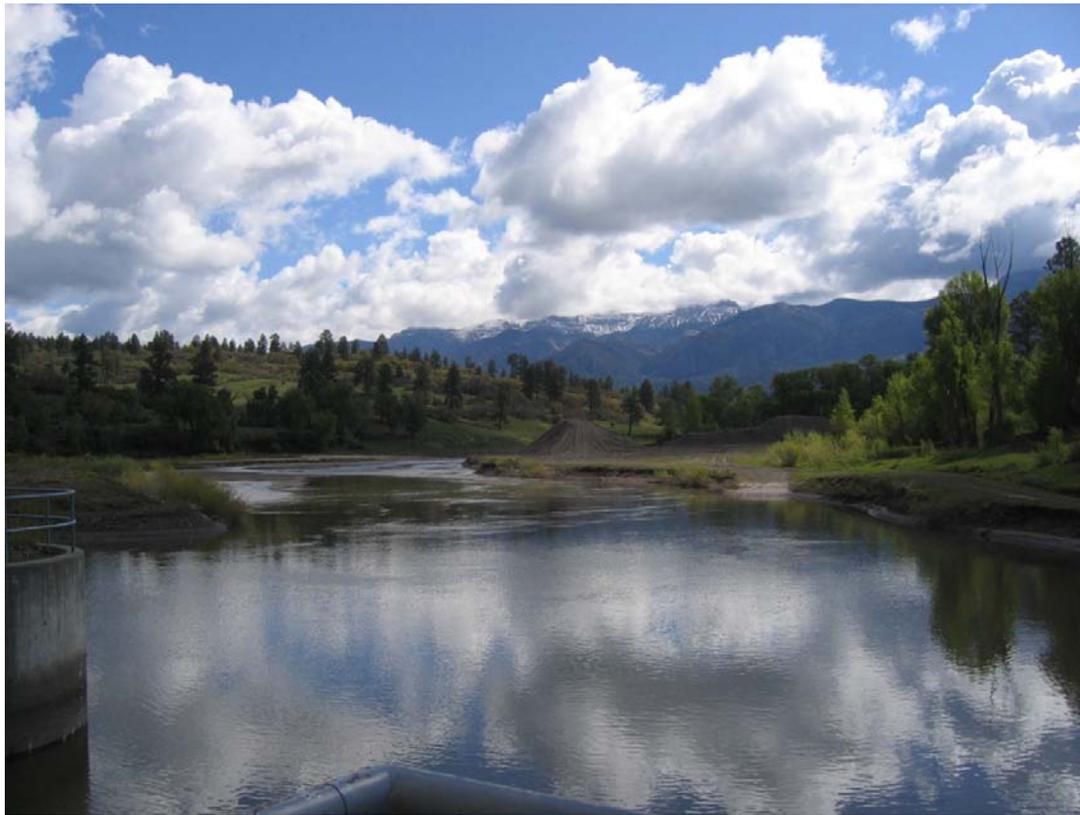


RECLAMATION

Managing Water in the West

DRAFT

SAN JUAN-CHAMA PROJECT INTEGRATED PEST MANAGEMENT PLAN 2011-2015



U. S. Department of the Interior
Bureau of Reclamation
Albuquerque Area Office
Environment Division
Albuquerque, New Mexico

September 2011

MISSION STATEMENT

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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The information contained in this document was developed for the Bureau of Reclamation; no warranty as to the accuracy, usefulness, or completeness is expressed or implied.

This plan was developed in accordance with the *Weed Management Plan Outline for Public Land Managers*.

INTERGRATED PEST MANAGEMENT (IPM): IPM is a systematic approach using several management techniques to achieve effective, economical, and environmentally acceptable management of a pest.

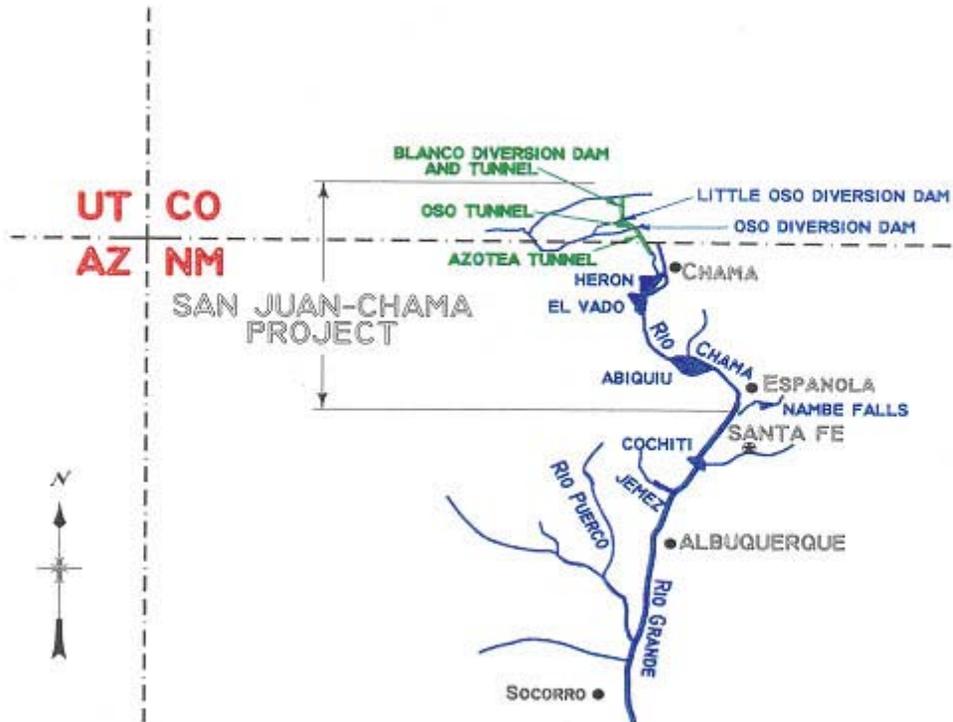
TRAINING AND CERTIFICATION: All individuals applying pesticides will be required to receive adequate training on safety and application procedures prior to spraying. Proper state certification, within the proper categories, is required when Restricted Use pesticides are being applied.

ACKNOWLEDGEMENT: The assistance of Douglas L. Parker in preparing this plan is appreciated.

San Juan-Chama Integrated Pest Management Plan, 2012-2017

Management Unit General Description

The San Juan-Chama (SJC) Project consists of a system of diversion structures and tunnels for movement of water from the San Juan River Basin to the Rio Grande Basin. Project was authorized by Congress in 1962 to supply water from the Navajo, Little Navajo, and Blanco Rivers, tributaries of the San Juan River, which are all part of the Colorado River system. The SJC Project includes three diversion dams (Blanco, Little Oso, and Oso) in Colorado and includes 27 miles of concrete-lined tunnels, one of which passes under the Continental Divide. In New Mexico, the SJC Project includes Heron Dam, modification to El Vado outlet works, and the Pojoaque Unit, which includes Nambe Falls Dam. The primary purpose of the SJC Project is to supply water to the middle Rio Grande Valley for municipal, domestic, and industrial uses. The SJC Project is also authorized to provide supplemental irrigation water and incidental recreation and fish and wildlife benefits.



San Juan Chama Project Location Map

Purpose and Need

The purpose of this plan is to outline the objectives, management alternatives, short- and long-term Integrated Pest Management (IPM) strategies, control techniques, mitigations and best management practices (BMPs), and monitoring and follow-up actions to control undesirable native plant species and invasive weeds on the following SJC Project facilities: (1) Blanco and Oso Diversion Dam sites, (2) Oso Diversion Dam wetlands, (3) Willow Creek Conveyance Channel, (4) Heron Reservoir, (5) Heron Dam, and (6) SJC office and equipment storage facilities located in Chama, NM.

Management of undesirable vegetation, which includes both native and exotic species, is necessary for the following reasons:

- To allow for proper surveillance and inspection of the structures and adjacent areas for seepage, cracking, sinkholes, settlement, deflection, and other signs of distress.
- To allow adequate access for normal and emergency Operation and Maintenance (O&M) activities.
- To prevent damage to structures due to root growth, such as shortened seepage paths through embankments; voids in embankment from decaying roots from dead or damaged trees; expansion of crack or joints of concrete walls; and plugging of perforated or open-jointed pipes.
- Keep plants from overgrowing and obscuring equipment, structures, and facilities
- Prevent the buildup and spread of exotic species from federal property to adjacent land of mixed ownership.
- Remove invasive plant species from wetland sites to protect native plant communities.
- Maintain or enhance the visual quality of structures and facilities that are adjacent to recreational sites
- Enhance desirable plant communities to provide favorable habitat for fish and wildlife



Willow Creek Conveyance Channel

Environmental Concerns

The wetlands at the Oso Diversion Dam site are being invaded by Canada thistle, and the infestation is expected to increase and replace desired native plant communities. In 2011, Russian knapweed and perennial pepperweed infestations were not observed in the wetlands, but these species have the potential to cause further damage to the wetlands.

