U.S. Department of the Interior
Bureau of Land Management

Oregon State Office
1300 N.E. 44th Avenue
Portland, Oregon 97213

August 1992

Western Oregon Program-Management of Competing Vegetation

Final Record of Decision

229 pages

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

BLM-OR-PT-92-36-1792

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Oregon State Office
P.O. Box 2965 (1300 N.E. 44th Avenue)
Portland, Oregon 97208

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

July 31, 1992

Dear Interested Party,

Enclosed for your information is approval of the Record of Decision for the vegetation treatment on BLM-administered lands in western Oregon. The enclosed document summarizes the provisions of the selected decision to govern the Bureau's integrated management treatment program for undesirable plants and competitive levels of vegetation on public lands in western Oregon. The decision is based upon the Final Environmental Impact Statement titled "Western Oregon Program-Management of Competing Vegetation." The Decision best reflects public involvement received throughout the process, including scoping and the drafts, supplements, and final EIS.

Release of this document to interested groups and individuals will serve as public notice of the Decision.

Thank you for your cooperation. We look forward to any further comment you may have that will assist us in managing the public land.

Sincerely,

State Director, Oregon

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Oregon State Office
P.O. Box 2965 (1300 N.E. 44th Avenue)
Portland, Oregon 97208

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

Decision

I approve the Final Record of Decision for the Final Environmental Impact Statement addressing the Vegetation Treatment Program on BLM-administered lands in western Oregon (1989) and its appropriate application as provided herein.

The public is advised that an integrated approach, using all available treatment methods, will be implemented in western Oregon. This includes the use of manual, mechanical, biological, prescribed fire, and herbicide treatments. Annually, an estimated 90,200 acres could receive vegetative treatment. No more than 8,800 acres would be treated with herbicides in any one year.

Implementation of this program is dependent on the level of funding received annually and the allocations determined by program priority in specific land use plans. Site-specific environmental analysis will precede project implementation to evaluate the need for treatment, identify project impacts, and design appropriate measures specific to the selected treatment method.

D. Dean Bibles
State Director, Oregon and Washington

July 31, 1992

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

WASHINGTON, D.C. 20240

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

I approve and concur in the selection of the Decision for vegetation treatment on BLM-administered lands in western Oregon as defined in the attached Record of Decision, and as analyzed in the Final Environmental Impact Statement titled "Western Oregon Program-Management of Competing Vegetation," February 1989.

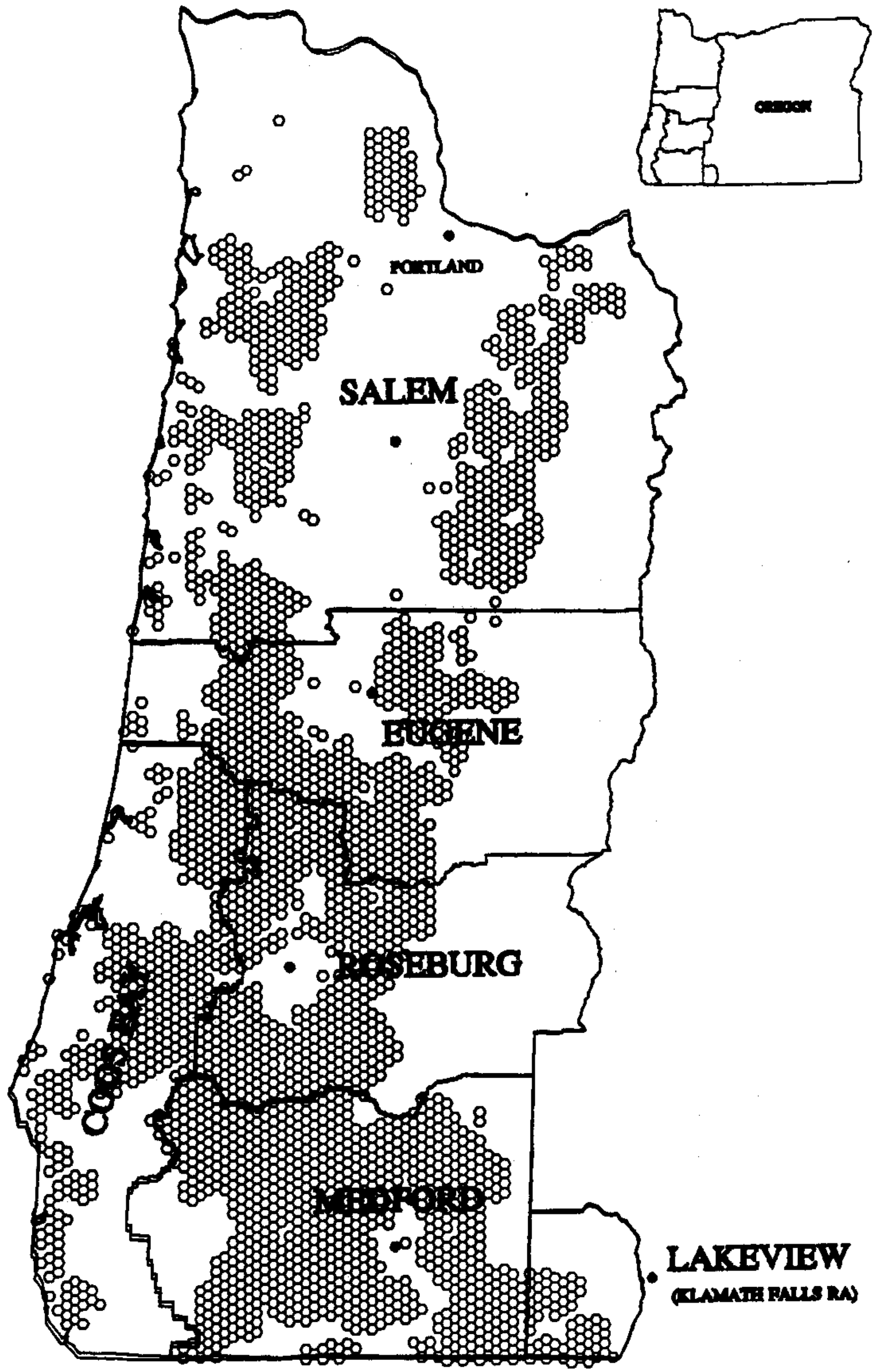
8-11-92
Date

Director

I concur in the above decision for vegetation treatment on BLM-administered lands in western Oregon as defined in the attached Record of Decision.

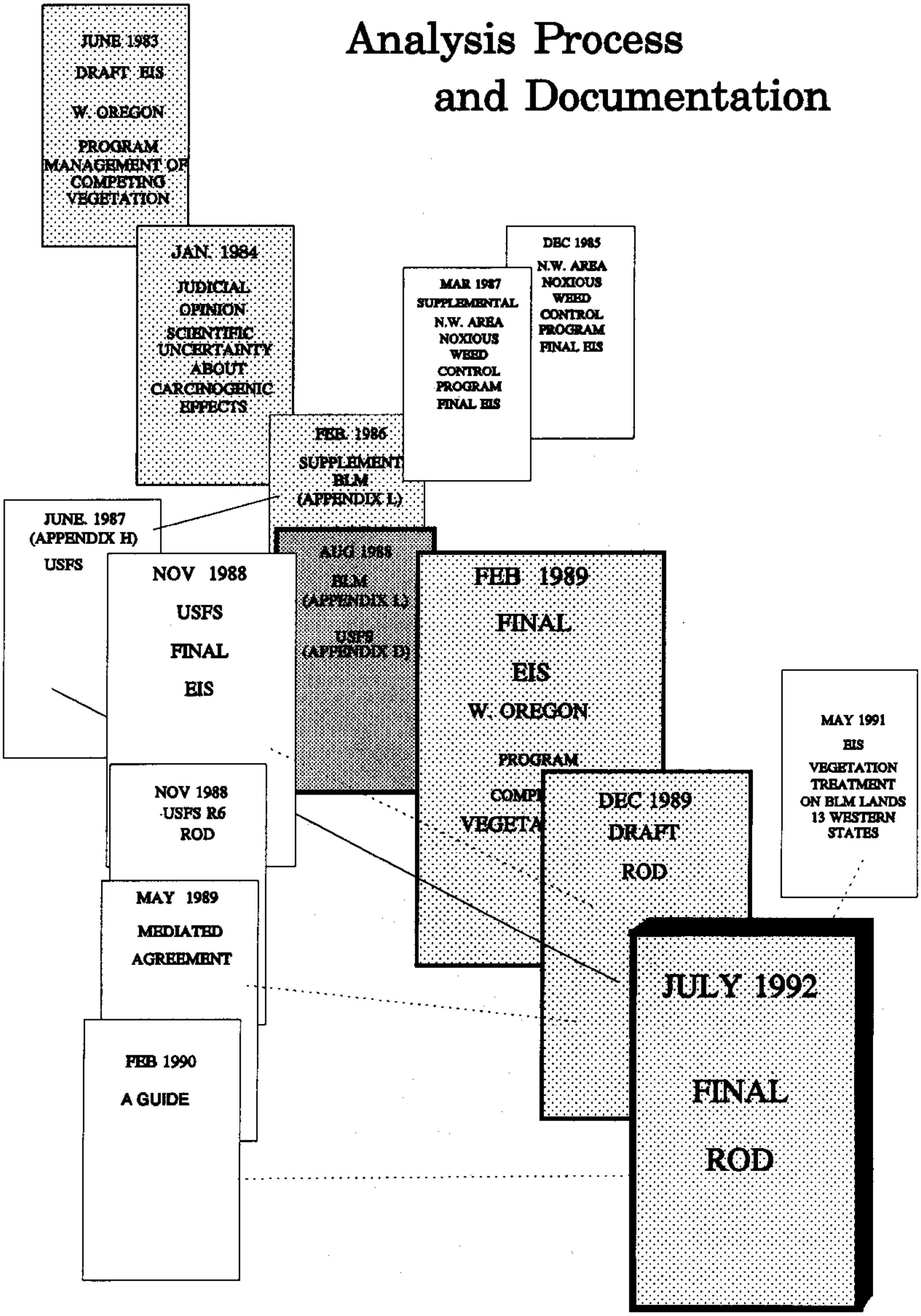
8-13-92
Date

Assistant Secretary
Lands & Minerals Management



OREGON
PORTLAND
SALEM
EUGENE
ROSEBURG
COOS BAY
MEDFORD
LAKEVIEW
(KLAMATH FALLS RA)

Analysis Process and Documentation



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FINAL RECORD OF DECISION

WESTERN OREGON PROGRAM-MANAGEMENT of COMPETING VEGETATION FINAL ENVIRONMENTAL IMPACT STATEMENT

CHAPTER 1 - INTRODUCTION

Overview

For the Bureau of Land Management (BLM) in western Oregon to maintain the health and productivity of the public lands and their important resources, the manipulation and control of vegetation is often required. Essential components of the program include managing for desired plants and plant relationships, and against damaging levels of competitive and unwanted vegetation. In this intricate situation, the BLM must make wise use of all available manipulation and control methods, develop acceptable approaches to favor the desired vegetation and to reduce the competitive vegetation, and assess and monitor the consequences of its actions.

In developing the Western Oregon Program-Management of Competing Vegetation Final Environmental Impact Statement (FEIS) and this Final Record of Decision (ROD), the BLM considered and evaluated a mix of alternative strategies and treatment methods, including burning, biological, mechanical, manual, and chemical (herbicides). The Decision retains all treatment options, while emphasizing preventive and then an early action approach. Some of the treatment methods have the potential for significant impacts on the environment.

Acreage figures for projected treatments are for analysis purposes only. The number of acres actually treated will be dependent upon various factors including funding, available workmonths, and need for treatment in any one year. The BLM will not, however, exceed the annual acres projected for herbicide use.

In finalizing the Decision, the BLM considered a literature search of open scientific literature covering the period 1986 to April 1991 for the proposed herbicides (see Attachment A). The large majority of papers did not reveal significant new information. For asulam, dicamba, glyphosate, hexazinone, and picloram there were no studies which would significantly alter the conclusions in the FEIS regarding these herbicides. The FEIS appears to overestimate concerns on exposure to triclopyr. Skin sensitization may result from exposure to picloram, or to Tordon mixtures containing picloram and 2,4-D. One report on 2,4-D appears to confirm possible male reproductive effects for occupationally exposed workers, and atrazine continues to indicate reproductive and animal carcinogenic potential. These findings confirm BLM in their Decision to use a conservative approach in placing atrazine and 2,4-D in a special consideration status. Precaution is also being extended to include asulam.

Careful consideration was also given to comments solicited from the public, scientists, and other government agencies. In addition, information packages about the treatment methods, and herbicide profiles, were prepared and are available in Attachments B and C, respectively.

The Decision was designed to provide proper emphasis to the preventive strategy that resulted from the above referenced analysis and public input.

In this ROD, a project design process is presented which emphasizes protecting human health, providing for long-term productivity, and meeting the goals and objectives of land management plans.

A five-step process will be used in planning and deciding which actions are most appropriate to implement to meet the program objectives. This process will take into account human health and environmental effects, timing, location, and site-specific factors. Site-specific analyses will be guided by the FEIS, the National Environmental Policy Act (NEPA), and this Decision.

As with all management programs, consideration must be given to statutory guidelines. The BLM in western Oregon is required to manage public lands and their resources according to the guiding principles of two major laws: the Federal Land Policy and Management Act (FLPMA) of 1976, and the O&C Sustained Yield Act of 1937. During the course of meeting its legal mandates, the BLM in western Oregon is directed by Section 102 (a)(12) of FLPMA that the "public lands be managed in a manner which recognizes the Nation's need for domestic sources of minerals, food, timber and fiber..." and Section 701 (b) which states that "notwithstanding any provision of this Act, in the event of a conflict with or inconsistency between this Act and the Acts of August 28, 1937 (50 Stat. 874; 43 U.S.C. 1181a-1181j), and May 24, 1939, (53 Stat. 753) insofar as they relate to the management of timber resources and disposition of revenues from lands and resources, the latter Acts shall prevail." The BLM must comply with numerous other laws and regulations while following the general guidelines set forth in FLPMA and the O&C Act.

In accordance with statutory requirements, A Final Environmental Impact Statement (FEIS) entitled Western Oregon Program-Management of Competing Vegetation was released to the public in February 1989. This was followed by a Proposed Record of Decision. Both of these documents provided formal public comment periods. The intent of the FEIS is to comply with NEPA and the courts in addressing the vegetative treatment program.

The Final ROD will be used to facilitate analysis of treatment alternatives in the process of planning and implementing of BLM's land use decisions.

Identified in the FEIS are impacts on the natural and human environment associated with eight alternatives which were designed to meet the vegetation management objectives in western Oregon and to address scoping issues including the safe use of herbicides and prescribed fire, particularly in regards to human health and forest ecosystems.

The alternatives have a wide range of potential effects including varying levels and types of action, and no action by presenting management options for review and consideration.

As the FEIS and Final ROD describes, the planning and implementing of vegetation management comprises a large program in western Oregon. It involves many people and numerous biological, environmental and social/economic components, which together have some significant environmental effects.

Vegetation Management Objectives

The following objectives for vegetative management are consistent with the resource management goals listed in Chapter 4. They are listed here to illustrate the types of activities within the scope of the FEIS.

* Site preparation benefiting the establishment, survival and growth of desired vegetation such as tree seedlings planted or occurring naturally on harvested sites.
* Maintenance and release treatments promoting survival and growth of desired vegetation.
* Maintenance or control of unwanted vegetation and growth within recreation sites and around administrative facilities.
* Maintenance or culturing of desired vegetation along roadsides and within right-of-way corridors for safety of users.
* Supporting research programs by controlling vegetation on research plots, such as those designed to compare tree growth in field trials which include progeny test sites and forest tree seed orchards.
* Retention, restoration, or improvement of specific habitats to benefit wildlife and botanical species.
* Reduction in the rates of unwanted vegetation invasion into wilderness and protected natural areas.
* Maintenance of vegetation and fuel hazards so wildfires are within natural levels of fire severity.

Relationship of the FEIS and Decision to Other Planning Documents

The FEIS, together with this ROD, is a western Oregon programmatic statement for managing competing and unwanted vegetation during implementation of land use plans. These plans, which address management for various resource values, are presented in the current Management Framework Plans (MFPs) and are being revisited in Resource Management Plans (RMPs) now being developed. The MFPs and RMPs make land use allocations based on specific local conditions, while this FEIS and ROD are written on a programmatic basis to address overall potential environmental impacts, and to identify mitigation measures to be used when applying vegetation management in the establishment and growth of young stands, and in associated forest management activities.

Site-specific environmental analysis and documentation will normally occur at the district or resource area level. Interdisciplinary impact analyses will adhere to the general process outlined in this ROD to address potential impacts and to select mitigation measures identified in the FEIS and other Bureau EISs, MFPs, or RMPs. Such analyses may reference other agency documents, including the U.S. Forest Service's FEIS for Managing Competing and Unwanted Vegetation, Mediated Agreement, and Guide to Conducting Vegetation Management Projects; BLM FEIS Northwest Area Noxious Weed Control Program; and the BLM's FEIS for Vegetation Treatment on BLM Lands in Thirteen Western States.

If site-specific analysis determines that a proposed project has potential for significant impact not described in an existing EIS, there may be need to prepare another environmental analysis or supplement to the EIS. Specific herbicide formulation proposals may require additional risk analyses. All proposed vegetative management projects will be reviewed and screened for NEPA compliance.

Public involvement will adhere to the Council of Environmental Quality (CEQ) regulations implementing NEPA. The appropriate methods of public notification, participation, review, and communication will be determined during project planning and analysis by the manager responsible for authorizing site-specific actions. The public notification and review process will occur in a timely manner prior to a final determination on the proposed actions.

Assumptions made in the MFPs and RMPs that all methods of managing vegetation will be potentially available is applicable to the Decision.

In addition, BLM incorporates USFS Appendix H by reference into its decision-making information base; this appendix is the component of the U.S. Forest Service 1988 FEIS, (Managing Competing and Unwanted Vegetation) entitled "Qualitative Risk Assessment." Excluded from incorporation are references to Forest Service manuals, Forest Service proposed mitigating measures, handbooks, and any laws and regulations which apply only to the Forest Service. BLM also incorporates only that material relating to the 10 herbicides it proposed for use from the 16 considered by the Forest Service.

CHAPTER 2 - THE DECISION AND ITS SPECIFIC PROVISIONS

The Decision

In managing competing and unwanted vegetation, the BLM's Decision incorporates features from seven of the eight original alternatives (the exception is Alternative 2 which emphasizes herbicide use). The Decision is designed to implement integrated vegetative management, emphasize a preventive strategy, reduce reliance on herbicides, and maintain the flexibility to potentially use all available treatment options. The Decision provides western Oregon-wide program guidance for the vegetation management program in a manner that is flexible for addressing site-specific variables occurring in the resource areas in the Cascade, Coastal and Klamath Provinces in western Oregon.

Annual treatment acreages proposed under the Decision are listed on Table 2.1, along with acres proposed for the eight alternatives analyzed in the FEIS, the FEIS existing (FY 1983), and current existing (FY 1990 and 1991). An annual cap of 8,800 acres is being placed on herbicide treatment in western Oregon. This limitation will retain current emphasis for the BLM to continue its search for nonchemical methods of vegetative management when control is needed.

The acreage of the treatments varies between the alternatives, depending upon their design. Biological method treatment acreage, for instance, is larger for the Decision than for any alternative shown in the FEIS. This can be attributed to a number of factors, one being that biological treatments were previously considered for implementation on an experimental basis, but are now considered to be at operational levels. Also, biological treatments are usually dependent and supplementary to site preparation and are used to actually decrease the need for conventional maintenance and release treatment; this often results in a double acreage count such as grass seeding to reduce competitor sprouting, and encouraging grazing or browsing to maintain the desired conditions.

Design features of the Decision are summarized in Table 2.2. For a comparison of Alternative 1 (which was the Preferred Alternative in the FEIS) and the Decision, see Table 2.3.

The BLM has given considerable analysis to the formulation and selection of the Decision features, weighed the risks associated with its implementation against the risks and severity of possible adverse impacts, evaluated public comments, consulted with accredited toxicologists and interest groups, analyzed the process involving the USFS mediation document and their implementation guide, solicited public input on the FEIS, and released a draft ROD for public review and comment.

As the FEIS provided, the Decision combines features from the original alternatives in the FEIS, identifies a vegetative management process, and specifies project design features and mitigating measures to be implemented. The Decision emphasizes planning and monitoring, employing a preventive strategy, and reducing reliance on herbicide use.

Table 2.1 - ACREAGE BY ALTERNATIVES AND DECISION, ACTIVITIES AND TREATMENT METHODS
Annual Acreage Estimates to Manage Competing and Unwanted Vegetation by Alternatives and Decision for Impacts Evaluation. Estimated "no action" acres are not included.

ACTIVITY	FEIS EXISTING FY 83	CURRENT EXISTING FY 90	FY 91	FEIS PREFER. Alt 1	EMPH. HERB. Alt 2	NO BURN Alt 3	LABOR INTENS. Alt 4	RESTR. AERIAL Alt 5	NO AERIAL Alt 6	NO HERB. Alt 7	NO ACTION Alt 8	SELECT ACTION DECISION
TOTAL ACRES MANAGED:	71,784	95,517	92,484	99,413	105,828	108,285	100,755	96,011	98,011	91,108	26,969	90,206
METHOD USING:												
MANUAL	24,461	59,586	54,721	17,504	15,791	22,721	27,913	18,395	31,098	48,742	3,485	43,112
MECHANICAL	12,043	13,141	11,816	12,689	10,038	23,551	10,377	12,519	12,919	14,702	8,555	13,704
BIOLOGICAL*	2,705	3,614	7,125	5,295	3,895	1,860	5,030	5,030	5,030	4,291	510	7,057
PRESC. FIRE	14,094	19,176	18,822	21,586	19,054	0	21,731	21,581	22,226	23,373	14,419	17,533
HERBICIDES	18,481	0	0	42,339	57,050	60,153	35,704	38,486	26,738	0	0	8,800

ACTIVITY	FEIS EXISTING FY 83	CURRENT EXISTING FY 90	FY 91	FEIS PREFER. Alt 1	EMPH. HERB. Alt 2	NO BURN Alt 3	LABOR INTENS. Alt 4	RESTR. AERIAL Alt 5	NO AERIAL Alt 6	NO HERB. Alt 7	NO ACTION Alt 8	SELECT ACTION DECISION
FORESTRY USES BY METHOD:	**62,021**	**84,479**	**77,841**	**83,408**	**90,867**	**98,500**	**84,122**	**80,026**	**82,066**	**76,034**	**18,360**	**74,306**
Manual	23,297	58,058	54,034	16,346	15,139	21,558	23,340	16,907	29,640	46,180	925	41,642
Mechanical	7,283	7,253	6,788	8,446	7,806	19,028	7,867	8,326	8,506	9,496	3,524	7,912
Biological*	1,974	1,794	2,661	830	130	595	565	565	565	545	0	2,700
Presc. Fire	13,533	17,374	14,358	18,026	17,271	0	18,171	18,021	18,666	19,813	13,911	13,841
Herbicides	15,934	0	0	39,760	50,521	57,319	34,179	36,207	24,689	0	0	8,211
Forestry: Site Prep	**30,304**	**26,389**	**23,184**	**40,677**	**42,042**	**43,537**	**40,525**	**36,529**	**38,103**	**32,251**	**18,360**	**28,181**
Manual	2,301	2,356	2,573	2,045	1,830	6,994	3,745	1,805	2,650	3,800	925	3,600
Mechanical	2,231	1,603	1,400	2,401	2,241	3,541	2,241	2,120	2,341	3,151	140	1,910
Gross yd #	4,932	5,100	4,871	5,515	5,385	15,009	5,506	5,485	5,485	5,535	3,384	5,100
Presc. Fire	13,169	17,330	14,340	17,986	17,231	0	18,131	17,981	18,626	19,765	13,911	13,821
Herbicides	7,671	0	0	12,730	15,355	17,993	10,902	9,138	9,001	0	0	3,750
Forestry: Maint/Release	**14,827**	**35,198**	**31,547**	**29,203**	**35,332**	**41,355**	**29,929**	**29,909**	**30,375**	**31,822**	**0**	**29,299**
Manual Maint.	580	26,394	25,386	448	150	468	913	518	5,718	19,542	0	17,760
Manual Release	4,445	7,010	3,305	1,205	436	1,388	5,834	1,656	8,364	11,355	0	4,300
Mechanical	0	230	195	350	0	258	0	541	480	580	0	580
Biological*	1,974	1,794	2,661	630	130	375	365	365	365	345	0	2,500
Herbicides	7,828	0	0	26,570	34,616	38,866	22,817	26,829	15,448	0	0	4,159
Forestry: PCT	**15,841**	**21,852**	**22,280**	**12,528**	**12,693**	**12,588**	**12,628**	**12,588**	**12,588**	**10,961**	**0**	**15,692**

ACTIVITY	FEIS EXISTING FY 83	CURRENT EXISTING FY 90	FY 91	FEIS PREFER. Alt 1	EMPH. HERB. Alt 2	NO BURN Alt 3	LABOR INTENS. Alt 4	RESTR. AERIAL Alt 5	NO AERIAL Alt 6	NO HERB. Alt 7	NO ACTION Alt 8	SELECT ACTION DECISION
Forestry: Test Site	1,049	810	830	1,000	800	1,020	1,040	1,000	1,000	1,000	0	1,134
Manual	130	446	490	120	30	120	220	340	320	522	0	290
Mechanical	120	320	322	180	180	220	120	180	200	230	0	322
Biological*	0	0	0	200	0	220	200	200	200	200	0	200
Presc. Fire	364	44	18	40	40	0	40	40	40	48	0	20
Herbicides	435	0	0	460	550	460	460	240	240	0	0	302
OTHER USES BY METHODS:	10,763	11,038	14,643	16,005	14,961	9,785	16,633	15,985	15,945	15,074	8,609	15,900
Manual	2,164	1,528	687	1,158	652	1,163	4,573	1,488	1,458	2,562	2,560	1,470
Mechanical	4,760	5,888	5,028	4,243	2,232	4,523	2,510	4,193	4,413	5,206	5,031	5,792
Biological*	731	1,820	4,464	4,465	3,765	1,265	4,465	4,465	4,465	3,746	510	4,357
Presc. Fire	561	1,802	4,464	3,560	1,783	0	3,560	3,560	3,560	3,560	508	3,692
Herbicides	2,547	0	0	2,579	6,529	2,834	1,525	2,279	2,049	0	0	589
Recreation:	31	37	23	50	50	50	50	50	50	45	33	85
Manual	25	32	18	23	5	23	23	23	23	25	23	29
Mechanical	3	5	5	10	10	10	10	10	10	10	10	18
Biological*	0	0	0	10	10	10	10	10	10	10	0	35
Presc. Fire	0	0	0	0	0	0	0	0	0	0	0	0
Herbicides	3	0	0	7	25	7	7	7	7	0	0	3
Roadside Maintenance:	7,207	5,621	4,424	6,207	5,883	6,207	6,855	6,207	6,207	6,041	6,041	6,432
Manual	1,824	967	424	824	616	824	4,091	824	824	2,224	2,224	1,187
Mechanical	3,354	4,654	4,000	3,354	2,058	3,354	1,787	3,354	3,354	3,817	3,817	4,691
Biological*	0	0	0	0	0	0	0	0	0	0	0	277
Herbicides	2,029	0	0	2,029	3,209	2,029	977	2,029	2,019	0	0	277

ACTIVITY	FEIS EXISTING FY 83	CURRENT EXISTING FY 90	FY 91	FEIS PREFER. Alt 1	EMPH. HERB. Alt 2	NO BURN Alt 3	LABOR INTENS. Alt 4	RESTR. AERIAL Alt 5	NO AERIAL Alt 6	NO HERB. Alt 7	NO ACTION Alt 8	SELECT ACTION DECISION
Wildlife:	1,757	3,588	8,980	7,020	7,000	800	7,000	7,000	6,970	7,000	1,000	7,072
Manual	10	0	0	0	0	0	30	30	0	0	0	10
Mechanical	600	0	0	100	100	300	50	50	60	100	0	50
Biological*	600	1,794	4,456	3,500	3,500	300	3,500	3,500	3,500	3,500	500	3,500
Presc. Fire	530	1,794	4,464	3,400	1,725	0	3,400	3,400	3,400	3,400	500	3,500
Herbicides	17	0	0	20	1,675	200	20	20	10	0	0	12
Right-of-way: (Permitees)	1,480	1,714	1,250	2,200	1,500	2,200	2,200	2,200	2,200	1,500	1,500	1,770
Manual	300	514	230	300	20	300	400	600	600	300	300	230
Mechanical	700	1200	1,020	700	30	700	600	700	900	1,200	1,200	970
Biological*	0	0	0	700	0	700	700	700	700	0	0	285
Presc. Fire	0	0	0	0	0	0	0	0	0	0	0	0
Herbicides	480	0	0	500	1,450	500	500	200	0	0	0	285
Buildg/Ground:	9	18	18	15	15	15	15	15	15	15	15	20
Manual	5	15	15	10	10	10	12	10	10	12	12	13
Mechanical	2	3	3	3	3	3	3	3	3	3	3	5
Herbicides	2	0	0	2	2	2	0	2	2	0	0	2
Rangeland:	276	52	0	490	490	490	490	490	490	450	0	490
Manual	0	0	0	0	0	0	15	0	0	0	0	0
Mechanical	100	26	0	75	30	150	60	75	85	75	0	57
Biological*	130	26	0	245	245	245	245	245	245	225	0	245
Presc. Fire	30	0	0	150	50	0	150	150	150	150	0	180
Herbicides	16	0	0	20	165	95	20	20	10	0	0	8
T & E:	3	16	0	23	23	23	23	23	23	23	20	31
Manual	0	0	0	1	1	6	2	1	1	1	1	1
Mechanical	1	0	0	1	1	6	0	1	1	1	1	1
Biological*	1	8	0	10	10	10	10	10	10	11	10	15
Presc. Fire	1	8	0	10	8	0	10	10	10	10	8	12
Herbicides	0	0	0	1	3	1	1	1	1	0	0	2

= Gross yard included in mechanical method totals.
* = Treatment acres may appear as more than one entry on same acreage -- such as burning and forage seeding, or burning, or herbicide to convert brush to grass or facilitate sprouting/growth of desired species.

TABLE 2.2 - SUMMARY OF MAJOR FEATURES OF THE DECISION

	MANUAL	MECHANICAL	BIOLOGICAL	PRESCRIBED FIRE	HERBICIDE
ANNUAL ACRES TREATED	43,112	13,704	7,057	17,533	8,800
GUIDELINES	BLM Manual 1112 Handbooks 1 & 2 (Safety) BLM Manual 6840 (Special Status Species)	BLM Manual 1112 Handbooks 1 & 2 BLM Manual 6840	BLM Manual 9014 BLM Manual 1112 Handbooks 1 & 2 BLM Manual 4100 BLM Manual 6840 BLM Manual 7000	BLM Manual 9210 (Fire Mgmt.) 9211 (Fire Planning) 9214 (Prescribed Fire) 9215 (Fire Training & Qualif.) BLM Manual 1112 Handbooks 1 & 2 BLM Manual 6840	BLM Manual 9011-1 Standards & Guidelines for Implementing Vegetative Mgmt. Plan (in revision) BLM Manual 6840 BLM Manual 1112 Handbooks 1 & 2
JOB HAZARD ANALYSIS	Physical dangers, dust and temperatures, cuts, poisonous plants, snakes, and insects.	Same as Manual.	Same as Manual.	Physical dangers, smoke and temperatures, injury from poisonous plants, snakes, and insects.	Same as Manual, plus effectiveness of protective measures. Screen for sensitive people or those not wanting to apply herbicides & make adjustments in project design, or reassign workers to separate task.
MINIMUM UNTREATED BUFFER WIDTHS ADJACENT TO STREAMS, LAKES, AND PONDS	n/a	25 feet	Enforce control of livestock near wetlands and riparian areas.	25 feet	Application Mode: Aerial: Flowing stream - 100 feet. Wetlands and lakes - 200 feet. Ground: 50 feet. Manual: 20 feet. Manual (wipe on): High water mark. Atrazine (in shallow water tables or in areas w/aquifers in alluvial deposits along major streams: Follow guidelines for above ground waterways. For picloram and atrazine: Require evaluation by, and approval of, hydrologist or soil scientist.
UNTREATED BUFFER WIDTHS NEAR RESIDENCES	n/a	n/a	Case-by-case analysis.	Buffer Rural Interface Areas per guidelines in land use plans.	Aerial: 600 feet unless written waiver; also may need additional analysis. Aerial of 2,4-D, asulam, and atrazine: 0.25-mile (1,380 feet) buffer. Ground: 100 feet.

TABLE 2.2 - SUMMARY OF MAJOR FEATURES OF THE DECISION continued

	MANUAL	MECHANICAL	BIOLOGICAL	PRESCRIBED FIRE	HERBICIDE
ADJACENT LANDOWNERS	n/a	n/a	For bioagents, notify any residents or landowners who likely could be affected. For other biological, notify as needed.	Notify residents & landowners who likely could be affected by smoke intrusions or other effects of prescribed fire.	Notify residents and adjacent landowners who likely could be affected by herbicide drift or accidental spill.
DOMESTIC WATER DIVERSIONS	Review municipal watershed agreements & follow any MOUs. Do not contaminate aquifers providing an area's principal source of drinking water. Adhere to Safe Drinking Water Act.	Same as Manual.	Same as Manual.	Same as Manual.	Same as Manual, plus Buffer as follows: <u>Aerial</u>: 200 feet. <u>Ground application methods</u>: 100 feet.
GUIDANCE TO WORKERS	Information package on Manual Method (Attachment B). Safety Training.	Information package on Mechanical Method (Attachment B). Safety Training.	Information package on Biological Method (Attachment B). Safety Training.	Information package on Prescribed Fire Method (Attachment B). Safety Training.	Information package on Herbicide Method (Attachment B); and Herbicide Profile (Attachment C). Safety Training. Certification for applicators or supervisors of applicators.
WORKER PROTECTION	Protective clothing & equipment.	Protective clothing & equipment.	Protective clothing & equipment.	Protective clothing & equipment.	Protective clothing & equipment. Clean clothes daily; extra set available onsite.
AIR QUALITY	Dust & Exhaust Abatement	Dust & Exhaust Abatement	n/a	Protect air quality and avoid smoke intrusions; comply with Oregon Smoke Mgmt. Plan and Clean Air Act. Protect visibility in Class I areas, esp. during periods of high public visitation including July-Labor Day. Adhere to Herbicide Profiles (Attachment C) re: burning herbicide-treated vegetation; or allow 6 months between the treatments.	Minimize herbicide drift.
POSTING OF UNITS	n/a	n/a	For bioagents, post units w/project description signs (in both English & Spanish) at points of common interest and prior to treatment; leave signs in place a minimum of 30 days.	n/a	Post units w/project description signs (in both English & Spanish) at points of common interest and 24 hours prior to treatment; leave signs in place a minimum of 30 days. In posting notices, identify: herbicide used, application date, and phone number to contact for additional information.

TABLE 2.2 - SUMMARY OF MAJOR FEATURES OF THE DECISION continued

	MANUAL	MECHANICAL	BIOLOGICAL	PRESCRIBED FIRE	HERBICIDE
METHOD-SPECIFIC RESTRICTIONS	n/a	Follow slope guidelines per land use plan. (Also see Soils on this table.) Restriction on equipment near special areas or for certain species where concern exists for spread of diseases.	For bioagents, comply with USDA APHIS and State Dept. of Agriculture guidelines. Restrict grazing to avoid introduction of weeds. Evaluate any introduction of vegetation for compatibility with natural diversity of ecosystem. Use only certified weed-free seed. Coordinate rest rotation systems to avoid overlapping animal use and treatments. Maintain forage production while treating.	Comply w/OSMP to protect VRM I areas and cities from smoke intrusion. Avoid over-consumption of residues on forest floor. Take precautions using gelled gasoline and fuels; avoid dermal contact. Have uncontaminated water in sufficient quantities onsite to wash any dermal areas exposed to gelled gasoline/fuels.	Herbicides proposed for use: - Atrazine - Asulam - 2,4-D - Dicamba - Glyphosate - Hexazinone - Picloram - Tricloypr Herbicides that will not be used: Fosamine, Diurine, Diquat, MSMA, Ammonium Sulfate; and Dalapon. Avoid dermal contact. Have uncontaminated water in sufficient quantities onsite to wash any dermal areas exposed to herbicides. Use Margin of Safety (MOS) levels as benchmarks to require additional mitigation. MOS below 10: high risk. MOS 11-100: moderate risk. MOS above 100: low risk. Treat recreation sites during periods of low or non-use, or restrict access. For 2,4-D, atrazine, and asulam: Require additional protective clothing and precautions. For picloram, 2,4-D, and dicamba: Restrict grazing for one grazing season following use of these herbicides. Inerts: Use least hazardous; avoid EPA-listed 1 and 2 inerts; kerosene limited to inert in 2,4-D and triclopyr. Diesel oil used if adjuvant (not >5% of spray mixture).
WATER QUALITY	Adhere to Best Mgmt. Practices (BMPs).	Adhere to BMPs.	Adhere to BMPs.	Adhere to BMPs.	Adhere to BMPs.

TABLE 2.2 - SUMMARY OF MAJOR FEATURES OF THE DECISION continued

	MANUAL	MECHANICAL	BIOLOGICAL	PRESCRIBED FIRE	HERBICIDE
SOILS	n/a	Minimize soil compaction: Restrict equipment on steep slopes; also restrict equipment on highly sensitive soils; time actions to dry times of year when compaction is less likely to occur.	n/a	Avoid broadcast burns on erodible and sensitive soils; prescribe low to moderate burns, avoiding hot burns.	Avoid use of herbicides that have high soil mobility in areas where soil type would contribute to the mobility. See precautions for picloram.
WILDLIFE HABITAT	Screen for potential to affect critical habitat needs.	Avoid treatment during times when critical habitat needs would be affected (i.e., nesting seasons).	Same as Mechanical.	Schedule any broadcast treatments in important wildlife calving and wintering areas to avoid forage reduction during those critical times.	Restrict herbicide use in areas of important fish and wildlife habitat by buffering areas, or by using herbicides with low toxicity to fish and wildlife while attaining effective treatment.
RIGHTS-OF-WAY	n/a	n/a	n/a	n/a	Special precautions due to high potential of exposure along rights-of-way.
MONITORING	BLM Manual 1734-2. Annual program-wide, and site-specific monitoring as required, for treatment effectiveness; water quality (using BMPs); compliance with FEIS and its ROD and land use plans including RMP; and worker & human health concerns. Young stand monitoring at 1, 3, and 5-year intervals. Retain project records for 3 years. Reference district RMP for other guidelines. Submit annual report to OSO and WO. Conduct drainage analysis during annual program review to anticipate potential for cumulative impacts, esp. relative to checkerboard land ownership patterns. Monitor for new information.	Same as Manual.	Same as Manual.	Same as Manual, plus monitor for hazardous components of smoke, using dosimeters.	Same as Manual. Monitoring for new data will include updating Table 6.4 for data gaps.

TABLE 2.3 - COMPARISON OF ALTERNATIVE 1 AND THE DECISION

ELEMENT	PREFERRED ALT. - ALT. #1 ALL EFFECTIVE METHODS AVAILABLE	THE DECISION: ALL EFFECTIVE METHODS AND TECHNIQUES AVAILABLE, NON-HERBICIDE METHODS PREFERRED.
Design Features	* Program features in conformance with quantitative risk assessment. * Program direction similar to that existing in 1983. * Standard operating procedures. * Prevention as one potential strategy. * Herbicides used when most effective method of ensuring survival and growth of conifers. * BLM or Oregon State certified training required.	* Program features utilize both quantitative and qualitative risk assessment data. * Analysis process defined. * Prevention strategy emphasis for all project planning. * Early treatment when evidence suggests growth loss or damage will occur. * Exposure and job analysis to help define project, public, and special worker safety requirements. * Retention of natural diversity and long-term productivity. * Interrelationship of project analysis and NEPA process displayed. * BLM and Oregon State certified training required for application of herbicides; BLM certified training for other hazardous jobs.
Human Health	* Use findings in quantitative human health risk assessment as a program base. * Worker and public health is major concern; MOS less than 100 requires incorporation of design features such as buffers and requiring workers to wear protective clothing.	* Disclosure of potential risks through method and herbicide profiles. * Project exposure analysis. * Margin of safety of 100 used as threshold for special design features. * Use both quantitative and qualitative risk analysis findings and procedures. * Periodic literature reviews. * Record herbicide profile for workers and their assignments. * Record and maintain incidents, accidents, and health complaints.

ELEMENT	PREFERRED ALT. - ALT. #1 ALL EFFECTIVE METHODS AVAILABLE	THE DECISION: ALL EFFECTIVE METHODS AND TECHNIQUES AVAILABLE. NON-HERBICIDE METHODS PREFERRED.
Public Involvement	* Early in planning process. * Before making decision to proceed with treatment actions, the public will be invited to review and comment on the site-specific analysis. * Posting of units. * Strive to keep adjacent landowners informed about vegetative management program.	* Early involvement through early project planning steps and FY program notification. * NEPA screening prior to EA, and review and comment on project site-specific projects. * Written notification of potentially-affected people (adjacent residents, landowners, and downstream water users). * Prior posting of units and recording concerns. * Program leader as public contact.
Environmental Effects	* All effective methods available for use. * Up to 42,000 acres could be treated with herbicides.	* Reduce reliance on potential herbicide use. * 8,800 acres cap on annual use of herbicides, and plan and practice avoidance as feasible.
Technique Effectiveness Analysis	* Pre-treatment needs survey for analysis and EA documentation. * Project cost and effectiveness analysis. * Routine monitoring post-treatment.	* Identify thresholds to determine competitive levels. * Pre-treatment needs survey for analysis and EA documentation. * Document project cost and effectiveness analysis. * Estimate effectiveness of mitigating measures. * Monitor sites at 1, 3, and 5 years post- treatment to verify needs and process. * Routine monitoring post-treatment of all projects to verify effect and assess needs for future programs.
Interagency Coordination	* Coordinate with federal, state, and local agencies. * Use Clearinghouse.	* Coordinate with federal, state, and local agencies. * Program Leader facilitates consultation and interagency coordination.
Permittee and Grantees	* Operations within rights-of-ways in compliance with Dept. of Interior regulations applicable to herbicide use.	* Operations within rights-of-way in compliance with Western Oregon ROD.
Cost of Treatment	* Cost-effectiveness as major decision factor.	* Pursue adequate funding to make alternative treatments feasible. * Consider cost-effectiveness along with health risks and environmental factors.

Important distinctions specific to this approach are as follows:

* A judicious approach to vegetative management through systematic (sequential) program and site-specific planning and analysis where vegetation manipulation is expected to be needed.

* Development of action thresholds for plant communities with the intent of defining conditions that trigger potential needs for corrective treatments, anticipating competition problems, and assisting in monitoring activities. Involves verifying appropriate thresholds for local conditions and effectiveness of the prescription and techniques.

* A specified limit on yearly potential herbicide acreage available to reduce reliance on herbicides.

* Pursuit of adequate funding to make alternative treatments feasible.

* Recognition that herbicides, formulations, and application techniques vary widely in their potential health effects, making site-specific analysis of risks and potential exposures an important part of the Job Hazard Analysis (risk to the worker) and risk assessment (risk to the public).

Included in the Decision is acceptance of the qualitative analysis of the Human Health Risk Assessment contained in BLM FEIS Appendix L that was done by the University of Washington (also see USFS 1988 FEIS, Appendix H for same documentation). The qualitative risk assessment addresses the quality of the data (its reliability) underlying the quantitative risk assessment. In the FEIS, acceptance of the qualitative assessment was reserved until development of the Final ROD; its acceptance here signifies its incorporation into both the FEIS and this ROD.

Using acreages of proposed treatments as a gauge for determining scope of impact, Table 2.1 (proposed treatment by acreages) and Table 6.1 (impacts of the Decision) show that the impacts of the Decision are within the scope of the actions discussed in the FEIS for the eight alternatives. On this premise, the significant impacts associated with the Decision are also considered to be within the scope of the environmental consequences addressed in the FEIS.

Scope of the Decision

This FEIS and ROD apply to all BLM-administered land in the Coos Bay, Eugene, Medford, Roseburg, and Salem districts, and the portion of the Lakeview District previously within the Medford District prior to 1987. Further, the decision applies only to the portion of each activity that pertains to management of competitive and unwanted vegetation. Excepted from the decision is noxious weed control which is analyzed in a separate document, the Northwest Area Noxious Weed Control Program EIS (1986).

The Decision's approach is to emphasize the use of prevention and natural processes to manage competing and unwanted vegetation. This approach applies to vegetation management planning and control activities, and sets guidelines and standard operating procedures for implementing such programs.

Treatment options available for consideration in the integrated management program include biological, manual, prescribed fire, mechanical, and chemical methods and techniques. In forest land management programs, these treatments are often essential for the establishment and maintenance of desired plants and for achieving good growth rates of desired vegetation to meet management goals. While controlling competition is key to both of these objectives, the manner in which adequate control of competitive vegetation is achieved varies. It is the variability, need, and manner of manipulation to ameliorate harmful competitive or unwanted vegetation that must be identified, analyzed and communicated on a site-by-site basis.

Planning and implementation of activities on a site-specific project basis will be done according to the NEPA process, and correlated with guidance set forth in this FEIS/ROD and approved land use plans. Site-specific projects may be planned and analyzed on either an individual or group basis.

General Provisions

The focus is two-fold:
(1) To prevent or minimize the need for future vegetation management or corrective action and also subsequently the need for later treatments, and
(2) To emphasize the use of preventive and natural processes.

