generally less than 1 month (Ashton 1982). Norris (1983) found the half-life of 2,4-D in soil to be 1 - 4 weeks with little potential for bioaccumulation. In general, 2,4-D is relatively mobile in soil compared with other herbicides (Ghassemi and others 1981). Microbial degradation (see Glossary) is the major mechanism by which 2,4-D is lost from the soil, especially under warm moist conditions with high soil organic matter—conditions that stimulate the growth of microorganisms. 2,4-D is not thought to leach into streams (Norris 1981) because it is adsorbed to soil organic material and rapidly degraded by soil microorganisms. Only minor losses of 2,4-D activity occur due to photodecomposition and, for most formulations, due to volatilization (see Glossary).

The fate of picloram in soil is determined by several factors, including volatilization, photodecomposition, adsorption and leaching, runoff, and chemical and microbial degradation. Volatilization is not considered a major determinant of environmental fate because of the low vapor pressure of picloram.

Picloram is degraded by natural sunlight and ultraviolet light, although the extent of photodecomposition under field conditions has not been measured.

Picloram is generally considered to be a mobile herbicide because its adsorption to soil particles is low. The mobility of picloram is less in soils high in organic matter.

Preliminary studies with various soil types found that picloram is usually confined to the upper 1 foot of the soil profile when application rates are low (less than 1 pound/acre), but that picloram can readily move to depths greater than 3 feet, even in relatively dry areas, when the application rate is high (3 to 9 pounds/acre) (NRCC 1974).

Table 3-1. Behavior of Herbicides in Soils

Active Ingredient/ Common Name	Behavior in Soil
2,4-D	Degradability in soil depends on microbial activity but is fast in organic and moist soils. Persistence is short, and mobility is relatively high.
Dicamba/Banvel	Moderately persistent, does not adsorb readily to soil particles, and is highly mobile. Mainly lost from soil by microbial decomposition.
Glyphosate/Roundup, Rodeo	Strongly adsorbed by soil. Adsorption is higher with organic soils and lowest in sandy soils. Decomposes rapidly by microorganisms.
Picloram/Tordon	Highly stable in plants, can be leached, relatively nonvolatile. Moderately to highly persistent in soil. Relatively mobile.

The persistence of picloram in soils is considered to be moderate to high because it may exist at phytotoxic levels for a year or more after normal application (Mitchell 1969, NRCC 1974). Picloram persistence in soil is related to both treatment rate and climate. The half-life of the compound has been reported to range from more than 4 years in arid regions to 1 month under highly favorable conditions of moisture, temperature, and organic content of the soil (NRCC 1974). On the other hand, two studies of picloram persistence in arid and semiarid soils suggest that application rates not exceeding 1 pound/acre/year significantly reduce the potential for accumulation in the soil; Scifres and others (1971) reported that studies on semiarid rangeland in northwest Texas found dissipation of 0.25 pound/acre of picloram from the soil profile within a year and usually within 90 days under warm dry conditions. Residues usually were restricted to the top 12 inches, at least for 60 days. Five ppb or less were detected below 12 inches 120 to 180 days after application. Vore and others (1982) reported that studies on different soil types in Wyoming showed the highest concentration of picloram was in the top 8 inches of soil. At applications of 1 pound/acre, concentrations ranged from 0.991 to 0.062 ppm after 117 days. As a comparison, the acceptable picloram tolerance level for forage grasses is 80 ppm (40 CFR 180.29).

Dicamba has a moderate (3 to 12 months) persistence in soil compared to other herbicides (Ashton 1982). Dicamba does not adsorb readily to soil particles and colloids (see Glossary) and thus has a high degree of mobility in most soils. The major route for loss of dicamba in soil appears to be microbial degradation rather than chemical degradation or photodecomposition.

Glyphosate is completely and rapidly degraded in soil by microbial degradation. In soil, glyphosate resists chemical degradation, is stable to sunlight, is relatively nonleachable, has a low tendency to runoff, is strongly adsorbed to soil particles, has a negligible volatility, and only slightly affects soil microflora. Because of its strong adsorption to soil particles, glyphosate is relatively immobile in most soil environments.

Use of the four chemical herbicides as proposed under alternatives 1 and 2 would not degrade soil productivity.

Alternatives 1, 2, and 3 would involve the burning of light noxious weed fuels that would not create the extremely high fire intensities that cause high losses of soil organic matter, the major source of nitrigen and sulphur in the soil, In addition to nitrogen and sulphur, nutrients, such as calcium, potassium, and phosphorous might be lost, resulting in short-term insignificant declines in soil productivity in the treated area.

Under Alternatives 1, 2, and 3, soil productivity could be slightly reduced by the destruction of some soil microorganisms, but impacts would be minor and shortlived because these alternatives would not involve the intense fires that reduce microorganisms most dramatically (Wells and others 1979).

Short-term, slight increases in erosion could occur until vegetation reoccupies the treated area.

The overall magnitude of burning impacts would be small because few acres are proposed for burning in the EIS area under any alternative (Table 1-2). Impacts on soils from burning weeds would be similar under Alternatives 1, 2 and 3. Alternative 4 would not involve burning.

Mechanical weed control practices such as tilling could result in slight short-term increases in erosion. The erosion rates would quickly decline as desirable vegetation reoccupies the treated area. No impacts from mechanical treatment would occur under Alternative 4.

Impacts on Water Resources

Alternative 1 (Proposed Action) would have varying impacts on water resources, including the introduction of herbicides into the water and increase in suspended sediments and dissolved solids. The degree of impact would depend on the size of the treated area, closeness to water, existing water quality, and type of treatment.

Impacts on Surface Water

The likelihood of a herbicide entering surface water depends upon the herbicide's persistence and mobility (see Glossary). Herbicides would most likely enter streams through drift (see Impacts on Air Quality). Some herbicides could also enter streams in surface runoff or through erosion of previously treated soils.

Where large streamflows occur, as in western Oregon and Washington, herbicides entering streams are heavily diluted so that little if any herbicide is detected.

In arid or semiarid areas, the normal streamflow is low or ephemeral. Where streamflow results from thunderstorms, surface runoff may flush herbicide residuals into streams in detectable levels. Amounts would depend on the length of time since spraying in which microbial action has been degrading the herbicide (see Impacts on Soils). The longer the interval, the less chance of residuals being present.

A study with 2,4-D applied for brush control on hill pastures in southern Oregon (Norris and others 1982) found that during 7 months following application, 4-5 grams of 2,4-D were discharged into streams, representing 0.014 percent of total amount applied. They concluded that most of the herbicide discharged into streams in this study were deposited in dry stream channels or from streambanks.

Ghassemi and others (1981) reviewed the persistence and fate of dicamba in aquatic systems. Because dicamba salts are highly water soluble and rapidly enter the soil, sufficient residues are unlikely to remain for transport via precipitation runoff into nearby waterbodies. Frank and Sirons (1980) found dicamba residues (0.7 parts per billion (ppb)) in only 1 of 949 stream samples after dicamba was applied to watershed soils.

