous understory was lacking and there were few trees. In some areas, however, a narrow herbaceous band was present which was associated with the low flat sedimentary and cobble terraces at the stream's edge. Vegetation growing on these terraces at the time of the site visits included reed canarygrass (*Phalaris arundinacea*), meadow fescue (*Festuca pratensis*), rabbitfoot grass (*Polypogon monspeliensis*), prostrate knotweed (*Polygonum aviculare*), pale smartweed (*Polygonum lapathifolium*), ladysthumb smartweed (*Polygonum persicaria*), coyote willow, witch grass (*Panicum capillare*), small fruited sedge (*Scirpus microcarpus*), Baltic rush (*Juncus balticus*), plains cottonwood seedlings (*Populus deltoides*), narrow-leaf cottonwood (*Populus angustifolia*), common spikerush (*Eleocharis palustris*), barnyard grass (*Echinochloa crusgalli*), boxelder (*Acer negundo*), devils beggartick (*Bidens frondosa*), Junegrass (*Koeleria cristata*), Nebraska sedge (*Carex nebraskensis*), bentgrass (*Agrostis scabra* and *A. stolonifera*), Torrey's rush (*Juncus torreyi*), foxtail barley (*Hordeum jubatum*), Dudley's rush (*Juncus dudleyi*), Canada thistle (*Cirsium arvense*), Canada goldenrod (*Solidago canadensis*), carpetweed (*Mullugo verticillata*), watercress (*Nasturtium officinale*), and showy milkweed (*Asclepias speciosa*).

2.2.5.2 Irrigation Diversion Ditches (Juchem and Bayou Ditches)

The width of riparian habitat along the Juchem and Bayou Ditches was very narrow, usually less than three meters. Both ditches were covered by an overstory of plains cottonwood, narrow-leaf cottonwood, boxelder, Siberian elm (*Ulmus pumila*), and crack willow (*Salix fragilis*) over much of their length within the Project Area. The eastern portion of the Bayou Ditch was covered by a dense continuous stand of coyote willow along both sides of the ditch but no overstory was present. The Juchem Ditch had very little wetland associated with the ditch since the banks were very steep. The first two hundred yards of the Bayou Ditch northeast of Clear Creek was covered by the tree overstory, but had some emergent wetland terraces and bars within the banks of the ditch which were dominated by reed canarygrass. Predominant vegetation established in the immediate vicinity of these ditches consisted primarily of mesic vegetation, however. Species included snowberry (*Symphoricarpus occidentalis*), wild rose (*Rosa woodsii*), and coyote willow. Herbaceous cover was sparse and consisted of less than 1 percent grass species.

2.2.5.3 Roadway Drainage Ditches

The roadway drainage ditches paralleling SH 58 were narrow (one meter to eight meters wide) and were characterized by alternating palustrine emergent wetlands and forested riparian areas. Overstory species in the forested areas consisted primarily of plains cottonwood, narrow-leaf cottonwood, boxelder, and Siberian elm. Forested understory consisted of coyote willow, golden currant (*Ribes aureum*), Arkansas rose (*Rosa arkansana*), boxelder, poison ivy, Virginia creeper (*Parthenocissus quinquefolia*), snowberry. Canada thistle, houndstongue, scouring rush (*Hippochaete laevigata*), Chinese clematis, domesticated hops (*Humulus lupulus*), and a mixture of various grasses and forbs. Herbaceous and graminoid ground cover in the forested areas varied from none to 30 percent cover.

Emergent wetland areas along the roadway drainage ditches were characterized by complete coverage with mixed and homogeneous stands of cattails (*Typha latifolia*), roundstem bulrush (*Scirpus validus*), small fruited sedge, blue vervain (*Verbena hastata*), three-square (*Scirpus americana*), watercress, common duckweed (*Lemna minor*), larger duckweed (*Spirodela polyrhiza*), wild licorice (*Glycyrrhiza lepidota*), Canada thistle, showy milkweed, swamp milkweed (*Asclepias incarnate*), common teasel, common nettle (*Urtica gracilis*), common spikerush, barnyard grass, and poison hemlock. Much of the emergent wetland area in the drainage ditches was bordered on both sides by dense stands of coyote willow. Vegetation in most of the emergent areas of the drainage ditches was two to seven feet tall and very dense.

2.2.5.4 Isolated Depressional Wetlands

Isolated depressional wetlands were identified in a few places within the Project Area. These were dry at the time of the site visits in September, but were occupied by mostly facultative and wetter vegetation which included cattails, Dudley's rush, common spikerush, Canada thistle, coyote willow, curly dock (*Rumex crispus*), witchgrass, foxtail barley, plains cottonwood, and narrow-leaf cottonwood.

2.2.5.5 Uplands

Other parts of the project area located away from the riparian corridors of Clear Creek and the ditches were characterized as dry upland. Characteristic vegetation identified in these sites included plains cottonwood, narrow-leaf cottonwood, Siberian elm, rubber rabbitbrush (*Chrysothamnus nauseosus*), snowberry, Canada thistle, musk thistle (*Carduus nutans*), prickly lettuce (*Lactuca serriola*), curlycup gumweed (*Grindelia squarrosa*), smooth brome (*Bromus inermis*), ragweed (*Ambrosia psilostachya*), white and yellow sweetclover (*Melilotus alba* and *M. officinalis*), golden currant, poison ivy (*Toxicodendron rydbergii*), teasel, field bindweed (*Convolvulus arvensis*), crested wheatgrass (*Agropyron cristatum*), cheatgrass (*Bromus tectorum*), blue gramma (*Bouteloua gracilis*), side oats gramma (*B. curtipendula*), and a large number of exotic weed and grass species.

2.2.6 Ecological Condition and Management History

The original topography of the area has been altered extensively. Current and past land uses which have shaped the landscape include commercial, industrial, and recreational uses as well as historic mining extraction (Arbogast et al. 2000). Extensive gravel mining has been a major factor in altering the topography and hydrology of the site in the recent past, especially in the portion of the project area located south of Clear Creek. Overall, with the exception of the extreme northeast corner, most of the site has been heavily used and altered. The vegetation is dominated by non-native and weedy species over most of the site and much of the landscape consists of reclaimed aggregate mining sites, unreclaimed aggregate mining sites, holding ponds, and overburden and construction storage sites.

3.0 PROJECT DESCRIPTION

The I-70/32nd Avenue interchange improvement process began with the development of a broad range of alternatives to address potential effects on traffic operations by regional growth and a proposed development located southwest of the I-70/SH 58 interchange. The *I-70/32nd Avenue Interchange System Level Feasibility Study* (FHU 2005) examined 21 alternatives and nine sub-alternatives. The System Level Feasibility Study, which was approved by the Colorado Transportation Commission in September 2005, advanced three alternative packages for further study in the EA. Technical screening and evaluation narrowed down the list of alternatives and resulted in identification of the Proposed Action.

3.1 Proposed Action

The Proposed Action is shown on **Figure 3-1** and consists of the following series of elements:

- **New I-70/32nd Avenue Interchange Hook Ramps**
  - Construction of off-set hook ramps at the I-70/32nd Avenue interchange with the westbound hook ramps located north of 32nd Avenue at approximately 38th Avenue and the eastbound hook ramps located at Youngfield Street and 27th Avenue
  - Construction of a third I-70 bridge over 32nd Avenue for the I-70 westbound ramp traffic
  - Closure of the existing westbound I-70 off-ramp that exits to 32nd Avenue. The existing westbound I-70 on-ramp would remain open but access would be limited to eastbound 32nd Avenue traffic only
  - Reconstruction and restriping of Youngfield Street between 27th Avenue and approximately 30th Avenue to achieve a 5-lane roadway section

- **32nd Avenue Improvements**
  - Widening of 32nd Avenue between approximately Alkire Street and approximately Xenon Street and the widening of Youngfield Street between approximately 35th Avenue and 30th Avenue in the vicinity of the I-70/32nd Avenue interchange
  - Connection of Cabela Drive with 32nd Avenue west of I-70 (40th Avenue to 32nd Avenue)

- **New SH 58/Cabela Drive Interchange**
  - Construction of a new diamond interchange on SH 58 west of Eldridge Street and connection of Cabela Drive to this interchange
  - Connection of Cabela Drive with 44th Avenue north of the new interchange on SH 58

- **I-70/Ward Road Interchange**
  - Restriping of the Ward Road and westbound I-70 on-ramp intersection to add an additional southbound left turn lane onto the ramp and widen the ramp to receive this lane
  - Addition of a second right-turn lane for the eastbound I-70/Ward Road off-ramp

- **Bicycle/Pedestrian Improvements**
  - Relocation of the Jefferson County Open Space Clear Creek trail in the vicinity of the new SH 58/Cabela Drive interchange

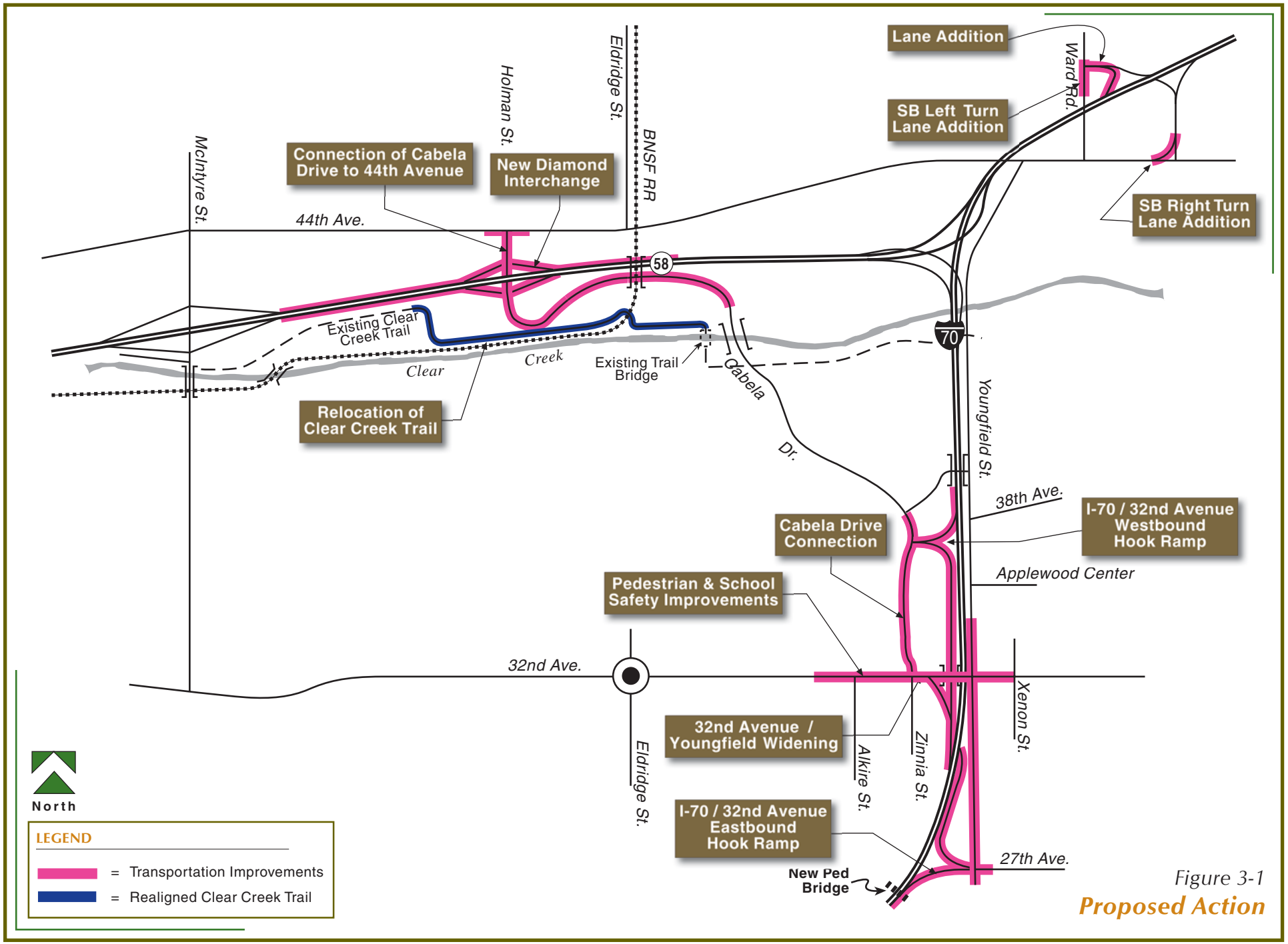


Figure 3-1

Proposed Action

- Replacement of the 32nd Avenue trail detached sidewalk along the south side of 32nd Avenue from Alkire Street to Cabela Drive with an attached sidewalk
- Improvements to pedestrian and school safety along 32nd Avenue
- Construction of an Americans with Disabilities Act (ADA) compliant pedestrian bridge at 27th Avenue to replace the existing pedestrian bridge at 26th Avenue as part of the eastbound I-70 hook ramps
- Provisions for Jefferson County Open Space Clear Creek Trail access through the development site from 32nd Avenue
- Wider sidewalks under I-70 on the south side of 32nd Avenue to better accommodate bicycles and pedestrians

3.2 Local Agency Projects

The City of Wheat Ridge submitted an application to CDOT for construction of a series of local agency projects that are common to each of the three alternative packages presented in the System Level Feasibility Study and that would be independent and stand on their own merits should no other improvements take place. The local agency projects do not preclude any of the alternatives evaluated in the EA. The local agency projects include:

- Construction of the 40th Avenue underpass of I-70
- Widening of Youngfield Street from 38th Avenue to 44th Avenue
- Construction of Cabela Drive from 40th Avenue to the proposed development just north of Clear Creek

These local agency projects are to be completed by the City of Wheat Ridge as separate projects that are not dependent on the interchange improvements or on federal funding and thus are included in the travel demand forecasting for the traffic analysis. Access approval through a Categorical Exclusion allowed access to interstate right-of-way to accommodate the 40th Avenue underpass of I-70 and the widening of Youngfield Street from 38th Avenue to 44th Avenue. Cabela Drive from 40th Avenue to the proposed development just north of Clear Creek is a local agency project and can proceed without FHWA and CDOT approval. As a local agency action not requiring CDOT right-of-way, FHWA/CDOT approval for construction of Cabela Drive from 40th Avenue to the proposed development just north of Clear Creek is not required; however, environmental permitting for these projects such as the Clean Water Act and other relevant environmental regulations will be the responsibility of the local agency or developer.

3.2.1.1 Youngfield Street Widening from 38th Avenue to 44th Avenue

The widening of Youngfield Street would occur from 38th Avenue north to 44th Avenue. From 32nd Avenue north to 38th Avenue, Youngfield Street is already a five lane facility; the widening of Youngfield Street would extend this cross-section further north to its terminus at 44th Avenue. The widening of Youngfield Street from 38th to 44th Avenue, from its current two lane configuration, would incorporate two additional through lanes in each direction and a center left turn lane at intersections.

The bridge over Clear Creek on Youngfield Street is wide enough for four lane usage, but currently only two lanes are being used. The barriers blocking the additional two lanes on the bridge would be removed and the bridge would begin to function as four 12-foot lanes.

The Youngfield Street improvements would also incorporate needed turn lanes at the 44th Avenue intersection such that double left turn lanes from westbound 44th Avenue and double right turn lanes from northbound Youngfield Street can be accommodated. These turn lane additions are also a common element to the three short-listed alternative packages.

3.2.1.2 40th Avenue Underpass of I-70

The 40th Avenue underpass of I-70 is proposed to be four lanes with a 10-foot sidewalk on the north side. Three lanes and the sidewalk would be initially constructed: one inbound to the proposed development and two outbound to Youngfield Street. Depending on the final extension of Cabela Drive to 32nd Avenue, this design could change slightly. The underpass would be designed to accommodate the potential future widening of I-70 and would accommodate all the improvements planned for the I-70 and SH 58 build out project by CDOT.

The 40th Avenue underpass would intersect with the Youngfield Service Road, creating an at-grade signed "T" intersection with the segment north of 40th Avenue. The southern segment of the Youngfield Service Road would not connect to 40th Avenue, but would continue to provide access to businesses located immediately north of 32nd Avenue on the service road. Access to the Jefferson County Open Space Clear Creek Trail would occur from the east via Youngfield Street through the 40th Avenue underpass to the northern portion of the Youngfield Service Road, and from the west via the proposed development roadway network.

3.2.1.3 Cabela Drive from 40th Avenue to Just North of Clear Creek

The construction of Cabela Drive would include a portion of 40th Avenue extending from the 40th Avenue underpass to the west where 40th Avenue would intersect with Cabela Drive, which is a north-south roadway. 40th Avenue is proposed to be a four lane facility with adjacent sidewalks through the proposed development site. From the Cabela Drive/40th Avenue intersection to the proposed development just north of Clear Creek, Cabela Drive would consist of four through lanes with a center turn lane and adjacent sidewalks. The Clear Creek bridge crossing of Cabela Drive would include three through lanes transitioning to a three through lane facility with a center turn lane north of Clear Creek. The proposed crossing of the Jefferson County Open Space Clear Creek Trail, south of Clear Creek, would be grade separated.

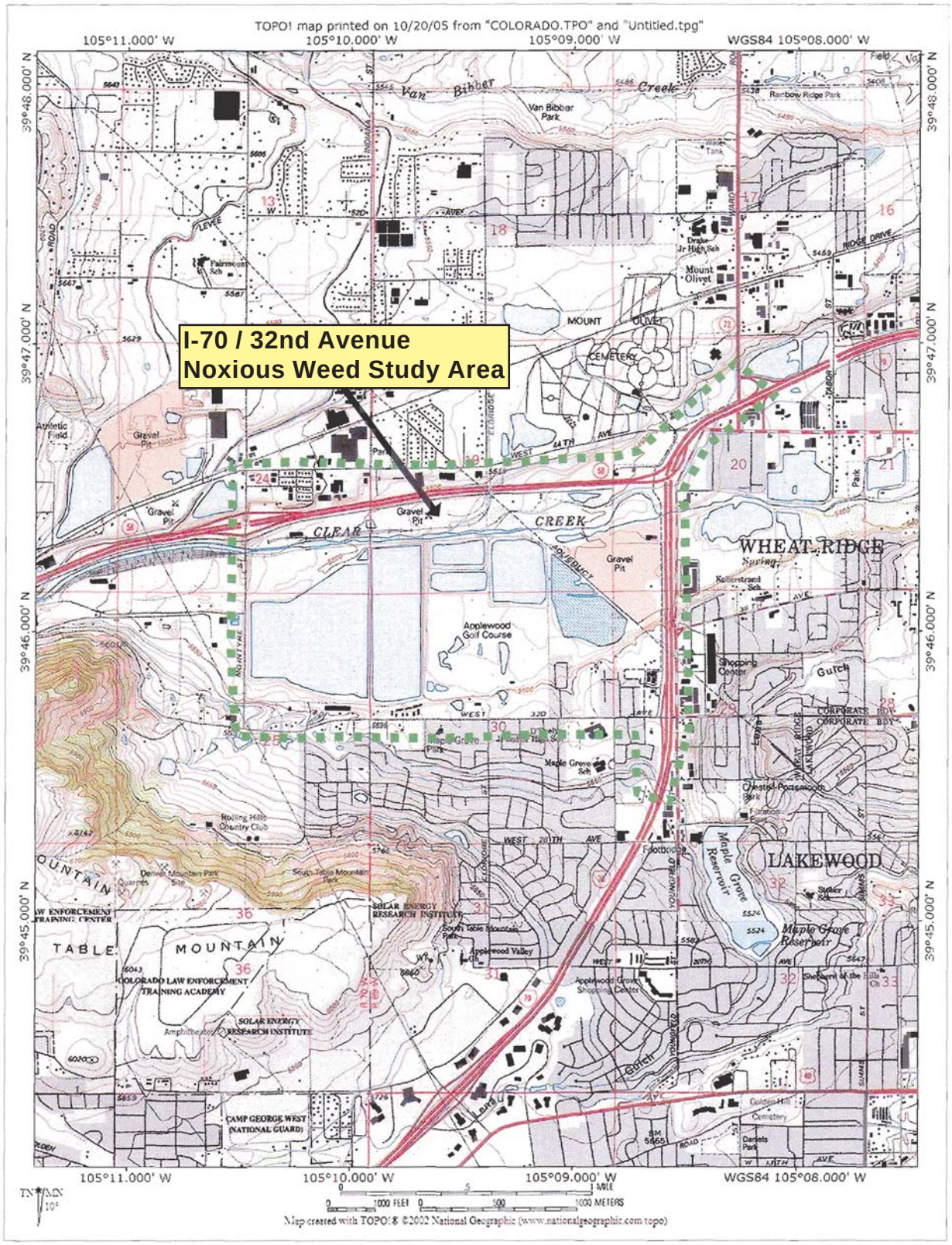
4.0 METHODS

NRSI conducted a noxious weed survey over the entire I-70/32nd Avenue Interchange EA project area between September 1 and September 26, 2005. The entire project site was thoroughly walked by Steve C. Johnson, Senior Ecologist with NRSI during that period. The study area (**Figure 4-1**) was visually searched on foot in a systematic fashion to thoroughly cover the area as efficiently as possible. Noxious weed species listed by the state of Colorado (Colorado Department of Agriculture 2005), Jefferson County (Jefferson county 2006), the City of Wheat Ridge (City of Wheat Ridge and ERO Resources Corporation 2002), and CDOT (CDOT 2006) were identified, locations and coverage areas were noted on a recent aerial photograph, and weed species densities. Density estimates were estimated using best professional judgment at each identified location and conformed to CDOT Region 6 density definitions, as follows*:

- **Very high** =1% to 100% of the area is occupied by noxious weed species
- **High** = 36% to 60% of the area is occupied by noxious weed species
- **Medium** = 11% to 35% of the area is occupied by noxious weed species
- **Low** = 0% to 10% of the area is occupied by noxious weed species

* The percentage of noxious weeds out of all the vegetation in the entire assessed location.

Onsite sampling procedures also included visual inspection of the soils, hydrology, and flora of the overall project site and identification of distinct plant communities. If a plant species could not be identified in the field, samples were taken to the lab for identification using appropriate reference books and keys (Carter 1988; Gleason and Cronquist 1963; Hitchcock and Chase 1971; Royer and Dickinson 1999; Weber 1976, Weber and Wittman 1996; Whitson et al. 2001; Wingate 1994).



North

Figure 4-1

Noxious Weed Study Area

5.0 RESULTS

The project area has a long history of land uses which have resulted in repeated disturbance of native soils (Arbogast et al. 2000). Such disturbances created optimum opportunities for invasive weed species to become established in the area.

The field survey conducted within the project area in September 2005 resulted in the identification of 24 noxious weed species which are listed on the Colorado Department of Agriculture Noxious Weed Lists A, B and C (Colorado Department of Agriculture 2005) (see **Table 5-1** and **Figures 5-1, 5-2, and 5-3**). Two of these, i.e. cypress spurge and myrtle spurge, are listed on the Colorado "A" list, sixteen are listed on the Colorado "B" list, and six are listed on the Colorado "C" list (see **Table 5-1**).

In addition, fifteen noxious weed species listed on the Jefferson County Noxious Weed List (Jefferson County 2006) were identified on the site (see **Table 5-1**). Ten of these species are listed on the Jefferson County List as requiring control and three species, cypress spurge, myrtle spurge and salt cedar, are listed by Jefferson County as requiring eradication (Jefferson County 2006). Many of the identified weed species were located in sparse to dense populations distributed throughout the entire project area (see **Table 5-2** and **Figures 5-1, 5-2, and 5-3**).

Also, fifteen of the seventeen noxious and undesirable plants listed in the City of Wheat Ridge Open Space Management Plan (City of Wheat Ridge and ERO Resources Corporation 2002) were identified within the project area (see **Table 5-1**). The only two weed species listed by Wheat Ridge and not identified on the site were buckthorn and purple loosestrife.

Finally, fifteen species of noxious weeds listed on the CDOT Maintenance Program Noxious Weed List (CDOT 2006) were identified within the project area (see **Table 5-1**).

Figures 5-1 through 5-3 show the locations and extent of coverage within the project area of weed species listed on the Colorado, CDOT, Jefferson County and City of Wheat Ridge lists. Most identified noxious weed populations were located on previously disturbed upland sites although weed populations were scattered throughout the project area to include some riparian areas along Clear Creek and the Bayou and Juchem Ditches and other wetland areas located along the SH 58 frontage road (see **Figures 5-1, 5-2, and 5-3**).