The Decision is designed to protect human health and promote long-term productivity of the forest ecosystem while meeting the goals and objectives of management plans for such activities as timber production, habitat management, and maintenance of both transportation systems and recreation sites.

It combines a number of features from seven of the FEIS alternatives (Alt.#2, increased herbicide use, is the excepted alternative) when corrective action is needed, minimizes impacts on air quality from prescribed fire, and reduces the potential for adverse human health effects.

To facilitate ongoing public involvement, the Decision provides for an interactive review of the vegetation management process throughout planning until project implementation. A public consultation process is also defined.

Guidelines for implementing the Decision are as follows:

* *Ecological relationships will be emphasized in designing program activities to meet land management objectives (such as timber harvest, roadside maintenance, and wildlife habitat maintenance and restoration).*

* *Human health risks to the public and workers will be evaluated to determine major design features.*

* *Where prevention is no longer a viable option, effective early treatment and alternatives to herbicides of special consideration are to be given priority.*

Vegetation Management Process

Definite steps recognized in the vegetative management process are as follows:

Step 1
Site analysis determines site conditions and potential needs for treatments according to objectives for the site.

Step 2
Strategies are evaluated to select the best planned course of action to implement a preventive approach, in the long term at a minimum.

Step 3
Project design for proposed treatment is developed which includes mitigating measures, public involvement, risk management, monitoring, and predicting of vegetation response.

Step 4
Vegetative management action implemented.

Step 5
Monitoring initiated to determine if course of action taken was effective and if further action is needed to promote the preventive approach.

Important Concepts to the Process

Concepts integral to the vegetation management process for the preventive approach include Integrated Pest Management, Prevention, Thresholds, and Scheduling of Detection and Action as described in the following sections.

Integrated Pest Management (IPM)

"IPM is a systems approach to reduce pest damage (competitive and unwanted vegetation) to tolerable levels through a variety of techniques, including natural predators and parasites, genetically resistant hosts, environmental modifications and when necessary and appropriate, chemical pesticides (herbicides)." (BLM M-9220) For clarity, the decision expands the IPM definition in the FEIS glossary to reflect the generic definition. Further, for consistency, this definition will be used in all BLM western Oregon vegetation management planning and implementation.

IPM generally relies upon a combination of strategies, treatment options and techniques as preventive and corrective defense mechanisms against competitive and unwanted vegetation. When initiated early, IPM can avoid vegetative management problems and, when needed, employ a variety of methods and techniques.

The BLM recognizes that the success of IPM is dependent upon several factors: knowledge of vegetative management strategies; a broad range of specific technical skills; planning, monitoring and implementing of multiple interactive steps over a fairly long time frame; potentially-high initial capital investments (e.g., mowers in roadside vegetative control); and consistent funding. Without the development of a vegetative community strategy, and without the planning that considers both single and sequential steps and treatment options, it is common for timing to be short between problem identification and action, and for there to be a lack of the available skills, workmonths, and funding to achieve the objectives. In the latter instances, and when unexpected situations occur, corrective or rescue actions are necessary to meet management objectives; IPM is then limited to selecting control alternatives or no action.

In view of the importance of an effective IPM program to the prevention strategy, the BLM will strive to have appropriate resources available. The BLM will encourage research on specific forest ecosystems and continue analysis on a site-by-site basis, linking these necessary steps to implement effective IPM programs and enable vegetative manipulation that avoids or reduces competitive and unwanted vegetation to acceptable levels. The BLM will also continue to support research towards gaining a thorough knowledge of the requirements of competitive and unwanted vegetation, and of the needs and vegetative growth characteristics of desired vegetation. Any actions that are similar or cumulative should ideally be anticipated during project planning stages and used to determine both the need and timing for control efforts under an IPM program.

Prevention Strategy

A key to implementing the Decision is the major emphasis on prevention as the priority strategy being accomplished through planning, to identify and take advantage of any situations where competitive or unwanted vegetation may not interfere with objectives, or to reduce the need for corrective actions.

In the context of the Decision, the term "prevention" will mean "to detect and ameliorate the conditions that cause or favor the presence of competing or unwanted vegetation in the forests. Prevention is in contrast to treatment, which refers to activities for controlling or eradicating infestations of competing or unwanted vegetation. It also should not be confused with early treatment, which refers to activities for controlling or eradicating existing, small infestations of competing or unwanted vegetation before they interfere with the agency's objectives for managing that area or adjacent lands." (USFS Mediated Agreement, 1989.)

Emphasis is on prevention and then early action if action is needed. Other strategies include no action, correction, maintenance, and rescue and restoration. The potential for prevention or another strategy to achieve the goals for a given site will be analyzed prior to commencing any sequence of treatments.

The concept of prevention as a planned course of action in forest management has continued to develop and gain emphasis during the past decade as an accepted vegetative management strategy. It was a scoping issue in 1982 at which time it was proposed that such practices be considered under all alternatives and used whenever feasible.

Thresholds Concept

Determining damage and action thresholds is an important part of determining the need for action during the vegetation management analysis process. Thresholds are a measure of the degree or level of competition which depletes environmental resources to the disadvantage of a desired plant.

The appropriate timing of vegetation manipulation should involve determining both damage and action thresholds for control of competitive and unwanted vegetation. Damage thresholds refer to the levels of vegetation abundance where there is a marked decrease in rate of the desired plants' survival and growth.

There appear to be two separate thresholds: one for tree survival and establishment, and another for growth maintenance and release.

A survival damage threshold may have a competitive vegetation density level many times greater than the levels desired for optimal growth (free-to-grow), at least for short periods. Also, adequate growth often infers far less than that for "free-to-grow" status.

Because plant communities are a complex aggregation of plants and animals, the thresholds need to be identified and tested for efficacy and dose response at the plant community, or on a more localized level, and over various time periods including periods of drought and adequate moisture. Variance of floristics, dominance, growth habits, and succession from site-to-site may indicate a need for intensive vegetative control in some locations and during some time periods, yet very little control in other years and locations. Meeting the management objectives and maintaining forest health for one or more similar sites is the key to determining thresholds and selecting a vegetative management approach.

Determination of competitive thresholds gives managers a better analytical approach in making choices about treatment need, treatment method, technique efficacy, and seedling performance on similar or comparable sites. It will also help determine the appropriate degree of tool intensity necessary to attain an expected level of plantation performance (Wagner et al. 1989; Radosevich et al. 1990). To emphasize effective preventive strategies, the BLM will continue developing, modeling, testing, and evaluating appropriate thresholds for action on a plant or ecological community basis.

In addition to the plant thresholds discussed above, there are other thresholds that need to be identified and considered, including smoke intrusion into important airsheds and encroachment of vegetation to or over road surfaces or areas for sight distance. The smoke threshold is governed by state standards (see discussion on Prescribed Fire), and the rights-of-way encroachment by the need for safety.

Scheduling of Detection and Action

Planning is a very essential part of the prevention strategy, due to the necessity to document site evaluations, develop a time-line for the occurrence of expected problems if action is prescribed, and use a pretreatment survey to verify if action is expected to be implemented. With planning, strategies can be developed to avoid certain competitive conditions, design alternative silvicultural schemes, and take early action. In this manner, vegetative and site damage can generally be minimized and further treatment often precluded.

The time to detect and ameliorate unwanted or competitive vegetation conditions is early in the project planning stages, before growth loss of desired vegetation becomes serious, and also before major corrective action is required. This determination of need can occur during regularly scheduled surveys, project analysis, and young stand monitoring.

Priorities

Based upon the foregoing, BLM has established vegetation management priorities to be used in selecting and designing treatment methods to achieve site-specific management objectives. Those priorities are as follows:

Priority 1 - Plan at the earliest opportunity to detect and ameliorate conditions that cause or favor the presence of competitive and unwanted vegetation. Also, review data from past treatments of comparable sites to determine potential need and treatment effectiveness.

Priority 2 - Search for, and use, effective nonchemical methods of vegetation control and selective treatments when feasible. Manipulate the potential vegetation and timing of any prescribed actions to attain the desired conditions and minimize the overall need for control of competitive vegetation.

Priority 3 - Use herbicides only after fully considering the effectiveness of all reasonable treatment options, combinations with various methods of manipulation, and herbicide environmental effects, safety, human health risks (exposure), specificity, effectiveness, and their relative costs of implementation. This includes reducing both use levels and exposures to herbicide by employing application techniques and efficient formulations to improve effectiveness and selectivity, minimizing size of treatment areas, and where feasible combining the herbicide option within a mix of other treatments and methods for a program of integrated pest management.

Because not all potential problems develop and many that develop do not reach a threshold level, it may be appropriate for managers to defer action on some units or portions of units to see if problems do develop or if the potential is serious. Generally, however, whenever treatment is needed it is best to take the earliest available action identified to maintain adequate conditions and growth for desired plants. The earliest action often is to manipulate or reduce the problem vegetation while that vegetation is small and easy to treat.

It may not always be necessary to collect new data to respond to issues and evaluate alternatives strategies. Applicable information may be found in existing site records, or from other comparable sites.

Ongoing Search for Alternative Treatments and Techniques

As part of the preventive and IPM approach, BLM managers and field employees will continue to test, use, and emphasize various prevention and early treatment techniques. The BLM will also evaluate the operational feasibility of new research findings on alternatives to herbicides, reduce practices that rely on corrective actions, and seek ways to reduce both the number and level of exposures to smoke emissions.

Specific techniques or silvicultural practices that generally mimic natural systems will be sought and improvised while applicable research results are being tested for significance. Exploration of new ideas for prevention or treatment of competitive and unwanted vegetation will be encouraged through such cooperative research as the Oregon State University (OSU) sponsored Coordinated Research Alternative Forest Treatment Systems (CRAFTS) and Coastal Oregon Productivity Enhancement (COPE), programs designed in part to address these issues; BLM's Pacific Basin and Rangeland Systems Cooperative Research and Technology Unit (in Corvallis, Oregon); and the National Wildfire Coordinating Group.

This ongoing research will emphasize a preventive and ecosystem approach with study focus on understanding of competitive relationships, determination of a threshold level, and development of techniques that minimize adverse environmental effects.

Examples of potential early and preventive treatments are as follows:

* Plant the largest, appropriate desired plants to provide height and growth advantage over anticipated competing vegetation.

* Use harvest prescriptions or logging systems which limit or tend to avoid the establishment of damaging levels of competitive and unwanted vegetation. These practices may also limit unintended mineral soil exposure.

* Conduct activity planning on both a site-specific and landscape basis to minimize use of site preparation that is advantageous to competitive or unwanted vegetation. Also avoid prescriptions that cannot be implemented during biological windows, over a specified length of time, or for specific locations.

* Manipulate density of desired and noncompetitive plants to get a competitive edge through arrangement, selection of crop species, and the timing of critical operations. Reduce vigor of sprouting understory plants by maintaining a dense forest cover canopy for 10 years prior to harvest.

* Emphasize manipulation of vegetation and timing of any prescribed actions to avoid or reduce damaging levels of competitive vegetation growth or dominance. Avoid prescribed fire on sites where a seed bank of a competing brush species is likely to germinate in reaction to the heat from fire.

* Use selective control techniques such as cutting, covering, pulling, bashing, injecting and dose. Include wound or cut-stump inoculation, or injection, to initiate disease development using chemical herbicides or bioherbicides.

* Use wildlife, and also directed and controlled livestock grazing, to achieve control of competitive or unwanted vegetation; use seedling protection to combine desired effects.

* Seed grass or other vegetation (e.g., live-mulching or smothering) to form a mat of vegetation to reduce growth and invasion of competitive or unwanted plants along roads and within young forest stands. Use forage seeding to attract desired wildlife as a means of manipulation.

* Consider using natural biological control actions (e.g. insects and diseases) on competitive vegetation, which involves setting conditions for, or in some cases injecting into stems, certain advantageous plant diseases. (Bioagents, while readily observed in the forest, however, may encounter as many of the registration requirements and the environmental constraints as herbicides do at present.)

* Reduce ground scarification on sites having conditions favorable to invasion of damaging levels of the competitive and unwanted vegetation.

* Use natural ability of desired and non-competitive native forest plants to out-compete other plants during some part of their development cycle. Avoid introduction of exotic vegetation. Use natural features as techniques to manage competitive plants and damaging animals.

* In planning, be aware that numbers of trees required for planting success have decreased, the number of spots needing treatment has declined, and the potential for spot treatment in contrast to broadcast has increased. Also realize that, except in drought prone areas, treating the area only in the immediate vicinity of a seedling may be adequate for establishment and release.

* Monitor and document desired plant development, recognizing that conditions and timing are critical to discover innovative strategies, anticipate future actions, and take effective action.

Public Involvement

The BLM will have an ongoing public involvement process and an information sharing policy in the implementation of the vegetation management program. When a site-specific project to treat competing or unwanted vegetation with any proposed measure of treatment is being considered, the BLM will notify the public. Such notice will precede the screening stage of any environmental analysis (EA) of the project under NEPA guidelines, which is normally after the stocking survey recommendation stage and prior to the pre-treatment evaluations for potential project status.

The public will be notified and invited to review and comment on the proposed project, the site-specific analysis, and expected effects. The public will also be promptly notified of the Finding of No Significant Impact (FONSI), if appropriate; or the FONSI except for previously identified impacts in another EIS; and the final decision for site-specific projects.

For more detailed procedures on public involvement, see Chapter 5.

Herbicides Dropped From the Proposal

Six chemicals are not considered for use. Diquat, MSMA, and ammonium sulfamate which were among the proposed herbicides in the DEIS were dropped from consideration in the FEIS. These three herbicides were omitted from the risk analysis.

Dalapon formulations are currently not registered for forestry use.

Diuron and fosamine, which were evaluated in the Human Health Risk document (BLM SEIS, Appendix L, 1986), will not be used. For these two herbicides, there was either a lack of sufficient testing, or methods of testing did not meet required test procedures, to conduct reliable toxicological evaluations when Appendix H was prepared (USFS 1987). If new information becomes available on these herbicides, and a need arises for their use, a similar risk analysis to Appendix H would be required.

It should be noted that Amitrole was never proposed for use in BLM's western

Oregon vegetative management program. This disclaimer statement is included here to rule out any potential concerns arising from the determination in the USFS FEIS and BLM Thirteen Western States FEIS that Amitrole toxicity was too high for use on public lands.

Herbicides Available for Use

When herbicides are considered, BLM could use formulations that contain one or more of the following herbicides: asulam, atrazine, 2,4-D, dicamba, glyphosate, hexazinone, picloram, and triclopyr. These herbicides were analyzed for use in the FEIS, in BLM Appendix L (USFS Appendix D), and in USFS Appendix H, all of which are incorporated into the BLM's FEIS. Use of these chemicals is subject to special mitigation measures summarized in this ROD, and the guidance provided in Attachment B (Information on Treatment Methods) and Attachment C (Herbicide Profiles). General information guidelines for all herbicide use is provided in the section of Attachment B applicable to herbicides. Information in the profiles is herbicide-specific, as summarized below:

* Basic information about the specific herbicide, including its use status, formulations, and residue assay methods.
* Herbicide uses including operational details and special precautions.
* Environmental effects and fate of the specific herbicide in soil, water, and air.
* Ecological effects on soil microorganisms, plants, and aquatic and terrestrial animals, including any threatened and endangered species.
* Toxicity data and specific hazards related to the specific herbicide use.
* Human health effects.
* Safety precautions.

Future Herbicides

New herbicides and biocides registered with the Environmental Protection Agency (EPA) for forestry and rights-of-way use will undergo the same risk analysis and implementation procedures as contained herein.

Herbicide Formulations and Inert Ingredients

The BLM encourages use of the least toxic inert ingredients available and requires disclosure necessary to determine conditions of safety before a product can be used.

The reason for this precaution is that most chronic tests of herbicides do not use the full formula (formulated), but test only the active ingredient. A proportion of these formulations have "inert" ingredients which often are neither chemically nor biologically inert and may have substantial toxicity themselves (see USFS Appendix H).

Accordingly, only those formulations that do not contain inert ingredients on the EPA's List 1 and 2 will be used, unless the risk associated with the listed inert ingredients is evaluated and the formulation found acceptable. In addition to considering the EPA information to judge and select the least hazardous inert formulations available for use, BLM will use publicly available manufacturers' data and request acknowledgement about List 1 and 2 inert ingredients. (See Attachment D for herbicides having inerts that are not on List 1 or 2.)

There are two inert ingredients of concern: kerosene and diesel oil (petroleum distillates); both have been reviewed by BLM. It was determined that neither of these ingredients would add significantly to the potency of the formulations in which they are used. To address concerns, however, the Decision will be to subject the use of kerosene and diesel oil as follows:

* Kerosene will not be used in herbicide applications except as an inert ingredient in the formulations of 2,4-D (Esteron) and triclopyr (Garlon 4).

* Diesel oil will not be used in herbicide applications as a carrier; however, diesel oil may be used as an adjuvant (not to exceed five percent of spray mixture).

Herbicide Use Restrictions and Precautions

An annual cap of 8,800 acres is placed on herbicide use during the effective life of this FEIS to reduce reliance on herbicides. When selecting a herbicide, the BLM will use only those herbicides for which herbicide profiles are available at the time.

Another precautionary measure in the use of herbicides is that the personnel directly involved in planning, applying, supervising, and reviewing herbicide applications must be certified. Other precautionary measures BLM will employ relative to all herbicide use include conducting periodic literature reviews by accredited toxicologists, providing herbicide profiles for each of the herbicides approved for consideration, adhering to label regulations, and requiring that applicators be trained regarding safety precautions and proper application technology.

Protective measures specific to herbicide use are provided in Chapter 5 and Attachments B and C. It should be recognized that further review may show that expanded use of herbicides is justified, or that further prudence is appropriate.

Herbicides of Special Consideration

Asulam, atrazine, and 2,4-D have cancer potency values noted in the FEIS, as if they are associated with cancer, or are carcinogenic (see Chapter 6). Also, recent toxicological data continues to recommend a cautious and conservative approach. Atrazine specifically has controversial and possible high risk reproductive margin of safety (MOS) values, especially for workers, and is a potential ground water contaminant. The possibility of contaminants is also a concern with 2,4-D.

The uncertainties about the potential for adverse effects from using atrazine, 2,4-D and asulam have been taken into consideration in the Decision by the placing of these three herbicides in a Special Consideration Category. Use of these herbicides will require specific analysis, including risk assessment for the public and job hazard analysis for the worker, and precautionary measures to assure high risk exposures do not occur. This will include ensuring that all feasible effective alternatives are considered and protection measures such as aerial restrictions, worker protection and posting and controlling access have been implemented as necessary for the specific herbicide being used. Herbicide-specific precautions are identified in Table 2.2, Chapter 5, and Attachments B and C. (The section on Effectiveness of Practice in Meeting Objectives has a related discussion on selection of herbicides of special consideration.)

Prescribed Fire

Because fire is an important ecological factor in western Oregon vegetation communities, it is BLM's philosophy that use of prescribed fire is a logical pattern to follow. Accordingly, where the potential exists to meet goals through burning, prescribed fire will be a main consideration. In its decision to employ prescribed fire, the BLM recognizes the potential risks, especially to human health, associated with the use of the method and with fire and smoke exposures.

The Clean Air Act of 1967, as amended, gives the State the responsibility for the administration and enforcement of air quality standards through their State Implementation Plan (SIP). The Oregon SIP specified a goal of a 22 percent reduction in emissions, using 1982-1984 levels as a baseline, by the end of the year 2001 and also identified certain designated and smoke sensitive areas. The BLM fully intends to comply with these mandates.

Due to the risks involved with its use, prescribed fire will be used only after conducting a worker Job Hazard Analysis. The analysis will include identification of measures for reducing potential health effects from exposure to aluminum soaps (a thickener for gelling petroleum fuels) and from the risk of escapement. The analysis for prescribed fire use will also involve development of a reasonable implementation plan that mitigates adverse short-term air impacts and particulate loading to the extent practical.

Current studies on prescribed fire are helping to determine representative estimates of the peak, short-term exposures, and the time-weighted averages of carbon monoxide, acrolein, formaldehyde, respirable particulate and benzene.

BLM will continue to support research on the quantities and qualities of materials released, the effects of smoke exposure from prescribed burns, and the qualities and quantities of materials released including gelled gasoline. Also to be done are studies on smoke exposure from prescribed fires to see how it is influenced by work activity and environmental factors such as wind speed and fuel moisture.

Additionally, due to concern for potential health effects involving the practice of brown-and-burn (use of herbicides to desiccate vegetation followed by burning), the technique will be subject to restrictions that permit the technique only as recommended in the herbicide profiles or as recommended by supplemental data made available to the public. In the absence of any such guidelines, burning will be permitted no sooner than six months of being treated with herbicides.

Program Size and Scope

The acreage guideline for herbicides (annual cap of 8,800 acres) will preclude a large one-shot effort to use herbicides to address a backlog of acres currently identified as needing treatment.

The size and scope of the annual treatment estimates projected in the FEIS were intended for the purpose of analyzing probable environmental effects, not to set management goals or limitations. Rather, the extent of the vegetation treatment program depends upon the presence, spread, and damage of competitive or unwanted vegetation.

Other determinants for the size and scope of the vegetative management program include goals in land use plans (MFPs and RMPs), length of time between actions (i.e., when timber sales are actually sold and logged), available annual budgets to carry out work in a timely manner, and activity plans for various resource objectives such as forestry, wildlife, recreation, watershed, range, roads, and fire management.

A summary of the annual projected treatments and activities to be implemented by acreage and alternative, including the Decision, is provided in Table 2.1.

The size of the overall program directed at managing competing and unwanted vegetation is large. For instance, at the beginning of Fiscal Year (FY) 1991 and FY 1992, the acreage described as needing vegetation treatment for forestry uses consisted of the acreage on the following chart.

Type of Treatment Needed	Acreage Needing Treatment FY '91	FY '92
Site Prep.	22,325	16,100
Young Stand Maintenance	33,100	47,612
Young Stand Release	18,215	23,100
Precomm. Thinning	43,067	50,000
TOTAL	116,707	136,812

Maintenance and release treatment will continue to predominate, and site preparation is expected to decline slightly for forestry use, but no significant change is expected in the acreage to be planned or analyzed for treatment in the next five-year period.

Increased emphasis on planning and prevention, along with continued site-specific analysis, will determine the projects and the number of acres needing treatment to meet vegetation management goals of current or future resource management plans. Vegetation management in complex vegetal types of western Oregon has not relied, and probably never will, on any single strategy, treatment, or method of control.

A western Oregon-wide review of vegetation management goals will be prepared annually, including a summary of acreage managed by different methods.

Selection Criteria for Treatment Methods

The best strategy, and a combination of available treatment methods and techniques, will be sought in meeting management objectives for an area. These objectives could include development and modification to a desired plant community, seral stage, or vegetative diversity; removal or reduction of undesirable species; and maintenance or enhancement of resources present.

Each proposed project will be evaluated at the earliest point feasible on a site-specific basis as individual or groups of similar projects. Evaluation will be conducted by an interdisciplinary team as part of the environmental analysis process required by NEPA. Public concerns will be sought and evaluated, and potential impacts will be mitigated where feasible in selecting and designing site-specific treatment methods.

The site-specific analysis will involve review and incorporation of required mitigating measures. Mitigating measures that are designed to avoid or reduce adverse effects are described in Chapter 5 and in Attachment B. Additional mitigating measures found in land use plans may either reduce some effects, or the effectiveness, of specific treatments.

Treatment methods and mitigating measures selected would be dependent upon characteristics of the soil and the target plant species; the location, size, terrain, and accessibility of the target area; and weather conditions prevalent at the time treatment is necessary.

In the treatment selection process, the BLM will have yardsticks for measuring safety and human health effects, potential environmental effects, vegetative diversity, project timing and longevity, effectiveness in meeting objectives, and cost-effectiveness. Those yardsticks are identified in the following sections.

Safety and Human Health Effects

In providing protection for human health, the Decision recognizes two important measures: (1) *Potential effects will be determined by using Job Hazard Analysis and exposure evaluation prior to use of all techniques, and* (2) *Reports will be made of any reported health effects associated with vegetation management activities.*

Information packages on treatment methods (Attachment B) and herbicide profiles (Attachment C) for specific herbicides will be provided to aid program managers, workers, and the general public in planning and implementing vegetation management projects. The treatment method information packages in Attachment B address the use of the five primary treatment methods in general, including potential hazards, exposure risk information and measures to reduce adverse effects. The herbicide profiles (as summarized in the section on Herbicides Available for Use, and as included in Attachment C) are also beneficial in protecting human safety and health.

In assessing exposure of herbicide use, BLM will use MOS standards based on criteria developed by the USDA Food Safety Inspection Service (see USDA, 1988). The categories for exposure and associated MOS are listed below:

Calculated MOS	Risk
Less than 10	High
Between 10 and 100	Moderate
Between 100 and 1,000	Low
More than 1,000	Negligible

Risk in the above chart refers to the ratio of an individual's exposure dose to a long-term, laboratory-determined, no-observed-effect level (NOEL) dose. The larger the MOS level, the lower the risk of toxic effects to human health; MOS levels between 10 and 100 pose a moderate risk; and MOS levels of 10 and below are considered to be high risk. MOS levels designated with a negative number indicate there is a risk of possible acute or chronic effects.

In this ROD, an MOS of 100, and a cancer risk of one in a million, will be used as thresholds when considering herbicide use. The various exposure scenarios (e.g., for workers: pilot, loader/mixer, etc.; and for publics: fishermen, hunter, berrypicker, etc.) listed in Tables 6.6 and 6.7 in Chapter 6 will be used as examples of risk and risk calculation.

As an overall safety measure, BLM will continue to gather information and periodically review the literature and implementation situations and risks, monitor implementation, and evaluate application techniques to minimize risks to human health.

Environmental Effects

Both the direct and indirect impacts on soil, air, water, wildlife habitat, vegetative community, visual resources, human health, and social values will be evaluated. The results of such evaluation must be documented in the environmental analysis process and compared to the FEIS and this ROD for presence of potential significant impacts not previously identified. Analysis will take into consideration any new or additional research findings, field experience (e.g., monitoring results), public input, and professional judgement.

When herbicide use is likely to have significant effects on wildlife, an evaluation will be made to minimize adverse effects by using the least toxic herbicide to the potentially affected wildlife while effectively controlling the unwanted vegetation. Timing and other restrictions will be placed on the application as needed to avoid periods when fish or other species of concern are in susceptible or sensitive life stages.

Selection of herbicides and application methods will involve giving consideration to site-specific water quality, soil properties, and herbicide characteristics (particularly their individual persistence and degradation time frame). In making distinctions between buffer sizes, it is important to remember that moving waters dilute herbicides. In most cases, consideration of these various factors will require designating buffer zones.

Vegetative Diversity

In context to this ROD, diversity is considered at the stand or site level and the immediately adjacent and surrounding areas. Decisions at the watershed, landscape and regional level are assessed under land use plans such as RMPs.

To support the maintenance of vegetative diversity, only levels of vegetation that interfere with site objectives will be subject to treatment; natural attributes or their ability to develop will be retained. A diverse mix of species, biological communities, and genes should be maintained; and silvicultural approaches and techniques will be diversified to make options available for maintaining the integrity of the natural ecosystem.

At the local level, major concern is for the maintenance of habitat specialist species (e.g., butterflies, plants and song birds) which are dependent on a particular and limited habitat for retaining viable populations and distribution.

Selective or spot treatments are preferred as opposed to broadcast treatments which have a greater potential of impacting the local diversity of vegetation on a community basis. The exposure of soil surface to erosion and the creation of seedbeds beyond that needed for adequate site preparation for desired plants are also poor management choices.

Concerns about sensitive plant populations which are at greatest risk from accidents, failure to follow prescriptions and proper management practices, and inadequate enforcement of mitigating measures, will be addressed in site-specific analysis.

Project Timing and Longevity

Project prescriptions will clearly identify the time period during which competitive or unwanted vegetation control is needed, the biological window to carry out the project, and the risks involved. Short biological windows should be considered a factor when the following actions are needed: avoidance, pre-harvest treatments, soil exposure (for a seedbed), and pulling or covering of unwanted vegetation. These types of actions, like herbicides, require timing and high priority budgeting to be effective.

Anticipating action needs and using the preventive approach can reduce the need for subsequent corrective action treatments. This can be done by analyzing the full cycle of the vegetation, and anticipating its roles of structure and function over time. Actions must meet the long-term objectives for that site in that landscape.

For instance, trees and snags left for wildlife habitat may preempt treatment methods, but are needed for long-term nontimber management objectives.

Effectiveness of Practice in Meeting Objectives

All methods must be evaluated for effectiveness in terms of achieving resource management goals and promoting desirable plant relationships along with their operational practicality and feasibility. A factor to consider is whether the treatment leads to a long-term prevention strategy.

For herbicides designated as Special Consideration, the yardstick for comparison is whether another method for treating the competing or unwanted vegetation can achieve the resource management goal. If another method can meet the goal, even though not as easily or quickly, then that other method is deemed effective. Conversely, if all other methods cannot achieve the resource management goal but the herbicides of special consideration can, then the other methods are ineffective.

For other vegetative management treatments, including herbicides, Priorities 1, 2 and 3 listed early in this Chapter are applied.

Cost-Effectiveness

The cost-effectiveness of each practice will be an important consideration in selecting the treatment method. There is neither ecological nor economic advantage to either controlling competitive vegetation more than is required to remove the plant from the competitive, unwanted or damaging category, or to not have adequate release of desired vegetation to attain site objectives over time. Methods that would make resource management goals untenable economically (i.e., not capable of being attained) are too expensive.

Determining cost-effectiveness will consider that a lower cost per acre is normally achieved when individual projects are consolidated into one contract. For instance, consolidation reduces the cost of moving equipment to and from the job sites; and having similar vegetation type contracts reduces site-by-site analysis, contract redundancy, and preparation costs.

Some practices should be cooperatively planned and executed with adjacent resource areas, districts, and agencies to take advantage of sharing work force and lowering the cost of treated acres.

Cost-effectiveness is also a factor when vegetation control activities are delayed or deferred. These treatment deferments often suspend planting programs or place new seedlings into situations where they cannot effectively compete with established vegetation. Consequently, more drastic vegetation control measures are required at a later time. Many rescue strategy operations can only be effectively implemented using broadcast methods involving scarification, herbicides, and brown-and-burn techniques.

Cost alone, however, will not be the sole determining criterion in the decision-making process. Both direct and indirect costs of a treatment will be taken into consideration. The effectiveness, environmental effects, risk, and cost will be weighed together on a site-specific basis in determining the most effective method to accomplish the desired results.

Monitoring

Monitoring will be conducted from three aspects: (1) individual units, (2) program assessment, and (3) worker and human health concerns. The details for each of these directed monitoring efforts is provided in the section on program implementation in Chapter 5.

Interrelationships

Due to the scattered nature of BLM-administered land in western Oregon, the BLM must coordinate its vegetation management activities with adjacent landowners and managers. The BLM will also work closely with other federal, state, and local government agencies responsible for special resource management programs, such as the EPA, U.S. Fish and Wildlife Service, National Park Service, Advisory Council on Historic Preservation, and Native Americans. In giving consideration to these agencies, Section 202.c.9 of FLPMA requires BLM to develop land use plans consistent with state and local governments to the extent of being consistent with Federal laws and regulations.

Program Coordinator

A Vegetation Management Program Leader in the BLM's Oregon/Washington State Office, in conjunction with a counterpart in each of the six western Oregon districts, has specific responsibilities, as follows:

1. Review proposed projects that may have potential implications for the use of herbicides in treating competing and unwanted vegetation before a decision is made to proceed with such projects.

2. Monitor for compliance with the FEIS and ROD. Ensure that field operations conform with management's expectations governing the use of herbicides and other vegetation management methods.

3. Participate in technology transfer meetings to address ideas, successful applications, and needed improvements in the BLM's western Oregon vegetation management program. Assist in holding meetings within the agency, and also between agencies, permittee and interest groups on vegetative control programs when consistency is needed on a regional basis or between districts.

4. Facilitate and serve as a contact for communication within the agency and with the public, agencies and permittee for BLM's western Oregon vegetation management program. Provide an annual meeting open to the public to address ideas, progress, and difficulties of the program. Maintain and periodically update a general or regional public involvement contact log including a list of individuals who want to participate in meetings, receive meeting notes, provide written input, and receive yearly summary newsletters.

5. Monitor, develop, and incorporate new information about vegetation management strategy, methods, and techniques into the western Oregon program. Revise assessments of risk and effects of using vegetation management methods, as needed, based on field experience. Monitor information on data gaps. Recommend revisions to mitigation methods and management practices to reflect current information.

CHAPTER 3 - ALTERNATIVES CONSIDERED

Review of Alternatives

Eight alternatives were formulated through the FEIS scoping process. This was done with the help of the public to address issues of concern, affected environment, and environmental consequences of the program. Full descriptions of these alternatives and their impact analysis is in the Final Environmental Impact Statement of Western Oregon Program-Management of Competing Vegetation.

The strategy for the eight alternatives was to focus on control or management of vegetation through various conventional means. These alternatives present a broad range of probable environmental consequences (impacts) for review and consideration and are the core of the analysis.

Development of the Decision was in response to public and agency comments, on-the-ground experience, vegetation management research, and the concerns expressed not only for the vegetative management program, but other programs as well to look at the overall perspective from a preventive aspect. It incorporates selection of a best planned course of action, introduces thresholds for action, and includes elements from seven of the eight originally analyzed alternatives.

The alternatives and their impact analyses, and the Decision which is within their scope, meet the requirements of the National Environmental Policy Act (NEPA) for considering the natural and human environment and for addressing known public concerns and issues.

Summaries of the eight alternatives and the Decision are provided below.

Alternative 1 is designed as an integrated program of vegetation control methods with ***the use of all approved methods and techniques*** known to be effective in meeting resource management goals. Alternative 1 was the preferred alternative in the FEIS.

In the draft ROD, Alternative 1 was modified and referenced as Alternative 1A. The modification consisted of introducing "course of action" and "project design," and changing strategic emphasis from corrective treatments to focus on prevention, early treatment, and effective alternatives to herbicides. Modifications of the prescribed burning program were also proposed to reduce undesirable emissions. Alternative 1A was the preferred alternative in the draft ROD.

Alternative 2 proposes use of all approved methods of vegetation control but with ***emphasis on the use of herbicides***. Aerial application would be used whenever aircraft could reasonably be used to reduce cost and worker exposure. Compared with the FEIS Preferred (Alt.#1), this alternative proposes a reduction in both prescribed burning and mechanical scarification for site preparation and initial vegetation control, and mechanical methods in roadside maintenance.

Alternative 3 proposes the use of approved vegetative management methods, but ***prohibits prescribed fire for site preparation and vegetation control.*** Prescribed burning for hazard reduction, however, would continue. The exclusion of prescribed burning would necessitate a major change to provide site preparation, early vegetation control, and planting access. There would be increased use of manual and mechanical site preparation treatments compared to Alternative 1 (the Preferred), and in many cases increased use of herbicides for vegetation control.

Alternative 4, which proposes use of all approved methods of vegetation control, ***emphasizes use of effective labor-intensive methods.*** Manual application of herbicides would be used where they would effectively and acceptably prepare sites or control competing vegetation. A factor in considering this approach is that many site preparation jobs where labor intensive methods were used extensively in the past decade have been mechanized with the use of grapples and "spiders." Cost-effectiveness (and budget) and exposure to herbicides are also major factors in this alternative.

Alternative 5 proposes use of all approved methods of vegetation control, but ***prohibits aerial application of herbicides within 0.25-mile of residences or domestic water diversions in treated drainages*** unless consented by the residents or water users. This herbicide restriction does not apply to herbicide applications applied by ground application methods.

Alternative 6 proposes the use of all vegetation management methods, but ***prohibits all aerial application of herbicides.*** In this alternative, herbicide use is proposed by mechanical, and backpack or similar ground application methods.

Alternative 7 proposes to use most methods of vegetation management, with the exception that ***all use of herbicides is prohibited.*** This alternative eliminates all risk associated with herbicide use. It essentially ***continues the current vegetative management program*** resulting from the U.S. District Court injunction of 1984.

Alternative 8 proposes ***no management of competing vegetation.*** It permits manual methods and gross yarding of timber harvest areas for site preparation to reduce fire hazard and provide planting access. It also allows manual methods for treating unwanted vegetation when public safety is clearly and directly threatened, such as, roadside brushing and maintaining campgrounds. Alternative 8 is the "no action" alternative required by regulation (40 CFR 1502.14). It would be a radical departure from the manner in which the BLM has administered public lands. Also of significance with this alternative is that the resource objectives dependent on manipulating competitive or unwanted vegetation would not be met.

Because it has the least potential risk of impacting human health, Alternative 8 is identified as the environmentally preferred alternative.

The Decision adopted in this ROD implements an integrated vegetative management program where ***all approved methods of vegetation management are considered for use.*** It adopts a ***preventive strategy*** to change emphasis from corrective to planning, includes more open public involvement, identifies ***priorities in control methods,*** and places an ***annual acreage cap of 8,800 acres*** on potential herbicide applications.

The active planning and documentation approach of the Decision, like Alternative 1A of the Proposed ROD, puts strategic emphasis on prevention, early treatment, and effective alternatives to herbicides. Emphasis on modifications of the prescribed burning program is included to reduce undesirable emissions. This alternative has a commitment to public and worker safety, project analysis, monitoring, and public involvement.

See Table 2.1 for a comparison between the existing situation and projected treatment acreage by method and activity for each of the alternatives and the Decision.

CHAPTER 4 - DECISION RATIONALE

General

In its decision process, along with following statutory requirements, the BLM considered the concerns and input of the public, interest groups, and other government agencies. BLM also took into consideration its resource management goals, as well as what was learned from analysis on the vegetative management program. Consideration of these various factors form the basis for the Decision. As can be expected, there are trade-offs with the selected approach that were needed to address the major concerns. The Decision does, however, represent a suitable and reasonable course of action that best meets the needs for the western Oregon vegetation management program.

The Decision considers pertinent new information and combines strategies from seven of the eight original alternatives (excepted alternative is Alt.#2 which addressed increased herbicide use). Impacts of the Decision are within the range of actions and impacts analyzed in the FEIS. In designing the Decision, four guiding processes were emphasized:

(1) Definition of vegetation management process and competitive and action thresholds.

(2) Analysis of risk and health concerns and a manner of recording effects.

(3) Public involvement inputs.

(4) Selection of treatment method.

Important elements of the Decision are summarized in Table 2.2.

Public Input

The people who provided input to the BLM were from a wide diversity of backgrounds and therefore had many and often differing ideas about how BLM should manage competing and unwanted vegetation. Some people expressed a desire for no vegetation management of public lands, while others accepted practices for achieving high levels of commodity and timber production.

Concerns were expressed about public and worker safety, forest health, watershed management, habitat diversity, stream and riparian areas, rural residential interface, analytical techniques and changing technology, social values, and economic conditions. The main messages are summarized as follows:

* People want the BLM to protect the forest environment, including both the health of public and workers and the health of the forest as a whole.

* People want the BLM to maintain productivity of the forest in both the commodity goods and services and the noncommodity goods and services, including wildlife habitat, watersheds, and air quality.

* People expect BLM to conduct careful resource analysis to ensure that treatment needs are fully analyzed, necessary, and communicated.

* People expect BLM to stay current with regulations, practices and procedures and to communicate information effectively throughout its own

organization, as well as with its neighbors and communities.

* People are very concerned about herbicide use and prescribed burning as vegetation management methods. Also, people want BLM to use practices that reduce future vegetation problems, and to look at long-term impacts and cumulative effects.

Statutory Considerations

Many statutory mandates guide BLM in managing competitive and unwanted vegetation on public lands. A list of the statutes representing the primary legal guidance BLM must consider in preparing vegetation management plans, while not inclusive, is provided below.

The four principal laws for this program are briefly described, as follows:

* **O&C Sustained Yield Act**. The BLM's western Oregon principal authority and direction to manage the O&C and CBWR grant lands is found in the O&C Sustained Yield Act of 1937 (50 stat. 874; 43 U.S.C. 1181a., et seq.).

* **Federal Land Policy and Management Act of 1976 (FLPMA)**. FLPMA established policy for BLM administration of public land. This Act requires BLM to develop and implement land use plans designed to help managers to make future site-specific and activity-specific decisions (90 Stat. 2743, 43 U.S.C. 1701).

* **National Environmental Policy Act of 1969 (NEPA)**. NEPA establishes a procedural process to be undertaken for proposed management actions. The NEPA process with its "action-forcing provisions" is intended to help managers make decisions that are based on understanding of environmental consequences; take actions to protect, restore and enhance the environment; and ensure that environmental information is available to public officials and citizens before decisions are made and before actions are taken (40 CFR Parts 1500-1508). Instructions for complying with the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act are in BLM Handbook H-1790-1.

* **Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as amended** which establishes procedures for the registration, classification, and regulation of all pesticides including herbicides.

Other statutory considerations applicable to vegetation management are found in additional legislation, as follows:

* Executive Order 11514 - Protection and Enhancement of Environmental Quality.
* Recreation and Public Purposes Act of 1926.
* Clean Air Act of 1967, as amended.
* Coastal Zone Management Act of 1972.
* Endangered Species Act of 1973.
* Soil and Water Resources Conservation Act of 1977.
* Federal Water Pollution Control Act of 1948, as amended.
* Safe Drinking Water Act of 1974.
* Wilderness Act of 1964.

Resource Management Goals

The BLM, in considering the needs of multiple uses, manages competing and unwanted vegetation to meet several basic resource management goals:

* Promptly reforest harvested lands.
* Promote desired vegetation relationships with competing vegetation to provide adequate light, moisture and nutrients.
* Keep road sight distances safe.
* Retain or restore riparian and watershed vegetation.
* Maintain and restore habitats for wildlife and botanical species.
* Reduce rates of weed invasion into protected natural areas.
* Maintain vegetative research plots designed to compare tree growth and field trials, including forest tree seed orchards.
* Maintain vegetation in a condition that provides for fire protection.
* Reduce unwanted vegetation in recreation areas and administrative facilities, and along rights-of-way, to protect safety of users.

This list illustrates the importance of vegetation management in supporting the goods and services of many resources. The objective in developing the Decision was to enable the BLM to meet a majority of its land management goals while ensuring that human safety and forest health were protected.

The resource goals that vegetative management supports are addressed in RMPs and are beyond the scope of this analysis.

Perspective on Treatment Methods

Vegetation management is not a resource goal in itself, but rather a process to support a multitude of other program services and land uses such as those described in the preceding section. In recognition of this function, the perspective of vegetation management is broadened to encompass not only techniques proposed for control actions, but to include project planning and long-term strategy as well. This broader perspective is provided to help the agency and public visualize how vegetation manipulation fits into the design of projects in resource management in western Oregon.

Another important part of the analysis process leading to the Decision was review of the period between 1984 and 1992 which provided an operational test of a number of strategies and techniques for all methods of vegetation management, except for the application of herbicides. This time interval demonstrated that various methods could be implemented with varying results attained, and also that not all units require vegetation management.

Results of using alternative treatment methods to herbicides have, in some instances, indicated that selective control of vegetation will avoid the need to treat full units, or may lessen the intensity of impacts on other resources.

Selecting vegetative management treatments to achieve effectiveness requires appropriate timing of actions. Correct timing is essential for all treatment methods, but is particularly critical for manual and herbicide applications. Physiological or response differences between desired and competitive species allow treatments to be timed to act when unwanted vegetation is susceptible and desired vegetation is either in a vigorous condition or is resistant. Close observations before and during operations, however, are critical to determine the correct timing for effectiveness and to keep damage to nontarget species at negligible levels.

Observations on most sites showed that minimum and often target stocking standards could be met with available treatments, but growth targets may not. In some cases where the stocking targets were not met by available treatments, or actions did not work effectively, "rescue" corrective actions (generally herbicide treatments) are now needed to meet management goals and stocking standards. A carryover of vegetation management work has accumulated where budget (including funding for projects and personnel) or effectiveness was less than adequate.

One way BLM judges effectiveness of treatments is by documenting the number of trees planted to enable figuring the percentage of survival. Other more widely used methods include visual observation and leader growth analysis, both of which are easily obtained. These latter two types of analysis, being subject to estimator bias and variable protocols, cannot be directly compared to other evaluations or studies (Zedaker and Miller, 1991). A good evaluator for young stand management has yet to be developed, but several procedures are being explored.

The importance of having all methods of vegetation control available to the manager is further clarified in the following discussions by treatment method.

Manual

Manual treatments have great flexibility, but are most effective where selective treatment is needed and when both a window for effective biological action and a labor force is available. Pulling, cutting, bashing and covering of vegetation have proven to be effective control measures and have sometimes been the only reasonable alternative for environmentally sensitive situations.

The BLM has effectively used manual methods when contracting for a sequence of site preparation, planting, maintenance, seedling protection and release.

A high level (over 50 percent) of reliance on manual methods is expected to continue throughout the next decade. This estimation is based on the flexibility to manually treat vegetation following different harvest options, the level of skills learned in prescribing and carrying out manual contract work, and the development of a skilled labor/workforce that has developed.

Factors that could restrict the use of manual treatments include worker protection and budget constraints.

Mechanical

The use of mechanical methods is dictated to a large degree by the site-specific slope and soils. In mechanical treatment methods, consideration must be given to both soil disturbance and the potential to incur compaction, which limits its application. An attendant impact of mechanical treatment is the creation of a seedbed, which can be both positive and negative. The two aspects need to be assessed in deciding whether mechanical treatment is appropriate. This is particularly important to the preventive strategy advocated in the Decision.