Norris and Montgomery (1975) sampled a stream following treatment of 165.5 acres of a total 602.7-acre forest watershed in the Pacific Northwest sprayed aerially with dicamba at a rate of 1 pound/acre. Samples taken where the stream flowed out of the watershed contained dicamba residues within 2 hours after the start of spraying. These residues rose to a high of 37 ppb at 5.2 hours and then dropped to background levels (less than 1 ppb) 37.5 hours after the start of spraying. The authors attributed these residues to drift and to direct application of dicamba to water surfaces.

Because of its mobility, picloram may be carried by surface runoff to nontarget areas, including streams and ponds. Runoff, however, removes less than 3 percent of the total picloram applied to soil, and the concentration of picloram in runoff generally decreases with time as well as with the time between application and the first rainfall (Trichell and others 1968 in National Research Council of Canada 1974.) Other factors that decrease the concentration of picloram in runoff include decreases in the slope of the terrain, the use of slow-release granular formulations rather than liquids, and the distance over which the runoff flows.

Aerial application of a mixture of picloram at 2.5 pound active equivalent (ai) per acre and 2,4-D at 5 pound ai/acre resulted in detectable levels of picloram in runoff for 30.5 months (Johnsen 1980). The highest concentration of picloram detected was 320 ppb in the first storm after treatment. Of the total picloram applied, 1.1 percent eventually left the area in runoff.

The strong adsorption of glyphosate to soil particles greatly reducès its mobility through leaching and surface washout. Rueppel and others (1977) tested the mobility of glyphosate in three different soils by means of soil thin-layer plates spotted with radiolabelled glyphosate. These plates were washed twice with water, and the final distribution of radiolabelled glyphosate was determined by beta camera analysis after each washing. On all three soils tested, even after the second washing, glyphosate moved only a short distance, indicating that it is an immobile herbicide.

Comes and others (1976) investigated the leaching of residues from irrigation canal banks treated with glyphosate. They detected neither glyphosate nor its metabolite, aminomethyl phosphonic acid, in the first flow of water through canals that had been dry for 23 weeks after glyphosate had been sprayed on the ditch banks at a rate of 5 pounds/acre.

Since herbicide drift is far more variable during aerial spraying, the amount of herbicide drift that reaches the water is expected to be greater with aerial applications and proportionately less with vehicle and hand applications. Often no effort is made to exclude aerial spraying across ephemeral stream channels. In these instances rainfall may flush herbicide residuals downstream when little time has passed since spraying.

Vehicle application produces much less drift than aerial application, and hand application would produce little or no drift. Therefore, if herbicides originating from hand application reach the stream channels, it is usually through surface runoff.

Alternative 2 would result in little herbicide reaching a stream through drift. Surface runoff would move less residual spray because less acreage would be involved and spray entering buffer zones could be better controlled. Thus less residue would exist for movement into the streams.

Alternatives 3 and 4 would result in no herbicides from BLM actions reaching the stream channel. As discussed in Chapter 2, some streams have background detectable levels of herbicides resulting from ongoing herbicide applications by state and county agencies and by private landowners. Because BLM actions consist of a extremely small (less than 1 percent) part of the overall chemical use in the EIS area, Alternatives 1 and 2 are not expected to affect the detectable background herbicide levels in those streams. Therefore, water quality would not be adversely affected since background herbicide levels would essentially remain unaltered by the proposed herbicide use.

Normal BLM herbicide applications, using standard controls such as buffer strips, would not affect suspended sediments, total dissolved solids, or water temperature. Other actions under Alternatives 1, 2, and 3, however, such as grazing, burning, and tilling, could affect these conditions.

Physical restrictions on tilling (such as steep slopes) along buffer strips next to surface water would prevent significant impacts to water quality. In addition, few acres would be treated by tilling under Alternatives 1, 2, and 3 (Table 1-2).

Grazing with sheep or goats to control selected weeds would produce little effect on overall water quality although trampling within the stream channels could degrade water quality. Water quality indicators such as coliform numbers would increase, and in shallow streams might exceed drinking water standards. These exceedance periods, however, would extend no longer than 24 hours after livestock removal.

Burning to control noxious weeds generally destroys all vegetation. This removal of vegetation cover would increase the potential of surface runoff and might increase suspended sediment and total dissolved solids levels in the streams. Rice and others (1972) found that the amount of sediment reaching streams is generally proportional to the amount of bare soil in a watershed. The size of the impact from a treatment would depend on amount of exposed soil, severity of the burn, and distance to the nearest stream.

Tilling for weed control on a small scale with streamside buffer strips can benefit water quality. The tilling action breaks the ground surface and allows a greater infiltration rate. Infiltration rates vary with soil types and slopes. But terrain restrictions and the scattered nature of weeds do not allow the widespread use of this technique. Impacts from tilling would be greatest under Alternative 3 and least under Alternatives 1 and 2 (Table 1-2).

Impacts on Ground Water

Since picloram, dicamba, and 2,4-D are relatively mobile herbicides, the potential exists for detectable traces to enter the ground water. The relative immobility of glyphosate prevents it from moving down into the soil profile (see Impacts on Soils). The degradability of picloram, dicamba, and 2,4-D highly depends on microbes in the soil and water. The number of microbes decreases as herbicides percolate down through the profile. Ground water contains few if any microbes to carry on the degradation.

In western Oregon and Washington, the many soil microorganisms and high precipitation would combine to degrade or dilute herbicides to the level where little or no trace would occur in ground water. On the remaining BLM-administered land in the EIS area, little herbicide would enter the ground water for other reasons. Although moderate microbial levels slow the degradation process, low precipitation and deep ground water aquifers prevent herbicides from reaching ground water.

No herbicides applied on BLM-administered lands have been reported to reach the ground water. Although little information exists, nonfederally applied herbicides on private land have been reported to enter the ground water.

Streams and wetlands are areas where the ground water often occurs close to the surface. These areas are also high in microorganisms. With use of buffer strips spray would reach these areas only by drift. Because the amounts of herbicides are low and the microorganisms in these areas are high, no impacts on the ground water are expected.

The site-specific environmental analysis process conducted before herbicide applications will address sensitive areas, including areas where herbicides could be introduced into the ground water—ground water recharge areas. These areas may require mitigation (see Appendix I) or no treatment at all.

Impacts on Vegetation

Impacts on Terrestrial Vegetation

Terrestrial vegetation is the environmental component that would be most affected by the proposed weed control program. Treatment of noxious weeds could affect both target and nontarget vegetation.

Alternative 1 would have the greatest effect on noxious weeds (target vegetation) in the EIS area by providing the best possible total cooperative weed control effort. Alternative 2 would have somewhat less impact than Alternative 1. Alternatives 3 and 4 would allow the spread of noxious weeds to continue, and neither would provide cooperative efforts with other landowners within the EIS area. The effectiveness of each herbicide on individual weed species is presented in Appendix E.