The SJC Project, authorized as a participating project of the Colorado River Storage Project, provides an average annual diversion of about 110,000 acre feet of water from the upper tributaries of the San Juan River for use in the Rio Grande Basin, New Mexico. The water is used for municipal, domestic, and industrial purposes. Supplemental water is provided for irrigation in the Middle Rio Grande Conservancy District (MRGCD) and Pojoaque Valley Irrigation District

Objectives and Standards

Managers must clearly define the resource objectives they want to achieve before an IPM strategy can be developed. The pest management objectives identified under this IPM plan for structures, facilities, and land managed by the SJC Project include:

- **Undesirable Terrestrial Plants**

- **Trees and shrubs.** The objective is to remove all plants that would interfere with the inspection or compromise the structural integrity of canal and dam structures.
- **Invasive and noxious weeds.** The objective is to eliminate or effectively reduce infestations on lands administered by Reclamation, and prevent buildup and spread of infestations to adjacent federal, state, and private lands.
- **Undesirable plants.** The objective is to control undesirable plants in maintenance yards and administrative sites that could obscure structures and pose a safety hazard, and to enhance visual quality of these sites.

The following IPM standards were established for control of terrestrial plants based on the assumptions that they are obtainable and measurable.

- **Annual Control Standard.** Annual treatment must show a strong potential for success, i.e., 80 percent or higher control of selected plant species.
- **Long-term Standard.** After two years of annual treatments, only one to four percent of the original number of targeted plants will remain or invade treatment areas, which will require minimal follow-up maintenance control.
- **Efficiency:** The standard will be to select control methods that provide the maximum level of control at the least cost.
- **Environmental Acceptability:** The standard will be to prevent or mitigate any adverse environmental effects associated with implementation of IPM methods. Prior to any on-the-ground management, an environmental analysis must be completed and approved.
- **Adaptive Management:** Adaptive management and managerial flexibility will be used, when appropriate, to take advantage of new information that becomes available after a decision has been reached. When a new or improved pesticide product becomes available during the course of this five year IPM plan, the product will be evaluated for possible use. If there is information to show that the new product will better meet the objective and standards of this Plan, the new product will be considered for use without further environmental analysis. This will only be the case if the new or improved product fits within the same effects analysis disclosed in an environmental document. The approval of any new product first need to be approved by the Albuquerque Area Office's Environment Division (ALB-

150) prior to any use. An analysis would be done and documented to show the similarities of effects and the decision could be adapted to include the new product.

- **Distribution and Mapping of Weed Infestations:** The standard is to determine the location of weed infestations and record the distribution on maps.
- **Cooperation:** The standard is to obtain a cooperative agreement with all involved parties prior to implementing control treatments.
- **Mitigations and Best Management Practices (BMPs):** The standard is to ensure that control activities, especially those involving the use of pesticides, are done in compliance with all county, state, and federal policies and laws (e.g., Federal Insecticide, Fungicide, and Rodenticide Act). Applicators will be trained to ensure that they understand established mitigations and BMPs.
- **Monitoring and Records:** The standard is to maintain adequate records to assess the effectiveness of treatments. Project records will include the following elements:
 - Date of application
 - Target pest(s)
 - Control technique(s) used
 - Common name of herbicide(s) used
 - Description of formulation or tank mix
 - Application method (aerial, backpack, etc.)
 - Quantity (ounces/pounds) of herbicide used
 - Weather conditions (highest temperature, average wind speed, precipitation, etc.)
 - Estimate of acreage treated
 - Estimate of annual treatment success
- **Oversight:** The standard is to ensure that annual oversight of the IPM program is completed to assess if the management objectives were met; treatments complied with standards, mitigations, and BMPs; and actions were in compliance with policy and law.

Identification and Description of Terrestrial Plants

- **Bull thistle (*Cirsium vulgare*).** Bull thistle is biennial that is in the sunflower family (Asteraceae). Leaves in the first year form a rosette on the soil surface. The stem in the second year can be two to five feet tall with a short, fleshy taproot. Flowers are dark purple and one and a half to two inches wide. Bull thistle was introduced from Eurasia and the species is widely distributed in North America. Pastures, fields, roadsides, and disturbed sites are potential

habitat for this highly competitive species. Bull thistle reproduces only from seed. It can be controlled by grubbing the rosettes and second year plants; , plants should be grubbed prior to seed set.



Bull thistle and Canada thistle infestation on disturbed soils,
Oso Diversion Dam Site

- **Canada thistle** (*Cirsium arvense*). This thistle, which is in the sunflower family (Asteraceae), is an aggressive perennial plant that forms colonies. It is a native of Europe, and it is considered to be the most difficult thistle to control, especially because of its widespread distribution in North America. Canada thistle differs from other thistles by having separate male and female flowers that occur on separate plants. Colonies of this plant grow from one to four feet tall. An important aspect for the survival of this plant is that it has creeping horizontal roots, and a single root can produce as many as 100 flower heads in a season. Wind dispersal of seeds is not considered to be significant, and dispersal by human activities may be the most likely mechanism. Hand-pulling or grubbing is not an effective method of control. Repeated mechanical (mowing and cultivation) can be effective, and it can be controlled with several different herbicides.
- **Willows** (*Salix sp*). The native willow species is a shrub or small tree in the willow family (Salicaceae). Willows usually form a thicket with long, slender stems, seldom exceeding 15 feet in height. The linear leaves are long, narrow,

and tapered at both ends, and the margins are usually smooth with few teeth. Willow species are found almost exclusively in riparian habitats, occupying banks of rivers and streams, lakes and ponds, and ditch banks. They reproduce by seed and rhizomes (forming clones). Regeneration may also occur through broken pieces of stems and roots that are transported and deposited by floodwaters that later sprout. This species is usually considered a desirable plant along most mountain streams, but it could become a problem along the Willow Creek Conveyance Channel because it decreases water delivery efficiency, may provide potential habitat to beavers and rodents that are not desired along the channel, and displaces the riprap. Willow species can be controlled by a variety of herbicides.

- **Thinleaf (Mountain) alder** (*Alnus tenuifolia*). This native species is common along the banks of mountain streams in the Rocky Mountains. It is in the alder family (Betulaceae). It is a shrub or small tree that can grow up to 30 feet tall and stems at the ground level can be six to eight inches in diameter. The flowers are catkins and the fruit is a nearly circular nut about a half inch long. The bark is thin, smooth, and red-brown. This species is usually considered a desirable plant along most mountain streams, but is a problem along the Willow Creek Conveyance Channel because it decreases water delivery efficiency, may provide potential habitat to beavers and rodents that are not desired along the channel, and displaces the riprap. The same herbicides used to control woody species like coyote willow will also control thinleaf alder.
- **One-seed juniper** (*Juniperus monosperma*). This juniper is a native species in the cypress family (Cupressaceae). It is a small, shrubby tree as a result of branches leaving the trunk just above the root collar, and it has shreddy bark. One-seed juniper is a relic of the cooler and wetter Pleistocene era, when woodlands of pinyon and juniper thrived where desert plants now eke out a meager living. The soft, bluish berries are actually cones, since this juniper is a conifer like pine trees. Birds relish the cones and they no doubt disperse the seeds. This tree is not able to sprout following cutting. Widely scattered trees have invaded the inner slope of Willow Creek.
- **Saltcedar** (*Tamarisk* spp.): Saltcedar is an exotic plant that is in the tamarisk family (Tamaricaceae). It is a deep-rooted deciduous shrub or small tree that can reach up to 25 feet in height. It is highly invasive and forms dense stands that supplant native species. Individual trees can produce up to half a million seeds in a season, which can start in late April and extend until October. The stem of saplings is reddish-brown, and the leaves are small and scale-like, on highly branched slender stems. Root growth is predominantly downward with little branching until plants reach the water table, and root depth can exceed 50 feet. Saltcedar trees readily form sprouts following cutting or burning of the above ground portions of the plant. The key to controlling this species involves killing the root, which is best accomplished by the use of herbicides.