Among the other soil-specific factors to consider is that some soils are very resilient, some only need a slash bed for access trails, and others permit only microsite disturbance.

The amount of residual vegetation on a site is another important consideration factor when considering mechanical treatment. Generally, the more reserved vegetation a site has, the more difficult it is to implement mechanical methods without incurring adverse impacts to the vegetation.

Some of the impacts of mechanical treatment may be minimized to an acceptable level when implementing advanced technologies. For example, there is improved, new equipment such as grapples or "spiders" now being used for pulling and masticating mechanical treatments. These machines and techniques are replacing blading and piling in site preparation activities where there is heavy lifting or pulling of sprouting clumps. Not unlike some of the older techniques, these newer methods require a certain level of creativity and assessment of access, but can be used to treat portions of units. A note to remember about using nonconventional equipment is that they require planning to implement and time to locate needed machinery.

Mechanical treatment methods will continue to be the major means of roadside maintenance. It has been cost-effective where used to prevent brush encroachment into driving lanes, maintain visibility on curves and around signs, and permit drainage structures to function as intended. For the most part, the initial investment in adequate equipment has already been made.

Gross yarding (not normally defined as site preparation) is a mechanical vegetative removal method that will continue to be important to remove unmerchantable material, improve access, and reduce accumulations of materials which could produce high smoke levels when burned. Traditional levels of gross yarding, however, have been reduced, mainly because down logs have been retained to contribute to habitat for an array of wildlife and to biological legacies. Decreased levels of gross yarding that may occur in the future are not accounted for on Table 2.1.

In the future, the use of mechanical site preparation in combination with biological methods such as "live mulch" or low-growing vegetation may have potential. There may be increased use of mechanical treatment as new equipment is developed to use in lieu of manual vegetative treatments that are tedious or hazardous. In some instances, decreases in the level of mechanical treatment may occur where culturing of desired vegetation can be implemented effectively to achieve safety objectives along roadsides.

In general, in considering cost of implementation, the mechanical methods that are feasible are relatively inexpensive. The main constraint with using mechanical treatment methods is that it requires a flexible approach designed on a site-specific basis to achieve desired vegetative diversity goals.

Overall, the use of mechanical methods is expected to increase slightly above levels projected in the FEIS. Those increases will occur mostly in young stand maintenance. Road maintenance will continue to account for over half of the needed mechanical treatment.

Biological

Biological treatments, including natural and cultural responses, are now recognized as being operational actions rather than experimental.

Natural biological changes affect vegetative composition in various ways.

For example, changes are occurring in species composition and coverage with the current drought and beetle epidemics by the thinning out and releasing of various vegetation. Changes are also being seen in the mosaics of vegetation following recent large wildfires in southern Oregon. Natural diseases, too, play a biological role; one example is *Phellinus* (laminated root rot) which limits Douglas-fir while promoting the establishment of red alder, redcedar or sugar pine.

Managed biological control using bio-agents is still in its infancy. However, where known to be effective, it may be used as a strategy to select, suppress, inhibit or control competitive or unwanted vegetation. Established biological methods include using insects to control exotic noxious weeds, and not introducing or spreading the problem weed in the first place.

An important scientific breakthrough in biological control includes the use of mycoherbicides (plant pathogens used in the same manner as herbicides to kill or constrain the growth of competitive or unwanted vegetation). While mycoherbicides may be a major industry in agriculture, their acceptance is not expected in the forestry environment due to various concerns and perceptions very similar to those associated with the use of herbicides.

Some biological treatments and techniques are quite simple. One example is the seeding of grass or low brush to prevent alder from occupying fill slopes and providing seed sources during site preparation. Another is mowing of vegetation or limiting the exposure of mineral soils in ditchlines near sources of Scotch broom or other noxious weeds to reduce their spread down road right-of-ways.

Vegetative maintenance can be achieved through biological treatments that favor desired plants and expose competitive plants to wildlife foraging. This technique involves cutting of vegetation to within browse heights and also maintaining or providing adequate game trail access.

It is not uncommon for biological treatments to involve a combination of actions. For example, tubing has been used to provide physical protection (prevent browse damage) to young seedlings in areas where forage plants have been provided for grazing. Another effective combination treatment, where moisture is adequate, has involved planting of seedlings and seeding of selected grass and forbs as a "live mulch" or as a quick seedbed cover on areas that have been burned by either broadcast prescription or wildfire. The seeding on these areas was done to encourage grazing by both domestic and wild animals as a means of controlling vegetation.

While domestic animals such as sheep, cattle and horses have been used to control top growth of some competitive and unwanted vegetation, such use can generally be selective only to a certain point.

The biological treatments discussed above have increased the estimated biological treatment acreage while having little or no significant adverse environmental impacts. Mutually beneficial techniques that combine timber site preparation with wildlife habitat manipulation will double the projected biological treatment methods previously estimated.

In addition to the above natural and historically-viewed biological methods, a number of operational practices conducted under land use plans to achieve multiple use objectives are recognized as biological treatments. These include commercial and precommercial thinning, release, stand maintenance, brush field conversions, reserving habitat for wildlife, and also creating wildlife opening and/or thickets.

To date, controversy about the use of natural biological control involving disease and insects has been high, which has been a constraint to its use. Research will continue to investigate the potential of biological treatments for practical, effective and acceptable applications. It should be recognized that, to a degree, the preventive strategy of the Decision, involving the manipulation of stands to avoid undesirable and unwanted vegetation and encourage desired vegetation relationships, is based upon biological responses.

In the future, management enhancement techniques may be able to detect when a pathogen is present and accentuate the conditions that either promote the pathogenic capacity of a fungus or reduce the physiological vigor of the host. There may be benefit realized in fungal relationships above or below the ground, insects, or establishment conditions that operate to the detriment of competitive or unwanted vegetation. Some locations of sugar pine, cedar and hardwood are expected to be best suited to these management practices.

Prescribed Fire

Prescribed burning continues to be a preferred site preparation method. It is effective in reducing natural and activity-created accumulation of plant debris, achieving vegetation control through desiccation, maintaining fire-dependent plant communities and environments, promoting available brush and forage vegetation or opening areas under the forest crown for wildlife, and sanitizing disease and insect-infested plant communities.

Protecting air quality and human health requires a reduction in acres burned and/or a reduction in smoke emissions. The acreage to be burned for site preparation can be reduced by leaving down materials in place, employing alternative treatment methods, using chemical vegetation controls for desiccation of green fuels, utilizing residues for commodity or redistribution of fuels within units by gross yarding, and using planting methods that do not require burning.

The most obvious way to reduce smoke emissions is to reduce the number of acres burned. While the Decision has decreased acres to be burned in post timber sale site preparation, the total projected burn acres is about the same. This is due to increases in underburning to reduce wildfire hazard, and in prescribed fire to maintain a natural diversity of species and to meet various other forest health issues. Overall, the acreage of prescribed fire is projected to continue at only slightly below current levels (see Table 2.1).

There are other factors besides the number of acres burned that contribute to the quantity of smoke emissions. A basic assumption in analyzing smoke emissions is that no two burns are exactly alike in emission loads and in dispersal patterns. In areas where air quality is of concern, smoke emissions can be lowered by implementing the following:

1) Reducing the amount of biomass consumed, the particular fuel bed components of the pre-burn fuel loading, the fuels consumed during different phases of combustion (pre-ignition, flaming, smoldering, and glowing), and limiting the emission to PM-10 lbs. per ton of fuel).

2) Using alternative treatments in conjunction with burning to improve the burning technique, and also learning improved burning techniques.

The BLM is employing several actions that will reduce emissions when using prescribed fire as the preferred treatment. Those techniques include spring burning, mass ignition, and quick mop-up. Currently, these are considered the best strategies for minimizing both biomass consumption and emission levels while still meeting project objectives.

Another key factor that has been found to control emission levels is burning when the litter layer and large fuels are moist, yet when the target fuel condition facilitates combustion. Minimizing the amount of smoke emitted during combustion is also effective in emission reduction. This is especially true for the live fuel component.

Impact of combustions associated with the use of gelled gasoline in fire ignitions is unknown. While the risks from such burning appear negligible (BLM, FEIS. 1989), the hazard data sheet recommends workers take precautions when handling both the solution and dust concentrate form of gelled gasoline.

Due to the reliance on prescribed fire to achieve site preparation and subsequent vegetative management needs since the 1983 court injunction on herbicide use, burning has been used to control vegetation where herbicide use would have been more effective and efficient.

A decrease in smoke emissions and the number of burn days is clearly being mandated by a concerned and changing public of forest residents, recreational users, and the public in general. These factors are expected to alter the uses, timing, and manner of implementing prescribed fire.

Herbicides

The Decision to put an annual cap on the yearly acreage of herbicide treatments does not infer that herbicides are ineffective or costly. Rather, this determination to limit herbicide use arises from a concern among many people, including professionals, about the use of herbicides.

Although markedly less toxic than insecticides, herbicides must be handled and applied with care. This need for caution is the reason that the EPA registers herbicides, the BLM conducts risk assessment for public exposure and job hazard analysis on site-specific projects.

There are several advantages to using herbicides:

(1) *Wide range of selectivity to target a broad range of species or individual plants.*
(2) *Variable periods of control.*
(3) *Does not disturb soil surface.*
(4) *Can be applied in a variety of techniques to meet most design criteria.*

Studies conducted by BLM in western Oregon, through the Forestry Intensified Research (FIR) and CRAFTS, have shown that herbicides are very effective in managing vegetation.

There are some disadvantages with herbicide use just as there are for all vegetative treatments. Mainly, the concern with herbicides are their detrimental potential for off-site or nontarget organisms effects, which have been subject to considerable analysis. These concerns have been addressed in the Decision through design features, including buffers, and other mitigating measures. These measures will minimize the potential for off-site effects. Also, off-site impacts become increasingly less significant with distances from treated sites. Site-specific analysis is also expected to mitigate the potential for off-site or nontarget impacts.

The Decision to have some herbicide treatment considered the above factors, FEIS disclosures, other FEISs and supporting documents, results of an additional open literature search, public and interest group comments, and presentation of FEIS data and evaluation by toxicologists who reviewed the FEIS (see Attachment A) and open literature sources. The BLM has determined that the herbicides considered for use (atrazine, asulam, 2,4-D, dicamba, glyphosate, hexazinone, picloram, and triclopyr) can be applied with precautionary measures to minimize potential adverse human health risks to the public and workers.

Several herbicides will not be considered for use due to insufficient information available to conduct an adequate toxicological evaluation. Diuron is one of the excluded herbicides; this exclusion was based on limited but available data suggesting relatively high toxicity and a high risk of exposure to the applicator. Also excepted from this Decision is the use of dalapon which is no longer registered for forestry use.

In designing its Decision, the BLM considered there were specific concerns for individual herbicides including their persistence, mobility, and decomposition; potential to adversely affect microorganisms, surface water and riparian zone vegetation; groundwater contamination; nontarget effects on vegetation, wildlife, invertebrates and microorganisms, and aquatic plants and animals; and human health effects and exposures. These characteristics change not only with the chemical used but also with the specific ecosystem where it is used, which requires each herbicide to be prescribed on a situational or site-by-site case.

The potential for adverse human health effects to workers, residents, and forest users, and for unacceptable environmental damage, are critical considerations when herbicides are proposed for use. Public controversy and concern requires that herbicide use involve specific prescription, public involvement and notification, careful implementation, standard and site-specific mitigating measures, and a high degree of monitoring. The BLM believes that these specific design features of the Decision address public concerns.

Herbicides differ from many other toxic substances. To be registered for commercial sale and public use, herbicides must provide specific economic and social benefits. This is not to say that herbicide use is free from environmental hazard or risk. In registering herbicides for commercial sale and public use, EPA must (according to FIFRA) include a finding as to whether the herbicide poses an unreasonable risk to human health or the environment when used in accordance with labeled instructions and, further, considering the benefits of its use. Such regulatory finding regarding human health risk has been made for each herbicide proposed for use by BLM.

The BLM's Decision, however, cannot and does not end with reliance on EPA's judgement under FIFRA that each herbicide is safe enough to be commercially sold and publicly used. This guarded position is taken due to discord between past studies supporting the registration of commercial products containing active ingredients proposed for use in the FEIS and the current protocols for human health research. New studies and disagreement among experts about past studies raise more questions; and yet, still other evidence confirms the studies supporting registration.

Perhaps most important, as the FEIS shows, there are data gaps (i.e., lack of some potentially relevant information) for some of the proposed use herbicides. These data gaps are listed in Chapter 6 tables.

A main reason for data gaps is that few studies are available on human health, so the evaluations are based on studies conducted on laboratory animals all of which are not complete. In some cases (e.g., where good laboratory procedures are not followed), extrapolation of information can result in many uncertainties. Because of these variables, the evaluation of human health risks uses a prudent assessment approach.

There are known uncertainties about the following:
- Field exposures to workers except for 2,4-D, picloram, and dicamba.
- Dermal penetration of most herbicides.
- Information on exposure of the public.
- Cancer potency of asulam, atrazine, 2,4-D, and picloram.
- Residual levels of herbicides on plants and animals over time.
- Toxicity information on the synergistic effects from exposure to more than one herbicide or many formulations.

In the context of this ROD relative to herbicide use, the term "safe" should not be construed to mean risk free. Rather, when applied to herbicide use, safe implies that the environmental hazards and risks of each herbicide are estimated to be acceptable under the cited parameters of its prescribed use. Risks of exposure to herbicides will be conducted situation-specifically and site-specifically, using calculated and compared margin of safety from herbicides in typical and operational worst-case forestry operations (including right-of-way and other situations) and accidental occurrences. Low risk, defined here as acceptable, is applied to situations having a margin-of-safety greater than 100 and to a cancer potency risk identified as one chance in a million of causing additional cancer over a person's lifetime. (See Chapter 6 for additional discussion.)

The decision to use herbicides rests upon the judgement that to continue forgoing their use substantially compromises BLM's efforts to manipulate, control or reduce competitive or unwanted vegetation, and further that the benefits of using herbicides outweigh potential hazards related to their use.

The BLM is studying situations where alternative methods to herbicides have a limited use or unreasonable costs. Agency records indicate that, totally forgoing the use of herbicides from the standpoint of precluding needed treatment and incurring increased environmental treatment costs, while considering the predicted low risk levels found by implementing the Decision and its mitigating measures, would be an unacceptable alternative.

The level of projected herbicide use will permit significant reductions in carry-over of "no other reasonable alternative" units within a 3-to-5 year period. It will also result in effective treatment of units where herbicide use is the best method, while keeping focus on preventive and alternative treatment methods.

Risk of Cancer

Nationwide, the chance of developing some form of cancer during one's lifetime is about one in four. Among the many causes of cancer are occupational exposure to carcinogens and contaminants, certain foods, and heredity. Between 4 and 20 percent of all cancers are estimated to be work-related. A review of state statistics shows that cancer accounts for 22.6 percent of all 1986 Oregon fatalities (USFS FEIS, 1988, p. Risk-63). The use of herbicide in the vegetative management program has a probability of adding approximately one cancer death per million.

The USDA Forest Service contracted with the University of Washington to provide expertise concerning toxicology additional to the quantitative analysis developed under contract by Labat-Anderson, Inc. Review of other published literature subsequently resulted in joint resolution of many differences of interpretation between the Appendix L (1986) and (1988). The goal was to determine the reliability placed on the characterization of herbicide toxicity. Since ratings of adequacy are not proven scientific facts, an expression of certainty was assigned to disclose, to a degree, the level of uncertainty for the base data. The two studies, considered to be complimentary, were both included in the ROD analysis and the Decision.

Additional new information available on these topics sometimes conflicted. To give a comprehensive look at the available data, the conflicts in MOS levels are displayed in Chapter 6 tables. A probable reason for the conflicts may be the differences in analysis processes discussed earlier in this chapter. Although the MOS approach is a dated analysis method, it is still considered to be acceptable.

Inert and carrier ingredients are chemicals added to the active ingredients to facilitate the effective application of the herbicide. These inert ingredients and carriers in certain formulations and under certain conditions have the potential to be a hazard to human health. It is BLM's intent to avoid using any inert ingredients shown to be carcinogenic or of high priority for testing. To assist with this effort, a list of the herbicides that do not have EPA-classified List 1 or 2 inerts has been provided in the Decision (see Attachment D).

Although kerosene contains small amounts of benzene and BaP that are known to cause cancer, kerosene has not been shown to cause cancer in laboratory animals; further, it has low toxic potential. The BLM is taking a conservative approach and limiting exposure due to insufficient information on various sources of kerosene by deciding to use it only in the ester formulation of triclopyr and 2,4-D where it is a minor constituent.

Regarding the used of diesel oil, another inert of concern, no acute human health effects have occurred in the long history of its use. Nevertheless, BLM is taking a conservative approach by deciding that diesel oil will not be used except as an adjuvant until more information on the potential risk of using these full mixtures can be assessed.

Health risks to the general public are liable to be experienced primarily from herbicide drift, and from the forest user who walks into or through a unit that is being treated or has recently (same day) been treated. With planned precautions, such as notification of neighbors and posting of units, it is unlikely that most members of the public would receive an exposure to levels that would incur ill effects. Specific steps will be taken to identify sensitive individuals who could have more severe effects (i.e., flu-like symptoms which would be reversible within a few days).

The Decision to retain the use of herbicides was based upon several factors:

(1) *For the public, a margin of safety (MOS) threshold of 100 or less is being used as a benchmark to require additional precautionary measures to minimize health risks. For example, BLM will avoid treatment of areas with nearby residents when estimated MOS levels are below 100.*

(2) *For workers, the high risk threshold (MOS of 10 or less) is being used as a benchmark to require special precautionary measures.*

(3) *Only herbicides that have sufficient data to determine their program risk will be used.*

(4) *When using herbicides that have shown increased tumor incidences with laboratory doses, the BLM will require extra precautions to minimize exposure to workers and the public.*

Emphasizing the use of herbicides that have MOSs greater than 100 in routine exposures, and a cancer potency sufficiently low under normal precautions with mitigating measures, will provide a conservative approach where exposure is precluded or minimized to a level within acceptable limits.

Designating asulam, atrazine, and 2,4-D as special consideration herbicides, is expected to reduce the risk of exposures to acceptable levels. While asulam has demonstrated some level of potency for cancer and has minimum testing of its human health potential, its other toxicity data and marginally adequate testing permits its use.

The reason for restricting atrazine is its potential for adverse health effects once within the body, especially to workers. There is much controversy about the ability of atrazine to enter the body via dermal exposure. Minimum requirements identified to reduce exposure include wearing protective gear; in backpack application, not treating vegetation above arm's height; and mandatory cleanup and laundering of clothing on a daily basis.

In the Decision, the BLM is taking a precautionary approach and applying the same restrictions for 2,4-D as for atrazine due to concerns of health and uncertainties on cancer potency. The 0.25-mile buffer stipulated for nearby residents when aerially applying herbicides, or when topography permits potential direct exposure, were included in the Decision to avoid off-site effects, especially to human health.

The timing guidelines for brown-and-burn methods (e.g., using herbicide as a desiccant to facilitate prescribed burning) will minimize any potential for exposure to herbicides.

Worker health recording and documentation will assure a tracking system for any indication of associated health problems, exposure and precautionary measures. This feedback system will be used to correct procedures or to discontinue specific herbicide use should health or environmental risks exceed those analyzed.

Two scenarios were identified as having moderate potential for health effects: accidental spill or direct spraying. Development of a spill and emergency plan will minimize the possibility of these types of exposures.

The BLM's Decision gives consideration to concerns about exposures to hyper-sensitive individuals, including children. Through public notification, posting, and retaining lists of people who know or suspect they are hypersensitive, the BLM will be able to determine the appropriate risk management measures to implement.

There was also consideration given to the synergism potential of using formulations containing two chemicals (e.g., picloram, and 2,4-D [Tordon]). Cumulative effects from the use of several herbicides, and particularly any human health effects, will be monitored for any possibilities of systemic or other adverse health effects.

Summary of the Situation

Except for noxious weed control, the BLM has not been able to use herbicides in controlling competitive and unwanted vegetation for the past eight years. Over those years, the budget level has essentially been equivalent to the time frame when herbicides were available. Considering the workload of alternative treatments, this budget level has been inappropriate and has resulted in a carryover of reforestation units needing treatments. Much of the carryover occurred where herbicide use had been planned to meet site preparation needs and long-term vegetation control.

Employing labor-intensive techniques, working within narrow effective biological treatment windows, and maintaining an adequate and sustained budget level became major concerns and put a larger workload on the vegetation maintenance program. The practice of "planting through" in many competitive vegetation plant communities was used to accomplish the initial planting phase. The short-term budget was increased to treat some of the ongoing vegetation management program needs, and a major effort was launched to fill the gap.

On some areas, however, due to the limitations of the approach, efforts have not been adequate or timely to accomplish the needed level of control. Identifying and implementing projects within the biological window is reasonable dependent on the size of the program. It is not reasonable, for example, when large acreage is involved because some vegetation situations escape, then necessitating corrective and rescue treatments. Plant communities of concern in this regard include drought prone sites with grass and ceanothus, and very wet sites with salmonberry and red alder. In some of these cases, often a single treatment of herbicide would convert land use back to forestry uses. For rescue operations, the most likely treatments would be broadcast.

Some alternative treatment methods (e.g., prescribed fire) have been used beyond their design capacity, and it is not logical to proceed in a vegetation management program without the use of herbicides. In many cases where prescribed fire was planned as a substitute for site preparation and vegetative control, it was not implemented because the window of opportunity was too small or there were smoke restrictions.

Alternatives to rodent habitat manipulation have required increased use of toxic substances, often with a series of treatments, where previously a single treatment with herbicides and moderate direct controls have been an effective treatment to establish an adequate young stand.

To continue to forgo using herbicides would ignore prevailing thought among weed science professionals who advocate the use of all methods to control competitive and unwanted vegetation. Most importantly, forgoing the use of herbicides would result in ineffective control of some competing and unwanted vegetation. The environmental and economic consequences of such an outcome are not outweighed by the hazards the herbicides pose on the natural environment and the risks to human health.

Overall, the level and effectiveness of vegetation management conducted on BLM-administered forest lands in western Oregon affects both commodity and noncommodity production. Harvest yields, employment and public revenues are affected. These issues are discussed in the FEIS and in the western Oregon land use plans.

The BLM believes that the preventive approach designed in the Decision involves a combination of methods, including the use of herbicides and early treatment, that would incur less cumulative impacts in the long term.

In preparing the Decision, the BLM considered that there are most likely more people living in the rural interface areas. However, the protective measures required for these areas, both in this ROD and land use plans (including protective buffers), is expected to minimize any potential for impacting these populations.

Another factor taken into consideration in the Decision was, that since publication of the FEIS and other supporting documents, there have been relatively minor changes in economic costs and benefits.

In conclusion, BLM believes that all effective vegetative control methods should be available for consideration, that herbicides should be available for treating vegetation which is difficult or impossible to treat otherwise, and that herbicides should be available as an effective early selective or broadcast treatment. To give consideration to concerns for public health and the FEIS analysis, including supporting documentation in Appendices thereto and this ROD, the BLM is limiting the acreage that can be treated annually by herbicides. Further, this herbicide acreage restriction is expected to maintain emphasis on developing other effective treatments, and to ensure that a new reliance on herbicides does not develop.

CHAPTER 5 - PROGRAM IMPLEMENTATION FEATURES

Program Design

Implementation of the vegetative management program has two parts: standard operating procedures and project design features. The *standards* are a list of important measures that are applied on a regular basis for the various types of vegetation treatment. *Project design features* are intended to ensure the proper and safe implementation of treatment methods, and are selected based upon site-specific analysis. Analysis of specific treatment areas may result in modification of the project design features, or the identification of others, to provide adequate protection to nontarget organisms and human health. Standard operating procedures are listed below, followed by a list of common project design features.

Standard Operating Procedures

Strategy

Use prevention and natural processes as the preferred strategy to manage competing and unwanted vegetation. Conduct planning and monitoring to anticipate, and take steps to avoid, potential vegetation management problems. When needed, plan corrective actions to occur early and timely as compatible with a long-term preventive strategy and natural disturbance and recovery pattern in the site-specific area.

Safety

Always consider the safety of both the general public and workers. This includes determining the degree of exposure, hazard and risk posed by various vegetation management treatment methods for forestry workers, forest users, and nearby residents.

Program-wide risk assessment will be conducted by the program leaders, prior to any treatment where there is potential for direct or indirect effects on human health, to evaluate human health exposure to any hazardous substances and injuries. It should be kept in mind that this preliminary analysis is about generalities, not site-specific instances. Low-risk or low exposure methods will be sought for implementation to minimize public exposure to injurious situations.

In general, the risk assessment process will involve three evaluation components: Hazard, Exposure, and Risk. These components and their interrelationship are described below:

Hazard Evaluation: Identify harmful characteristics of the proposed vegetation management methods.

Exposure Evaluation: Estimate the kinds and levels of exposure and doses likely to result from potential exposures under routine, worst case, and accidental scenarios.

Risk Evaluation: Combine hazard information with dose level exposures to predict the health effects under the given conditions of exposure.

These evaluations are conducted for two groups of people: the general public and the occupationally exposed. A Job Hazard Analysis (JHA) is used to anticipate site-specific human health effects. For the general public, evaluation is done for single exposures and exposures over a 30-year time period.

When considering potentially harmful situations in site-specific evaluations, estimate exposure by identifying: (1) who is being exposed, (2) when the exposure will occur, (3) where exposure will occur, and (4) the amount, duration, and frequency of exposure. These estimates should then be compared to the average conditions found in the FEIS risk assessment and used to determine design and adequacy of mitigating measures.

The "amount" of exposure is the actual quantity or level of a substance that comes in contact with an individual. "Duration" is length of contact, and "frequency" is the number of encounters with the substance. Other factors to consider in exposure analysis include proximity (distance) to human habitation, water source, or potential food stuffs, and recreation use patterns, weather conditions, and access to site.

All employees active in vegetation management will be trained in the safe use of prescribed fire, cutting tools and equipment operation, herbicides, and other techniques. Proper protective clothing will be worn by employees as prescribed in use manuals for methods such as chemicals and fire (BLM Manual 1112, Handbooks 1 and 2).

The project design of prescribed fire will include consideration of such measures as smoke management, reduction, avoidance, and scheduling to protect recreationists and rural residents from smoke exposure (see Attachment B).

Information packets containing data on the potential hazards of chemical treatment methods will be made available to employees, the public, and contractors (see Attachment B and Herbicide Profiles, Attachment C). As new data becomes available, the information packets will be supplemented.

Worker Protection, Public and Occupational Accident/Incident and Illness Reporting

All workers who use or are exposed to hazardous tools/equipment including herbicide applications will utilize protective clothing and equipment that meet the specifications of the BLM Safety Manual, labels approved by the Environmental Protection Agency (EPA), and/or BLM risk analysis. (See worker protection in BLM Manual 9022; Manual 1112, Handbooks 1 and 2, Chapters 14-16; and H-9011-1.)

A Job Hazard Analysis will be used for monitoring the impacts on human health. In addition an accidents and incidents system will be used for reporting employee, contractor, volunteer and public. In addition to injuries and illnesses, the system will be used to report vehicle accidents, property damage and fire losses (Departmental [DM] Manual 485, Chapter 7; and BLM Manual 1112, Handbooks 1 and 2). Forms CA-1 and/or CA-2 for occupational exposure or injury and DI-134 for all reported accidents, incidents, and illnesses will be used.

The Report of Accident/Incident (DI-134) will be used additionally to report health effects associated with vegetation management projects for forwarding to the Program Coordinator to be entered in the Safety Management Information System (SMIS), reported to OSHA and used internally for trend analyses. The Federal

Record System retains records for any employees exposed to toxic substances or harmful physical agents for 30 years (29 CFR Ch XVII 1910.20). Contractors will be required by stipulation to complete a DI-134 for each employee. The DI-134 along with the Project Accomplishment Report (herbicide use report) will list date of project work, specific assignments, herbicide formulation (if any) and ingredients used, safety or health hazards, and any health complaints.

Planning

The BLM will conduct an environmental analysis of proposed vegetation management actions and, as needed, prepare an environmental assessment (EA) which documents the environmental analysis in conformance with NEPA requirements. The process is outlined on Table 5.1.

In implementing the Decision, a prevention strategy will be considered as early in the planning process as feasible. Environmental analysis of proposed projects utilizes an interdisciplinary approach and serves several purposes, which are listed below:

1. Identifies objectives and analyses of impacts, specifically to include the following:

   * Weigh benefits of control and no action to environmental, economic, and social ramifications.

   * Determine scope of proposed projects and integrate with measures for protecting watershed, wildlife habitat, botanical resources, and other values.

   * Determine, for target competitive species, the possible courses of action and evaluate relative merits for adequate survival and growth of the selected nontarget vegetation.

   * Select a proposed method to meet objectives within acceptable risks to the environment. When a method is selected, the goal is to select those with the least adverse environmental effect.

2. Coordinates with other agencies, requests both consultation and assistance, as needed.

3. Provides for public involvement. If proposed action is of a controversial nature, notify public early and review proposed plans and program with user and interest groups and the general public.

4. Requires site-specific pre-treatment surveys as needed to evaluate and document vegetative conditions prior to treatment, and post-treatment surveys be conducted to evaluate the effect of the treatments.

5. Documents analysis, but avoids duplication of effort when sample units can be employed. Recognizes that the magnitude of the project and public interest determine extent of analysis.

6. Uses an interdisciplinary approach in planning and analyzing potential projects. An interdisciplinary team will review individual or grouped projects for compliance with NEPA procedural and documentation requirements, conformance with land use goals, compliance with the ROD procedures, and comparison analysis of FEIS environmental effects.

TABLE 5.1 - SUMMARY OF VEGETATION MANAGEMENT PROCESS

ENVIRONMENTAL ANALYSIS (The NEPA Process)	VEGETATION MANAGEMENT PROCESS	SILVICULTURAL PRESCRIPTION PROCESS
SCOPING		
1) Identify the action.	Site Analysis	Identify Objectives
2) Identify agencies and responsible official.		
3) Look for issues.		
4) Explore possible effects and existing direction.	Site Analysis Select Strategy	Stand Diagnosis Identify Objectives
5) Assess public participation; make contacts.	Design Project	
6) Identify skills needed.	Design Project	
7) Convene interdisciplinary team, identify cooperators, and assign tasks.	Design Project	
8) Expand public involvement as appropriate.	Design Project	
9) Plan for an orderly analysis. - Formulate analysis criteria. - Formalize issues. - Explore alternatives - Determine other needs. - Continue public involvement.	Site Analysis Design Project	
COLLECT DATA	Site Analysis	Stand Examination
INTERPRET DATA	Select Strategy	Stand Diagnosis
DEVELOP ALTERNATIVES	Design Project Site Analysis	Develop Options
ESTIMATE EFFECTS	Site Analysis	Predict Results Select Strategy
EVALUATE ALTERNATIVES	Select Strategy Evaluate Options	
IDENTIFY PREFERRED ALTERNATIVE DOCUMENTATION	Select Strategy	
DECISION	Select Strategy	Prescribe Treatment
IMPLEMENTATION	Action	Implement
MONITORING	Monitor	Monitor

Source: USFS Region 6

Public Involvement

Minimum considerations for public involvement will follow the process in Table 5.2, with the need or level to be determined by reviewing the type of management actions. BLM management actions are divided into five categories (Manual 1790-1):

* Exempt from NEPA. Includes Congressional, emergency and rejected proposals.

* Categorical exclusions. Specifically identified actions, not restricted by exceptions list, that do not require an environmental assessment (EA).

* Actions already covered by an existing FONSI and EA, or EIS. Timber sales and multi-year EA. (Noxious weed control is in a separate EIS.)

* Actions covered by an EIS and require an EA.

* Actions that require an environmental impact statement.

Public involvement is to be encouraged and facilitated in vegetation management environmental analyses. The level and degree of public involvement will depend on public interest, type of analysis performed, and the method of treatment proposed.

The BLM will provide public notice whenever a site-specific project is considered to prevent or treat competing or unwanted vegetation with any proposed measure of treatment. (Excepted are actions exempt from NEPA or covered within a categorical exclusion.)

Public notice will precede the screening stage of the environmental analysis of the project under NEPA guidelines. Notification methods will include, at a minimum, a notice in local newspapers. Additional standard methods may include posting of public notices in the state office, district office and resource areas; and in other public rooms used to distribute public information concerning proposed Bureau actions. Notification lists maintained by the program coordinators will be used in notifying the interested public of any proposed use of herbicides.

In case of an action with effects primarily of local concern, the notice may include: areawide clearinghouses, notices to potentially interested community organizations, direct mailing to owners and occupants of affected property, and posting of notice on- and off-site in the area where the action is located. The level of controversy will determine the need for notices and posting. Herbicide use areas will be posted. Notices must indicate procedures for interested persons to get information or status reports.

The public will be notified of the availability of the EA and FONSI (Finding of No Significant Impacts, if appropriate; or of no significant impacts beyond those not already analyzed in a program's EIS). The manager responsible for authorizing the action determines the appropriate means of public notification and ensures its availability based on the extent of concern and interest in the action. All individuals or organizations that have requested notification on a specific action should be notified by mail where feasible. When considering the use of herbicides of special consideration the potential use will be made known to the public at the earliest practical time.

TABLE 5.2 - MINIMUM CONSIDERATIONS FOR PUBLIC INVOLVEMENT WITH VEGETATION MANAGEMENT PROJECTS

METHOD	SCREENING	INFORMATION GATHERING & ANALYSIS	ENVIRONMENTAL ANALYSIS	DECISION	IMPLEMENTATION MONITORING EVALUATION
OBJECTIVES TO MEET	Identify affected members of public including public agencies. Notify of vegetative management objective for project area. Invite early public involvement.	Collect and identify public concerns and issues to be addressed in the analysis. Provide opportunities for public involvement in analysis planning.	Provide readable, clear analysis and documents. Invite review and comment on environmental document and recommended alternative.	Notify public of availability of FONSI and the final decision in a timely manner. Address public comments.	Give early notice of project implementation date. Invite participation & observation of project implementation. Invite participation & observation of project monitoring and evaluation.
MANUAL	Analyze for categorical exclusion. If not categorically excluded, see Mechanical.				
MECHANICAL	Written notice of proposal in newspaper, by letter, or public meeting.	Provide written contact with interested people. Acknowledge their response. Invite participation in analysis process. Share what we perceive to be the public issues and solicit feedback.	Written notice of availability of environmental analysis for review and comment, providing comment period, and identifying person to direct comments to. Send notice to mailing list for project.	Incorporate comments into decision by addressing concerns, which may be in the form of alternations to the program. Letter from decisionmaker to people on mailing list.	Notify affected people early of implementation date by direct contact (letter, phone, visit). Send notice to project mailing list.
BIOLOGICAL	For bioagents, same as Herbicide. For other biological, same as Mechanical.	For bioagents, same as Mechanical plus local media notice. For other biological, same as Mechanical.	For bioagents, same as Mechanical plus local media notice. For other biological, same as Mechanical.	For bioagents, same as Mechanical plus local media notice. For other biological, same as Mechanical.	For bioagents, same as Mechanical plus general public notice in local newspapers. For other biological, same as Mechanical.
HERBICIDE	Same as Mechanical plus contact adjacent residents and landowners and the downstream water users; also send letter to herbicide mailing list, and news release to local newspaper.	Same as Mechanical plus local media notice.	Same as Mechanical plus local media notice.	Same as Mechanical plus public notification of potential for public exposure.	Same as Mechanical plus general public notice in local newspaper.
PRESCRIBED FIRE	Same as Mechanical plus contact adjacent residents and downstream water users.	Same as Mechanical plus local media notice.	Same as Mechanical plus local media notice.	Same as Herbicide.	Same as Herbicide.

Source: Adapted from USFS R6 form.

Before a decision is made to proceed with controversial treatment methods such as herbicides, the public will be invited to review and comment on the site-specific analysis of the project. When a decision is made for a site-specific project, the public will be promptly notified of the final decision whether it is to proceed, or not to proceed.

Environmental analysis and public involvement will normally occur as indicated in four levels of project screening:

1. Screen unit for need of action, and set priorities.
   Where: Reforestation of timber sales or wildfire areas. Actions where no herbicides are proposed for use and the proposed treatment qualifies for categorical exclusions. Examples of current categorical exclusions:
   - Precommercial thinning
   - Manual maintenance and release.
   - Paper mulching and spot scalping.

2. Screen for need and complete environmental analysis. (Outside exclusions or controversial.)
   - Mechanical site preparation

3. Screen for need, complete environmental analysis, inform downstream water users.
   - Biological and grazing methods.

4. Screen for need, complete environmental analysis, inform downstream water users, notify adjacent property owners, provide public notification when there is a probable public exposure, and request response from those individuals who are hypersensitive. This screening should be done when proposing projects for herbicides and prescribed fire to determine appropriate risk management measures.

Pre-Treatment Surveys and Site Specific Analysis

Initial or follow-up surveys entered in the MICRO*STORMS data base are generally used to identify the potential need for vegetative management treatment and site-specific pre-treatment surveys.

Site-specific analysis will be documented (using a revision of the form in the draft ROD) to identify the following:

* Characteristics of the target plant species (size, distribution, density, and life cycle).

* Associated plant species, including their nature and role.

* Land use of the target area.

* Size, slope, accessibility, and soil characteristics (rockiness and erodibility) of the area to be treated.

* Climatic conditions present at the time of treatment (e.g., wind speed, precipitation, or season).

* Proximity of the area targeted for vegetation treatment to sensitive areas (e.g., special status plant or animal species, riparian zones, significant aquatic resources and unstable watersheds, or areas of human or livestock habitation).

* Need for subsequent revegetation; and time of year treatment could occur.

* Historical record of past practice on the unit, including past treatments, efficacy of treatment, and their effect on existing

vegetative conditions.

Some of the considerations during site-specific analysis and preliminary planning of vegetative management programs include:

* Management program and/or objective for the site.

* Implementing the preventive strategy, to include documenting existing conditions that favor the presence of competing and unwanted vegetation; identifying past management actions that may have exacerbated the situation; and recognizing any natural controls that exist on the site, particularly those that may be used to encourage natural controls or help avoid the conditions that favor the presence of competing or unwanted vegetation.

* Total acres in the unit.

* Predominant competitive or unwanted species of concern in a unit.

* Number of acres with existing or potential levels of competitive or unwanted vegetation that exceed damage thresholds or action thresholds.

* Consideration of all reasonable management alternatives, including:
  - Identification of unmitigated environmental effects on fish, wildlife, soil, ground and surface water, air, special status plant and animal species, nontarget plants and culture sites.
  - Human health hazards associated with each method.
  - Effectiveness of each treatment method.
  - Cost of treatment.
  - Cost of each method's mitigating measures regarding hazards to nontarget species.
  - Map of survey unit.
  - Growth characteristics, sensitivity to treatment method, stage of growth, life span, etc., of both target and nontarget plant species at the time of treatment.

* Recommended treatment methods, or combination of methods.

* If herbicides are recommended, the following additional information is required:
  - Herbicide common name, application rate, carrier.
  - Posting requirements, if needed.
  - Positive placement techniques planned to minimize drift and effects on nontarget areas.
  - Method of application (ground, aerial, or backpack).
  - Special restrictions on the herbicide label or BLM regulations with regard to handling, buffer strips, grazing, re-entry, wind, droplet size, etc.
  - Monitoring plants (e.g., water, efficacy, nontarget effects, and target effects).

Pre-treatment proposal projects should include both action and no action to enable analysis of both conditions for probable cause and effect.

Costs and Budgets

For comparison purposes when planning site-specific projects, consider the most cost-effective method along with human health risks and environmental effects.

Costs will be evaluated for implementing site-specific feasible treatment methods.

This evaluation will consider the actual per acre project costs, both direct and indirect, such as:

* Administration.
* Training.
* Performance of work.
* Emergency response planning.
* Notification and posting.
* Herbicide/tool storage.
* Marking buffers and sensitive areas.
* Pre- and post-treatment monitoring.
* Mitigating measures.
* Public meeting and information sessions.
* Protective equipment and clothing.
* Recordkeeping.
* Costs and benefits of forgoing action pending development of more complete information.

For some methods, figuring cost-effectiveness may include assessing the number of years treatment is needed to obtain control. For instance, effective control of some sprouting shrubs and forbs may require more than one manual cutting. If two or more years of treatment are needed, then one treatment by itself is not effective.

Budgets will be requested that are adequate to implement the planned program, and also support the continuing search for methods, techniques and tools that minimize adverse environmental effects.

Special Precautions

Site-specific analysis may determine a need for special precautions due to the scope of the project or the presence of unique physical characteristics on the site. Listed below are a number of special precautions that are required for special status species, archeological/historic resources, recreation sites or use areas, special management areas, wildlife habitat, municipal watersheds, and livestock.

Special Status Species

Any projects that may affect special status species or their habitat will require specific resource surveys. All units selected for treatment will have an updated survey conducted prior to treatment if the last survey is more than two years old and the proposed treatment involves a broadcast technique, <u>or</u> if a herbicide is considered or expected to be used.

If any special status species are located on proposed treatment sites, the action will be postponed or site design modified to protect the presence of these species. Such protection will be guided by the policies contained in BLM Manual 6840 for Special Status Species Management. Section 7 Consultation, as required by the Endangered Species Act, will be initiated with the U.S. Fish and Wildlife Service.

Archeological/Historic Resources

Projects that may affect areas of historic, cultural, or archeological values will be subject to standard cultural surveys and site clearances. Projects will be altered to protect significant resources where any are found.

Recreation Sites or Use Areas

Recreation sites proposed for vegetation management will generally be treated during treatment effectiveness windows at times having the least exposure to hazard, during low use or nonuse, or when recreational use is excluded. If treatments occur when use is excluded, the recreation sites will be closed to access until such time the potential hazards no longer exist. Treatment sites with potential for public use will be posted to notify the public of any potential hazards, and public access into these areas will be controlled. Public safety will be the major decision rationale.

Special Management Areas

Any vegetative management proposed for Areas of Critical Environmental Concern and other special areas will be consistent with land use and activity plans specific to each area.

Wildlife Habitat

Proposed projects will be scheduled, modified or deferred to protect areas crucial to wildlife such as important wildlife mating and nesting areas, and travel routes where reduced or lost cover, habitat disturbance, or debris accumulation would be detrimental.

Proposed broadcast treatments that reduce forage production in important wildlife calving and wintering areas will be scheduled to avoid any significant impacts to forage resources. In selecting herbicides for use in areas where there are important fish and wildlife values, herbicides with minimum toxicity to potentially affected fish and wildlife will be given priority consideration while maintaining adequate toxicity to the target plant species.

Retention of wildlife trees will follow guidelines of applicable land use plans. Retain as much natural or beneficial material for wildlife and other organism habitat as is practical in accordance with applicable management in land use plans and site-specific needs. Consider future habitats that may evolve as the forest or treatment area develops over time.

Municipal Watersheds

Review agreements involving municipal watersheds and work closely with advisory groups on all proposed vegetation management programs. The BLM will adhere to the Safe Drinking Water Act, which stipulates that where EPA has designated an aquifer that serves as the principal source of drinking water for an area as a sole source, federal agencies are prevented from contaminating such an aquifer.

Livestock

Coordinate rest rotation systems to avoid overlapping animal use and treatments. Maintain forage production while controlling toxic plants and undesirable vegetation.

Project Design Features

Review site-specific conditions to determine which of the following project design features are needed.

Notification of Adjacent Landowners and Water Users

Residents and adjacent landowners within 0.5-mile of proposed treatment sites who likely could be directly affected by chemical drift, smoke, food or water contamination, or an accidental spill will be notified prior to any chemical, broadcast burning, or biological application, and actions will be taken to minimize any potential effects.

Minimum Width Buffer Strips

District guidelines and State water quality standards will be met by using buffer strips and contractual stipulations on method and techniques. Untreated buffers will be reserved along streams, lakes and ponds according to guidelines in this ROD or resource management plans, whichever is greater. Stream classification and treatment method are the two main consideration factors determining buffer strip widths. Other factors of concern to consider include stream bank stabilization, sediment rates, water temperature, sensitive vegetation and other organisms, and bacteria counts.

For mechanical and burning treatments, the minimum buffer along streams will be 25 feet.

When herbicides are used, the minimum buffer strips listed below will be reserved. These minimum buffers will be in accordance with current interim protection requirements of the Oregon State Forest Practice Act requirements and definitions, or as specified on the herbicide use label.

Minimum Buffer Widths for Waterways When Herbicides are Proposed for Use

Application Technique	Minimum buffer Width
Manual wipe-on	High water mark
Manual (Backpack)	20 feet
Mechanical (Ground)	50 feet
Aerial (Flowing streams)	100 feet
Aerial (Lakes and ponds)	200 feet

Applications of atrazine, a persistent chemical, in areas having shallow water tables or where aquifers are located in alluvial deposits along major streams, will be subject to guidelines for surface waterway buffers listed above.

Residences, Domestic Water Diversions and Agricultural Areas

Minimum buffer strips near residential, domestic water, and agricultural areas is determined by the site-specific application technique.

For aerial application of herbicides in areas adjacent to residences, a minimum buffer strip measuring at least 600 feet wide will not be treated unless a written waiver is provided by the landowner. For domestic water diversions in a drainage where aerial herbicide application is used, the minimum buffer will be 200 feet. Additional risk (exposure) assessment may be required for aerial herbicide treatment within 600 feet of a residence.

Aerial application of herbicides of special consideration (e.g., 2,4-D, asulam and atrazine) will be prohibited within 0.25-mile (1,380 feet) of residences.

For ground applications of herbicides, the minimum untreated buffer reserved between treatment areas and residences will be 100 feet.

