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Invasive Plant Prevention Guidelines¹

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Introduction

The most effective, economical, and ecologically sound approach to managing invasive plants is to prevent their invasion in the first place. Often landowners and land managers direct limited resources into fighting firmly established infestations. By that stage, management is expensive and eradication is probably impossible. Certainly it is necessary to manage infestations to limit the spread of invasive plants – which are often categorized as “weeds” – into non-infested areas. However, limited resources might be spent more efficiently on proactive weed management that controls existing weed infestations but also focuses strongly on prevention or early detection of new invasions.

Elements of a proactive weed prevention plan include:

- limiting the introduction of weed seeds into an area;
- early detection and eradication of small patches of weeds;
- minimizing disturbance of desirable vegetation along roadsides, trails, and waterways;
- managing land to build and maintain healthy communities of native and desirable plants to compete with weeds;
- careful monitoring of high-risk areas such as human and animal transportation corridors and disturbed or bare ground;
- revegetating disturbed sites with desirable plants; and

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- evaluating annually the effectiveness of the prevention plan so appropriate adaptations can be implemented the following year.

The purpose of this guide is to provide practical techniques to prevent the invasion and permanent establishment of invasive plants on roadsides and in natural areas. It is divided into four sections:

- **Invasive Plant Prevention: Lands** addresses prevention strategies for site-disturbing projects such as road-building and timber harvesting, considerations for land-use planning, and movement of people and equipment within natural areas.
- **Invasive Plant Prevention: Water** addresses prevention strategies in riparian areas and watersheds, as well as providing tips for aquatic recreation.
- **Invasive Plant Prevention: Animals** addresses prevention strategies specific to grazing management, wildlife, and movement of horses and pack animals into the backcountry.
- **Invasive Plant Prevention: Fire** addresses prevention strategies for prescribed burns as well as firefighting and post-fire land rehabilitation.

Another word for “prevention” is “protection.” This guide was developed with the firm conviction that we can protect our healthy, non-infested ecosystems from the introduction and establishment of invasive plants by following practical, proactive, weed prevention guidelines.

Invasive Plant Prevention: Lands

Site-Disturbing Projects and Maintenance Programs

When planning projects that will disturb grasses, forbs, and shrubs and result in bare ground – even temporarily – land managers must incorporate weed prevention and control into project layout, design, and evaluation, as well as all project decisions. Consider how to rebuild or maintain healthy plant communities that will effectively compete with weeds after the disturbance.

- Environmental analyses for projects and maintenance programs should assess weed risks, analyze high-risk sites for potential weed establishment and spread, and identify prevention practices. Determine weed prevention and management needs at the onset of project planning.
- Include site-specific vegetation monitoring in project plans.
- Learn to recognize desirable plants as well as weeds.

Avoid or remove sources of weed seed and other propagules to prevent new weed infestations and the spread of existing weeds.

- Before ground-disturbing activities begin, inventory and prioritize weed infestations for treatment in the project operating areas and along access routes. Identify what weeds are on site or within the project's vicinity and do a risk assessment accordingly. Control these weed infestations. Ideally, weeds should be managed three to five years prior to the planned disturbance to minimize weed seeds in the soil.
- Begin project operations in non-infested areas. Restrict movement of equipment or machinery from weed-contaminated areas to non-contaminated areas. This restriction includes machinery used for or by construction, recreation, agriculture, forestry, oil and gas exploration and production, utility companies, mining, and tourism.
- Locate and use weed-free project staging areas. Avoid or minimize travel through weed-infested areas, or restrict travel to those periods when spread of seed or propagules is least likely, such as prior to seed development.
- Identify sites where equipment can be cleaned. Remove mud, dirt, and plant parts from project equipment (preferably with a 2,000-PSI pressure washer) before moving it into a project area. Seeds and plant parts should be collected and incinerated. The cleaning area should be monitored for weeds for several years following.
- Clean all equipment before leaving the project site if operating in areas infested with weeds.
- Inspect, remove, and properly dispose of weed seed and plant parts found on clothing and equipment. Proper disposal means bagging the seeds and plant parts and incinerating them.
- Evaluate options to regulate the flow of traffic on sites where desired vegetation needs to be established or maintained.

Prevent the introduction and spread of weeds caused by infested sand, gravel, and fill material. Work with the responsible transportation agencies to voluntarily adopt prevention practices.