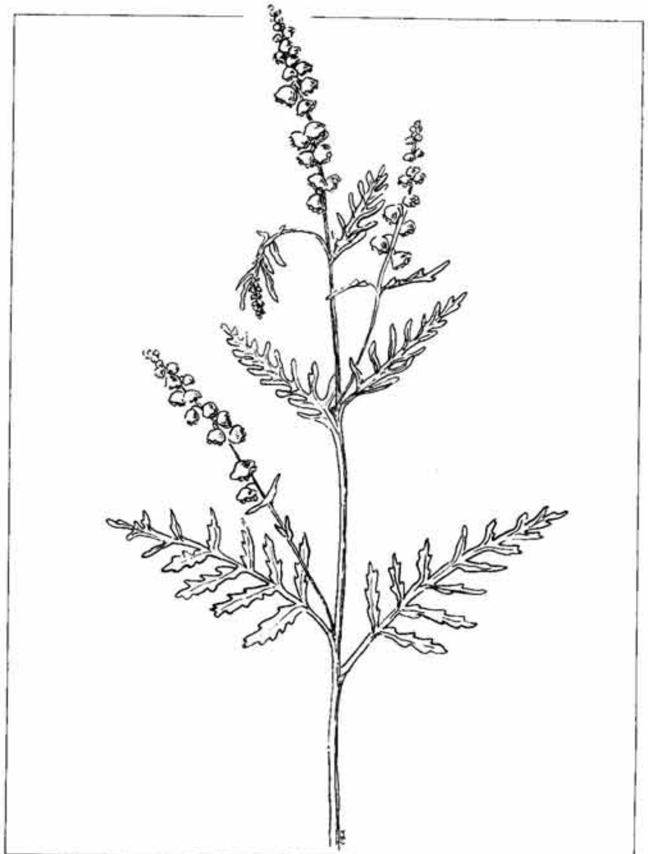
The proposed herbicides, excepting glyphosate, are selective, affecting broadleaf plants but not grasses. Glyphosate is a broad spectrum, nonselective herbicide that affects most perennial plants, annual and biennial grasses, sedges, and broadleaf plants. Under chemical techniques, some chemical residue may be left for varying periods, depending upon soil and climatic conditions.

Aerial application of herbicides, rather than ground application methods, presents the greater risks for effects on nontarget vegetation because of the broadcast application. (Note: Glyphosate would not be aerially applied.)

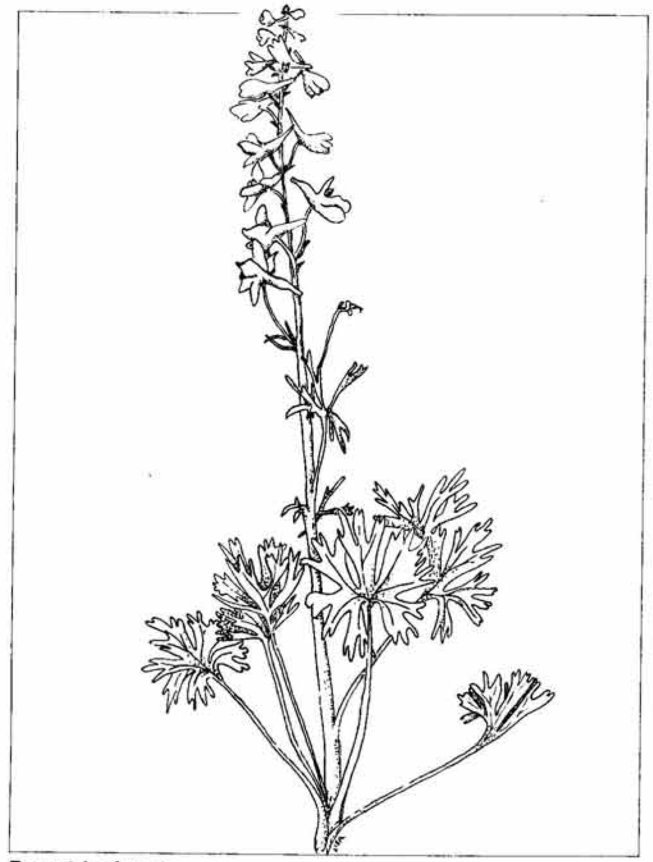
Because chemical drift could injure or kill nontarget vegetation, herbicides would not be applied when weather conditions would defeat their effectiveness or when controlling the treatment would be a problem (Appendix I).

Appendix G presents the susceptibility of terrestrial vegetation to herbicidal active ingredients. Glyphosate, the least selective of the herbicides that would be used under Alternatives 1 and 2, would result in the greatest loss of nontarget vegetation. For dicamba, picloram, and 2,4-D, broadleaf plants would be the main nontarget group affected. Plants such as rabbitbrush, greasewood, mountain mahogany, sagebrush, willows, aspen, and many forbs in or near treatment sites could be weakened or destroyed.

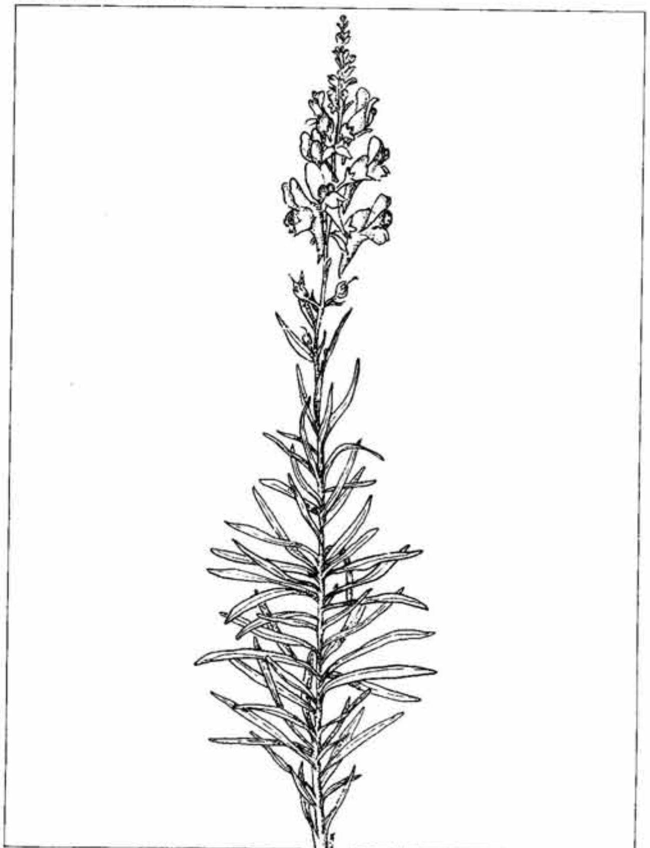
The extent of any nontarget vegetation loss would depend on closeness of desirable species to treated weeds, method and rate of herbicide application, formulation of the herbicide, and herbicide used. Because herbicide application rates would be reduced in riparian areas, injury to nontarget plants in these areas would be minimized.