Local conditions may require an expansion of the minimum widths. Some examples of site-specific factors that may necessitate additional buffer width include mode of transport (direct application, drift, and water flow), adjacent topography, buffer vegetation structure and functions, and nearby agricultural areas or gardens.

<u>Other Sensitive Conditions</u>

Buffer strips may also be recommended for wildlife habitat, scenic corridors, and other concerns as identified in land use plans.

Soil Protection

Erosion, soil compaction, and soil health will be considered in planning and implementing vegetative treatment in accordance with land use plans. Tractor operations may be limited to periods of minimum soil moisture levels to minimize soil compaction, erosion, and movement. Any tractor operations in municipal watersheds will be conducted in accordance with memorandum of understanding with local municipalities.

Soil health will be evaluated for retention of beneficial conditions and microorganisms that maintain productive soils for the selected leave trees.

Protective Measures Specific to Methods

<u>For All Treatment Methods</u>

* Conduct screening and environmental analysis, as required, for each proposed project.

* Use silvicultural prescriptions in planning and analyze support for a preventive approach.

* Protective clothing and equipment will be worn during implementation.

* Adhere to state and federal laws, and to the BLM's health and safety guidance (Manual 1112, Handbooks 1 and 2).

* Prepare a job hazard analysis and human health risk assessment plan for each treatment method and project as needed.

* Provide training and quality control at the state, district and resource area levels.

* Have first aid equipment and communication onsite, and also someone trained in first aid per job hazard analysis.

Manual Methods

* Analyze worker exposure to potential hazards and risks including physical dangers; exposure to dust and temperatures; risks of cuts; and exposure to poisonous plants, snakes and insects.

Mechanical Methods

* Limit tractors and other mechanical equipment to low-impact operating periods.

* Follow slope restrictions per land use plans.

* Analyze worker exposure to potential hazards and risks including physical dangers; exposure to dust and temperatures; risks of cuts; and exposure to poisonous plants, snakes and insects.

Biological Agents, Cultural Methods, and Grazing

* Adhere to BLM Manual 9014 for Biological Control.

* Comply with the USDA Animal and Plant Health Inspection Service and the individual State Department of Agriculture guidelines when proposing

biological control agents.

* Post units with project description signs at least 24 hours prior to biocide agent treatment, and leave signs in place during potency period.

* Inform downstream water users that could be directly affected; evaluate need to incorporate water quality monitoring when domestic water impacts expected.

* Enforce control of livestock near wetlands and riparian areas.

* Use stock tanks and other methods to ensure animal movement and dispersal within the treatment area when necessary.

* Evaluate all introductions of vegetation into a site for compatibility with natural diversity of that forest ecosystem.

Prescribed Fire

* Avoid consuming more of the residues and forest floor components than necessary to meet burn objectives.

* Develop a prescribed fire plan to meet objectives of the vegetation community and to enhance or maintain the desired vegetative diversity.

* Comply with policies, principles, objectives, procedures and standards for guidance in carrying out prescribed fire responsibilities as described in BLM Manuals 9210 (Fire Management), 9211 (Fire Planning), 9214 (Prescribed Fire), and 9215 (Fire Training and Qualifications).

* Protect air quality and avoid smoke intrusions. Comply with Oregon Smoke Management Plan.

* Analyze worker exposure to potential hazards and risks including physical dangers; exposure to smoke and temperatures, risks of injury; and exposure to poisonous plants, snakes and insects.

* Have washing supplies available onsite with sufficient uncontaminated water and soap for washing of hands or the body in the event of accidental contact with gelled gasoline or fuels.

* Take precautionary measures specific to handling gelled gasoline and fuels. At a minimum, avoid the following: skin and eye contact, excessive inhalation of the powder form by wearing approved dust mask; inhalation; and ingestion. Reference material safety data sheets for gelled gasoline for other precautions that may be needed.

* Use the best available technologies applicable to prescribed fire to reduce smoke and adverse environmental impacts.

* Burning of herbicide-treated vegetation will be delayed six months, or as disclosed on herbicide profiles or supplements.

Herbicides

* Each District will provide guidance and prepare a Herbicide Application Handbook to specifically address local concerns, plan for training and quality control, and identify safety needs for project implementation. The handbook will be consistent with the guidance of the FEIS and this ROD, the district's land use plan, safety handbooks, and accidental spill and other applicable policies.

* Submit herbicide use proposals for clearance review and reporting to the BLM's Oregon/Washington state office; and in the case of restrictive herbicides, also to the Washington D.C. national office. The receiving offices will record and verify the district, project number, herbicide label for intended use, and the formulation's current status. These registered proposals will be linked to contract site proposals, personnel exposure records, and accident/incident reports.

* Develop a safety plan that aids project personnel in case of emergency. Radio contact must be maintained during herbicide transportation and project implementation.

* Provide notification of proposed herbicide use, potency period posting and recommend protective measures for hypersensitive individuals who could, or believe they could, be affected by proposed projects. This includes adjacent public, households with children (children receive a net mg/kg dose approximately 35 percent greater than adults), and BLM personnel identified as being highly sensitive to chemicals.

* The Federal Insecticide, Fungicide, and Rodenticide Act of 1972, Public Law 92-51 as amended and revised in 1988, requires that all personnel applying restricted-use herbicides be certified in the use of herbicides or be under the direct supervision of certified applicators.

  It will be the policy of BLM that this requirement be applicable to <u>all</u> herbicide use. All personnel involved in planning, reviewing, supervising, or applying herbicides must be adequately trained to handle herbicides and equipment properly. Continued training, periodic examinations, and appropriate certification of personnel are required to stay current with best management practices, understand risks of contamination of the environment, and consider and prescribe only appropriate uses of herbicides on public lands.

* Adhere to state and federal laws, including EPA label instructions, applicable to herbicide use.

* Meet the standards and guidelines in BLM H-9011-1 Handbook which identify authority for use of herbicides and establish the objectives and the responsibilities of administrative levels. The handbook also describes worker protection measures, monitoring documentation, safety planning, and training.

* Apply herbicides within prescribed conditions on the label, and in environmental assessments and issued permits. These conditions include wind speed, humidity, air temperature, presence of surface water and conditions to reduce drift.

* No spraying if winds exceed 6 mph, unless label specifies a different maximum wind speed.

* Backpack sprayers will avoid treating (spraying over) vegetation that is taller than themselves; preferably treating vegetation waist high or less.

* All workers involved in herbicide operations will wear personal protective equipment (PPE) or clothing as stipulated on herbicide use labels, in BLM Handbook-9011-1, and according

to job hazard analysis (BLM Manual 1112, Handbooks 1 and 2). Avoid skin contact with herbicides, diesel oil and kerosene.

(Note: Typical doses and margin of safety for realistic-typical exposure in Environmental Consequences is based on workers wearing protective clothing and taking special precautions against exposure. The calculated worst case doses (MOS) are based on workers working with bare hands and wearing ordinary work clothing.)

* Herbicide treatments along rights-of-way will require special precautions due to the high potential of exposure at such sites.

* All workers should wear a complete set of clean clothes daily, and additionally should have a complete change of clothes available at the work site in case of accidental exposure to herbicides.

* Information packages and herbicide profiles specific to the treatment methods and herbicides to be used on a project will be supplied to each worker, and the margin of safety (MOS) rating for each activity and chemical will be emphasized.

* Use herbicide formulations that are effective for the application period, method of application and contain least toxic inert ingredients (are recognized as generally safe by the EPA or are of low priority for testing). Proposals to use formulations with inert ingredients that are higher priority for testing, or are shown to be hazardous, will require an assessment of human health risks incorporated into the NEPA decisionmaking process.

* Provide public notification identifying specific sites and chemical potency periods for all applications where potential exists for public exposure (including from residues on plants for vegetation picker, berry picker, hiker or hunter). The notice will request that people who know, or suspect, they are hypersensitive to herbicides contact the BLM office proposing the project to assist in determining appropriate risk management measures.

* Provide notification to any downstream water users who may be potentially affected by projects.

* Record and report all herbicide application projects, to include such details as herbicide used, areas treated, dates and times of applications, names of people involved, mitigation measures followed, and occurrences of any illnesses or symptoms and exposure incidents or accidents. Report adverse health effects associated with vegetation management activities for both workers and public.

* Post project description signs at points of common public access to areas where herbicides are used and leave the signing in place during the potency period. Provide the posted information in both English and Spanish, and at least 24 hours prior to treatment.

* Submit any proposals to use atrazine or picloram treatments to a hydrologist and/or soil scientist to be evaluated for potential leaching and long-term nontarget phytotoxic (toxic to plants) impacts water contamination both on and off-site before a decision on such a treatment.

* The following Margins of Safety (MOS) levels will be used as benchmarks to determine the need for extra precautionary measures; MOS levels below 10-high risk; MOS levels between 10 and 100-moderate risk.

* Provide alternate work assignments that do not involve direct contact with herbicides for employees not wanting exposure to chemicals.

* For all herbicide application projects, washing facilities with sufficient supplies of uncontaminated water and soap will be available at the work site in quantities necessary for washing of hands as required, and the entire body in the event of accidental contact with herbicides.

* Areas used for storing and mixing herbicides, and for cleaning equipment, will be located where any accidental spillage will not run into surface waters or result in contamination of ground water.

* Control drift of herbicides to minimize its occurrence and maintain prescribed buffer strips. Spray only under favorable weather conditions and use spray equipment that limits the number of small spray droplets. Nozzle sizes and pressure would be used that are designed to produce droplets with diameter of 200 to 400 microns or larger. A variety of techniques are available to minimize drift while providing adequate coverage of target vegetation. These will be addressed in activity- and site-specific project assessments.

* Minimize introduction of chemicals into ephemeral streams and other areas where there is potential for subsurface leaching. Consider the time of application and the chance of significant rainfall in the 60 days following application, soil moisture conditions/permeability, herbicide mobility and persistence, and downstream water use.

* Equipment used in aerial and vehicle equipment will have a positive shut-off apparatus to be used prior to equipment being used near or over buffers, open water, residences, and other sensitive areas.

* Truck drivers, mixers, and handlers will be briefed on a project safety plan and the Spill Response Plan. They will also be trained and equipped to take remedial action in the event of equipment failure or an accidental spill.

* Avoid transporting mixtures and only mix quantities needed to complete projects.

* A radio network will be maintained during spray operations to link all parts of the project. Direct radio communication between spray aircraft, ground crews, and the BLM office will be established.

* Utilize the training programs administered by the Department of Agriculture in Oregon. Training and testing of applicators covers laws and safety, protection of the environment, handling and disposal, herbicide formulations and application methods, calibration of devices, use of labels and data sheets, first aid, and symptoms of herbicide exposure.

Monitoring and Evaluation

Monitoring of the western Oregon vegetation management program will be done in accordance with established BLM procedures as provided for in BLM Manual H-1734-1, land use plans, and as indicated below. The need and type of monitoring will be dictated by the nature of critical components in the site-specific treatment area.

General guidelines for monitoring are as follows:

* Monitoring is to be done annually at both the program-wide and site-specific basis, and for worker and human health concerns. The Program Coordinators will: (1) project three-year estimates of proposed methods and techniques, (2) describe whether management actions are making satisfactory progress toward meeting objectives to reduce reliance on herbicides and meet prescribed fire air quality goals, and (3) present criteria for meeting goals.

* Site-specific post-treatment monitoring will be conducted to aid future planning, and at a minimum will include:

  - Efficacy of treatment or no treatment.
  - Costs, both direct and indirect.
  - Analysis of mitigating measures, unintended effects, and accidents.
  - Estimate of degree of success.
  - Assessment of both short and long-term effects on vegetation.

* Water quality monitoring will be conducted per goals in land use plans to meet or exceed Best Management Practices guidelines. Monitoring of the spray operation will be conducted to determine if mitigating measures are being observed, are effective in maintaining water quality, and are in compliance with state water quality standards and herbicide label requirements. The potential for contamination of aquifers used by fish, or for municipal water or irrigation, will be considered in site-specific environmental assessments.

* The program-wide assessment will consider:

  - How well strategy is meeting management objectives (site preparation, seedling survival, improving wildlife habitat, roadside maintenance). Include "no action" locations in comparisons.

  - Whether assumptions are correct and potential impacts are as expected.

  - Effectiveness of mitigating measures.

  - Impacts on other resources (i.e., wildlife, water, air).

  - How projected need for herbicide and prescribed fire treatments can be reduced.

  - Consistency with federal agencies, state and local governments.

  - New data that would require alteration of program.

* Recording and reporting human health concerns would be done to verify job hazard analysis and risk assessments and would include review of:
  - Exposure incidence.
  - Accidents.
  - Worker health complaints.
  - Recording of treatment methods,

including for herbicides: the exact identity, formulation, manufacture, mixture and method of application.
- BLM Herbicide (Pesticide) Application Record, and worker and public Reports of Accidents/Incidents or Illnesses (DI-134, CA-1 or CA-2) for vegetative management projects.
- Names of personnel working on herbicide projects, their assignments and dates of actual work (29 CFR XVII, 1910.20)

* The Program Coordinator will incorporate any new data that would require alteration of the program.

* Conduct young stand monitoring during standard stocking survey at intervals of one, three, and five years and record treatment effectiveness, or as a post-treatment evaluation survey on a sampling basis to be filed with BLM Project Implementation (Herbicide Application) Records.

* Monitor for hazardous components of wood smoke such as aldehydes, ketones and respirable particulate (PAH), which are correlated to carbon monoxide. Use dosimeters to sample and index exposure to carbon monoxide (CO) as needed.

* Submit annual report to BLM's Oregon State and Washington D.C. offices for herbicide usage describing the acreage, amount, usage, location, and use strength for each chemical used. Retain project records for three years.

The above monitoring, along with planning and providing "no action" units or portions of units will help to determine effectiveness and need for action as a baseline comparison. Through these actions, the BLM will be able to determine if the actions are giving the desired management results.

CHAPTER 6 - SUMMARY OF ENVIRONMENTAL CONSEQUENCES OF DECISION

Introduction

This chapter presents a summary of the environmental consequences of implementing the BLM vegetation management program described in Chapter 2 (The Decision). Consonant with the programmatic level of the FEIS which addresses a wide variety of treatment methods within western Oregon, the following summary of impacts is given on a general situation level. Impact analysis for special situations and site-specific locations will be addressed through environmental assessments tiered to this document when within a similar scope.

Impacts of implementing various levels of vegetative treatments are described in Chapter 3 of the February 1989 FEIS entitled Western Oregon Program-Management of Competing Vegetation.

For comparative purposes, the level of manual and mechanical treatments of the Decision are similar to those for Alternative 7 (No Herbicide) of the FEIS. There is a lower level of prescribed burning, and also a lower level of herbicide treatments. The acreage cap for herbicides is considerably below that for any of the alternatives that proposed herbicide use. Biological treatments projected under the Decision exceed the level of any of the alternatives due to linking of site preparation, maintenance, prevention, early treatment to reduce reliance on herbicides. Combined treatments often involve two treatments sometimes considered as a single action or closely-related action for a double treatment. (See Table 2.1 for alternative and Decision comparison, and Table 6.1 for impacts comparison.)

The potential impacts of the Decision are summarized in the following sections, first for environmental effects by resource, and then for potential human health effects by treatments. In general, health risks to the public at large are roughly correlated with exposures and the overall level of vegetative management activity. The level of vegetative management activity also roughly correlates with levels of economic productivity.

The FEIS, including the quantitative analysis in Appendix L (Appendix D of the USFS FEIS, 1988), provides the nucleus for the environmental consequences summarized below. The summary of impacts also considered the qualitative analysis in Appendix H, which is incorporated by this ROD. Several other documents were reviewed to compare impacts and to update guidance and design protective measures. Those include: U.S. Forest Service Region 6 FEIS entitled "Managing Competing and Unwanted Vegetation" (1988); the USFS R6 ROD, mediated agreement, and Guide; and the BLM FEIS on Vegetative Treatment on BLM Lands in Thirteen Western States (1991).

Incorporated into the ROD are toxicological reports requested by the BLM (see Attachment A), profiles of treatment methods (Attachment B), individual herbicide profiles (Attachment C), and research data and other information supplied during public input to the assessment process.

Table 6.1 - SUMMARY COMPARISON OF IMPACTS BY ACTUAL CONDITIONS, SELECTED ALTERNATIVE, AND DECISION

ENVIRONMENTAL COMPONENT IMPACTED	HISTORIC CONDITION (1983)	RECENT CONDITIONS (1990)	ALTERNATIVE 1 FEIS PREFERRED	ALTERNATIVE 7 NO HERBICIDES	ALTERNATIVE 8 NO ACTION	DECISION
Method Using:						
Manual	24,461 acres	59,586 acres	17,504 acres	48,742 acres	3,485 acres	43,112 acres
Mechanical	12,043 acres	13,141 acres	12,689 acres	14,702 acres	8,555 acres	13,704 acres
Biological	2,705 acres	3,614 acres	5,295 acres	4,291 acres	510 acres	7,057 acres
Presc. Fire	14,094 acres	19,176 acres	21,586 acres	23,373 acres	14,419 acres	17,533 acres
Herbicides	18,481 acres	0 acres	42,339 acres	0 acres	0 acres	8,800 acres
Human Health	Historic risk pattern.	Historic risk, but without herbicides.	Historic risk with some increased risk to public and workers from herbicides.	Historic risk continues with fire, but none from herbicides.	Less manual work, so reduced risk; presc. fire continues; no herbicide risk.	Reduced risks from fire and smoke. Low risk to public and to workers from herbicide use.
Air Quality Meet smoke goals (total suspended particulates) by year 2000.	Occasional smoke intrusions occur, but none exceeded EPA particulate standards.	Most state-of-the-art methods introduced. Reduction in emissions with spring burns, mass ignition, and mop-up.	Reduction in emissions 20% from historic due to improved methods; timing of emissions not to exceed EPA standards.	Numbers of acres prescribed burned continue at high levels.	Numbers of acres prescribed burned continue at moderate levels.	Number of acres reduced from Alternative 1 by 20%; using state-of-the-art implementation to reduce emissions.
Soils Mechanical	Estimated 15% productivity loss on about 2,200 acres treated each year.	Estimated 15% productivity loss on about 1,600 acres treated each year.	Estimated 15% productivity loss on scarified and piled lands on portion of 2,400 acres.	Estimated 15% loss on portion of 3,150 acres scarified and piled.	Productivity loss negligible--140 acres.	Estimated 15% loss on portion of 1,900 acres scarified and piled.
Soils Prescribed Burning	Some productivity losses. Impacts are proportional to the number of acres burned.	Some productivity losses.	Some productivity losses from burning. Impacts proportional to acres.	See Alternative 1.	Some productivity losses from prescribed burning.	Some productivity losses from prescribed burning. (13,800 forestry site preparation)
Water Quality	Suspended and dissolved solids are less than 100 mg/l from all sources. Herbicide residues found in 20% of treated area samples; none at significant levels.	Suspended and dissolved solids are less than 100 mg/l from all sources. No herbicide contamination from BLM sources.	Increase in potential for herbicide contamination. Accident rate of 1/12,000 acres. Risks 3.5 by increased treatment.	No potential of herbicide contamination of water from BLM sources.	No potential of herbicide contamination of water from BLM sources.	Potential for herbicide contamination. Accident rate of 1/12,000 acres; 50% risk of historic. Buffers expanded.

ENVIRONMENTAL COMPONENT IMPACTED	HISTORIC CONDITION (1983)	RECENT CONDITIONS (1990)	ALTERNATIVE 1 FEIS PREFERRED	ALTERNATIVE 7 NO HERBICIDES	ALTERNATIVE 8 NO ACTION	DECISION
Long-Term Productivity	Historic conditions.	Current conditions.	Continuation of current conditions, as modified by applicable land use/ resource mgmt. plans.	Some loss in timber productivity due to no effective treatment method for some acreage.	Little loss in site productivity.	Current conditions, continue as modified by applicable land and resource mgmt. plans.
Animals	Populations at moderate levels. Populations of cavity nesters and song birds declining.	Populations at moderate levels. Populations of cavity nesters, song birds, and small mammals declining.	Slight reduction in big game. Reduction in diversity and populations of small mammals and cavity nesters.	Populations at moderate levels. Populations of cavity nesters and song birds declining.	Populations at moderate or increasing levels. Populations of cavity nesters, song birds, and small mammals increasing.	Populations at moderate levels. Populations of cavity nesters, song birds, and small mammals stable or declining.
Fish	Most habitat in good-to-fair condition. 40% of Coho salmon habitat in poor condition. Streams producing at 50% of optimum.	Unchanged conditions and population levels. Potential for contamination moderate.	Unchanged conditions and population levels.	Unchanged conditions and population levels.	Unchanged conditions and population levels.	Unchanged conditions and population levels. Potential for herbicide contamination low.
Economic Conditions Compared to Standard Program	Income normal to counties; employment high.	Income high to counties; employment high in vegetation mgmt.	Income normal to counties; employment high in vegetation mgmt.	Slight decrease in income to counties; employment high in vegetation mgmt.	Slight decrease in income to counties; employment low in vegetation mgmt.	Slight decrease in income to counties; employment high in vegetation mgmt.
Coordination and Cooperation	Interested public and public agencies informed. Comments requested; strongly polarized reactions.	Interested public and public agencies informed and asked for comments; low public involvement.	Interested public and public agencies informed and asked for comments. Likely to generate strong reactions.	Interested public and public agencies informed and asked for comments; low involvement.	Very low need for public involvement in vegetation mgmt.	Emphasis on early involvement of public and agencies; and involvement throughout project development, implementation, and monitoring.

ENVIRONMENTAL COMPONENT IMPACTED	HISTORIC CONDITION (1983)	RECENT CONDITIONS (1990)	ALTERNATIVE 1 FEIS PREFERRED	ALTERNATIVE 7 NO HERBICIDES	ALTERNATIVE 8 NO ACTION	DECISION
Effectiveness of Techniques	Limited problems in vegetation mgmt. Effective and productive techniques available.	Some problems in alder, salmonberry, tan oak and madrone, ceanothus and grass, and grass-gopher vegetation. Tough vegetation areas avoided. Early tree mortality and growth losses in subject young stands.	Limited problems expected in vegetation mgmt. Effective and productive techniques available. Most economic methods available.	Same as Recent Conditions. Effectiveness reduced where large amounts of competitive vegetation occur.	Problem expected in vegetation manipulation. Few effective and productive techniques except preventive strategy.	Preventive measures stressed in project design and corrective actions. Some loss in effectiveness on dense vegetation and near residences and drainages due to restricted herbicide use.

The tables included in this ROD were compiled to help the public and others understand the parameters of the FEIS and its Decision and also the impacts associated with its implementation.

Most impacts of vegetation manipulation occur on lands following timber harvest, within forest stands of early seral stages of 0-15 years, and along roadsides. There are currently (1992) approximately 370,400 acres in early seral age classes in a landbase of approximately 2.4 million acres which represents 16 percent of the western Oregon BLM-administered lands.

A basic assumption of the analysis was that sufficient funding and personnel would be available, and further that design features in the FEIS and the ROD are linked to RMPs for each Oregon west-side district.

Environmental Effects

Vegetation Resources

The overall effect of managing competing vegetation will be to attain adequate stocking and survival of desired vegetation, suppress or remove unwanted vegetation, accelerate growth of desired vegetation, and retard the growth of competitive vegetation succession within the grass-forb and brush-seedling stages. The suppression of undesired vegetation would increase moisture, nutrients, and sunlight being allocated to desired vegetation.

Target, nontarget, and desired vegetation may be beneficially or adversely impacted by treatments. A significant beneficial impact would be increases in conifer survival and growth for reforestation success and a potential increase in volume of timber production over time. Since timber volume estimates are subject to uncertainty, any long-term adjustments would be addressed following inventory and subsequent to resource management plans being developed or supplemented.

Vegetative management benefits many other major program objectives including rangeland restoration, maintenance or improvement; wildlife habitat restoration, maintenance or improvement; watershed riparian protection and enhancement; and modification of wildfire fuel hazard types.

In many cases, seral stages could be simplified where control methods are highly effective in reducing susceptible species. Some injury or loss of nontarget vegetation will occur on the treated site from all methods, especially site preparation activities. The degree of adverse effects on off-site nontarget vegetation (i.e., adjacent agricultural crops) may be significant if standard operating procedures, buffers, and site-specific mitigation measures were inadequate or misapplied. Prescribed fire could decrease site plant productivity when a "hot burn" occurs.

Species composition and coverage will be altered. For example, in some areas dominance may shift from shrub to herbaceous species through the release of seed banks or the planned introduction of seeding. On other areas, the vegetative strategy may involve shifting dominance away from one woody species by controlling it and releasing another desirable or undesirable woody species.

Prescribed fire may provide site preparation, or reduce wildfire hazard or severity. Underburning to reduce fuel ladders and debris accumulations could decrease some wildfire hazards. While the risk of escape with prescribed fire will be low due to precautions taken, the potential for impact from an escaped fire could be large, especially if escaped fire encroached into rural residential areas.

Herbicides used for site preparation or release could cause damage or mortality to both target and desired vegetation depending on the time of application, plant community, method and rate of application, and selectivity and residual effects of formulation. The impacts of chemical treatments would vary depending on how closely related the target and nontarget species were, the selectivity of the herbicide used, and time and rate of application. More sensitive annual plants would be affected to a greater degree than perennials, especially if application preceded the plant's seed production. The ability of many plants, however, to maintain viable seeds in the soil for several years should reduce the susceptibility of these plant species to herbicides.

Changes in plant community composition can either provide beneficial conditions or alter its composition to a more competitive environment for desired vegetation. Some vegetation would be precluded from sites due to herbicide residual effects for up to three years, which could be either positive or negative, depending upon the type of vegetative treatment needed.

Manual treatments, which cover a broad range of tools and techniques, have minimal adverse impacts on nontarget vegetation. Generally for site preparation and maintenance applications, however, manual treatments provide only temporary changes in levels of target or unwanted vegetation. Vegetation that sprouts or suckers, such as vinemaple and salmonberry, usually increase in density when manually cut or bashed. For some species such as ceanothus, handpulling of one/two-year seedlings reduces target species to desired densities; however, handpulling is not effective for rhizomatous species.

Mechanical treatments impact vegetation in a similar manner as manual cutting, scraping and pulling treatments. An additional impact that occurs with mechanical treatment, when equipment is contaminated, is the introduction of seeds or reproductive portions of unwanted vegetation, noxious weeds, or diseases. Scarification activities and right-of-way construction or maintenance expose seedbeds which often encourages unwanted vegetative invaders and noxious weeds, depending upon the intensity of soil disturbance. Two examples of diseases that are easily spread by mechanical treatment are *Phytophthora* in Port-Orford-cedar and *Phellinus* in Douglas-fir. The stipulation of protective mitigating measures such as washing of equipment before entering project areas prone to such infestations will reduce spread of these diseases.

Biological treatments involving seeding of desired grasses, forbs, or shrubs; grazing by domestic or wildlife animals; and manipulating of stand conditions that favor desired plants continue to increase. The use of such combination treatments is projected to double in the next decade. While these types of treatments have positive results from reducing target vegetation, they also can have negative impacts on a localized basis from the animals feeding on nontarget vegetation. Also, domestic livestock grazing, like mechanical treatment, has introduced competitive vegetative species including noxious weeds.

Impacts within the treatment site depend upon amount of susceptible nontarget species interspersed with target species, vegetation zones, competition for moisture, and supplemental food and water sources for grazing animals. Use of non-native plants and untested seed sources may introduce unwanted plants and reduce natural vegetative diversity.

Air Resources

Significant impacts to air quality would be moderate to short-term increases in smoke and particulates from prescribed fires, spray drift from herbicides, and dust and exhaust generated by manual and mechanical treatment methods.

Smoke introduces contaminants into the air, notably particulates which are harmful to human health. However, overall prescribed fire impacts assessed considering the requirements of the Clean Air Act and the Oregon Smoke Management Plan are expected to be within national ambient air quality standards. Due to changing weather conditions, some smoke may intrude into designated Class 1 areas where protection of visibility is a concern.

The amount of emissions produced would depend upon the number of acres burned, moisture of various sizes of fuel at time of burn, fuel quantities, type of burn, and weather conditions. Burning of herbicide-treated units also has potential to introduce additional particulates that cause adverse health impacts. Restrictions on burning of treated vegetation will minimize impacts of this nature.

The potential for impacting human health would depend mainly upon the proximity of people to the treated unit and their sensitivity to smoke contaminants. Implementation monitoring and control, and weather prediction are significant risk factors. (See Human Health for additional discussion.)

Aerial broadcast application of herbicides presents the greatest potential for adversely affecting nontarget locations. The herbicide type and its formulations, and standard operating procedures used will minimize most, if not all, potential adverse effects. Examples of measures that would reduce such impacts include restricting applications to certain weather conditions, wind speed and direction, and droplet sizes; using appropriate buffers; and stipulating spray release heights above the vegetation. Even when such measures are implemented, there would still be potential for fluctuations in air movement to cause some herbicide drift.

There will be temporary, localized noise from using aircraft and equipment (e.g., powersaws) during vegetation treatments.

Soil Resources

Site preparation using mechanical or prescribed fire treatments has the highest potential for direct adverse impacts on soils. Specifically, mechanical treatment exposes soils to levels of compaction and surface erosion which adversely impacts soil productivity and permeability. On the acres that are conventionally treated (scarified or piled), productivity losses of approximately six percent are expected, even taking into consideration standard operating procedures and mitigating measures. Overall impacts will be proportional to the number of acres treated, soil types, and degree of soil disturbance. Using techniques such as the grapple or "spider" machines and designating "skid trails" will reduce impacts to a level below conventional methods.

Prescribed fire, particularly fire that results in hot burns, may adversely affect important duff layers reducing organic matter and nutrients, and exposing soil to surface erosion. Site productivity can be reduced moderately in the short term (2 to 3 years) or even potentially in the long term. Severely burned areas on steep slopes are susceptible to movement of surface soil and rocks; and areas that have granite and volcanic soils would be susceptible to erosion. Surface erosion, and the ability to absorb and store water, would be proportional to burn severity and soil susceptibility. Severe burns, which may alter the soil microbial community, could occur on up to 10 percent of areas subject to slash pile burning. Generally, however, severe burning occurs when levels of moisture in the fuel, duff and soil are low (BLM's FEIS for Thirteen Western States, 1991). In most cases, prescribed fire would not be done when these conditions are present, which would reduce the potential risk of severe burning and its attendant impacts.

Soils are a receptor of herbicides, which is a factor considered for those herbicides that persist in or move through soils. A herbicide's persistence or mobility rate depends on the characteristics of the site-specific soils including the different soil types and microorganisms present, and the selected herbicide formulation. The persistence of herbicides at the point of their application is increased in soils that have organic material, clay, high pH, and cold temperatures. Soils that are sandy increase the mobility of persistent herbicides from target to nontarget locations. Other analysis has shown that soil microorganisms may decompose herbicides or be adversely affected.

In general, the persistence of the specific herbicide and formulation, its susceptibility to water transport, local weather and climatic conditions, and the rate and frequency of applications determine the potential for residual herbicide accumulation in the soil and off-site movement. Picloram and atrazine both have potentially long persistence in soils and water, which is the reason for designing measures specific to their use. Alkaline soil conditions in particular increase persistence of picloram.

Long-term soil productivity impacts from prescribed fire and herbicide use at 60 to 120-year intervals are uncertain, although according to Miller et al. (1989) there were no significant effects on tree growth between burned and unburned sites after 30 years.

Biological treatments using grass seeding may cause microbial and mycorrhizal changes in some forest soils, and grazing may cause some compaction but of a limited degree.

Manual treatments are expected to cause minimal adverse impacts on soils.

Water and Aquatic Resources

The highest potential for adverse impacts on water and aquatic resources will occur from increased sedimentation into nearby streams and lakes following mechanical scarification and broadcast burning, nutrient movement into ponds and marshes following soil-disturbing activities, and contamination of surface and groundwater from herbicide drift and accidental direct application.

Mechanical site preparation involving broadcast soil disturbance is expected to increase short- and potentially long-term sedimentation, with the extent depending on techniques used, timing, terrain and slope steepness, proximity to water, compaction increasing surface water runoff, and soil properties.

Prescribed fire could increase sedimentation and leaching of nutrients. This would occur indirectly from the removal of surface duff which reduces the ability of soils to absorb and store water and consequently increases runoff. Public water intakes can be negatively impacted in these locations. In general, impacts are expected to be short term (1 to 5 years). Nitrogen increases are expected to occur for one to two years after burning in headwater creeks that directly drain from burned units.

Herbicide treatments can affect the quality of both surface and groundwater. Considering the protective measures that would be implemented in regards to waterways, impacts to water resources are expected to be minimized. The most likely means of entry into surface water would be from herbicide drift from aerial and mechanical streamside application. When persistent herbicides are applied to upland water channels and ditchlines that are subsequently subject to a storm event, the flushing of herbicides that occurs is a potential source of stream and pond contamination. When contamination occurs the chemical concentration is greatest at the application source, and then diminishes with dilution, dispersion, degradation and adsorption of the herbicide. In a worse case scenario, a direct application peak rate would be near 736 parts per billion (ppb). In an aerial herbicide application scenario, a 100-foot no-spray buffer capable of intercepting drift should reduce peak stream contamination to below 36 ppb (Newton and Norgren, 1977).

Wet, marshy areas are capable of retaining contamination for longer periods of time than upland areas. Areas with shallow water tables are also especially susceptible to causing water contamination because a slight rise in the water table can flush quantities of persistent chemicals into a stream system or pond (Norris 1980).

Precipitation occurring prior to herbicide degradation can cause soluble herbicides to become mobile and enter stream channels. Circumstances that dictate the degree of contamination include herbicide degradation rate, time elapsed since application, amount of precipitation, and other site-specific factors.

Standard operating procedures used by the BLM that reduce the potential for adverse impacts to water resources include using nontreated buffers adjacent to waterways; controlling application rates and droplet size; and determining appropriate placement and timing of application.

All risks cannot be mitigated. Measures that cannot be completely guaranteed and that would carry some risk as a result include positive identification of no-spray areas, shutting off equipment, avoiding water-logged soils with sensitive chemicals, predicting current and future rain events, and timing applications.

With implementation of the standard design features, including best management practices and site-specific protection measures, the BLM would most likely be within the EPA-recommended limits for water quality. Past water monitoring samples have been helpful in confirming the effectiveness of buffers and in identifying needed modifications in application methods and mitigating measures (BLM FEIS, 1989).

The ability of a herbicide to reach

groundwater is affected by its placement, solubility, adsorption by soil particles and organic matter, the persistence of the chemical used, and its specific formulation. Other contributing factors include the quantities and frequency of applications over time.

Water tables that are closer to the surface have a greater potential to become contaminated. When bound tightly to soils, herbicides may move only a few inches from the point of application regardless of the amount of infiltrating water. The greatest potential for herbicide mobility occurs where herbicides are highly water soluble, relatively persistent, and not readily absorbed by soils or are applied to soil that does not have the potential to absorb them.

Of the herbicides proposed for use in the BLM's vegetative management program, the formulations of atrazine, dicamba and picloram are of concern due to their potential for mobility. These herbicides dissolve readily in water and, due to their persistence, can leach into groundwater under certain soil and weather conditions, or when standard operating procedures and best management practices are not followed. The precautions included in the Decision, specifically the requirement for approval of a soil scientist or hydrologist in projects planning to use these herbicides, should provide for water protection.

The checkerboard ownership pattern of western Oregon BLM-administered lands could lead to increases in impacts when adjacent lands are treated at the same time. The potential for any cumulative impacts should be identified and minimized by conducting a drainage analysis as part of the annual program or project planning to consider actions on neighboring property.

Combining biological control methods, such as seeding forage and introducing domestic animals or concentrating wildlife, may cause water contamination through increases of the nutrient base in some streams for short periods.

Notification of downstream water users or requesting identification of downstream water users, which is standard operating procedure, should assure that significant adverse impacts are anticipated and avoided.

Manual vegetation control methods in municipal watersheds, as with other methods, may require special control measures to reduce fecal contamination.

Wildlife and Fish Resources

As many as 200 to 300 wildlife species might use a single vegetation treatment area (BLM 1989 FEIS, page 40). In cases where site preparation occurs immediately after timber harvest, residual species may be directly affected. Those species at most risk would be the smaller mammals and birds, particularly those residing or nesting on the ground or in vegetation. These species may be killed or injured. Other species would incur losses in habitat cover and forage. Broadcast treatments would have the most potential for impact.

The early seral stage species may be directly affected by vegetation habitat manipulation through the abbreviation of grass, forbs, brush and hardwoods in favor of mid-seral conifer development which will displace some species. The brush phase is especially reduced, whereas the forb stage may be extended under maintenance and release treatments. Such modification or elimination of habitat below a critical level could, in the short term, adversely impact some wildlife by reducing their populations and also prey diversity. Short-term vegetation effects benefit species requiring open conditions and food supplies within reach of browsing species.

Some vegetative treatments may have species-specific habitat impacts on food, cover or living space. Some song birds, for example, may be affected if vegetative management destroyed or altered their nesting, foraging, and dispersal habitats, and increased their susceptibility to parasites and predation.

Other wildlife species would benefit from site preparation and vegetative maintenance that provides short-term forage and access benefits. Maintenance of habitat for obligate species (e.g., those requiring a narrowly-defined habitat within early seral stages) is critical to analyzing overall adverse impacts on a site-specific basis.

In the long-term, vegetative management would modify habitat diversity by reducing the populations of species dependent upon high levels of the competitive or unwanted species. Shifts in wildlife species abundance and diversity will occur, with the level of such impact being dependent on the sensitivity of affected ecological communities, and current and potential population levels. The potential for any such impacts would be determined on site-by-site verification. One of the most critical impacts identified has been accessory effects such as loss of snags and down logs during site preparation. Much of this impact has occurred, not from direct treatment method implementation, but in reducing human risks during implementation practices or potential escapes of fire.

Fish and aquatic organisms can also be impacted by changes in aquatic, streamside, riparian, and adjacent upland habitat. Designing and maintaining buffer integrity is critical to protect water. Developing or retaining multi-storied vegetative structures adjacent to streams also provides habitat for insect populations and a future source of detritus for input to the stream. Impairment of buffers could cause both short-term and long-term adverse impacts to aquatic resources. Stream sedimentation could occur if adjacent units were subjected to surface-disturbing activities and, before the soils were stabilized, a storm occurred that carried sedimentation to streams. These circumstances could have significant negative effects on fisheries.

Some herbicides can have toxic effects on wildlife, especially the smaller mammals and birds, and under worst case scenarios. The herbicides proposed for use in this ROD show no tendency to bioaccumulate (BLM 1989 FEIS, Appendix P). The ecotoxicological categories for herbicides proposed for use in this ROD are provided in Table 6.2.

Atrazine, an ester form of 2,4-D, and triclopyr, are highly toxic to aquatic organisms and present risks during broadcast aerial applications and ground-based roadside applications on water-logged soils or near flowing roadside ditches, streams, or irrigation ditches.

Most herbicides could have significant short-term impacts during accidental or worst case scenarios when concentrate or large volumes are spilled into water bodies (see Herbicide Profiles, Attachment C). Since most application timing is a compromise to maintain effectiveness on target vegetation, minimize damage on desired vegetation, and reduce damage to nontarget species including wildlife, some level of adverse effects will occur on all

TABLE 6.2 - INHERENT TOXICITY OF HERBICIDES TO WILDLIFE
Maximum Inherent/Potential Toxic Effects, Classifications, and Toxicity Reference Levels used in Analysis

Estimated environmental concentration (EEC) levels exceeding 1/5 LD_{50} represent a risk that should be mitigated by restricting use of the herbicide--moderate risk. BLM judges EECs that exceed the LD_{50} as unacceptable risks--significant risks. Doses below the 1/5 LD_{50} level are assumed to present low or negligible risk. When there are differences in toxicity levels, the BLM will use the conservative reference levels which are designated in bold.

	TOXICITY VALUES			
Herbicide Active Ingredient	Mammalian Acute Oral Lethal Dose (mg/kg) LD_{50} rat *[1/5 LD_{50}]*	Avian Acute Oral Lethal Dose (mg/kg) LD_{50} bird *[1/5 LD_{50}]*	Aquatic Organisms Lethal Conc. LC_{50} trout *[1/10 LC_{50}]*	Reptiles Acute Oral Lethal Dose (mg/kg) LD_{50} bird *[1/5 LD_{50}]*
Asulam	4000 *[800]* *Practically nontoxic******	2600 partridge *[520]* **1600+** *** *[320]* *Slightly toxic******	Slightly toxic *Slightly to practically nontoxic******	2600 *[520]* *Slightly toxic*
Atrazine	1869 *[188]* **672*** *[134]** *Slightly toxic******	940 bobwhite *[188]* *Moderate to slightly toxic*	Moderately to highly toxic *[2.4]* 24* ***Moderately to slightly toxic******	940 *[188]* ***Moderately toxic***
2,4-D	100 dog *[20]* (acid 375 rat) (ester 620 rat) (100 cow*) *Highly toxic*	472 pheasant *[40]* **200** chukar* *Moderately toxic******	Moderate to highly toxic ester; acid less toxic 9* *[0.9]* Moderate to highly toxic* *Ester is highly toxic/ amine is nontoxic******	200 toad *[40]* *Moderate to highly toxic*
Dicamba	757 *[151]* **566** rabbit* *[113]** *Moderately toxic******	673 pheasant *[135]* *Slightly toxic******	28* *[2.8]* *Slightly toxic**	673 *[135]* *Slightly toxic*
Glyphosate	**3800 rabbit** *[760]* 4320 rat *Practically nontoxic******	4640 quail *[400]* **2000+** quail* *Slightly toxic******	38* *[3.8]* *Rodeo: practically nontoxic* *Roundup: moderately toxic*	2000 *[400]* *Slightly toxic*

	TOXICITY VALUES			
Herbicide Active Ingredient	Mammalian Acute Oral Lethal Dose (mg/kg) LD_{50} rat *[1/5 LD_{50}]*	Avian Acute Oral Lethal Dose (mg/kg) LD_{50} bird *[1/5 LD_{50}]*	Aquatic Organisms Lethal Conc. LC_{50} trout *[1/10 LC_{50}]*	Reptiles Acute Oral Lethal Dose (mg/kg) LD_{50} bird *[1/5 LD_{50}]*
Hexazinone	860 guinea pig *[172]* *Slightly toxic******	2258 bobwhite *[452]* *Practically nontoxic******	Slightly toxic *[32]* 320* *Practically nontoxic**	2258 *[452]* *Slight to nontoxic*
Picloram	1000 sheep *[144]* **720 sheep*** *Slightly toxic******	2000+ pheasant *[400]* *Practically nontoxic******	12.5* *[1.25]* Moderately to slightly; chronic needs testing *Tordon 101 (a common mix with 2,4-D) is moderately toxic**	2000+ *[400]* *Practically nontoxic*
Triclopyr	310 guinea pig *[62]* *Moderately toxic******	1698 mallard *[340]* G4 4640 *Slightly toxic******	117* *[11.7]* Significant *Ester highly toxic; amine is practically nontoxic**	1698 *[340]* *Slightly toxic*
Diesel Oil*	7380 *[1476]* *Practically nontoxic******	16,400 mallard *[3,280]* *Practically nontoxic******	0.19* *[0.019]* *Moderately to highly toxic**	16,400 *[3280]* *Practically nontoxic*
Kerosene	28,000+ *[5,600]* *Practically nontoxic******	16,400 *[3,280]* *Practically nontoxic*	0.006* *[0.003]* *Moderately to highly toxic**	16,400 *[3,280]* *Practically nontoxic*

* = BLM Thirteen Western States FEIS, p. E8-5-15 (1991).
*** = Herbicide Profiles (Attachment C).

Formulations proposed for use are normally less acute toxic than the active ingredient, see Table 3-17, p. 114. An exception may be Roundup, a formulation with glyphosate, at 1,600 mg/kg per Thomas/Easton (1991), Literature Review and Evaluation for BLM, Attachment A.

Source: FEIS, Appendix P, pp. 265-305 (1988).

these systems.

Data on the toxic effects of herbicides to wildlife is limited. Uncertainty exists in terms of sublethal long-term effects on common vertebrate wildlife and direct toxic effects on microorganisms in the soil or water, and on the surface of the forest floor or flora. The relationship of these potential impacts to forest nutrient cycling is unknown.

Potential effects to livestock from vegetative treatment are generally minimal due to the low application rates of herbicides and their form of application. Animals consuming forage treated with picloram, 2,4-D, or dicamba cannot be slaughtered within a time frame specified on labels. Grazing is also restricted for one grazing season on sites subjected to these three herbicides. Based on estimated doses in BLM's FEIS on Vegetative Management for Thirteen Western States (1991, Appendix E-8), the risk of direct toxic effects to livestock is negligible, even assuming exposure immediately after herbicide treatment. Except for short-term adverse impacts on livestock forage, no direct impacts to livestock are expected with any of the treatments. In some cases, forage production can be maintained or improved with the control of undesirable vegetative species.

Cultural Resources

Of the proposed vegetation treatments, mechanical will have the most potential to impact cultural resources and traditional American lifeways. However, the probability of such impact should be reduced by standard measures for protecting cultural resources, including surveys preceding proposed activities and standard mitigating measures to take in the event of locating cultural resources. The review given through the public consultation process should also reduce the potential for impacting areas of cultural importance. Generally, however, impacts cannot be determined at the programmatic level, but must be addressed on a site-specific basis.

Adverse impacts from prescribed fire and mechanical clearing could occur to undiscovered archaeological sites. Mechanical tilling and blading can damage and disrupt cultural materials and burning can destroy surface combustible materials. It is unlikely that cultural artifacts would be adversely affected by herbicide treatments.