Saltcedar infestation along the bank of Heron Lake

- **Big sagebrush** (*Artemisia tridentata*). Big sagebrush is a native species that averages less than three feet in height. It is in the sunflower family (Asteraceae). It is considered an evergreen, even though the leaves have a grayer color in the winter months. In the summer, the leaves are a silvery blue due to dense gray hairs on both sides. Yellow flowers appear in late August and seed formation and shed usually occurs in October. This shrub is a highly competitive species that can severely limit grass production. It can be a problem if it invades dam faces and similar facilities. It can be controlled by herbicides, although the control results are occasionally marginal.
- **Gray rabbitbrush** (*Ericameria nauseosus*): Gray rabbitbrush is a native plant. It is a medium-size (about 5 feet tall), woody shrub, with light green foliage. Gray rabbitbrush commonly occurs along dry stream beds, along the sides of roads, and on dry plains. Several other species of rabbitbrush, which are in the sunflower family (Asteraceae), occur in the West. It has yellow flowers that occur in the fall. This shrub will readily sprout following removal of the aerial portions by cutting or burning. This shrub will readily invade disturbed sites. This plant has a deep taproot and will sprout follow cutting or burning; thus, it is difficult to control. Based on tentative results, triclopyr products appear to provide marginal control.
- **Russian knapweed** (*Acroptilon repens*). This exotic plant is a member of the sunflower family (Asteraceae). Individual plants range from 18 to 36 inches

tall. The plant is spread by deep growing roots that penetrate to a depth of over 8 feet. It is a perennial that forms dense colonies of plants that develop from adventitious shoots from widely spreading roots. It has cone-shaped flowers that are pink to lavender. Flowering occurs from June to September. Russian knapweed invades cultivated fields, pastures, roadsides, urban sites, and riparian areas. This plant is highly invasive and it can eliminate desirable native plants from a wide variety of habitats. It is a serious problem in northern New Mexico where infestations are displacing native plant communities. Russian knapweed can be controlled with herbicides, but manual and mechanical methods are not effective.

- **Perennial pepperweed** (*Lepidium latifolium*). Perennial pepperweed is an exotic plant in the mustard family (Brassicaceae). It is a deep rooted perennial that can grow up to three feet tall. Leaves are bright green in color and lance-shaped. Plants have many white flowers, and individual flowers have four petals. This plant can reproduce from root segments and seed. Plants emerge in early spring, and they bloom and set seed by late June or early July. This species commonly occurs on disturbed sites, but it is highly competitive with native plant species once it becomes established. This species has not been observed on SJC Project lands, but it is known to occur in meadows and wet sites adjacent to Project managed lands. This species cannot be controlled by manual or mechanical methods. It is even difficult to control with herbicides.
- **Oxeye daisy** (*Leucanthemum vulgare*): This exotic species, which is a native of Eurasia, belongs in the sunflower family (Asteraceae). It is a perennial that can be found in meadows, rangelands, roadsides, ditches, and other disturbed sites. Plants are usually 10 to inches tall, with white flowers that have yellow centers. Plants have perennial, creeping root systems. Reproduction can occur from perennial roots, root fragments, and seed production. To be effective, the entire root system must be removed by manual and mechanical methods. The most effective and economical control approach is to use herbicides.
- **Kochia** (*Kochia scoparia*): This member of the goosefoot family (Chenopodiaceae). It is an annual broadleaf weed that reproduces only by seed. Kochia can grow over 6 feet tall under favorable conditions. The leaves are lance-shaped and ½ to 2 inches long. The upper surface of leaves is smooth and the lower surface is usually covered with soft hairs. Flowers are inconspicuous. Flowering and seed production occur from July to October. Each plant can produce as many as 15,000 to 25,000 seeds per plant, but most seeds are short-lived in soil and die within the first year. Therefore, most kochia problems result from plants that set seed the previous year. Kochia germinates in the early spring. Roots can penetrate to a depth of 10 feet or more in the soil; thus, this explains its ability to withstand drought and also explains why kochia is a dominant weed during drought years. This plant is a native of Europe and is found throughout North America. In the West, it is

common in cultivated fields, roadsides, waste areas, and riparian sites, especially sites with bare ground. When the plants are young, livestock will readily feed on it, but mature plants are not as attractive as a food source. Its occurrence can be a safety problem in equipment storage areas and roadways because dense stands of kochia can obscure structures. Dense stands along roadways can be controlled by scraping of soil with a grader. Widely scattered plants around facilities can be removed by grubbing. Several different herbicides can control this species/

- **Russian Thistle** (*Salsola iberica*): This plant is in the goosefoot family (Chenopodiaceae). Since being introduced from Russia in the later part of the 1800's, this plant has become one of the most widely distributed and troublesome weeds in the drier regions of the United States. It is an annual that has a rounded, bushy appearance that can reach up to 3 feet tall. Seeds are spread as mature plants break off from the root and are scattered by the wind as tumbleweeds. It is well adapted to occupy disturbed sites, overgrazed grasslands, and dry wastelands. It can be controlled by hand-pulling, grubbing, or with several herbicides.

Treatment Priority

- **Oso Diversion Dam Site (approximately 80 acres):** Containment and control of invasive weeds on this site is considered the most important priority for the SJC Project. In August 2011, it is estimated that less than 30 acres were infested with invasive weeds at the Oso Diversion Dam site.
 - **Wetlands:** At least once per year, inspect sites for the presence of weed infestations will be necessary, and treat all detected weed infestations with herbicides will be needed to protect native plant communities. Canada thistle and bull thistle are the primary weed species that must be controlled.
 - **Terrestrial Sites:** At least once per year, inspect all terrestrial sites for the presence of weed infestations, and conduct control operations with herbicides will need to be done to reduce the population levels. Control operations will prevent spread to adjacent areas. Again, Canada thistle and bull thistle are the primary weed species that must be controlled. Once weed populations have been controlled, it would be beneficial to plant grasses on treatment sites to prevent reinvasion of problem weeds.
- **Willow Creek:** The second priority is to control scattered trees and shrubs on the inner slopes along about nine (9) miles of the channelized portions of Willow Creek. Large thinleaf alders should be pulled using heavy equipment, but no more than 200 trees (0.5 acres total) should be removed per year to

prevent an unacceptable discharge of silt into the creek from disturbance of soil by root removal. Alders less than two (2) inches in diameter ground level and willows should be controlled by the application of herbicides. Scattered one-seed juniper trees can be controlled by cutting stems as close to the ground level as possible with a chainsaw.

- **Heron Lake:** The third priority is to remove scattered saltcedar trees and shrubs around the edge of the lake. Trees over two (2) inches in diameter at ground level can be cut with a chainsaw or use of a mower, and the cut surfaces immediately treated with a herbicide. Smaller saltcedar plants that have smooth bark above the ground level can be controlled by an oil basal application of an herbicide. The location and acreage of the saltcedar infestation needs to be determined prior to conducting control operations. However, infestations appear to be relatively small, it is estimated that less than 50 acres were infested in August 2011.
- **Blanco Diversion Dam Site:** A fourth priority is to control patches of bull thistle, Canada thistle, and oxeye daisy at this site. The infestations are small, and there are only a few scattered individual plants or clumps of plants on the site. The total area infested by the three species is about one (1) acres in size.
- **Office Complex:** Various herbaceous and grass species were observed at this facility. These species have and continue to be controlled by mowing and mechanical removal by a weedwacker. However, species like kochia, Russian thistle, or Russian knapweed could become a problem in the future. Chemical control of these species in the office complex is listed as a low priority, but it is worthwhile to have this option if weeds become a major problem.
- **Heron Dam Outer Slope:** There are a few scattered shrubs (unknown species) occurring on the outer slope of the dam. It does not appear that these shrubs have the capacity to impair the operations or threaten the integrity of the structure. Nevertheless, it is possible that rabbitbrush, big sagebrush, or other shrubs could be a problem in the future; thus, control of these species has been identified as the lowest priority for treatment.

Strategies

Management actions can be optimized by adopting a systematic approach such as Integrated Pest Management (IPM). Successful managers choose a variety of management options for prevention, containment, and control of target plants. Implementation of proven IPM strategies provides the best opportunity to achieve effective, economical, and environmentally acceptable management of target pests over the long term.