Table 5-1 Noxious Weed Species Identified in the Project Area

Scientific Name	Common Name	Colorado Weed List A, B or C?[1]	Jefferson County Weed List Requirements[2]	Listed by the City of Wheat Ridge[3]	Listed on the CDOT Maintenance Program Noxious Weed List[4]
Arctium minus	Common burdock	C			
Bromus tectorum	Downy brome (Cheatgrass)	C			
Cardaria draba	Whitetop (Hoary cress)	B	Control Required		Yes
Carduus nutans	Musk thistle	B	Control Required	Yes	Yes
Centaurea (Acosta) diffusa	Diffuse knapweed	B	Control Required	Yes	Yes
Cichorium intybus	Chickory	C			
Cirsium arvense	Canada thistle	B	Control Required	Yes	Yes
Cirsium vulgare	Bull thistle	B		Yes	Yes
Clematis orientalis	Chinese clematis	B	Control Required	Yes	Yes
Conium maculatum	Poison hemlock	C		Yes	
Concolvulus arvensis	Field bindweed	C			Yes
Cynoglossum officinale	Houndstongue	B	Control Required		Yes
Dipsacus fullonum	Common teasel	B	Control Required	Yes	
Dipsacus laciniatus	Cut-leaf teasel	B	Control Required	Yes	
Elaeagnus angustifolia	Russian olive	B		Yes	Yes
Euphorbia cyparissias	Cypress spurge	A	Eradication required		
Euphorbia esula	Leafy spurge	B	Control Required	Yes	Yes
Euphorbia myrsinites	Myrtle spurge	A	Eradication required		Yes
Linaria genistifolia	Dalmatian toadflax	B	Weed of Concern	Yes	Yes
Linaria vulgaris	Yellow toadflax	B	Weed of Concern	Yes	Yes
Onopordum acanthium	Scotch thistle	B	Control Required	Yes	Yes
Saponaria officinalis	Bouncingbet	B			
Tamarix ramosissima	Salt cedar (Tamarisk)	B	Eradication required	Yes	Yes
Verbascum thapsus	Common mullein	C	Weed of concern		

[1] Colorado Department of Agriculture (2006).
[2] Jefferson County (2006).
[3] City of Wheat Ridge and ERO Resources Corporation (2002).
[4] Colorado Department of Transportation (2006)

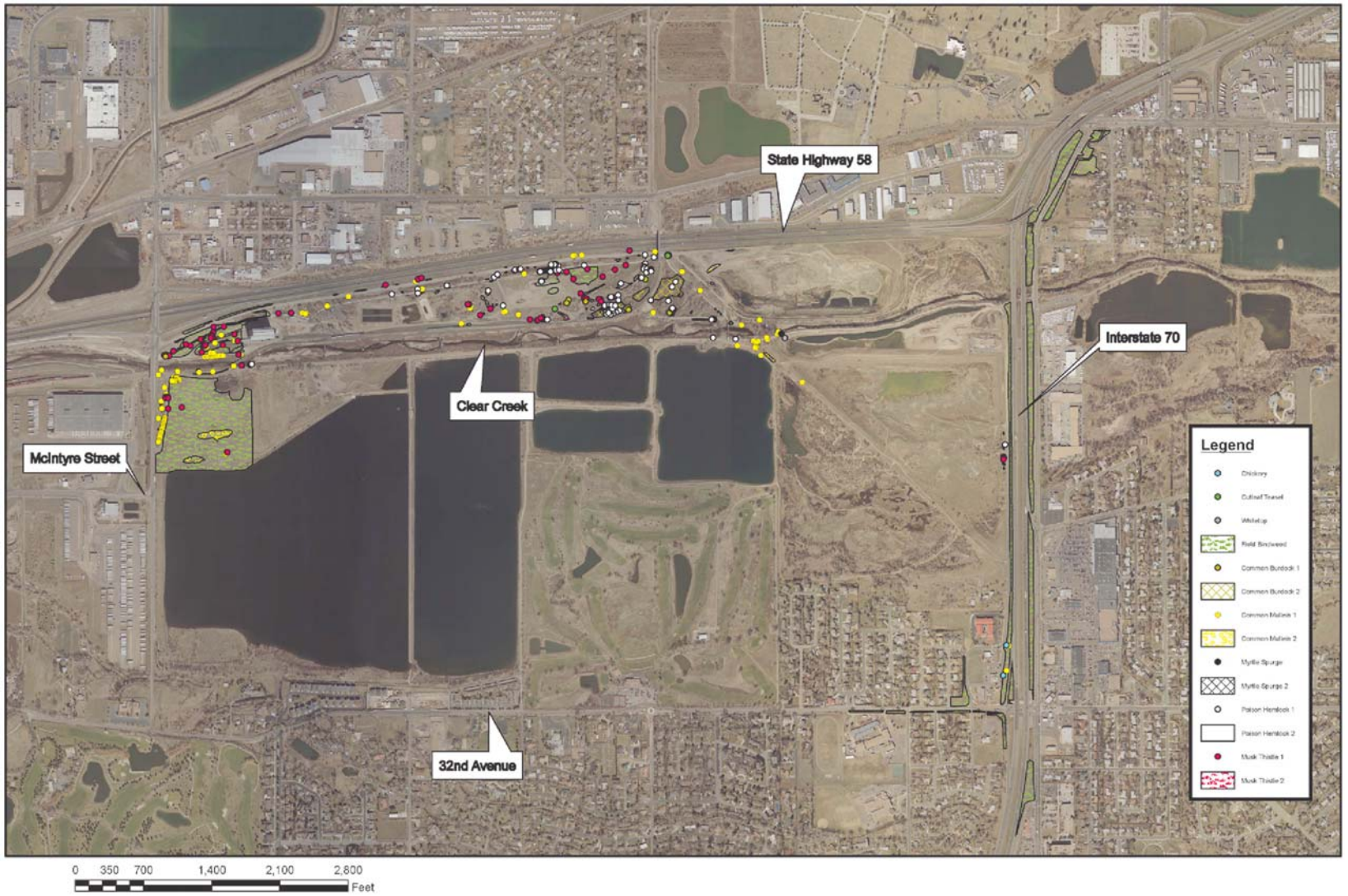


Figure 5-1

Nine of 24 Noxious Weed Species within the Project Area

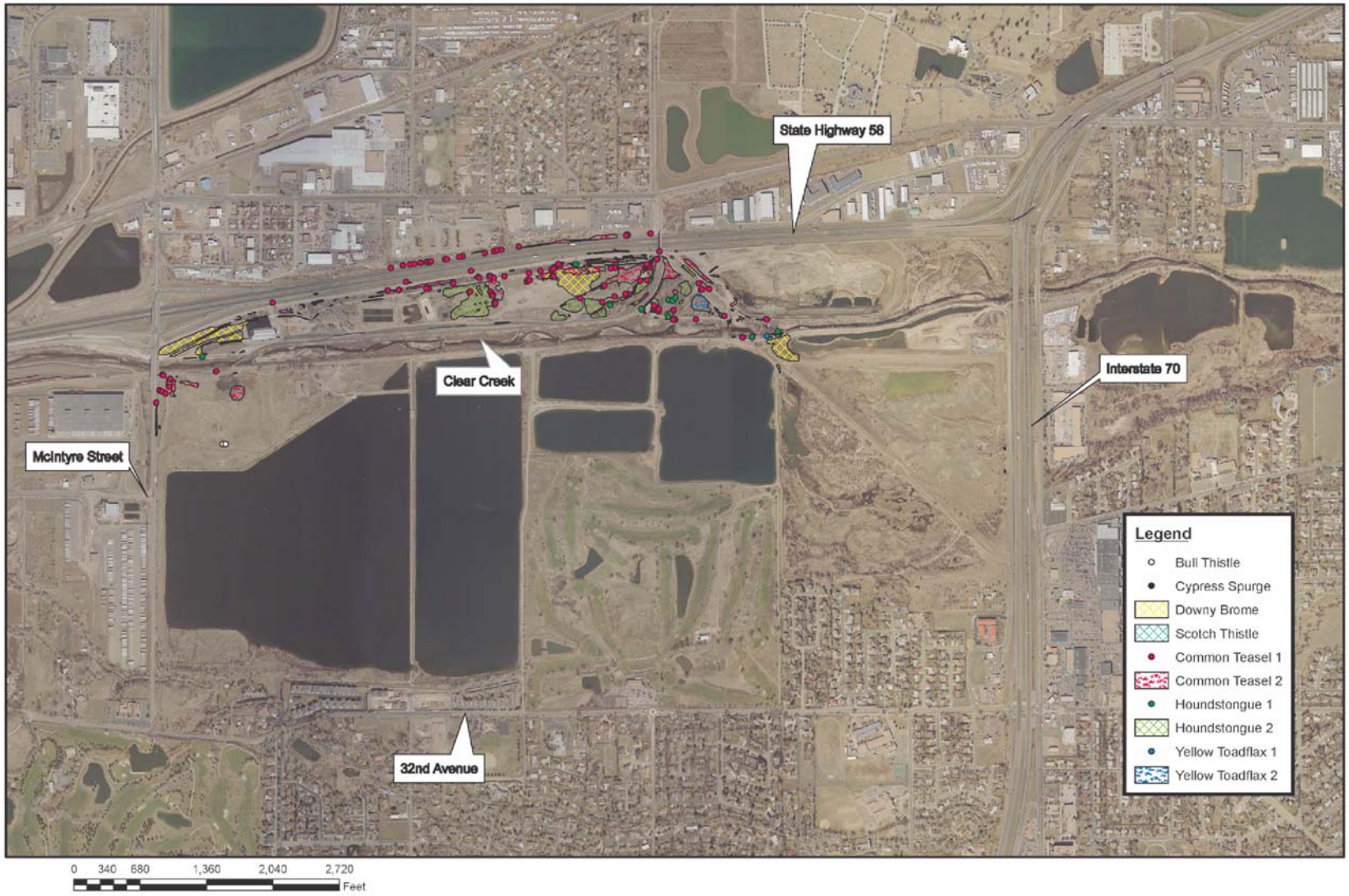


Figure 5-2

Seven of 24 Noxious Weed Species within the Project Area

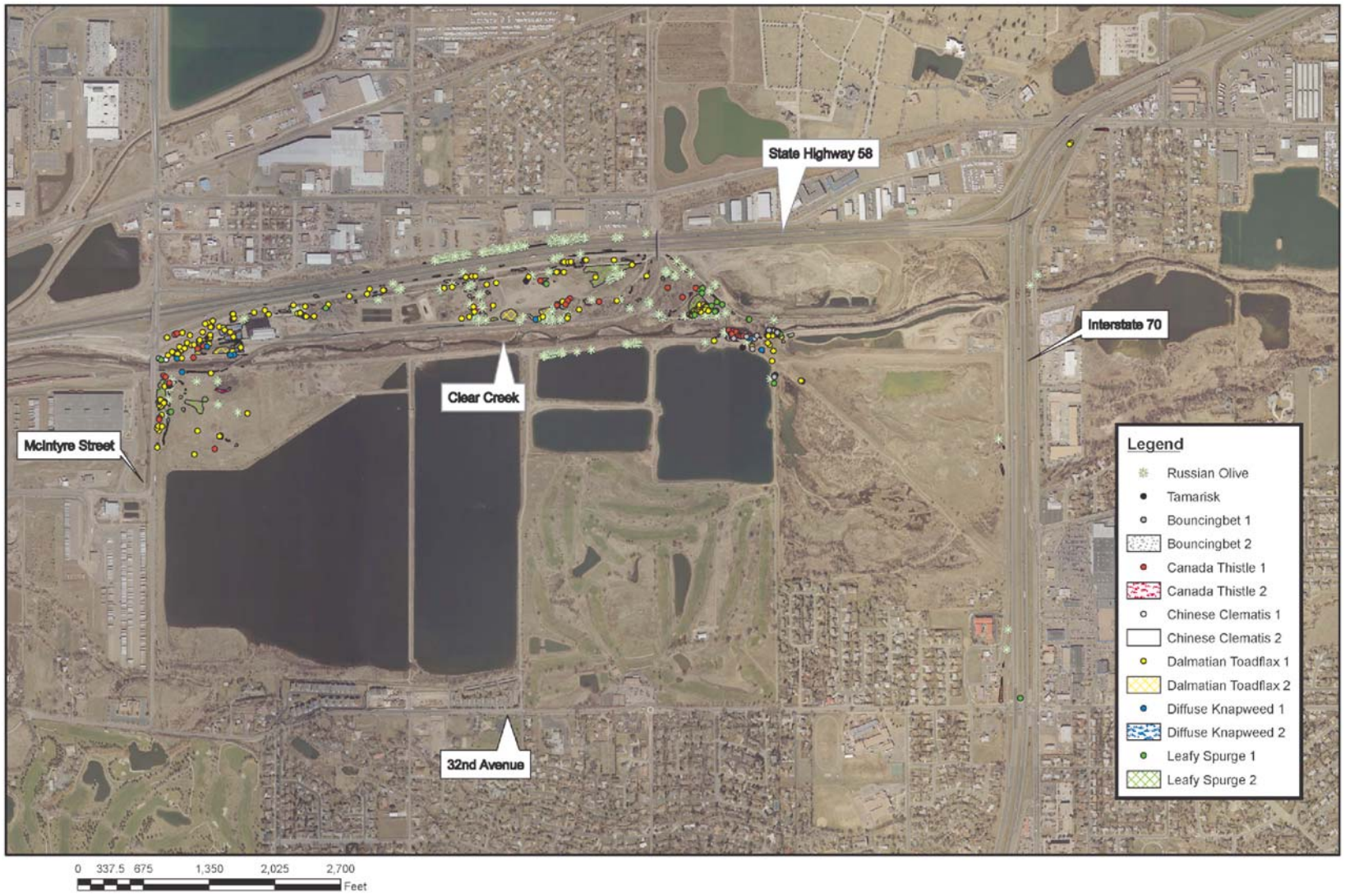


Figure 5-3

Eight of 24 Noxious Weed Species within the Project Area

Table 5-2 Characteristics of Noxious Weed Species

Common Name	Scientific Name	Density within the I-0/32nd Ave. Project Site	Seasonality of Occurrence[abc]	Habitat Preference[abc]
Common burdock[f]	*Arctium minus*	Common. Sparse to dense populations in most riparian forested areas on the site.	Summer biennial. Reproduces by flowers and seed the second year.	Roadsides, ditchbanks, pastures and waste areas.
Cheatgrass (Downy brome)[f]	*Bromus tectorum*	Very common. Small to large areas along most roadsides and in open areas throughout the site.	Winter annual grass.	Disturbed and overgrazed grassland and fields.
Whitetop (Hoary cress)[eh]	*Cardaria draba*	Uncommon. One small population at the east end of the property.	Perennial which reproduces by sprouting from horizontal roots and by seed, flowering in spring and early summer.	Roadsides, open rangeland and disturbed areas.
Musk thistle[eh]	*Carduus nutans*	Common. Sparse to dense populations scattered throughout the site.	Biennial or winter annual. Reproduces by seed.	Pasture, rangeland, forestland, roadsides, waste areas, ditches, farmland, disturbed areas.
Diffuse knapweed[eh]	*Centaurea* (*Acosta*) *diffusa*	Abundant. Dense stand west of the grain silos at the west end of the project site. Scattered sparse stands in a few other areas.	Perennial with an extensive deep root system. Flowers from late June until frost. Reproduces by seed and sprouting from roots.	Disturbed and undisturbed grassland and shrubland.
Chickory[f]	*Cichorium intybus*	Uncommon. Sparse populations at two sites just south of SH 58 and at 32nd Avenue/I-70 Interchange.	Perennial which flowers from July through September.	Roadsides, open range and disturbed areas.
Canada thistle[eh]	*Cirsium arvense*	Very common. Moderate to dense stands throughout most of the riparian areas and wetlands of the project area.	Perennial with an extensive root system. Flowers from June through August. Reproduces by seed and sprouting from deep roots.	Disturbed ground, open soil, wet areas.
Bull thistle[e]	*Cirsium vulgare*	Uncommon. Sparse population at one location.	Annual reproducing by seed..	Disturbed and cultivated areas.
Chinese clematis[eh]	*Clematis orientalis*	Common. Moderate to dense populations throughout most shrubby areas of the project site.	Perennial woody vine reproducing from seeds which flowers from late June through August.	Riparian corridors, rocky areas, shrubby roadsides.
Poison hemlock[f]	*Conium maculatum*	Common. Moderate to heavy infestations within most riparian and wetland areas on the site.	Summer biennial. Reproduces by flowers and seeds.	Wet areas, stream and ditch banks, pastures.
Field bindweed[f]	*Convolvulus arvensis*	Abundant. Moderate to dense infestations throughout most of the open areas of the project area.	Perennial with an extensive root system. Flowers from late June until frost. Reproduces by seed and sprouting from roots.	Cultivated fields, pastures, lawns, disturbed areas, waste areas, roadsides.
Houndstongue[eh]	*Cygnoglossum officinale*	Very common. Common in the forested riparian areas over the entire project area.	Biennial or short lived perennial forb. Reproduces by flowers and seed.	Disturbed areas with bare ground.
Common teasel[eh]	*Dipsacus fullonum*	Very common. Sparse to very dense stands in most riparian and wetland areas of the project area.	Biennial to short lived perennial. Reproduces by seed. Flowers from June to October.	Disturbed soil.

Common Name	Scientific Name	Density within the I-0/32nd Ave. Project Site	Seasonality of Occurrence[abc]	Habitat Preference[abc]
Cutleaf teasel[eh]	*Dipsacus laciniatus*	Uncommon. One sparse population immediately east of the railroad and immediately south of the SH 58 frontage road.	Summer annual reproducing by seed.	Disturbed areas, roadsides and waste areas.
Russian olive[e]	*Elaeagnus angustifolia*	Fairly common. Sparse to dense stands throughout the site.	Perennial small tree.	Does best in lower wetter sites but grows well in a variety of conditions.
Cypress spurge[dg]	*Euphorbia cyparissias*	Uncommon. Sparse population at one location within the site.	Perennial which reproduces by lateral roots and seed, flowering in summer and early fall.	Open areas and disturbed areas.
Leafy spurge[eh]	*Euphorbia esula*	Abundant. Moderate to dense populations at several locations throughout the site.	Annual which reproduces by flowers and seed in summer and early fall.	Disturbed sites.
Myrtle spurge[dg]	*Euphorbia myrsinites*	Uncommon. Sparse to dense populations at several locations, primarily near Clear Creek.	Perennial which reproduces only by seed. Flowers from March to May.	Disturbed and open sites in the dryer parts of the state.
Dalmatian toadflax[ei]	*Linaria genistifolia* ssp. *dalmatica*	Abundant. Sparse to moderate populations throughout most open areas of the site.	Perennial reproducing by seed and by underground root stalks.	Roadsides and rangeland. Crowds out desirable species.
Yellow toadflax[ei]	*Linaria vulgaris*	Fairly common. Scattered small populations throughout the site north of Clear Creek.	Perennial weed reproducing from lateral root growth and seeds. Flowers May to October.	Disturbed and degraded roadsides, rangeland and mountain parks.
Scotch thistle[eh]	*Onopordum acanthium*	Uncommon. Sparse in a few widely scattered locations.	Biennial. Reproduces by seed.	Disturbed and waste areas and roadsides.
Bouncing bet[e]	*Saponaria officinalis*	Fairly common. Heavy infestation along the roadway immediately south of Clear Creek and moderate populations in a few other areas of the site.	Perennial herbaceous forb growing in dense colonies. Reproduces by seed and rhizomes.	Disturbed areas.
Tamarisk (Salt cedar)[eg]	*Tamarix ramosissima*	Uncommon. Single plants found at two locations, one seedling south of Clear Creek at east end and one large bush just south of the trail in the center of the site.	Deciduous shrub or small tree which reproduces by sprouting and by seeds, flowering from mid-spring through late July.	Forms dense thickets in areas where ground water is near the surface. Redily established in disturbed areas in riparian areas.
Common mullein[fi]	*Verbascum thapsus*	Common. Scattered infestations throughout the entire site.	Summer biennial. Reproduces by flowers and seed in 2nd year.	River bottoms, pastures, meadows and waste areas.

a Whitson et al (2001).
b Colorado Natural Areas Program (2000).
c Personal communication with Kelly Uhing, Adams County, Colorado Weed Supervisor (2003).
d Listed on the Colorado Department of Agriculture Noxious Weed "A" List effective May 2005.
e Listed on the Colorado Department of Agriculture Noxious Weed "B" List effective May 2005.
f Listed on the Colorado Department of Agriculture Noxious Weed "C" List effective May 2005.
g Listed by Jefferson County as a required species to eradicate.
h Listed by Jefferson County as a required species to control.
i Listed by Jefferson County as a weed of concern.

Characteristics of noxious weed species listed by Jefferson County (2006) and the Colorado Department of Agriculture (2005) which were identified within the I-70/32nd Avenue Interchange EA Project Area during field surveys conducted by Natural Resource Services, Inc. between September 1, 2005 and September 26, 2005.

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6.0 IMPACT ANALYSIS

The following is a description of the anticipated impacts which may be incurred by implementation of the No Action Alternative and the Proposed Action.

6.1 Weed Impacts to Public Lands

Publicly owned or controlled lands adjacent to the project area of the Proposed Action include various highway rights of way for I-70, SH 58, 32nd Avenue, 44th Avenue, Ward Road, Youngfield Street, and McIntyre Street (see **Figure 2-2**) as well as the Jefferson County Open Space Clear Creek Trail which parallels Clear Creek and the south side of SH 58. Most of these sites are also occupied by some or all of the noxious weed species identified within the project area during this study. Control measures to include mowing and some chemical control are implemented periodically on some of these sites by the controling agencies. Activities implemented in association with construction of the proposed alternative could impact these adjacent properties, especially the area bordering the Jefferson County Open Space Clear Creek Trail.

The local agency projects to be completed by the City of Wheat Ridge include:

- Construction of the 40th Avenue underpass of I-70
- Widening of Youngfield Street from 38th Avenue to 44th Avenue
- Construction of Cabela Drive from 40th Avenue to the proposed development north of Clear Creek

One or more of these local agency projects are located adjacent to City of Wheat Ridge Open Space properties located along the Clear Creek corridor at the eastern end or the site (City of Wheat Ridge and ERO Resources Corporation 2002) and the Jefferson County Open Space Pedestrian Trail. Noxious weed species identified in the areas where the above listed local projects are proposed included field bindweed, musk thistle, Dalmatian toadflax, common mullein, whitetop (hoary cress), myrtle spurge, poison hemlock, houndstongue, downy brome, common teasel, yellow toadflax, bouncingbet, Russian olive, diffuse knapweed, leafy spurge, tamarisk, Chinese clematis, and Canada thistle (see **Figures 5-1, 5-2, and 5-3**). Control measures implemented for noxious weed control within the local agency projects should be cognizant of the proximity of the sensitive open space properties.

6.2 Weed Impacts to Open Water and Wetlands

Open water areas in the project area include the large Coors Brewing Company ponds south of Clear Creek, the small Coors ponds north of Clear Creek, the Bayou and Juchem Ditches, and the Clear Creek channel itself. Wetlands in the project area include a network of forested, scrub-shrub and emergent wetlands associated with the Bayou and Juchem Ditches and the stormwater runoff system associated with SH 58 and its frontage road. Some of the wetlands will be directly impacted during the construction of the Proposed Action. Construction activities may contribute to the spread of noxious weed seeds through water flowing along the ditches or Clear Creek. Care should be exercised around wetlands and open water if chemical control methods are implemented during project construction.

6.3 Weed Impacts to Agricultural Lands

No agricultural lands are located immediately adjacent to the project site. Two irrigation ditches do flow through the site, however, and could serve as conduits for the spread of weed seeds or parts and for chemical weed control agents to downstream agricultural sites.

7.0 PREVENTIVE MEASURES

The following CDOT approved preventive measures should be used to prevent the spread of noxious weeds and minimize the potential effects from control treatments (CDOT 2006).

- Minimization of soil disturbance to the maximum extent possible
- Staging of equipment will not be permitted in weed-infested areas
- Clean all construction-related equipment thoroughly before off-loading at the project site and after working with weed-contaminated soils
- Use of a state-licensed herbicide applicator
- Coordination of weed management efforts with local jurisdictional agencies and adjacent landowners to the extent possible
- Avoidance of non-target injury to adjacent native plant communities, landscaping, sensitive wildlife habitat, and nearby persons or beekeeping operations (if present)
- Herbicides can be used immediately adjacent to wetlands, riparian areas, and/or water bodies only IF the label indicates its use is appropriate for such areas
- Application of herbicides immediately adjacent to active prairie dog colonies will not be permitted
- Noxious weeds observed in and near the construction area, within the CDOT right-of-way, will be treated with herbicides or mechanically removed prior to the start of construction to minimize spread
- Re-seeding of all disturbed soil with a certified weed-free seed mix within seven days of completion of work between September 1 until consistent ground freeze and from spring thaw until June 1
- For those areas that can not be re-seeded within seven days (due to the time of year as stated above), certified weed-free mulch and mulch tackifier will be used for temporary erosion control (weed-free is defined and regulated by the Weed Free Forage Act, title 35, Article 27.5, CRS)
- Certified weed-free straw bales will be used for sediment barriers
- Revegetate all areas disturbed by construction activities with an appropriate certified weed-free native seed mix appropriate for the soils (e.g., wetland, upland, sodium-affected) in the disturbed area
- Fertilizer will not be used in seeded areas because it can enhance the growth of noxious weeds at the expense of desired vegetation
- Use of A horizon soil material currently supporting noxious weed cover of more than 10% should not be used as topsoil during revegetation unless treated with pre- and post-emergent herbicides
- Any imported topsoil will first be treated with pre- and post-emergent herbicides before being used on the site
- Monitor all areas treated for noxious weeds during construction and re-treat, if necessary, to prevent re-establishment of noxious weeds

Additional preventive measures which should be considered include:

1. Have a weed specialist inspect the construction area immediately prior to, during, and immediately after construction

2. Temporary fences should be installed to limit construction traffic in weed-infested areas in an effort to reduce erosion and the spread of weeds

3. Minimize soil disturbance during construction. Replant with desirable species as soon as possible after disturbance

4. Keep on site all topsoil which is collected from the site and which is to be reapplied after construction during the landscaping phase to prevent dispersal of weed seeds and cuttings. If topsoil remains stockpiled for more than one month, the stockpile should be seeded with annual grasses.

5. Employ mechanical control methods, e.g., hand pulling or removal with construction machinery to remove and control species which are uncommon on the site or which can be easily removed mechanically (e.g., Dalmatian toadflax, bouncing bet, tamarisk, Scotch thistle, bull thistle, cutleaf teasel, myrtle spurge, cypress spurge, and Russian olive).

6. Employ spot spraying in the late spring with a broad spectrum herbicide such as glyphosate to remove and control noxious grass species such as cheatgrass

7. Treat weed sprouts on all stockpiled topsoil piles with a mixture of picloram and 2,4-D herbicide at least 7 days prior to reapplication of topsoil to the site for landscaping

8. Treat all landscaped areas with a grass tolerant broad leaf specific herbicide such as a mixture of picloram and 2,4-D in the early fall after construction and landscaping are completed. This treatment should be applied in the fall only if landscaping was completed early enough to allow treatable weed sprout growth to occur prior to treatment. Otherwise, postpone treatment to the following mid to late spring after sprouting has occurred.

9. Following construction, the site should be monitored for the need for follow-up weed control at least twice over the first growing season

CDOT required standards for herbicide use:

1. **Colorado DOT Standard Specifications Section 217 requires safe handling of all herbicides and submission of documentation prior to application certifying that the herbicide(s) is applied by an insured and licensed Commercial Applicator in right-of-way application**.

2. **All herbicides shall be labeled for use in the proposed area of application and labeling information shall be provided to the CDOT Engineer**.

8.0 CONTROL MEASURES

Table 8-1 presents species specific recommended control measures which may be implemented.

When multiple species of noxious weeds are present in a given area, the optimal herbicide (or other method) to eradicate state of Colorado A-listed species should be used. Otherwise, the most effective herbicide for all B-listed species present should be used (CDOT 2006). Timing of the application or other treatment should be coordinated at the optimal time based on the ecology of the species present, particularly the A-listed species, if construction conditions permit.