Impacts to Native Americans vary directly with the extent to which target plants are important to maintaining traditional lifeways.

Recreation and Visual Resources

Most units that show visual effects from vegetative management are those that are site prepared following timber harvest or stand conversion practices. Downed material and dying vegetation (i.e., red needles, toppled trees and dead, discolored vegetation) that may occur as part of the vegetative management practice could alter visual aesthetics in the short term. The degree of impact, however, is expected to be minimal when considering the visual effects already present from harvest practices in most units that are treated.

The land, water, and snow based recreation sites in western Oregon comprise less than one percent of the total acreage covered in this FEIS. Removal of undesirable vegetation (including poisonous plants, briars and aquatic weeds at boat ramps) from these areas by herbicides can effectively reduce or remove troublesome or sprouting plants. Treatment that involves temporary closures of sites to treat the vegetation or treatment during low use periods will minimize the potential to negatively impact human health.

Impacts to resource-dependent activities such as hunting, fishing, berrypicking, birdwatching and hiking will vary by treatment method. Recreationists will avoid burned areas, but generally not notice changes in areas subjected to manual and biological treatments. Areas where herbicides are used and which involve signed site closures will reduce the availability of those areas for recreational purposes for the length of the closure.

Risks will occur when people ignore signs or enter units from edges of units other than normal access points. Of the public users, hunters, hikers and fishermen will be at greater risk to direct dermal exposure or to off-site drift deposits because these users generally enter forest areas or use forest resources on a more frequent basis than other users.

Special Status Species

The type of impacts to special status plant and animal species would be the same as those discussed under vegetation and wildlife and fish, except that the potential impacts could be more severe for special status species due to their unique habitat needs or limited range. At most risk would be species that are obligate to narrowly-defined habitat occurring on target areas or closely associated with target vegetation. Failure to identify and provide adequate protection for these species will, at the minimum, place a portion of their population at significant risk.

For identified special status species on proposed treatment sites, avoidance or protection protocol is expected. Special status species plants that occur but have not been identified or located could be susceptible to any impacts described for target vegetation. Direct effects include injury or death of plants, causing the potential for immediate elimination of a species from a potentially significant portion of its range. Subtle changes that could occur in either plant community structure or function may reduce or eliminate a species through the alteration or loss of its competitive ability.

Special status animals could lose foraging, nesting, hiding, thermal cover and prey sources.

Wilderness and Special Areas

There would be potential adverse impacts to wilderness areas and other special areas such as research natural areas, recreation trails, and areas of critical environmental concern from the risk of prescribed fire escapement, from herbicide drift during aerial application, or from herbicide spills. While risks of this nature have a low probability, any such occurrence could incur significant effect. It is most likely that positive effects will occur when undesirable vegetation is removed and controlled to allow native plants to compete better.

Human Health Effects

This section provides an overview of the potential adverse human health effects associated with the vegetation management program outlined in this document. The injunction of 1984 specifically required a worst case analysis be conducted on the use of herbicides and potential human health effects. Since the injunction, the

BLM has evaluated, characterized and made decisions about managing human health risks for all treatment methods and made it a primary consideration in evaluating vegetation management alternatives.

Manual, mechanical, prescribed fire, and herbicide methods of vegetation treatment all have some level of risk to human health and safety. All methods have possible short-term and long-term health effects which depend on innate hazards of the technique and then the exposures of forest workers, forest users, and nearby residents to those treatment methods. Even the No Action Alternative has levels of risk associated with areas needing roadside brushing, recreation sites having poisonous plants, and fuel levels that present a fire hazard. Consideration of these various factors constitute the assessment of risk.

Two views of risks are summarized. One view emphasizes what is known about human health effects and the record of safe use; the other view emphasizes what is not known. While the disclosure of uncertainty is troubling to many people, it is believed that the public and workers understand there are everyday risks associated with most daily activities. Giving attention to the information on treatment methods (Attachment B) and individual herbicides profiles (Attachment C) will help in minimizing potential hazards associated with the various methods and herbicides.

The following is a summary of potential human health impacts by vegetation management method.

Manual

Working with chainsaws and brush cutters can be hazardous under most forestry situations. In general, members of the public are not at risk from manual methods since they would not be handling the equipment involved. For BLM employees or contract workers, injury rates reflect a relatively safe work situation since workers are trained and understand the risks involved, although the work is considered above average in terms of hazard.

Workers could be cut by their tools or fall onto the sharp ends of cut stumps or brush. The potential for injuries ranges from abrasions to severe injuries such as major arterial bleeding or compound bone fractures. Worker fatigue can be a contributing factor. Minor injuries are almost certain to occur with the use of handtools; hearing impairment occurs with loud equipment; and exposure to exhaust gases and vapors will occur with mechanized equipment. While there are a number of minor injuries that have a high probability of occurring even with safety training, severe injuries occur at a much lower frequency.

Training, instruction, protective gear, rest breaks, and supervision will minimize potential adverse impacts. Based on cases reported to the Oregon State Accident Fund, the biggest percentage of accidents (50 percent) are expected to involve strains and bruises; the least likely event is a fracture (about 5 percent). Some insect bites and poisonous plant exposures will occur; however, the potential for fatalities is expected to be slight if protective measures are used.

The relationship between hours worked and frequency of injuries appears to be reliable which suggests that the quality of data is fair to good. Job experience, which could be a factor, was not considered in analyzing data. Long-term health effects and local data to support such associations are not well reported. Disabling cuts, hand and wrist numbness, and back problems are long-term risks for chainsaw workers. Minor injuries are almost certain to occur; for analysis purposes, one accident per 130 acres has been used in estimates.

Mechanical

The potential for risks to the general public from mechanical methods is expected to be very low. Injuries that occur are generally associated with rolling or flying debris when the public enters a treatment area. The risk of injury to BLM or contract workers will be similar to agricultural or construction work involving use of tractors or heavy equipment. While injuries from mechanical treatment are rare, when they do occur they are often severe. The severity of the hazards are often correlated to the steepness and roughness of an area, and the soil terrain. For workers, risks generally are associated with machines overturning or flying debris. There will also be risks from roadside brushing and mowing depending on road design, visibility, and traffic control.

The quality of data on health effects of mechanical treatment is poor. Risks to the public during equipment transit from storage to working sites are low as are on-the-job accidents.

Biological

A risk for human health impacts from grazing cows, sheep, goats or wildlife for vegetation control exists due to potential domestic or recreational water contamination from fecal matter or animal borne sources. The risk is expected to be minimal due to the limited acreage of grazing done for vegetative control. For example, in 1991, seeding for brush control and wildlife habitat improvement occurred on 422 acres, and grass/legume seeding was done on 2,239 acres.

Impacts of biological treatment are drawn by inference because little or no information exists on the spread of water borne pathogens from vegetative management by biological methods (principally livestock grazing), or on the incidence of human illness that could be attributed to such treatment. Quality of data is considered poor.

Prescribed Fire

Prescribed fire presents human health risks to the general public, forest users, adjacent residents, and occupational workers. The risks include chemical or particulate injury or irritation from the smoke; cancer risk from chemical compounds produced when forest residues (including vegetation previously treated with herbicides) are burned; various injuries from fire escapement; and direct physical injury to workers and adjacent residents by burning or rolling objects. The potential for toxins from burning herbicide-treated vegetation is addressed in the Herbicide Profiles (Attachment C).

Escaped fires pose the most severe risk to the general public. No data is available on public health impacts from such escapes. Compiled data for western Oregon BLM districts for 1990 shows there were 17,330 acres of prescribed fire, 113 acres of escaped fire (1 in 153) of which the largest was 77 acres. In 1991, there were 12,166 acres of prescribed fire, and 201 acres of escaped fire (1 in 60) of which the largest was 168 acres (BLM Facts, 1990 and 1991).

Worker injury data suggest one minor injury for every 500 acres burned and one disabling injury for every 7,500 acres burned. Carbon monoxide exposure may exceed time-weighted threshold values for short periods for occupational workers. Personnel who manually light burns would be exposed to diesel oil and gasoline, in addition to the effects of smoke and fire.

Particulates carried on smoke from burning could cause eye and lung irritation to sensitive members of the public and workers. Of particular concern are tiny particulates that can be inhaled deeply into lungs and deposited there along with attached chemicals. The particles may be irritating, with associated chemicals such as aldehydes being acute irritants. Other components, such as polyaromatic hydrocarbons (PAH) are known carcinogens. The components of forest fire smoke are fairly well known but the amount produced on a site varies considerably by fuels, fuel moisture and fire temperatures.

Although information on escaped prescribed fires is readily available, the quality of data on the effects of smoke from prescribed fire is generally poor. While some smoke concentrations resulting from slash burning have been measured, most conclusions must be extrapolated from studies done for other types of burning activities.

The public, particularly local residents, would be at risk if smoke management plans and burning techniques failed or unexpected weather conditions occurred. Concerns about human health effects from combustion products prompted an analysis (BLM FEIS, Appendix O, 1989)) which assumed 20 six-hour exposure days for each of 10 years of residence. In the analysis, Dost (FEIS, 1989) estimated the upper probability of additional risk to contracting cancer for the public was 1.1 in one million.

In general, the public is not likely to incur serious injury. There are some indications, however, that members of the public may incur long-term health effects from toxic constituents in fire smoke if they are exposed to relatively high levels of smoke from intrusions that exceed state air quality standards.

Because considerable uncertainty is associated with the analysis, BLM continues to sponsor a "Smoke Exposure Assessment at Prescribed Burns" through the USDA Forest Service PNW Research Station at Seattle, Washington. Reports from that research are periodically being made available to verify and modify these conclusions.

Herbicides

Potential human health effects from using the proposed herbicides (e.g., asulam, atrazine, 2,4-D, dicamba, glyphosate, hexazinone, picloram, and triclopyr), the inert ingredient kerosene, and the herbicide carrier diesel oil were evaluated in a risk assessment (FEIS Appendix L).

The risk assessment quantified the general systemic (general health) and reproductive human health risks for a given herbicide by dividing the laboratory animal studies no-observed-ill effects-levels (NOEL) by the levels of exposures a person might get from applying the herbicide or from being near an application site.

The human cancer risk was then calculated for those herbicides that caused tumor growth in laboratory animal studied. This was done by multiplying a person's estimated lifetime dose of the herbicide by a cancer probability value (cancer potency) calculated from the animal tumor data.

In preparing the Decision, data presented in Appendix L (1988) was compared to that documented in the BLM's FEIS for Thirteen Western States (Appendix E) as a verification test. Both data sets, if different, are presented in the tables summarized in this document.

Potential human health effects from using the proposed herbicides were evaluated in a risk assessment (FEIS Appendix L, 1988). In analyzing the impacts of using herbicides and in the decisionmaking process, the BLM uses the same quantitative risk assessment done by Labat-Anderson, Inc. (FEIS Appendix L, 1989; USFS FEIS, Appendix D 1988). An evaluation of the data for chronic hazards (qualitative risk assessment) was compiled by the University of Washington (USFS FEIS Appendix H). (The relationship of these documents is presented in a figure at the front of the ROD.)

Additionally, BLM is using periodic toxicological literature searches and cooperating in producing information packages/herbicide profiles with the U.S. Forest Service and the Bonneville Power Administration (BPA). Periodic supplemental data sheets summarizing pertinent open literature, health reports and operational effects will also be produced and made available to interested people and workers.

Questions of uncertainty occur since only a few herbicides have data addressing human health effects from herbicide exposure. Poisoning incidents and chronic effects are relatively rare. The quantification of risks depends on available studies on laboratory animals.

The constraints placed on herbicide use in the Decision will result in few risks to members of the public. There may be some effects under worst case conditions or when people are exposed as result of an accidental spray or spill. There are risks to workers, particularly in applications where long exposure and high application rates are used.

While complex, the process for analyzing health effects for herbicides is important due to concern about their effects and the likelihood of people being exposed. A summary of the process is presented below. See the parent documents for more detailed discussions.

Because each herbicide is a distinct chemical with its own particular properties, profiles have been developed which describe the following for each herbicide:

* Estimated toxicity or poisonous quality (chemical inherent hazard).

* Doses that might produce health effects and kinds of toxic effects.

* Exposure amount that would be in a person's immediate surrounding (i.e, exists in the air, can rub onto skin, or occur in food or in drinking water).

* Amount that would enter the body (dose).

* Risk for the possibility that humans will experience toxic effects from exposures occurring in routine-realistic vegetation management field operations.

Hazard Analysis - Toxicity

Evaluations of potential human health effects caused by herbicides are generally based on results of toxicity tests in laboratory exposures. Any actual human exposures that are available are used to supplement and verify the estimated toxic effects.

Most probable routes of exposure are oral, dermal, and inhalation. Levels of exposure (doses) are expressed as milligrams of the chemical per kilogram of body with of the test animal (mg/kg). Doses that occur over time are expressed per unit of time as milligrams per kilogram per day (mg/kg/day).

The reference dose (acceptable daily intake) is an estimate of daily exposure of the human population that is not likely to have an appreciable risk of harmful effects during a lifetime (EPA 1988). This dose is a useful point of reference to gauge potential exposures of workers and the public.

Toxicological tests were reviewed in several categories. Inherent toxic and reference values for the herbicides analyzed and available for use are summarized in Table 6.3 for effects on human health.

Toxicity is the ability to produce an adverse effect on an organism. Toxicity tests are designed to identify specific toxicity endpoints, such as death or cancer, and toxicity reference levels for kinds of toxic effects.

A numerical indicator used in assessing the relative toxicity of herbicides is the LD_{50}; this is the amount of material applied orally which is fatal to the average laboratory rat. Assumptions are that if a similar dose/body weight (mg/kg) is taken by humans, poisoning will likely occur. Acute toxicity (LD_{50}) studies are used to determine a number of toxicity endpoints based on a single dose or several large doses of a substance. In the BLM's vegetation management program, no one is expected to encounter an LD^{50}.

Studies designed to determine the effects of repeated exposures are called *chronic* studies. Repeated dosing in chronic and subchronic studies are designed to determine systemic effects, cumulative toxicity, latency periods, reversibility of toxic effects, and the level in particular at which the long term dose no longer results in apparent adverse effects in test animals (or the *no-observed-effect level, or NOEL level*). The uncertainty about whether people would be at risk of exposure to these levels led to development of the risk assessment.

Quantification of program-wide herbicide risks was based on three key numerical indicators of a herbicide's toxic properties:

1) NOEL for *general or systemic* (acting throughout the body) toxicity.

2) NOEL for *reproductive* (fertility and effects on offspring) toxicity.

3) *Cancer potency* (increased tumor incidence with laboratory doses).

Most chemicals are assumed to have a chronic NOEL threshold level below which no adverse effects occur to the test organism. In general, because chemicals are considered to possess no such threshold level for cancer and mutations, a toxic endpoint is assumed to occur with a certain level of probability even in the presence of extremely small quantities of the substance.

These doses are also known as *reference values* for assessing risks with small doses. Since reference values for actual cause-

TABLE 6.3 - INHERENT TOXICITY OF HERBICIDES TO HUMAN HEALTH
Acute and Chronic Toxicological Reference Levels From Laboratory Determined Studies Used In The Risk Analysis, Thresholds, and Classifications

The larger the numbers, the lower the risk of toxic effects. All chemicals are injurious to health at some level of intake. These large doses are not expected in the Western Oregon Vegetation Management Program. When there are differences in toxicity levels, the BLM will use the conservative reference levels which are designated in bold.

Characteristic Toxicity	**TOXICITY CLASSIFICATION**							
	Acute Toxicity **Poisoning**		**Chronic Toxicity**					
			Systemic		**Reproductive/Development**		**Cancer/Mutagenic**	
HERBICIDE Active Ingredient[1]	Lethal Dose (rat) LD_{50} (mg/kg of body weight) --------- Acceptable Human Daily Intake Dose*	Category (EPA) -------- *Eval. System (Food Safety Inspect Svc)***	NOEL (mg/kg/dose/day of body weight)	General Health Hazard** -------- Observed damage to functions**	NOEL (mg/kg/dose/day of body weight)	Hazard Rating --------- Class **	Cancer Potency $(mg/kg/day)^{-1}$ --------- Ability to induce tumors EPA Class*	Potential --------- Tumor/damage DNA
Asulam	4,000 mg/kg 0.05 mg/kg/day	Slight (Caution) *Negligible*	50.0 mg/kg/day (rat)	Low Damage transient & reversible	50.0 mg/kg/day (rat)	Moderate Suspected adverse effect in one species	0.02 Group C, Weakly mutagenic, evidence	Moderate Thyroid, adrenal, skin and sarcomas
Atrazine	**672 mg/kg** 2,850*** 1,869[2] 0.005 mg/kg/day 0.0025	Slight (Caution) *Low*	0.48 **0.38*** mg/kg/day (dog)	Low/Mod. Transient to serious; reversible	0.5 mg/kg/day (rat)	High Adverse effects in rats	**0.03** 0.22 human* Group C, Weakly mutagen, evidence[2]	Moderate Female mammary; male testicular#
2,4-D	375 mg/kg Varies by form: salt is 1100 ** 0.01 mg/kg/day	Moderate (Warning) *Low*	1.0 mg/kg/day (rat)	High Irreversible	5.0 mg/kg/day (rat)	High Adverse effects in rats	**0.00503** 0.029* Group C, controversy uncertainty; testicular[2]	Low/Mod. Weakly mutagen/ brain tumor
Dicamba	757 mg/kg 0.03 mg/kg/day	Slight (Caution) *Low*	15.8 mg/kg/day (rat)	Low Transient; reversible	3.0 mg/kg/day (rabbit)	High Adverse effects in rabbits	Group D, no positives undetermined	Low/Insuf. Info No adverse evidence shown
Glyphosate	4,320 mg/kg[2] 0.10 mg/kg/day	Slight (Caution) *Negligible*	31.0 mg/kg/day (rat)	Low Transient; reversible	10.0 mg/kg/day (rat)	Moderate Suspected adverse effects in rats	.000026 **.000024*** Group E Repeat test* Non-carcinogenic***	Mod./Low Insuf. Info Weakly mutagenic

Characteristic Toxicity	TOXICITY CLASSIFICATION							
	Acute Toxicity Poisoning		Chronic Toxicity					
			Systemic		Reproductive/Development		Cancer/Mutagenic	
HERBICIDE Active Ingredient[1]	Lethal Dose (rat) LD_{50} (mg/kg of body weight) --------- Acceptable Human Daily Intake Dose*	Category (EPA) -------- *Eval. System (Food Safety Inspect Svc)***	NOEL (mg/kg/ dose/day of body weight)	General Health Hazard** ------- Observed damage to functions**	NOEL (mg/kg/ dose/day of body weight)	Hazard Rating --------- Class **	Cancer Potency $(mg/kg/day)^{-1}$ --------- Ability to induce tumors EPA Class*	Potential --------- Tumor/ damage DNA
Hexazinone	1,690 mg/kg 0.033 mg/kg/day	Slight (Caution) *Negligible*	10.0 mg/kg/day (rat)	Low/Mod. Transient to serious; reversible	50.0 mg/kg/day (rat)	Low/Moderate No adverse effects suspected in rats	Group C	Low/Insuf. Info Weakly mutagenic/ mice
Picloram	8,200 **4,012* mg/kg** 0.07 mg/kg/day*	Slight (Caution) *Negligible*	7.0 mg/kg/day (dog)	Low/Mod. Transient to serious; reversible	50.0 mg/kg/day (rat)	Low/Moderate No adverse effects suspected in rats	**0.00057** 0.003* Group D* Class not determined	Moderate/ Insuf. Info Weakly mutagenic, evidence female liver
Triclopyr	630 mg/kg 0.025 mg/kg/day*	Slight (Caution) *Low*	2.5 mg/kg/day (dog)	Moderate Serious; reversible	10.0 mg/kg/day rabbit	High Adverse effects in rabbits	No evidence of carcinogenic-ity shown***	Moderate Weakly mutagenic
Diesel Oil	7,380 mg/kg	Very slight *Negligible*	7.38* mg/kg/day	Insuf. Info	751* mg/kg/day	Insuf. Info	.0000049 BaP and benzene	Insuf. Info
Kerosene	28,000 mg/kg	Very slight *Negligible*	28* mg/kg/day	Moderate (chemical pneumonia)	751* mg/kg/day	Insuf. Info	.0000049 BaP and benzene	Insuf. Info

* = FEIS Vegetation Treatment on BLM Lands in Thirteen Western States, pp. E3-15 & E5-2 (1991).
** = USFS FEIS, R6 (1988), Table IV-15, p. 131.
*** = Herbicide Profiles (1992), Attachment C.

[1] Formulations proposed for use are normally less acute toxic than the active ingredient, see Table 3-17, p. 114; an exception may be Roundup (1,600 mg/kg), a formulation of glyphosate.
[2] Thomas/Eaton (1991), Literature Review and Evaluation for BLM, Attachment A.

Source: FEIS (1989), acute toxicity: p. 97 and Appendix D, p. 3.22-28 (1988); chronic: systemic, pp. 97 & 101; chronic reproductive, pp. 97 & 101; cancer potency: pp. 97 and p 109; and distillates, p. 114.

and-effect in humans are rare, levels have been estimated using animal laboratory data and factoring by dividing the lowest long-term dose that does not result in apparent adverse effects in test animals (NOEL) by 100 (10 for animal to human x 10 from estimated average human effects to include sensitive humans) to provide a *human low risk standard or margin of safety of 100 (MOS 100).* It is the western Oregon BLM's intent to provide this level of public safety.

There are three types of chronic testing: Teratogenicity, Reproduction, and Carcinogenicity. Each is described below:

* *Teratogenicity* - Determines the potential of a chemical to cause malformations in an embryo or a developing fetus between the time of conception and birth. Used for detection of structural and functional deformities.

* *Reproduction* - Determines the effect of the chemical on reproductive success as indicated by fertility, direct toxicity to the developing fetus, and survival and weight of offspring for low-level, long-term exposure.

* *Carcinogenicity* - Ability to induce tumors over a test animal's lifetime. Cancer potency is extrapolated from very high dose levels and reflects the probability of getting cancer sometime in a person's lifetime for each mg/kg/day. It is assumed that any dose, no matter how small, has some probability of causing cancer. This principle, however, is an area of scientific controversy in cancer risk assessment.

  Mutagenicity studies are also conducted to draw conclusions about the risk of a chemical to cause genetic effect. See Table 6.4 for a list of EPA-required studies.

Much of the data on herbicide toxicity has been generated to comply with the FIFRA, which establishes procedures for registration, classification and regulation. The EPA is responsible for its implementation. The EPA registration standards consist of thorough reviews of all data submitted for registration or re-registration, and require a high level of "general laboratory procedures." Where procedures have not been adequate or further testing is requested is where gaps in relevant information occur. Over time, these EPA-requested tests and procedures change. On the other hand, open literature often is not based on these same stringent procedures, but do provide indications of potential concerns. These differences in procedures explain why test results sometimes differ. These gaps in information concerning uncertainty are called *data gaps.*

At the time of the risk assessment, the Council on Environmental Quality (CEQ) regulations required preparation of a "worst case" analysis before proceeding when there were data gaps in relevant information that could not be filled.

Currently known data gaps where information is incomplete or unavailable by EPA standards are listed on Table 6.4. The list of data gaps is in the process of being updated and will be made available when complete.

The baseline for data gaps that the BLM is using is the EPA data (1988). See also Appendix L (1988) and discussion FEIS (pages 90-96) for further discussion on data gaps.

TABLE 6.4 - STATUS OF EPA HERBICIDE DATA GAPS

Due to continuing reviews of herbicides, these data gaps are subject to change. For this reason, this table includes data gaps listed for other reference sources. The first column for every herbicide lists the status of data gaps presented in the BLM FEIS (1989). The second column (Other) lists inconsistencies between the FEIS status of data gaps and the various reference sources.

TOXICOLOGICAL TEST	ASULAM		ATRAZINE		2,4-D		DICAMBA		GLYPHOSATE		HEXAZINONE		PICLORAM		TRICLOPYR	
	FEIS[1]	Other	FEIS	Other	FEIS	Other	FEIS	Other	FEIS	Other	FEIS	Other	FEIS	Other	FEIS	Other
Acute toxicity testing																
Acute oral - rat	C	R**	C		C		C		C		C	P*, R**	C		C	
Acute dermal	C	R**	C		C		C		C		C	P*, C**	C		C	
Acute inhalation - rat	C	R**	C		C		C		R	W**, C*	C	P*, C**	X	C*, C**	C	
Eye irritation - rabbit	C		C		C	X*, C**	C		C		C		C		C	
Dermal irritation - rabbit	C		C		C	X*, C**	C		C		C		C		C	
Dermal sensitiz. - gn. pig	C		C		C		C		C		C		C		C	
Subchronic testing						acid amine										
90-day feeding - rodent	C		C		C	R S	C		C		C		C		C	
90-day feeding - nonrodent	C		C		C	R R	C		C		C		C		C	X*
21-day dermal	C		C		C	C,X*,R	X		C		C	R*	C	X*	C	
90-day dermal	C		C		C		C		C		C		C		C	
90-day inhalation	C		C		C		C		C		C		C		C	
90-day neurotoxicity	C		C		C		C		C		C		C		C	
Chronic testing																
Chronic - dog	C, x		C, x	R*	C, x	X*	C, x		C		C, X	X*	X, x	R*	C, x	
Chronic - rodent	R, x		R	C*	C		C, x		C, x		C		C		C, x	
(Carcinogenicity tumor)																
Oncogenicity - rat	R, x	R**	R		R	R*, R**	C, x		C, x	X*, C**	C		C	X*, R**	C, x	
Oncogenicity - mouse	C, x		C, x		R, x	P*	X, x	C**	C	X*, C**	C	R**	C, x	X*, R**	C, x	
(Birth defects develop)																
Teratogenicity - rat	C, x		R, x	C*, R**	C, x		C		C		C		C, x	X*, R**	C	
Teratogenicity - rabbit	C, x		R, x	C*	C, x	X*, R**	C, x		C		C		C, x	X*, R**	C, x	
(Fertility - fetus)																
Reproduction - rat	C, x		X, x	R*, R**	C		C, x		C, x		C	R**	C, x	R*, R**	C, x	
(Genetic material DNA)																
Mutagenicity	X, x	R**	X, x	R*, R**	X	R*, R**	C		C, x		C		X, x	C**	C	

C = EPA data requirement complete

X (upper case) = Data gap

x (lower case) = California data gap; see Table 3-8 (CDFA, 1986), p. 93.

P = Partial data gap

W = Requirement waived by EPA

R = Under further review. (However, sufficient data was available for risk analysis.)

* = FEIS (1991), Vegetative Treatment on BLM Lands in Thirteen Western States, Appendix E, p. E3-23.

** = Herbicide Profiles (1992) prepared for this ROD (Attachment C).

[1] FEIS (1989), Western Oregon, Table 3-7 (EPA, 1987), p. 92, and Table 3-8 (CDFA, 1986), p.93.

Although registration of a herbicide under FIFRA requires these data gaps be filled, data is available in most instances from EPA review materials or other sources to characterize the toxic endpoints of concern.

To assess the quality of chronic toxicity information available in Appendix L (1986), the USFS hired the University of Washington to produce Appendix H which assessed the quality of data used as an information base. That qualitative analysis is summarized in Table 6.5.

The quality of data for 2,4-D and picloram is considered adequate to draw inferences about possible human health effects. The EPA is, however, currently conducting further evaluation on the effects of 2,4-D, and any new information will be considered by BLM in the implementation of its program.

For asulam, atrazine, dalapon, glyphosate, and hexazinone, the overall quality of data has useable information for evaluating toxicity, but was considered to be marginal; additional data would refine reference numbers and increase reliability. For dicamba and triclopyr, the quality of data was judged to be marginal to inadequate. More recent information (Attachment A) indicates triclopyr data is near adequate and that glyphosate is no longer considered as having carcinogenic potential. The quality of data for two herbicides, fosamine and diuron, was considered inadequate and led to the decision not to use those chemicals.

Exposure Analysis

Two primary conditions are necessary before a human receives a herbicide dose that may result in a toxic effect: 1) The potential for exposure to herbicide must exist; and 2) the herbicide must be taken into one's system.

To expound upon the first condition, the herbicide must be present in a person's immediate environment (e.g., in the air, on the skin, or in food or water) making it available for intake. The amount of herbicide available to be taken into the body is called the *Exposure*.

The second condition involves the entering of a herbicide into a person's body by such routes as being eaten as on food or drank, being absorbed by dermal routes, or being inhaled. The amount of herbicide that enters the body is called the *Dose*.

Information on exposure to the public, residue levels on food or in drink, residue on vegetation over time, and dermal absorption for most herbicides, and cancer potency have been causes of uncertainty and considered data gaps (FEIS p. 90). A conservative approach will be used until information clarifying these issues are available.

Dermal penetration data was only available for the herbicides 2,4-D (6 percent), picloram (0.48 percent) and dicamba (5 percent). (These percentages infer that for 2,4-D, for instance, only six percent of the herbicide exposure amounts are actually taken into one's body.) For all other herbicides, 10 percent was the assumed exposure take-up rate. This data has been very controversial for atrazine which may have 10 times actual dose estimated in the risk analysis tables. Both Appendix L (1988) and Ciba-Geigy calculations are shown in the tables.

Routine operation scenarios with and without protective gear, worst case operations, and accident and spill

TABLE 6.5 - THE QUALITY OF THE INFORMATION IN APPENDIX L (BLM, 1986) ABOUT HERBICIDE TOXICITIES DERIVED FROM VARIOUS STUDIES

CHEMICAL	SYSTEMIC	CANCER	REPRODUCTIVE	DEVELOPMENTAL	NEUROLOGIC	IMMUNOLOGIC
Asulam	M	A	M	M	I	I
Atrazine	M	M	M	M	M	I
2,4-D	A	M	A	M	A	M
Dicamba	I	M	M	M	I	I
Diuron	I	I	I	M	I	I
Fosamine	M-I	I	I	I	I	I
Glyphosate	M-I	M	M	A	I	I
Hexazinone	M	A	M	M	I	I
Picloram	A	M	M	M	I	I
Triclopyr	M-I	M	M	A	I	I
Diesel Oil	I	M-I	I	M	I	I
Kerosene	I	I	I	M	I	I

Quality of Data:

A = Adequate information is available. Studies are of sufficient quality and quantity that estimates of human health are considered reliable. New studies are unlikely to change estimates of health effects.

M = Marginal but useable information available for evaluating toxicity. There were studies of adequate quality and results did not vary greatly, but more information would increase reliability. Although new studies may change estimates of health effects, the results are considered moderately reliable.

M-I = Some useable information exists for evaluating toxicity for health effects. There were some studies of marginal quality that provided useful information, but studies were inconsistent and some contained flaws. It is likely that new studies would change estimates of health effects.

I = Inadequate information available for evaluating toxicity. There were too few studies of sufficient quality to yield useful or reliable information.

Source: USFS FEIS, 1988, Table IV-17, p. IV-138, which summarizes the Characterization and Management of Risk (Appendix H) complied by the University of Washington.

exposures were analyzed. Public single and multiple route exposures, and transport modeling by drift, residues on plants, in water and fish were calculated (Appendix L and BLM's FEIS for Thirteen Western State, Appendix E). Potential routes of exposure vary by resident, forest user or those occupationally involved.

Risk Analysis

Risk analysis is done where either workers or the public are exposed to any of the herbicides or carriers. These risks are expressed in terms of margins of safety (MOS) which are a comparison of the predicted exposure and dose to the estimated NOEL from laboratory animal studies.

In numerical calculations, an MOS greater than 100 is predicted to have low to negligible human health effects. The risk rating (e.g., high, moderate, low, and negligible) used in this ROD correlates to the risk MOS rating developed by the USDA Food Safety Inspection Service and used by the USFS.

Risks that exceeded the risk criteria (MOS less than 100, or cancer risk greater than one in one million) for the forestry program indicate areas of concern and a need for precaution.

Preparation of the ROD involved review of similar documents completed by this and other agencies, and interest groups. In some instances, there are differences in the calculation of MOS levels assigned to similar exposure scenarios. The differences, however, do not infer that any one of the analysis is any less reliable than another; in fact, they indicate similar concerns. The same chemicals appear as concerns in all documents reviewed, and the MOSs (even though differing) are less than 100 for the same chemicals.

Public

For members of the public, MOS levels for each herbicide proposed for forestry use for routine-realistic and routine worst-case situations are listed in Tables 6.6.

Various publics were identified, including berrypickers, hikers, nearby resident, and anglers. These people are judged to be the most likely publics to be exposed. For instance, berrypickers could be exposed by walking through treated vegetation or eating contaminated berries, and anglers could be affected by eating fish from contaminated waters. The greatest concern is for the person who receives multiple exposures from more than one activity and consequently the highest dose (i.e., routine worst case).

Members of the public are not expected to be exposed to a health risk considering completion of exposure analysis and implementation of protective measures for each program. Exposure risks, however, do occur. For instance, when access is not controlled or treatment areas not fully secured within an aerial or right-of-way treatment area, the public could accidentally be exposed to levels conservatively calculated for an unprotected worker in worst case scenarios. Residue on plants or berries in unsigned, sign-ignored, or drift-affected areas could also have potential health impacts. Another potential impact would be from drinking contaminated water.

For typical exposures, the public is not expected to be exposed to either systemic or reproductive effects from any of the proposed herbicides. Under worst-case scenarios, the public could have systemic effects from 2,4-D, or reproductive effects from atrazine (Table 6.6). For the public, a routine-realistic exposure is assumed to account for 95 percent of the total dose, and a worst case dose for five percent.

Routine aerial application scenarios pose a moderate risk to the public assuming the Appendix L (1988) scenarios are correct. Risks to the public potentially occur from aerial routine application of atrazine if mitigating measures identified in the Decision are not used. This potential for impact is the reason for designating special precautions with the use of atrazine. If further review and clarification shows these precautions are not adequate or unwarranted, this ROD may be amended.

Because there is much controversy about the atrazine potential effect; the most conservative approach was applied. Mitigating measures, including selection of alternative treatment methods, were designed and included in this Decision to assure that possible effects from atrazine or any other alternative having a potential for an MOS below 100 are minimized.

Worker

Potential risks to workers from forestry work having MOS levels less than 100 or cancer risk greater than one in one million are presented in Table 6.7. Workers are under potential risk in several categories for which special precautions greater than the labelled precautions are required. While no worker is expected to be exposed to routine high risk situations, the potential still occurs.

Herbicides that have high and moderate risks include right-of-way applications (BLM FEIS, Thirteen Western States, 1991). Worker exposure for right-of-way applications is slightly higher for triclopyr and dicamba.

Exposures to workers involved in herbicide applications were conservatively calculated to avoid underestimation. Workers or accidentally-exposed public who receive exposures to some herbicides may be at risk.

For workers, the routine-realistic case assumes some level of protective clothing or equipment was worn, while the routine worst-case represents no protection (see Tables 6.7). Despite all precautions, workers present during operations are likely to be exposed at least to some minimal extent to the worst-case realistic.

Workers under routine-realistic exposures could be exposed to systemic effects from 2,4-D and triclopyr, and to reproductive effects from atrazine. A worker is expected to receive the realistic dose 90 percent of the time, and the worst case dose the remaining 10 percent.

Under the worst-case, workers are at risk of systemic effects from atrazine, 2,4-D, hexazinone, dicamba, triclopyr, and diesel oil; and reproductive effects from atrazine, 2,4-D, dicamba, triclopyr, and glyphosate. Further, for occupationally-involved people, the theoretical cancer risk from atrazine and 2,4-D combinations is increased.

Risks to Human Health from Accidents

Accidental exposures that have MOS levels less than 100 and potential cancer risks greater than one in one million in forestry applications are presented in Table 6.8. Significant effects are expected to be mitigated or reduced due to herbicide use proposals at the site-specific district level

TABLE 6.6 - PUBLIC EXPOSURE MODERATE AND HIGH RISK POTENTIALS FROM USE OF HERBICIDES ON FOREST LAND VALUES

Scenarios in which Margin-of-Safety (MOS) ratios are 100 or less, or cancer risk probabilities are greater than 1 in 1 million, for members of the public exposed to herbicide drift sources. The larger the MOS number, the lower the risk of toxic effects to human health. **High risk is MOS of 10 or less** (possible harmful effects) [bold in tables]; moderate effects are 11-100 (sensitive individual may be at risk). The MOS of 0 = NOEL threshold; negative MOS is a clear risk of possible acute or chronic effects; positive numbers are relative margins of safety. (Note: MOSs displayed are for exposures occurring on the day of application (dose rate on Tables). Herbicide adverse health effects potentials degrade [see Appendix L, Table 4-10, p. 4-42].)

EXPOSURE SCENARIO [1] [2]	REALISTIC EXPOSURES Drift Sources [3]			WORSE CASE EXPOSURES Drift Source [3]		
	Systemic	Reproductive	Cancer Risk 1 exposure *(30 exposures)*	Systemic	Reproductive	Cancer Risk 1 exposure *(30 exposures)*
AERIAL APPLICATIONS	40 acres drift distances: 600' human, 100' veg/berries, 50' water			400 acres drift distance: 100' human, 100' berries, 50' water		
Spray drift (dermal exposure to drift)				AT(28) *AT(146)* [4] 4D(98)	AT(30) {33*} *AT(145)* [4]	*AS(1.73/million)* *AT(3.11/million)*
Vegetation contact by hiker (dermal contact recent drift on vegetation)						
Vegetation contact by picker (dermal contact extensive to recent drift on contaminated foliage)	AT(79)	AT(80)	*AT(1.11/million)*	AT(11) 4D(38)	AT(12) {13*} DC(98*)	*AS(4.46/million)* *AT(8.02/million)*
Drinking contaminated water (oral ingestion of fresh drift)				AT(38) 4D(79) TC(99)	AT(40) {33*} TC(99)	*AT(2.32/million)*
Eating vegetables/ berries (unwashed leafy vegetable or berries with fresh drift)				AT(23/46) 4D(48/96) TC(60)	AT(24/48) TC(60)	*AS(2.13/million)* *AT(3.82/million)*
Eating fish (fish that bioaccumulates contaminated water)	AT(68)	AT(70)	*AT(1.29/million)*	AT(19) 4D[67]	AT(20) {33*}	*AT(4.65/million)*
Hiker multi-exposed (dermal--direct drift + veg contact + oral--drinking recent drift contaminated water)				AT(16) 4D(43) TC(81)	AT(17) {16*} TC(81)	*AS(3.05/million)* *AT(5.48/million)*
Berrypicker multi-exposed (dermal--direct drift + veg contact + oral--drinking water)	AT(41)	AT(43)	*AT(2.14/million)*	**AT(6)** {50*} 4D(17) [96] TC(38)	**AT(6) [68] {7*}** 4D(84) DC(46*) GL(95) TC(38)	*AS(8.55/million)* *AT(1.54/100,000)* *4D(1.83/million)*

EXPOSURE SCENARIO [1] [2]	REALISTIC EXPOSURES Drift Sources [3]			WORSE CASE EXPOSURES Drift Source [3]		
	Systemic	Reproductive	Cancer Risk 1 exposure *(30 exposures)*	Systemic	Reproductive	Cancer Risk 1 exposure *(30 exposures)*
Fisherman, multi-exposed (dermal--direct drift + veg contact + oral--drinking water + eats fish)	AT(45)	AT(47)	*AT(1.95/million)*	AT(9) {80*} 4D(36) {48*} TC(61)	AT(9) {10*} DC(100*) TC(61)	*AS(3.57/million)* *AT(1.01/100,000)*
Hunter, multi-exposure (dermal--direct drift + veg contact + oral--drinking water)	AT(98)	AT(100)		AT(12) 4D(32) TC(53)	AT(13) DC(91*) TC(53)	*AS(3.94/million)* *AT(7.08/million)*
Nearby resident, multi-exposed (dermal--direct drift + veg contact + oral--drinking water + eats contaminated vegetables)	AT(63)	AT(65)	*AT(1.39/million)*	AT(9) 4D(23) TC(34)	AT(10) {33*} DC(66*) TC(34)	*AS(5.17/million)* *AT(9.3/million)* *4D(1.35/million)*
BACKPACK APPLICATIONS	6 acres with drift distance 100' human, 50' berries, 20' water			60 acres with drift distance 50' human, 50' berries, 20' water		
Spray drift, direct dermal						
Veget. contact, hiker						
Veget. contact, picker					AT{18*}	
Drinking contam. water						
Eating vegetation/berries						
Eating fish from water contam. with spray drift				4D[77]		
Hiker						
Berrypicker multi- exposed					AT{18*}	
Angler multi-exposed				4D[50]	AT[76]	
Nearby resident multi-exposed						

EXPOSURE SCENARIO [1, 2]	REALISTIC EXPOSURES Drift Sources [3]			WORSE CASE EXPOSURES Drift Source [3]		
	Systemic	Reproductive	Cancer Risk 1 exposure *(30 exposures)*	Systemic	Reproductive	Cancer Risk 1 exposure *(30 exposures)*
GROUND MECHANICAL	12 acre roadway with drift distance 100' human, 50' berries, 20' water			40 acre right-of-way with drift distance 50' human, 50' berries, 20' water		
Spray drift, dermal						
Veget. contact, hiker						
Veget. contact, picker				4D[81] {60*}	AT[81] {8*}	
Drinking water						
Eating fish water contam.						
Hiker multi-exposed						
Berrypicker multi-exposed				4D[77] {60*}	AT[76] {6*}	
Fisherman multi-exposed						
Nearby resident						

AS = Asulam AT = Atrazine 4-D = 2,4-D TC = Triclopyr
GP = Glyphosate HX = Hexazinone PC = Picloram
DE = Diesel KE = Kerosene DC = Dicamba

{*} Right-of-way applications in Thirteen Western States FEIS.
(*) Used only in right-of-way applications.

1 Application rates used vary by scenario: see Table 4-3, p. 4-12, Appendix L; BLM (Thirteen Western States) Table E4-5, p. E4-10, and Table E4-9, p. E4-14.
2 Exposure routes, Appendix L, Table 4-7, p. 4-26; BLM (Thirteen Western States) Table E4-1, p. E4-4.
3 Offsite drift deposition of herbicides, Appendix L, Table 4-8, p. 4-33; BLM (Thirteen Western States) Table E4-2, p. E4-7, and Table E4-3, p. E4-8.
4 Appendix L assumes 10% dermal absorption for atrazine; Ciba-Geigy (1990) noted absorption could be as low as 1% for dermal exposures.

Source:
( ) FEIS (1989), Appendix L (1988), Attachment C: Systemic/Reproductive, Tables C-39 through C-128, and Cancer Potentials, Tables 5-11 and 12, or see USDA R6 FEIS, Appendix D, for same documentation.
[ ] FEIS (1991) Vegetation Treatment on BLM Lands in Thirteen Western States, Systemic and Reproductive, Table E5-6, p. E5-9; all other exposures were above MOS threshold.

TABLE 6.7 - WORKER EXPOSURE TO HERBICIDES ON FOREST LAND (MODERATE AND HIGH RISK WHEN WEARING TYPICAL PROTECTIVE CLOTHING)[3]

Scenarios in which estimated Margins-of-Safety (MOS) (i.e., dose ratios) are 100 or less, cancer risk probabilities are greater than 1 in 1 million, for workers occupationally exposed to herbicide. The larger the MOS number, the lower the risk of toxic effects to human health. **High risk is MOS of 10 or less** (possible harmful effects) [bolded in tables]; moderate effects are 11-100 (sensitive individuals may be at risk). The MOS of 0 equals NOEL threshold. Positive numbers estimate a relative margin of safety. Negative MOS is a clear risk of possible acute and chronic effects.