- Inspect materials at the source to ensure that they are weed-free before transport and use. If sources of sand, gravel, and fill are infested, eradicate the weeds, then strip and stockpile the contaminated material for several years, if possible, to further deplete the soil seed bank. Check regularly for weed re-emergence.
- When material from a weed-infested but herbicide-treated source is used in a project, inspect and document the project area annually for at least three years to ensure that any transported weeds are promptly detected and controlled.
- Maintain stockpiled, non-infested material in a weed-free condition by preventing weed seed contamination with physical barriers and by frequently monitoring and quickly eradicating new weeds prior to seed production.

Avoid creating environmental conditions that promote weed germination and establishment.

- Minimize soil disturbance.
- When working in vegetation types with relatively closed canopies, retain shade to the extent possible to suppress weeds and prevent their establishment and growth.
- Retain native vegetation in and around the project activity as much as possible.

Where project disturbance creates bare ground, re-establish vegetation to prevent conditions that favor weeds.

- Revegetate disturbed soil to optimize establishment of desirable plants for that specific site. Define for each project what constitutes disturbed soil and objectives for revegetation.
- Revegetation may include topsoil replacement, planting, seeding, fertilization, liming, and weed-free mulching. Use native material where appropriate and feasible. Consider hiring a contractor to chip local brush or cut and bale local weed-free grass for mulch – an added benefit is that mature seeds in the grass or brush can help restore localized vegetation on the site. Use certified weed-free hay or straw.
- Monitor sites where seed, hay, straw, or mulch has been applied. Eradicate weeds before they develop seed. In contracted projects, contract specifications can require that the contractor maintain the site weed-free for a specified time. Ensure contractors do not skip weed control steps to save time on a project.
- Where practical, salvage weed-seed-free topsoil and replace it on disturbed areas such as road embankments or landings. Healthy topsoil contains microorganisms, invertebrates, and living plant propagules that enhance revegetation.
- Use local seeding guidelines to determine procedures and appropriate seed mixes. A certified seed laboratory should test each lot according to Association of Seed Technologists and Analysts (AOSTA) standards (which include an all-state noxious weed list) and provide documentation of the seed inspection test. Check state and federal lists to see if any local weeds need to be added prior to testing. If AOSTA standards are not required, use state- or regionally-certified weed-free seed.
- Inspect and document all ground-disturbing operations in noxious weed infested areas for at least three growing seasons following completion of the project. For ongoing projects, continue to monitor until reasonably certain that weeds will not reappear. Plan for follow-up treatments based on inspection results.

Improve effectiveness of prevention practices through weed awareness and education.

- Educate people in weed identification, biology, impacts, and effective prevention measures.
- Provide proficient weed management expertise at each administrative unit of a public land management agency. Expertise means that necessary skills are available and corporate knowledge of ongoing weed management strategies is maintained.
- Develop incentive programs encouraging weed awareness, detection, reporting, and identifying new weed invaders.

Set the example; maintain weed-free administrative sites.

- Treat weeds at administrative sites and implement weed prevention practices to maintain sites in a weed-free condition. This includes early detection and rapid response practices.

Timber Harvest

Avoid or remove sources of weed seed and propagules to prevent new weed infestations and the spread of existing weeds.

- Treat weeds on timber-harvest projects – including landings, skid trails, and helibases – well before activities commence. Identify and avoid infested areas where activities could spread weed seed.
- Maintain weed-free mill yards, equipment parking, staging areas, and logging roads.
- To prevent weed germination and establishment, retain native vegetation in and around timber harvests and minimize soil disturbance. Logging practices that reduce soil disturbance include:
 - Over-snow logging
 - Skyline or helicopter logging
 - Reuse of landings, skid trails, and helibases when they are weed-free
- Minimize the period from end of logging to site preparation, revegetation, and contract closure. Prompt reforestation and revegetation is required for long-term restoration and weed suppression.
- Monitor for and eradicate new weeds promptly.

Land Acquisition and Subdivisions

Avoid or remove sources of weed seed and propagules to prevent new weed infestations and the spread of existing weeds. Monitor for and eradicate new weeds promptly.