The following species should not be mowed (because mowing stimulates growth):

- Downy Brome (*Bromus tectorum*)
- Field Bindweed (*Convolvulus arvensis*)
- Leafy Spurge (*Euphorbia esula*)
- Yellow Toadflax (*Linaria vulgaris*)

Mowing is ineffective for these species unless combined with herbicide treatment:

- All Knapweeds (*Centaurea* (*Acosta)* sp.)
- Kochia (*Kochia scoparia)*
- Perennial Pepperweed (*Lepidium latifolium)*

Table 8-1 Recommended Control Measures For Noxious Weed Species

Common Name	Scientific Name	Recommended Control Measures[defg]
Common burdock	*Arctium minus*	Mechanical control by pulling or mowing frequently. Herbicide treatment using spot application of a broadleaf herbicide such as glyphosate (Roundup), 2,4-D, or picloram (Tordon) during the spring and summer growing season before seed set.
Downy brome (Cheatgrass)	*Bromus tectorum*	Minimize disturbances and enhance desirable species as competition. Combine grazing or burning with springtime herbicide applications using glyphosate (Roundup) or imazapic (Plateau) followed by fall seeding with desirable species.[abc]
Whitetop (Hoary cress)	*Cardaria draba*	Cultural management (enhanced competition from desirable species); Monthly mechanical mowing and/or cultivation to prevent bolting; Biological control by grazing and experimental insects such as the seed-head weevil (*Rhinocyllus conicus*); Application of herbicides such as picloram (Tordon), clopyralid (Stinger or Redeem), chlorsulfuron (Telar), glyphosate (Roundup & Rodeo), chlorsulfuron methyl (Escort), dicamba (Banvel), and premixed clopyralid and 2,4-D (Curtail) in the late spring before budding or early fall while still green.[bc]
Musk thistle	*Carduus nutans*	Cultural management (enhanced competition from desirable grasses); Mechanical mowing and grubbing; biological control using experimental insects such as the seed head weevil (*Rhinocyllus conicus*) combined with the crown weevil (*Trichosirocalus horridus*); Application of herbicides such as picloram (Tordon), glyphosate (Roundup & Rodeo), chlorsulfuron methyl (Escort), dicamba (Banvel), and 2,4-D in the late spring before budding or early fall while still green.[bc]
Diffuse knapweed	*Centaurea diffusa*	Cultural management (enhanced competition from desirable species); Mechanical mowing and cultivation early season; Application of herbicides such as chlorsulfuron (Telar), picloram (Tordon), glyphosate (Roundup), dicamba (Veteran 10G), and premixed clopyralid and 2,4-D (Curtail) from rosette through prebud stage.[bc]

Common Name	Scientific Name	Recommended Control Measures[defg]
Chickory	*Cichorium intybus*	Mechanical control by pulling or mowing frequently. Herbicide treatment using spot application of a broadleaf herbicide such as, 2,4-D, or picloram (Tordon) during the spring and summer growing season before seed set.[cd]
Canada thistle	*Cirsium arvense*	Cultural management (enhanced competition from desirable species); Monthly mechanical mowing and/or cultivation to prevent bolting; Biological control by grazing and experimental insects such as the seed-head weevil (*Rhinocyllus conicus*); Application of herbicides such as picloram (Tordon), clopyralid (Stinger or Redeem), chlorsulfuron (Telar), glyphosate (Roundup & Rodeo), chlorsulfuron methyl (Escort), dicamba (Banvel), and premixed clopyralid and 2,4-D (Curtail) in the late spring before budding or early fall while still green.[bc]
Bull thistle	*Cirsium vulgare*	Mechanical control by pulling. Herbicide treatment using spot application of a broadleaf herbicide such as glyphosate (Roundup), clopyralid plus triclopyr amine (Redeem), or Grazon (picloram plus 2,4-D).
Chinese clematis	*Clematis orientalis*	Mechanical control by pulling or mowing frequently. Herbicide treatment using spot application of a broadleaf herbicide such as glyphosate (Roundup), 2,4-D, or picloram (Tordon) during the spring and summer growing season before seed set.[cd]
Poison hemlock	*Conium maculatum*	Application of herbicides suitable for broad leafed woody species such as picloram (Tordon), glyphosate (Roundup), and Grazon (picloram plus 2,4-D) during the growing season before bolting. This plant occurs commonly in wetland areas so precautions should be taken to prevent undesirable results such as stream and groundwater contamination.[bc]
Field bindweed	*Convolvulus arvensis*	Mechanical by cultivation, grubbing or covering; Application of herbicides such as picloram (Tordon), fosamine (Krenite); atrazine; glyphosate (Roundup & Rodeo), dicamba (Banvel), and 2,4-D during the flowering stage, in the fall, or after precipitation when actively growing.[bc]
Houndstongue	*Cygnoglossum officinale*	Cultural management through enhanced competition from desirable perennials; Mechanical mowing for several years to prevent seed maturation; Application of herbicides such as premixed clopyralid and 2,4-D (Curtail), dicamba (Veteran 10G), or metsulfuron to the green rosettes in spring prior to bolting.[bc]
Common teasel	*Dipsacus fullonum*	Difficult to control. Mechanical control by pulling or mowing frequently. Herbicide treatment using spot application of a broadleaf herbicide such as glyphosate (Roundup), clopyralid plus triclopyr amine (Redeem), or Grazon (picloram plus 2,4-D).
Cutleaf teasel	*Dipsacus laciniatus*	Difficult to control. Mechanical control by pulling or mowing frequently. Herbicide treatment using spot application of a broadleaf herbicide such as glyphosate (Roundup), clopyralid plus triclopyr amine (Redeem), or Grazon (picloram plus 2,4-D).
Russian olive	*Elaeagnus angustifolia*	Mechanical removal; Application of herbicides suitable for broad leafed woody species such as picloram (Tordon), glyphosate (Roundup), and Grazon (picloram plus 2,4-D).
Cypress spurge	*Euphorbia cyparissias*	Mechanical control by pulling or mowing frequently. Herbicide treatment using spot application of a broadleaf herbicide such as 2,4-D, or picloram (Tordon) during the spring and summer growing season before seed set.[cd]
Leafy spurge	*Euphorbia esula*	Mechanical control by pulling, grazing with sheep or mowing frequently. Biological control with flea beetle. Herbicide treatment using spot application of a broadleaf herbicide such as 2,4-D, glyphosate (Roundup), or picloram (Tordon) during the spring and summer growing season before seed set.[cd]
Myrtle spurge	*Euphorbia myrsinites*	Mechanical control by pulling or mowing frequently. Herbicide treatment using spot application of a broadleaf herbicide such as glyphosate (Roundup), 2,4-D, or picloram (Tordon) during the spring and summer growing season before seed set.[cd]
Dalmatian toadflax	*Linaria genistifolia* ssp. *dalmatica*	Difficult to manage due to an extensive root system and reproduction from the roots. Mechanical pulling only if all roots are pulled up. Biological control with insect. Herbicide treatment with picloram (Tordon 22K) works best during the growing season and before seed set.[bc]
Yellow toadflax	*Linaria vulgaris*	Difficult to manage due to an extensive root system and reproduction from the roots. Mechanical pulling only if all roots are pulled up. Biological control with insect. Herbicide treatment with picloram (Tordon 22K) works best during the growing season and before seed set.[bc]
Scotch thistle	*Onopordum acanthium*	Cultural management (enhanced competition from desirable grasses); Mechanical mowing and grubbing; Application of herbicides such as picloram (Tordon), glyphosate (Roundup & Rodeo), chlorsulfuron methyl (Escort), dicamba (Banvel), and 2,4-D in the late spring before budding or early fall while still green.[bc]
Bouncing bet	*Saponaria officinalis*	Minimize disturbance of the root system. Prevent seed production. Mechanical control through repeated mowing to keep plants from flowering. Application of herbicides such as picloram (Tordon), dicamba (Vetaran 10G), or glyphosate (Roundup) after mowing.[b]

Common Name	Scientific Name	Recommended Control Measures[defg]
Salt cedar (Tamarisk)	*Tamarix ramossissima*	Mechanical removal. Application of herbicides suitable for broad leafed woody species such as picloram (Tordon), glyphosate (Roundup), and Grazon (picloram plus 2,4-D).
Common mullein	*Verbascum thapsus*	Difficult to control. Mechanical control by pulling or mowing frequently. Herbicide treatment using spot application of a broadleaf herbicide such as glyphosate (Roundup), clopyralid plus triclopyr amine (Redeem), or Grazon (picloram plus 2,4-D).

[a] Witson et al (2001).
[b] Colorado Natural Areas Program (2000).
[c] Personal communication with Kelly Uhing, Adams County, Colorado Weed Supervisor (2003).
[d] Colorado Department of Agriculture(2005).
[e] Mechanical control measures include physical removal by mowing, mulching, tilling, prescribed burning, grazing, or hand pulling.
[f] Cultural control includes enhancement of the native plant community using fertility management or revegetation.
[g] Biological control includes releasing a weed's native natural enemies using insects, grazing animals or disease.
[h] Chemical control includes the use of herbicides or other chemicals to kill weeds.

Recommended control measures for noxious weed species listed by Jefferson County (2006) and the Colorado Department of Agriculture (2005) which were identified within the I-70/32nd Avenue Interchange EA Project Area during field surveys conducted by Natural Resource Services, Inc. between September 1, 2005 and September 26, 2005.

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APPENDIX A PROJECT AREA PHOTOGRAPHS

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Photo 1. I-70 westbound onramp at Ward Road, January 14, 2006.. Mix of weed species in mowed area.

Photo 2. Mix of weed species including common teasel, leafy spurge, diffuse knapweed, and musk thistle at the west end of the project area on September 26, 2005.

Photo 3. Common teasel and houndstongue along a drainage ditch just south of the SH 58 frontage road at the west end of the project area on September 26, 2005.

Photo 4. Site occupied by myrtle spurge in the foreground. East end of the project area along the north bank of Clear Creek on September 27, 2005.

Photo 5. Common teasel along the banks of the Bayou Ditch at the east end of the project area on September 27, 2005.

Photo 6. Diffuse knapweed at the west end of the project area on September 26, 2005.

Photo 7. Common mullein and leafy spurge along the McIntyre Street bridge over Clear Creek berm at the west end of the project area on September 26, 2005.

Photo 8. Musk thistle and leafy spurge (left foreground) along the McIntyre Street berm at the west end of the project area on September 26, 2005.

Photo 9. Russian olive and leafy spurge along the Coors access road paralleling McIntyre Street at the west end of the project area on September, 26, 2005.

Photo 10. **L**eafy spurge along the Coors access road paralleling McIntyre Street at the west end of the project area on September, 26, 2005.

Photo 11. Dalmatian toadflax (lower center of photo) at the west end of the project area on September 26, 2005.

Photo 12. Field bindweed at the west end of the project area on September 27, 2005.

Photo 13. Scotch thistle at the west end of the project area along the railroad tracks on September 27, 2005.

Photo 14. Chinese clematis along the Coors access road at the east end of the project area on September 29, 2005.

Photo 15. Bouncingbet along the Coors access road at the east end of the project area on September 27, 2005/

Photo 16. Cheatgrass, Russian thistle, diffuse knapweed and other noxious weeds near the Dog Pit pond at the east end of the project area on September 29, 2005.

Photo 17. Yellow toadflax in the center of the project area just south of the Jefferson County Open Space Pedestrian Trail on September 30, 2005.

Photo 18. Salt cedar (Tamarisk) in the center of the project area just south of the Jefferson County Open Space Pedestrian Trail on September 29, 2005.

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APPENDIX B STATE, LOCAL, AND AGENCY NOXIOUS WEED LISTS

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The noxious weeds designated for special attention by each of the governmental entities having jurisdiction over the I-70/32nd Avenue Interchange Project Area are listed as follows:

***Noxious Weeds Listed by Jefferson Count, Colorado*:**

Jefferson County Noxious Weeds Requiring Eradication*

Cypress spurge	*Euphorbia cyparissias*
Myrtle spurge	*Euphorbia myrsinites*
Orange hawkweed	*Hieracium aurantiacum*
Purple loosestrife	*Lythrum salicaria*
Russian knapweed	*Acroptilon repens*
Spotted knapweed	*Centaurea maculosa*
Salt cedar (Tamarisk)	*Tamarix* sp.
Yellow starthistle	*Centaurea solstitalis*

(*Jefferson County's Noxious Weed List, http://www.co.jefferson.co.us/weed/weed_T71_R0.htm Accessed January 16, 2006.

Jefferson County Noxious Weeds Requiring Control*

Canada thistle	*Cirsium arvense*
Chinese clematis	*Clematis orientalis*
Diffuse knapweed	*Centaurea diffusa*
Hoary cress (Whitetop)	*Cardaria* sp.
Houndstongue	*Cygnoglossum officinale*
Leafy spurge	*Euphorbia esula*
Musk thistle	*Carduus nutans*
Scotch thistle	*Onopordum* sp.
Teasel	*Dipsacus* sp.

(*Jefferson County's Noxious Weed List, http://www.co.jefferson.co.us/weed/weed_T71_R0.htm Accessed January 16, 2006.

Jefferson County Other Noxious Weeds of Concern*

Common mullein	*Verbascum thapsus*
Dalmatian toadflax	*Linaria genistifolia*
Yellow toadflax	*Linaria vulgaris*

(*Jefferson County's Noxious Weed List, http://www.co.jefferson.co.us/weed/weed_T71_R0.htm Accessed January 16, 2006.

***Noxious Weeds Listed by the City of Wheat Ridge*:**

City of Wheat Ridge Noxious and Undesirable Plants**

Diffuse knapweed	*Centaurea* (*Acosta*) *diffusa*
Canada thistle	*Cirsium arvense*
Musk thistle	*Carduus nutans*
Bull thistle	*Cirsium vulgare*
Chinese clematis	*Clematis orientalis*
Poison hemlock	*Conium maculatum*
Common teasel	*Dipsacus fullonum*
Cutleaf teasel	*Dipsacus laciniatus*
Russian olive	*Elaeagnus angustifolia*
Leafy spurge	*Euphorbia esula*
Dalmatian toadflax	*Linaria genistifolia* ssp. *dalmatica*
Yellow toadflax	*Linaria vulgaris*

Purple loosestrife	*Lythrum salicaria*
Scotch thistle	*Onopordum acanthium*
Buckthorn	*Rhamnus cathartica*
Tamarisk (Salt cedar)	*Tamarix ramosissima*
Poison ivy	*Toxicodendron rydbergii* (native species)

**The City of Wheat Ridge listed certain species of noxious weeds as noxious and undesirable plants in its Open Space Management Plan completed in 2002 (City of Wheat Ridge and ERO Resources Corporation 2002). These species are targeted for control by the city.

Noxious Weeds Listed by the State of Colorado*:**

State of Colorado Noxious Weed List A (designated for eradication)

African rue	*Peganum harmala*
Camelthorn	*Alhagi pseudalhagi*
Common crupina	*Crupina vulgaris*
Cypress spurge	*Euphorbia cyparissias*
Dyer's woad	*Isatis tinctoria*
Giant salvinia	*Salvinia molesta*
Hydrilla	*Hydrilla hydrilla*
Meadow knapweed	*Centaurea pratensis*
Mediterranean sage	*Salvia aethiopis*
Medusahead rye	*Taeniatherum caput-medusae*
Myrtle spurge	*Euphorbia myrsinites*
Orange hawkweed	*Hieracium aurantiacum*
Purple loosestrife	*Lythrum salicaria*
Rush skeletonweed	*Chondrilla juncea*
Sericea lespedeza	*Lespedeza cuneata*
Squarrose knapweed	*Centaurea virgata*
Tansy ragwort	*Senecio jacobaea*
Yellow starthistle	*Centaurea solstitialis*

State of Colorado Noxious Weed List B (development and implementation of management plans required to stop the continued spread of species)

Absinth wormwood	*Artemisia absinthium*
Black henbane	*Hyoscyamus niger*
Bouncingbet	*Saponaria officinalis*
Bull thistle	*Cirsium vulgare*
Canada thistle	*Cirsium arvense*
Chinese clematis	*Clematis orientalis*
Common tansy	*Tanacetum vulgare*
Common teasel	*Dipsacus fullonum*
Corn chamomile	*Anthemis arvensis*
Cutleaf teasel	*Dipsacus laciniatus*
Dalmatian toadflax, broad-leaved	*Linaria dalmatica*
Dalmatian toadflax, narrow-leaved	*L. genistifolia*
Dame's rocket	*Hesperis matronalis*
Diffuse knapweed	*Centaurea diffusa*
Eurasian watermilfoil	*Myriophyllum spicatum*
Hoary cress (Whitetop)	*Cardaria draba*
Houndstongue	*Cynoglossum officinale*
Leafy spurge	*Euphorbia esula*
Mayweed chamomile	*Anthemis cotula*
Moth mullein	*Verbascum blattaria*

Musk thistle	*Carduus nutans*
Oxeye daisy	*Chrysanthemum leucanthemum*
Perennial pepperweed	*Lepidium latifolium*
Plumeless thistle	*Carduus acanthoides*
Quackgrass	*Elytrigia repens*
Redstem filaree	*Erodium cicutarium*
Russian knapweed	*Centaurea repens*
Russian-olive	*Elaeagnus angustifolia*
Salt cedar (Tamarisk)	*Tamarix chinensis, T. parviflora and T. ramosissima*
Scentless chamomile	*Anthemis arvensis*
Scotch thistle	*Onopordum acanthium and O. tauricum*
Scotch thistle	*Onopordum tauricum*
Spotted knapweed	*Centaurea maculosa*
Spurred anoda	*Anoda cristata*
Sulfur cinquefoil	*Potentilla recta*
Venice mallow	*Hibiscus trionum*
Yellow nutsedge	*Cyperus esculentus*
Yellow toadflax	*Linaria vulgaris*

State of Colorado Noxious Weed List C (development and implementation of management plans required to provide education, research and biological control resources to local jurisdictions)

Chicory	*Cichorium intybus*
Common burdock	*Arctium minus*
Common mullein	*Verbascum thapsus*
Common St. Johnswort	*Hypericum perforatum*
Downy brome	*Bromus tectorum*
Field bindweed	*Convolvulus arvensis*
Halogeton	*Halogeton glomeratus*
Johnsongrass	*Sorghum halepense*
Jointed goatgrass	*Aegilops cylindrica*
Perennial sowthistle	*Sonchus arvensis*
Poison hemlock	*Conium maculatum*
Puncturevine	*Tribulus terrestris*
Velvetleaf	*Abutilon theophrasti*
Wild proso millet	*Panicum miliaceum*

***Colorado Department of Agriculture (2005). Website URL accessed January 16, 2006: *http://www.ag.state.co.us/CSD/Weeds/statutes/weedrules.pdf*

Colorado Department of Transportation Maintenance Program Noxious Weed List**:**

Absinth wormwood	*Artemisia absinthium*
Black henbane	*Hyoscyamus niger*
Bull thistle	*Cirsium vulgare*
Canada thistle	*Cirsium arvense*
Chinese clematis	*Clematis orientalis*
Dalmatian toadflax, broad-leaved	*Linaria dalmatica*
Dalmatian toadflax, narrow-leaved	*L. genistifolia*
Dame's rocket	*Hesperis matronalis*
Diffuse knapweed	*Centaurea diffusa*
Field bindweed	*Convolvulus arvensis*
Hoary cress (Whitetop)	*Cardaria draba*
Houndstongue	*Cynoglossum officinale*
Jointed goatgrass	*Aegilops cylindrica*
Leafy spurge	*Euphorbia esula*

Musk thistle	*Carduus nutans*
Myrtle spurge	*Euphorbia myrsinites*
Orange hawkweed	*Hieracium aurantiacum*
Oxeye daisy	*Chrysanthemum leucanthemum*
Perennial pepperweed	*Lepidium latifolium*
Plumeless thistle	*Carduus acanthoides*
Purple loosestrife	*Lythrum salicaria*
Russian knapweed	*Centaurea repens*
Russian-olive	*Elaeagnus angustifolia*
Salt cedar (Tamarisk)	*Tamarix chinensis, T. parviflora and T. ramosissima*
Scentless chamomile	*Anthemis arvensis*
Scotch thistle	*Onopordum acanthium and O. tauricum*
Scotch thistle	*Onopordum tauricum*
Spotted knapweed	*Centaurea maculosa*
Yellow starthistle	*Centaurea solstitialis*
Yellow toadflax	*Linaria vulgaris*

****Colorado Department of Transportation (2006).

APPENDIX C PROFILE INFORMATION FOR NOXIOUS WEEDS IN THE PROJECT AREA

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APPENDIX C

I-70/32nd Avenue Interchange Project
Integrated Noxious Weed Management Plan

Profile Information for Noxious Weeds in the Project Area

Common burdock

Arctium minus (Hill) Bernh.

Family: *Asteraceae* (Sunflower)
Other Names: lesser burdock, wild burdock, bardane, wild rhubarb, beggar's button.
USDA Code: ARMI2
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Common burdock can be easily identified by its bur-like flowerheads.
- Plants are highly branched and may grow up to, and occasionally over, seven feet in height.

Identification

Growth form: Biennial forb.
Flower: Flowers are purple and are borne in clusters at the ends of branches.
Seeds/Fruit: Mature flower heads form a prickly bur that readily sticks to clothing or animals.
Leaves: Stem leaves are alternate, broadest at the leaf base and somewhat diminished upward. Leaf margins are toothed or wavy, and the entire leaf is wooly beneath and dark green above. Rosette leaves are large, hairy, and heart-shaped.
Stems: Mature plants are 3-7 feet tall. The stem is erect, coarse, and much branched.
Roots: Large fleshy taproot.
Seedling: Leaves of the rosette stage are large, simple and usually heart-shaped (Stubbendieck et al. 1995).

Similar Species

Exotics: *Arctium lappa* has larger heads on longer peduncles, and is less common. Cocklebur (Xanthium strumarium) has smaller, spiny-margined leaves.
Natives: None known.

Impacts

Agricultural: Common burdock is not considered a problem in crops since it is intolerant to cultivation. Livestock are fond of common burdock and the foliage imparts a bitter taste to the milk if it is eaten in large quantities. Common burdock burs can become entangled in the hair of sheep damaging the quality and reducing the value.
Ecological: Due to its biennial nature, common burdock is confined to areas that are not severely disturbed on an annual basis.
Human: Because of its diuretic effects, common burdock has been listed as a poisonous plant (Gross et al. 1980).

Habitat and Distribution

General requirements: Common burdock can commonly be found growing along roadsides, ditchbanks, in pastures and waste areas. It generally prefers riparian areas that have moist, fertile soils with high nitrogen contents.
Distribution: Established throughout much of the United States. Very common in central and north central Colorado.
Historical: Common burdock is a native of Eurasia. The hooked spines of the flower heads gave rise to the idea of Velcro (Whitson et al. 1996).

Biology/Ecology

Life cycle: The bulk of germination occurs in early spring (Gross et al. 1980). During the first year the plant forms a rosette. The following year the plant produces a stout, grooved, rough stem with numerous branches. Flowering and seed production occur from July to September. Seeds are mature by September and are shed continuously throughout the autumn, winter, and following spring.
Mode of reproduction: Common burdock reproduces solely by seed.
Seed production: Common burdock typically produces between 6,000-16,000 seeds per plant.
Seed bank: No information available.
Dispersal: Bur-like seed heads are readily dispersed by sticking to animal fur or clothing.
Hybridization: Likely to hybridize with other *Arctium* species.

Control

Biocontrol: None known.
Mechanical: Tillage can be used to kill the plants in the first year rosette stage. Mowing or cutting can be used to eliminate seed production. Mow after the plant has bolted but before it has flowered.
Fire: No information available.
Herbicides: Common burdock can be controlled with 2,4-D, picloram, or dicamba at 1 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre. Herbicides are most effective when applied to first-year rosettes.

Keys to Control:
- Eliminate first year rosettes through tillage or herbicide applications.
- Eliminate seed production in second year plants through mowing or cutting.

Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Integrated Management Summary

As with other plants which reproduce solely by seed, integrated management efforts must include the elimination of seed production and the depletion of the seed bank. Combine herbicide or tillage treatment of rosettes with removal of seed heads from any plants that have bolted. Preventing dispersal of burs is particularly important.

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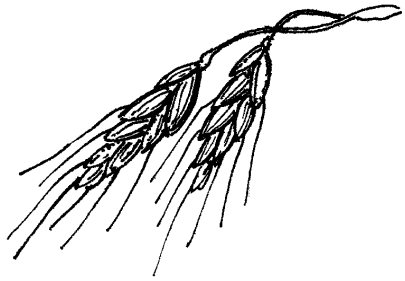
Downy brome

Bromus tectorum (L.); ***Anisantha tectorum*** (L.) Nevski

Family: *Poaceae* (Grass)
Other Names: cheatgrass, downy chess, early chess, drooping brome, downy cheat, slender chess, downy bromegrass, military grass, broncograss, Mormon oats
USDA Code: BRTE, ANTE6
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Downy brome can be identified by its drooping branches.
- In the late spring and early summer downy brome changes from green to purple to tan or brown allowing for easy identification. It often remains purple during the winter months.

Identification
Growth form: Annual or winter annual grass.
Flower: Downy brome panicles (loose, irregularly compound flowering part of plant with flowers borne on individual stalks) change color from green to purple to brown as the plant matures and eventually dries out. Branches are slender, drooping, hairy, flexuous, with up to eight spikelets.
Seeds/Fruit: Spikelets including awns are 0.8-2 inches long, nodding, with 2-8 florets.
Leaves: Leaves are light-green and hairy. Sheaths are fused except near the node at the bottom of each sheath. The lower sheaths are conspicuously hairy, while the upper sheaths are sometimes smooth.
Stems: Mature plants are generally 4-30 inches tall. Stems are erect, slender, glabrous, or slightly hairy.
Roots: The finely divided fibrous root system typically reaches a depth of about 12 inches, but can grow to 60 in. deep in the field (Hironaka 1961; Hulbert 1955).
Seedling: Downy brome seedlings can usually be distinguished by their hairy leaf blades and sheaths.



Similar Species
Exotics: Similar to Japanese brome *(Bromus japonicus)* and rye brome *(Bromus secalinus).*
Natives: None known.