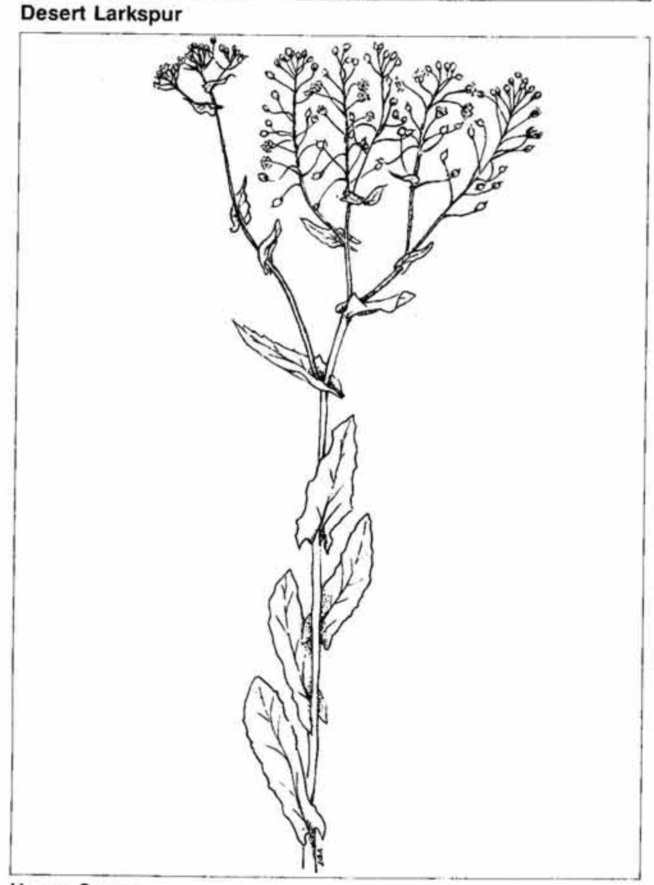
Common Ragweed



Desert Larkspur



Yellow Toadflax



Hoary Cress

Most grasses resist applications of the expected use rates of picloram, dicamba, and 2,4-D. Grasses should become more abundant as plant competition is reduced after weed control is implemented.

The impacts of chemicals would be greatest under Alternative 1 and less under Alternative 2. Alternative 3 and 4 would not apply chemicals.

Annual weeds would be the easiest to control by manual methods, but perennials and some biennials would tend to rapidly regenerate. Trampling impacts of manual treatment would be greatest under Alternative 3, progressively less under Alternatives 2 and 1, and nonexistent under Alternative 4.

Prescribed burning would suppress competing vegetation. Burning would promote regeneration of some grasses, forbs, and hardwoods but could destroy shrubs and other trees. Some noxious weeds such as leafy spurge regenerate rapidly from their root system after a burn and compete with more desirable species. The control of such species might thus require burning followed by applying low rates of herbicides. Impacts of burning would be greatest under Alternative 3 and progressively less under Alternatives 2 and 1. Alternative 4 would not permit burning.

Mowing would remove most aboveground vegetation in treated areas and would damage or kill nontarget vegetation. Mowing would mainly decrease the amount of seed production of noxious weeds. Mowing would also weaken root and rhizome systems of creeping perennial weeds when the treatment site is mowed every 21 days. Impacts of mowing would be greatest under Alternative 3 and progressively less under Alternatives 2 and 1. Alternative 4 would not involve mowing.

Tilling would injure both top growth and the upper 12 inches of the underground systems of all vegetation within the treatment area and would tend to break up the rhizomes of creeping perennials. Tilling would create a better seedbed for weeds promoting further spread. Impacts of tilling would be greatest under Alternative 3, and progressively less under Alternatives 2 and 1. Alternative 4 would not involve tilling.

Sheep and goats have been used to a small degree for leafy spurge control but only grazed on certain species of leafy spurge and removed only top growth. Since the greatest consumption of leafy spurge is about 50 percent, sheep and goats would also consume some nontarget species during the treatment period. Alternative 3 would have the greatest adverse impacts on nontarget species. No impacts would occur under Alternative 4.

Although the use of insects is the most effective biological control method, there are only a few insects which are effective in controlling specific weeds (See Appendix F). No significant impacts would result from the use of insects or pathogens under any alternative.

Impacts on Threatened and Endangered Plants

Unidentified populations of threatened and endangered plants could be susceptible to any impacts described for terrestrial vegetation. Direct effects of injury or death to plants could immediately eliminate a species in a portion of its range. The more subtle effects of vegetation community changes could eventually eliminate a species on a specific site locally through the loss of the ability to compete with other vegetation.

If the U.S. Fish and Wildlife Service determines that any vascular plant species is threatened or endangered, any action that would contribute to its extinction or to its threatened or endangered status would violate the Endangered Species Act of 1973, as amended. Therefore, environmental analysis before any site-specific action would document any threatened or endangered plants known on the site and identify measures to protect these species.

Conclusion

The most effective and efficient control of noxious weeds would be provided by Alternative 1. Implementing this alternative would improve rangeland ecological condition by reducing or eliminating competition from weed species. Alternative 2 would have impacts similar to those of Alternative 1 except in areas accessible only to aerial herbicide treatment, where weeds would continue to spread.

Alternative 4 would allow noxious weeds to spread unchecked and contribute to a decline in ecological condition. Noxious weeds would outcompete desirable plant species, resulting in reduced grass production and less forage for both livestock and wildlife. Weeds would spread to uninfested private land, resulting in a decline in agricultural productivity and increased economic burden on landowners.

Alternative 3 would most likely result in impacts similar to those of Alternative 4 because (1) manual and mechanical methods are much less effective

and efficient than herbicides in controlling noxious weeds and (2) most biological agents are are still in experimental stages, and their ability to effectively control noxious weeds is in question.

Impacts on Animals

Impacts on Livestock and Wild Horses

Impacts to livestock and wild horses could occur directly from the ingestion of poisonous noxious weeds and indirectly from changes in the current forage supply and exposure to herbicides. Toxic reactions occur to livestock that ingest poisonous weeds found in the EIS area (Table 3-2). Leafy spurge, for example, contains an irritant to the eyes of cattle and horses. It also causes diarrhea in cattle and sheep which sometimes leads to death. A study of knapweed has shown that infestation can drop forage production from 891 to 54 pounds per acre in a relatively short period (French and Lacey 1983). Effects range from blisters to death within 30 minutes. Data adapted from Nielson (1978) show the annual estimates (not including swine, goats, or horses) as follows:

Cattle - 1 percent mortality of adult animals
Cattle - 1 percent reduction in calf crop
Sheep - 3.5 percent mortality of adult animals
Sheep - 1 percent reduction in lamb crop

These estimates are based on the assumption that some degree of poisonous weed control is accomplished.

Chemical treatments are generally applied in a form or at such low rates that they do not affect livestock. Most major treatments under the proposed alternatives would be applied when livestock are not in the treated pasture, but spot treatments would be applied at any time, regardless of the presence of livestock. Animals consuming forage treated with certain herbicides (picloram, 2,4-D, and dicamba) cannot be slaughtered for food within the period of time specified on the herbicide label. Dairy animals should not be grazed on areas treated with certain herbicides (picloram, 2,4-D, and dicamba) for the length of time specified on the label.