- Conduct weed inventories of all lands considered for acquisition, sale, or exchange. Weed treatment may be written into a contract as a condition of land purchase or exchange. Long-term weed management may be considered in the maintenance cost of the property.
- Public land managers may include a weed prevention and control provision in new permits, easements, or leases. Consider amending existing authorizations when ground-disturbing activities are involved.

Incorporate weed prevention into project layout, design, evaluation, and decisions for mining, oil and gas exploration, and utility work.

- Include weed prevention measures, including project inspection and documentation, in operation and rehabilitation plans.
- To prevent conditions favoring weed establishment, minimize bare soil conditions and to establish vegetation as soon as possible on disturbed or bare ground.

Incorporate weed management and prevention practices in land subdivision planning.

- Encourage the landowners' association to prevent weed problems through education and awareness. Ensure that property owners understand the impacts caused by weeds, including effects on property values.
- Develop weed management guidelines or a weed prevention plan for the entire subdivision rather than individual lots.
- Include building contractors, utilities, and others in requirements to clean equipment and use weed-free materials.
- Communicate and coordinate with the local county weed district or weed management area.
- Develop standards for grazing, landscaping, and revegetation that promote healthy plant communities.
- Develop road maintenance plans that address weed management along roadsides to reduce the spread of weeds throughout the subdivision.

Recreation and Wilderness

To prevent new weed infestations and the spread of existing weeds, avoid or remove sources of weed seed and propagules.

- Avoid moving through weed infestations whenever possible.

- Inspect and clean motorized and mechanized trail vehicles of weeds and their seeds at a controlled site.
- Wash boots before hiking into a new area. Inspect and clean packs, equipment, bike tires.
- Keep dogs and other pets free of weed seeds. Weeds often grow along trails; leash dogs when weeds are in seed.
- Avoid picking unidentified “wildflowers” and discarding them along trails or roadways.
- Support the development and distribution of weed-free feed, hay, straw, and mulch.
- Maintain trailheads, boat launches, outfitter and public camps, picnic areas, airstrips, roads leading to trailheads, and other areas of concentrated public use in a weed-free condition. Consider high-use recreation areas as high priorities for weed eradication.
- In areas susceptible to weed infestation, limit vehicles to designated, maintained travel routes. Inspect and document travel corridors for weeds and treat well before seed production.
- Monitor for and eradicate new weeds promptly.
- Improve effectiveness of prevention practices through weed awareness and education.
- To be most effective, unify landowners in implementing proactive weed management and cooperative group to maintain common weed-free areas.
- Post weed awareness messages and prevention practices at strategic locations such as trailheads, roads, boat launches, information kiosks, and forest portals.
- Recreation permits and hunting and fishing licenses should include weed prevention guidelines and/or information on weeds that hunters and fishermen are likely to encounter.
- Weed prevention messages should include information about where to report sightings of weeds.

Roads and Utilities

Incorporate weed prevention into road and utility project layout, design, evaluation, and decisions.

- Develop Best Management Practices for road construction material sites, sand and gravel pits, mulch, and other material source sites.

- Clean all equipment before leaving the project site when operating in areas infested with weeds. Seeds and plant parts should be collected and incinerated. Designate a site where equipment will be cleaned and frequently monitor the site for new weeds.
- Remove mud, dirt, and plant parts from project equipment before moving it into a project area. Seeds and plant parts should be collected and incinerated.
- Communicate with the local weed district or weed management area about projects and best practices for prevention and develop cooperative strategies.
- To avoid weed invasion, build and maintain self-sustaining, healthy plant communities whenever possible, including utility rights of way, roadsides, highway landscaping projects, rest area construction, scenic overlooks, and state entrances.
- Remove roadside sources of weed seed that could be transported to other areas.
- Periodically inspect roads and rights-of-way for noxious weeds. Train road maintenance staff and utility truck operators to recognize weeds and report locations to the local weed specialist. Inventory weed infestations and schedule them for treatment.
- Schedule roadside mowing so weed-free roadsides are mowed after seed maturation, ensuring desirable plants grow unrestricted and produce seed for next year's stand. Weedy roadsides should be treated when the weeds have reached the early flowering stage (well before seed development) to avoid spreading matured weed seed.
- Coordinate blading or pulling of noxious weed-infested roadsides or ditches in consultation with the local weed specialist. Blade from least infested to most infested areas. Ensure weeds remain on-site.
- Avoid acquiring water for road dust abatement where access to the water is through weed-infested sites.
- Treat weeds in road decommissioning and reclamation projects before roads are made impassable. Sites with moderate to high weed density should be treated for several seasons prior to decommissioning. Regardless of weed density, revegetation speeds recovery and mitigates soil erosion, as well as prevents weed invasion. Reinspect and follow up based on initial inspection and documentation.