Impacts
Agricultural: Downy brome can be a troublesome weed in winter wheat and other crops.
Ecological: Downy brome can greatly alter the species composition of dry native rangeland vegetation by competitive exclusion of reproduction of native plant species and by facilitation of wildfires (Mosky et al. 1999). Invasion of downy brome is greatest in drier environments, particularly in sagebrush-steppe communities. The process in which a pristine Great Basin shrub-steppe ecosystem deteriorates into one that is dominated by downy brome takes several years and has several distinct cycles. First, some sort of disturbance, such as heavy grazing, allows downy brome and other annuals to invade and proliferate. The dry stands of downy brome in the summer increase the frequency of fires. Initially, this creates an environment dominated by annual grasses, broom snakeweed (*Gutierrezia sarothrae*), and rabbitbrush (*Chrysothamnus* spp.). As fires become even more frequent, the area will be dominated by annual grasses alone, with the loss of surface soil, nutrients, and near permanent deterioration of the site. Species that are commonly displaced by downy brome include big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), bluebunch wheatgrass (*Agropyron spicatum = Pseudoroegneria spicata*), crested wheatgrass (*Agropyron cristatum*), western wheatgrass (*Agropyron smithii =*

Pascopyrum smithii), Sandberg bluegrass (*Poa sandbergii = Poa secunda*), needle-and-thread grass (*Stipa comata = Hesperostipa comata*), and Thurber's needlegrass (*Stipa thurberiana*)
Human: No information available.

Habitat and Distribution
General requirements: Downy brome is common in recently burned rangeland and wildlands, winter crops, waste areas, abandoned fields, eroded areas, and overgrazed grasslands (Upadhyaya et al. 1986). It can invade rangelands that have never been grazed by livestock (Svejcar and Tausch 1991).
Distribution: Common throughout Colorado from 4,000 to 9,000 feet. Widely distributed throughout North America. Although downy brome occurs in a variety of habitats, it is most prominent on the Columbia-Snake River Plateau, Wyoming Basin, and the northern edge of the Great Basin in disturbed sagebrush steppe communities (Rice and Mack 1991, West 1983).
Historical: No information available.

Biology/Ecology
Life cycle: Vast numbers of downy brome seedlings usually germinate after the first fall rain in infested areas (West 1983). The leaves typically grow little in the fall, and plants are normally 1-2 inches in height when covered by snow in December. The young, fall-germinated seedlings often over-winter in a semi-dormant state and complete their lifecycle the following spring (Upadhyaya et al. 1986). However, downy brome roots can grow in soil temperatures approaching freezing (West 1983), and roots will continue to grow throughout the winter until soil temperatures drop below about 37 degrees F. Plants head in late April to early May followed by flowering within a week (Upadhyaya et al. 1986). The seeds mature in mid to late June (Upadhyaya et al. 1986).

During ripening downy brome flowers turn purple and then brown as they mature. Once the seeds have matured, plants dry and become flammable. There is a correlation between plant color and moisture status during the drying process (FEIS 1996). Downy brome passes from green (>100% moisture content), to a purple hue (30-100% moisture content), to a straw color (<30% moisture content) as it dries (FEIS 1996). The onset of purple coloring should be taken as a warning that hazardous fire conditions will develop within two weeks (FEIS 1996).
Downy brome greens up earlier in the spring than most other species. Depletion of soil moisture is a mechanism by which downy brome suppresses seedlings of desirable, perennial grasses (Melgoza et al. 1990). In addition, thick mulch in dense downy brome stands favors downy brome seedling germination and establishment while inhibiting that of perennial bunchgrasses (Svejar and Tausch 1991).
Mode of reproduction: Reproduces by seeds.
Seeds production: Downy brome can be a prolific seed producer and is capable of producing up to 400 lbs. of seeds/acre (Upadhyaya et al. 1986). Seed production per culm, per plant, and per unit area is dependent on plant density and environmental factors (Upadhyaya et al. 1986). Average seed production per plant is generally lowest where plant density is highest (Rice and Mack 1991). If precipitation is adequate, the majority of downy brome seeds will germinate in the fall, or within a year of maturation (Upadhyaya et al. 1986). However, dry conditions can cause environmentally induced dormancy, which may last several years and break down at erratic intervals (Young and Evans 1985).
Seed bank: Low survival rates in the soil, but seeds may last in the seed bank for a few years.
Dispersal: Seeds are dispersed short distances by wind, and the long awns can attach to the fur or feathers of an animal, as well as clothing.
Hybridization: No information available.

Control
Biocontrol: Livestock grazing can help control downy brome. Two grazing periods each spring are required for at least two consecutive years. Plants should first be grazed at the stage just before the inflorescences emerge ("boot" stage), then grazed again before panicles emerge (about 3-4 weeks). Grazing intensity needs to be light enough to leave at least a 3-inch residual height to protect desirable grasses (Mosely 1996). Winter grazing downy brome can reduce mulch, thereby hindering downy brome establishment and favoring perennial grass establishment.

Keys to Control:
- Maintain healthy stand of perennial plants.
- Seeding may be needed where perennial grasses have been depleted.
- Manage grazing carefully in seeded areas to promote the establishment of new perennial plants.

Mechanical: Cutting is not a recommended control method for downy brome. Plants that are cut before seed ripening will produce new stems and seeds at the cut height. Plants that are cut after seed ripening will die, but by this point the seeds are already viable. In one study, repeated mowing (every three weeks) during the spring and summer was as effective at controlling downy brome seed production as an application of glyphosate (Ponzetti 1997). However, this method was very labor-intensive and a cost/benefit analysis should be conducted before any choice is made.

Hand-pulling downy brome plants in small infestations before seed set would effectively eliminate current seed production, but may not eliminate the infestation. The large seed production commonly associated with downy brome infestations will allow plants to recover for several years without noticeable reductions in plant density. Hence, any pulling program must be conducted for several years, or until the seed bank has been exhausted. Also, seeds that blow into the cleared areas from adjacent uncleared areas may negate the effects of pulling. When pulling, an effort should be made to extract as much of the root as possible so that the plant cannot simply regrow and produce new seeds.

Fire: Burning is usually conducted in Colorado in June after the plant has dried, but before the seeds have dropped (Carpenter and Murray 1998). However, some seeds will survive and if a burn is not followed by reseeding downy brome will recover to pretreatment proportions within 3 to 4 years (Carpenter and Murray 1998). Reseeding should be done in late fall (a dormant seeding).

Herbicides: There are several types of herbicides that can be used alone or combined to provide effective control of downy brome. Refer to the product label for detailed application directions so as to minimize the damage to non-target species. For relatively small infestations, a backpack sprayer is recommended to minimize the danger to non-target plants. However, infestations are often so large that a four-wheeler, tractor, or truck fitted with a sprayer is necessary. The following herbicides are divided into two groups, spring applied and fall applied.

In most cases, herbicide application should be made in early spring when non-target species are dormant to insure selective control. Downy brome was reported to be controlled best when the plants were 10 cm or less and growing vigorously at the time of application (Wiese et al. 1995). Spring applied herbicides include quizalofop, fluazifop-p-butyl, sethoxydim, glyphosate, and imazapic.

On sites where desirable plants are largely absent, control of downy brome must be followed by reseeding. Chemical fallow with glyphosate at 0.5 lb. ai/ac applied in the early spring when plants are actively growing is one option. The site can be reseeded in the fall (Mosely et al. 1999). Alternatively, one could graze downy brome plants twice with livestock then apply glyphosate.

Fall herbicide applications should be conducted after downy brome seeds have germinated and are beginning to grow. Fall applications are generally used in cropland situations by farmers growing winter wheat or other cool season crops. However, sometimes these herbicides are used in pastures and rangelands. Fall-applied herbicides for non-crop situations include sulfometuron methyl, and metribuzin.

Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, and maintaining healthy native communities.

Integrated Management Summary

Downy brome is characterized by its early maturation, high seed production, and vigorous growth under favorable environmental conditions. Although, downy brome readily invades perennial forage crops and rangeland under poor management, it also invades communities in the absence of disturbance (Douglas et al. 1990). In undisturbed sites, downy brome will most commonly spread along soil cracks and work its way outward into the natural community (Rice and Mack 1991). Downy brome has a dual role as a serious weed and important early season forage for cattle and sheep (Upadhyaya et al. 1986). Downy brome provides the bulk of early spring forage for all classes of stock on grazing lands in the Intermountain and Pacific Northwest regions (Upadhyaya et al. 1986). Lasting control of downy brome will require a combination of chemical control, physical control, vegetative suppression, and proper livestock management where land is grazed. This “cumulative stress” method will keep the plants constantly under stress, reducing their ability to flourish and spread. Also, a cumulative stress approach provides a level of redundancy in case one type of treatment is not implemented or proves to be ineffective (Carpenter and Murray 1998).

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=List B

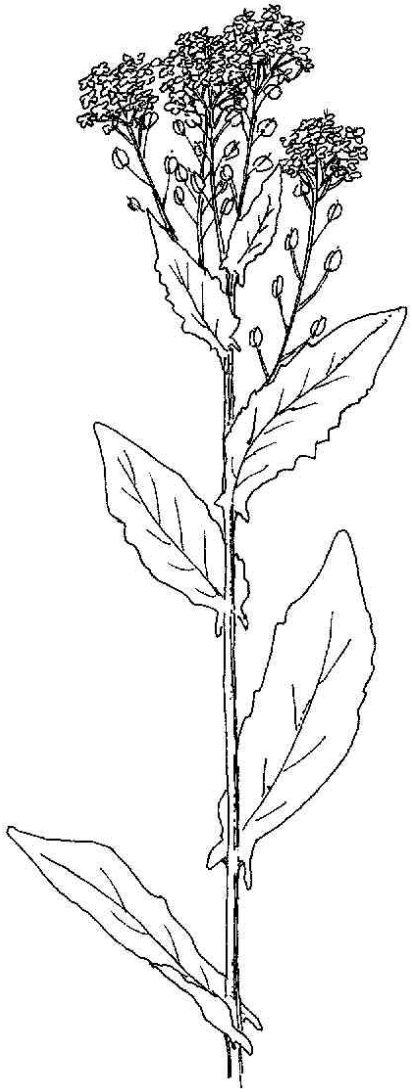
Whitetop/Hoary cress

Cardaria draba (L.) Desv.

Family: *Brassicaceae* (Mustard)
Other Names: heart-podded hoary cress, pepperweed, whitetop
USDA Code: CADR
Legal Status: Colorado Noxious List B (top ten worst)

Keys to Identification:
- Whitetop can be easily identified by the clusters of numerous, four-petaled, white flowers that give it a flat-topped appearance.

Identification
Growth form: Perennial forb.
Flower: Numerous white flowers with four petals, give the plant a white, flat-topped appearance.
Seeds/Fruit: Seed capsules are heart shaped, and contain two reddish-brown seeds.
Leaves: Leaves are alternate, 1.6-4 inches long, blue green in color, and lance-shaped. Lower leaves are stalked, while the upper leaves have two lobes clasping the stem.
Stems: Mature hoary cress plants are up to two feet tall with erect stems.
Roots: Roots are rhizomatous and usually occur at depth of 29-32 inches, but have been recorded to penetrate to a depth of 30 feet in the Pacific Northwest (FEIS 1996).
Seedling: No information available.



Similar Species
Exotics: Two other closely related species, *Cardaria pubescens* and *Cardaria chalapensis* are designated as noxious weeds in some states (Sheley and Stivers 1999).
Natives: Rosettes of gumweed *(Grindelia squarrosa)* are similar, and are found in similar habitat.

Impacts
Agricultural: Hoary cress is generally considered unpalatable to livestock.
Ecological: Hoary cress is invading rangelands throughout North America. It is a highly competitive weed once it becomes established. Hoary cress spreads primarily by extremely persistent roots and will eventually eliminate desirable vegetation and become a monoculture.
Human: No information available.

Habitat and Distribution
General requirements: Hoary cress is typically found on generally open, unshaded, disturbed ground. Hoary cress grows well on alkaline soils that are wet in late spring and generally does better in areas with moderate amounts of rainfall. It is widespread in fields, waste places, meadows, pastures, croplands, and along roadsides (FEIS 1996). Hoary cress is commonly found in saltcedar (*Tamarix* spp.), antelope bitterbrush / rough fescue (*Purshia tridentata* / *Festuca scabrella*), antelope bitterbrush / bluebunch wheatgrass (*Pseudoroegneria spicata*),

big sagebrush (*Artemisia tridentata* spp.), and Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) communities (FEIS 1996).
Distribution: It is widespread in the United States except along the southern boundary of the western and south-central states (USDA 1971). In Colorado, hoary cress is commonly found at elevations of 3,500 to 8,500 feet.
Historical: Hoary cress is a weed of Eurasian origin.

Biology/Ecology
Life cycle: The root system of hoary cress consists of vertical and horizontal roots from which new rosettes and flowering shoots arise (Mulligan and Findlay 1974). Plants emerge in very early spring. The first leaves appear aboveground 5 to 6 weeks after planting (Mulligan and Findlay 1974, FEIS 1996). During this period, the first leaves emerge and form a loose rosette (Mulligan and Findlay 1974, FEIS 1996). Stems arise from the center of each rosette in late April (FEIS 1996). Plants flower from May to June, are self-incompatible, and are pollinated by insects. Hoary cress plants set seed by mid-summer (Whitson et al. 1996). If conditions are favorable, a second crop of seeds can be produced in the fall (Sheley and Stivers 1999).
Mode of reproduction: Reproduces both by seeds and vegetatively. Hoary cress spreads vigorously by creeping roots (FEIS 1996). Within three weeks of germination, a seedling root can begin producing buds (FEIS 1996). One plant can eventually result in a large colony and push out other vegetation to form a hoary cress monoculture.
Seed production: One plant can produce from 1,200-4,800 seeds.
Seed bank: 84% of seed produced are viable the first season (Mulligan and Findlay 1974, FEIS 1996). Buried seeds can remain viable for three years in the soil (Sheley and Stivers 1999).
Dispersal: No information available.
Hybridization: No information available.

Control
Biocontrol: Currently, there is little information about biological controls that attack hoary cress. Sheep grazing may control whitetop, but evidence is limited. Managing the grazing is important so desirable plant species are not damaged.
Mechanical: Mowing 2-3 times a year for several years may slow the spread and reduce seed production of hoary cress. Mowing may increase the effectiveness of subsequent herbicide application (Sheley and Stivers 1999). Mowing should be conducted during the bud stage and repeated when the plants re-bud. The effectiveness of a mowing program can be increased by planting perennial grasses as competitors.

Keys to Control:
- Exhaust the root system and eliminate seed production by mowing or treating with herbicides.
- Maintain a healthy cover of perennial plants to discourage the establishment and spread of hoary cress.

Fire: Rapid growth rate may favor hoary cress after fires which temporarily eliminate native vegetation. Plants may resprout from rhizomes or establish from seeds (FEIS 1996).
Herbicides: Hoary cress is most commonly controlled with herbicides. However, multiple applications are usually needed to provide lasting control. The best time to apply herbicides is in May or June before flowering. The non-crop herbicides metsulfuron and chlorsulfuron are the most effective herbicides as long as the plants still have green tissue (CSU 1998a). It is important to use a non-ionic surfactant with the herbicide (Sheley and Stivers 1999). 2,4-D + dicamba is very effective when applied during the early pre-bud stage (late May through early June) (CSU 1998a). Glyphosate at 1.5 lb. ai/acre applied during the flower stage will provide good control of hoary cress. Picloram does not control whitetop. Also, spraying followed by spring mowing can control hoary cress by up to 90% (FEIS 1996).
Cultural/Preventive: Cultivation alone will control hoary cress when tillage begins at flowerbud stage and is repeated every ten days throughout the growing season (FEIS 1996). Reseeding of depleted areas with competitive grasses would probably be an effective complement to sheep grazing. Also, nitrogen fertilization can increase the growth of grasses and slow the rate of whitetop invasion (Sheley and Stivers 1999).

Integrated Management Summary
Hoary cress is an aggressive weed since it reproduces both from seed and vegetatively. It can crowd out desirable species and form a hoary cress monoculture. In the absence of a competitor, a single plant can spread over an area 12 feet in diameter in a single year (FEIS 1996). Hoary cress is commonly controlled with herbicides and less commonly controlled by mowing. Control of hoary cress is difficult because of the perennial root system, abundant seed production, and diverse habitats of the plant (FEIS 1996).

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=List B

Musk thistle

Carduus nutans L. subsp. ***macrolepsis*** (Peterman) Kazmi

Family: *Asteraceae* (Sunflower)
Other Names: nodding thistle, nodding plumeless thistle
USDA Code: CANUM2
Legal Status: Colorado Noxious List B (top ten worst)

Keys to Identification:
- Musk thistle can be identified by the broad, spine-tipped bracts located under the flower.
- Flowering heads are terminal, solitary and usually nodding.

Identification

Growth form: Biennial, or sometimes winter annual forb.
Flower: Flower heads are terminal, solitary, 1.5 to 3 inches in diameter, and usually nodding. Flowers are deep rose, violet or purple, occasionally white. Flowers are subtended by broad, spine-tipped bracts.
Seeds/Fruit: One-seeded oblong fruit (achene) about 0.2 inches long, shiny, yellowish-brown with a plume (pappus) of white hair-like bristles.
Leaves: Leaves are alternate, dark green, deeply lobed, and spiny margined. The leaf margins are often white. The leaves extend onto the stem giving a winged appearance (Whitson et al. 1996). Basal rosettes are well developed, leaves elliptical to lanceolate, 6-14 inches, smooth to densely hairy.
Stems: Mature plants can grow as tall as 6 feet. It can appear solitarily or with several stems from one base, and is highly branched above.
Roots: Fleshy taproot.
Seedling: No information available.

Similar Species

Exotics: Musk thistle is similar to plumeless thistle *(Carduus acanthoides)*. Rosettes of plumeless thistle are distinguished from those of musk thistle by having leaves that are deeply serrate (saw-toothed) almost to the midrib.
Natives: There are many native thistle species (in the genus *Cirsium*). The natives generally do not have leaves clasping the stem all the way from node to node (strongly decurrent leaves), and many have hairy upper and lower leaf surfaces and are blue-green or gray in color.

Impacts

Agricultural: Likely to infest pastures, and is unpalatable to livestock.
Ecological: Musk thistle is a highly competitive weed which invades disturbed areas, pasture, rangeland, forest land, cropland, and waste areas throughout most of the United States. Musk thistle spreads rapidly and forms extensive stands, which force out desirable vegetation (Rutledge and McLendon, 1998). Musk thistle may produce allelopathic chemicals that inhibit desirable plants beyond the spread of the rosettes (Wardle et al. 1993).
Human: No information available.

Habitat and Distribution

General requirements: Musk thistle does not appear to have any specific climatic requirements other than a cool period of vernalization for flowering (Butterfield et al. 1996). It occurs in areas with as little as 10 inches of annual

precipitation (FEIS 1996). Musk thistle establishes best on bare soil, and small shallow cracks are ideal for seedling establishment (FEIS 1996). Musk thistle grows in all soil textures, but the soils must be well-drained (Butterfield et al. 1996) It occurs on soils with a pH range of 6.0 to 8.9 (Butterfield et al. 1996).
Distribution: In Colorado, musk thistle is found up to approximately 10,000 feet in elevation (Beck 1999). It is found throughout North America.
Historical: Native to Eurasia.

Biology/Ecology
Life cycle: Seeds germinate in the fall, forming a rosette of leaves. Typically, musk thistle over-winters as a rosette and bolts the following spring between April-June. Flowering begins in late May or early June and continues through mid-July (Butterfield et al. 1996). Seeds mature and are dispersed 1 to 3 weeks after flowering. Seedlings establish only on bare soils and grow less when shaded by neighboring plants (Beck 1999).
Mode of reproduction: Musk thistle reproduces solely by seed.
Seed production: Musk thistle is a prolific seed producer Average productivity is approximately 10,000 seeds/plant, however, a single plant can produce up to 100,000 seeds (Beck 1999).
Seed bank: Musk thistle seeds appear to remain viable for at least 10 years.
Dispersal: Seed dispersal is by wind water, wildlife and livestock (Beck 1999).
Hybridization: May hybridize with plumeless thistle *(Carduus acanthoides).*

Control
Biocontrol: A number of insects have been used to help control musk thistle. The Division of Plant Industry's Biological Pest Control Section has two species, *Rhinocyllus conicus*, and *Trichosirocalus horridus*, that may be available for redistribution. The most widely released insect is the weevil *Rhinocyllus conicus* (Butterfield et al. 1996). In the spring, adults will feed on the leaves, mate, and deposit eggs on the bracts (Butterfield et al. 1996). When the eggs hatch the larvae begin to bore into the flowerhead, reducing the ability of the plants to produce viable seed. In some cases the weevil has reduced musk thistle populations to less than 10% pre-release levels (Rutledge and McLendon, 1998). However, this weevil will attack native thistles, including rare species (Louda et al. 1997).

Keys to Control:
- Managing rangeland to minimize the amount of bare soil is essential to long-term control.
- Hand chopping at ground level just before flowering, or cutting and bagging seed heads before dispersal can be used to eliminate seed production.
- Repeated treatments over the course of several years can eliminate a musk thistle infestation.

Mechanical: Repeated mowing, hand pulling, or cutting can be used to stop the spread of musk thistle. Mowing or hand-chopping after flowering, but before seed set, prevents seed development and dispersal (Heidel 1987). When pulling musk thistle, it is important to completely remove the crown so that the plant does not simply re-bolt and produce seeds. Repeated visits at weekly intervals over the 4-7 week flowering period is necessary because not all plants flower at the same time (Heidel 1987). Cut plants should be deeply buried or burned because seeds can mature and become viable after cutting (Rutledge and McLendon, 1998).
Fire: No information available.
Herbicides: Musk thistle is most often controlled with herbicides. The most effective chemical control occurs when musk thistle is still in the rosette stage, and quickly decreases once the plant has bolted (Butterfield et al. 1996). 2,4-D, clopyralid at 0.25 lb., or dicamba at 1 lb. ai/acre are effective when applied 10-14 days prior to bolting. A combination of 2,4-D plus dicamba provided 97% control in an experiment in Minnesota (Butterfield et al. 1996). Fall application of picloram at 0.25 lb. ai/acre to rosettes when other plants are dormant is often effective and has less impact on non-target species (Butterfield et al. 1996). Metsulfuron and chlorsulfuron are effective on bolted plants (Beck 1999).
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Integrated Management Summary
The key to managing musk thistle is to prevent seed production. Most control methods will have a detrimental effect on other plants and may cause a disturbance that will favor re-invasion by other exotic species (Rutledge and McLendon, 1998). Dense musk thistle stands along roadsides and in degraded areas can be treated by spot use of herbicides, and in high-quality areas by a persistent program of pulling or cutting (Rutledge and McLendon, 1998).

Due to the long seed viability of musk thistle, up to 10 years, control methods may have to be repeated for many years to completely eliminate a stand.
One integrated approach to musk thistle management involves 1) managing livestock grazing to increase grass vigor and reduce bare ground; 2) spray rosettes with clopyralid or 2,4-D; 3) re-seed treated ground with competitive desirable plants in the fall after spraying; 4) follow-up with spot cutting of entire plants when first flowers appear annually for several years to deplete the seed bank in the soil.

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=List B

Diffuse knapweed

Centaurea diffusa Lam.; ***Acosta diffusa*** (Lam.) Sojak

Family: *Asteraceae* (Sunflower)
Other Names: spreading knapweed, tumble knapweed
USDA Code: CEDI3
Legal Status: Colorado Noxious List B (top ten worst)

Keys to Identification:
- The floral bracts have yellow spines with teeth appearing as a comb along the spine margins.
- Flowers are usually white, but may be rose-purple to lavender in appearance.
- Seedlings have finely divided leaves that are covered with short hairs.

Identification
Growth form: Biennial or short-lived perennial forb.
Flower: Flower heads are broadly urn-shaped, 0.6-0.8 inches tall, solitary or in clusters of 2-3 at the ends of the branches. Floral bracts are yellowish with a brownish margin, sometimes spotted, fringed on the sides, and terminating in a slender bristle or spine. The heads contain two types of flowers, ray flowers around the edges surrounding tubular disk flowers. The ray flowers are white, rose-purple, or lavender.
Seeds/Fruit: Seeds are light brown to black.
Leaves: Basal leaves are stalked and divided into narrow, hairy segments. Stem leaves are smaller, alternate, less divided, stalkless, and become bract-like near the flower clusters.
Stems: Stems are upright, 4-24 inches tall, highly branched, angled, with short, stiff hairs on the angles.
Roots: Taproot.
Seedling: Seedlings have finely divided leaves that are covered with short hairs.

Similar Species
Exotics: Diffuse knapweed may be distinguished from other knapweeds by the terminal spine on the floral bract.
Natives: None.

Impacts
Agricultural: Diffuse knapweed reduces the productivity of rangeland by displacing desirable forage species.
Ecological: Diffuse knapweed is a pioneer species that can quickly invade disturbed and undisturbed grassland, shrubland, and riparian communities. Once established, diffuse knapweed outcompetes and reduces the quantity of desirable native species such as perennial grasses. Diffuse knapweed has been reported to contain allelopathic chemicals, which can suppress competitive plant growth and create single species stands (Watson and Renney 1974). The densities of these stands can range from 1-500 plants/m^2. The replacement of native grassland with diffuse knapweed can reduce biological diversity and increase soil erosion (Sheley et al. 1997).
Human: No information available.

Habitat and Distribution
General requirements: Diffuse knapweed is found on plains, rangelands, and forested benchlands. It is generally found on light, dry, porous soils. Diffuse knapweed has been observed at elevations up to 8,500 feet (K.G. Beck, pers. comm.). It grows in open habitats as well as shaded areas (Watson and Renney 1974). Diffuse knapweed is not common on cultivated lands or irrigated pasture because it cannot tolerate cultivation or excessive moisture (Watson and Renney 1974).
Distribution: Diffuse knapweed is now common in the Front Range counties, and has been reported in scattered infestations from both the east and west slope of Colorado.

Historical: Native to Eurasia.

Biology/Ecology

Life cycle: Diffuse knapweed plants first form low rosettes and may remain in this form for one to several years depending on environmental conditions. Diffuse knapweed is a semelparous perennial; it grows as a rosette unitl it reaches a critical size, then bolts, flowers and usually dies (Thompson and Stout 1991). Flower buds are formed in early June and flowering occurs in July and August (Watson and Renney 1974). Mature seeds are formed by mid-August (Watson and Renney 1974).