Different strategies must be implemented to address the various pest problems on wetlands, streams, structures, facilities, and other SJC Project sites.

- **Bull thistle.** Bull thistle establishment is favored in open areas and sites with disturbed soils. Therefore, management actions that favor the establishment of desirable vegetation, especially perennial grasses, will prevent bull thistle invasion. On sites with a few plants, hand-grubbing with a hoe or shovel is a practical control method. On sites with extensive stands of this weed, the application of herbicides is usually the most economical method of control. Clopyralid, 2,4-D, or a combination of these two herbicides (Curtail®) will provide excellent control of the rosette or seedling stages in either the Spring or Fall. Prior to flowering, bull thistles can be controlled with aminopyralid, 2,4-D, or dicamba. Glyphosate would control this plant, but this herbicide is non-selective and will kill grasses. Therefore, glyphosate will only be recommended for use as a last resort.
- **Canada thistle.** Canada thistle infestations can spread by sexual reproduction (seeds) and asexual spread by creeping, horizontal roots. Therefore, manual methods like-pulling or grubbing will not control established stands because it is almost impossible to remove the entire root system. The same herbicides that will control bull thistle will provide acceptable control of Canada thistle, including aminopyralid, clopyralid, 2,4-D. Also, dicamba, and metsulfuron will control Canada thistle. Since Curtail® will also control bull thistle, this product would be the most practical material to use. If there is any possibility of water contamination, an aquatically labeled herbicide must be used.



Canada thistle infestation on silt tailings, Oso Diversion Dam site

- **Thinleaf alder and Willows.** Removal and control of these two woody plants is necessary to improve the water delivery efficiency, remove potential habitat for rodent establishment, and prevent their root systems from disturbing the riprap along the Willow Creek Conveyance Channel. The largest trees can be excavated with heavy equipment, but this type of treatment can disturb soils and can result in an unacceptable discharge of sediment into the water. Also, soil disturbance by mechanical removal of trees above the riprap would impede the development of desirable grasses and favor invasive species like bull thistle, Russian knapweed, and perennial pepperweed. The following herbicides will provide effective control of woody shrubs and trees: 2,4-D, glyphosate, hexazinone, imazapyr, metsulfuron, and triclopyr. Glyphosate and imazapyr are non-selective herbicides that will kill most plants. Triclopyr, metsulfuron, and 2,4-D are selective herbicides that will control woody plants, but they will have little or no effect on grasses. Since herbicides are registered by site, it will be necessary to select a product that has an aquatic label if there is a possibility of getting spray into the water, which includes Rodeo® (glyphosate), Habitat® (imazapyr), and Renovate 3® (triclopyr). Elsewhere, the other herbicides could be an option. Since triclopyr will control saltcedar, in addition to coyote willow and thinleaf alder, there is an advantage to use the same products and methods to control them.



Willow Creek Conveyance Channel with thinleaf alder and clumps of willows growing in riprap

- **One-seed juniper.** Since this juniper species does not sprout, individual plant removal by cutting the stem or trunk just above the ground is the most effective and economical method of control. Herbicides also can be used to control this juniper species, but chemical control is not as economical as manual methods.
- **Saltcedar.** The treatment strategy is to remove all trees and shrubs around the edge of Heron Lake. Saltcedar is highly invasive and infestations could expand in size and density. Annual removal of woody species will protect the shoreline of Heron Lake and reduce seed production, which will help to reduce treatment costs in future years. Revegetation of treatment sites will not be needed since the objective is to remove the plants and create bare ground on the edge of the lake. It will be necessary to achieve root-kill of these trees because they have the ability to sprout if the aerial portions are cut or burned. Therefore, herbicides will need to be used, singly or in conjunction with mechanical methods, to achieve root-kill of these tree and shrub species. Mechanical mowing of these trees or shrubs along the lake's edge is a viable option to remove larger plants or clumps of shrubs if it is done in conjunction with immediate application of an amine formulation of triclopyr to the cut surfaces. Effective control of saltcedar also can be achieved by foliar, cut-surface, and oil basal applications of an herbicide. Foliar applications of a mixture of imazapyr and glyphosate are effective when applied between June and September, but the best results can be achieved by applying these herbicides in late August and September when the trees are moving carbohydrate reserves to their root systems. However, this technique would not be economical to treat existing infestations. Also, small saltcedar saplings and regrowth (stems less than 2 to 3 inches in diameter at ground level and less than 8 feet tall) can be controlled by a basal application of triclopyr (ester formulation) mixed with vegetable oil or another proven carrier. Triclopyr applications can be done at any time of the year, although early fall or late spring applications are preferred. The most practical approaches to control the limited saltcedars along the lake's edge would be as follows: (1) for small trees, use the oil basal approach using Garlon 4® in Improved JLB Oil Plus; and (2) for large trees, cut the stems with a mower or chainsaw and immediately treat the cut surfaces with Garlon 3A®. Renovate 3®, which is an aquatically labeled triclopyr product, can be used immediately adjacent (within 5 feet) to water.
- **Big sagebrush.** Extensive stands of big sagebrush can be controlled by mechanical methods and the use of prescribed fire, but these techniques are not practical for controlling scattered shrubs that could invade SJC Project lands. Individual plant foliar applications of an herbicide, especially an ester formulation of 2,4-D, would be the most effective and economical method of control.

- **Gray Rabbitbrush.** This shrub cannot be effectively controlled by removing the above ground portions of the plant. It will readily sprout from the deep taproot. Grubbing, digging, or mechanical removal of the root system is too costly and impractical, and the soil disturbance will favor invasion of these shrubs as well as invasive by species like kochia and Russian knapweed. The only proven method of control is using picloram (Tordon 22K®). This product is a Restricted Use herbicide that will provide excellent control (90 percent or higher) at a cost of \$40 to \$60 per acres depending on the density and size of shrubs being controlled. This herbicide is highly mobile in soil and should not be used where the water table is within six (6) feet of the soil surface or on the inner slopes of canals where surface flow could get into water. Applicators must be certified to apply this product. Also, daily use records must be kept for the application of this herbicide, and these records must be kept for a minimum of three years. The preferred option is to use triclopyr, especially since it is a selective herbicide that will have little or no effect on grasses. Application trials were conducted in the Alamosa Field Division, and tentative results indicate that adequate control can be achieved if proper application techniques are employed.
- **Russian knapweed.** Hand removal of Russian knapweed is ineffective due to the extensive root system the will readily produce sprouts if disturbed. Mechanical options will not control Russian knapweed for the same reasons that hand removal does not work. Herbicide use is the only current option available to control Russian knapweed on Reclamation managed lands. Effective control for two years after treatment of greater than 95% can be obtained with application of aminopyralid, clopyralid, or a combination of clopyralid plus 2,4-D (Curtail®). Aminopyralid will provide the best results, but it should not be used near water or where ground water is within is (6) feet of the soil surface or on inside faces of canals where surface flow could contaminate water. Curtail® is the best product to use on the inside faces of canals to control Russian knapweed. However, care must be taken to not get any spray in water. In 2011, no infestations are known to occur on SJC Project lands.
- **Perennial pepperweed.** Since this plant is a deep rooted perennial, hand pulling or grubbing is not an effective method. Mechanical control is not possible for the same reasons that hand removal does not work. On roadsides, rangelands, and waste areas, metsulfuron methyl (Escort ®) or chlorsulfuron (Telar ®) can be applied to actively growing rosettes early in the spring will provide effective control. These herbicides also can be applied to the regrowth before the bud stage or fall regrowth before a killing frost. However, it is best to treat plants before seeds are produced to the seed bank in the soil and reduce subsequent treatments. These two herbicides cannot be used where they could get into the water. If plants are growing within five (5) feet of water, the best option is to use an aquatically labeled formulation of 2,4-D (DMA® 4 IVM or comparable product).