Invasive Plant Prevention: Water

Aquatic Recreation

To prevent new weed infestations and the spread of existing weeds, avoid or remove sources of weed seed and propagules from recreation equipment. Avoid moving weeds from one body of water to another.

- Inspect boats (including air boats), trailers, and other boating equipment and remove any visible plants, animals, or mud before leaving any waters or boat-launching facilities. Drain water from motor, live well, bilge, and transom wells while on land before leaving the vicinity. Wash and dry boats, tackle, downriggers, anchors, nets, floors of boats, props, axles, trailers, and other boating equipment to kill weeds not visible at the boat launch.
- Encourage boat-launching facilities to provide proper washing equipment and kiosks that describe proper and thorough cleaning.
- Before transporting to new waters, rinse boat and boating equipment with hot (40°C or 104°F) clean water, clean boat or trailer with a pressure washer, or dry boat and equipment for at least five days.
- Inspect seaplanes and remove weeds from floats, wires, cables, water rudders, and pump floats; wash with hot water or spray with high-pressure water, or dry for at least five days.
- Avoid taxiing seaplanes through heavy surface growths of weeds before takeoff; raise and lower water rudders several times to clear off plants. If weeds were picked up during landing, clean off the water rudders before take-off and leave the water rudders up during take-off. If water rudders were down during take-off, raise and lower water rudders several times to free weed plant fragments while over original body of water or over land. If weeds remain visible on floats or water rudders, the pilot may return to flight origin and remove plants if an extra landing and takeoff is not a safety concern.
- Maintain a 100-foot weed-free clearance around boat launches and docks.
- Promptly post sites if aquatic invasive weeds are found. Confine an infestation; where prevention is infeasible or ineffective, close the facility until the infestation is contained.
- Wash and dry fishing tackle, downriggers, float tubes, waders, and other equipment to remove or kill harmful species not visible at the boat launch.
- Avoid running personal watercraft through aquatic plants near boat access locations. Instead, push or winch watercraft onto the trailer without running the engine. After the watercraft is out of the water, start the engine for 5 to 10 seconds to blow out any excess water and vegetation. After engine has stopped, pull weeds out of the steering nozzle. Inspect trailer and any other sporting equipment for weed fragments and remove them before leaving the access area. Wash or dry watercraft before transporting to another body of water.

- Waterfowl hunters may use elliptical, bulb-shaped, or strap anchors on decoys because these types of anchors avoid collecting submersed and floating aquatic plants. Remove aquatic plants and rinse mud from waders and hip boots before leaving the water. Remove aquatic plants, animals, and mud attached to decoy lines and anchors.
- Divers should clean their equipment after each use. Be especially careful to wash the buoyancy control device and other items that retain water. All gear should be rinsed with water heated to at least 140° F and everything should be allowed to dry completely between dives.
- Construct new boat launches and ramps at deep-water sites. Restrict motorized boats in lakes near areas that are infested with weeds. Move sediment to upland or quarantine areas when cleaning around culverts, canals, or irrigation sites. Clean equipment before moving to new sites. Inspect and clean equipment before moving from one project area to another.
- Drain the water in bait buckets, live wells, and transom wells on land or back into the water from which it was taken.
- Avoid dumping aquarium water or aquatic plants into local waters. Many plants for water gardens and aquaria are highly invasive.

Watershed Management

Avoid or remove sources of weed seed and propagules to mitigate new weed infestations and the spread of existing weeds.

- Frequently and systematically inspect and document riparian areas and wetlands for noxious weed establishment and spread. Eradicate new infestations before they become established – effective tools for riparian-area management are limited.
- When possible, maintain conditions (for example, water levels) that sustain desired riparian plant systems that compete effectively with weeds.
- Promote dense growth of desirable vegetation in riparian areas to minimize the availability of landing and germination sites for weed seeds and propagules that might be produced upstream.
- Address noxious weed risks in watershed restoration projects and water quality management plans.
- Pay particular attention to practices listed under “Site-disturbing Projects and Maintenance Programs” in this document.