Mode of reproduction: Reproduces by seeds.

Seed production: A single diffuse knapweed plant can produce up to 18,000 seeds (Harris and Cranston 1979) and a stand of diffuse knapweed can produce up to 40,000 seeds per square meter (Watson and Renney 1974). Along the Colorado Front Range, seed production of 500-1500 seeds pre plant is more typical (Beck et al. 1998).

Seed bank: Seeds may remain dormant for several years.

Dispersal: Seed dispersal for diffuse knapweed is mainly by wind (Watson and Renney 1974). When the seed capsule sways in the breeze or is disturbed, the seeds fall from the small opening in top of the flower head and are distributed around the parent plant (Watson and Renney 1974). However, most of the involucres remain closed until the plant dries up, breaks off at ground level and effectively becomes a tumbleweed, allowing seeds to be dispersed over long distances (Zimmerman 1997). Diffuse knapweed stalks readily lodge under vehicles, expanding their long distance dispersal.

Hybridization: No information available.

Control

Keys to Control:
- Eliminate seed production.
- Stress the plants nutrient reserves as well as the soil seed bank through persistent management.
- Re-seed infested area with desirable species and manage them to produce a vigorous stand of plants.

Biocontrol: Currently, biological control agents are available but the extent to which they effectively control diffuse knapweed populations is unclear. The Division of Plant Industry's Biological Pest Control Section has five species that may be available for redistribution. These five species are *Urophora affinis*, *Urophora quadrifasciata*, *Agapeta zoegana*, *Sphenoptera jugoslavica*, *Cyphocleonus achates*. The seedhead weevil *Larinus minutus* may also become available for distribution.

Mechanical: Cutting or mowing the above-ground portion of the plant, before seed set may be an effective way to reduce seed production, but it will not eliminate the infestation. Mowing usually increases diffuse knapweed density, due to increased germination from the soil seed bank. Mowings should therefore be followed by a fall herbicide treatment (Sebastian and Beck 1999). When a diffuse knapweed plant has been cut, the rosette may live and re-bolt. Additionally, diffuse knapweed seeds can remain dormant for several years, requiring any cutting program to be repeated several times annually (spring, summer, and fall) to be effective. Mowing or fire can be used as a way to remove standing dead material such that subsequently applied herbicide will be more effective (Roché and Roché 1999.)

Pulling can be effective for knapweed control, but it must be repeated frequently. Youtie and Soll (1994) suggested hand-pulling knapweeds three times annually until the plant disappears. The first pulling is in spring when the soil is moist, allowing enough of the plant to be pulled to kill it. The second pulling in June focuses on bolted plants, with the third pulling just before seed dispersal to kill any remaining plants.

Fire: In areas without abundant native perennials, burning has been shown to be an effective control of diffuse knapweed with strong grass regrowth occurring on burned sites (Zimmerman 1997). A low-severity fire may only top-kill (not kill the root) diffuse knapweed, but a severe fire will probably kill the entire plant. Dry soil conditions associated with burns may discourage diffuse knapweed re-infestation as moisture is the limiting factor for diffuse knapweed seed germination. Re-seeding desirable species after burning helps to prevent a re-infestation of diffuse knapweed or other exotic species.

Herbicides: Several herbicides are relatively effective at controlling diffuse knapweed. Picloram is the most widely recommended (Harris and Cranston 1979). Other effective herbicides include clopyralid, dicamba, 2,4-D, and glyphosate (Beck 1997, Youtie 1997, Watson and Renney 1974). To save money and reduce grass injury resulting from higher use rates of a single herbicide, several of these herbicides can be combined (Beck 1997). Tank-mixes of picloram and dicamba (0.25 to 0.5 lb./acre + 0.125 to 0.25 lb./acre), picloram plus 2,4-D (0.188 lb./acre + 1.0 lb./acre), clopyralid (0.25 lb./acre), clopyralid+2,4-D (0.2+1.0 lb./acre) and dicamba plus 2,4-D (0.5 lb./acre + 1.0 lb./acre) all control diffuse knapweed (Beck 1997). A backpack sprayer or a wick is recommended in

small areas to minimize damage to non-target plants. Herbicides should either be applied before the mature plants set seed, or to rosettes in the fall, to maximize effectiveness.
Cultural/Preventive: Prevent establishment of new infestations, and manage grazing or other land use to maintain vigorous native communities.

Integrated Management Summary
Integrated treatment of diffuse knapweed depends on each situation. Single treatments provide temporary but not long-lasting control. In grasslands where the forb component is minimal or expandable, suggested strategies include altering grazing management to promote vigorous grasses, spraying with picloram, re-seeding with competitive grass species, followed by spot treatment with picloram or hand-pulling. According to Roché and Roché (1997), the best case scenario is establishing competitive forage species that can, with the help of biological control agents and proper livestock management, maintain knapweed at low levels. The most effective method of control for diffuse knapweed is to prevent its establishment. Areas that are adjacent to known patches of diffuse knapweed should be monitored two to three times a year (spring, summer, and fall) and any new rosettes should be destroyed. Established plants or stands of diffuse knapweed can be pulled or spot treated with picloram. Burning may be an effective means of controlling diffuse knapweed in areas where seasonal or occasional fires are part of the natural ecosystem (Zimmerman 1997). Seeding desirable perennial grasses is essential to prevent weed reinvasion (Beck 1997).

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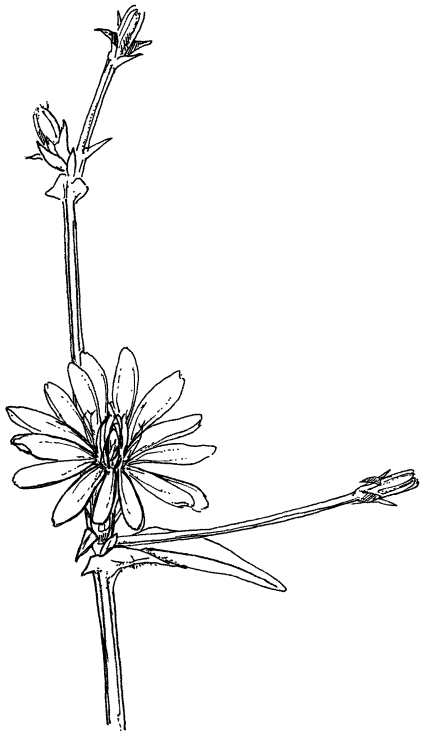
Chicory

Cichorium intybus L.

Family: *Asteraceae* (Sunflower)
Other Names: coffeeweed, blue sailors, succory
USDA Code: CIIN
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Flower heads are 1.5 inches in diameter and are normally blue, but may appear white or purple.
- Flowers are square on the end and lobed.
- Stalkless flowers.

Identification
Growth form: Perennial forb.
Flower: Flowers are born in the axils of the upper leaves. Flowers are 1.5 inches in diameter, usually blue, but are occasionally purple or white.
Seeds/Fruit: Fruits are ribbed and tipped by a crown of minute scales.
Leaves: Basal leaves are rough, 2-10 inches long, lance-shaped, toothed or pinnately parted. Upper leaves are smaller, alternate, stalkless, clasping the stem, with undivided margins.
Stems: Mature plants range in size from 1-6 feet tall. Stems are erect and branched above.
Roots: Plants grow from a deep taproot.
Seedling: No information available.
Other: The entire plant exudes a milky juice when broken.



Similar Species
Exotics: None known.
Natives: Chicory can be distinguished from blue lettuce *(Lactuca pulchella)* by its more branched growth pattern, and flowers which are essentially stalkless.

Impacts
Agricultural: Although it is grown as a hay crop in Europe, dairy products from cows which eat it may have a bitter taste (Stubbendieck et al. 1995).
Ecological: Chicory is a ruderal species that invades disturbed areas.
Human: Milky latex may cause dermatitis.

Habitat and Distribution
General requirements: Chicory is widespread along roadsides and in disturbed areas. It can adapt to a wide range of soils and environmental conditions.
Distribution: Common throughout North America.
Historical: Chicory is a native of the Mediterranean region. It is often planted for use as salad greens and the root used as a substitute for or additive to coffee (Whitson et al. 1996).

Biology/Ecology
Life cycle: Flowering occurs from July to September.
Mode of reproduction: Reproduces by seeds.
Seed production: No information available.

Seed bank: No information available.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: Chicory may be controlled by mowing, cutting, or pulling plants before seed production. This process may have to be repeated annually to exhaust nutrient reserves in the roots of plants as well as to control plants that emerge from the soil seed bank.
Fire: No information available.
Herbicides: Chicory can be controlled with a mixture of picloram + 2,4-D (Grazon P+D™) if it is applied when plants are actively growing (Dow AgroSciences 1998). In general, use 2-4 pints of the mixture in enough water to give a total spray volume of 10-20 gallons per acre (Dow AgroSciences 1998). Dicamba, 2,4-D, and picloram at 1.0 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre, will also control chicory. To provide more complete control, add an agricultural surfactant and/or a drift control additive for improved deposition (Dow AgroSciences 1998).
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Keys to Control:
- Maintain a healthy cover of perennial plants.
- Re-seed controlled areas with desirable species.
- Minimize additional disturbance.

Integrated Management Summary

This perennial weed is difficult to eliminate. Because it prefers disturbed areas, the maintenance of healthy plant communities and revegetation of disturbed areas can help prevent the spread of chicory. Combine preventive measures with mechanical and chemical control.

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=List B

Canada thistle

Cirsium arvense (L.) Scop.; ***Breea arvensis*** (L.) Lessing

Family: ***Asteraceae*** (Sunflower)
Other Names: field thistle, Californian thistle
USDA Code: CIAR4
Legal Status: Colorado Noxious List B (top ten worst).

Keys to Identification:
- Purple flowers form in clusters of 1-5 per branch.
- The floral bracts of Canada thistle are spineless.
- Small heads, vanilla scent

Identification
Growth form: Perennial forb.
Flower: Flower heads are white to purple and borne in clusters of 1-5 per branch, with a strong vanilla scent. Heads are only about 1cm in diameter.
Seeds/Fruit: One-seeded fruits (achenes) are straw or light brown in color, straight or slightly curved (Moore 1975).
Leaves: Leaves are spiny, alternate, oblong or lance-shaped, with the base leaves stalkless and clasping, or extended down along the stem.
Stems: Mature plants range from 2-4 feet in height.
Roots: Canada thistle has two types of roots, horizontal and vertical. The horizontal roots produce numerous shoots, while vertical roots store water and nutrients in their many small branches.
Seedling: Early spring growth appears as rosettes with spiny-tipped, wavy leaves.
Other: The floral bracts of Canada thistle are spineless.

Similar Species
Exotics: Bull thistle (*Cirsium vulgare*); flower bracts are somewhat tapered and covered with spines. Scotch thistle (*Onopordum acanthium*); stems appear the have wings, floral bracts are covered with spines. Plumeless thistle (*Carduus acanthoides*); floral bracts are covered with sharp spines. Musk thistle (*Carduus nutans*); floral bracts are broad with spiny tips. Russian knapweed and Canada thistle are often confused.
Natives: Wavyleaf thistle (*Cirsium undulatum*): flower bracts often have a prominent white glandular dorsal ridge (often sticky to touch) and minutely hairy margins (Whitson et al. 1996). Leafy thistle (*Cirsium foliosum*): the leaves surrounding the terminal flowers are pink to white. Yellowspine thistle (*Cirsium ochrocentrum*): flower bracts are covered with cobweb-like hairs and have a spreading yellow spine at the tip. The tall biotype of Colorado thistle *(Cirsium coloradense)* and *Cirsium traceyi* are also similar. Most native thistles are more hairy and lighter green/blue in color. Canada thistle is comparatively darker green.

Impacts
Agricultural: Canada thistle is an aggressive, creeping, perennial weed. It infests crops, pastures, rangelands, roadsides, and riparian areas (Beck 1996).
Ecological: Canada thistle spreads rapidly through horizontal roots, which give rise to shoots (Moore 1975). Its root system can be extensive, growing horizontally as much as 18 feet in one season (Nuzzo 1998). Most Canada thistle patches spread at a rate of 3-6 feet/year, crowding out more desirable species and creating thistle monocultures.
Human: Spiny thickets of Canada thistle can restrict recreational access to infested areas.

Habitat and Distribution

General requirements: Canada thistle thrives in the Northern Temperature Zone due to its day length response and a high temperature limitation on growth (Haderlie et al. 1991). Although Canada thistle mainly invades disturbed areas, it does invade native plant communities, open meadows (including wetlands), and ponderosa pine savanna (Rutledge and McLendon 1998). Canada thistle is adapted to a wide range of soil types and environmental conditions (FEIS 1996). It is best adapted to rich, heavy loam, clay loam, and sandy loam, with an optimum soil depth of 20 inches (FEIS 1996, Rutledge and McLendon 1998). Canada thistle can tolerate saline soils (up to 2% salt) and wet or dry soil (Rutledge and McLendon 1998). However, it does not tolerate waterlogged or poorly aerated soils. Canada thistle usually occurs in 17-35 inch annual precipitation zones or where supplemental soil moisture is available (Beck 1996). Canada thistle is also somewhat shade intolerant. It can grow along the edge of forested areas, but is rarely found within forests.

Distribution: Canada thistle is common found along roadsides, fields, pastures, meadows, and other disturbed areas statewide in Colorado (FEIS 1996, Rutledge and McLendon 1998). In Colorado, Canada thistle is typically found from 4,000-9,500 feet. Canada thistle is found throughout the northern half of the United States and lower portions of Canada.

Historical: Canada thistle is a native of southeastern Eurasia. It was introduced to Canada as a contaminant of crop seed as early as the late 18th century. Since its introduction, it has spread throughout North America (Whitson et al. 1996).

Biology/Ecology

Life cycle: Over-wintering roots develop new underground roots and shoots in January and begin to elongate in February (Nuzzo 1998). Shoots emerge between March and May, when mean weekly temperatures reach 5° C, and form rosettes (Nuzzo 1998). Early in the spring, plants remain near the soil surface until long days (over 14 hours of light) trigger flowering and stem elongation (Haderlie et al. 1991, FEIS 1996). Canada thistle is dioecious (male and female flowers are produced on separate plants). Female flowers can be readily distinguished from male flowers by the absence of pollen (abundant in male flowers) and presence of a distinct vanilla-like fragrance. Flowering occurs from June to October in Colorado (Rutledge and McLendon 1998). Seeds mature July to October.

Mode of reproduction: Canada thistle reproduces primarily vegetatively through creeping horizontal roots, and can quickly form dense stands. Every piece of the root system is capable of forming a new plant (Rutledge and McLendon 1998). This allows dense monocultures of Canada thistle to form even without seed production. Canada thistle growth is limited or stopped when temperatures exceed 30° C for extended periods of time.

Seed production: A female Canada thistle plant can produce up to 5,200 seeds in a season, but the average is about 1,500 seeds/plant (Rutledge and McLendon 1998).

Seed bank: Mature seeds germinate most readily in mid-spring. Seeds that do not germinate may remain dormant for several years but most studies indicate that the majority of seeds do not remain viable after three years of burial (Rutledge and McLendon 1998).

Dispersal: Seeds are distributed by wind.

Hybridization: No information available.

Control

Keys to Control:
- Eliminate seed production.
- Reduce the plant's nutrient reserves through persistent management.

Biocontrol: Currently, there is no single biological control agent that effectively controls Canada thistle. However, there are several agents that have been reported to provide very limited control. One species, *Urophora cardui* (a gall fly), may be available for redistribution from the Division of Plant Industry's Biological Pest Control Section.

Mechanical: Mowing pastures and hay meadows can be an effective control if it is repeated at about one-month intervals throughout the growing season. Combining mowing with herbicides will further enhance control of Canada thistle. However, a recent study (Beck and Sebastian 2000) found that mowing or mowing+herbicide was only effective where the root system of Canada thistle is restricted by a high water table, such as near rivers or sub-irrigated meadows.

Fire: Prescribed burning in the spring has been proposed as a means of slowing the spread of Canada thistle. Such fires could reduce the number of mature plants, decrease seed production, and stimulate the growth of native grasses (FEIS 1996).

Herbicides: Chemical control of Canada thistle should be conducted in the spring or fall depending on local environmental conditions. In general, fall treatments are more effective as herbicide absorption is enhanced in the

late summer and fall when shoot to root translocation is the greatest. However, translocation of the herbicide is dependent on moist soil conditions. If fall is a dry period in your area, a spring application around the flower bud stage (early June), when root carbohydrate reserves are at their lowest, is recommended.

Clopyralid + 2,4-D (commonly sold as Curtail®) applied at a rate of 2-3 quarts/acre will effectively control Canada thistle. Curtail should either be applied in the late spring (when Canada thistle plants are entering the bud growth stage) or in the fall (October) when Canada thistle roots are actively growing. The performance of Curtail can be improved when proceeded by two or three mowings under conditions when the root systems are restricted (Beck 1996, Beck and Sebastian 2000). Begin mowing when Canada thistle is 12-15 inches tall and repeat at about one month intervals (Beck 1996). Apply Curtail in October or about one month after the last mowing. Clopyralid alone can be applied at a rate of 2/3 to 1 pint/acre in the spring or fall. Spring applications should be timed to the rosette to bud growth stages. 2,4-D or picloram are effective when applied at a rate of 1 lb. ai/acre in the spring when Canada thistle is in the pre-bud to early bud growth stages (about 10-15 inches tall). For increased control, retreat with dicamba (1 lb. ai/acre) in the fall to prevent regrowth of plants.

Cultural/Preventive: Reduce the spread of Canada thistle seeds by always purchasing "weed free" seeds. Quickly eliminate new seedlings before they have a chance to form a well-developed root system.

Integrated Management Summary

The tendency of this species to grow in wet areas may restrict the use of certain herbicides. Control efforts should target Canada thistle plants in high-quality areas first (typically areas that contain mostly native species and few undesirable species), and then work on controlling lower quality areas (areas that are already infested with undesirable species and have fewer desirable species present). Management strategies should be adjusted to reflect weather conditions (Nuzzo 1998). For example, drought stress reduces the effectiveness of most herbicides, but increases the effectiveness of mechanical controls (e.g., mowing or burning). It takes at least two years of control to determine whether a particular method is effective. Several studies have recorded a temporary decline in Canada thistle in the first year of control followed by a return to the pre-treatment conditions the second growing season (Nuzzo 1998). For one example of Canada thistle control, see page 60.

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Bull thistle

Cirsium vulgare (Savi) Tenore

Family: Asteraceae (Composite)
Other Names: common thistle, spear thistle, fuller's thistle
USDA Code: CIVU
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Bull thistle can be distinguished from other thistles by rubbing the upper surface of its leaves. Bull thistle leaves are prickly hairy above and cottony below.
- Bull thistle has stiff pointy spines on its leaf tips and spine-tipped, purple flower heads.

Identification
Growth form: Biennial forb.
Flower: Flowers are 1.5-2 inches wide and clustered at the ends of branches. The flower bracts are somewhat tapered and covered with spines (Whitson et al. 1996). Flowers are pinkish to dark purple.
Seed/Fruit: Seeds are capped with a circle of plume-like white hairs.
Leaves: Leaves are alternate. Bull are the only thistles in Colorado that are prickly hairy on the top surface of the leaves. They are cottony-hairy on the undersides.
Stems: In mature plants the leaves extend down, clasping the stem and are divided into segments (i.e. strongly decurrent).
Roots: Has a short, fleshy taproot with several primary roots extending from the root crown. Each bears a number of smaller lateral roots.
Seedlings: Seed leaves (cotyledons) are round to spatulate, and smooth. First true leaves are oval to spatulate with spines and a rough, bumpy surface (Carey et al. 1993). First year plants form a rosette with leaves easily distinguished from other thistles by the above leaf characteristics.
Other: Mature plants range between 2-5 feet tall with many spreading branches and (Whitson et al. 1996).

Similar Species
Exotics: Bull thistle is similar to other thistles (*Breea, Carduus, Cirsium* and *Onopordum* genera) but can be distinguished by flower size, bract appearance and leaf surfaces. In rosette form it can be readily distinguished by the prickly upper surface of its leaves.
Natives: There are many native *Cirsium* species, some common (like *Cirsium undulatum*) some rare (like *Cirsium perplexans*). The natives generally do not have leaves clasping the stem all the way from node to node (strongly decurrent leaves), and many have hairy upper and lower leaf surfaces and are blue-green or gray in color.

Impacts
Agricultural: Heavy infestations can exclude livestock from areas. Additionally, the presence of bull thistle in hay decreases the forage value and lowers the market price (Zimmerman 1997). It is an aggressive weed, but it will not survive where cultivation has cut back its stem and destroyed its root system (FEIS 1996).
Ecological: Bull thistle is often a transient species, appearing in recent clear cuts or disturbed areas and becoming a dominant species for several years (Rees et al. 1996).
Human: Bull thistle has been reported to cause hay fever in some individuals (FEIS 1996).

Habitat and Distribution

General requirements: Bull thistle grows in dry to moist habitats. It thrives on nitrogen-rich soils, and it grows on gravelly to clay-textured soils. Bull thistle cannot withstand deep shade, and is nearly absent if light is reduced to less than 40% of full sunlight (FEIS 1996). Potential habitats include pastures, overgrazed rangeland, roadsides, and logged areas.

Distribution: Distribution within Colorado is not well known, but it is certainly found along the Front Range, as well as throughout the Western Slope (A. Green, pers. comm.) In Colorado, bull thistle is most often found between 5,000-10,800 feet in elevation. It is widespread throughout the United States and parts of Canada.

Historical: Bull thistle was introduced to North America as a seed contaminant and is now widespread.

Biology/Ecology

Life cycle: During the first year following germination a basal rosette is formed. The rosette grows until winter, partly dies back, and begins to grow again in early spring (FEIS 1996). Age at bolting is dependent upon plant size and almost all plants require a period of cold temperature to bolt. Flowering occurs from July through September. After flowering and seed production, the plant dies.

Mode of reproduction: Bull thistle reproduces solely by seeds.

Seed production: Mature plants can produce up to 4,000 seeds per plant (Zimmerman 1997).

Seed bank: Seeds have little dormancy, and germinate rapidly whenever conditions are favorable, usually in the spring and fall (FEIS 1996). Although most of the seeds on or near the surface do not remain viable for more than a year, seeds that are buried at a depth of 5 inches may remain viable for up to three years (Zimmerman 1997).

Dispersal: Seeds are capped with a circle of plume-like white hairs and can be windblown for long distances. However, it has been found that 65% of the seeds land within two meters of the parent plant (Zimmerman 1997). Seeds are also likely to be spread by birds, especially goldfinches.

Hybridization: There is no information available on hybridization with other thistles.

Control

Biocontrol: The bull thistle seedhead gall fly (*Urophora stylata*) can reduce seed production up to 80% in some areas (Zimmerman 1997). This agent has been established in Colorado, and prefers open meadows (Rees et al. 1996). However, this species is currently unavailable for redistribution by the Division of Plant Industry's Biological Pest Control Section. Due to its spiny stems and leaves, bull thistle is unpalatable to most livestock (FEIS 1996). However, sheep will graze on bull thistle seedlings or small rosettes.

Keys to Control:

- Kill bull thistle plants after they have bolted, but before plants have flowered.
- Repeat control for several years to deplete the bank of thistle seeds in the soil.

Mechanical: Cutting, mowing, and/or severing the taproot just below the root crown before seed set will eliminate current year seed production, and if continued annually, eliminate an infestation. The best time to cut is late in the season when most of the plants have bolted, but before a significant number have flowered (FEIS 1996). Plants will re-bolt if they are mowed too early. Cutting again a month after the first sweep will eliminate any late bolting plants, and improve the effectiveness of the procedure.

Fire: No information available.

Herbicides: Spot applications of picloram at 0.5 lb., dicamba or 2,4-D at 1 lb. ai/acre will provide effective control. Glyphosate at 1.5 lb. ai/acre is another herbicide that can be used to provide some control of bull thistle. Herbicides should be applied in rosette stage or after mowing as the plant becomes more tolerant of herbicides once the flower stalk is produced (FEIS 1996).

Cultural/Preventive: Minimize disturbance and establish healthy stands of tall grasses or forbs to outcompete bull thistle.

Integrated Management Summary

Bull thistle does not tolerate shade and therefore does not compete well in areas that are populated by tall grasses and forbs. Improving the health of a natural area, and guarding against disturbance or overuse, can be a good preventive measure against bull thistle. Apply herbicides to rosettes in early spring (May, June), and then mow or sever taproots after the plants have bolted but before flowering (probably late June to July). A second mowing or cutting is suggested a month later to pick up late bolting plants. Do not cut or spray if using seedhead biocontrols.

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Chinese clematis

Clematis orientalis L.

Family: *Ranunculaceae* (Buttercup)
Other Names: oriental virginsbower, orange peel, lemon peel
USDA Code: CLOR
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Solitary, yellow-sepaled flowers weth feathery fruits.

Identification
Growth form: Perennial herbaceous to woody vine.
Flower: Flowers solitary, with four yellow sepals (petal-like structures), often nodding.
Seeds/Fruit: Each flower produces numerous feathery long-tailed achenes (single seeded fruits) which are conspicuous as the fruits mature.
Leaves: Opposite leaves, ternate (having 3 leaflets).
Stems: Vigorous climbing vines up to ten feet long.
Roots: No information available.
Seedling: No information available.
Other: Flowers are delicately scented.

Similar Species
Exotics: None known.
Natives: The native virgin's bower, *Clematis ligusticifolia*, has white-sepaled flowers in clusters, and is much more common, especially at lower elevations.

Impacts
Agricultural: No information available.
Ecological: In the past 25 years, Chinese clematis has spread especially rapidly, becoming weedy and constituting a threat to young trees and native shrubby and herbaceous species (Flora of North America Editorial Committee 1997).
Human: No information available.

Habitat and Distribution
General requirements: Most *Clematis* species prefer sunny, well drained soils, although they may be shade tolerant to some degree. In Utah, Chinese clematis is found in sagebrush, mountain brush, and ruderal habitats up to 7,500 feet (Welsh et al. 1987).
Distribution: *Clematis orientalis* has been naturalized in the Rocky Mountains since the late nineteenth century, and is now well established in Utah and Colorado, scattered in several other western states (Flora of North America Editorial Committee 1997). In Colorado, Chinese clematis is found in mountain areas in the south and central parts of the state.
Historical: Clematis species and hybrids are popular as ornamental garden plants.