- **Oxeye daisy.** This plant is a perennial that has extensive, creeping roots. Nevertheless, grubbing roots to a depth of six (6) inches could be a practical control option, although repeated manual applications might be necessary. The oxeye daisy infestation at the Blanco Division Dam site occupies less than 1/10 acre; thus, manual control would take little effort. A spot application of a two (2) percent solution of Redeem™ R&P (triclopyr and clopyrid) or Curtai® (clopyralid and 2,4-D) would provide the best control with the least effort. This plant is listed as a noxious weed in Colorado.
- **Kochia.** For small infestations (less than 1/10 of an acre), young plants can be easily removed by hand-pulling or by grubbing with a hoe or similar tool. Removal must be done when the plants are less than two feet tall before they set seed. To be effective, mechanical treatments have to remove all kochia plants in a project area before they set seed. Since the majority of kochia seeds are not viable for more than one year, preventing seed production by mowing can substantially reduce infestations the following season. The best time to mow or surface scrape plants is before they exceed 2 feet in height to reduce the amount of vegetative matter left on the ground. Although it is probably not an option for SJC Project lands, cutting kochia for feed can be a viable option for extensive infestations. Kochia has been used as livestock feed during droughts. As a forage crop, kochia is noteworthy because it has good drought tolerance, salinity tolerance, good leafiness, high yields, and it has high protein and carbohydrate content. Kochia can, however, be harmful or toxic to cattle if it comprises more than 50 percent of their diet. Kochia contains toxic substances including saponins, alkaloids, oxalates, and nitrates. Animals that consume large amounts of this plant may exhibit a range of health problems and have lower weight gains. Since each plant can produce up to 25,000 seeds, all plants on selected sites will need to be removed by mechanical means. In addition, consideration must be given to control of kochia infestations on adjacent sites to prevent wind dispersal of seeds into control sites. Several herbicides will effectively control kochia. Glyphosate, imazapyr, dicamba, pendimethalin, metsulfuron methyl, sulfometuron methyl, and 2,4-D products will provide excellent control results if applied correctly. If desirable grasses are present, selective herbicides like Escort (metsulfuron), 2,4-D ((DMA® 4 IVM or comparable product)), or dicamba (Banvel®) will remove kochia and have little or no effect on the grasses. Arsenal® (imazapyr) or Accord XRT® (glyphosate) are broad spectrum herbicides that can be used where bareground control would be acceptable. Glyphosate and 2,4-D will likely be the most cost effective products to use. However, when glyphosate is used, ammonia sulfate (17 pounds/100 gallons of spray or equivalent rate) must be added to prevent any potential antagonism with divalent cations in alkaline water common in the Southwest. The herbicides can be applied by on-the-ground power sprayers or by backpack sprayers. Broadcast application works well on relatively flat ground where access is good. The key to success in applying herbicides is to spray early when the

kochia plants are small. This plant is the first to emerge in the spring and it is usually well advanced by the time other broadleaf weeds emerge. Good coverage is also important, and the more persistent products, such as Escort, will provide extended results. However, if there are not desirable plant species present to occupy the site to prevent invasion by undesirable species, repeated treatments will need to be done. At the Chama Field Office complex, it would be worthwhile to add oryzalin (Surflan® A.S.) to spray solution of glyphosate to inhibit germination of seeds in the soil, which will increase lasting control of many weed species.

- **Russian Thistle.** This exotic species is an annual that readily invades disturbed sites. With extensive infestations, the best strategy is to conduct annual mechanical or herbicidal treatments. Grubbing small infestations (less than 1/10th acre) near structures or facilities can be the most efficient approach. Grubbing should be done early to late June when the plant are small and have not set seed, which will help to reduce the seed bank in the soil. For extensive infestations, mowing or plowing (surface removal) is an effective approach. The following herbicides will provide effective and economical control of Russian thistle: (1) glyphosate (Rodeo® on the inside of canals and Accord XRT® or a comparable product on terrestrial sites); and (2) Curtail® (clopyralid and 2,4-D). Again, when glyphosate is used, it may be necessary to add ammonia sulfate (17 pounds/100 gallons or equivalent rate) if the mixing water is alkaline.

Herbicide Application Techniques

Bull Thistle

- **Use:** A foliar application of 2,4-D or a mixture of clopyralid and 2,4-D (Curtail®) will provide acceptable control of this invasive species. On sites with a few plants, grubbing is an effective method of control.
- **Equipment**
 - **Backpack sprayer:** A backpack sprayer with a diaphragm pump is recommended for treating relatively small infestations, such as at the Blanco Diversion Dam site. Swissmex or Solo models are commonly used units that are relatively inexpensive. Chemical Containers, Inc. is a company that can provide assembled backpack units, spray guns and nozzles, and safety equipment (1-800-346-7867 or www.chemicalcontainers.com). A WCCI 210 Trigger Jet spray gun with an extension tube and a TP 1501, TP1502, or TP 1503 flat fan spray tip (increase nozzle size for larger stems) will allow applicators to efficiently spray stem of shrubs or trees. Depending on the ease of application to spray small to large plants, use a TP 1503, TP 2503, or TP2504 flat spray tip. A TP 1503 tip will spray at an angle of 15

degrees at 0.3 gallon of solution at 40 pounds per square inch (psi), which is efficient for spraying small plants. Use a TP 2503 nozzle to spray larger plant or clumps of plants.

- **Power Sprayer:** When accessible, a power unit with a handgun having an adjustable nozzle is more efficient when spraying patches of plants occupying more than a 1/10 acre. The power unit must not provide too much pressure or emit too high a volume of spray solution. This can be checked by comparing the spray distribution and volume of a backpack sprayer.
- **Mixing:** For spot applications, mix the herbicide concentrate in water to produce a two (2) percent solution. Broadcast applications should be applied at an equivalent rate. A high quality surfactant must be added as recommended in the pesticide label.

**How to mix a 2% solution of 2,4-D for foliar spraying:
Add 2.5 ounces of herbicide concentrate, plus the
amount of a recommended surfactant, to each gallon of
water.**

- **Spraying:** Wet the foliage from the top of shrubs down, being sure to spray all growing tips. The foliage should be sprayed until the leaves glisten, but not to the point of dripping. Be sure to cover the foliage on all side of the shrubs being treated. Spraying should be avoided on windy days (average wind speed of 10 miles per hour) to spray avoid drift.

Canada Thistle

- **Use:** On terrestrial sites, a foliar application of aminopyralid (Milestone®) applied at am rate range of five (5) to seven (7) ounces per acre will provide acceptable control of Canada thistle. However, aminopyralid cannot be used near water, where groundwater is within six feet of the soil surface, or on the inside faces of a canals or stream bank where surface flow could contaminate water. A 2,4-D product registered for both terrestrial and aquatic sites would be the most economical product to use when stands of Canada thistle occur on both sites. Curtail® (clopyralid and 2,4-D) can be used on the inner slope of a non-irrigation canal, but the spray needs to be applied to avoid getting any of the solution in water. It would be efficient to control Canada thistle with Curtail® if bull thistle is being treated on the same site.
- **Equipment**
 - **Backpack sprayer:** Again, a backpack sprayer with a diaphragm pump is recommended for treating a relatively small number (less than

100) of individual shrubs. Depending on the ease of application to the foliage, use either a TP 2503, 2504 or TP 4006 flat spray tip

- **Power Sprayer:** A power unit with an adjustable nozzle is more efficient when spraying a large number of shrubs can be reached with the equipment.
- **Mixing**
 - **Aminopyralid (Milestone™).** Applications using this herbicide should be applied to a rate of seven (7) fluid ounces per acre per annual growing season. A high quality non-ionic surfactant should be added to the spray mixture. The amount of aminopyralid to be mixed can be determined by following the instructions on page four (4) of the label.
 - **2,4-D (DMA™ 4 IVM or comparable product) and Curtail®.** For spot applications mix these herbicides in water to produce a two (2) percent solution as described in the mixing instruction for control of bull thistle. Broadcast applications should be applied at an equivalent rate. A high quality surfactant must be added as recommended in the pesticide label.
- **Spraying:** Spray volume should be sufficient to thoroughly and uniformly wet the target plants as outlined for spraying bull thistle.

Saltcedar, Thinleaf Alder, and Willow Species

- **Low-Volume, Oil Basal Herbicide Application Method**
 - **Use:** Garlon 4® (triclopyr), which is a general use herbicide, is recommended for this method. It will provide acceptable control of woody shrubs and trees. This approach also can be used to treat sprouts. This method would provide effective control of trees and shrubs that have stems with smooth bark and a stem diameter of about two inches or less at ground level. The estimated cost will be \$30 to \$60 per acre, which includes labor. The best time to do the treatment is the fall to early spring. Application should not be done if the stems are wet or there is a threat of rain.
 - **Equipment**
 - **Backpack sprayer:** A four (4)-gallon backpack sprayer is the best equipment to individually treat individual shrubs or trees in inaccessible sites such as on dam faces. A WCCI 210 Trigger Jet spray gun with an extension tube and a TP 1501,

TP1502, or TP 1503 flat fan spray tip (increase nozzle size for larger stems) will allow applicators to efficiently spray stem of shrubs or trees.