Invasive Plant Prevention: Animals

Grazing Management

Incorporate noxious weed prevention and control practices in the management of grazing allotments. Promote grazing practices that minimize impacts on desirable vegetation.

- Consider prevention practices and cooperative management of weeds in grazing allotments. Proper grazing management and prevention practices may include:
 - Altering season of use (avoid grazing the same plants at the same time year after year)
 - Animal exclusion
 - Activities to minimize ground disturbance, especially in riparian areas
 - Preventing weed seed transportation on animals, humans, or equipment
 - Maintaining healthy, weed-free vegetation (consider proper stocking rates and allow plant recovery before regrazing)
 - Managing weed infestations to limit weed seed dispersal into weed-free areas
 - Revegetation of sites susceptible to weed invasion
 - Frequent and systematic monitoring for new weeds
 - Reporting and follow-up management
 - Ensure grazing allotment permittees are aware of the impacts of weeds and can identify weeds threatening the management area.

Avoid or remove sources of weed seed and propagules to prevent new weed infestations and the spread of existing weeds. Minimize transport of weed seed into and within allotments.

- If livestock may contribute to seed spread in a weed-infested area, schedule livestock use for prior to seed-set or after seed has fallen.
- Consider grazing domestic sheep on weed-infested sites during early summer to minimize flower and seed production of weeds. Schedule cattle grazing after sheep when desirable grasses have matured and dispersed seeds.
- If livestock were transported from a weed-infested area, annually inspect and treat entry areas for new weed infestations.
- Avoid moving livestock from weed-infested sites to weed-free rangeland.
- Close infested pastures to livestock grazing when grazing will either continue to exacerbate the condition or contribute to weed spread. Designate those pastures as unsuitable range until weed infestations are adequately managed.
- Provide supplemental feeding in a designated area so new weed infestations can be detected and treated quickly. Pelletized feed is unlikely to contain viable weed seed.

- Weed seed can be introduced into weed-free rangeland by passing through the digestive tracts of livestock. Keep new livestock (especially livestock that may have been fed poor-quality hay) in a holding field for 24 to 48 hours before releasing onto open range.

Maintain healthy, desirable vegetation that resists weed invasion, establishment, and growth.

- Manage the timing, intensity (utilization), duration, and frequency of livestock activities to maintain the vigor of desirable plants and retain live plant cover and litter to minimize exposed soil.
- Manage livestock grazing in restoration areas to ensure that desired vegetation is well established. This may involve animal exclusion for at least two years. Consider practices to minimize wildlife grazing such as temporary fencing, if necessary.
- Reduce ground disturbance. Consider changes in the timing, intensity, duration, or frequency of livestock use; location and changes in salt grounds; restoration or protection of watering sites; and restoration of yarding/loafing areas, corrals, and other areas of concentrated livestock use.
- After moving salt, consider revegetating the old salt ground by raking the site before and after broadcast seeding, then fencing the site until seedlings are well established. Note that compacted soil may require scarification before broadcast seeding.
- Inspect areas of concentrated livestock use for weed invasion. Inventory and manage new infestations.
- Improve effectiveness of weed prevention practices through awareness programs and education. Promote weed awareness and prevention efforts among range users.
- Use education programs or annual operating instructions to increase weed awareness and prevent weed spread associated with livestock management.
- Agency land managers may consider loaning small GPS units to permittees who can then document weed locations on their allotments.

Wildlife

Avoid creating bare ground or soil disturbances that promote weed invasion, growth, and establishment.

- Periodically inspect and document areas where wildlife concentrate in the winter and spring that might result in overuse or soil scarification.
- Use weed-free materials at big game baiting and feeding stations.

Outfitting and Recreation

Avoid moving weed seeds or propagules into the backcountry.