Biology/Ecology
Life cycle: Perennial woody vine which flowers in summer to fall.
Mode of reproduction: Reproduces by seeds.
Seed production: No information available.

Seed bank: No information available.
Dispersal: No information available.
Hybridization: No information available.

Control

The only recommendation available is for herbicide control with Escort® (metsulfuron). The rate is 1 oz of product per acre plus 0.25% v/v non-ionic surfactant (K.G. Beck, pers. comm.).

Integrated Management Summary

There is little or no information available on the control of Chinese clematis. Preventing the spread of this species by eliminating seed production from established stands, and discontinuing its use as an ornamental are possible strategies.

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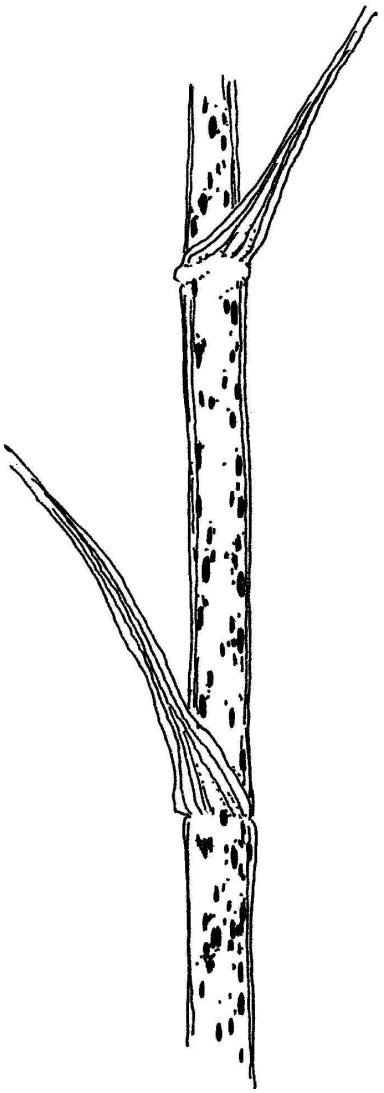
Poison hemlock

Conium maculatum L.

Family: *Apiaceae* (Parsley)
Other Names: hemlock
USDA Code: COMA2
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- The leaves of poison hemlock are glossy, green and fern-like in appearance.
- The stems are covered with purple spots.

Identification
Growth form: Biennial forb.
Flower: The white flowers are borne in umbrella-like clusters that are supported by a stalk.
Seeds/Fruit: Seeds are light brown, ribbed, and concave.
Leaves: Leaves are generally alternate, but may be opposite above (Stubbendieck et al. 1995). Leaves are shiny, green, finely divided and leaflets are segmented leaves on short stalks. Leaves have a strong musty odor.
Stems: Mature plants grow 4-10 feet tall. Stems are erect, extensively branched, and covered with purple spots.
Roots: Taproot.
Seedling: Seedling leaves are fernlike in appearance.



Similar Species
Exotics: Superficially similar to other exotic members of the Parsley family, such as wild caraway *(Carum carvi)* or wild carrot *(Daucus carota).* Spotted stems are diagnostic.
Natives: Native members of the Parsley family, including water hemlock *(Cicuta douglasii),* and osha *(Ligusticum porteri)* are somewhat similar in overall appearance, but lack the distinctive spotted stems.

Impacts
Agricultural: Poison hemlock crowds out desirable forage species and can poison livestock and humans. Sheep are less sensitive than cattle and horses (DiTomaso 1999).
Ecological: Although it is not an aggressive invader, poison hemlock may gradually increase in frequency in native riparian and lowland communities.
Human: Poison hemlock is a highly poisonous plant that should be handled with care. All parts of the plant are poisonous.

Habitat and Distribution
General requirements: Poison hemlock is generally found on dry to moist soils and can tolerate poorly drained soils. Poison hemlock plants tend to be scattered in riparian areas. It is usually found along streams, roadside ditch banks and irrigation ditches, the borders of pastures and cropland, and will gradually invade perennial crops.
Distribution: Naturalized throughout the United States.
Historical: Poison hemlock is a native of Europe, and is generally believed to be the plant that was used to kill Socrates.

Biology/Ecology

Life cycle: Poison hemlock is a biennial that can grow to impressive heights (up to ten feet). The first year plants form a small seedling that resembles wild carrot. Plants typically bolt the second year and produce numerous clusters of white flowers. Plants flower from April through July (USDA 1997). Seeds are dispersed for an extended period beginning in July and continuing into winter. Most seeds mature before dispersal and can germinate immediately if environmental conditions are favorable; however, some seeds are dormant (Baskin and Baskin 1990).
Mode of reproduction: Poison hemlock reproduces by seeds.
Seed production: No information available.
Seed bank: Seeds may remain viable in the soil for about three years (Calweed 1999).
Dispersal: Seeds can be spread in mud which sticks to machinery and clothing, or in transported soil. Also dispersed to a limited extent by water or wind.
Hybridization: No information available.

Control

Keys to Control:
- Eliminate seed production and exhaust the soil seed bank.
- Re-seed controlled areas with desirable species.

Biocontrol: The European palearctic moth (*Agonopterix alstroemeriana*), was somehow introduced into the United States. It apparently feeds exclusively on poison hemlock. It is found in Colorado, and is a biological control agent in Idaho, Oregon and Washington where it is effective (William et al. 1996).
Mechanical: Poison hemlock can be controlled by digging, repeated mowing, pulling, or by spring/winter burns. Care should be taken to avoid contact with bare skin (wear gloves). Wash hands thoroughly after handling any part of this plant, especially when plant sap is present.
Fire: No information available.
Herbicides: Tebithuron can provide excellent pre-emergent control of poison hemlock. Chlorsulfuron and chlorsulfuron + metsulfuron provide both pre-emergent and foliar control (DiTomaso 1999). Picloram, dicamba, 2,4-D at 1 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre, can also be used to provide chemical control of poison hemlock. Apply foliar herbicides during the rosette stage with a wick to minimize damage to adjacent desirable vegetation. Cut any stems that arise after treatment. Herbicide treatment may need to be repeated for several years until the seed bank is depleted (Panter and Keeler 1988).
Cultural/Preventive: Prevent the establishment of new infestations by eliminating seed production and maintaining healthy native communities.

Integrated Management Summary

The tendency of this species to grow in wet areas may restrict the use of certain herbicides. Eliminate seed production and exhaust the soil seed bank by removing seed heads before seeds mature. Use gloves for hand pulling, and avoid touching the plant with bare skin. Integrated management of poison hemlock could also utilize an introduction of the palearctic moth and treatment with herbicides, combined with reseeding and altered livestock grazing management to promote healthy plant communities.

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=List B

Field bindweed

Convolvulus arvensis L.

Family: *Convolvulaceae* (Morning-glory)
Other Names: small-flowered morning glory, wild morning glory, perennial morning glory, creeping jenny.
USDA Code: COAR4
Legal Status: Colorado Noxious List B

Keys to Identification:
- Leaves of field bindweed are shaped like arrowheads.
- Flowers are funnel-shaped, white to pink, and have two small bracts 1 inch below the flower base.

Identification

Growth form: Perennial forb.
Flower: Flowers are white to pink, borne singularly or in pairs on long stalks from the axils of the leaves with two bracts.
Seeds/Fruit: Seeds are ovoid to pearl-shaped, three-angled with one rounded and two flattened sides. Seeds are dull, brownish-gray, and coarsely roughened.
Leaves: Leaves are alternate, simple, glabrous to finely pubescent, more or less arrowhead-shaped.
Stems: Stems are prostrate, 1-4 ft long, often climbing or forming dense mats.
Roots: The roots system and rhizomes are extensive, whitish, cord-like, and fleshy. The primary root is a taproot from which lateral roots develop (Peterson 1998).
Seedling: Seed leaves (cotyledons) are spatulate, and are broad and indented at the tip.

Similar Species

Exotics: *Fallopia convolvulus* (black bindweed) in the knotweed family *(Polygonaceae)* is similar.
Natives: *Calystegia sepium* (hedge bindweed) has larger leaves and flowers.

Impacts

Agricultural: Can be a problem in cultivated fields.
Ecological: Field bindweed can be a serious threat to native plant communities because it has such a great capacity for regeneration (Peterson 1998). Detached roots and rhizomes have the potential to produce large numbers of new shoots. Both a high rate of seed production, and long-term viability allow the plant to spread and persist. Disturbance, especially cultivation and/or overgrazing, is a prerequisite for bindweed to invade. Field bindweed's broad range of environmental tolerances make it highly competitive in most areas.
Human: No information available.

Habitat and Distribution

General requirements: Field bindweed occurs, and is competitive on, disturbed ground that is rich in introduced species. Field bindweed cannot tolerate shade and uses its viney stems to move into sunlight. Therefore, it is unlikely that field bindweed persists in later stages of community succession (FEIS 1996). Field bindweed is

commonly found on more basic (rather than acidic) soil types and those of heavier texture. It can persist in dry to moderately moist soils, and is capable of surviving drought (Rutledge and McLendon 1998).
Distribution: Field bindweed may be found at altitudes as high as 10,000 feet (Whitson et al. 1996).
Historical: Native to Europe, introduced in North America as early as the 1730s (Peterson 1998).

Biology/Ecology
Life cycle: The leaves of field bindweed vary greatly in size and shape with environmental factors such as light intensity, soil moisture, and with damage due to frequent cultivation. Flowers appear from June to September and occasionally until the first fall frost (Rutledge and McLendon 1998). Seeds mature within 2 weeks after pollination during hot summer days (FEIS 1996). Germination can occur in the fall or spring, over a wide range of temperatures (FEIS 1996). Field bindweed overwinters by means of its roots and rhizomes. Shoots are killed back to the crown by freezing temperatures, but hardened roots can withstand temperatures as low as -6° C (Peterson 1998). Most lateral roots die back each year but some persist for several years, spreading horizontally (Peterson 1998). Buds arise on the lateral roots and develop into rhizomes that have the potential to establish new crowns when they reach the surface. Excised root segments establish new roots and crowns more effectively than rhizome segments (Peterson 1998).)
Mode of reproduction: Reproduces both by seed and vegetatively.
Seeds production: The number of seeds produced per plant ranges from 25 to 300 and seed production is variable and depends on environmental conditions.
Seed bank: Field bindweed seeds can remain viable in the soil for over 20 years (Peterson 1998).
Dispersal: Seeds have a hard impermeable seed coat. They generally fall near the parent plant but can be dispersed by water, as a contaminant in crop seeds, and by mammals and birds after ingestion.
Hybridization: No information available.

Control
Biocontrol: Currently, there has been little evidence of a biological control agent that significantly damages or reduces populations of field bindweed. Two agents that are present in the U.S. and being studied are *Aceria mahlerbae*, a gall mite, and *Tyta luctuosa*, a moth (Rees et al. 1996).
Mechanical: Cutting, mowing, or pulling has a negligible effect unless plants are cut below the surface in the early seedling stage. Well-established populations have a large seed bank in the soil that can remain viable for long periods of time (over 20 years).

Keys to Control:
- Contain and persistently control existing stands of field bindweed in order to exhaust the root system and deplete the soil seed bank.
- Maintain a healthy cover of perennial plants to discourage field bindweed establishment.

Fire: Prescribed fire is not recommended as a control for field bindweed due to its potential for vegetative regrowth and a long-lived seed bank.
Herbicides: Chemical treatment often requires high rates as well as repeated applications. Successful treatment of bindweed can result in substantial damage to desirable plants. Foliar applications of glyphosate at 1.5 lb. ai/acre or picloram at 0.25-0.5 lb. ai/acre, dicamba, or 2,4-D at 1 lb. ai/acre can provide good control. Control is best when applied during early flowering and when soil moisture is low (Peterson 1998). Repeated applications are advised for long-term control.
Cultural/Preventive:

Integrated Management Summary
Field bindweed can be a serious weed in native plant communities. Field bindweed requires active management once it is established because of its potential to regenerate rapidly. Even small infestations should be viewed as a serious threat and managed aggressively. It is also tolerant of a variety of environmental conditions which makes it highly competitive for resources (Rutledge and McLendon 1998). Due to the vegetative reproductive ability of field bindweed, as well as the large seed bank of established populations, successful control requires repeated applications over several years.

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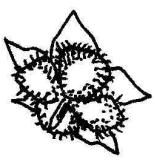
Houndstongue

Cynoglossum officinale

Family: *Boraginaceae* (Borage)
Other Names: hound's tongue, dog bur, gypsy flower
USDA Code: CYOF
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Five-petaled reddish-purple flowers in panicles.
- Prickly nutlets are distinctive.



nutlets

Identification
Growth form: Biennial or short-lived perennial forb.
Flower: Flowers are reddish-purple, with five petals, arranged in panicles in the upper leaf axils.
Seeds/Fruit: The fruit is composed of four prickly nutlets each about 1/3 inch long (Whitson et al. 1996).
Leaves: Leaves are alternate, 1-12 inches long, 1-3 inches wide, rough, hairy, and lacking teeth or lobes (Whitson et al. 1996). Leaves often appear dusty and insect-ridden. Basal leaves are elliptical to oblanceolate and tapered at the base.
Stems: Houndstongue produces a single flowering stem. The stem is erect, stout, heavy, 1.5 to 3 feet high and usually branched above.
Roots: Houndstongue has a thick, black, woody taproot.
Seedling: Houndstongue forms a rosette the first year of its life cycle.

Similar Species
Exotics: Rosettes may resemble burdock.
Natives: If not flowering, could be mistaken for members of the *Hackelia* or *Lappula* genus (stickseeds).

Impacts
Agricultural: Houndstongue contains toxic alkaloids that stop liver cells from reproducing. Therefore, houndstongue reduces livestock and wildlife forage and grazing animals should be kept away from houndstongue infested areas. Animals may live six or more months after eating a lethal dose of houndstongue. Sheep are more resistant to houndstongue poisoning that cattle or horses. The burs may reduce the value of wool.
Ecological: Houndstongue is an early sucessional species on recently disturbed sites.
Human: Due to its toxicity to grazing animals, houndstongue should not be eaten by humans.

Habitat and Distribution
General requirements: Houndstongue prefers areas with more than 10% bare ground (Butterfield et al. 1996), and is common on gravelly, alkaline soils (Stubbendieck et al. 1995).
Distribution: Houndstongue is found over much of North America. It grows on rangeland, pastures, abandoned cropland, roadsides, and waste places (Butterfield et al. 1996). Houndstongue is found on rangeland, pastures, and roadsides throughout Colorado up to about 9000 feet.

Historical: Houndstongue is a native of Eurasia that was introduced to North America as a contaminant in agricultural seed.

Biology/Ecology

Life cycle: Houndstongue is a biennial that produces a rosette the first year. During the second year a flowering stem bolts and produces fruit.
Mode of reproduction: Reproduces solely by seed.
Seed production: Mature plants can produce up to 2,000 seeds (Butterfield et al. 1996).
Seed bank: Seeds remaining on the parent plant may remain viable for 2-3 years. Buried seed rarely survive more than one year (Butterfield et al. 1996).
Dispersal: Seeds stick to clothing and animals and have the ability to be spread great distances.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: Mowing second year plants during flowering but before seed maturation reduces seed production and may kill the plant.
Fire: No information available.

Keys to Control:
- Eliminate seed production.
- Re-seed controlled areas with desirable species.

Herbicides: Picloram at 0.25-0.5 lb., 2,4-D, or dicamba at 1.0 lb., or metsulfuron at 0.6 oz. ai/acre applied in spring provides control of houndstongue. Spring treatments with picloram, dicamba, or metsulfuron are more effective than fall treatments (Sebastian and Beck 1995). Chlorsulfuron applied 0.5 lb. ai/ac gave complete control when applied any time beginning with the rosette stage until the bolted plant had attained 10 inches in height (Butterfield et al. 1996).
Cultural/Preventive: Maintaining a healthy population of native perennials the best way to prevent the establishment and spread of houndstongue.

Integrated Management Summary

Houndstongue is poor competitor with native perennials and requires disturbed or bare areas to establish. Once established, houndstongue quickly forms dense monocultures. Treat first year plants with herbicides. Mow bolted plants to eliminate seed production. Repeat this process for several years to exhaust the seed bank. It is imperative to establish a healthy population of native perennials on treated areas to prevent the re-establishment of houndstongue or other noxious weeds.

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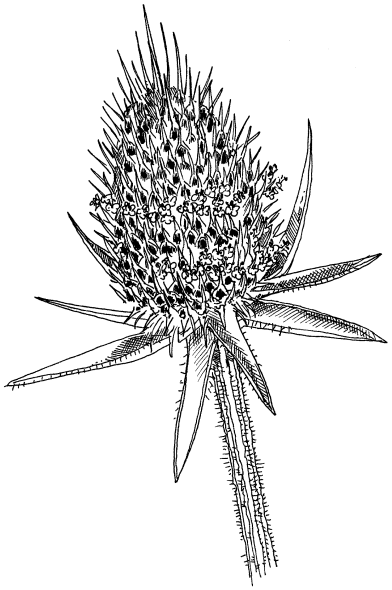
Common teasel

Dipsacus fullonum (L.) ssp. ***sylvestris*** (Huds.) Clapham

Family: *Dipsacaceae* (Teasel)
Other Names: teasel, fuller's teasel, Venus's basin, card thistle, barbers brush, brushes and combs, church broom
USDA Code: DIFU2
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Common teasel can be identified by its distinctive flower head. Flowers are small and packed in dense, oval-shaped heads.
- Flowers are subtended by stiff, spiny bracts that give the flower heads a bristly appearance and texture.

Identification
Growth form: Biennial or sometimes monocarpic perennial forb.
Flower: Flowers are purple, and subtended by spiny, awned bracts. The floral bracts at the base of the head are generally longer than the head.
Seeds/Fruit: The fruits are four-angled, each contains a single seed.
Leaves: Rosette leaves are conspicuously veined, with stiff prickles on the lower midrib (Whitson et al. 1996). Stem leaves are simple, opposite, net-veined, stalkless, and clasp the stem. Flowering plants have large, oblong, opposite leaves that form cups, which are capable of holding water (Wisconsin DNR 1998).
Stems: Mature plants can grow up to six feet tall. The taprooted stem is rigid, furrowed (striate-angled), with several rows of downward turned prickles.
Roots: Shallow taproot with secondary fibrous root system.
Seedling: No information available.



Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: Common teasel is not considered palatable and is generally ignored by livestock. It displaces native vegetation and decreases range quality.
Ecological: Common teasel can be an aggressive competitor in disturbed areas. Massive seed production and high germination allow it to quickly invade an area and outcompete other plants.
Human: No information available.

Habitat and Distribution
General requirements: Common teasel grows in open, sunny habitats that range from wet to dry. It is generally found along irrigation ditches, abandoned fields, pastures, waste places, and forests.
Distribution: Common teasel is spreading rapidly in America, particularly in the Pacific Northwest. In Colorado, teasel is usually found in relatively moist, disturbed situations. It is known to be collected and spread as an ornamental decoration for dried flower arrangements.
Historical: Common teasel is a native of Europe where it has historically had many uses. The heads of a cultivated variety of teasel are used for wool "fleecing", or raising the nap on woolen cloth. (Grieve 1995). These heads are fixed on the rim of a wheel, or on a cylinder, which is made to revolve against the surface of the cloth (Grieve 1995). No machine has yet been invented which can compete with teasel in its combined rigidity and elasticity

(Grieve 1995). The roots of common teasel are also reported to have various medicinal values ranging from a remedy for jaundice to a cleansing agent (Grieve 1995).

Biology/Ecology

Life cycle: Common teasel is a biennial or sometimes monocarpic perennial. The plant grows as a basal rosette for a minimum of one year, and then sends up a tall, flowering stalk (Wisconsin DNR 1998). After flowering and seed set, the plant dies (Werner 1975). Flowering occurs from July to August.
Mode of reproduction: Reproduces by seeds only.
Seed production: A single teasel plant can produce over 2,000 seeds, of which 30-80% may germinate (Wisconsin DNR 1998).
Seed bank: Seeds can remain viable for at least two years.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: Seed production should be eliminated by cutting flowering stalks.
Fire: No information available.
Herbicides: Metsulfuron at 0.3 oz. ai/acre will control teasel. Dicamba at a rate of 0.25-0.5 lb. ai/acre can be applied on teasel rosettes less than three inches in diameter (PMIS). For rosettes 3 inches or more in diameter, increase to 0.5-1.0 lb. ai/acre (PMIS). When teasel is bolting, apply 1.0-1.5 lb. ai/acre (PMIS).
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Keys to Control:
- Eliminate seed production by cutting seed stalks after flowering, and exhaust the seed bank in the soil.
- Re-seed controlled areas with desirable species.

Integrated Management Summary

The key to controlling common teasel is to eliminate seed production and exhaust the seed bank in the soil. Common teasel does not reproduce vegetatively and dies after seed production (Werner 1975). Therefore, cutting the stalks of flowering plants is recommended as the best control in natural areas. Cut stalks should be bagged and burned. This usually requires several years of control to eliminate an infestation.

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=List C

Cypress spurge

Euphorbia cyparissias L.

Family: *Euphorbiaceae* (Spurge)
Other Names: graveyard spurge
USDA Code: EUCY2
Legal Status: Colorado Noxious List C (not yet widespread in Colorado – call your county weed supervisor!)

Keys to Identification:
- Stem leaves are narrow and dark-green.
- Tiny flowers are clustered in small, cup-like structures.
- Stems exude a milky sap when broken.

Identification
Growth form: Semi-woody perennial forb.
Flower: The tiny, lime green to white flowers are clustered in small, cup-like structures.
Seeds/Fruit: The three-capsuled fruits of cypress spurge explode at maturity, ejecting the seeds.
Leaves: Leaves are stalkless, alternate, narrow, linear to lance-shaped.
Stems: Mature plants are about 1-1.5 feet tall.
Roots: The root system consists of long indeterminate roots, which spread both in horizontal and vertical planes, and short determinant roots, which spread in a strictly horizontal plane.
Seedling: No information available.
Other: The entire plant exudes white, milky sap that can be irritating to the skin.

Similar Species
Exotics: Can be distinguished from leafy spurge *(Euphorbia esula)* by its slender stems with numerous, crowded, narrow leaves.
Natives: None known.

Impacts
Agricultural: Its milky latex is toxic, but it is rarely consumed in quantities sufficient to cause serious injury. It does not tolerate intensive cultivation and is not a problem in crops.
Ecological: Cypress spurge is weedy plant that invades disturbed areas. Cypress spurge can reproduce rapidly, and quickly invade an area. Its ability to spread vegetatively is a major factor contributing to its success.
Human: Humans should be careful to avoid contacting the latex with bare skin.

Habitat and Distribution
General requirements: Cypress spurge commonly occurs in dry to moderately moist meadows, pastures, forest edges, roadsides, rights-of-way, cemeteries, and gardens. Cypress spurge generally does not occur on intensively cultivated soils (Stahevitch et al. 1988).
Distribution: Not yet widespread in Colorado, this species is typically found around residential areas and local open spaces.
Historical: Native to Europe, an escaped ornamental.

Biology/Ecology

Life cycle: Plants overwinter as seed or root and crown tissue. Perennating buds develop on the indeterminate roots (Stahevitch et al. 1988). New shoots emerge, and seeds germinate, each spring soon after the snow cover melts. Flowering begins the first or second week of May. Seeds may mature as early as the third week in June. A second flowering often occurs in late summer or early fall.
Mode of reproduction: Cypress spurge reproduces by vegetative propagation or seed.
Seed production: Cypress spurge generally produces between 30-900 seeds per plant, which exhibit germination rates of 85% (Stahevitch et al. 1988).
Seed bank: No information available.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: Sheep and goats are usually good biocontrol for spurges.
Mechanical: Repeated mowing can be used to eliminate seed production and exhaust the nutrient reserves in the root system.
Fire: No information available.
Herbicides: Cypress spurge is often lumped into the "leafy spurge complex", and treatment is similar to that for leafy spurge. Picloram at 0.5 lb, picloram+2,4-D at 0.25+1.b, dicamba or 2,4-D at 1 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre will control cypress spurge. Apply herbicides with a wick to minimize damage to adjacent desirable plants.
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Keys to Control:
- Mow or spray infestations in order to eliminate seed production and exhaust the plants nutrient reserve.
- Re-seed controlled areas with desirable species.

Integrated Management Summary

This species is not yet widespread in Colorado, and should be a priority for immediate eradication if found. Control of cypress spurge can be hard to achieve due to its extensive root system and highly efficient seed dispersal. As with other perennial rhizomatous species, an integrated control strategy should focus on eliminating seed production while depleting the nutrient reserves in the root system. Mechanical and/or chemical control should be combined with land management practices which maintain healthy native plant communities.

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=List B

Leafy spurge

Euphorbia esula L.; ***Tithymalus esula*** (L.) Scopoli

Family: *Euphorbiaceae* (Spurge)
Other Names: none widely accepted
USDA Code: EUES
Legal Status: Colorado Noxious List B (top ten worst)

Keys to Identification:
- Flowers are yellowish-green and have a pair of heart shaped yellow-green bracts below each inconspicious flower.
- The entire plant contains white, milky latex.

Identification
Growth form: Perennial forb.
Flower: Flowers are yellowish-green, small, arranged in numerous small clusters and subtended by paired heart-shaped yellow-green bracts.
Seeds/Fruit: Seeds are oblong, grayish to purple, contained in a 3-celled capsule.
Leaves: Leaves are alternate, narrow, 1-4 inches long.
Stems: Mature plants are up to 3 feet tall. Stems are thickly clustered.
Roots: Extensive lateral root system.
Seedling: Seed leaves (cotyledons) are linear to lanceolate, with entire margins.
Other: The entire plant contains white, milky latex. Foliage of the plant is smooth and hairless.

Similar Species
Exotics: None known.
Natives: Leafy spurge is distinguished from native spurges such as *Euphorbia brachycera* by its long linear leaves.