The use of trade or firm names in this plan is provided for information and does not imply endorsement by the Bureau of Reclamation.

- **Power sprayer:** Since saltcedar infestations are relatively small, the use of a power sprayer would not be needed.

Mixing: A 25 percent mixture of the Garlon 4® (triclopyr) in vegetable oil is recommended. Another product registered for industrial sites, which includes dams and adjoining sites, is Tahoe 4®. Triclopyr is a selective herbicide, which is especially useful for control of trees and woody shrubs. It acts by mimicking the activity of auxin, a natural growth hormone. It also is a systemic material that readily moves through the stems of treated trees or shrubs and then moves throughout the plant to the sites of growth where herbicidal activity occurs. It has little or no herbicidal activity in soil and the average half-life in soil is 30 days. Triclopyr is categorized as slightly toxic to humans and animals. Herbicides can be obtained from the following companies: Helena Chemical in Albuquerque, New Mexico (505-797-5800) or (www.helenachemical.com); or UAP Timberland in Las Cruces, New Mexico (505-525-8783) or (www.upatimberland.com). The recommended oil is Improved JLB OIL Plus®, which is produced by Brewer International (1-800-228-1833 or www.brewerint.com). This product is a blend of vegetable oils plus limonene, which is a bark penetrant. Other oil products, such as Amigo® (twice refined soybean oil), can be substituted, but these products have not been tested and they may not provide the same level of control.

How to obtain a 25% mixture: Add 1 gallon (one part) of herbicide formulation to 3 gallons (three parts) oil.

- **Spraying:** Spray the herbicide/oil mixture evenly but lightly from the base of the stem(s) up to 12 inches above the ground. For small shrubs (below 2 feet), it is only necessary to spray about 3- to 4 inches above the ground. Larger shrubs should be sprayed up to 12 inches. It is important to cover the entire circumference of the stem(s), but not to point of runoff. Improved JLB Oil Plus (Brewer International product) is an all natural oil product that was used during testing. The oil helps the spray mixture to wrap around the stem(s) as it flows downward with gravity. Limonene helps the herbicide to move through the bark. Where there are many stems in a shrub, it usually is necessary to spray

from 2 to 3 sides of the clump to ensure that all sides of stems are sufficiently covered. Do not conduct treatments when the stems are wet from rain or snow. Water and oil do not mix, and the control results will not meet the objective (80% or higher control). It is not necessary to use a marker dye in the spray. Treated plants are easy to detect, even months following spraying.

- **Low-Volume, Cut Surface Method with Triclopyr**

- **Use:** This method involves a combination of mechanical and herbicide treatments to achieve root-kill of trees that are too large to be treated by the low-volume, oil basal method. This technique is this best method to control trees that have thick, furrowed bark. The first step is to use a chain saw or mower to cut the stems just above the ground. Removal of large trees using a chainsaw is expensive. It also is important to have well trained personnel to do the cutting, because chain saw use is inherently dangerous. Also, experience chain saw operators are much more efficient. The overall cost can exceed \$1,000 per acre to treat dense stands of large trees, but the cost would be substantially less by cutting the stems with a mower. Cut surfaces need to be horizontal to the ground to allow the herbicide to soak into the cut surface and not run off. Prior to applying the herbicide mixture, all sawdust needs to be removed for the cut surface. A mixture of 50 percent Garlon 3A and 50 percent water yields adequate control results at the least cost (possibly \$100 per acre). Garlon 3A is a product with a triethylamine salt of triclopyr that mixes with water. It is legal to use the formulation at full strength, but this is usually not necessary.
- **Equipment:** A one quart spray bottle is the most efficient and safe equipment to use to apply the herbicide mixture to cut stems. Spray bottles with chemically resistant Viton seals are recommended. They can be obtained from Chemical Containers, Inc., for about \$3.00 per spray bottle. The herbicide solution also can be applied by a backpack sprayer.
- **Mixing:** A 50 percent mixture with an equal part of Garlon 3A and water usually provides acceptable control results. If it is found that this mixture does not provide adequate results, the percent of Garlon 3A can be increased, including a straight (100%) application of the product. To make a quart (32 ounces) of a 50 percent mixture, add one pint (16 ounces) of Garlon 3A to one pint of water.

How to obtain a 50 percent mixture for the cut stump method: Add one part of Garlon 3A to an equal part of water.

- **Spraying:** Immediately following the cutting of trees, remove the sawdust and spray the entire perimeter of the sapwood (lighter colored wood that conducts water) of the cut surface. The mixture will sink into water conducting tissues and will be moved to the growing center of the roots. On large stems that are four (4) inches in diameter or larger, the darker colored heartwood is dead tissue and should not be sprayed. For small stems, the practical approach is to just spray the entire cut surface. To kill large trees, it is often necessary to apply a second application (immediately following absorption) of the spray mix to the stump to get enough herbicide into the tree to achieve adequate root kill.

- **Foliar Spray Method to Control Saltcedar, Thinleaf Alder, and Willow Species**
 - **Use:** Although foliar treatment is not recommended for use on the SJC Project, a foliar application of imazapyr (Arsenal® or Habitat®) or a mixture of imazapyr and glyphosate (Accord XRT or Rodeo®) will provide effective control of saltcedar, willows, and thinleaf alder. The cost will range from \$40 to \$300 per acre, depending on the number and size of trees being treated. Habitat® and Rodeo® are registered for aquatic application and should be used if there is any possibility of spray getting into water.

 - **Equipment**
 - **Backpack sprayer:** Again, a backpack sprayer with a diaphragm pump is recommended for treating a relatively small number (less than 100) of individual shrubs on sites that cannot be reached by power spray units. Depending on the ease of application to the foliage, use either a TP 2503, 2504 or TP 4006 flat spray tip.

 - **Power Sprayer:** In accessible areas, a power sprayer can be more efficient when there is a need to treat a large number of trees and shrubs. The units can be mounted on a truck or trailer where there is adequate access or on a boat for remote sites. Depending on the ease of application, a spray gun with an adjustable nozzle or a TP 2503, 2504, TP 4006 flat fan nozzle can be used. Also, an adjustable spray gun or dual spray Gunjet with a WCCI-124 valve and nozzle assembly with TP

0512 and a TP 4010E nozzles. The wide angle tip will allow efficient coverage of close stands a cattail and the TP 0512 tip can be switched over for treatment of further away stands.

○ **Mixing**

- **Backpack sprayer:** For a backpack application, mix 2 ounces of glyphosate (Accord XRT®, Accord Concentrate, or comparable product) with a half an ounce of imazapyr (Arsenal®) per gallon of water. Also, a third of an ounce of a nonionic surfactant (Sunwet® made by Brewer International or comparable product) should be added per gallon of the spray mix.

How to mix a 2% solution of glyphosate and half percent of imazapyr for foliar spraying: Add 2 ounces of glyphosate concentrate, plus 0.6 ounce of Arsenal®, with 0.3 ounces of a nonionic surfactant per gallon of water.

- **Power sprayer:** Mixing instructions for a power sprayer are shown below.

Mixing 100 gallons: Fill the tank half full of water. Add 8 quarts of glyphosate, 2 quarts of Arsenal®, add one quart of a nonionic surfactant plus water to make 100 gallons. For smaller volumes, multiply the various products by the appropriate fraction. For example, multiply the above products by ½ to mix 50 gallons.

- **Spraying:** Wet the foliage from the top of shrubs down, being sure to spray all growing tips. The foliage should be sprayed until the leaves glisten, but not to the point of dripping. Be sure to cover the foliage on all side of the shrubs being treated. Applications should not be done on windy days to avoid spray drift.

One Seed Juniper

- **Manual Methods:** Cutting small stems (one to two inches in diameter) with pruning shears and larger stems with a chainsaw will control this non-sprouting juniper species.

- **Mechanical Control:** Mowers can be used to remove dense stands of juniper seedlings in accessible areas, but there presently are no dense stands on SJC Project lands.
- **Herbicidal Control.** Juniper species can be control by the application of picloram (Tordon 22K®). As previously mentioned, this is a restricted use herbicide that can only be applied by certified applicators. Also, this herbicide cannot be used where water contamination is a possibility. Considering these aspects, it was concluded that picloram would not be considered as a control option.