EXPOSURE SCENARIO [1 2]	TYPICAL EXPOSURES[4]			ROUTINE WORST CASE EXPOSURES[4]		
	Systemic	Reproductive	Cancer Risk 5 years	Systemic	Reproductive	Cancer 30 years
AERIAL APPLICATIONS	160-acre application [50-acres]; {50-acres*}			400 acres at high active ingredient application rates [200-acres]; {300-acres}		
Pilot	AT(15) {40*}, 4D(79)[79]	AT(16)[47] **{5*}**	AS (9.02/million) AT (1.93/100,000) 4D (1.5/million)	**AT(2)[10] {-1*}**, **4D(6)[2] {3*}**, DC(81)[94*] {31*}, GP(88) {62*}, HX(48)[40] **{7*}**, TC(27)**[7] {2*}**, DE[44] {29*}	**AT(2)[1] {-10*}**, 4D(30)[12] {17*}, DC(13)[18*] **{6*}**, GP(29)[40] {*20}, HX{37*}, TC(27)[30] **{10*}**	AS (1.66/100,000) AT (1.85/10,000) AT [2.22/100,000] AT {3.08/10,000*} 4D (1.44/100,000) 4D [3.51/million] 4D {2.44/million*}
Mixer-loader	**AT(6) {10*}** *80*[5], 4D(32)[32] {63*}, TC(95)[95] {47*}	**AT(6)**[19] **{2*}** *35*[5]	AS (1.24/100,000) AT (2.67/100,000) 4D (2.05/million)	AS(96), **AT(-1)[9] {-2*}** *40*[5], **4D(3)[2] {3*}**, DC(36)[74*] {25*}, GP(40)[97] {48*}, HX(21)[31] **{6*}**, TC(12)**[6] {2*}**, DE[35] {23*}, KE{87*}	AS(96), **AT(1)[1] {-13*}** *40*[5], 4D(13)**[10]** {13*}, DC**(6)**[14*] **{5*}**, GP(13)[31] {16*}, HX{29*}, TC(12)[23] **{8*}**	AS (1.19/10,000) AT (2.56/10,000) AT [3.43/100,000] AT {4.53/10,000*} 4D (1.97/100,000) 4D [5.42/million] 4D {3.58/million*}
Fuel truck operator/supervisor	AT(100)			AT**(10)** {20*}, 4D(34)[81], TC{81*}	AT(11)[48] **{3*}**, DC(74*)	AS (1.39/100,000) AT (2.95/100,000) AT {9.59/million*} 4D (2.32/million)
BACKPACK APPLICATIONS	6 hours spraying 3 acres at normal rates [2-acre]; {2-acres*}			9 hours spraying 4.3 acres at high rates [4-acres]; {4-acres}		
Applicator	AT(3) *27*[5], 4D(16)	AT(3)[35] {35*} *30*[5], 4D(81)	AS (5.93/100,000) AT (1.81/10,000) 4D (1.34/100,000)	AS(77), AT(-1)[20] **{2*}** *13*[5], **4D(2)[8] {8*}**, DC(29), GP(32), HX(17)[91] {91*}, TC**(10)**[23] {11*}, DE[67] {67*}	AS(77), **AT(1)[2] {2*}** *20*[5], 4D(11)[38] {38*}, DC(5)[27] {27*}, GP**(10)**[91] {45*}, HX(86), TC**(10)**[91] {45*}	AS (5.22/10,000) AT (1.59/1,000) AT [1.51/100,000] AT {1.51/100,000*} 4D (1.18/10,000) 4D [1.19/million] 4D {1.19/million*} GP (2.20/million)

EXPOSURE SCENARIO [1] [2]	TYPICAL EXPOSURES[4]			ROUTINE WORST CASE EXPOSURES[4]		
	Systemic	Reproductive	Cancer Risk 5 years	Systemic	Reproductive	Cancer 30 years
GROUND MECHANICAL	12 acres (33 feet wide by 3 miles long) [25-acres]; {25-acres*}			40 acres treatment [100 acres]; {50-acres}		
Applicator/right-of-way sprayer	4D[81]	AT[56] {56*}	AS (3.86/million) AT (8.88/million)	AT(3)[9] {1*}, 4D(25)[2] {6*}, DC[60] {60*}, GP[78], HX[25] {14*}, TC[5] {5*}, DE[28] {56*}	AT(4)[-1] {-5*}, 4D[8] {31*}, DC(60)[11] {11*}, GP[25] {38*}, HX{70*}, TC[19] {19*}	AS (3.57/100,000) AT (8.21/100,000) AT [2.37/100,000] AT {1.06/10,000*} 4D (4.86/million) 4D [3.5/million] 4D {1.06/million*}
Mixer-loader	AT(63), 4D[79] {79*}	AT(65)[24] {24*}	AS (2.86/million) AT (6.31/million)	AT(2)[20] {3*}, 4D(18)[4] {15*}, HX(75)[60] {34*}, TC(85)[11] {11*}, DE[67]	AT(3)[2] {-2*}, 4D(91)[19] {76*}, DC(45)[27] {27*}, GP(90)[60] {91*}, TC(85)[45] {45*}	AS (2.64/100,000) AT (5.83/100,000) AT [1.59/100,000] AT {5.01/100,000*} 4D (3.72/million) 4D [1.94/million]
HAND APPLICATIONS	[2-acres]; {2-acres*}			[4-acres]; {4 acres*}		
Applicator/hack and squirt	4D(35)[65] {65*}, TC(97) {97*}	AT[19] {19*}, DC(76)	4D (7.26/million)	AT[30] {30*}, 4D(3)[12] {12*}, DC(42), TC(28)[17] {17*}, DE[52] {52*}	AT[3] {3*}, 4D(16)[58] {58*}, DC(7)[42] {42*}, GP[93] {93*}, TC(28)[70] {70*}	AT [2.26/100,000] AT {2.26/100,000*} 4D (4.98/100,000) 4D [1.79/million] 4D {1.79/million*}

AT = Atrazine; 4D = 2,4-D; DC = Dicamba; GP = Glyphosate; HX = Hexazinone; TC = Triclopyr; DE = Diesel

* = Used only in right-of-way applications.

[1] Table 4-1, p. 4-5 and pp. 4-11 through 13, Appendix L (1988); rates of application, Table 4-3, p. 4-12.
[2] Dose rates for worker exposures used in study, Table 4-4, p. 4-15, Appendix L; *Tables E4-6 through E4-11, Thirteen Western States.*
[3] Percentage reduction in dose by wearing typical protective clothes, p. E4-14, Thirteen Western States.
[4] Typical application rates used in forest land and right-of-way programs, Table E4-5, p. E4-10, and Table E4-9, p. E4-14.
[5] Ciba-Geigy (1990).

Source: ( ) FEIS (1989), Appendix L (1988), see USDA, USFS R6, FEIS, Appendix D.
[ ] FEIS (1991) *Vegetation Treatment on BLM Lands in Thirteen Western States, Table E5-7, p. E5-10.*
{*} Right-of-Way application, BLM Land in Thirteen Western States, Table E5-13, p. E5-19.

TABLE 6.8 - ACCIDENTAL EXPOSURE TO HERBICIDES

Potential Injury, High and Moderate Risks (MOS) from Accidents to Exposed People from Herbicide Use on Public Forest Land. Negative MOS exceed laboratory-determined NOEL and signify adverse human health effects; probability of occurrence is one accident per 12,587 acres (Appendix L, p. 5-30). High risks are defined as those exposures that may result in a margin of safety less than 10; moderate risks 11-100; or a cancer risk greater than 1-in-1 million. Injury is expected when MOS is negative unless emergency action is immediately taken.

EXPOSURE SCENARIO	SYSTEMIC[1]	REPRODUCTIVE[1]	CANCER LIFETIME RISK[1] (1 exposure) *30 exposures*
Skin spill, concentrate (Dermal exposure conc.)	AS(-5), AT(-500), 4D(-140), DC(-11), GP(-6), HX(-12), PC(3), TC(-16), DE, KE	AS(-5), AT(-120), 4D(-29), DC(-56), GP(-18), HX(-2), PC(23), TC(-16), DE, KE	AS (1.69/10,000) AT (1.46/ 1,000) 4D (1.47/10,000) GL (2.28/million)*
Skin spill, mixture (Dermal exposure of mix)	AS(2), AT(-54), 4D(-14), DC(-1), GP(1), HX(-2), PC(13), TC(-3), DE, KE	AS(2), AT(12), 4D(-3), DC(-6), GP(-3), HX(3), PC(93), TC(-3), DE, KE	AS (1.41/100,000) AT (1.47/ 10,000) 4D (1.47/100,000)
Directly sprayed person at full application rate (Dermal and inhalation exposure)	AT(1), 4D(10), HX(40), TC(45), DE	AT(1), 4D(49), DC(22), GP(48), TC(45)	AT (2.16/million) *[AS 4.39/million]* *[AT 6.49/100,000]* *[4D 3.15/million]*
Drinking directly sprayed water contaminated at full application rate (Oral ingestion)	AT(4), 4D(17), PC(95), TC(21)	AT(4), 4D(83), DC(43), TC(21)	
Hiker - immediate reentry (wet) application rate (Dermal exposure to just-sprayed vegetation)	AT(94)	AT(100)	
Picker of vegetation, immediate reentry (Dermal exposure to just-sprayed vegetation)	AS(93), AT(-2), 4D(4), DC(53), GP(58), HX(16), TC(18), DE	AS(93), AT(1), 4D(19), DC(8), GP(19), HX(78), TC(18)	AT (5.58/million) *[AS 1.13/million]* *[AT 1.67/10,000]* *[4D 8.12/million]*
Eating directly sprayed vegetables without washing (Oral ingestion)	AT(2), 4D(10), HX(69), PC(58), TC(13)	AT(2), 4D(50), DC(26), GP(83), TC(13)	AT(1.26/1,000,000) *[AS 2.55/million]* *[AT 3.77/100,000]* *[4D 3.05/million]*
Fisherman - eating fish, direct dermal, reetry hiker, drinking water from directly sprayed water (Oral and dermal)	AT(-2), 4D(5), DC(79), GP(99), HX(27), PC(66), TC(11)	AT(1), 4D(27), DC(13), GP(32), TC(11)	AT(4.48/1,000,000) *[AS 6.62/million]* *[AT 1.34/10,000]* *[4D 5.78/million]*
Berrypicker - direct dermal to just-sprayed vegetation, drinks water, and eats berries (Oral and dermal)	AS(57), AT(-3), 4D(2), DC(30), GP(35), HX(9), PC(48), TC(6)	AS(57), AT(-1), 4D(11), DC(5), GP(11), HX(47), TC(6)	AT (9.11/million) *[AS 1.85/100,000]* *[AT 2.73/ 10,000]* *[4D 1.46/100,000]*
Nearby resident - eight full application rate exposures to direct dermal, reentry hiking, drinking water, and eating vegetables (Oral ingestion, dermal)	AT(-2), 4D(4), DC(58), GP(76), HX(21), PC(35), TC(7)	AT(1), 4D(19), DC(9), GP(25), HX(100), TC(7)	AT(4.21/million) *[AS 8.55/million]* *[AT 1.26/10,000]* *[4D 8.09/million]*
Drinking 1 liter of water contaminated by a helicopter jettison of 80 gals of mixture into pond (Oral ingestion of contaminated water)	AT(6), 4D(14), DC[*], HX[*], PC(76), TC(17), DE	AT(7), 4D(68), DC(41), GP, TC(17)	AT*
Drinking 1 liter of water contaminated by a batch truck 2000 gal spill into pond (Oral ingestion of contaminated water)	AS(41), AT(-3), 4D(-2), DC(11), GP(17), HX(9), PC(4), TC(-1), DE, KE	AS(41), AT(-1), 4D(3), DC(2), GP(5), HX(45), PC(27), TC(-1)	AT (8.99/million) 4D (1.51/million)

AS=Asulam	TC=Triclopyr	HX=Hexazinone	4-D=x,4-D	KE=Kerosene
GP=Glyphosate	AT=Atrazine	DE=Diesel	PC=Picloram	DC=Dicamba

[1] BLM 1989 FEIS, Appendix L, Table C (USFS, 1988, FEIS Appendix D, Table C, pp. 130-160, for Systemic and Reproductive; pp. 165-166 for Cancer Lifetime Risk).

Source: ( ) = FEIS (1989), Appendix L (1988); or see USDA, USFS R6, FEIS Appendix D.
[*] = FEIS (1991) Vegetation Treatment on BLM Lands in Thirteen Western States.

by addressing accidental exposures and spill potential situations and designing specific mitigating measures.

In the event of an accident, members of the public may be exposed to much greater amounts of herbicides than under normal exposure circumstances (see Table 6.8). The possibility exists for potential systemic and reproductive effects, through dermal methods or by ingestion, for several of the proposed herbicides, as well as kerosene and diesel oil.

Workers who spill the concentrate or some of the prepared spray mixture on their skin during mixing, loading, or spraying operations, or who are doused if a transfer hose breaks would be dermally exposed. Workers or members of the public who are accidentally sprayed with herbicide because they are beneath a spray aircraft or are too close to a truck or backpack applicator would receive a dermal dose.

The dermal dose would depend on the concentrate of herbicide in the spray mix, the area of the sprayed person's exposed skin, the extent to which the person's clothing absorbed herbicide (which depends on fabric and finish), and the time that elapses before the person can wash. Indirect dermal (reentry) exposure may occur if workers or members of the public brush up against freshly sprayed vegetation (wet, spray has not dried) in the sprayed area.

Members of the public may accidentally be exposed to the herbicide by eating food or drinking water that has been directly sprayed. For example, members of the public may eat berries that have been directly sprayed. Exposure to even higher levels of herbicide is possible if a container of herbicide concentrate were to break open and spill into a drinking water supply.

Risks from burning herbicide-treated vegetation: Brown-and-burn operations involve vegetative treatment with herbicides before burning to dry the vegetation and accomplish a more efficient prescribed burn. Herbicides that could be used in these types of treatment are 2,4-D, glyphosate, and triclopyr. The reference half-lives of these herbicides are 16, 14, and 18 days, respectively. The conservative approach identified in this Decision is expected to minimize or prevent any effects from this practice. That conservative approach includes either following label guidelines or, in the absence of such guidance, not burning until six months after a herbicide application.

In Appendix D of the BLM's FEIS for Thirteen Western States, the calculated risks from herbicide brown-and-burn operations estimated that neither workers nor the public will be at risk from herbicide residues volatilized in such an operation. The western Oregon policy appears to be adequately conservative.

Cancer Risks

A worst case analysis of cancer risk was done for those herbicides that have suggestive evidence of causing tumor growth in laboratory animals or for which there was scientific uncertainty. Herbicides included were asulam, atrazine, 2,4-D, glyphosate, and picloram. There is no evidence that suggests cancer would result from use of the other proposed use herbicides. Data available since the worst case analysis indicates that glyphosate has no cancer potential (see Glyphosate Herbicide Profile in Attachment C).

Nationally, during one's lifetime, there is about one chance in four of a person developing some form of cancer (Calabrese and Dorsey 1984, NRC 1987). The cancer risk to the public from the proposed vegetative management program is judged to be very low (less than one chance in one million) and indistinguishable from cancer risks to which the public is generally exposed.

Accidental exposure, such as to a hiker in a unit or a person eating berries in a recently sprayed unit, increases the risk to 25 chances in one million.

Herbicide workers would have a higher cancer risk than the public under the various scenarios analyzed for 2,4-D, asulam, atrazine, glyphosate (slight) and picloram. Risk would vary according to chemical, formulation, and application technique used. The backpack applicator, who is the worker with the highest exposure, would have cancer risks of 1.51 chance in 100,000 for atrazine, and approximately one in one million for 2,4-D (see Table 6.7).

In general, the only people at risk are those who may actually be exposed to herbicides by accidental exposure, or those people in or near an area where herbicides are being applied or have recently been applied.

The risks calculated in the worst case analysis did not consider mitigation measures that protect workers and the public and reduce the identified risks. With extra restrictions and precautions, exposure of workers and the general public may be reduced below the levels indicated in the FEIS.

Heritable Mutations

Available studies on humans do not associate any of the proposed herbicides with heritable mutations. Tests on rodents indicate mixed results, both positive and negative, for atrazine, 2,4-D and picloram. The conservative estimate is that risk of heritable mutations is the same as the cancer risks.

Inert Ingredients and Synergistic Effects

Commercial herbicide formulations generally contain one or more inert ingredients classified by the EPA according to known toxicity as List 1, 2, 3 or 4. Inerts on List 1 are of toxicological concern and the EPA is recommending product reformulation or identification on the product label. Inerts on List 2 are potentially toxic and high priority for testing, List 3 inerts are of unknown toxicity, and List 4 inerts are of minimal concern.

A list of herbicide formulations that do not contain inert ingredients on EPA Lists 1 or 2 is provided in Attachment D.

Toxicity data for various inert ingredients in the proposed herbicide formulations is presented in the herbicide profiles (Attachment C) and further data will be available in Supplemental Information Sheets.

Formulations such as Esteron-99 (2,4-D) and triclopyr contain kerosene, a petroleum distillate of high priority for testing by the EPA. Assessment of the literature reviewed for the FEIS and information displayed on Table 6.3 indicates that kerosene will not add significantly to cancer potency of 2,4-D or triclopyr formulation toxicity. The analysis indicates sufficiently low risk.

Diesel oil and kerosene as herbicide carriers have had specific toxicological analyses completed in the BLM FEIS for Thirteen Western States. Workers would be at risk of systemic effects from diesel oil, but there would be no significant systemic, reproductive or carcinogenic risks to the public.

Synergistic adverse effects could occur as a result of exposure to two or more herbicides. Available data substantiates that pesticide combination or combinations with other toxic substances could be synergistic. There are no known synergistic effects in humans who have used the proposed herbicides in mixtures; however, there is evidence that mixtures of 2,4-D in picloram may cause skin sensitization (Thomas 1991).

Hypersensitive Individuals

There may be a higher potential for impact to hypersensitive individuals, which includes children (due to their body size and immature development) and/or adults who may have pre-existing sensitivity, diseases, certain diet characteristics, genetic conditions, medical conditions, or other unknown factors that contribute to sensitivity. This potential exists even when applications are well within safety margins.

There is a low probability that BLM vegetative management operations would affect sensitive individuals. One factor leading to this conclusion was the low probability of exposure to the general public, and a proportionately lower rate to sensitive individuals who comprise between 5 and 20 percent of the total population. Another consideration factor was that mitigation measures have been designed for implementation to provide precautions and protection for sensitive people. Accidental exposure for sensitive workers, as for the public, poses a risk.

Cumulative Effects

Cumulative effects on workers and the general public have been considered in the exposure scenarios used in the risk assessment. Backpack applicators are at the greatest risk from cumulative effects. For occupational workers, exposures to repeated applications of low amounts of herbicides over a lengthy time may trigger reactions in some hypersensitive individuals.

Risks to the general public from herbicides is very low. People who live adjacent to units, however, and receive multiple exposures of some herbicides over a short time could incur potentially significant risks. For instance, individuals fully exposed to atrazine or 2,4-D by a combination of drift or direct application, through drinking contaminated water or by eating contaminated food (e.g., unwashed berries) or by entering recently-treated units, can accumulate realistic exposures that would result in a margin of safety (MOS) as low as 21 and 50 respectively.

Workers involved with hand applications (backpack and injection) of atrazine, 2,4-D, or triclopyr would receive the highest realistic exposure. Mitigation measures that require the wearing of protective clothing are expected to increase MOS levels two-to-ten-fold. However, even if mitigation measures are very good (e.g. near ten-fold), some MOS levels would still be less than 100.

The probability of the public receiving repeated exposures to the same herbicide is low due to the remoteness of most treatment units, the widely-spaced timing of treatments, and the use of a variety of herbicides.

Conclusions

Unavoidable Adverse Effects

Some treatments would cause the following adverse effects:

1. Temporary effects on vegetation diversity and changes in relative species abundance and distribution.

2. Short-term adverse effects on quality, quantity, and distribution of some wildlife habitat and species.

3. Soil erosion, compaction and topsoil displacement.

4. Temporary decreases in visual quality.

5. Temporary local air pollution from smoke produced by burning treatments or from chemical vapors from aerial herbicide application.

6. Disturbance or loss of some cultural resources since all cannot be identified by surface inventories or evaluations.

Risks to Human Health and Environment

All vegetation management methods could cause risks to human health and the environment; however herbicide risks are the major concern to the public. The risk analysis identified the specific herbicides and application techniques that pose the greatest risk to workers and the general public, and to the environment.

CHAPTER 7 - OVERVIEW OF ANALYSIS PROCESS AND PUBLIC INVOLVEMENT

Chronology of EIS Analysis Process

Development of the program for vegetation management in western Oregon started in 1982 with initial scoping, and continued to 1992 when the herbicide profiles became available and the Decision was finalized. (A figure showing this process has been placed at the front of the ROD for reference purposes.)

In the first year of the EIS analysis process, BLM held public scoping meetings throughout western Oregon to identify public concerns needing to be addressed in the program. Concerns centered on human health, ecology (including biological diversity and habitat maintenance), economic conditions, fish and wildlife, and social factors (FEIS, Appendix A). Herbicides and prescribed burning were identified as controversial vegetation management methods, with the potential for human health effects being the major issue concerning these two methods.

The Draft Environmental Impact Statement for the Western Oregon Program on Management of Competing Vegetation (DEIS) was released in June 1983 for public review and comment. The DEIS describes and analyzes the environmental impacts of implementing various treatment methods when vegetation interferes with the survival and growth of commercial tree species, adversely affects wildlife habitat or other resource values, or encroaches upon recreation sites and roads.

In 1983, the BLM was enjoined by court order from using any herbicides in its Medford, Oregon district until preparation of a Worst Case Analysis (WCA). The following year, 1984, all Oregon BLM districts were also enjoined from using herbicides pending completion and acceptance of a WCA and EIS. The USDA Forest Service (USFS) throughout Region 6 (Pacific Northwest) was similarly enjoined.

According to NEPA, a "worst case" analysis is required before proceeding when there are gaps in relevant information that cannot be filled. In the vegetative management program, data gaps involve the scientific uncertainty about the carcinogenicity of 2,4-D, picloram, and asulam.

Cooperatively, the BLM and the USFS-R6 conducted a Risk Analysis on routine and worst case impacts of herbicide use on human health. In February 1986, the BLM released a WCA Supplement to the DEIS as Appendix L. (For the USFS, this WCA is Appendix D.) A 60-day comment period followed release of the SEIS.

A qualitative Risk Assessment (Appendix H, 1988) was prepared for the Forest Service to assess the certainty of the quantitative data on both the information the data contains and the quality of information in Appendix L.

Appendix L was updated to 1988 and issued as a joint document (USFS FEIS, Appendix D).

This ROD is tiered to both the quantitative and qualitative documents, Appendix D and H respectively, which are readily available.

In reviewing its 1982 scoping process for control of competing vegetation and that of the USFS Vegetation Management EIS in 1986, the BLM did not identify any new issues. Herbicide use and prescribed burning continued to be controversial, and potential human health effects related to these two methods remained the major issue.

Continuation of the environmental analysis process involved consultation between many agencies, including the USFS and BLM, particularly in the extensive public participation process conducted by the USFS which has been the lead agency in addressing these controversial issues. The designation of cooperating agencies is a provision of NEPA. Specifically, the lead agency may request any other federal agency with jurisdiction by law, or with special expertise related to an environmental issue, to be a cooperating agency.

Subsequent to this additional analysis, the Final Environmental Impact Statement for Western Oregon Program-Management of Competing Vegetation (FEIS) was issued in February 1989. The FEIS updated the material in the DEIS, incorporated Appendix L, responded to public comments, and included literature reviews through 1987.

To ensure consideration of all available data, analysis, and public concerns in the decisionmaking process, a public review period was designated for the FEIS that extended to May 6, 1989, allowing for a 60-day comment period.

Analysis of vegetative management was being conducted almost concurrently by the U.S. Forest Service Region 6. The USFS issued their FEIS and Record of Decision for Managing Competing and Unwanted Vegetation in December of 1988, and submitted it to the court. After a court-ordered mediation, an agreement was reached between the USFS and the original litigants in May of 1989. That same month, the U.S. District Court in Portland dissolved the herbicide injunction and dismissed the complaint against the Forest Service.

BLM published a Draft or Proposed ROD in December of 1989 and again provided additional opportunity for public input. The Proposed ROD included a modified Alterative 1, designated as 1A, which was based largely on the suggestions, comments and documents received concerning the FEIS, Forest Service mediation results, and public input.

Public comments received during the analysis process were valuable to the decisionmaking. During the FEIS comment period, BLM received over 50 letters; responses to the issues in these letters were included in the Proposed ROD. The BLM then considered these 50 comment letters, along with the 53 received on the Proposed ROD, in the decisionmaking process and incorporated relevant information, suggestions or changes into the Final ROD. The outcome of that consideration is that much of the information listed in the Proposed ROD comment response section was incorporated into the Decision.

Another important part of the analysis process was review of the period between 1984 and 1992 which provided an operational test of methods and techniques representing all methods of vegetation management, except for the application of herbicides. This strategy essentially represents Alternative 7. The timeframe between 1984 and 1992, when no herbicides were used, demonstrated that various methods could be implemented with varying results attained, that not all units require vegetative management, and that some units were extremely difficulty to treat effectively without a herbicide tool.

The varied public involvement and lengthy analysis process described above helped BLM in identifying the important issues about its vegetative management program and in designing the Decision.

CHAPTER 8 - ISSUES AND RESPONSES

In reviewing the EIS scoping process, the 103 comment letters received on the FEIS and the Proposed ROD, and issues and concerns identified in the USFS FEIS, BLM identified seven main issues about the BLM's vegetation management program: Human Health, Public Involvement, Forest Ecosystem, Monitoring, Social and Economic Effects, Cost and Benefit Analysis, and Interagency Coordination. Each of these issues is discussed separately below, with the response being relative to the Decision.

Issues listed and answered in the Proposed ROD are incorporated.

Human Health

Issue: Concerns about human health include the effects of using all control methods, especially herbicide and prescribed fire; potential toxicity of inert ingredients in herbicide formulations; synergism of ingredients and cumulative actions; reaction of hypersensitive people; and whether a threshold safety (no effect or NOEL level) really exists.

Response: Health concerns were discussed in the Western Oregon Program-Management FEIS (1989); the analysis for health effects of using herbicides, which was the Worst Case Analysis, was included in Appendix L (BLM SEIS) and Appendix D (USFS 1988 FEIS); and the reliability of herbicide analysis information was addressed in Appendix H (USFS) which is the Qualitative Risk Assessment.

Concerns expressed throughout the process, including those identified during the analysis and decision process, were of primary consideration in designing the Decision presented in the Final Record of Decision. Some of the major issues about human health that were addressed in the analysis and Decision are listed below:

1) The BLM has decided not to use herbicide formulations containing any inert ingredients on EPA list 1 and 2 without a detailed analysis of their effects on human health. BLM also recognizes that List 3 inerts may need to be studied further, and will monitor literature and formulations for other concerns.

2) The BLM now conducts periodic, independent toxicological reviews and health risk assessments for proposed herbicide use in general and on a site-specific basis.

3) A qualitative health risk assessment was issued in 1986 (USFS, Appendix H), updated in 1991 for proposed chemicals, and is planned for periodic updating in the future. The U.S. Forest Service qualitative risk assessment conducted through the University of Washington has been incorporated by reference in this ROD to aid site-specific hazard analysis of treatments.

4) The BLM has made a search of incidence reports on actual and potential public and worker exposure during the use of herbicides. While some accidental exposure has occurred, no verified reports of adverse human health effects from herbicide use have been found. Nevertheless, each incidence is

important in determining precautions that may be needed in the timing, location and method of herbicide use. These reports were used in development of the final ROD and design of mitigating measures.

5) Risks of using herbicides are displayed in tables in Chapter 6 for high and moderate risks. These risks were considered in designing additional precautions for herbicide use under the Decision.

6) The recognition of data gaps was the reason for preparation of the Worst Case Analysis. Accordingly, the BLM will use a conservative approach (assuming carcinogens and mutagens) and continue to monitor information. The BLM recognizes there is much data indicating that materials can be used without presenting unreasonable risks, and that required studies for nonfood crop use herbicides do not include all types of toxicity studies.

7) Job Hazard Analysis and exposure analysis are a part of standard operating procedures with all treatments, including non-chemical methods. Recording of data for workers has also been adopted.

8) The BLM has specified standard operating procedures and reduced the number of acres treated by prescribed fire in response to concerns about the use of prescribed fire and changes in practices to reduce smoke and emissions.

9) The decision emphasizes the importance of assuring protection of human health for workers and the public. Specific and detailed mitigation measures are designed to protect human health on a programmatic level and site-specific basis.

10) An annual acreage limit has been placed on the use of herbicides, and numerous precautions stipulated for their use.

Important to the analysis of human health effects is the consideration of risk factors. The Decision represents a choice among alternatives with different risks. One alternative was for the BLM to use herbicides to obtain their benefits in controlling or removing undesirable vegetation while accepting the environmental consequences. Another alternative was to avoid the hazards of herbicides to the natural environment and risks to human health, while accepting the consequences that BLM's ability to control and manage competitive and undesirable vegetation was compromised. In making its Decision, the BLM acknowledges acceptance of a level of risk.

The BLM acknowledges the Decision will have limits due to technical capability, sensitivity to realistic conditions, procedural adequacy, and problem definition and needs analysis in determining both the need for action and the degree of risk. Standards will be responsive to the current technological constraints and yet flexible to alternative possibilities or new information.

Public Involvement

Issue: Members of the public have asked to be included in the vegetative management analysis process and to continue sharing information after the decision is made. They have also asked to be part of site-specific project planning, to be kept informed of the processes, and to assist in or review documentation to ensure that the information analysis is presented in an easily readable and clearly understood manner.

Response: The Decision provides guidance for information sharing and ongoing dialogue with neighbors and interested parties. A vegetation management Program Coordinator position has been established to provide monitoring of program implementation and to facilitate communication within the agency and between the public, other agencies, and permittees. The Decision provides for a five-step site-specific analysis process, which includes consideration for public involvement (See Table 5.2).

Social and Economic Effects

Issue: Reasonable alternatives are needed to meet production of goods and services while protecting the sustained yield of ecosystems. Significant socioeconomic issues include the economic effectiveness of practices, maintenance of natural ecosystems, and vegetative diversity within stands and on a landscape basis.

Response: Treatments must be operational and effective. Decisions will be guided by cost-effectiveness, as well as by concern for human health and environmental effects. It is anticipated that in some cases the least cost alternative will not be applied due to concerns for other values. Emphasis will continue to be placed on research and development of strategies, methods, and application techniques that can be explored on a program-wide and site-specific basis. The decision to provide for the use of all methods and to conduct risk assessments allows for these developments. The need and effectiveness of treatments will be monitored, and research will be sponsored to answer both operational and far reaching program questions.

Cost and Benefit Analysis

Issue: People are concerned about the costs and benefits of the methods used in managing forest vegetation, and that money and resources be wisely managed and put to the highest and most beneficial use.

There is concern that implementation of BLM's timber management program relies upon using herbicides, and that maintaining the agency's current budget is not adequate to implement alternative treatments to herbicides.

Response: In determining which vegetative management methods to implement, the BLM does not conduct cost and benefit analysis but rather bases their decisions partly upon cost-effectiveness (see Chapter 2). A review of the historic records regarding costs of vegetative management showed information to be adequate for making the analysis.

Forest Ecosystem

Issue: The public has been consistently concerned about the physical and biological effects of vegetation management. Long-term forest health, vegetative diversity, and productivity are continuing issues.

Response: Emphasis in the decision on preventive management, the use of natural processes, and mitigating measures for protection of forest and human environmental quality responds to this concern. The required prevention strategy with early planning, identifying sequence of expected practices, and monitoring in a 5-step project design process when pesticides are considered for use directly addresses the need to minimize environmental effects upon the forest ecosystem. Long-term forest health, diversity, and productivity will be further addressed in BLM's six western Oregon resource management plans now in publication (July 1992).

Monitoring

Issue: There is concern that BLM does not conduct appropriate monitoring for vegetative management actions.

Response: Under the Decision, monitoring will be conducted from three aspects: individual units, program assessment, and worker and human health concerns.

Interagency Coordination

Issue: BLM needs to coordinate with national, state and local entities in developing the BLM program for vegetation management.

Response: Cooperative planning is necessary for all vegetation management projects conducted by BLM to consider local and state planning, and land uses of the affected area. Such coordination occurs at the state, district, and resource area level. Provisions of the EIS and ROD will be incorporated in all relevant agreements, special use permits, easements, coordinated resource management plans, memoranda of understanding, and work plans.

ACRONYMS/GLOSSARY

Absorption - The taking up of liquids by solids or the passage of a substance into the tissues of an organism as the result of diffusion, filtration, or osmosis.

Active ingredient - The chemical in a herbicide that is primarily responsible for the desired effects.

Acute toxicity - The quality or potential of a substance to cause injury or illness shortly after exposure to a relatively large dose.

Adsorption - Adhesion of substances to the surfaces of solids or liquids. Technically, the attraction of ions of compounds to the surface of solids or liquids.

Adverse impacts - Impacts that harm one or more ecosystem component or process.

Best Management Practices (BMPs) - A practice or combination of practices that is determined after problem assessment, examination of alternative practices, and public participation to be the most effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint source to a level compatible with water quality goals.

Buffer Strip/Zone - A strip of vegetation that is left or managed to reduce the impact that a treatment or action on one area might have on another area.

Carcinogenic - Capable of producing or inciting cancer.

CEQ - Council of Environmental Quality

CFR - Code of Federal Regulations

COPE - Coastal Oregon Productivity Enhancement

CRAFTS - Coordinated Research Alternative Forest Treatment Systems

DEIS - Draft Environmental Impact Statement

Dermal Exposure - That part of an amount of toxic substance that an organism receives as a result of the substance coming into contact with the organism's body surfaces.

Desirable Vegetation - Species which management seeks to enhance or maintain to meet desired plant community objectives for a particular site.

Dose - Amount of chemical administered or received by an organism, generally at a given point in time.

Environmental Analysis (EA) - Evaluation process by which alternatives for achieving a purpose are analyzed to determine their environmental effects.

Environmental Assessment (EA) - A systematic environmental analysis of a site-specific BLM activity used to determine whether the activity would have a significant effect on the quality of the environment and whether an environmental impact statement is required.

Environmental Impact Statement (EIS) - An analysis that assesses the probably effects of proposed actions and alternatives on the environment, in accordance with the National Environmental Policy Act.

EPA - Environmental Protection Agency

FEIS - Final Environmental Impact Statement

FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act

FIR - Forestry Intensified Research

FLPMA - Federal Land Policy and Management Act

FONSI - Finding of No Significant Impact (beyond that already identified)

Groundwater - Subsurface water that is in the zone of saturation. The top surface of the groundwater is the "water table." Source of water for wells, seepage, and springs.

Hazard Analysis - Gathering of information used to determine the toxic properties of each herbicide.

IPM - Integrated Pest Management. A systems approach to reduce pest damage (competitive and unwanted vegetation) to tolerable levels through a variety of techniques, including natural predators and parasites, genetically resistant hosts, environmental modifications, and when necessary and appropriate, chemical pesticides (herbicides).

Job Hazard Analysis - Analysis of potential for risk to workers

LD_{50} - Dosage 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.

Margin of Safety (MOS) - Ratio between the no-observable effect level (NOEL) and the estimated dose.

MOU - Memorandum of understanding

Methods - Ways to manipulate vegetation including manual, mechanical, prescribed fire, biological, and herbicides.

MFP - Management Framework Plan

Mitigation Measures - Means taken to avoid, compensate for, rectify, or reduce the potential adverse impacts of an action.

Monitoring - The orderly collection, analysis, and interpretation of resource data to evaluate progress toward meeting management objectives.

NEPA - National Environmental Policy Act

NOEL (no-observed-effect level) - The dose level at which no toxic effects are observed in a test organism.

Nontarget Vegetation - Vegetation that is neither expected nor planned to be affected.

Prevention - To detect and ameliorate the conditions that cause or favor the presence of competing or unwanted vegetation in the forests before vegetation develops that could interfere with the objectives for managing that area or adjacent lands.

Riparian - The banks and adjacent areas of water bodies, water courses, seeps, and springs. These waters provide soil moisture sufficiently in excess of that otherwise available locally to provide a more moist habitat than that of contiguous floodplains or uplands.

Risk - The likelihood that a given exposure to an item or substance that presents a certain hazard will produce illness or injury.

Risk Analysis - The description of the nature and often the magnitude of risk to organisms, including attendant uncertainty.

RMP - Resource Management Plan

ROD - Record of Decision

Scoping - The process by which significant issues relating to a proposal are identified for environmental analysis. Scoping includes eliciting public comment on the proposal, evaluating concerns, and developing alternatives for consideration.

SEIS - Supplemental Environmental Impact Statement

Silviculture - The care, harvest, and regeneration of stands of timber, including preparing sites for reforestation, planting trees, controlling competing vegetation, thinning, fertilizing, controlling insects and disease, and applying various harvest systems.

SIP - State Implementation Plan

Site Preparation - Removal of slash and/or competing vegetation and usually the exposure of bare mineral soil to prepare an area for regeneration.

Strategies - Planned approach and project designs to meet objectives.

Systemic Toxicity - Effects produced as a result of the distribution of a poison or foreign substance from the point of exposure to a distant site within the body.

Tiering - The coverage of general matters in broad environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analysis (such as regional program statements, or ultimately, site-specific statements). These narrower statements reference the general discussions and concentrate solely on the issues specific to the region or site.

Toxicity - A characteristic of a substance that makes it poisonous.

Undesirable Vegetation - Species which occupy or can potentially occupy a site in larger quantities than is wanted from the standpoint of site management objectives.

USFS - United States Forest Service

WCA - Worst Case Analysis

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ATTACHMENT A

TOXICOLOGICAL REPORTS

Thomas & Thomas Technologies, Inc.

May 17, 1991

Mr. Roger A. Sharp
Contracting Officer
U.S. Department of the Interior
Bureau of Land Management
1300 NE 44th Avenue (951)
Portland, Oregon 97213

Dear Mr. Sharp:

I have reviewed the document Western Oregon Program Management of Competing Vegetation FEIS and the Forest Service Appendix D as specified as supporting documentation. In general, the conclusions reached within the document are justifiable based on the information available to the Bureau at the time the document was written. However, I am concerned that the methods and discussions that were associated with those conclusions should have been given more careful consideration.

I have reviewed the available literature published since 1989. I have found several articles that will be of interest to the BLM. They may or may not affect decisions of the BLM. They would undoubtedly be judged as relevant in a public forum. Some of them highlight issues that need to be addressed from a different standpoint than that presented in the EIS.

In order to support these conclusions I am submitting a report in two sections. Section I reviews the EIS and its appendices in light of the evidence available at the time it was submitted. Section I is divided into General and Specific Comments on the toxicology and risk assessment presented within the EIS and its appendices. That is followed by a general discussion of the relevance of the literature published since 1989 with comments on how that literature might be relevant to the analysis of human health effects.

SECTION I - THE EIS AND APPENDIX D

GENERAL COMMENTS

1. The primary problem with the EIS is it was written using a old approach, the MOS approach. Many organizations are currently using the reference dose approach (RfD) and several international

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organizations continue to use the acceptable daily intake (ADI) approach. For this reason, it is difficult to compare the results from this analysis with the results obtained by other organizations. Nevertheless, the MOS approach does still provide an acceptable approach, though dated. It needs to be noted that a few of the NOEL's used for estimating the MOS values have changed since the publication the EIS.

Since the MOS approach is relatively difficult to follow and not well described in the EIS, the public may be left with the feeling that BLM is not being genuine in its analysis. This is especially true when so much time is taken to explain away some high exposure values.

In general for this type of analysis, I recommend the use of the "reference dose" method for the analysis of risk. This is similar to the old acceptable daily intake (ADI) method. In the "reference dose" method the animal NOEL is divided by an uncertainty factor to set a reference dose below which adverse effects are not expected. This method has two advantages. First, it allows the toxicologist to set the most appropriate standard based on the total weight of evidence. For example, there may be no need to divide a NOEL by 100 when one has two or three major studies to confirm a NOEL value and one wishes to set a safe level for only three exposures over a lifetime. Further more, current dosimetric calculations may further modify the uncertainty factor needed for a limited number of exposures.

This method clearly defines a point that the BLM can use to make a determination. If an evaluation based on "real world" conditions and appropriate standards shows negative consequences, I believe the BLM would wish to take mitigation actions. BLM has already shown its willingness to act upon toxicological information when it removed diuron from its list of herbicides, a decision which was well supported by the toxicological information available at the time.

Page 99, column 2, full paragraph 2 and page 101, column 2, paragraph 1 are examples of the seeming need to rationalize results making the analysis appear irrelevant.

2. The exposure analysis should be re-evaluated using the USEPA Exposure Factors Handbook and other recent reference materials. For example, the EIS uses a value for berry consumption of 0.9 lbs (408 grams). According to the USEPA (1989; Table 2-10), 408 grams of a fruit is greater than the 99th percentile for consumption of any fruit for a week. For strawberries, the 99th percentile is 225 grams per day and the daily average is 46 grams/day. This "dose inflation" contributes to the need to "explain away" the conclusion of the analysis.

3. I recommend that the EIS stick to the facts for hazard characterization. Using the "worst-case" approach when it comes to analysis of hazard is a risk management decision, not a risk assessment function. Furthermore, it is not considered good risk management because it confuses the toxicology in considering reasonable exposure conditions as a part of understanding acceptable risk. This gives an impression in the EIS of a lack of balance. For example, on page 89 of the EIS it states:

> "based on the positive results in the dominant lethal rat assay, triclopyr may be mutagenic in some test systems and may present mutagenic risk to human germ cells."

In fact, triclopyr was negative in three Ames assays, negative in three chromosomal aberration assays, two of which were done in vivo, and equivocal in a fourth assay. The weight of evidence is that this compound is not a mutagenic hazard and not a hazard for chromosomal effects. The most one can say is that it might be positive in some other *in vitro* gene-tox assay because it was equivocal in one. But this does not make it a mutagenic hazard. Thus, giving an impression of a lack of balance in the analysis of triclopyr.

On page 99, column 2, para 4, it states that "the cancer *potency value multiplied by an estimated human lifetime dose* provides an estimate of human cancer risk". It should add:

> as if it was a carcinogen using the criteria "any tumor type in the most sensitive species".

It should be noted, that this worst case approach to hazard will probably have negative consequences in the future. If one labels a compound a potential or possible human germ cell mutagen or carcinogen, it may be impossible to remove that label from the compound. This is because all the future negative studies that could be developed will not "prove" no effect. So the compound will be in danger of carrying that hazard label whether it earned it or not. An example of this is glyphosate.

A preferred strategy for BLM might be to develop a risk management strategy for compounds with incomplete or highly conflicting information. For example, regular review is one such approach. Three to five years of occasional use under strictly controlled conditions is certainly a reasonable strategy for a compound with incomplete carcinogenic information and no information that may indicate carcinogenic potential. Further review might show that expanded use is justified or that further prudence is called for. Or one might want to suspend the use of a compound pending further review and bring it back when appropriate studies are completed.

4. I recommend the BLM emphasize mutagenicity tests as a predictor of carcinogenic potential and de-emphasize the issue of human germ cell mutagenesis. There has not been a concerted effort on the part of the regulatory community, or of the toxicological community in general, to determine if pesticides are germ-cell mutagens. In addition, the issue of germ-cell mutation is associated with reproductive effects, another field that until recently has not been given a great deal of emphasis by the regulatory community and its assessment is an area of contention within the scientific community. The argument that carcinogenicity risk assessment can be used to approximate human heritable mutation risk has several deficiencies. In short, BLM is opening itself up to a very difficult area of analysis with the possibility of competing expert witnesses and drawn out contentious scientific debate.

5. Some statement of the relative confidence in the data needs to be made. For example, I wrote about Diuron at the time:

> "Because there is some evidence for a high degree of hazard associated with this herbicide in animal studies conducted so far and few other studies are available to clarify the meaning of these results, the available information on Diuron is considered to be inadequate to provide confidence in inferences drawn from it."

6. The hazard characterizations should be written for the layman and most numbers should be removed. (see Pages 86 - 89.) The phrase "EPA has established a NOEL of 2.5" is false. EPA does not set these numbers, they arise out of toxicological studies. Furthermore, the phrase and the number is meaningless as a hazard characterization and potentially misleading. The original authors have confused the process of choosing a value for use in a risk characterization designed to answer a particular question mandated by FIFRA for the process of hazard evaluation in an EIS written under a NEPA mandate.

The following is an example of a hazard evaluation I submitted three years ago for the US Forest Service EIS. (It needs to be updated.)

> Based on the amount of picloram necessary to poison laboratory rats, picloram can be considered in the USEPA acute toxicity category of "very slight". Most formulations of picloram are not irritating to the skin. However, some mixtures of 2,4-D and picloram may produce sensitizing reactions in humans.
>
> Based on available short-term and chronic studies with rats,

mice, and dogs, picloram appears to be primarily a liver toxicant. In a three-generation rat reproductive study picloram has caused reduced fertility and has caused toxicity to the fetuses in a rat birth defects study. No birth defects were seen in a rabbit study.

Picloram was positive in only one traditional assay for DNA damage and negative in three assay designed to detect chromosome damage. Picloram appears to present little or no carcinogenic risk. In carcinogenicity bioassays done by the National Cancer Institute, tumor in male or female mice could not be significantly associated with the doses given. However, in female rats the incidence of benign tumors at the highest dose was suggestive of an ability of picloram to cause cancer.

The information available on picloram is sufficient to make an adequate evaluation of hazard and risk of the use of picloram in this program.

I have enclosed a recent report that we wrote at NAS/NRC entitled "Frontiers in Assessing Human Exposures to Environmental Toxicants." It presents a easier presentation of scientific information in a more understandable format. You will notice that most of the numbers have been removed.

SPECIFIC COMMENTS

Page 94, column 1, para 3

Most pesticides, with the exception of 2,4-D had not been tested for immunotoxicity which is different from what was said.

Page 95, column 2, para 4

Tordon may cause skin sensitization. There is a difference between irritation and sensitization.

Page 96 column 2, para 6.

Do not equate mutagenicity with heritable mutations.

Page 99, column 1, para 2

The LD50 cannot be used as a reference for safety as it represents a lethal outcome. A safe acute dose should be developed using accepted toxicological procedures if the BLM would like to have one. In addition, there are other accepted levels for acute emergency exposure such as EEGLs, ERPGs, SMACs, IDLHs etc. These should be considered.

Page 101, column 2, para 1

What is the justification for stomach problems?

Page 102, column 2, para 2.

The issue of consuming a "bushel of berries" was not analyzed.

Page 103, column 1, para 2

It does not appear the analysis examines workers exposed chronically.

Page 103, column 1, para 2

This describes a potentially serious situation but that may be as a result of the analysis method. Further analysis is warranted.

Page 105, column 1. para 2

A 27% reduction in exposure will not be protective if the MOS is less than 10. This is a serious allegation that should be analyzed further.

Page 114, column 1, para 2

Benzo(a)pyrene is not considered a human carcinogen by any national or international regulatory or scientific agency. It is an animal carcinogen, primarily in skin painting studies in mice.

SECTION II - THE LITERATURE SINCE 1989

Attachment 1 is a list of articles identified using the National Library of Medicine Computer Databases. From this list I have identified articles that could be relevant to potential health effects in the BLM program.

1. Jensen, P.C. (1989)

This is a short letter which is included to illustrate the point that "chemical hypersensitivity" is an issue that has gained a high profile in the public sector. It was the subject of several comments in the Letters Section of the EIS. The EIS itself makes very little mention of the controversy (page 112). The issues that it discusses under this heading and the way they are discussed fail to adequately address these issues framed by clinical ecologists. A recent article (Barinaga, M. 1991. Better data needed on sensitivity syndrome. Science 251: 1558) in

Science provides a background and synopsis.