Impacts
Agricultural: Leafy spurge can invade rangeland that is in excellent condition, making it worthless for cattle and horse grazing and reducing land values (Lajeunesse et al. 1999).
Ecological: Leafy spurge is an aggressive, long-lived, perennial weed that tends to displace all other vegetation in rangeland, pasture, and native habitats (Biesboer 1998). Leafy spurge decreases rangeland diversity, threatens native plants and degrades wildlife habitat (Lajeunesse et al. 1999). It produces a large number of seeds and underground shoot buds. These two reproductive techniques allow it to rapidly displace native species, and form a leafy spurge monoculture. Rapid re-establishment of treated stands often occurs after an apparently successful management effort because of the large nutrient reserve stored in the roots of leafy spurge plants. Also, leafy spurge produces an allelopathic compound that inhibits the growth of other plants (Butterfield et al. 1996).
Human: The milky latex associated with leafy spurge can cause irritation, blotching, blisters, and swelling in sensitive individuals.

Habitat and Distribution
General requirements: Leafy spurge grows in a wide range of habitats.

It is most aggressive in semi-arid areas, but can be found in xeric to subhumid and subtropic to subarctic habitats (Butterfield et al. 1996). Leafy spurge occurs most commonly on untilled, non-crop areas such as rangeland, pastureland, woodland, prairies, roadsides, stream and ditches, and waste sites. It grows on all kinds of soils, but is most abundant in coarse-textured soils and least abundant on clayey soils (Butterfield et al. 1996).
Distribution: In Colorado, leafy spurge is common on disturbed soils between 5,000 to 6,500 feet (Rutledge and McLendon 1998), but can be found up to 9,000 feet.
Historical: No information available.

Biology/Ecology
Life cycle: Leafy spurge is one of the earliest plants to emerge in the spring, usually in mid-April to late May (Butterfield et al. 1996). The development of terminal flower clusters begins 1 to 2 weeks after stem emergence. Flower clusters have 8 to 16 branches. Each branchlet forms a greenish yellow bract in May. Flowering generally ends in late June to mid-July as the plants do not usually flower, and growth is reduced, during the hotter portion of the summer. However, if conditions are favorable, leafy spurge may produce a few lateral flowers throughout the summer and in the fall. Thus, it is possible for the plant to produce seed until frost. Seeds mature about 30 days following pollination. Peak germination occurs from late-May to early June. If adequate moisture is present, germination can occur throughout the growing season.
Mode of reproduction: Despite being a successful seed producer, leafy spurge primarily reproduces vegetatively through its extensive lateral root system. Long roots have the capability to produce shoots and can reach nearly 15 feet laterally, and about 30 feet in depth. As many as 300 buds have been counted on these long roots (Butterfield et al. 1996).
Seed production: Each flowering stem produces from 10-50 capsules with a seed yield range of 200-250 seeds per flowering shoot (Best et al. 1980). A large plant may produce up to 130,000 seeds (Rutledge and McLendon 1998).
Seed bank: Seeds can remain viable in the soil for 5-8 years although 99% of the viable seeds will germinate in the first two years (Butterfield et al. 1996).
Dispersal: The three-sided capsules explode when ripe, sending the enclosed seeds up to 15 feet from the parent plant. Seeds float on water, and can be transported and deposited by flood water.
Hybridization: No information available.

Control

Keys to Control:
- Develop a management scheme that uses several control methods that are compatible with your site.
- Persistently monitor your area and quickly control new infestations.

Biocontrol: Currently, there is extensive research on biological control agents for leafy spurge with over 15 insects being studied (Biesboer 1998). However, control of leafy spurge by insects is often limited by the thick milky latex, which tends to clog the mouth or sucking parts of most insects (Butterfield et al. 1996). Successful biological control will most likely require a combination of insects and a long-term management program to establish them. The Division of Plant Industry's Biological Pest Control Section has released eight species in an effort to control leafy spurge. Three of these species, *Aphthona nigriscutis, A. cyparissiae*, and *A. czwalinae*/*lacertosa*, have become established and may be available for distribution from the Insectary. The most effective biological control agents seem to be six species of root- and foliage-feeding beetles in the genus *Aphthona*, and a stem- and root-boring beetle *Obera erythrocephala* (Lajeunesse et al. 1999).

Grazing sheep on infested areas has been used successfully to control spurge on ranches in Montana, but ranchers agree that once the sheep were removed the spurge would quickly return (Biesboer 1998). Sheep grazing is likely to be most effective in the spring and summer when the spurge plants are succulent and when sheep tend to prefer forbs over grasses, rather than in fall when sheep forage more on grasses (Lajeunesse et al. 1999). Two grazing periods during the spring-summer with a recovery period (for the grasses) between are recommended rather than season-long grazing. Fall grazing by goats followed by application of picloram and 2,4-D (each 1 qt./ac) can provide good control (Lajeunesse et al. 1999). A recent study near Denver found that sheep grazing for a short period in early July every year for 5 years reduced leafy spurge density by 90%. This study also produce excellent results by combining sheep with *Apthona* beetles (Beck and Rittenhous, 2000).
Mechanical: Tillage is not generally a practical control method for areas where leafy spurge grows. Mowing can actually increase the density of leafy spurge, and may not be effective even when combined with herbicide (K.G. Beck, pers. comm.). Pulling leafy spurge is ineffective, even for small infestations because of the deep root system and the presence of numerous root buds.

Fire: Burning alone will not likely provide adequate control of leafy spurge due to regeneration from the root system. However, combinations of burning and herbicide application 5 weeks later might provide adequate control (Biesboer 1998). In one study, plots of leafy spurge were sprayed with a mix of 2,4-D and picloram in September and burned the following April. The plots were sprayed again in June and burned again in October (Biesboer 1998). This process is designed to exhaust the nutrient reserves in the root system of the plant and hinder its ability to compete with other species. Therefore, reseeding desirable species is also necessary.
Herbicides: Herbicides can provide some control of leafy spurge. However, due to its extensive root system and general hardiness, follow up applications are necessary for herbicides to be effective. Picloram is recommended for eradication of small infestations, with herbicide application extending for 10-15 feet beyond the leafy spurge patches (Lajeunesse et al. 1999). A combination of picloram and 2,4-D (1-1.5 pints of picloram with 1-1.5 quarts of 2,4-D) was shown to provide the best control when applied in the spring when flowers emerge (Beck 1996). Research in North Dakota has shown that a tank mix of picloram (1 pt./ac) and 2,4-D (1 qt./ac) (based on concentrate of 4 pounds active ingredient / gallon) applied 2 weeks after the yellow bracts appear and applied annually is a cost effective treatment for leafy spurge (Lym et al. 1993). Picloram at 1 qt./ac for 2-3 consectutive years is also effective, but more expensive. An annual combination of dicamba plus 2,4-D (4-8 oz + 0.5-1 quart/acre) also provided good control (Beck 1996). Glyphosate is most effective when applied sequentially at 1 quart/acre at one-month intervals, coupled with fall grass seeding (Beck 1996).
Cultural/Preventive: Long-term control of leafy spurge requires, among other things, a competitive plant community dominated by desirable species. For reseeding, select a mixture of grass species with early-, mid-, and late-season growth, and with shallow-, intermediate-, and deep-rooting depths. The resulting plant community will maximize the use of water and nutrients by the desirable species and will effectively compete with leafy spurge. After reseeding, it is imperative to manage grazing animals carefully so as to invigorate and not harm perennial grasses. Consider grazing sheep or goats with cattle so the former can graze spurge plants.

Note of Caution: The milky latex associated with leafy spurge can cause irritation, blotching, blisters, and swelling in sensitive individuals. The eyes should never be rubbed until after the hands are thoroughly washed. Gloves should be worn while pulling or coming into contact with this plant.

Integrated Management Summary

Persistent monitoring of areas with known or potential infestations is crucial to managing leafy spurge. New infestations are much more easily controlled than established infestations. 100% eradication of leafy spurge is rarely achieved, but infestations can be reduced to manageable levels. Herbicides are most commonly used to control leafy spurge. However, damage to non-target species is always a concern. Sheep and goats can be used to control leafy spurge. Leafy spurge is extremely difficult to control by chemical means and is almost impossible to control by cultural or physical methods. Therefore a management scheme that combines control methods over four to five years is recommended (Beck 1996). Lym (1998) recommends combinations of re-seeding with competitive grasses, biological control insects, sheep or goat grazing and herbicide (2,4-D + picloram) treatment. Grazing animals and biological agents are generally appropriate only for larger infestations. Although leafy spurge can be poisonous to cattle, sheep can be taught to feed on it and goats will seek it out. For an example of one rancher's integrated approach to leafy spurge control, see page 61.

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Myrtle spurge

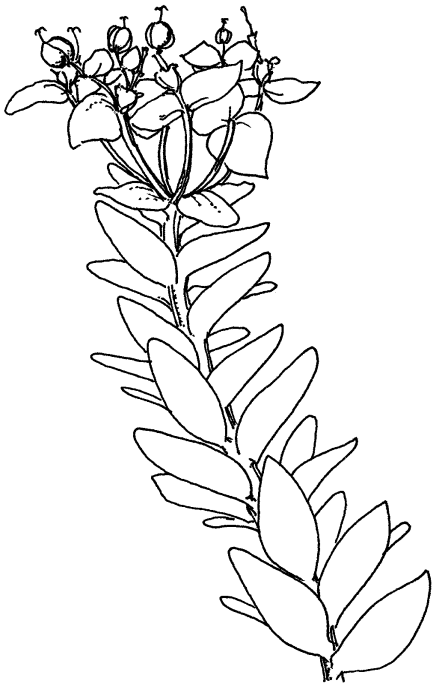
Euphorbia myrsinites L.

Family: *Euphorbiaceae* (Spurge)
Other Names: creeping spurge, donkeytail
USDA Code: EUMY2
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Myrtle spurge can be identified by its trailing stems of fleshy, blue-green leaves.
- Yellow-green flower-like bracts appear in early spring.
- When broken, plants exude a milky latex that can be irritating to the skin.

Identification
Growth form: Perennial forb.
Flower: Yellow-green flower-like bracts appear in early spring.
Seeds/Fruit: No information available.
Leaves: The plant produces trailing stems of fleshy, blue-green alternate leaves.

Stems: Mature plants are 4-6 inches tall and spread up to 18 inches laterally.
Roots: Taproot.
Seedling: No information available.
Other: The plant exudes a milky sap that can be irritating to the skin.



Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: Myrtle spurge plants exude a milky sap that is considered toxic and may cause skin irritations and in extreme cases, livestock poisoning. Livestock and animals generally avoid myrtle spurge and large infestations can reduce forage production. Myrtle spurge does not tolerate frequent cultivation and therefore is not a problem in crops.
Ecological: Although not a particularly aggressive invader, myrtle spurge can inhabit disturbed ground and exclude native plants.
Human: Milky latex can cause minor skin irritation.

Habitat and Distribution
General requirements: Myrtle spurge prefers dry to moist, well-drained soils, in areas that receive partial shade to full sun. It is an escaped ornamental that inhabits disturbed areas and waste places and is primarily found in municipal areas and nearby wildlands.
Distribution: Myrtle spurge is increasingly common in Colorado, particularly in residential areas and local open spaces where it has escaped cultivation as an ornamental species.
Historical: Native to Eurasia.

Biology/Ecology
Life cycle: Myrtle spurge is a perennial that produces new stems from the center (taproot) each year. Plants flower in early spring.

Mode of reproduction: Myrtle spurge spreads by seed.
Seed production: No information available.
Seed bank: No information available.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: Small infestations can be dug or pulled, depending upon the size of the infestation.
Fire: No information available.
Herbicides: 2,4-D or dicamba at 1 lb. ai/acre, and glyphosate at 1.5 lb. ai/acre should provide adequate control of myrtle spurge (Stahevitch et al. 1996). Picloram at 0.5 lb ai/acre is another possible control. Apply herbicides with a wick to avoid damage to adjacent desirable plants. The seedling stage is generally the best time to apply herbicides.
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Keys to Control:
- Eliminate seed production of existing plants and destroy any new seedlings that emerge.
- Re-seed controlled areas with desirable species.

Integrated Management Summary

This species is not yet widespread in Colorado, and should be a priority for immediate eradication if found. As with other plants which reproduce solely by seed, integrated management efforts of myrtle spurge must include the elimination of seed production and the depletion of the seed bank. Combine herbicide or mechanical removal of rosettes with removal of flowering parts from any plants that have bolted.

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=List B

Dalmatian toadflax

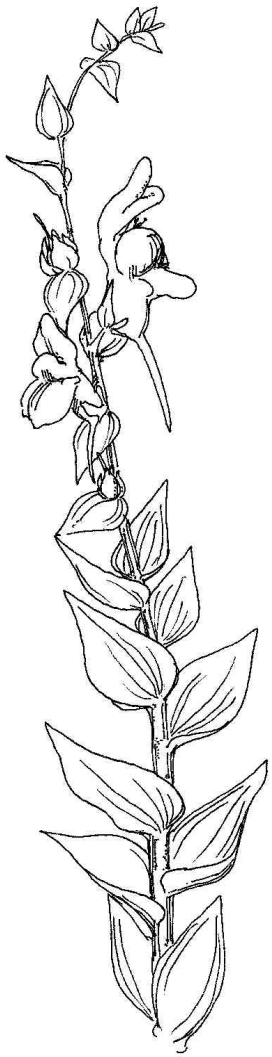
Linaria dalmatica (L.) Miller;
Linaria genistifolia ssp. ***dalmatica*** (L.) Marie and Petitmengin

Family: ***Scrophulariaceae*** (Figwort)
Other Names: broad-leaved toadflax, wild snapdragon
USDA Code: LIDAM
Legal Status: Colorado Noxious List B (top 10 worst)

Keys to Identification:
- Dalmatian toadflax can be easily identified by its bright-yellow, snapdragon-shaped flowers.
- Dalmatian toadflax can be distinguished from yellow toadflax by its larger flowers and more ovate leaves (rather than the linear, somewhat pointed leaves that are characteristic of yellow toadflax).

Identification

Growth form: Perennial forb.
Flower: Flowers are borne in loose, elongate, terminal racemes. Flowers are bright yellow and resemble snapdragons.
Seeds/Fruit: Fruits are egg-shaped to nearly round capsules. Seeds are sharply angular, and slightly winged.
Leaves: Leaves are broad, ovate to ovate-lanceolate, and are alternate, generally clasping but crowded.
Stems: Mature plants are up to three feet tall. A single toadflax plant contains from 1-25 vertical floral stems. which are thick-walled and somewhat woody.
Roots: The taproot may penetrate one meter into the soil. Horizontal roots may grow to be several meters long, and can develop adventitious buds that may form independent plants.
Seedling: No information available.



Similar Species

Exotics: Yellow toadflax *(Linaria vulgaris)* is similar in appearance, but has more linear pointed leaves, and is generally a smaller plant.
Natives: None known.

Impacts

Agricultural: Low-till cultivation practices have contributed to the resurgence of toadflax populations on agricultural lands (McClay 1992). Dalmatian toadflax contains a glucoside, a quinoline alkaloid, and peganine which make it toxic to livestock (Rees et al. 1996). However, Dalmatian toadflax is generally considered unpalatable, and reports of livestock poisonings are rare.
Ecological: Dalmatian toadflax is a persistent, aggressive invader and capable of forming colonies through adventitious buds from creeping root systems. These colonies can push out native grasses and other perennials, thereby altering the species composition of natural communities. New infestations of Dalmatian toadflax can occur in naturally occurring disturbances or in small openings in pristine or excellent-condition rangeland (Lajeunesse 1999). Dalmatian toadflax can rapidly colonize open sites. It is most commonly found along roadsides, fences, rangelands, croplands, clear cuts, and pastures. Disturbed or cultivated ground is a prime candidate for colonization. Toadflax can significantly reduce crop yields and stress native communities. In one study, toadflax-free plots produced 2.5 times more grass than plots where toadflax was present (Robocker 1974). The seedlings of toadflax are considered ineffective competitors for soil moisture with established perennials and winter annuals (Morishita 1991). However, once established both species of toadflax suppress other vegetation mainly by intense competition for limited soil water. Mature plants are

particularly competitive with winter annuals and shallow-rooted perennials (Robocker 1974).
Human: No information available.

Habitat and Distribution
General requirements: Dalmatian toadflax can adapt its growth to fit a wide range of environmental conditions, and is tolerant of low temperatures and coarse-textured soils.
Distribution: In Colorado, Dalmatian toadflax is commonly found between 5,000 to 6,500 feet in oak, aspen, sagebrush, mountain brush, and riparian communities. It can be found growing up to 9,000 feet (A. Green, pers. comm.).
Historical: Native to Mediterranean region.

Biology/Ecology
Life cycle: Spring emergence occurs about mid-April and depends primarily on temperature. During the first year the plant forms a rosette and develops a deep root system. Prostrate stems emerge in September and produce ovate leaves. Prostrate stems are tolerant to freezing and are associated with floral stem production the following year (Robocker 1974). The strong upright floral stems that characterize mature toadflax plants develop after a winter's dormancy, and emerge about the same time as new seedlings in mid-April. A single plant will produce from 1-25 floral stems. Flowering occurs from May-August and seeds mature from July-September. Dalmatian toadflax can also reproduce vegetatively. Stems develop from adventitious buds on primary and lateral roots. Vegetative reproduction from root buds can occur as early as 2-3 weeks after germination, and is possible from root fragments as short as 1 cm in length (Zimmerman 1996). These buds can grow their own root and shoot systems, and become independent plants the next year. In addition to promoting growth, the large, deep, root systems of Dalmatian toadflax exploit water efficiently. The taproot may penetrate 3-4 feet into the soil and lateral roots may be 6-12 feet long.
Mode of reproduction: By seeds and vegetatively
Seed production: A mature Dalmatian toadflax can produce up to 500,000 seeds annually (Morishita 1991).
Seed bank: Seeds may remain viable in the soil for up to ten years.
Dispersal: Seeds are winged, and wind-dispersed.
Hybridization: No information available.

Control
Biocontrol: The Division of Plant Industry's Biological Pest Control Section currently has one species, *Calophasia lunula*, that may be available for redistribution on Dalmatian toadflax infestations. *C. lunula* larvae feed extensively on leaves and flowers of toadflax, severely damaging the plants.

Keys to Control:
- Maintain a dense cover of vigorous perennial plants.
- Picloram, dicamba, and glyphosate are effective when applied during flowering.
- Hand pulling is effective for small areas, especially in sandy soils.

Mechanical: Cutting or removal of the above ground portion of toadflax plants reduces the current year growth, but it will not kill the plant. Cutting toadflax stands in spring or early summer is an effective way to eliminate plant reproduction through seed production and dispersal. However, the long dormancy of toadflax seeds requires that the process be repeated annually for up to ten years. Hand pulling toadflax before seed set each year can be an effective control method. The hand pulling experiment on The Nature Conservancy's Magnusson Butte Preserve in Washington showed that toadflax can be significantly reduced by pulling once a year as long as new seed is eliminated. Again, this method must be repeated annually for up to ten years to completely remove a stand. Sheep can help suppress Dalmatian toadflax infestations and reduce seed production. The sheep showed no ill effects from eating toadflax and showed good weight gain (Lajeunesse 1999).
Fire: No information available.
Herbicides: Herbicides have highly variable effects on Dalmatian toadflax, probably due to its high genetic variability. Fall applications of picloram 0.5-1.0 lb. ai/acre has provided excellent control for one year. However, the higher concentrations of picloram may be injurious to desirable plants, plus picloram has been ineffective on some sites. A tank mix of picloram + 2,4-D controlled over 90% of Dalmatian toadflax when applied pre-bloom or in the fall. A six-year study found that phenoxypropionic herbicides such as diclorprop were more effective at controlling toadflax than phenoxyacetic herbicides such as 2,4-D (Robocker 1968). 2,4-D, MCPA, MCPB, and mecoprop used alone do not control toadflax.

Cultural/Preventive: Intensive clean cultivation techniques are recommended for successful toadflax control on agricultural land. Discing can be an effective method of toadflax control on agricultural lands. This method requires at least two years with eight to ten cultivations in the first year, and four to five cultivations the second year (Morishita 1991). Weed control should be accompanied by reseeding with a variety of plant species to occupy the site so as to prevent re-establishment of toadflax. An ideal mix of species would include cool- and warm-season plants as well as plants that root at a variety of depths. For example, shallow rooted, cool-season species such as Sandberg bluegrass (*Poa secunda*) compete with toadflax seedlings.

Integrated Management Summary

Management of Dalmatian toadflax must focus on both reducing the rate of vegetative spread and reducing seed production (Lajeunesse 1999). Successful management requires integrating as many control tactics as possible. Dalmatian toadflax has high genetic variability, and local populations can respond differently to control actions, especially herbicide treatments. Successful control can be obtained by pulling, or killing the plants with herbicide before toadflax seed production begins (Carpenter and Murray 1998). Since the plant also spreads through vegetative propagation, and the seeds can remain dormant for up to ten years, this process must be repeated every year for at least ten years to completely remove a stand. Competitive perennial grasses and forbs should be planted to utilize water and nutrients that would otherwise be readily available to toadflax.

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=List B

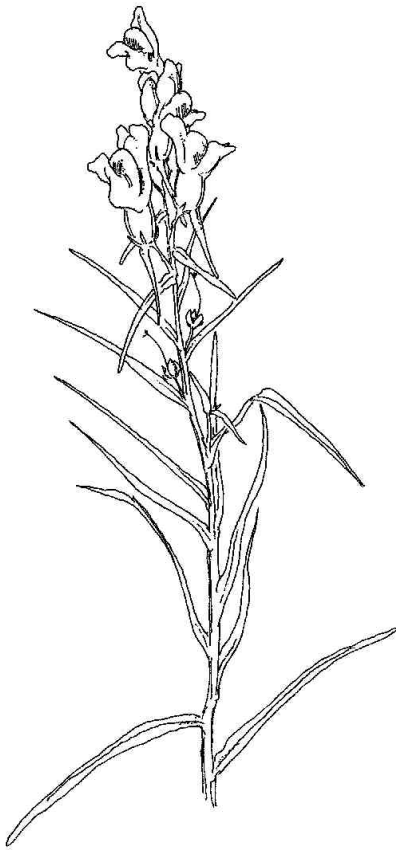
Yellow toadflax

Linaria vulgaris P. Miller

Family: *Scrophulariaceae* (Figwort)
Other Names: butter and eggs, wild snapdragon, common toadflax
USDA Code: LIVU2
Legal Status: Colorado Noxious List B (top ten worst)

Keys to Identification:
- Yellow toadflax can be identified by its yellow, snapdragon-like, flowers and disagreeable turpentine-like scent.
- It can be distinguished from dalmation toadflax by its leaves. The leaves of yellow toadflax are narrow, lance-shaped, and pointed at both ends. The leaves of dalmation toadflax are shorter, wider, and broad-based.

Identification
Growth form: Perennial forb
Flower: Flowers are bright yellow and resemble snapdragons. Flowers are arranged in a raceme at the ends of the branches.
Seeds/Fruit: Seed capsules are round-ovate, 0.3-0.5 inches long, and two-celled. Seeds are brown or black, circular, and surrounded by a notched wing.
Leaves: Leaves are soft, lance-shaped, and pale green. Leaves are mainly alternate but lower leaves appear to be opposite due to crowding.
Stems: Mature yellow toadflax plants are 1-3 feet tall with 1-25 smooth erect floral stems.
Roots: Taproots may be up to a meter in length. Horizontal roots may grow to be several meters long, and can develop adventitious buds that may form independent plants.
Seedling: No information available.
Other: Closely related to Dalmatian toadflax *(Linaria dalmatica).*



Similar Species
Exotics: Leaves of Dalmatian toadflax *(Linaria dalmatica)* are shorter, wider, and broadbased, clasping the stem.
Natives: None known.

Impacts
Agricultural: Yellow toadflax contains a poisonous glucoside that is reported to be mildly poisonous to cattle (Morishita 1991). However, the plant is considered unpalatable and reports of livestock poisonings are rare.
Ecological: Yellow toadflax is quick to establish in open sites and is capable of adapting growth to a wide range of environmental conditions. Yellow toadflax aggressively forms colonies through adventitious buds from creeping root systems. These colonies can push out native grasses and other perennials, thereby altering and simplifying the species composition of natural communities and reducing forage production for livestock and wildlife.
Human: No information available.

Habitat and Distribution
General requirements: Yellow toadflax has a highly variable habitat that depends on environmental factors such as shading, grazing, and soil type (Saner et al. 1995).

Distribution: Yellow toadflax now occurs throughout the continental United States and in every Canadian province and territory (Saner et al. 1995). In Colorado, yellow toadflax is abundant on the Western Slope, but can be found on the Front Range as well. It is typically found from 6,000 to 8,500 feet, but can be found up to 10,000 feet.
Historical: Yellow toadflax was introduced from Eurasia as an ornamental.

Biology/Ecology
Life cycle: Spring emergence occurs around mid-April and depends primarily on temperature. A smaller flush of seedlings can occur in the fall. Prostrate stems emerge in September and produce leaves that are ovate, 0.9-1.5 inches in size. Prostrate stems are tolerant to freezing and are associated with floral stem production the following year (Robocker 1974). The strong, upright floral stems that are characteristic of mature toadflax plants develop after a winter's dormancy, and emerge about the same time as seedlings in mid-April. Flowering occurs from May through August and seeds mature from July through October (Saner et al. 1995). Yellow toadflax is self-incompatible and relies on insects for pollination. The two most important pollinators are bumblebees and halictid bees (Zimmerman 1996).
Mode of reproduction: Yellow toadflax can reproduce both by seeds and vegetatively. Vegetative reproduction enables a stand of toadflax to spread rapidly. Stems develop from adventitious buds on primary and lateral roots. These buds can grow their own root and shoot system, and become independent plants the next year. Yellow toadflax colonies persist mostly via vegetation means while those of Dalmatian toadflax persist both by vegetative and seed reproduction (Lajeunesse 1999).
Seed production: A mature plant can produce up to 30,000 seeds annually. A single stem has been reported to contain over 5,000 seeds (Saner et al. 1995).
Seed bank: Seeds can remain dormant for up to ten years.
Dispersal: Winged seeds aid wind dispersal. Seeds may also be dispersed by water and ants (Rutledge, 1998).
Hybridization: No information available.

Control

Keys to Control:
- Limit vegetative spread of colonies.
- Destroy seedlings that emerge from the soil seed bank.
- Maintain a cover of native perennial plants to discourage infestation elsewhere.