Big Sagebrush

- **Use:** A foliar application of 2,4-D or metsulfuron will provide marginal control of big sagebrush. On terrestrial sites, an ester formulation of 2,4-D will provide the best level of control. Where there is a threat of getting the spray in water, an amine formulation of 2,4-D registered for use on aquatic sites must be used, but the level of control will be less than the ester formulation. Metsulfuron (Escort®) will provide about the same level of control as 2,4-D, but the cost would be higher. Therefore, metsulfuron will only be considered for use as a backup herbicide to 2,4-D.
- **Equipment**
 - **Backpack sprayer:** Again, a backpack sprayer with a diaphragm pump is recommended for treating a relatively small number (less than 100) of individual shrubs. Depending on the ease of application to the foliage, use either a TP 2503, 2504 or TP 4006 flat spray tip.
 - **Power Sprayer:** A power unit with an adjustable nozzle is more efficient when spraying a large number of shrubs when access is good.
- **Mixing:** To obtain a two (2) percent solution, mix 2.5 ounces of a 2,4-D formulation per gallon of water. This herbicide is non-selective herbicide that will have little or no effect on annual and perennial grasses. It works by affecting growth in plants.

<p>How to mix a 2% solution of 2,4-D for foliar spraying: Add 2 and a half ounces of herbicide concentrate, plus the amount of a recommended surfactant, to each gallon of water.</p>
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- **Spraying:** Wet the foliage from the top of shrubs down, being sure to spray all growing tips. The foliage should be sprayed until the leaves glisten, but not to the point of dripping. Be sure to cover the foliage on all side of the

shrubs being treated. Spraying should be avoided on windy days (average wind speed of 10 miles per hour) to spray avoid drift.

Russian Knapweed

- **Use:** Aminopyralid applied at 4 to 6 ounces per acre will provide the most effective, economical, and environmentally acceptable herbicide for control of Russian knapweed. However, aminopyralid must not be used near water or where groundwater is within 6 feet of the soil surface or on inside faces of canals where surface flow could contaminate water. Curtail® (clopyralid plus 2,4-D) also will provide effective control. Curtail® is the best product to use on the inside faces of canals to control Russian knapweed. This product will only provide control for one season. Care must be taken to not get any spray in water.
- **Equipment:** The same equipment described for the foliar application of bull thistle should be used.
- **Mixing**
 - **Aminopyralid (Milestone™):** Mix the amount of this herbicide (fluid ounces) to the desired application rate in 0.5 to 2.5 gallons of water, depending upon the spray volume required to treat 1,000 square feet (10.5 by 10.5 yards). A delivery of 0.5 to 2.5 gallons per square feet is equivalent to 22 to 109 gallons per acre.
 - **Curtail®:** For spot applications mix these herbicides in water to produce a two (2) percent solution as described in the mixing instruction for control of bull thistle. Broadcast applications should be applied at an equivalent rate. A high quality surfactant must be added as recommended in the pesticide label.

Perennial Pepperweed

- **Use:** On sites where water contamination is not a possibility, Escort® or Telar® can be applied in the spring, post-emergence at the rosette stage or at flowering, to achieve effective control. On the inner face of the Canal, where drift and runoff could enter water, the only herbicide option would be to use a 2,4-D product that is labeled for both terrestrial and aquatic sites, such as DMA 4 IVM.
- **Equipment:** Use the same equipment described for foliar application for bull thistle.
- **Mixing:** Prepare a chemical stock solution by mixing a half ounce of Escort® or Telar® in 64 ounces of water in a watertight container. Shake the mixture

well to uniformly suspend all of the herbicide. Measure out 8 ounces of the stock solution and add this to a 3 gallon backpack sprayer (note that this equals 3/4 grams of dry herbicide that will also approximate an application rate at one ounce of herbicide based on a calibrated sprayer output of 50 gallons of water per acre). Add one fluid ounce of a non ionic surfactant (Sunwet® or comparable product) to the three gallons in the backpack. For 2,4-D, use a two (2) percent solution that will be mixed as described for bull thistle.

- **Spraying:** Wet the foliage from the top downward being sure to spray all growing tips. The foliage should be sprayed until the leaves glisten, but not to the point of dripping. Spraying should not be done on windy days to avoid drift that could enter water in a Canal or stream. Application should be done to the rosette stage or the pre-bloom stage.

Oxeye Daisy

- **Use:** The most effective and economical control option would be to apply a two (2) percent solution of Redeem™ R&P (triclopyr and clopyrid) or Curtail™ (clopyralid and 2,4-D)
- **Equipment:** The same equipment described for the foliar application of bull thistle should be used.
- **Mixing:** Again follow the instructions for mixing a two (2) percent solution as previously described.
- **Spraying:** The foliage of target plant must be well covered to obtain acceptable control.

Kochia

- **Use:** A foliar application of 2,4-D or glyphosate will provide the most economical control of kochia, especially on sites where bare ground is desirable, like an equipment storage yard. Glyphosate is a broad spectrum herbicide that will kill most plants; thus, it should not be used along stream banks or other sites where grasses would be killed. However, glyphosate would be the preferred product to control weeds in equipment storage areas or where bare ground would be desirable. Rodeo®, which has an aquatic label, can be used to control plants that occur along the edge of a canal or stream. The best results with 2,4-D and glyphosate will be obtained by treating plants when they are small. Also, adding oryzalin (Surflan® A.S.) to a glyphosate spray solution in equipment storage areas and around facilities will prevent plants from germinating from the soil. Therefore, oryzalin will improve effectiveness over a longer period of time.

- **Equipment:** Use the same equipment described for foliar application for bull thistle.
- **Mixing:** Again follow the instructions for mixing a two (2) percent solution previously described for bull thistle.
- **Spraying:** Wet the foliage from the top of shrubs down, being sure to spray all growing tips. The foliage should be sprayed until the leaves glisten, but not to the point of dripping. Be sure to cover the foliage on all side of the shrubs being treated. Spraying should not be done on windy days to avoid drift. Also, extreme care must be used to avoid getting the spray solution on desirable plants with glyphosate because it is a broad spectrum herbicide.

Russian Thistle

- **Use:** On site where bare ground is desired, a foliar application of a two (2) percent solution of glyphosate will provide acceptable and safe control of Russian thistle. On sites where there is a need to protect grasses, Curtail® can be applied as a two (2) percent solution. Add high quality surfactants to spray solutions when they are recommended on the pesticide label.
- **Equipment:** For broadcast applications, use a power sprayer with nozzles that will provide good coverage of the foliage of target plants.
- **Mixing:** Again follow the instructions for mixing a two (2) percent solution as previously described.
- **Spraying:** The foliage of target plant must be well covered to obtain acceptable control.

Mitigations and Best Management Practices (BMPs) for Pesticide Use

The application of pesticides is tightly controlled by state and federal agencies. The Bureau of Reclamation is required to follow all state and federal laws and regulations applicable to the application of herbicides. The following mitigation measures will followed when applying herbicides:

1. Mitigations

- All pesticide label requirements will be followed.
- Prior to doing any mechanical treatments, especially removal of large trees and/or shrubs, contact the Albuquerque Area Office Environment Division's Archaeologist to determine if the State Historic Preservation Office will require consultation.

- All Best Management practices will be followed.
- Pesticides will not be directly applied to water unless they are labeled for aquatic use.
- Herbicides applications will not be made when threatened or endangered wildlife species are present (November through March).
- Picloram will not be use where groundwater is within 6 feet of the soil surface, on the inner faces of canals, or any site where surface movement could contaminate water.
- Spot applications of herbicides will not be done within 5 feet of water being used for irrigation unless they are labeled for aquatic use.
- Applicators will be required to wear long-sleeved shirts and long pants, boots plus socks, and other personal protective equipment as required on the label.
- All requirements in the following Safety and Spill Plan will be followed.
- Pesticides will be secured at all times.
- Pesticides will be transported according to safety requirements.

2. Pre-spray BMPs

- Comprehensive project files will be maintained.
- Techniques that do not involve the use of a pesticide will be evaluated for use when they are known to provide acceptable control (over 80%) at a reasonable cost.
- Pesticides will only be used to pests when they provide the most effective control relative to cost and do not present unacceptable environmental or safety risk.
- Pesticides will be selected based on their ability to provide the most effective control and least cost.
- Applicators will be required to read and understand the pesticide label and Material Data Safety Sheet for all products being used.
- The lowest effective rate for herbicides and insecticides will be used.