Table 3-2. Impacts of Toxic Weeds on Foraging Livestock

Common Name	Scientific Name	Poison Symptoms	Causative Agent	Animals Affected
Cocklebur	*Xanthium straumarium*	Vomiting, weakness, ataxia, spasms and death within 24 hours.	glycoside	swine, cattle, sheep, goats
Common groundsel	*Senecio vulgaris*	Acute and chronic liver damage, colic, and death.	alkaloids	all
Death camas	*Zigadenus paniculatus*	Weakness, prostration, convulsions, coma and death. High mortality.	alkaloid	cattle, sheep, goats
Halogeton	*Halogeton glomeratus*	Slobbering, weakness, prostration, coma, death.	oxalates	sheep, goats and cattle
Indian hemp	*Apocynum cannabinum*	Dilation of pupils, sore mouth, sweating, death.	glucoside	horses, cattle, sheep, goats
Jimsonweed	*Datura stramonium*	Paralysis, delirium respiratory paralysis and death.	alkaloid (scopolamine)	all
Larkspur	*Delphinium spp.*	Constipation, bloat; death results from respiratory and cardiac failure.	alkaloid (delphinine)	cattle
Leafy spurge	*Euphorbia esula*	Diarrhea, blisters in digestive tract, collapse and death.	euphorbon	all, but sheep graze on some biotypes without harming them.
Locoweed	*Astragalus spp.*	Diarrhea, blindness, labored breathing, prostration, death.		all
Nightshade	*Solanum spp.*	Diarrhea, incoordination paralysis, convulsions, death.	glycoside and alkaloid (solanin)	swine, sheep, goats
Poison hemlock	*Conium maculatum*	Paralysis of skeletal muscle nerves, death due to respiratory failure, birth defects.	alkaloid (y-coniceine)	all
Sneezeweed	*Helenium spp.*	Diarrhea, vomiting, loss of muscle control, death.	glycoside (dugaldin)	all
St. Johnswort	*Hypericum perforatum*	Photosensitization-blisters and scabs about eyes, mouth, ears, nose, and feet.	helianthrone (hypericin)	cattle, hogs, sheep, goats
Tansy ragwort	*Senecio jacobaea*	Liver lesions, staggering weakness, and death.	alkaloids	all
Water hemlock	*Cituta douglasii*	Irritant action on nerve and muscle cells - spasms, death after 30 minutes.	resinoid (cicutoxin)	all
Yellow starthistle	*Centaurea solstitialis*	Animals are unable to eat and die of starvation or thirst (chewing disease).		horses
Lupine	*Lupinus spp.*	Spasms, cerebral excitement and death within 48 hours, birth defects.	alkaloids (lupinine, lupanine)	sheep, goats, horses, cattle
Russian knapweed	*Centaurea repens*	Nervous disorders.		horses
Coast fiddleneck	*Amsinckia intemedia*	Hepatic cirrhosis, dermatitis.	pyrralizidine alkaloids	all
Western false-hellebore	*Veratrum californicum*	Cyclopia, limb deformities (monkey faced lamb, crooked calf).	steroidal alkaloids	ruminants
Snakeroot	*Eupatorium rugosum*	Trembling, labored respiration, inability to stand and "milk sickness".	alcohol (tremetol)	ruminants

[1]Symptoms may vary according to dose, duration, and plant growth stage at ingestion. Sources: Hulbert and Oehme 1961; Muenscher 1961; Keeler and Tu 1983; Hawkes and others 1985

Burning of weeds would temporarily reduce forage for livestock and in some cases could result in a denser weed regrowth than existed before burning. Combinations of burning, regrowth, and applying lower rates of herbicides could effectively control noxious weeds and allow forage grasses to regenerate more rapidly. Mechanical treatments may also reduce livestock forage during the treatment period.

Where sheep and goats are used for biological control, their performance may decline because of their having to eat less desirable vegetation when confined in particular areas. Other biological means (insects, microorganisms) would require that livestock not be allowed to use a pasture during relatively short periods. This would depend upon the biological agent used and guidelines for the establishment of the agent.

Alternatives 1, 2, and 3 provides more desirable forage for livestock and wild horses. The number of plants toxic to livestock or wild horses, such as leafy spurge, tansy ragwort and larkspur would decline. Alternative 4 would result in a decline in desirable forage. Noxious weeds toxic to livestock and horses would spread, leading to increased animal losses. Alternative 3 would probably result in impacts similar to Alternative 4's since manual, mechanical and biological methods are less effective and efficient in controlling noxious weeds than are herbicides.

Impacts on Wildlife and Fish

Most impacts on birds and mammals would result from the destruction of nontarget vegetation. Depending on the rate of application and formulation of the herbicides, aerial application would cause varying degrees of injury or losses of nontarget vegetation, thus decreasing vegetation for wildlife. These losses would be insignificant in the short term over the entire area because of the small areas treated (usually less than 100 acres in size and most often less than 10 acres) as compared to the land base that is spread over five states. The effects of weed control would be significantly beneficial over the long term in that

Pileated woodpecker

Snowshoe hare

weeds would be prevented from further degrading the habitat. (National Academy of Sciences 1968, and Morris and Bedunah, 1984.)

The risks to the health of wildlife and fish from exposure to the herbicides 2,4-D and glyphosate are discussed at length in the Final Environmental Impact Statement on the Eradication of Cannabis on Federal Lands in the Continental United States at pages 4-20 to 4-41 and Appendix C (U.S. Department of Justice, Drug Enforcement Administration, July, 1985). The expected exposure to wildlife and fish to 2,4-D and glyphosate under the proposed action are analagous to those discussed in the FEIS on the Eradication of Cannabis on Federal lands. Hence, the Drug Enforcement Administration's FEIS evaluation of the impacts on wildlife and fish from exposure to 2,4-D and glyphosate, which includes both a hazard assessment and a Worst Case Analysis, is incorporated by reference. Specifically, the following two summaries of these impacts in that EIS are noted:

- Under routine circumstances, no animals are likely to receive highly toxic or fatal doses of any of the proposed herbicides. However, under unusual circumstances, where animals are directly sprayed and feed exclusively on vegetation containing herbicide residues, individual animals could receive acute toxic herbicide doses. It is also possible, although very unlikely, that under extreme case conditions, some individuals from some species could be severely affected by 2,4-D. However, even under those conditions, no species are likely to receive acute toxic doses of glyphosate. Therefore, no wildlife populations are likely to be adversely affected.

- Under routine case operations, no impact to slight impacts could occur to fisheries as a result of proposed herbicide use. In the extreme case, 2,4-D could cause individual aquatic species to be exposed to lethal concentrations for a short period of time and localized fish kill could occur.

A more thorough summary of impacts on wildlife and fish from exposure to 2,4-D and glyphosate from the incorporated FEIS may be found in Appendix K, Wildlife Health Effects.

Although trout have been found sensitive to the herbicide picloram, a no observed effect level of 0.29 ppm has been determined for trout fry (Woodward 1979). Incorporation of design features (Appendix I) under Alternatives 1 and 2 would eliminate any adverse impacts from applying picloram. Likewise, use of dicamba, glyphosate, and 2,4-D as proposed should cause no adverse effects.

Prescribed burning could destroy animals, including birds, unable to flee treated areas or escape into burrows. Spring burns (March through June) would destroy nests with eggs and young hidden in vegetation.

Prescribed burning could also temporarily destroy wildlife habitat for some species until regrowth of wildlife habitat occurs. Effects on ground cover would vary with burn intensity. Lower intensity burns on wet sites would remove less ground cover than higher intensity burns on dry sites. Loss of small ground cover and charring of larger branches and logs in small areas of cottonwood stands (with trees exceeding 3 inches in diameter) would harm some birds (woodpeckers, chickadees) and small mammals (weasels, rabbits, deer mice) that use these riparian area residues for food or shelter. Charring of large branches and logs would also harm insects, an important link in the food chain. These impacts from burning are usually short term, whereas in the long term wildlife could benefit from increased forage production in important areas. Burning of downed woody material could cause a long-term reduction of this important habitat in riparian areas.