Biocontrol: The Division of Plant Industry's Biological Pest Control Section currently has one species, *Calophasia lunula*, that may be available for redistribution on yellow toadflax infestations. *C. lunula* larvae feed extensively on leaves and flowers of toadflax, severely damaging the plants.
Mechanical: Hand pulling toadflax before seed set each year can be an effective control method especially in coarse-textured soils where large portions of the roots can be pulled. However, this method must be repeated as long as there are viable seeds in the soil (up to 10 years). Cutting or mowing yellow toadflax reduces the current year growth and possibly seed dispersal, but will not kill the plant. These techniques are not recommended to control any toadflax species (Lajeunesse 1999).
Fire: Burning is not a recommended control method for yellow toadflax (Saner et al. 1995). The large, deep root system protects the plant from burning. In fact, areas that have been recently disturbed by fire are susceptible to increased toadflax infestation.
Herbicides: Effectiveness of herbicides on both toadflax species is highly variable, reflecting in part their high genetic variability (Lajeunesse 1999). Yellow toadflax is difficult to control with herbicides. Herbicides should be applied during flowering when carbohydrate reserves in the root of the plants are at their lowest. Picloram or dicamba at 1 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre, will kill yellow toadflax plants in some situations. 2,4-D, MCPA, 2,4-DB, MCPB and mecoprop are ineffective on yellow toadflax (Lajeunesse 1999). Picloram+2,4-D at 0.5+1.0 lb. ai/acre (as Grazon P+D®) controlled 95-100% of yellow toadflax when applied for 1-3 consecutive years (Sebastian and Beck 1999).
Cultural/Preventive: In agricultural areas, miminum-till cultivation practices have contributed to the resurgence of toadflax populations (McClay 1992). By not tilling the soil, and subsequently damaging the root system of toadflax plants, toadflax colonies have been able to flourish. Intensive clean cultivation techniques are recommended for successful toadflax control on agricultural land. This requires at least two years with 8-10 cultivations in the first year and 4-5 cultivations in the second year (Morishita 1991).

Integrated Management Summary

Yellow toadflax rapidly colonizes open sites. It is most commonly found along roadsides, fences, rangelands, croplands, clear cuts, and pastures. Disturbed or cultivated ground is a prime candidate for colonization. The seedlings of yellow toadflax are considered ineffective competitors for soil moisture with established perennials and winter annuals (Morishita 1991). However, once established, yellow toadflax suppresses other vegetation mainly by intense competition for limited soil water. Mature plants are particularly competitive with winter annuals and shallow-rooted perennials.

The key to controlling yellow toadflax is to limit vegetative spread of established colonies (by cutting, pulling, or spraying seed stalks prior to seed set, or by using insects to destroy flowers, seeds, or damage plants). Once current seed production has been controlled, toadflax seedlings that emerge from the soil seed bank must be destroyed every year until the seed bank is diminished.

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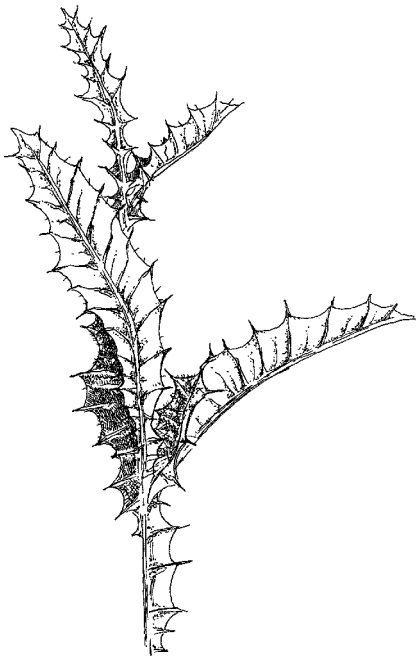
Scotch thistle

Onopordum acanthium L. and ***O. tauricum*** L.

Family: *Asteraceae* (Sunflower)
Other Names: cotton thistle, winged thistle
USDA Code: ONAC, ONTA
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Scotch thistle can be distinguished from other thistles by its large size, and by the spiny wings attached to the stems and the dense, fine hair that give it a characteristic grayish-blue or blue-green color.
- Rosettes often have huge, broad leaves.

Identification
Growth form: Perennial forb.
Flower: Flower heads are numerous, 1-2 inches in diameter, with spine-tipped bracts. Flowers are violet to reddish.
Seeds/Fruit: One-seeded fruit (achene) is wrinkled, brown to grayish-black, tipped with a plume (pappus) of slender bristles (Stubbendieck et al. 1995).
Leaves: Leaves are alternate, very large, irregularly lobed, and have sharp yellow spikes. Rosette leaves may be up to 2 feet long and 1 foot wide (Whitson et al. 1996). Upper and lower leaf surfaces of *O. acanthium* are covered with a thick mat of cotton-like or woolly hairs, giving the foliage a gray-green color (Dewey 1991).
Stems: Mature plants can grow up to 12 feet tall, and have a large, fleshy taproot. Stems are numerous, branched, and have broad spiny wings.
Roots: Thick fleshy taproot.
Seedling: No information available.



Leaves

Similar Species
Exotics: *Onopordum acanthium* is the predominant Scotch thistle species in the western United States and is characterized by its hairy leaves (Beck 1991). A hairless species, *Onopordum tauricum*, also occurs but much less frequently, mostly in the Arkansas River drainage in Colorado (Beck 1991).
Natives: There are many native thistle species (in the genus *Cirsium*). The natives generally do not have leaves clasping the stem all the way from node to node (strongly decurrent leaves), and many have hairy upper and lower leaf surfaces and are blue-green or gray in color.

Impacts
Agricultural: Scotch thistle is an aggressive plant that is competitive with desirable native forage species. It can form dense stands that are impenetrable to livestock.
Ecological: No information available.
Human: No information available.

Habitat and Distribution
General requirements: Scotch thistle is often found along roadsides, irrigation ditches, waste areas and on rangelands. The seeds contain a water-soluable germination inhibitor, so Scotch thistle is particularly successful in moist areas that are adjacent to riparian or sub-irrigated deeper soils along stream courses, lower alluvial slopes and bottomlands.
Distribution: Occurs sparsely over much of the United States. It is increasing throughout Colorado.

Historical: Native to Eurasia.

Biology/Ecology

Life cycle: Scotch thistle is a biennial that produces a large, ground level rosette the first year, and a tall, spiny plant the second. Flowering occurs from mid-June to September.
Mode of reproduction: Scotch thistle reproduces by seed.
Seed production: One plant produces70-100 flowering heads containing 100-140 seeds per head (Young and Evans 1969).
Seed bank: Seeds may remain viable in the soil for over 30 years.
Dispersal: Plumed seeds can be dispersed by attaching to clothing and animal fur. Seeds may be transported in hay and machinery, and seed heads may be carried by wind and water.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: As with other perennial forbs, mechanical controls such as mowing or hand cutting are most effective in combination with other methods. Plants can regrow from severed roots, and cut stems may still produce viable seed.
Fire: No information available.

Keys to Control:
- Scotch thistle is best controlled in the rosette stage.
- Sever the taproot of Scotch thistle 1-2 inches below the ground.

Herbicides: Picloram at 0.25 lb., dicamba at 0.5 lb., or 2,4-D at 1 lb., clopyralid at 0.2 lb. ai/acre, or a combination of dicamba+2,4-D, or clopyralid+2,4-D are commonly used to control Scotch thistle. Herbicides should be applied in spring before Scotch thistle bolts or in the fall to rosettes (Beck 1991). Metsulfuron or chlorsulfuron are effective on Scotch thistle after bolting begins (Beck 1999). Herbicide rates will vary depending upon stand density and environmental conditions (Beck 1991).
Cultural/Preventive: No information available.

Integrated Management Summary

Scotch thistle is best controlled in the rosette stage. Scotch thistle can be controlled by severing its taproot 1-2 inches below the ground. Control can be enhanced by a follow-up application of herbicides to the surviving rosettes. One integrated approach to Scotch thistle management involves 1) managing livestock grazing to increase grass vigor and reduce bare ground; 2) spray rosettes with clopyralid or 2,4-D; 3) re-seed treated ground with competitive desirable plants in the fall after spraying; 4) follow-up with spot cutting of entire plants when first flowers appear annually for several years to deplete the seed bank in the soil.

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Bouncingbet

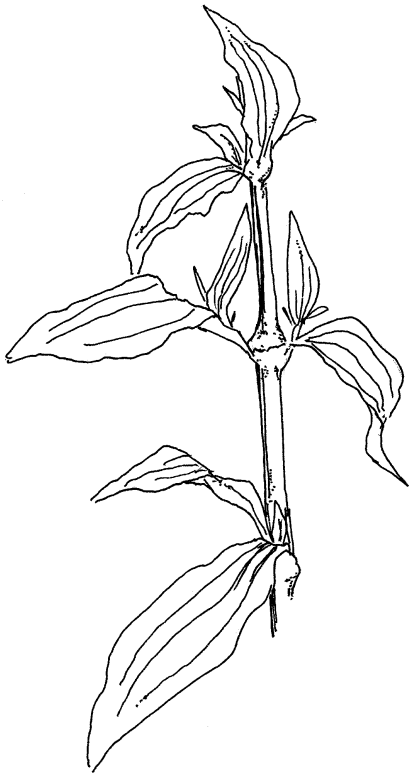
Saponaria officinalis L.

Family: *Caryophyllaceae* (Pink)
Other Names: soapwort, lady by the garden gate
USDA Code: SAOF4
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Flowers are clustered at the ends of branches.
- Bouncingbet leaves originate from slightly swollen nodes.

Identification

Growth form: Perennial forb.
Flower: The flowers are crowded at the ends of branches, and have five petals that are generally pink and slightly notched at the apex.
Seeds/Fruit: Fruits are many-seeded capsules. Seeds are dull-black and roundish or kidney-shaped.
Leaves: Leaves are opposite, smooth, narrow, 2-4 inches long and have three distinct veins from the base.
Stems: Mature plants are up to three feet tall with stout, erect, smooth, branching stems.
Roots: Rhizomatous root system
Seedling: No information available.



swollen nodes

Similar Species

Exotics: None known.
Natives: *Cerastium* spp. (mouse-ear) have separate (usually white) petals instead of united petals. Many other members of the pink family appear similar.

Impacts

Agricultural: Bouncingbet can be poisonous to livestock although it is generally considered unpalatable.
Ecological: Bouncingbet spreads rapidly, replacing more valuable species (e.g. perennial grasses).
Human: No information available.

Habitat and Distribution

General requirements: Bouncingbet is often found in large dense patches on hillsides, along river courses, roadsides, meadows, and waste areas. It prefers moist, well-drained soil, and full sun to partial shade and is currently found primarily in municipal areas and nearby wildlands.
Distribution: Scattered throughout the United States. Bouncingbet is increasingly common in Colorado, particularly in residential areas and local open spaces where it has escaped cultivation as an ornamental species.
Historical: Bouncingbet was originally introduced from Europe as a garden ornamental and for its saponins, which are the source of it soap-producing qualities (Lokker and Cavers 1995).

Biology/Ecology

Life cycle: Flowering begins in July and continues until September.
Mode of reproduction: Reproduces by seed and spreads clonally by rhizomes.

Seed production: No information available.
Seed bank: No information available.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: Bouncingbet can be controlled by mowing or pulling several times a year. Mowing or pulling should be conducted after the plants have bolted but before seed production. This process should be repeated on any re-emerging shoots from the root system.
Fire: No information available.
Herbicides: Picloram or dicamba at 1 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre will provide effective control. Hexazinone is used to control bouncingbet in corn and feed crops.
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Keys to Control:
- Eliminate seed production and exhaust the nutrient reserves in the roots.
- Maintain a healthy cover of perennial plants.

Integrated Management Summary

Bouncingbet is not yet widespread in Colorado, so the most important control is to be on the lookout for it and prevent new infestations. If infestations are discovered, they should be controlled immediately, and all seed production prevented. Since bouncingbet usually grows in dense patches it is relatively easy to spot and treat. Be aware that this species is often found in wet areas, which may restrict the use of certain pesticides. As with all perennial weeds that have extensive root systems, the key to controlling bouncingbet is to eliminate seed production while depleting the nutrient reserves in the roots.

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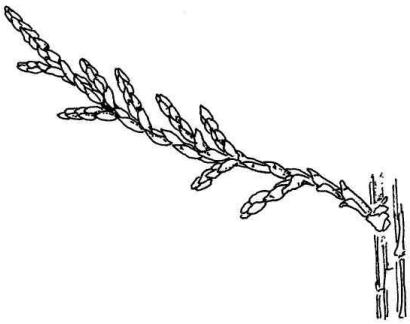
Saltcedar

Tamarix ramosissima Ledeb. and ***Tamarix parviflora*** DC.

Family: ***Tamaricaceae*** (Tamarisk)
Other Names: tamarisk, salt cedar
USDA Code: TARA, TAPA4
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Saltcedar is a tall shrub or small tree that has large sprays of small whitish or pinkish flowers that are born in finger-like clusters.
- Leaves are very small and scaly.

Identification
Growth form: Deciduous, loosely branched shrubs or small trees.
Flower: Flowers are whitish or pinkish and borne on slender racemes 2-5 cm long on the current year's branches and are grouped together in terminal panicles. Petals are usually retained on the fruit.
Seeds/Fruit: The seeds are borne in a lance-ovoid capsule.
Leaves: Leaves are minute, appressed scaly leaves, alternately arranged.
Stems: Branchlets are slender; plants may reach heights of 15 feet or more.
Roots: The primary root can grow to a depth of up to 30 meters or more (Baum 1978). Plants can develop spreading horizontal roots after reaching the water table. These can spread up to 50 meters and are capable of producing adventitious buds (DiTomaso 1996).
Seedling: No information available.



Branch

Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: No information available.
Ecological: Saltcedar is an aggressive, woody invasive plant species that has become established over as much as a million acres of the western United States (Carpenter 1998). Saltcedar crowds out native stands of riparian and wetland vegetation. It increases the salinity of surface soil, rendering the soil inhospitable to native plant species. Saltcedar provides generally lower wildlife habitat value than native vegetation. It uses more water than comparable native plant communities and dries up springs, wetlands, riparian areas and small streams by lowering surface water tables. However, in places where beaver dams or other structures have raised the water table, saltcedar can be outcompeted by *Salix exigua* (R. Roberts, pers. comm.) Saltcedar widens floodplains by clogging stream channels and increases sediment deposition due to the abundance of saltcedar stems in dense stands.
Human: No information available.

Close up of leaves

Habitat and Distribution
General requirements: Saltcedar grows well on moist sandy, sandy loam, loamy, and clayey soil textures (FEIS 1996). Saltcedar is tolerant of highly saline habitats, and it concentrates salts in its leaves. Over time, as leaf litter accumulates under saltcedar plants, the surface soil can become highly saline, thus impeding future colonization by many native plant species. Saltcedar is not tolerant of shading. Shaded plants have altered leaf morphology and

reduced reproduction (FEIS 1996). Saltcedar commonly occurs along floodplains, riverbanks, stream courses, saltflats, marshes, and irrigation ditches in arid regions of the Southwest and the Southern Great Plains (FEIS 1996).
Distribution in Colorado: In Colorado, saltcedar is most commonly found between 3,400 to 7,000 feet (FEIS 1996), but can be found up to 8,000 feet (A. Green, pers. comm.). It is widespread in riparian areas throughout the western United States.
Historical: Introduced to North America for use as ornamental, windbreak, and erosion control.

Biology/Ecology
Life cycle: Saltcedar generally flowers in its third year of growth or later, but may flower during the first year (FEIS 1996). Saltcedar buds generally break dormancy in February or March. The flowers are most abundant between April and August, but may be found any time of the year in desert areas. Saltcedar flowers continuously under favorable environmental conditions but the flowers require insect pollination to set seed. Seedlings grow slowly and require saturated soils throughout the first 2-4 weeks of growth (FEIS 1996). Ideal conditions for first-year survival are saturated soil during the first few weeks of life, a high water table, and open sunny ground with little competition from other plants.
Mode of reproduction: Reproduces by seeds as well as vegetatively. Saltcedar sprouts from the root crown and rhizomes, and adventitious roots sprout from submerged or buried stems (FEIS 1996). This allows saltcedar to produce new plants vegetatively following floods from stems torn from the parent plants and buried by sediment.
Seed production: A mature saltcedar plant can produce 600,000 minute seeds annually (FEIS 1996).
Seed bank: Seeds are viable for up to 45 days under ideal conditions during summer, and can complete germination within 24 hours following contact with water (Carpenter 1998). Saltcedar seeds had no dormancy or after-ripening requirements.
Dispersal: The seeds are readily dispersed by wind and water.
Hybridization: No information available.

Control
Biocontrol: The USDA has permitted the release of two species of insects for saltcedar biocontrol but widespread releases have not yet been permitted (A.T. Carpenter, pers. comm.).
Mechanical: As an alternative to herbicides, a bulldozer or prescribed fire can be used to open up large stands of saltcedar. Once opened, the resprouts can be sprayed when they are 1 to 2 m tall using imazapyr, or imazapyr plus glyphosate, or triclopyr.
Fire: See above.
Herbicides: For larger areas (> 2 hectares) that are essentially monotypic stands of saltcedar, the best methods would likely be foliar application of imazapyr herbicide to the intact plants or burning or cutting plants followed by foliar application of imazapyr or triclopyr to the resprouted stems. Foliar application of imazapyr or imazapyr in combination with glyphosate can be effective at killing large, established plants. Over 95% control has been achieved in field trials during the late summer or early fall (Carpenter 1998). The herbicide can be applied from the ground using hand-held or truck-mounted equipment or from the air using fixed-wing aircraft. Foliar application of herbicide works especially well in monotypic stands of saltcedar, although experienced persons using ground equipment can spray around native trees and shrubs such as cottonwood and willow.

Keys to Control:
- Select the appropriate control method based on the size of the area and other environmental or cultural considerations.
- Re-seed controlled areas with desirable species to protect the soil resource and to prevent or retard saltcedar reinvasion.

Saltcedar eradication in areas that contain significant numbers of interspersed, desirable shrubs and trees is problematic. Depending upon site conditions, it may not be possible to rapidly kill saltcedar plants without also killing desirable shrubs and trees. It such situations, it may be necessary to cut and treat saltcedar stumps with herbicide, as outlined in the next paragraph. While this method is relatively slow and labor-intensive, it will spare desirable woody plants. Alternatively, it may be more cost-effective to kill all woody plants at a site and replant desirable species afterward.

For modest-sized areas (< 2 hectares), cutting the stem and applying herbicide (known as the cut-stump method) is most often employed. The cut-stump method is used in stands where woody native plants are present and where their continued existence is desired. Individual saltcedar plants are cut as close to the ground as possible with chainsaws, loppers or axes, and herbicide is applied immediately thereafter to the perimeters of the cut stems. Herbicides must be applied immediately to the cut because wound healing ocurrs very quickly and decreases herbicide penetration. The herbicides triclopyr and imazapyr can be very effective when used in this fashion. This treatment appears to be most effective in the fall when plants are translocating materials to their roots. The efficacy

of treatments is enhanced by cutting the stems within 5 cm of the soil surface, applying herbicide within one minute of cutting, applying herbicide all around the perimeter of the cut stems, and retreating any resprouts 4 to 12 months following initial treatment.

Cultural/Preventive: No matter how effective initial treatment of saltcedar might be, it is important to re-treat saltcedar that is not killed by initial treatment. After saltcedars are killed, other vegetation must be established to protect the soil resource and to prevent or retard saltcedar re-invasion (Frasier and Johnsen 1991). Establishing a canopy cover on treated areas with seeded grasses and planted cottonwood cuttings could reduce the chances of saltcedar successfully re-invading an area (Frasier and Johnsen 1991).

Integrated Management Summary

Saltcedar is native of Eurasia that was introduced as an ornamental and stream bank stabilizer. It is a pioneer species that establishes on freshly exposed alluvium, sand and gravel bars, and streambanks or floodplains after disturbance (FEIS 1996). Once established it often occurs in pure stands, persisting indefinitely in the absence of disturbance (FEIS 1996). It can replace or displace native woody species, such as cottonwood, willow and mesquite, which occupy similar habitats, especially when timing and amount of peak water discharge, salinity, temperature, and substrate texture have been altered by human activities. Saltcedar produces massive quantities of small seeds and can propagate from buried or submerged stems.

Saltcedar can be controlled by five principal methods: 1) applying herbicide to foliage of intact plants; 2) removing aboveground stems by burning or mechanical means followed by foliar application of herbicide to resprouts; 3) cutting stems close to the ground followed by application of triclopyr (Garlon™) to the cut stems; 4) spraying basal bark with triclopyr; and 5) digging or pulling plants (Carpenter 1998).

Selecting an appropriate control method involves considering the size of the area where saltcedar is to be controlled, restrictions on the use of particular herbicides or herbicides generally, the presence or absence of desirable vegetation where saltcedar is growing, the presence or absence of open water, adjacent land uses that might restrict prescribed burning, and the availability and cost of labor (Carpenter 1998).

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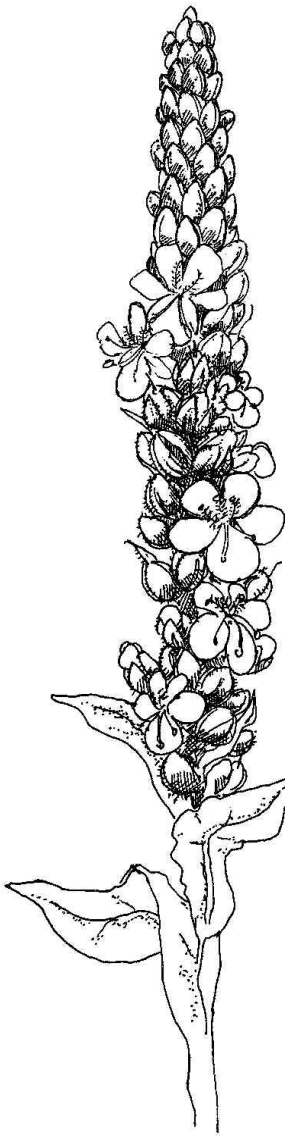
Common mullein

Verbascum thapsus L.

Family: *Scrophulariaceae* (Figwort)
Other Names: flannel leaf, fleawort, Jacobs staff
USDA Code: VETH
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Mullein can be easily identified by its yellow flowers grouped in a "corn cob" shaped flowering raceme.
- The leaves of mullein are alternate, overlapping, and densely wooly.

Identification
Growth form: Biennial forb
Flower: Flowers are 1 inch in diameter, five-lobed, and sulfur yellow in appearance. Flowers are grouped in a "corn cob"-shaped flowering raceme.
Seeds/Fruit: Many-seeded capsules, with small cylindrical seeds. Seeds have numerous ridges and grooves.
Leaves: Leaves are alternate, overlapping, light-green, and densely woolly. The rosette leaves are covered with soft, fine hairs.
Stems: Mature plants have a single, stout, erect, stem which can grow up to 6 feet in height (Whitson et al. 1996). The stem is longitudinally ridged by the bases of leaves that continue down the stem beyond the point of attachment. The stem is densely woolly with branched hairs.
Roots: Taproot.
Seedling: Produces a rosette the first year.



Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: Common mullein is not considered palatable to livestock due to its woolliness. Common mullein is not considered a serious agricultural weed since it can be controlled by cultivation (Gross and Werner 1978).
Ecological: If mullein seeds are already present in the soil, mullein seedlings are likely to be the initial colonists in newly disturbed sites because the seeds are viable for decades (Hoshovsky 1986). If the seeds are not present when the disturbance occurs or when a field is abandoned, then the limited dispersal ability of the seeds will probably not enable mullein seeds to arrive and establish while bare ground is still available (Hoshovsky 1986). Common mullein can be hard to control due to its prolific seed production (Gross and Werner 1978). It is easily outcompeted in areas with a densely vegetated ground cover but readily grows in disturbed sites (Hoshovsky 1986). It is an ephemeral plant, which is eventually displaced by other plants in undisturbed sites (Hoshovsky 1986).
Human: No information available.

Habitat and Distribution
General requirements: Common mullein is commonly found throughout Colorado in pastures, meadows, fencerows, waste areas, and along river bottoms. Common mullein prefers dry, gravelly to sandy, coarse-textured soils (Gross and Werner 1978).
Distribution: Common mullein is found throughout Colorado from 4,500 to 9,500 feet, and is also common throughout temperate parts of North America (Rutledge and McLendon 1998).

Historical: Common mullein is native to Eurasia and was probably introduced to America as a medicinal herb. For centuries, mullein has been used as a remedy for coughs and stomach ailments. Aristotle recorded it as a fish poison and a methanol extract from the plant has been effective against mosquito larvae (Hoshovsky 1986).

Biology/Ecology

Life cycle: Seeds of common mullein germinate in the early spring, forming a rosette that continues to grow into late autumn and over winter (Gross and Werner 1978). The following spring the plant produces a tall stem topped with a flowering raceme. Flowering and seed production occur from June to August.
Mode of reproduction: Reproduces by seeds.
Seed production: Common mullein may produce 100,000 to 180,000 seeds per plant (Hoshovsky 1986).
Seed bank: Seeds may remain viable for 100 years (Hoshovsky 1986).
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: A curculionid weevil (*Gywmnaetron tetrum*), that is specific to common mullein has been introduced to America and is capable of reducing seed production by 50% (Hoshovsky 1986).
Mechanical: Mullein can usually be controlled using mechanical methods. Plants should be pulled as soon as they are large enough to grasp but before they produce seeds. Plants are best pulled after a rain when the soil is loose. Mullein stems can be cut or mowed to prevent flower and seed production. Stems must be cut below the root crown or rosettes will re-bolt.

Keys to Control:
- Manually remove plants before flowering.
- Maintain a dense cover of native vegetation and minimize the availability of bare soil.

Fire: Mullein is often an early invader of burned areas; fire is not recommended as a control method.
Herbicides: Metsulfuron at 0.6 oz. ai/acre, applied at very early bolt stage provides good control. Tebuthiuron at 4-6 lb. ai/acre has been reported to achieve long-term control of common mullein (Hoshovsky 1986). Repeated applications of tebithuron at half the initial rate will suppress regrowth (Hoshovsky 1986). Adding a surfactant to the herbicide mixtures will help penetrate the woolly hairs of mullein plants and increase the effectiveness of the treatment.
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Integrated Management Summary

As with other plants which reproduce solely by seed, integrated management efforts must include the elimination of seed production and the depletion of the seed bank. Combine herbicide or mechanical removal of rosettes with removal of seed heads from any plants that have bolted. Revise land management practices to promote the health of native plant comminities.

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