2. Wigle et al (1990); Bond et al. (1989); Lilienfeld and Gallo (1990).

These three illustrate the continuing controversy over the issue of the evidence that 2,4-D is carcinogenic. Wigle relates non-Hodgkins lymphoma to acres sprayed with herbicide and fuel and oil use on the farm. Bond et al say the weight of evidence does not support a conclusion that phenoxy herbicides present a carcinogenic hazard. Lilienfeld and Gallo conclude that there is a weak to moderately strong carcinogenic effect of phenoxy herbicides on only one type of cancer, non-Hodgkins Lymphoma.

3. Blakely et al (1989a,b and c); Lerda and Rizzi (1991)

The three articles by Blakely et al. describe a complicated series of experiments designed to examine the reproductive and developmental toxicity of Tordon 202c. They reach the following conclusions:

Tordon 202c is embryotoxic and teratogenic in CD-1 mice.

Tordon 202c can cause paternally mediated toxicity.

Combined preconceptional and gestational exposure of female dams is required for teratogenesis and fetal growth depression.

The authors raise the possibility that 2,4-D and picloram act synergistically or that the presence of inerts affects the toxicity of the product.

These studies will require rigorous scrutiny and analysis. They present the potential for lowering the reproductive-developmental NOEL for picloram from 50 to (no-NOEL-determined.) This is because in Blakely et al (1989b) the lowest dose in which the picloram level was 5 mg/kg/day showed effects. To overcome this conclusion, an argument would have to be made that the effects were probably due to 2,4-D.

The Lerda and Rizzi (1991) study suggests that 2,4-D causes effects on the human male sperm. If it is shown that the paternal toxicity in the Blakely et al. study is real, this could change the hazard characterization for 2,4-D.

4. Stott et al. (1990)

A chronic assay orally dosing Fischer 344 rats with picloram was negative. This will potentially change the hazard characterization.

5. Timchalk et al. (1990) and Carmichael et al (1989)

This article presents evidence that supports the conclusion that triclopyr reaches and may accumulate in the testes. (the experimental protocol may be problematic, i.e. cold dose followed by hot which leaves a lot of unanswered questions). The problem is that the EIS suggests that triclopyr might have a "slight mutagenic risk to humans". This now needs to be combined with the evidence of accumulation in the testes.

The data on reproductive toxicity and mutagenicity will need to be reviewed for the characterization of hazard.

Carmichael et al. report the absorption rate of triclopyr through the skin is 1.65%. The EIS used 10 %.

6. Gojmerac et al. (1989 a and b)

In these two articles the authors show that atrazine crosses the blood-brain barrier in rats. They report that atrazine influences rat neuroendocrine tissues. They conclude:

> "In the case of atrazine and deethylatrazine, their interference with the biochemical process responsible for the normal activity of reproductive processes is doubtless."

The reproductive toxicity assays associated with atrazine will need to be examined for whole-animal evidence of interference in reproductive processes.

7. Moody et al. (1980)

The authors present dermal absorption data for a wide range of 2,4-D formulations and types that may be applicable to the exposure analysis.

8. Martinez et al (1990)

The authors examined the acute toxicity of Roundup:

"It is possible that the combination of glyphosate and POEA (polyoxyethyleneamine) potentiate each others toxicity. It is therefore not reasonable to quote or rely on calculations based on individual toxicities when both ingredients are present in combination."

The authors also claim that aspiration of Roundup may contribute to its toxicity.

The authors also list nine reports of acute toxicity to Roundup and suggest that its acute toxicity might be lower than estimated based on the rat LD50. These articles dating back to 1987 should be gathered and examined for applicability to the BLM program. The BLM reports that one ounce of glyphosate might be fatal (Table 3-9).

9. Perocco et al (1990)

This study could change the hazard characterization for mutagenicity of Dicamba.

10. Pinter et al (1990)

This study could change the risk assessment for atrazine and increase the certainty of the hazard characterization for atrazine as an animal carcinogen.

CONCLUSION

Finally I received Appendix D from BLM on April 24, so as I indicated previously, the analysis could not be completed by May 3, 1991. Nonetheless, I have tried to finish my review as soon as possible so that you could have my review comments in a timely fashion. I have enjoyed reading the EIS and the supporting Appendix and hope that these comments will help BLM in making the necessary revisions. Attached are copies of the above referenced articles. I am willing to provide further assistance in revising the EIS or in helping BLM address the new scientific studies that have become available since the EIS was written.

Sincerely yours,

Richard D. Thomas

Richard D. Thomas, Ph.D., D.A.B.T.
Consultant in Toxicology

Attachments: Referenced Articles and Publications

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Director

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Thursday, May 9, 1991

Mr. Roger Sharp
US Department of the Interior
Bureau of Land Management
1300 NE 44th Avenue (931.6)
Portland, OR 97208

RE: Purchase Order #H952-P-1-4361

Dear Mr. Sharp:

Enclosed please find the final written report of our literature review and evaluation of the BLM FEIS for herbicide use in forest lands. The attached report includes copies of the two papers (out of 96 reviewed in detail) which we deemed as providing new "ultimately significant" information that could impact the interpretation of the FEIS, as well as several other reports which provide substantive supporting information for the FEIS, but which do not significantly impact the conclusions of the report. We have on file all other papers (over 900 pages) which we reviewed. We did not include copies of those that were deemed to be of little overall significance to the FEIS, but have included title, citation, and a summary review of each as it pertains to the FEIS. Copies of these individual studies are available upon request.

This report fulfills the "deliverables" as defined in the above referenced contract. Please contact me at (206) 685-3785 if you have any questions regarding this final report.

Sincerely,

David L. Eaton, Ph.D., DABT
Consultant in Toxicology

Review of Pertinent Health Effects Literature from 1986-1991 for Eight Herbicides Proposed for Use on BLM Land

Asulam,Atrazine, Dicamba, 2,4-D, Glyphosate, Hexazinone, Picloram and Triclopyr

Bureau of Land Management Work Order H952-P-1-4361

Prepared by David L. Eaton, Ph.D., DABT and Lucio G. Costa, Ph.D.

Submitted to Mr. Roger Sharp

This report was done under contract for the Bureau of Land Management. The scope and purpose of this contract is described in the "Scope of Work" (Appendix A). Four tasks were identified in this scope of work:

1. Conduct a search of the available literature pertaining to potential human health impacts on each of eight herbicides proposed for use: Atrazine, Asulam, Glyphosate, Hexazinone, Triclopyr, 2,4-D, Picloram and Dicamba. This search will focus on available literature over the past five years.

2. Compare the FEIS and its Appendices against that literature up to February 1989 to identify any major reports, studies or other data for each herbicide that was omitted from evaluation in the original FEIS, and which would significantly impact any scientific conclusions about the relative risk to human health of said herbicide(s).

3. Identify any major reports, studies or data available in the open literature that have been published since February, 1989. For each of these reports, a determination will be made as to whether the scientific information available in the report would substantially alter opinions or conclusions about the human health risks of the herbicide in question stated in the original FEIS.

4. Review the FEIS and Appendices, and determine whether the discussions on the proposed use of the herbicides adequately disclosed potential significant adverse human health effects that could reasonably be expected to arise under the agency's proposed program.

PART 1. EXECUTIVE SUMMARY:

A computerized literature search of the open scientific literature for ther period late 1986 to April, 1991 was conducted for eight forest use herbicides: Atrazine, Asulam, Glyphosate, Hexazinone, Triclopyr, 2,4-D, Picloram and Dicamba. In total, over 370 "hits" (titles and references identified collectively in all searches) were obtained, and from a preliminary evaluation of titles and abstracts, 96 papers were retrieved and reviewed. Of these, 52 were identified for the period late 1986-through 1988, and 44 were for the period 1989-present. The large majority of these papers provided no useful, relevant and/or significant new information that would substantially alter the conclusions stated in the FEIS. A number of papers were identified which provided substantial additional background and support for assumptions used in the FEIS. In a few instances, papers were identified which suggested that the FEIS was more conservative (e.g., tending to overestimate exposure and/or risk) than initially intended.

For Asulam, Atrazine, Dicamba, Glyphosate, Hexazinone and Picloram, there were no studies which would significantly alter the conclusions in the FEIS regarding these herbicides.

For 2,4-D, one new report suggested that 2,4-D can affect sperm motility and morphology in occupationally exposed humans. Although the findings are difficult to verify because of the poor quality of the report, as a reasonable precaution additional measures should be taken to limit exposures by those working occupationally and routinely with 2,4-D. The nature of the effect and the doses encountered in the study would suggest that this type of risk would be of no concern for populations (e.g., the public) other than those exposed occupationally to relatively high doses. The additional studies available on the possible relationship between occupational 2,4-D exposure and non-Hodgkin's lymphoma do not provide a substantially different picture of this controversial issue than was presented in the FEIS.

For Triclopyr, one new study published in 1990 suggested that the FEIS may have overestimated the dermal exposures by a factor of 5. For scenarios where dermal absorption is important , the margins of safety would be increased 5-fold (e.g., for backpack sprayers under routine-worst case exposure scenario the MOS would increase from 3 to about 10); this may have significant bearing on the acceptability of triclopyr for forest use practices, making it relatively more acceptable than would have been inferred from the FEIS.

A review of the FEIS and appendices led to the conclusion that the approaches, assumptions and review of pertient scientific information were adequate to reasonably evaluate pontential human health impacts that could result herbicide use in forest vegetation management. Overall, it is our opinion that the document has used a highly conservative approach, and thus it would be exceedingly unlikely that it would have underestimated the potential for adverse human health effects to occur. However, because of the uncertainties involved in such assessments, conservatism is warranted, and thus we believe that the document does a reasonable job of ensuring public health protection for forest use herbicides.

PART 2. COMPLETION OF INDIVIDUAL TASKS:

Task 1. *Conduct a search of the available literature pertaining to potential human health impacts on each of eight herbicides proposed for use: Atrazine, Asulam, Glyphosate, Hexazinone, Triclopyr, 2,4-D, Picloram and Dicamba. This search will focus on available literature over the past five years.*

An extensive computerized search of the scientific literature on the eight herbicides was completed. This search covered the years late 1986 through March, 1991, and included the following data bases: Toxline, Medline, NIOSHTEC, NTIS, Federal Register Abstracts, GPO Monthly Catalog, Agricola, CAB Abstracts.

Searches were conducted using the chemical name and CAS number, as well as appropriate synonyms. Additional key words were used to focus the searches on toxicity and health effects. Scientific journals, government reports, symposium proceedings, books and book chapters, abstracts of scientific meetings, and other sources of scientific publication were covered in these searches. As prescribed in the contract, this search was performed in two parts: A) - an evaluation of literature which became available between the publication of the Draft EIS in October, 1987 and the final EIS in February, 1989 (e.g., from 1987-1988; task 2), and an evaluation of new literature that became available since the publication of the Final EIS (1989-present; task 3).

Task 2. Compare the FEIS and its Appendices against that literature up to February 1989 to identify any major reports, studies or other data for each herbicide that was omitted from evaluation in the original FEIS, and which would significantly impact any scientific conclusions about the relative risk to human health of said herbicide(s).

Table 1 summarizes the results of the search of recent literature from late 1986-1988. For each of the eight herbicides under review, the number of total "hits" (citations) are shown, together with the number that were determined to be of relevance to a health risk evaluation, and the number which were shown to have potentially significant information worthy of further review. Potential Relevance was assessed by a review of the title, source and abstract. If it was deemed that the publication might contain useful scientific information, a copy of the full manuscript was obtained and reviewed (Potentially Significant). The full publication was then reviewed in context with the previous evaluation of each of the eight herbicides. If the information found in the publication was of sufficient substance and quality as to significantly support or alter the conclusions in the original EIS, then it was listed as "Ultimately Significant". A summary of each of the "Potentially Significant" reports is found in the discussion of Task 2 below, together with an evaluation of the significance that each study has on the original conclusions in the EIS.

Table 1. Results of Computerized Search of Scientific Literature on Eight Herbicides from late 1986-1988.

Herbicide	Total Hits*	Potentially Relevant	Potentially Significant	Ultimately significant
Asulam	11	3	0	0
Atrazine	39	22	11	0
Dicamba	22	13	4	0
2,4-D	41	33	25	0
Glyphosate	18	13	5	0
Hexazinone	10	2	0	0
Picloram	12	9	7	0
Triclopyr	4	0	0	0
TOTAL	157	95	52	0

TASK 2. SUMMARY EVALUATION FOR POTENTIALLY SIGNIFICANT REPORTS FOR THE PERIOD LATE 1986-1988, BY CHEMICAL:

ASULAM, 1986-88

A review of the literature did not reveal any new publications which could potentially alter the conclusions of the FEIS for Asulam.

Final Conclusions: No scientific information was revealed in the period 1986-1988 which would significantly alter the conclusions of the FEIS regarding potential human health impacts of Asulam in forest vegetation management.

ATRAZINE, 1986-88

A review of the literature for 1986-88 reveal thirteen publications which could potentially be significant to the the FEIS conclusions regarding Atrazine.

1). Dellarco VL, Mavournin KH and Waters MD. Aneuploidy Data Review Committee: Summary compilation of chemical data base and evaluation of test methodology. Mutation Research 167:149-169, 1986. The occurrence of aneuploidy following in vitro exposure to atrazine was evaluated. Negative data were obtained in the Drosophilla, while positive results were observed in plant systems and in Neurospora crassa. These results do not substantially change the conclusions of the FEIS on the chromosomal effects of atrazine.

2). Hoar Zahm S, Weisenburger DD, Babbitt PA, Saal RC, Cantor KP and Blair A. A case-control study of non-Hodgkin's lymphoma and agricultural factors in Eastern Nebraska. American Journal of Epidemiology 128(4):901, 1988. This abstract of a a case control study among farmers reports an approximately 2-fold increased risk of non-Hodgkin's lymphoma in farmers using atrazine for more than 15 years. Insufficient details are presented to allow for a thorough review of this study. It is not inconsistent with the presumption in the FEIS that atrazine may be a weak carcinogen, and thus does not substantially alter the conclusions of the FEIS, as this was taken into account in the risk assessment.

3). Ikonen R, Kangas J and Savolainen H. Urinary atrazine metabolites as indicators for rat and human exposure to atrazine. Toxicology Letters 44:109-112, 1988. This report does not provide any new information that would significantly alter the conclusions of the FEIS.

4). Infurna R, Levy B, Meng C, Yau E, Traina V, Rolofson G, Stevens J and Barnett J. Teratological evaluations of atrazine technical, a triazine herbicide, in rats and rabbits. Journal of Toxicology and Environmental Health 24:307-319, 1988. Atrazine technical was evaluated for its embryotoxic, fetotoxic and teratogenic potential in both rats and rabbits (oral doses: 0, 10, 70, 700 mg/kg and 0, 1, 5, 75 mg/kg, respectively). Toxic effects were observed in both mother and fetus at the high doses, particularly in the rabbit. However, the compound was not teratogenic at maternally toxic dose levels in either species. This study was published after the date of the FEIS but appears to contain data that were already considered. The conclusions of the FEIS remain , therefore, as stated.

5). Ishidate M Jr., Harnois MC and Sofuni T. A comparative analysis of data on the clastogenicity of 951 chemical substances tested in mammalian cell cultures. Mutation Research, 195:151-213, 1988. This comprehensive review paper concludes that atrazine is not or is only weakly clastogenic, and is therefore consistent with the FEIS conclusions.

6). Kappas A. On the mutagenic and recombinogenic activity of certain herbicides in *Salmonella typhimurium* and in *Aspergillus nidulans*. Mutation Research 204:615-621, 1988. Atrazine was tested for point mutations in *S. typhimurium* and for mitotic recombination in *A. nidulans* and found to be negative. This findings support the conclusions of the FEIS.

7). Lisi P, Caraffini C and Assalve D. A test series for pesticide dermatitis. Contact Dermatitis 15:266-269, 1986. This report found that atrazine is not a dermal irritant. The findings in this study do not significantly alter the FEIS conclusions.

8). Lisi P, Caraffini C and Assalve D. Irritation and sensitization potential of pesticides. Contact Dermatitis 17:212-218, 1987. This and the preceding paper conclude that atrazine does not induce skin irritation or sensitization.

9). NTIS, Drinking water Criteria Document for Atrazine, Dynamac Corporation, Rockville, MD, August 1988, pp.120 (microfiche). Two carcinogenicity studies are discussed. A 91-week oral feeding study in CD-1 mice (0, 10, 300, 1500, 3000 ppm, equivalent to 1.4 to 482.7 mg/kg/day) revealed no dose-related increases in the incidence of neoplasms. A two-year study in Sprague-Dawley rats (0, 10, 70, 500, 1000 ppm) showed a significant increase of mammary tumors at 70 ppm and above. Closely related analogs of atrazine (propazine, simazine, terbutryn) also cause mammary tumors in this strain of rats. A classification as a possible human carcinogen (EPA group C) is suggested. This rat study was already considered in the FEIS. The overall conclusions of the FEIS are not substantially changed by this report.

10). Ohta T, Wantanabe M, Tsukamoto R, Shirasu Y and Kada T. Antimutagenic effects of 5-fluorouracil and 5-fluorodeoxyuridine on UV-induced mutagenesis in *Escherichia coli.* Mutation Research, 173:19-24, 1986. This report does not provide any new information that would significantly alter the conclusions of the FEIS.

11). Pino A, Maura A and Grillo P. DNA damage in stomach, kidney, liver and lung of rats treated with atrazine. Mutation Research 209:145-147, 209. Acute (875 mg/kg) or subacute (5 or 15 x 350 mg/kg) oral administration of atrazine caused DNA damage (mainly single strand breaks) in stomach, kidney and liver, but not in lung. This information supports the tentative conclusion in the FEIS that atrazine is positive in DNA damage/ repair assays.

12). Santa Maria C, Moreno J and Lopez-Campos JL. Hepatotoxicity Induced by the Herbicide Atrazine in the Rat. Journal of Applied Toxicology 7(6):373-378, 1987. High doses of atrazine (100, 200, 400 mg/kg/day for 14 days or 600 mg/kg/day for 7 days) caused hepatotoxicity. The doses are 100 to 600 fold higher than the NOEL. Similar observation were reported in the FEIS and these results do not change its conclusions.

13). Shah PV, Fisher HL, Sumler MR, Monroe RJ, Chernoff N and Hall LL. Comparison of the penetration of 14 pesticides through the skin of young and adult rats. Journal of Toxicology and Environmental Health 21:353-366, 1987. The dermal penetration of atrazine was found to be slightly higher (ratio of young/adult of 1.2-1.4) in young (33 day-old) than in adult (82 day-old) rats. However, the toxicity of atrazine was higher in adult (90 day-old) than in weanling (30-45 day-old) rats (see Gaines and Linder, *op. cit.*). Dermal penetration rates of 3-8% were found, consistent with assumptions used in the FEIS. Thus, data in this study generally support the assumptions and conclusions in the FEIS.

Final Conclusions: No scientific information was revealed in the period 1986-1988 which would significantly alter the conclusions of the FEIS regarding potential human health impacts of atrazine in forest vegetation management.

DICAMBA, 1986-88

A review of the literature for 1986-88 revealed four publications which could potentially be significant to the the FEIS conclusions regarding Dicamba.

1). Gaines TB and Linder RE. Acute Toxicity of Pesticides in Adult and Weanling Rats. Fundamental and Applied Toxicology 7:299-308, 1986. The acute toxicity of dicamba was higher in adult than in weanling rats by a factor of two. The LD50 reported for Dicamba in this study for adult male, adult female, and weanling rats, was 1,404 mg/kg, 1039 mg/kg and 3294 mg/kg, respectively. For adult animals, this is approximately twice the value used in the FEIS. Thus, all margins of safety based on LD50 for dicamba would be adjusted upward by a factor of 2 if this study were used. However, the conservative basis for the Risk Assessment would utilize the lower value of published LD50s, thus this paper supports the conservative nature of the MOS for dicamba based on LD50s, used in the FEIS.

2). Makary MH, Street JC and Sharma RP. Toxicokinetics of Dicamba (3,6-Dichloro-2-methyoxy-benzoic Acid) and Its 3,5-Dichloro Isomer following Intravenous Administration to Rats. Pesticide Biochemistry and Physiology 25:98-104, 1986. See discussion below:

3). Makary MH, Street JC, and Sharma RP. Pharmacokinetics of Dicamba Isomers Applied Dermally to Rats. Pesticide Biochemistry and Physiology 25:258-263, 1986. These two papers report that dicamba is only slowly absorbed from the skin suggesting that washing is an effective means of lessening internal exposure following accidental dermal exposure. Dicamba is also rapidly excreted. The total extent of dermal absorption in rats was 14%, or about 3 times greater than the assumed 5% used in the FEIS. However, the FEIS relied upon human data, which are more relevant. Furthermore, it is generally accepted that dermal penetration of many substances in the rat occurs more rapidly than in humans. Thus, in general, these studies support the assumptions and conclusions of the FEIS for dicamba.

4). Travis CC and Arms AD. Bioconcentration of Organics in Beef, Milk, and Vegetation. Environ. Sci. Technol. 22(3):271, 1988. This report does not provide any new information that would significantly alter the conclusions of the FEIS.

Final Conclusions: No scientific information was revealed in the period 1986-1988 which would significantly alter the conclusions of the FEIS regarding potential human health impacts of dicamba in forest vegetation management.

2,4-D, 1986-88

A review of the literature for 1986-88 revealed twenty-five publications which could potentially be significant to the the FEIS conclusions regarding 2,4-D.

1). Bacher MA and Gibson GG. Chlorophenoxyacid herbicides induce microsomal cytochrome P-450 IVA1 (P-452) in rat liver. Chem. Biol. Interactions 65:145-156, 1988. 2,4-D and other phenoxyacids were found to selectively induce hepatic cytochrome P450 IVA1. This report does not provide any new information that would significantly alter the conclusions of the FEIS.

2). Bond GG, Wetterstroem NH, Roush GJ, McLaren EA, Lipps TE and Cook RR. Cause specific mortality among employees engaged in the manufacture, formulation, or packaging of 2,4-dichlorphenoxyacetic acid and related salts. British Journal of Industrial Medicine 45:98-105, 1988. The mortality of 878 chemical workers potentially exposed to 2,4-D was examined with particular attention to brain tumors. No cause-effect relation between 2,4-D exposure and mortality from all causes, total malignant neoplasm or any specific cancer was found.

3). Dierickx PJ. Reaction of 1,4-benzoquinone and 2,4-dichlorophenoxyacetic acid with *microsomal glutathione transferase from rat liver.* Archives Internationales de Physiologie et de Biochimie 96:1-5, 1988. This paper does not provide any new evidence that would alter the conclusions of the FEIS.

4). Elo HA, Hervonen H and Ylitalo P. Comparative study on cerebrovascular injuries by three chlorophenoxyacetic acids (2,4-D, 2,4,5-T, and MCPA). Comp. Biochem. Physiol. 90C(1):65-68, 1988. Damage to the blood brain barrier in selected brain areas from rats was found following administration of high doses of 2,4-D (300-600 mg/kg). These cerebrovascular injuries were species-specific, since they were not observed in mice, guinea pigs, Syrian hamsters, rabbits and chickens.

5). Garrett NE, Stack HF and Waters MD. Evaluation of the genetic activity profiles of 65 pesticides. Mutation Research 168:301-325, 1986. This paper does not provide any new evidence that would alter the conclusions of the FEIS.

6). Grover R, Cessna AJ, Muir NI, Riedel D, Franklin CA and Yoshida K. Factors Affecting the Exposure of Ground-rig Applicators to 2,4-Dimethylamine Salt. Arch. Environ. Contam. Toxicol. 15:677-686, 1986. This paper provides detailed studies on the exposure pathways for 2,4-D during spray rig applications. For 10 subjects, the average dermal bioavailability (roughly estimated from skin patch assessment of dermal exposure and urinary excretion) was 5.6%, consistent with the 6% assumed value used for comparative purposes in the FEIS. However, of the 10, two subjects accounted for a disproportionately high fraction absorbed (39.5 and 12.5%). Excluding these two, the average for the other 8 was only 0.5%. The amount of actual exposure measured in 9 applicators ranged from 0.002 - 0.057 mg/kg day, with a mean of 0.011 mg/kg/day. This value is consistent with the conservative estimates for occupational exposure used in the FEIS (0.012 - 0.057 mg/kg/day for ground applicators, Table 4-4, Appendix D). Thus, this study supports the assumptions in the FEIS.

7). Grover R, Franklin CA, Muir NI, Cessna AJ and Riedel D. Dermal exposure and urinary metabolite excretion in farmers repeatedly exposed to 2,4-D amine. Toxicology Letters 33:73-83, 1986. This study provides interesting information on the relationship between dermal exposure and urinary excretion. Although units of calculation used in this study make direct comparisons difficult, it appears to generally support the assumptions used in the FEIS.

8). Hall W. The Agent Orange controversy after the Evatt Royal Commission. The Medical Journal of Australia 145:219, 1986. This paper did not provide any new evidence that would alter the conclusions of the FEIS.

9). Kelley M and Vessey DA. The Effect of Pretreatment with 2,3,7,8-Tetrachlorodibenzo-p-dioxin on the Hepatic Metabolism of 2,4,5-Trichlorophenoxyacetate (2,4,5-T and 2,4,-Dichlorophenoxyacetate (2,4,-D). Toxicology and Applied Pharmacology 91:295-298, 1987. This paper did not provide any new evidence that would alter the conclusions of the FEIS.

10). Kitchin K and Brown JL. Biochemical Effects of Three Chlorinated Phenols in Rat Liver. Toxicological and Environmental Chemistry 16:165-172, 1988. 2,4-D (75 mg/kg) did not have any effect on DNA in blood and liver, liver glutathione, P450 and ornithine decarboxylase.

11). Lavy TL, Norris LA, Mattice JD and Marx DB. Exposure of forestry ground workers to 2,4-D, picloram and dichlorprop. Environmental Toxicology and Chemistry 6:209-224, 1987. Exposure of forestry ground workers to 2,4-D was evaluated. This study provides direct assessment of the exposure assumptions used for different types of applications for forest workers. Overall, it suggests that Routine-realistic exposure estimates for workers (Tables C-5 and C-21, Appendix D) were highly conservative in the FEIS (overestimated by between 5-20 fold, depending upon method and assumption). For example, the FEIS estimated routine realistic exposure of backpack sprayers to average 0.198 mg/kg/day, whereas this study measured an average exposure of 20 workers daily over a 12 day period (thus the average is estimated based on 240 actual urinary measurements) of 0.015 mg/kg/day, or 13 times less than estimated by the FEIS. Likewise, estimates for the hack and squirt procedure and injection bar technique overestimated exposures by 19 times for the routine realistic estimates shown in Table C-5 (appendix D). As all other estimates of dermal exposure were to some extent based on the exposure assumptions for 2,4-D, this study suggests that the FEIS is indeed conservative for worker risks, overestimating exposures and thus risks by 5-20 fold.

12). Lynge E. Background and Design of a Danish Cohort Study of Workers in Phenoxy Herbicide Manufacture. American Journal of Industrial Medicine 11:427-437, 1987. Although some interesting methodological issues for cohort studies on phenoxy acid herbicides were discussed, this paper does not provide any new evidence that would alter the conclusions of the FEIS.

13). Manninen A, Kangas J, Klen T, Savolainen H. Exposure of Finnish Farm Workers to Phenoxy Acid Herbicides. Arch. Environ. Contam. Toxicol 15:107-111, 1986. This study supports the general exposure assumptions used in the FEIS, as farmers using tractor spray rigs had average daily exposures of 0.026 mg/kg/day. The FEIS assumptions for mixer loaders and injection bar application was 0.043 and 0.025, respectively. It also documented further the assumption used in the FEIS that dermal exposure is substantially more important than inhalation exposure. Thus, this study supports the FEIS.

14). Mohammad FK and Omer VEV. Behavioral and Developmental Effects in Rats Following *In Utero* Exposure to 2,4-D/2,4,5-T Mixture. Neurobehavioral Toxicology and Teratology 8:551-560, 1986. Exposure to a 2,4-D/2,4,5-T mixture during pregnancy (0-125 mg/kg from day 6 to day 15 of gestation) had some effects on the neurobehavioral development of the offspring. Since 2,4,5-T alone has been shown to induce similar effects, the contribution of 2,4-D is unclear and not easily discernable. As the NOEL for reproductive/developmental effects used in the FEIS was 10-fold lower (5 mg/kg/day) than the lowest dose used in this study (50 mg/kg/day), the conclusions from this study do not significantly affect the FEIS.

15). Mohammad FK and Omer VEV. Effects of Prenatal Exposure to 2,4-D/2,4,5-T Mixture on Postnatal Changes in Rat Brain Glutamate, GABA, Protein, and Nucleic Acid Levels. Bull. Environ. Contam. Toxicol. 40: 294-300, 1988. A decrease in glutamate levels were found in brain of developing rats following prenatal exposure to a 2,4-D/2,4,5-T mixture. This result does not have any impact on the conclusion of the FEIS.

16). Mustonen E, Kangas J, Vuojolahti P and Linnainmaa K. Effects of phenoxyacetic acids on the induction of chromosome aberrations *in vitro* and *in vivo*. Carcinogenesis 1(4):241-245, 1986. Pure 2,4-D did not increase the number of chromosome aberrations in human lymphocytes in culture while the commercial formulation (containing 550 mg/l 2,4-D as amine salt) did. No increases of chromosomal aberrations were found in lymphocytes from exposed workers. These results do not substantially change the conclusion of the FEIS but point out a possible explanation for the often contradictory results obtained with 2,4-D, that is the formation and toxicity of chlorophenol contaminants.

17). NTIS, Drinking water Criteria Document for 2,4-dichlorophenoxyacetic acid, Environmental Criteria and Assessment Office, EPA, March 1988, pp.198 (microfiche). No substantial new information are provided by this document.

18). St. Omer VEV and Mohammad FK. Ontogeny of swimming behavior and brain catecholamine turnover in rats prenatally exposed to a mixture of 2,4-Dichlorophenoxyacetic and 2,4,5-Trichlorophenoxyacetic acids. Neuropharmacology 26(9):1351-1358, 1987. Small neurochemical changes were found following developmental exposure to a 2,4-D/2,4,5-T mixture. Again the contribution of 2,4-D is not known.

19). Schulze GE and Dougherty JA. Neurobehavioral Toxicity and Tolerance to the Herbicide 2,4-Dichlorophenoxyacetic Acid-n-butyl Ester (2,4-D Ester). Fundamental and Applied Toxicology 10:413-424, 1988. This study found some neurobehavioral effects of 2,4-n-butyl ester in rats given s.c. injections of 150 - 250 mg/kg/day for four consecutive 14 day periods. The study showed peak effects by the third injection, and tolerance by the 14th. Because of the high dose used relative to the NOEL used in the FEIS (1 mg/kg/day), and because of the unusual route of administration, this study has no significant relevance to the FEIS assumptions and conclusions.

20). Schulze GE and Dougherty JA. Neurobehavioral Toxicity of 2,4-D-n-Butyl Ester (2,4-D Ester): Tolerance and Lack of Cross-Tolerance. Neurotoxicology and Teratology 10:75-79, 1988. This study found some neurobehavioral effects of 150 mg/kg/day of 2,4-D, administered by s.c. injection for 10 consecutive days. Because of the high dose used relative to the NOEL used in the FEIS (1 mg/kg/day), and because of the unusual route of administration, this study has no significant relevance to the FEIS assumptions and conclusions.

21). Schulze GE. 2,4-D-n-Butyl Ester (2,4-D Ester) Induced Ataxia in Rats: Role for n-Butanol Formation. Neurotoxicology and Teratology 10:81-84, 1988. This study compared the neurobehavioral effects of different formulations of 2,4-D, and concluded that in vivo formation of n-butanol from 2,4-D-n-butyl ester is responsible for the motor incoordination, but not depression of locomotor activity, of daily s.c. doses of 150 mg/kg/day of 2,4-D-n-butyl ester. The author concluded that different formulations of the same herbicide can produce differential behavioral effects. Because of the high dose used relative to the NOEL used in the FEIS (1 mg/kg/day), and because of the unusual route of administration, this study has no significant relevance to the FEIS assumptions and conclusions.

22). Schulze GE. Formulation and Food Deprivation Affects 2,4-D Neurobehavioral Toxicity in Rats. Neurotoxicology and Teratology 9:363-367, 1987. This paper by Schulze investigates the neurobehavioral effects of 2,4-D butyl ester, the formulation used in Agent Orange. Effects were found at minimum dose equivalent to about 1/3 of the LD50.The primary effects were decrease in schedule-controlled lever pressing and photocell locomotor activity and increasing landing foot splay. These effects may be suggestive of a peripheral neuropathy but were rapidly reversible and tolerance developed, therefore making the presence of a peripheral neuropathy very unlikely. 2,4-D had no significant effects in these behavioral tests. On the other hand, n-butanol, a metabolite of 2,4-D butyl ester, induced behavioral effects similar to those of the parent compound.These findings do not alter the conclusions of the FEIS regarding the neurotoxicity of 2,4-D.

23). Sterling TD and Arundel AA. Health effects of phenoxy herbicides.A review. Scand. J. Work Environ. Health 12:161-173, 1986. This study is an evaluation of previous epidemiological studies on the association of phenoxy acid herbicides and certain types of cancer. It does not provide any new information not previously discussed in the FEIS, and thus does not alter the conclusions.

24). Turkula TE and Jalal SM. Induced Clastogenicity in White Rats by the Herbicide 2,4-D. Cytologia 52:275-281, 1987. Administration of commercial 2,4-D to young rats caused chromosomal aberrations in bone marrow following administration of 100 µg/kg. This positive result adds to those included in the FEIS on in vivo animal studies for clastogenicity (3 positive, 6 negative). The overall conclusion of FEIS is not substantially changed.

25). Yeary RA. Urinary excretion of 2,4-D in commercial lawn specialists. Appl. Ind. Hyg.1(3):119, 1986. The maximal quantity of 2,4-D excreted by lawn care specialists making daily use of this herbicide was 0.0032 mg/kg, well below the WHO/FAO acceptable dietary intake of 0.3 mg/kg. These data are generally consistent with the estimated magnitude of exposures that were projected under comparable circumstances in the FEIS. For example, this study found that commercial lawn specialist who routinely apply 2,4-D had daily urinary excretions rates (and thus doses) of between 0.0005 and 0.006 mg/kg/day. Thus, this study generally supports the exposure assumptions used in the FEIS.

Final Conclusions: A substantial amount of additional scientific information was revealed in the period 1986-1988 which largely supports the assumptions and conclusions of the FEIS regarding the potential adverse human health effects of 2,4-D in forest vegetation management.

GLYPHOSATE, 1986-88

A review of the literature for 1986-88 revealed five publications which could potentially be significant to the the FEIS conclusions regarding Glyphosate.

1). Jackson JR. Toxicity of herbicide containing glyphosate. The Lancet 8582:414, 1988. This letter to the editor address the acute poisoning of glyphosate presented by Sawada et al (see below), and does not provide any significant new information that would alter the conclusions of the FEIS.

2). Li AP and Long TJ. An Evaluation of the Genotoxic Potential of Glyphosate. Fundamental and Applied Toxicology 10:537-546, 1988.Glyphosate was found to be negative in a number of in vitro and in vivo tests for genotoxicity . These results confirm and expand the FEIS conclusion that glyphosate is not genotoxic.

3). Mowbray DL. Pesticide Poisoning in Papua New Guinea and the South Pacific. Papua New Guinea Med. J. 29:131-141, 1986. This study has no significant relevance to the FEIS assumptions and conclusions.

4). NTIS, Drinking water Criteria Document for Glyphosate, Dynamac Corporation, Rockville, MD, April 1990, pp.57 (microfiche). Information in this document does not substantially change the conclusions of the FEIS.

5). Sawada Y, Nagai Y, Ueyama M and Yamamoto I. Probable toxicity of surface-active agent in commercial herbicide containing glyphosate. The Lancet 8580:299, 1988. This study reports on 51 high dose acute poisonings (48 suicide attempts, 3 infant poisonings) with glyphosate. The report suggests that the polyoxyethylamine surface-active agent, rather than glyphosate, is responsible for injury and death following ingestion of "Roundup" formulations. The findings of this study suggest that LD50 estimates of glyphosate formulations that are based on the active ingredient may underestimate acute toxicity following large ingestion doses. However, the circumstances under which this is relevant (e.g., intentional ingestions among adults or accidental ingestions in young infants) are quite different than those intended to be addressed in the FEIS, and thus the results of this study do not substantially alter the conclusions of the FEIS.

Final Conclusions: No scientific information was revealed in the period 1986-1988 which would significantly alter the conclusions of the FEIS regarding potential human health impacts of Glyphosate in forest vegetation management.

HEXAZINONE, 1986-88

A review of the literature for 1986-88 revealed no publications which would potentially be significant to the the FEIS conclusions regarding Hexazinone.

Final Conclusions: No scientific information was revealed in the period 1986-1988 which would significantly alter the conclusions of the FEIS regarding potential human health impacts of Hexazinone in forest vegetation management.

PICLORAM, 1986-88

A review of the literature for 1986-88 revealed seven publications which could potentially be significant to the the FEIS conclusions regarding Picloram.

1). Gorzinski SJ, Johnson KA, Campbell RA and Landry TD. Dietary toxicity of picloram herbicide in rats. Journal of Toxicology and Environmental Health, 20:367-377, 1987. A one-year toxicity study with Picloram was conducted in rats (highest dose was 200 mg/kg/day). Signs of liver toxicity were found. The NOEL was determined as 20 mg/kg/day. This finding does not substantially change the evaluation of the FEIS, which reports a NOEL of 7 mg/kg/day. It does provide some additional assurance that the MOS for systemic toxicity were conservative, as all systemic MOS would be increased by a factor of 3 if this NOEL were used.

2). Hayes JR, Condie LW and Borzelleca JF. Acute, 14-Day Repeated Dosing, and 90-Day Subchronic Toxicity Studies of Potassium Picloram. Fundamental and Applied Toxicology 7:464-470, 1986. Acute and subacute toxicities of potassium picloram (in drinking water) were evaluated. No specific organ site toxicity could be identified.Some liver toxicity was observed at the high doses. No NOEL could be determined since the lowest dose (60 mg/kg/day) caused slight toxicity. As such, this study does not substantially change the evaluation of the FEIS, which reports a NOEL of 7 mg/kg/day.

3). Lavy TL, Norris LA, Mattice JD and Marx DB. Exposure of forestry ground workers to 2,4-D, picloram and dichlorprop. Environmental Toxicology and Chemistry 6:209-224, 1987. Exposure of forestry ground workers to picloram was evaluated. The margin of safety (NOEL/ total absorbed dose) ranged from 32,294 to 55,625. This supports the conclusion of FEIS that no adverse human health effects are expected to occur for worker exposure to picloram, and provides substantial support for the use of a dermal absorption factor for picloram that is considerably lower than 2,4-D.

4). NTIS, Drinking water Criteria Document for Picloram, Dynamac Corporation, Rockville, MD, April 1990, pp.64 (microfiche). Information in this document do not substantially change the conclusions of the FEIS on picloram.

5). Reidy GF, Rose HA and Stacey NH. Effects of picloram on xenobiotic biotransformation in rat liver. Xenobiotica 17(9):1057-1066, 1987. Picloram was found to cause induction of one hepatic cytochrome P450 (that also inducible by 3-methylcholanthrene) following one or two weeks ip administration of 50 or 100 mg/kg/day . For comparison, the NOEL is 7 mg/kg/day. Increase liver weight had already been observed. This finding does not appear to have a substantial influence on the conclusions of the FEIS regarding systemic toxicity or carcinogenicity.

6). Smith RA and Lewis D. A Potpourri of Pesticide Poisonings in Alberta in 1987. Vet. Hum. Toxicol. 30(2):118, 1988. This report describes a potential poisoning of sheep with picloram that may have resulted from using a picloram container to transport water to the sheep pen. However, the evaluation is sketchy, and not particularly relevant, and thus has no significant impact on the assumptions or conclusions of the FEIS.

7). Sterling TD and Arundel A. Review of recent Vietnamese studies on the carcinogenic and teratogenic effects of phenoxy herbicide exposure. International Journal of Health Services 16(2):265, 1986. This study found an association between herbicide use in Viet Nam and the incidence of hydaditiform moles (molar pregnancy) in Vietnamese women. Because the study was unable to disassociate the various types of herbicides used (2,4-D, 2,4,5-T, picloram etc), it is impossible to attribute potential increased risk of adverse pregnancy outcome with any specific chemical. Unfortunately, there have not been studies in other populations to evaluate the consistency of this interesting and potentially significant observation.

Final Conclusions: No scientific information was revealed in the period 1986-1988 which would significantly alter the conclusions of the FEIS regarding potential human health impacts of picloram in forest vegetation management.

TRICLOPYR

A review of the literature did not reveal any new publication that would significantly alter the conclusions of the FEIS for Triclopyr.

Final Conclusions: No scientific information was revealed in the period 1986-1988 which would significantly alter the conclusions of the FEIS regarding potential human health impacts of Triclopyr in forest vegetation management.

Task 3. Identify any major reports, studies or data available in the open literature that have been published since February, 1989. For each of these reports, a determination will be made as to whether the scientific information available in the report would substantially alter opinions or conclusions about the human health risks of the herbicide in question stated in the original FEIS.

Table 2 summarizes the results of the search of recent literature (1989-present). For each of the eight herbicides under review, the number of total "hits" (citations) are shown, together with the number that were determined to be of relevance to a health risk evaluation, and the number which were shown to have potentially significant information worthy of further review. Potential Relevance was assessed by a review of the title, source and abstract. If it was deemed that the publication might contain useful scientific information, a copy of the full manuscript was obtained and reviewed (Potentially Significant). The full publication was then reviewed in context with the previous evaluation of each of the eight herbicides. If the information found in the publication was of sufficient substance and quality as to significantly support or alter the conclusions in the original EIS, then it was listed as "Ultimately Significant". A summary of each of the "Potentially Significant" reports is found in the discussion of Task 3 below, together with an evaluation of the significance that each study has on the original conclusions in the EIS.

Table 2. Results of Computerized Search of Scientific Literature on Eight Herbicides from 1989-1991.

Herbicide	Total Hits*	Potentially Relevant	Potentially Significant	Ultimately significant
Asulam	20	4	0	0
Atrazine	43	11	5	0
Dicamba	17	7	2	0
2,4-D	54	25	22	1
Glyphosate	32	8	6	0
Hexazinone	5	1	0	0
Picloram	30	5	6	0
Triclopyr	12	5	3	1
TOTAL	**213**	**66**	**44**	**2**

* This number includes many "duplicate" hits which occurred when the same citation was found in searches of different data bases.

A summary evaluation of the potentially significant literature which has been published from 1989-present is provided below for each of the eight herbicides. A final opinion as to whether the information in the report would substantially alter the conclusions in the FEIS regarding the potential adverse impacts of the herbicide on human health is presented for each study.

TASK 3. SUMMARY EVALUATION FOR POTENTIALLY SIGNIFICANT REPORTS FOR THE PERIOD 1989-PRESENT, BY CHEMICAL

ASULAM, 1989-PRESENT:

A review of the literature did not reveal any new publications which would significantly alter the conclusions of the FEIS for Asulam.

Final Conclusions: No scientific information was revealed in the period 1989-present which would significantly alter the conclusions of the FEIS regarding potential human health impacts of atrazine in forest vegetation management.

ATRAZINE, 1989-PRESENT:

A review of the literature between 1989-present revealed five potentially significant published reports on atrazine toxicity.

1). Butler, MA. and Hoagland, R.E. Genotoxicity Assessment of Atrazine and Some Major Metabolites in the Ames Test. *Bull. Environ. Contam. Toxicol (1989)* 43: 797-804. The mutagenicity of atrazine and atrazine metabolites was evaluated at two test doses in 3 strains of salmonella typhimurium, with and without metabolic activation systems, in a standard Ames test. The results were uniformly negative. These results were consistent with numerous previous mutagenicity assays reviewed in the FEIS, and thus support the FEIS conclusions that atrazine in non-mutagenic in bacterial systems.

2). Reed, JP, Hall, FR and Krueger, HR. Measurement of ATV Applicator Exposure to Atrazine Using an ELISA Method. Bull. Environ. Contam. Toxicol (1990) 44: 8-12. This paper evaluated dermal and inhalation exposure to atrazine that can occur during various spray operations. Comparison of dose estimates obtained in this study with those used in the FEIS suggest that exposure estimates used in the FEIS were reasonably close to what was found by measurement in this study. For example, the exposure estimate used for mixer-loaders working with atrazine was 108 μg/kg/day (Table C-3), whereas this paper estimated a dermal contact of 272 - 827 μg/kg and inhalation of 12 μg/kg. If one were to use the 10% dermal bioavailability factor used in the FEIS, then the total dose in the Reed et al. study would be 39 - 95 μg/kg/day, compared to 108 μg/kg/day used in the FEIS. As the size and quality of this study is marginal, and the results yield exposure estimates comparable to those used in the FEIS, this study does not substantially alter the conclusions of the FEIS regarding worker exposure to atrazine.

3). Catenacci, G., Maroni, M., Cottica, D. and Pozzoli, L. Assessment of Human Exposure to Atrazine Through the Determination of Free Atrazine in Urine. Bull. Environ. Contam. Toxicol. (1990) 44: 1-7. This study evaluated occupational exposure via dust and dermal contact during manufacturing of atrazine (bagging operation). The results of this study were of little value in assessing atrazine dermal bioavailability or disposition, and does not significantly alter the conclusions of the FEIS.