- Treatment sites will be checked to ensure they are not occupied by threatened, endangered, or sensitive species.

3. Pesticide Spraying BMPs

- Individuals spraying pesticides will receive safety and application training prior to doing any treatment.
- Spraying will not be done when members of the public are present on Reclamation lands.
- Spraying will not be done when the average wind speed exceeds 8 miles per hour or as indicated on the label.
- Applications will not be done when there is a threat of rain or snow.
- Treatment areas will be posted with information signs to inform the public that pesticides are being used and the date of application.
- Mixing of pesticides will not be done near water, recreation sites, residences, or areas frequented by the public.
- Daily pesticide treatment records will be kept.
- Daily use records for the application of Restricted Use pesticides will be maintained for at least three years.
- Applicators will use appropriate personal protective equipment (PPE).

4. Post-spray BMPs

- Treatment areas will be checked to assess efficacy.
- Application records will be maintained in the project file.
- Managerial oversight will be done annually to ensure compliance with all requirements.

Appendix A: Pesticide Safety and Spill Plan

1. Information and equipment

- All individuals applying pesticides will receive training on safety and application procedures prior to spraying.
- A copy of pesticide labels and MSDS will be available at all times during project operations, and applicators will be completely familiar these documents.
- Required Personal Protective Equipment (PPE) will be worn at all times when herbicides are being mixed and applied.
- An emergency spill kit, with directions for use, will be present when herbicide are being transported, mixed and applied.
- Employees will be trained in the use of the spill kit prior to initiation of operations.
- The spill kit will contain the following equipment:
 - Clean water and soap
 - Shovel
 - Broom
 - Ten pounds of absorbent material, such as kitty litter
 - Box of plastic bags
 - Nitrile gloves

2) Procedures for pesticide spill containment

Information in this section is derived from the EPA document “Applying Pesticides Correctly: A Guide for Private and Commercial Applicators,” and the rules and regulations for the New Mexico Pesticide Control Act administered by the New Mexico Department of Agriculture, Pesticide Management Bureau.

The following information will be reviewed by workers who handle herbicides:

- Immediately notify the direct supervisor of an incident or spill. Identify the nature of the incident and extent of the spill, including the product and chemical names and the EPA registration number(s).
- Remove any injured or contaminated person to a safe area. Remove contaminated clothing and follow MSDS guidelines for emergency first aid procedures regarding exposure. Do not leave an injured person alone. Obtain medical help for any injured employee.

- Contain the spilled pesticide as much as possible on the site. Prevent the herbicide from entering ditches, gullies, wells, or water systems.
- **Small Spills** (Less than 1 gallon of pesticide formulation or less than 10 gallons of herbicide mixture)
 - Qualified employees will be present to confine a spill.
 - Follow MSDS guidelines for emergency first aid procedures in the event of an accidental exposure.
 - Restrict entry to the spill area
 - Contain the spread of the spill with earthen dikes.
 - Cover the spill with absorbent material.
 - Place contaminated materials into leak-proof container(s) and label.
 - Dispose of contaminated material according to label instructions and State Requirements.
- **Large Spills** (More than 1 gallon of pesticide formulation or more than 10 gallons of herbicide mixture)
 - Keep people away from the spill.
 - Follow MSDS guidelines for emergency first aid procedures in the event of an accidental exposure.
 - Contain the spread of the spill with earthen dikes.
 - Cover the spill with absorbent material.
 - Spread the absorbent material around the perimeter of the spill and sweep toward the center.
 - Call the direct supervisor and the local fire department, and follow their instructions for further actions.

3) Procedures for pesticide mixing, loading and disposal

- Mixing of pesticides and adjuvants will be done at least 100 feet from well heads or surface waters.

- Dilution water will be added to the spray container prior to the addition of the pesticide concentrate.
- Hoses used to add dilution water to spray containers shall be equipped with a device to prevent back-siphoning, or a minimum 2-inch air gap.
- Workers mixing pesticide will wear the maximum personal protective equipment required by the label.
- Empty containers will be triple rinsed. Rinsate will be added to the spray mix or disposed of on the application site at a rate that does not exceed amounts addressed on the label.
- Unused pesticide will be stored in a locked facility in accordance with herbicide storage instructions provided by the manufacturer, and in accordance with the New Mexico Department of Agriculture regulations.
- Empty and rinsed pesticide containers will be punctured and disposed of according to label instructions.

4) Transportation and Security

- Transport only the quantity of pesticide needed for the day's operation.
- Do not leave vehicles being used to transport pesticides unattended unless the herbicides are secured in a locked area.
- Keep pesticides separated from drivers and passengers when they are being moved from storage sites to field locations
- Do not transport open container with pesticides.
- Make sure all lids or bungs are tight on pesticide containers prior to transport.
- Maintain security of pesticides at field sites.

Appendix B: Pesticide Labels and MSDS Sheets

Pesticides

1. Accord XRT® (Glyphosate)
2. Rodeo® (Glyphosate labeled for aquatic use)
3. DMA® 4 IVM (2,4-D labeled for terrestrial and aquatic use)
4. Garlon 4® (Ester formulation of triclopyr)
5. Garlon® 3A (Amine formulation of Triclopyr)
6. Arsenal® (Imazapyr)
7. Habitat® (Imazapyr labeled for aquatic use)
8. Milestone® (Aminopyralid)
9. Curtail® (Clopyralid and 2,4-D)
10. Reclaim® (Clopyralid)
11. Redeem™ R&P (triclopyr and clopyralid)
12. Surflan® A.S (oryzalin)

Adjuvants

1. Improved JLB Oil Plus®
2. Amigo®
3. Sunwet®

APPENDIX C: PREVENTION BY HEAVY EQUIPMENT HYGIENE

Introduction

Construction equipment hygiene and clean-down procedures is necessary to prevent the spread and development of noxious weeds and invasive plants.

- **The Issue.** Relocating construction equipment from project to project, or from one site to another, is a significant factor in the spread of weeds and development of weed infestations.
- **Contaminants Causing Spread.** The most common contaminants on equipment are weed seeds and plant debris or plant parts that can result in vegetative reproduction. Some seeds are small and they can be difficult to remove, especially when they penetrate deep into mechanical parts of the equipment.

Initial Preventive Measures

An effective and economical preventive approach is for equipment operators to avoid contamination of machinery. This approach can reduce or eliminate the need to clean equipment. Some useful practices include:

- Work from non-infested areas into infested areas.
- Strategically designate equipment wash-down sites at each project to minimize weed spread.

Machinery Most at Risk

The types of machinery and equipment that are of concern in the spread of weeds follow:

- Track Equipment (dozer, excavator, crane, mulcher, etc.),
- Pneumatic Wheel Equipment (loader, grader, scraper, backhoe, chipper, etc.).

Critical Contamination Areas

When decontaminating equipment and attachments, there are certain areas of the machine that require particular attention. These areas of critical contamination generally come into contact with the soil or plant material when the equipment is in use.

Clean-Down Options

The following are effective methods to remove weed seeds and plants:

- **Wash-down** can be achieved by applying water to the equipment at high pressure using a pressure cleaner or spray tank and pump. The critical areas on equipment must be rigorously targeted and thoroughly washed clean.
- **Air blast** assists decontamination of machinery, especially for those hard-to-reach areas such as cavities and joints. A compressor with hose and suitable nozzles is required.
- **Physical removal** with hand-held tools is an option that is most appropriate for contaminants that adhere to equipment. Physical removal is often undertaken prior to or as a follow up procedure to both water and/ or air blast clean-down. This may be labor intensive, but it will ensure that contaminants are removed and disposed of correctly. Brooms, brushes, shovels and scraping tools can help with clean down procedures.

Clean-Down Considerations

When implementing hygiene protocols a number of considerations need to be addressed to minimize further infestations and achieve maximum hygiene standards.

These include:

- Whether to clean the equipment on or off project site;
- Whether to utilize companies that provide portable equipment cleaning facilities;
- Or, whether to use existing equipment wash bay facilities located at local commercial enterprises.

Important Consideration

When engaging contractors, verify that they implement equipment hygiene protocols as a standard practice. Undertake physical inspections of their equipment to confirm weed free status, before and after the job is undertaken.

General Movement of Equipment

Everyone has a responsibility to ensure that they check their equipment for possible weed seed and plant part contaminants and implement appropriate clean down procedures.