Mechanical treatments could displace large animals for the time of the project and could have indirect effects associated with damaged target and nontarget vegetation.

Biological controls involving the use of sheep or goats would probably displace some big-game species during the treatment period and might cause some temporary loss of feed for the treatment year. Other biological methods (insects, microorganisms) should not adversely affect wildlife. Biological control methods would not significantly affect aquatic plants or animals.

The risk of wildlife and fish health effects from exposure to the herbicides dicamba and picloram would be less than that arising from the use of 2,4-D and glyphosate (USDI, FWS, 1980).

Impacts on Threatened and Endangered Animals

Threatened and endangered species receive special attention under the Endangered Species Act of 1973, as amended, and BLM policies and guidelines. Noxious weed control activities will avoid known nest and roost sites and critical habitat of listed species or will take special precautions to ensure the well-being of these species (see Chapter 1, Weed Management Treatments and Design Features). No adverse impacts are expected to occur to these existing sites.

Conclusion

Implementing the proposed weed control program would cause a temporary loss of productivity of treated sites grazed by livestock and serving as an ecological niche for wildlife. Controlling exotic noxious plants and encouraging native plant growth would ensure future productivity and use of the land for livestock grazing and wildlife.

In the short term, the loss of target and nontarget vegetation would cause temporary loss of food, cover, and other habitat requirements for wildlife and livestock in the treatment areas. Over the long term, increased vegetation productivity of grasses and forbs would increase the productivity of the land for livestock and wildlife. Failure to control or limit the spread of such noxious weeds as knapweed and leafy spurge, would reduce by 60 percent the long-term productivity of palatable native plants. (Bucher and Baker. 1984, unpublished).

Under alternatives 1 and 2, habitat diversity would improve over the long term thereby benefiting all animal species. Likewise, fish would not be adversely affected.

Under Alternative 4 a dramatic loss in forage production in weed-infested areas would harm foraging animals. The immediate impact would be displacement, which would place greater stress on other forage areas and force more competition between livestock and big game. In the long term, big game populations would decline. The loss of plant diversity in an ecological community can lead to decreased vigor in the animals occupying the community, making them more susceptible to other stress factors. The loss of forage may cause animals to more readily consume weeds that may harm them and even cause death. An example is larkspur, a noxious weed that is fatal to livestock. Similar but lesser impact would occur under Alternative 3.

Impacts on Cultural Resources

Mechanical and burning control measures could potentially disturb or destroy unidentified cultural resources on or near the ground surface. The potential for damage would vary with the amount of ground disturbance and burning under each alternative. Tilling weeds could damage artifacts and disrupt relative positions of cultural materials. Mixing organic matter in archeological sites could contaminate carbon 14 dating samples, making them unreliable for scientific analysis. Uncovering sites could increase the possibility of illegal artifact collecting. Burning for weed control could destroy combustible cultural materials and damage stone and ceramic artifacts.

Cultural resource surveys, however, would precede management actions that could damage cultural resources (BLM Manual 8100, Cultural Resource Management). Under all alternatives, sites found during these surveys would be protected in accordance with the National Historic Preservation Act of 1966 (PL 89-665) and Executive Order 11593, as stated in the Code of Federal Regulations (36 CFR 800).

Impacts on Visual Resources and Recreation

Treatments such as tilling, burning, and applying herbicides cause visual impacts mainly by creating color contrasts between treated areas and surrounding vegetation. Tilling disrupts the land surface and exposes bare soils to view. In addition to causing color contrasts, applying herbicides reduces vegetation variety and can prevent the occurrence of seasonal changes (spring flower, fall color) within treated areas. Burning creates contrasting blackened areas and releases smoke, which temporarily impairs visibility. These short-term impacts, however, would end with the reestablishment of other plants on the sites.

Most weed control treatments would be applied in visual resource management (VRM) Class IV areas (see Glossary). Because these public lands are generally of low to moderate scenic quality, are low sensitivity areas seldom seen by most people, and are intermingled lands managed mainly for livestock grazing, visual and recreation impacts in VRM Class IV would be low under all alternatives.

Impacts of herbicide residue on the health of public land visitors are discussed in Impacts on Human Health.

Designated BLM recreation sites that are treated with herbicides will have signs posted stating the chemical used, date of application, and a contact number for more information. Signs will remain in place for at least 2 weeks after spraying.

Alternative 4 (No Action) would increase the exposure of visitors to recreation areas infested with noxious weeds, including: stickers of thistles; ragweed pollen; the irritant latex of leafy spurge; the poisons of water hemlock, nightshades, and lupines; and the clinging seed pods of the buffalo burr. Visitor use would decline. These impacts would also apply under Alternative 3 in areas where nonchemical treatment would fail to produce desired effects. Alternatives 1 and 2 would decrease visitor exposure to detrimental effects of noxious weeds.

Roosevelt elk

Impacts on Wilderness and Special Areas

The suppression of noxious weeds in wilderness and wilderness study areas (WSAs) under Alternatives 1 and 2 would maintain or increase naturalness by controlling exotic weeds that would otherwise compete with native plants. Alternative 3 would have the same impact as Alternatives 1 and 2 when nonchemical measures sufficiently control noxious weeds. Alternative 3, however, would allow noxious weeds to continue to spread as under Alternative 4 and compete with other plants when nonchemical treatment is not effective, causing a decline in naturalness.

As in wilderness areas or WSAs, all weed control treatments applied on or near the following designated or proposed areas would incorporate features designed to avoid or mitigate impacts on important resources: research natural areas; outstanding natural areas; national wild, scenic, or recreation rivers; national scenic or recreation trails; state recreation trails; and areas of critical environmental concern. Impacts would be most likely under Alternative 1, which proposes aerial spraying, and nonexistent under Alternatives 3 and 4. Site-specific impacts to special areas will be addressed further in state or district environmental analysis that precedes weed management action.

Impact on Economic Conditions

This analysis considers the effects of the alternatives on livestock grazing and the effects of weed control activities and the spread of noxious weeds on the regional economy. Economic impacts are presented for each alternative on the basis of changes in forage availability, change in weed control activities, and potential spread of noxious weeds. Table 3-3 shows increases in forage, weed control costs, and acres treated and not treated under each alternative.

A potential economic impact of noxious weeds on BLM lands is the spread to adjacent private lands. No monetary value of this affect has be projected due to the difficulty of making meaningful estimates. However, the alternatives have been ranked relative to each other based on acres of noxious weeds remaining on BLM lands as a source of potential spread to other lands.

Under Alternative 1, local economic activity (employment and personal income) would slightly increase from increased AUMs, increased livestock production, and reduced livestock deaths from poisonous plants. The increase in AUMs is a maximum figure based on the assumption that no livestock now graze the infested area. In addition, local expenditures on equipment and materials for controlling weeds would generate spending in the local economy. The impacts to adjacent land owners would be least under this alternative because less land area would remain infested with noxious weeds.