- Noxious weeds can be introduced in livestock dung. Feed pack and saddle stock **only** weed-free feed for several days before traveling into the backcountry.
- Inspect, brush, and clean animals (especially hooves and legs) before entering **public** land. Inspect and clean tack and equipment.
- Enter public trails with clean shoes and clothing. Clean dogs if there is a possibility **they** are carrying weed seeds. Wearing gators when hiking in weedy areas can greatly reduce the chance of picking up weed seeds in socks and shoelaces.
- Do not pick “wildflowers” unless they are distinctly identified and plant-harvesting is allowed. Invasive weeds often bloom with pretty flowers.
- Thoroughly clean bicycles prior to using public trails.
- Provide weed identification information at trailheads. Encourage trail-users to **hand-pull** and bag taprooted weeds when found. Note that hand-pulled weeds should not be discarded along the trail because seed could still be produced.
- Regularly inspect trailheads and other staging areas for backcountry travel. Bedding in trailers and hay fed to pack and saddle animals may contain weed seed or propagules.
- Tie or hold stock in ways that minimize soil disturbance and avoid loss of desirable native vegetation.
- Authorized trail sites for tying horses should be monitored several times per growing season to quickly identify and eradicate new weeds. Trampling and permanent damage to desired plants are likely. Tie-up sites should be located away from water and in shaded areas where the low light helps suppress weed growth.
- Use weed-free forage or pelleted feed in the backcountry.

Invasive Plant Prevention: Fire

Wildfires require immediate action. Therefore, it’s important to plan weed management strategies, prepare equipment, and educate firefighters *before* emergency situations strike.

Fire Planning

Improve effectiveness of prevention practices through weed awareness and education.

- Increase weed awareness and weed prevention in all fire training. Note that fires can increase soil nitrogen, decrease shade, and decrease competition from desirable plants – all conditions that favor weed invasion.
- Provide weed identification aids.
- For prescribed burns, inventory the project area and evaluate potential weed spread with regard to the fire prescription. Areas with moderate to high weed cover should be managed for at least two years prior to the prescribed burn to reduce the number of weed seeds in the soil. Vigilant weed management will be necessary after the burn.
- Ensure that a weed specialist is included in a Fire Incident Management Team when wildfire or control operations occur in or near a weed-infested area.
- Avoid or remove sources of weed seed and propagules to prevent spreading weeds.
- Use operational practices to reduce weed spread (for example, avoid weed infestations when locating base camps, helibases, and staging areas).
- Locate and treat weeds in practice jump areas.
- Maintain the network of airports, helibases, camps, and staging areas in a noxious weed-free condition.

Fire-Fighting

Avoid or remove sources of weed seed and propagules to prevent new weed infestations and the spread of existing weeds.

- Ensure that all equipment has been thoroughly cleaned and is free of weed seed and propagules.
- Designate equipment-cleaning sites. Inspect and treat weeds that establish at equipment-cleaning sites after fires.
- When possible, use fire suppression tactics that reduce disturbances to soil and vegetation.
- Avoid moving water buckets from aquatic-weed-infested lakes to lakes that are not infested. There is no hazard in using water infested with aquatic weeds on terrestrial sites.

- Given a choice of tactics, avoid ignition and burning in areas at high risk for weed establishment or spread.

Fire Rehabilitation

To prevent conditions favoring weed establishment, as soon as possible after a fire revegetate disturbed ground that is unlikely to recover to desired plants naturally. Use certified weed-free seed mixes.

- To prevent weed spread, treat weeds in burned areas. Weeds can recover as quickly as two weeks following a fire.
- Weed-free or relatively weed-free burned areas should be monitored for weeds throughout the following growing season.
- Determine soon after a fire whether revegetation is needed to speed recovery of a competitive plant community, or whether desirable plants in the burned area will recover naturally. Consider the severity of the burn and the proportion of weeds to desirable plants on the land before it burned. In general, more severe burns and higher pre-burn weed cover increase the necessity of revegetation. Consider revegetating an area if the desired plant cover is only 20 to 30%.
- Monitor, document, and treat weeds at fire access roads, cleaning sites, fire lines, staging areas, and within burned areas. Control infestations to prevent spread within burned areas; control nearby infestations to prevent spread into burned areas.
- Seed and straw to be used for burn rehabilitation (for wattles, straw bales, dams, mulch, etc.) should be certified free of weed seed and propagules.
- Defer livestock grazing in burned areas until vegetation has successfully reestablished, usually after two growing seasons. Restrict travel to established roads to avoid compacting soil that could hinder the recovery of desired plants.
- Request that a weed specialist review burned area rehabilitation reports to ensure proper and effective weed prevention and management is addressed.
- Develop a burned-area integrated weed management plan, including a monitoring component to detect and eradicate new weeds early.