Under Alternative 2, the loss of AUMs from the spread of noxious weeds would reduce the gain in AUMs as a result of controlling some of the weeds. Livestock could die on the untreated acres, and expenditures on weed control would generate economic activity in the local economy. The local economy would benefit slightly under this alternative, but the gains would be smaller than under Alternative 1. Economic effects of spread to adjacent land owners would be greater than under Alternative 1, but less than under Alternative 3 and 4.

Table 3-3. Acres Treated, Forage Changes, and Acres Remaining Untreated

	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Acres of treatment	44,014	40,974	28,960	0
Most AUMs of forage gained frim treated area[1]	4,700	4,200	2,900	0
Untreated acres [2]	0	3,040	15,054	44,014
Estimated acres of noxious weeds in 10 yrs. 13% rate of spread	0	10,300	51,100	149.400
Estimated loss of AUMs from untreated acres in 10 yrs [2 3]	0	-900	-3,400	-8,700
Total 1st year cost of control (1984 dollars)	$1,350,000	$1,350,000	$1,350,000	0

[1]Based on the statewide average acres/AUM for each of the five states: Idaho, 11 acres/AUM, Montana, 5 acres/AUM; Oregon, 11 acres/AUM; Washington, 8 acres/AUM; Wyoming, 10 acres/AUM. Also based on the assumption that no livestock graze noxious weed-infested land.

[2]Based on Alternative 1 as total targeted acreage for treatment.

[3]Based on 13 percent annual rate of spread and increasing reduction in carrying capacity from 25 percent in first year to 100 percent in the 4th through 10th years.

Alternative 3 would result in both a loss of AUMs from the untreated acres and a gain in AUMs from the treated acres. Livestock could die on the untreated acres, and expenditures on weed control would generate economic activity in the local economy. Under this alternative, the local economy would either be unaffected or slightly changed. Economic effects to private land owners would be greater than under Alternative 1 and 2, but less than under Alternative 4.

Under Alternative 4, no short-term loss in AUMs would occur, but future losses could result from the annual unchecked spread of noxious weeds. Applying a figure of $4.33 ($19.5 million divided by 4.5 million acres, Penhallegon, 1983) per acre, one could calculate that in 10 years the economic loss from untreated BLM lands in the EIS area would amount to $647,000. Untreated noxious weeds on BLM land would continue to serve as a seed source, and infest adjacent nonpublic land, contributing to continuation of and probable increase in the economic losses referred in the studies cited in Chapter 2, Economic Conditions. In addition, livestock deaths from poisonous plants would continue. (See Impacts on Livestock and Wild Horses for a discussion of livestock production losses under Alternative 4.) Economic losses to adjacent landowners would be greatest under this alternative.

Total cost per acre of controlling weeds under Alternatives 1, 2, and 3 are as follows: Alternative 1--$36, Alternative 2--$39, and Alternative 3--$55.

Impacts on the Social Environment

BLM's noxious weed control program would directly and indirectly affect social conditions and attitudes. Direct impacts would occur when senses of personal well-being or economic security are affected by BLM's decisions on the use or restriction of vegetation management practices. Indirect effects would occur as a result of economic outcomes of BLM policies and in response to gains or losses of recreational opportunities or access to subsistence activities. Examples of social effects deriving from economic impacts include people's reactions to changes in the availability of different kinds of jobs and their dependence on certain jobs. Whether direct or indirect, all of these impacts could affect lifestyles.

The economic impacts of the alternatives on the local economy are discussed in the preceding section of Chapter 3. The economic effect on individuals who gain or lose jobs would be essentially the same wherever they live. Social effects, however, would depend on whether the jobs gained or lost are concentrated or dispersed or in small or large communities. For example, the gain or loss of 100 jobs scattered around the larger cities in the EIS area would not have significant social effects. In contrast, the concentration of those 100 jobs in two small towns with a combined workforce of 500 would significantly affect social conditions in these towns.

The social impacts of employment changes can be estimated, but data do not exist to allow the projection of where those impacts would occur.

Alternatives 1 and 2 would probably have beneficial social impacts on communities in the EIS area, and none of the alternatives is expected to have significant social impacts resulting from employment changes associated with increases or decreases in forage. The affected jobs would probably be scattered across the entire region.

Because of the controversy surrounding herbicide use, Alternatives 1 and 2 would have social effects specifically related to this issue. Alternatives 1 and 2 propose the use of herbicides and would be perceived as involving some harm by those opposed to herbicides. These impacts would be greatest under Alternative 1 and somewhat less under Alternative 2. Alternatives 3 and 4 would be perceived as having the most adverse impacts by those who support the use of herbicides in weed management.

Many people believe that herbicides are safe to use and that risks associated with herbicide use are acceptable to themselves as individuals and to society. These people could perceive limitations on the use of herbicides as threatening to their jobs and lifestyles, and in some large sense to society as a whole. The threat they perceive to society is usually articulated as job losses forcing some to go on welfare.

On the other side of the herbicide controversy are others, particularly residents near areas to be sprayed, who perceive helicopter spraying as a threat because they associate helicopters with military activities or because they feel helpless to avoid exposure or to stop the spraying in case of unexpected drift or accidental overflight of nontarget areas. These people would be adversely affected by Alternative 1, which proposes helicopter spraying of herbicides.

Another category of social effects related to the use of herbicides includes fears and anxieties about human health and personal safety. These concerns would be related to the amount of herbicides used and would thus be greatest under Alternative 1 and less under Alternative 2. For those concerned about this issue, Alternatives 3 and 4 would have beneficial impacts.

Impacts on Human Health

Under Alternatives 1, 2 and 3, the use of hand tools (manual), tilling (mechanical) and grazing, insects, and pathogens (biological) methods of weed control would not adversely affect human health. The other methods that would be used under these alternatives are discussed below.

Mechanical Treatments

Smoke from burning is not expected to significantly affect human health under any alternative. Levels of suspended particulates (a suspected factor in some health problems) are expected to be well below the 150 micrograms per cubic meter (ug/m^3) public welfare standard and the 260 ug/m^3 public health standard published by EPA.

Workers on burn areas would be exposed to potential injury from the manual treatments they would apply and the conditions under which they would work (see discussion under Manual and Mechanical Treatments below). Workers who manually ignite burn areas would be exposed to burning materials, which could cause physical injuries.

The probability of workers on burn areas being injured would be about the same under Alternatives 1 and 2, but injuries associated with burning would increase under Alternative 3. Alternative 4 would not permit burning.

Public safety would not be affected by any method of igniting burn areas. Most burning would occur where the public either would not be present or would be highly visible to those doing the burning. Further, those on or near a burning area would be well aware of impending activities because several hours of active preparation are required before ignition begins. Safety measures normally taken to protect firefighters participating in prescribed burning would also protect the public.

Operators of machinery (tractor-mounted mowers) could be injured by losing control of equipment on steep terrain or by coming into contact with flying debris and brush. Such hazards would be most likely under Alternative 3 and least likely under Alternative 1.

Manual Treatments

Under Alternative 1, and particularly Alternatives 2 and 3, some hand pulling would be needed. Hand pulling exposes workers to the hazards of physical contact with irritant weeds that cause blisters, inflammation, and dermatitis (leafy spurge, *Euphorbia esula*; common tansy, *Tanacetum vulgare*). Sensitive individuals can react severely to the pollen of ragweed *(Ambrosia)* species, and the close contact of hand pulling could cause major discomfort or health risk. A severe hazard of hand pulling is thé high potential for poisonous snake bite. The remoteness of many treatment areas and the time needed to gain medical attention would complicate some cases of snake bite poisoning.

Chemical Treatments

Herbicides are intended to be toxic to plants. They are designed to interfere with vital plant processes that do not occur in animals: seed germination, hormone (auxin)-mediated growth and development, and photosynthesis. Basic biological and physiological differences between plants and animals partly account for the relatively low toxicity of herbicides to animals.

The main impacts on human health from chemical treatments depend upon the toxicity of the chemical and the level of human exposure. All chemical effects on biological systems follow a dose-response relationship: as dose increases so does effect, and vice versa. The chemicals of concern in this EIS have not been found to cause significant mutagenic or carcinogenic effects. For such chemicals, a no observed effect level (NOEL) dose can be established as the highest dose that causes no toxicologic change in exposed animals. The term threshold is also used to identify this dose range.

Chemical exposure may be brief (acute) or prolonged (chronic). The terms acute and chronic may be used to describe duration of effect as well as duration of exposure. The kind of response (acute or chronic) observed in organisms depends on the route of intake (oral, dermal, inhalation) and frequency of exposure, coupled with the specific mechanisms of toxicity. A chemical of high toxicity may represent no or limited hazard if exposure and dose are low, just as a chemical of limited toxicity may be hazardous if exposure is high.

Extensive studies of the absorption, distribution, metabolism, and excretion of herbicides in animals (DOE, BPA 1983) have shown that the herbicides of concern in this document and their metabolites are rapidly eliminated from most animals and do not substantially accumulate in animal tissues. These traits further reduce the possibility that exposure will result in harmful consequences.

An often used term is the acute oral LD_{50}, which is the dose of toxicant, expressed in milligrams of toxicant per kilogram of animal body weight, required to kill 50 percent of the animals in a test population when given orally. The oral LD_{50} value is a useful general guide for comparing the acute toxicity of chemicals. But because the acute toxicity of most herbicides is low, LD_{50} is not used as a basis for comparing hazards. Acute dermal (skin contact) toxicity levels are almost always less than acute oral levels. Although dermal exposures are most common, they are of limited use except when an unusual response is found in the laboratory or for judging topical irritant potency. Table 3-4 shows the relative oral LD_{50} toxicity levels of herbicides proposed for use under the alternatives in this EIS.

Of concern is the probability that use of a chemical will result in an irreversible disease such as reproductive or genetic effects. Reproductive effects include infertility, miscarriage, general fetal toxicity, and birth defects (teratogenesis). Genetic effects are those that alter cellular DNA (see Glossary) and could result in cancer or mutations. Almost all chemicals will produce reproductive effects in the laboratory at some dose, although some cause maternal death before any detectable impact on the fetus. Of the great number of chemicals in commerce that have been tested, few have been shown to cause cancer, and few have shown significant mutagenic activity in the variety of tests used to screen for genetic activity.

Possible reproductive effects may involve (1) toxicity to the fetus, ranging from completely reparable effects to lethal damage or (2) true teratogenicity in which the development of the fetus goes awry, resulting in malformation. Such effects may be caused either by direct impact of the chemical during the period of organogenesis (see Glossary) or by genetic damage in one or both parents before conception. Genetic damage is considered a mutational effect. A characteristic of chemical teratogenesis is that a threshold of effect exists, just as is the case for all nongenetic insults. Oral chronic or subchronic effects are often expressed

Table 3-4. Relative Toxicity Levels of Herbicides

	Dicamba	Glyphosate	Picloram	2,4-D
Trade name	Banvel	Roundup; Rodeo	Tordon	
LD_{50} (mg/kg)[1]	1,040-2,900	4,320-4,900	2,000-8,200	374-1,960
Commonly Used[2] terms	Slightly toxic	Slightly toxic	Slightly toxic	Moderately to slightly toxic
Activity in soil	Poorly absorbed by soil; short persistence	Inactivated upon contact with the soil.	Sorption by organic matter and clays; may leach in sandy soils; persistent.	Leached in sandy soil; breakdown depends on microbial activity.
Chronic NOEL[3] (mg/kg/day)	5	30	20	20
Tolerances for residues in or on foodstuffs (parts per billion)	50	100-6,000	50-500	100-500

[1]Most LD_{50} values are expressed as a range, reflecting the lack of precisenass of experimental data and differences in experimental condition, the type of carrier in which the toxicant is dissolved, or the species of test animal used.

[2]Moderately toxic is 50-500 mg/kg; slightly toxic is 500-5,000 mg/kg; practically nontoxic is 5,000-15,000 mg/kg; relatively harmless is more than 15,000 mg/kg in a single oral dose to rats.

[3]The highest dosage level at which no reproductive effects have been observed in test animals, including decreased fertility, reduced litter size, reduced offspring size or poor viability (reproductive) and fetus malformations during development; not associated with genetic change (teratogenic).

Sources: Oregon State University, Extension Service 1982; DOE, BPA 1982, Table 7-7; Walstad and Dost 1984

as the no observed effect level (NOEL) in mg/kg/day. NOEL is the highest daily dose that causes no effect in the animal test population. Table 3-4 shows the relative NOEL values for the herbicides proposed for use under the alternatives in this EIS.

The four chemicals proposed for use to control noxious weeds are picloram, 2,4-D, glyphosate, and dicamba. The next four paragraphs summarize toxicity for each.

Picloram is considered moderately to highly persistent in soils under conditions of normal application. No impairment of reproductive capacity has been associated with chemical treatment. Teratonic effects have not been shown. Picloram has produced no detectable mutations in *in vitro* tests. Research has not shown picloram to be carcinogenic, but an open and valid scientific question exists concerning the meaning of nodules or benign tumors produced in the livers of female rats. Because of apparent scientific discord surrounding the carcinogenic potential of picloram, an assessment of such risks is presented in Appendix N of this EIS.

2,4-D is considered to be a relatively nonpersistent herbicide, which generally remains within the top foot of the soil profile. It has shown weak mutagenic activity in some of the many assays to which it has been subjected. It can cause fetal toxicity when the dose is raised high enough. It is a teratogen in some animal species but not in others. Like many chemicals, 2,4-D can cause subtle reproductive effects at high dosages. It does not present a mutational hazard at amounts found either in the workplace or in the general environment. Long-term studies in animals have found 2,4-D to be a "suspect carcinogen," but no conclusive data show the carcinogenicity of this compound. Because of the weak mutagenic effect, the absence of data to support a conclusion that 2,4-D is not valid carcinogenic, and the controversy surrounding the use of this chemical, Appendix N of this EIS presents an assessment of 2,4-D's carcinogenic potential.

Glyphosate has short persistence in soil and water and has low toxicity to mammals. No treatment-related effects on reproductive performance have been observed. No evidence of birth defects has been observed. There is no evidence that glyphosate is a mutagen. A recent chronic mouse