4). Gorjmerac, T. and Kniewald, J. Atrazine Biodegradations in rats - A model for mammalian metabolism. Bull Environ. Contam Toxicol. (1989). 43: 199-206. This study evaluated the metabolism of atrazine in rats. The results and conclusions had no significant bearing on assumptions or toxicological evaluation for atrazine in the FEIS, and thus does not alter final conclusions.

5). Tricker, AR, Spiegelhalder, B. and Preussmann, R. Environmental exposure to preformed nitroso compounds. Cancer Survey (1989) 8: 251-272. This report mentioned previous studies noting that "atrazine was found to form nitrosamines in soil, but only when high levels of nitrite were present". The potential significance of nitrosoatrazine was discussed in the FEIS, and this paper does not add anything new to that evaluation, and thus does not have any effect on the conclusions of the FEIS regarding atrazine.

Final Conclusions: No scientific information was revealed in the period 1989-present which would significantly alter the conclusions of the FEIS regarding potential human health impacts of atrazine in forest vegetation management.

DICAMBA, 1989-PRESENT:

A review of the literature between 1989-present revealed two potentially significant published reports on dicamba toxicity.

1). Perocco, P, Ancora, G. Rani, P., Valenti, A.M., Mazzullo, M., Colacci, A. and Grilli, S. Evaluation of genotoxic effects of the herbicide dicamba using in vivo and in vitro test systems. Environ. Mol. Mutagen. (1990) 15: 131-135. This study evaluate the mutagenicity of dicamba in 3 different mutagenicity assays, a) unwinding rate of DNA from rats treated ip, b) unscheduled DNA synthesis (UDS) induced in cultured human lymphocytes, and c) sister chromatid exchange (SCE) in cultured human lymphocytes. The authors found a statistically significant, dose-related increase in DNA unwinding from dicamba. There were slight but statistically significant increases in both UDS and SCE, although the author concluded that the SCE differences was less than 2-fold so was not biologically significantly increased. The authors concluded that "the present study suggests that a genotoxic hazard by dicamba exists". These marginally significant and somewhat variable findings are somewhat consistent with previous mutagenicity studies evaluated in the FEIS. One previous UDS study for dicamba was negative (evaluated in the FEIS), in contrast to the positive finding in this study. The FEIS classified Dicamba as "±" for mutagenicity via clastogenic (Marginal data) and DNA repair (Adequate data). This report is consistent with those conclusions, and thus does not alter final conclusions of the FEIS regarding the potential mutagenicity of dicamba.

2). Agnihortri, PK, Mirthy, PSR and Mukherjee, SK. Effect of herbicide banvel [dicamba] on rabbit vaginal mucus membrane. In. J. Expt. Biol. (1989) 27: 1090-1091. This study evaluated the irritancy potential of dicamba, using rabbit vaginal mucosa as a test site. The authors stated that "The results suggest that banvel and dicamba are not primary irritants but should nevertheless be employed with caution" because the slight irritancy noted appeared to last for a long time. These results are consistent with recommendations made in the FEIS and thus do not significantly alter conclusions of the FEIS.

Final Conclusions: No scientific information was revealed in the period 1989-present which would significantly alter the conclusions of the FEIS regarding potential human health impacts of dicamba in forest vegetation management.

2,4-DICHLOROPHENOXY ACETIC ACID (2,4-D), 1989-PRESENT:

Twenty-two published studies on 2,4-D were identified in 1989-91 that were potentially significant.

1). Arnold, EK, Beasley, VR. The Pharmacokinetics of Chlorinated Phenoxy Acide Herbicides: A literature Review: Vet. Hum. Toxicol. 31 (1989), 121-125. This review article does not provide any new information, and thus has no impact on the FEIS conclusions.

2). Blair, A. and Zahm, SH. Methodologic issues in exposure assessment for case-control studies of cancer and herbicides. Amer. J. Ind. Med. (1990) 18: 285-293. This study does not provide any new data on the potential relationship between phenoxy acid herbicide exposure and certain types of cancer, but does provide an interesting and useful discussion on the inherent limitations and methodological considerations of case-control studies, and suggests that problems and differences in the assessment of exposure may contribute to the inconsistent findings in the literature. The authors note that many of these problems may result in "A tendency for false-negative findings."

3). Blakely, PM, Kim, JS and Firneisz, GD. Effects of paternal sub-acute exposure to Tordon 202c on fetal growth and development in CD-1 mice . Teratology 39: 237-241, 1989.

4) Blakely, PM, Kim, JS and Firneisz, GD. Effects of preconceptional and gestational exposure to Tordon 202c on fetal growth and development in CD-1 mice. Teratology 39: 547-553, 1989.

5) Blakely, PM, Kim, JS and Firneisz, GD. Effects of gestational exposure to Tordon 202c on fetal growth and development in CD-1 mice . J. Toxicol. Env. Health 28: 309-316, 1989.

This series of reports established a reproductive/developmental NOEL in mice of 5 mg/kg/day for picloram and 84 mg/kg/day for 2,4-D when the two were administered concomitantly as a Tordon formulation during preconception and gestation. At higher doses, dose-related adverse effects on maternal and fetal growth and development were observed. These results are generally consistent with conclusions drawn in the FEIS regarding the potential developmental effects of 2,4-D. This study suggests a NOEL for developmental/reproductive effects a factor of 15 higher than the 5 mg/kg/day NOEL used in the FEIS. However, of particular interest was the finding that exposure to male CD-1 mice alone (females were not exposed before or during gestation) resulted in a statistically significant elevation in incidence of fetal "variants". In this instance the variant was an increase in number of fetuses with extra pair of ribs. Delayed ossification was observed at the highest dose. Thus, if one considers extra ribs and delayed ossification as adverse effects (or at least indicative of developmental toxicity), then a NOEL was not established in this study. As the lowest dose used was approximately 84 mg/kg/day, and the NOEL used in the FEIS for developmental/reproductive effects was 5 mg/kg/day, and the NOEL used for systemic toxicity was 1 mg/kg/day, this series of studies do not significantly impact the conclusions of the FEIS, except that they provide some additional qualitatively relevant data for developmental effects of 2,4-D (or potentially picloram) at higher doses. Because both picloram and 2,4-D were used, it is not possible to definitely attribute the observed adverse effects to one compound or the other. However, as the effects seen were more consistent with previous studies using 2,4-D than with studies using picloram, and the dose of 2,4-D was about 15-times greater, it is reasonable to assume that the effects noted were largely, if not exclusively, due to the 2,4-D component.

6). Bond, GG, Bodner, KM and Cook, RR. Phenoxy herbicides and cancer: Insufficient Epidemiologic Evidence for a Casual Relationship. Fund. Appl. Toxicol., 12: 172-188, 1989. This review article, published by scientists from the Department of Epidemiology for Dow Chemical Company, evaluates all of the epidemiologic data on the association between 2,4-D exposure and Hodgkin's Disease, non-Hodgkin's lymphoma and soft tissue sarcomas. The authors conclude that "Consideration of the combined cohort studies of workers exposed to the phenoxy herbicides per se provides little or no evidence of carcinogenicity. Thus, the total weight of evidence currently available does not support a conclusion that the phenoxy herbicides present a cancer hazard to humans." The conclusions of these authors are in contrast to the EPA conclusions stated in the FEIS (p. 87) that "The Agency considers the new [epidemiology] study [of Hoar et al] to show 2,4-D as positive for cancer". The impact of this review on the overall risk assessment is that it would suggest that the assumption that 2,4-D is a carcinogen is incorrect, and thus risk estimates for carcinogenicity would not be appropriate. However, as the interpretation of these studies is controversial, this review can be considered to be supportive, but not conclusive, of the view that 2,4-D does not present a cancer risk to humans.

7). Brown, LM, Blair, A., Gibson, R. et al. Pesticide exposure and other agricultural risk factors for leukemia among men in Iowa and Minnesota. Cancer Res. 50: 6585-6591, 1990. This study found no significant association with leukemia and 2,4-D exposure, and thus does not significantly alter the conclusions of the FEIS.

8). Clausen, M., Leier, G. and Witte, I. Comparison of the cytotoxicity and DNA-damaging properties of 2,4-D and U46 D fluid (dimethylammonium salt of 2,4-D). Arch, Toxicol. 64: 497-501, 1990. This article demonstrated that the dimethylammonium salt of 2,4-D produced DNA damage (single strand breaks), and that this response was different from the "free acid" of 2,4-D. This report concludes that "the different molecular structures of 2,4-D and U46 D fluid.... can explain some of the controversial result on genotoxicity and mutagenicity of 2,4-D cited in the literature". As the FEIS noted such discrepancies, and listed 2,4-D as "non mutagenic in 28/43 assays" (table 3-16, p. 109), this paper does not significantly alter the conclusions of the FEIS.

9). Flanagan, RJ, Meredith, TJ, Ruprah, M, Onyon, LJ and Liddle, A. Alkaline diuresis for acute poisoning with chlorophenoxy herbicides and ioxynil. The Lancet 335: 454-58, 1990. This article pertains to emergency management of acutely poisoned individuals, and does not provide any new information that would significantly alter the conclusions of the FEIS.

10). Green, LM. A cohort mortality study of forestry workers exposed to phenoxy acid herbicides. Brit. J. Ind. Med. 48: 234-238, 1991. This study of 1222 electrical utility workers exposed for at least 6 months to phenoxy acid herbicides between 1950-82 found no deaths among the 80 total attributable to non-Hodgkin's lymphoma or soft-tissue sarcoma. As noted by the authors, the study is small and the population is still young, and thus follow-up must be done before arriving at any conclusions. Thus, this study does not provide any significant new information that would alter the conclusions of the FEIS.

11). Lerda, D. and Rizzi, R. Study of reproductive function in persons occupationally exposed to 2,4-dichlorophenoxyacetic acid (2,4-D), Mutation Res: 47-50, 1991. This study examined sperm morphology and motility in 32 male farm sprayers exposed to 2,4-D (formulation(s) not specified)., and compared the results to 25 non-exposed controls. 2,4-D concentration was measured in urine as a means of verifying exposure. The authors report that the mean value of 2,4-D in the urine samples was 9.02 mg/l. Unfortunately, no individual data, no information on the urine volume recovered, nor the time frame in which urine was collected was provided. Thus, these exposure data can be used only qualitatively to demonstrate that, on the whole, exposure did occur in this group. The authors reported that "The percentages of asthenospermia, mobility, necrospermia and teratospermia were greater in the exposed group than in controls", and concluded that "This study shows that 2,4-D exposure produces moderate effects in male germ cells in this population. Asthenospermia, mobility and necrospermia were reversible, while teratospermia persisted in the exposed group." The results of this study are potentially profound, in that a marked effect on sperm motility and morphology were reported in humans following occupational exposure to 2,4-D. Unfortunately, the quality of this report is poor, as the presentation of data were so limited as to make a thorough scientific evaluation nearly impossible. However, it should be noted that this study does appear in a "peer reviewed" journal, and thus should not be completely discounted. In the absence of more information on the variability in the measured responses (data are presented only as mean values of three groups - control, post-exposure period 1 and post-exposure period 2- with no standard deviations or individual data reported for any group), and in the potential dose-response relationships among individuals in the population, it is difficult to make firm conclusions about this study. Never-the-less, in the absence of data to the contrary, the findings must be taken seriously, and the BLM should consider further steps to limit the exposure of workers to 2,4-D during application, perhaps including the elimination of phenoxy acid herbicides from use.

12). Lillienfeld, DE and Gallo, MA. (1989). 2,4-D, 2,4,5-T and 2,3,7,8-TCDD: An overview. Epidem. Rev. (1989) 11: 28-58. This review article does not provide new data, but does provide some useful perspectives on the interpretation of previous epidemiologic studies related to the potential association of non-Hodgkin's lymphoma and phenoxy herbicide exposure. The authors conclude: "The lack of consistent findings and the small attributable risks that have been identified in heavily exposed populations indicate that these chemicals are not strong carcinogens; rather, they appear to be weak-to-moderate human carcinogens, associated with a specific malignancy, i.e., non-Hodgkin's lymphoma. The issue of whether soft-tissue sarcomas are caused by phenoxy herbicides is still an open one." These conclusions are consistent with those derived in the FEIS, and thus do not significantly alter them.

13). Mattsson, JL and Eisenbrandt, DL. The improbable association between the herbicide 2,4-D and polyneuropathy. Biomed. Environ. Sci. (1990) 3: 43-51. This paper reviews older data on the potential polyneuropathy that has been reported in case studies following 2,4-D exposures. The authors conclude that "the weight of evidence indicates that 2,4-D is an unlikely cause of polyneuropathy". This report does not present any new information which would significantly alter the conclusions of the FEIS.

14). Moody, RP, Franklin, A., Ritter, L, and Maibach, HI. Dermal absorption of the phenoxy herbicides 2,4-D, 2,4-D amine, 2,4-D isooctyl, and 2,4,5-T in rabbits, rats, rhesus monkeys, and humans: A cross species comparison. J. Toxicol. Env. Health (1990): 29: 237-245. This study found that, for all 2,4-D formulations except the amine, dermal absorption of 2,4-D in humans was substantially less than that of other species. The total extent of dermal absorption in humans for all forms except 2,4-D amine was 6%, consistent with the value used in the FEIS. In the case of 2,4-D amine, dermal absorption was substantially higher (58%) but highly variable (SD = 22.6%, n= 6). Regarding this unusual finding, the authors state that "It is possible that the high variation obtained in the human 2,4-D amine test (58% ± 22.6%) was related to the variable environmental conditions of the individual human participants. If the dermal absorption rate of 58% for the 2,4-D amine were used in the FEIS, rather than the 6% value used, it would <u>increase</u> the margins of safety (reduce the apparent risk) for all other herbicides by a factor of 10 because the exposure estimates were determined using the ratio of assumed dermal penetration rate (0.1% for amitrole, 0.48% for picloram, 10% for all others) to that assumed for 2,4-D (6%). It would not affect the MOS for 2,4-D, because exposures were based on actual exposure data obtained in multiple studies (see Table 4-4, appendix D), rather than the assumed dermal absorption rate of 6%. Because all other forms of 2,4-D (other than 2,4-D amine) used in this study had dermal absorption rates close to the 6% value used in the FEIS, the selection of the 6% value for use in the FEIS is reasonable. This conclusion is supported by the study of Grover et al (see number 6 in the 1986-88 section).

15). Pearce, Neil and Reif, JS. Epidemiologic studies of cancer in agricultural workers. Amer. J. Ind. Med (1990) 18: 133-148. This review article examines the potential causes of increased risks for certain types of cancer prevalent in agricultural workers, but does not provide any new data or interpretations of previous data that would significantly alter the conclusions of the FEIS.

16). Pelletier, O. Ritter, L. Caron, J. and Somers, D. Disposition of 2,4-dichlorphenoxyacetic acid dimethylamine salt by Fischer 344 rats dosed orally and dermally. J. Toxicol. Environ. Health (19989) 28: 221-234. This study evaluate the dermal absorption of 2,4-D, and found that in rats about 10% of a dermally-applied dose was absorbed over a period of 72 hrs. This value is slightly greater than the 6% value used in the FEIS exposure assessment. However, the later value was obtained from human studies, and is much more relevant, as rats are not good models for human dermal penetration studies. Thus, this study does not provide any new information that would significantly alter the assumptions or conclusions derived in the FEIS.

17). Tyynela, K., Elo, HA and Ylitalo, P. Distribution of three common chlorophenoxyacetic acid herbicides into rat brain. Arch. Toxicol. (1990) 64: 61-65. This paper does not provide any data that would alter the conclusions of the FEIS.

18). Weisenburger, DD. Environmental epidemiology of non-Hodgkin's lymphoma in eastern Nebraska. Amer. J. Ind. Med. (1990) 18: 303-305. This population-based case control study of non-Hodgkin's lymphoma found a weak association (odds ratio of 1.5, CI 0.9-2.4) between non-Hodgkin's lymphoma and 2,4-D. However, higher odds ratios were found for multiple other agricultural chemicals (organophosphates, 1.9; carbamates, 1.8; chlorinated hydrocarbons, 1.4; nitrates in groundwater, 2.0). Because the presentations of methodology and data in this short paper are inadequate to allow a thorough evaluation, and the statistical significance of the findings are questionable, this paper does not present any new information that would significantly alter the conclusions of the FEIS.

19). Wigle, DT, Semenciw, RM, Wilkeins, K. et al. J. Nat'l. Cancer Inst. (1990) 82: 575-582. This cohort study found a weak association between non-Hodgkin's lymphoma and the "acres sprayed in 1970" with herbicides. Although the overall incidence of non-Hodgkin's lymphoma was not statistically increased, there was a significant dose-response relationship between this disease and acres sprayed with herbicides. The authors concludes that "On the whole, the findings of this and previous studies are consistent with a hypothesis of increased risk of non-Hodgkin's lymphoma in association with spraying herbicide formulations". It is also of interest to note that the authors found an association between non-Hodgkin's lymphoma and exposure to fuel and oil.

20). Wingfield, YY and McLenaghan, C. Levels of N-nitrosodimethylamine in nitrogen fertilizers/herbicide mixtures containing 2,4-D present as dimethylamine salt. Bull. Env. Contam. Toxicol. (1990) 45: 847-852. The authors evaluated whether potentially carcinogenic nitrosamine derivatives of 2,4-D dimethylamine salt can form on storage of the formulation. The authors concluded that "mixtures of various fertilizers and 2,4-D DMA salt do not generate any significant additional NDMA". This report has no significant implications for the FEIS.

21). Wolfe, WH, Michalek, JE, Miner, JC. et al. Health status of Air Force veterans occupationally exposed to herbicides in Vietnam. JAMA (1990) 264: 1824-1831. This study found that Vietnam Veterans involved in Operation Ranch Hand experienced significantly more basal cell carcinomas (OR, 1.5, CI 1.0-2.1) than comparison subjects. However, as this is the only study of phenoxy acid exposed populations to suggest such an association, the data are, and the risk factor is relatively small and marginally significant, it would be premature to conclude that this association was causal. For other types of cancer, the study concluded that "In general, no evidence suggested that Ranch Hands were experiencing significantly increased systemic cancer at any particular site". In summary, this study does not provide findings that would significantly alter the conclusions of the FEIS.

22). Ylitalo, P., Narhi, U. and Elo, HA. Increase in the acute toxicity and brain concentrations of chlorophenoxyacetic acids by probenecid in the rat. Gen. Pharmacol. (1990) 21: 811-814. This paper does not provide any new data that would alter the conclusions of the FEIS.

Final Conclusions: One new report suggesting that 2,4-D can affect sperm motility and morphology in occupationally exposed humans is of concern. Although the findings are difficult to verify because of the poor quality of the report, as a reasonable precaution additional measures should be taken to limit exposures by those working occupationally and routinely with 2,4-D. The nature of the effect and the doses encountered in the study would suggest that this type of risk would be of no concern for populations (e.g., the public) other than those exposed occupationally to relatively high doses. The additional studies available on the possible relationship between occupational 2,4-D exposure and non-Hodgkin's lymphoma do not provide a substantially different picture than was presented in the FEIS.

GLYPHOSATE, 1989-PRESENT:

A review of the literature between 1989-present revealed six potentially significant published reports on glyphosate toxicity.

1). Malik, J., Barry, G. and Kishore, G. The herbicide glyphosate. Biofactors (1989) 2: 17-25. This minireview, written by scientists working for the manufacturer of glyphosate (Monsanto) provides a review of the mechanism of herbicidal action of glyphosate, the environmental fate of glyphosate. and the animal toxicity data available for glyphosate. The review does not discuss any new data, and the animal studies mentioned were all reviewed in the FEIS. The only new information was a reference to a study in British Columbia (Reynolds, P.E. [1989], Proceedings of the Carnation Creek Herbicide Workshop) which apparently demonstrated that "glyphosate dissipates rapidly both from soil and from water. There were no observable effects of any of the mammals or aquatic life observed in the study". We revealed this report in our computer search, and have evaluated it for human health significance. Thus, no new information was available in this study that would alter the conclusions of the FEIS regarding glyphosate.

2). Torstensson, NTL, Lundgren, LN and Stenstrom, J. Influence of climatic and edaphic factors on persistence of glyphosate and 2,4-D in forest soils. This study demonstrated that glyphosate disappears more rapidly from "northern soils than in southern soils", at least in Sweden, although trace amounts of glyphosate remained in soil longer in the north than the south. Although it is possible that the conclusions regarding the rate of disappearance of glyphosate from soils could potentially influence evaluation of the environmental impacts of glyphosate, the assumptions used in assessment of human exposures for glyphosate would not be significantly altered by changes in this factor, and thus this study does not significantly alter conclusions regarding potential adverse human health consequence from glyphosate exposure.

3) Jensen, P.C. Exposure to roundup (letter to the editor). Southern Medical Assoc. J. 82(7) 934, 1990. This anecdotal story relates "nervous system and immune system problems" with glyphosate. There is insufficient information to reach any conclusions about this self-report, and thus this cannot be considered to be of scientific value. However, the author of the letter mentions that Monsanto is keeping a registry of such reports. If reports were followed up for medical evaluation, it could eventually prove useful. At this point there is insufficient information in this report to warrant altering any conclusions regarding glyphosate toxicity from what was reviewed previously.

4) Martinez, T.T., Long, WC and Hiller, R. Comparison of the toxicology of the herbicide roundup by oral and pulmonary routes of exposure. Proc. West. Pharmacol. Soc. 33: 193-197.1990. This interesting study compared the toxicity of the glyphosate formulation Roundup®, which also contains the surface active agent polyoxyethylenamine (POEA), when given by oral versus inhalation exposure. The authors concluded that the POEA may itself possess significant toxicity, especially given by pulmonary route, and that POEA may potentiate the toxicity of glyphosate. The primary purpose of this study was to evaluate the hazards associated with intentional ingestion of Roundup formulations that occurs with suicide attempts. The most important finding is that aspiration of ingested glyphosate containing POEA may cause severe aspiration pneumonitis, probably from POEA or an interaction between POEA and glyphosate. This paper suggests that the estimation of lethal dose of glyphosate alone underestimates the lethal dose

in Roundup formulations. Utilization of the LD50 estimate of 4,320 (table 5-1, appendix D of FEIS) may be inappropriate for Roundup formulations, based on this paper. The utilization of a LD50 value of 1,600 mg/kg may be more appropriate for risk comparisons which utilize the LD50. Thus, the Margins of Safety in Tables C-11, C-27, would appropriately be adjusted downward by a factor of 2.7. The Margin of Safety using the Worst-case scenario for a backpack sprayer (highest exposure of all scenarios) would thus be reduced from 1,400 to 520. Given the highly conservative nature of the assumptions used to derive exposure, this still represents a very large margin of safety, and thus this study, while affecting some calculations in the FEIS, would not substantially alter the conclusions regarding acute toxicity hazards associated with glyphosate. It is not possible to conclude from this study that the POEA-glyphosate interaction proposed for inhalation exposure to concentrated formulations of Roundup have any relevance to NOEL calculations which serve as the basis for margin of safety calculations for other types of risk from glyphosate.

5). Wan, MT, Watts, RG and Moul, DJ. Effects of different dilution water types on the acute toxicity to juvenile pacific salmonids and rainbow trout of glyphosate and its formulated products. Bull. Environ. Contam. Toxicol. 43: 378-385, 1989. This report evaluated the toxicity of glyphosate formulation to salmonids. Although it may have some bearing on conclusions reached in the FEIS regarding environmental impacts of glyphosate,the study does not provide any meaningful data regarding potential human health impacts, and thus would not alter the conclusions of the FEIS regarding the potential adverse human health effects of glyphosate.

6) Moses, M. Glyphosate herbicide toxicity JAMA 261: 2549, 1989; Hoogheem, TJ. (reply by M. Moses), The Safety of Roundup Pesticide, JAMA 262: 2679, 1989. These letters to the editor debate the dermal irritancy of Roundup, but do not provide substantive new scientific information. They do reflect some disagreement as to how both dermal toxicity and oncogenicity studies are evaluated and classified. These letters to the editor do not, however, provide any substantive new information that would significantly alter the conclusions of the FEIS regarding the potential dermatotoxicity or oncogenicity of glyphosate.

Final Conclusions: No scientific information was revealed in the period 1989-present which would significantly alter the conclusions of the FEIS regarding potential human health impacts of glyphosate in forest vegetation management.

HEXAZINONE:

A review of the literature did not reveal any new publications which would significantly alter the conclusions of the FEIS for hexazinone.

Final Conclusions: No scientific information was revealed in the period 1989-present which would significantly alter the conclusions of the FEIS regarding potential human health impacts of hexazinone in forest vegetation management.

PICLORAM:

A review of the literature revealed six new publications which might were deemed to be potentially relevant to the conclusions of the FEIS for picloram.

1). Blakely, PM, Kim, JS and Firneisz, GD. Effects of paternal sub-acute exposure to Tordon 202c on fetal growth and development in CD-1 mice . Teratology 39: 237-241, 1989.

2). Blakely, PM, Kim, JS and Firneisz, GD. Effects of preconceptional and gestational exposure to Tordon 202c on fetal growth and development in CD-1 mice. Teratology 39: 547-553, 1989.

3). Blakely, PM, Kim, JS and Firneisz, GD. Effects of gestational exposure to Tordon 202c on fetal growth and development in CD-1 mice . J. Toxicol. Env. Health 28: 309-316, 1989.

See the discussion under 2,4-D in this section. Because both picloram and 2,4-D were used, it is not possible to definitely attribute the observed adverse effects to one compound or the other. However, as the effects seen were more consistent with previous studies using 2,4-D than with studies using picloram, and the dose of 2,4-D was about 15-times greater, it is reasonable to assume that the effects noted were largely, if not exclusively, due to the 2,4-D component. Thus, these studies do not significantly alter the conclusions of the FEIS regarding picloram.

4). Rosenkranz, HS and Ennever, FK. An association between mutagenicity and carcinogenicity. Mutation Res. 244: 61-65, 1990. This study utilized data considered in the original FEIS, and thus does not provide any significant new information.

5). Stott, WT, Johnson, KA, Landry, TD, Gorzinski, SJ and Cieszlak, FS. Chronic toxicity and oncogenicity of picloram in Fischer 344 rats. This study did not show any oncogenic effects of picloram, and found a NOEL of 20 mg/kg. Thus, it would increase MOS in systemic effects by a factor of 3 if it were used. However, as MOS are already large for this compound, and the potential carcinogenic risks calculated for picloram on the assumption that it might be carcinogenic are very small, this study does not significantly alter the conclusions of the FEIS, except that it supports the generally conservative nature of the analysis for picloram.

6). Rosenkranz, HS and Klopman, G. Structural basis of carcinogenicity in rodents of genotoxicants and non-genotoxicants. Mutation Res. 228: 105-124, 1990. This study provides no new information and thus does not significantly alter the conclusions of the FEIS.

Final Conclusions: No scientific information was revealed in the period 1989-present which would significantly alter the conclusions of the FEIS regarding potential human health impacts of picloram in forest vegetation management.

TRYCLOPYR:

A review of the literature between 1989-present revealed three reports of potential significance.

1). Carmichael, NG, Nolan, RJ, Perkins, JM, Davies, R and Warrington, SJ. Oral and dermal pharmacokinetics of triclopyr in human volunteers. Human Toxicol. 8: 431-437, 1989. This study provides direct evidence in humans of a dermal bioavailability factor for Triclopyr of 1.6%. As the FEIS assumed 10% value in the absence of data, this study would result in an increase in MOS by a factor of 3 for all scenarios where dermal exposure predominates. This would increase all MOS to above 2,000 for routine-realistic exposures where dermal exposures are the predominant route (most occupational scenarios, hiking). It would not affect MOS for those scenarios in which ingestion exposure (drinking water, berry consumption, etc) is the predominant route. In general, this study provides important new information that enhances the confidence that MOS and risk estimates were conservative, and thus is supportive of the conclusions in the FEIS.

2). Timchlak, C. Dryzga, MD and Kastl, PE. Pharmacokinetics and metabolism of triclopyr (3,5,6-trichoro-2-pyrdinyloxyacetic acid) in Fisher 344 rats. Toxicology 62: 71-87, 1990. This study demonstrates the relatively rapid elimination of triclopyr by the renal route, and is supportive of the assumptions and conclusions in the FEIS.

3). Whisenant, SG and McArthur, ED. Triclopyr persistence in Northern Idaho forest vegetation . Bull. Environ. Contam. Toxicol. 42: 660-665, 1990. Although this study may be relevant to risk estimates for wildlife, it does not contain information that would significantly alter the conclusions of the FEIS regarding human health.

Final Conclusions: One study revealed in the period 1989-present suggests that the FEIS may have significantly overestimated the dermal exposures (by a factor of 5) for triclopyr. However, as the margins of safety for scenarios where dermal absorption is important would be increased 5-fold (e.g., for backpack sprayers under routine-worst case exposure scenario the MOS would increase from 3 to about 15); this may have significant bearing on the acceptability of triclopyr for forest use practices, making it relatively more acceptable than would have been inferred from the FEIS.

Task 4. Review the FEIS and Appendices, and determine whether the discussions on the proposed use of the herbicides adequately disclosed potential significant adverse human health effects that could reasonably be expected to arise under the agency's proposed program.

(The following conclusions pertain only to the evalution and conclusions of the FEIS regarding assessment of potential human health effects. The authors have not reviewed other aspects of this FEIS such as environmental (non-human health) impacts, efficacy of proposed alternatives, or economic aspects of the plan.)

The Bureau of Land Management's FEIS on "Western Oregon Program-Management of Competing Vegetation" dated February, 1989, is a comprehensive document which considers many options for vegetation management. The degree of uncertainty in determining human health impacts from herbicide use requires the assessment of many different "target" populations and routes of exposure. Such assessments require numerous assumptions, many for which little supporting scientific data are available. Thus, it is appropriate and prudent to make "conservative" assumptions, recognizing that the final risk analysis may overestimate risks to a large extent. The FEIS has followed this "conservative" philosophy by adopting "worst-case" exposure scenarios, and by utilizing toxicological information which yields the highest estimate of risk, when more than one source of information is available. The FEIS and appendices detail a very large number of exposure scenarios, and adequately document where assumptions are made. The review and interpretation of the scientific literature available was thorough, and a reasonable (perhaps in some instances excessive) degree of conservatism was built into the selection of studies for which quantitative assessments were based. The report also contains a section which discusses "qualitative" information, as well as the traditional "worst-case analysis" quantitative risk assessment. This section provides a thorough review of the quality of information that is available in each of a number of different health effects endpoints, for each of 16 herbicides reviewed.

The conclusions of this document led to elimination of a substantial number of herbicides from use - largely because of the lack of available information, rather than because of scientific evidence demonstrating that an unreasonable risk would be present if the chemical(s) were used. In reviewing the FEIS and appendices, it is our opinion that the document has adequately disclosed potential adverse health effects that could reasonably be expected to arise if the chemicals were used according to standard forest use practices. Accident scenarios and worker exposure scenarios adequately described the potential for adverse human health effects under anticipated "non-routine" scenarios. Overall, it is our opinion that the document has used a highly conservative approach, and thus it would be exceedingly unlikely that it would have underestimated the potential for adverse human health effects to occur. However, because of the uncertainties involved in such assessments, conservatism is warranted, and thus we believe that the document does a reasonable job of ensuring public health protection for forest use herbicides.

ATTACHMENT B

INFORMATION ON TREATMENT METHODS

- Adapted from USFS Region 6 Mediated Agreement -

ATTACHMENT B - TREATMENT METHODS
TABLE OF CONTENTS

MANAGING COMPETING AND UNWANTED VEGETATION

MANUAL TREATMENT

There are five primary methods for managing and treating competitive and unwanted vegetation: manual, mechanical, biological, prescribed fire, and herbicides. These profiles are intended to aid BLM managers, workers, and the public in planning and implementing vegetation management projects. Manual methods are discussed here.

Hand operated tools are used to cut, clear, girdle, or prune herbaceous and woody plant species. Competing or unwanted vegetation are removed, and the immediate environment is modified to favor desired species.

Non-powered hand tools include axes, brush hooks, hoes, hand girdlers, and hand clippers. Powered tools include chain saws and motorized brushcutters (weed-eaters with a saw-type blade). Manual methods also include use of mulch, weed barrier, cloth, and other materials to inhibit the growth of vegetation.

IMPLEMENTATION

Scalping is one of the most commonly used manual methods when planting seedlings. A small area is cleared with a hand tool to remove potentially competing vegetation before the seedling is planted.

Power saws are commonly used to release newly planted trees. Competing brush is cut, providing the crop tree more space and nutrients. This method has increased as an alternative to the use of herbicides. Release is occasionally achieved by hand-pulling weeds or small competing seedlings and girdling larger stems.

Hand labor is frequently used at recreation and administrative facilities, tree nurseries, and occasionally along roadsides that have been invaded by weeds.

As in all methods, the timing of manual treatments is critical. The resprouting of brush is partly dependent on when it was cut, and the effectiveness of hand pulling depends on when weeds germinate.

ADVANTAGES

Hand methods are highly selective and have the least impact on soil. In riparian areas and sites with sensitive plant species, they can remove the target species without disturbing adjacent vegetation. When vegetation removal must be very selective, the cost-effectiveness of hand treatment methods generally increases.

Because hand methods are labor-intensive, the number of employment opportunities created is relatively high.

DISADVANTAGES

Manual methods, being labor-intensive, can be more expensive. For broad scale treatments, production rates can be lower, and per acre costs higher than for alternative methods.

Plant species which resprout from the stem or roots pose greater difficulty for effective manual treatment unless their root systems can be removed. In some species, especially when they are seedlings, the entire plant can be pulled manually. When pulling is not possible, other treatments may be timed to take advantage of reduced resprouting at certain times of year. These treatment windows have not been identified for all species.

Chain saws and motorized brushcutters can also cause injuries.

ENVIRONMENTAL EFFECTS

Soil disturbance caused by manual methods is usually negligible. The duff layer may be disturbed in a very small area. If large areas are cleared of duff and debris on steep slopes, there is a potential for accelerated erosion.

Manual cutting severs vegetation above the ground; soil is seldom exposed. Residues are usually left in the treatment area, promoting nutrient cycling as they decompose. This may temporarily increase fire hazard.

Manual clearing, chopping, and weeding have a low potential for adverse impacts on water quantity or quality. Measures must be taken to prevent oil and fuel used in power tools from entering streams.

HUMAN HEALTH EFFECTS

The risk of any effect on human health from vegetation treatment is based on two factors:

* Hazardous characteristics of the tool that could cause illness or injury.
* When and how people would be exposed to these hazardous characteristics.

The FEIS made quantitative or numerical estimates of all known risks associated with each vegetation management technique and method. It also reviewed the quality of the scientific data that was used in making these risk estimates. For individual projects, site-specific quantitative estimates need not be calculated to assess project risks. Rather, particular characteristics of the project should be identified that might expose either workers or the public to greater risks than those estimated in the FEIS. Then planners must identify mitigating measures, from the FEIS or elsewhere, and qualitatively describe how effective they would be in reducing particular concerns about exposure.

Hazard

Working with such handtools as axes, brush hooks, machetes, and chainsaws can be hazardous under any circumstance. In forestry work, where site conditions can be extreme, handtools can be an even greater hazard.

When temperatures are high, workers may experience increased fatigue, heat exhaustion, or heat stroke. Power equipment is loud and can require the use of protective gear to prevent hearing impairment.

Workers can be cut by their tools or fall onto the sharp ends of cut stumps or brush. Injuries can range from minor cuts, sprains, bruises, or abrasions to severe injuries such as major arterial bleeding or compound bone fractures. The possibility of injuries from power tools such as chainsaws increases if crew members are working close together. Worker fatigue can be a contributing factor.

Falls or other accidents may adversely affect pregnant female workers. Continued work in rugged terrain may initiate or exacerbate chronic health effects, such as ligament damage or arthritis. In extreme cases, exertion from manual methods in rugged terrain may bring on a heart attack or stroke in workers who are prone to such health effects. In addition, workers could be exposed to poison oak, ticks, bees, and poisonous snakes.

Exposure

The likelihood of injury depends on the amount of time on the job and the type of work being performed. Other factors include terrain, type of vegetation, and worker experience.

Members of the public are not likely to come close enough to any operations to be exposed to manual treatment hazards.

Risk

Minor injuries are almost certain to occur with the use of handtools. Severe injuries may occur, but they are anticipated to be at a much lower frequency. Chainsaws are of particular concern. The incidence of such injuries can be reduced with precautions such as training, protective gear, rest breaks, and equipment maintenance and repair.

Quality of Information on Health Effects

The relationship between hours worked and frequency of injuries appears to be reliable which suggests that the quality of data is fair to good. One factor, job experience, is not accounted for in available studies. Associations between using these tools and long-term health effects are not yet supported by quality data.

MEASURES FOR REDUCING ENVIRONMENTAL AND HUMAN HEALTH EFFECTS

1. Conduct an analysis of worker exposure to potential hazards and risks. Implement measures for reducing the risk when required by circumstances.

2. Depending on the tools which are employed, risk assessment should include the following:

   * Potential for physical dangers such as falls; sprains; falling snags; cuts; and poisonous plants, snakes, or insects.

   * Possibility of exposure to exhaust gases, vapors when mixing fuel, dust, or temperature extremes.

3. Injuries inflicted by chain saws are of particular concern. Appropriate training, scheduled rest breaks, protective clothing, and equipment maintenance and repair can reduce the incidence of injuries.

4. Adhere to state and federal laws, and to the BLM Safety Management Operational Guidance (Manual 1112, Handbooks 1 and 2).

5. Plan to have first-aid equipment and communications onsite and also someone trained in first aid.

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MANAGING COMPETING AND UNWANTED VEGETATION

MECHANICAL TREATMENT

There are five primary methods for managing and treating competing and unwanted vegetation: manual, mechanical, biological, prescribed fire, and herbicides. These profiles are intended to aid BLM managers, workers, and the public in planning and implementing vegetation management projects. Mechanical methods are discussed here.

Crawler tractors or low ground pressure tractors equipped with blades or mowing attachments are most commonly used for mechanical treatments.

IMPLEMENTATION

Mechanical site preparation uses tractors with various types of blades to remove plants, their roots, and, sometimes, part of the top layer of soil.

Tractors with attached discs or chains are also used to remove competitive or unwanted vegetation for reforestation or revegetation. Machines can either partially or totally clear a site. Preparing spots for planting is called scalping, plowing a strip is called furrowing or contouring, and complete removal of vegetation is called scarification.

Tractors are also used to pile unmerchantable material which may produce a fire hazard or create difficult conditions for reforestation. When working away from road surfaces, activities are timed to avoid high soil moisture content for prevention of undue compaction.

Graders, tractors, and other machines use attached brush cutters for roadside brush control and generally travel on the road surface.

Cable systems can be used to yard unmerchantable material from timber harvest areas when it poses a fire hazard or impedes tree planting.

ADVANTAGES

The cost of mechanical methods may be less than more labor intensive manual treatments and high efficiencies are possible. In many cases, the entire plant, including roots, is removed. Where rainfall is low or seasonal, mechanical methods have a wide treatment window.

DISADVANTAGES

Intense disturbance of soil and groundcover is a major disadvantage, particularly during site preparation. In areas of high or year-round rainfall, the window for treatment without inflicting lasting soil damage may be narrow or non-existent.

Mechanical treatment is relatively non-selective; although tractors can be maneuvered or the blade may be lifted to avoid specific areas, all plants within the path of the blade are likely to be affected.

Machines with tracks or wheels can only be used on relatively flat terrain. Although cable systems are commonly used for removal of logging debris on steeper slopes, their use for treating competing vegetation is rare at this time.

ENVIRONMENTAL EFFECTS

Soil and Water

Tractor piling of slash or scarification for site preparation can cause soil compaction, puddling of water, and surface erosion. Disturbing the duff layer and removing organic material can lead to a reduction in site productivity.

Yarding of unmerchantable material involves removing residue which, if left undisturbed, would be available to decompose and supply organic matter and nutrients to the soil. This can affect nutrient cycling and long-term productivity.

Increased surface water runoff and sedimentation may result from mechanical treatment depending on type of soil, operating practices, slope steepness, and distance to the stream channel.

Vegetation

Mechanical methods can significantly affect site vegetation. Direct effects are generally limited to the time when activities take place. They may persist, however, if soils are compacted or if undesirable plants become established on disturbed ground.

Numerous trees and plants adapted for germination on exposed mineral soils may become established after mechanical treatment. This includes important conifer trees such as Ponderosa pine, lodgepole pine, and Douglas-fir. But a competitive species such as red alder is also well-adapted to disturbed sites. Increases in these species may adversely affect timber or forage production and result in a need for further treatment.

Productivity may be increased after site preparation if desired species can be quickly re-established on the disturbed site prior to the emergence of undesired plants.

Wildlife and Livestock

Soil-dwelling animals such as ground squirrels, pocket gophers, and salamanders may be directly affected when mechanical treatments are implemented. Mechanical treatments conducted in the spring may affect ground-nesting birds.

Downed trees and slash provides important habitat for small mammals, birds, reptiles, amphibians, insects, and other invertebrates. Removal of downed trees and slash can reduce populations of these species. Such habitat removal can also indirectly affect predator or prey populations by reducing their food sources.

For large grazing animals (e.g., deer, elk, and livestock), logging slash or natural accumulations of woody debris can impair access, reducing their use of an area. Removal or strategic placement of some of this material can improve access, allowing the animals to make better use of the forage. Partial or selective removal of debris can favor grazing by some animals more than others.

Mechanical treatments may provide opportunities to improve habitat for grazing animals by providing a good seed bed for establishing high-quality mixes of grasses, legumes, and forbs.

Scenery and Cultural Resources

Mowing larger vegetation along roadside rights-of-way can sometimes leave a ragged, ungroomed appearance. Conversely, chopping or chipping large debris is used to improve the appearance of vegetation treatments along roadsides.

Of the five approved methods of controlling unwanted vegetation, the use of off-road mechanical equipment poses the highest potential for damage to uninventoried cultural resources.

HUMAN HEALTH EFFECTS

The risk of any effect on human health from vegetation treatment is based on two factors:

* Hazardous characteristics of the tool that could cause illness or injury.
* When and how would people be exposed to these hazardous characteristics.

The FEIS made quantitative or numerical estimates of all known risks associated with each vegetation management technique and method. It also reviewed the quality of the scientific data that was used in making these risk estimates. For individual projects, site-specific quantitative estimates need not be calculated to assess project risks. Rather, particular characteristics of the project should be identified that might expose either workers or the public to greater risks than those estimated in the FEIS. Then planners must identify mitigating measures, from the FEIS elsewhere, and qualitatively describe how effective they would be in reducing particular concerns about exposure.

Hazard

Serious injuries to the operators of mechanical equipment and other workers in the vicinity can result if the operator loses control of the machine. The steepness, roughness, and soil type of terrain affects the severity of the hazard.

Accidents may occur when operating machines under conditions of poor visibility, when encountering a short headwall or road cut, or when misjudging the slope. When machines overturn, operators may be seriously injured, and flying debris can harm others. Such accidents are uncommon among experienced operators, but they are difficult to eliminate entirely.

Workers can be struck by falling trees or by debris thrown by the equipment. The size and type of vegetation being treated can affect the seriousness of this hazard. In these circumstances, workers on the ground are at greater risk than the operator.

The noise of heavy equipment can cause hearing impairment.

Exposure

The equipment operator and ground crews are the only individuals likely to be exposed to injury from mechanical equipment operating away from roads.

Risk

The most serious accidents involve the overturning of machinery. Rolling or snapping vegetation can also cause injury. Risks to workers are proportional to the length of exposure, modified by terrain factors, and the type of vegetation being treated.

Risks to the general public from mechanical vegetation treatments away from roads is very low because the likelihood of exposure is remote. Risks from roadside brushing and mowing depend on road design factors that influence visibility and speed. Traffic control and warning systems can reduce these risks.

Quality of Information on Health Effects

The quality of data on health effects of mechanical methods is poor; there is no real evidence from forestry to substantiate the intuitive relationship between length of exposure and injury rate.

MEASURES FOR REDUCING ENVIRONMENTAL AND HUMAN HEALTH EFFECTS

1. An analysis of worker exposure to potential hazards and risks must be performed. Measures for reducing the risk will be implemented when required by circumstances.

2. Depending on the tools and equipment which are employed, risk assessment should include the following:

   * Potential for physical dangers such as falls; sprains; falling snags; cuts; and poisonous plants, snakes, or insects.

   * Possibility of exposure to exhaust gases, vapors when mixing fuel, dust, or temperature extremes.

3. Appropriate training, scheduled rest breaks, protective clothing, and equipment maintenance and repair can reduce the incidence of injuries. Of special importance is safety training in the use of chain saws.

4. Adhere to state and federal laws, and to the BLM Safety Management Operational Guidance (Manual 1112, Handbooks 1 and 2).

5. Plan to have first-aid equipment and communications onsite and also someone trained in first aid.

6. Limit use of both rubber-tired and treaded tractors to low impact operating periods. Follow slope restrictions per land use plan. Use caution on soils where there is a high potential for compaction and erosion. The approval of a soil or water specialist is required.

7. Buffer strips must be left along streams, lakes, and wetlands. The timing of mechanical treatments is crucial in minimizing the impact on soil and water.

8. For roadside brushing, project risk plans should evaluate risks of accidents to other forest road travelers and reduce these risks through traffic and/or operational restrictions.

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MANAGING COMPETING AND UNWANTED VEGETATION

BIOLOGICAL TREATMENT

There are five primary methods for managing and treating competing and unwanted vegetation: manual, mechanical, biological, prescribed fire, and herbicides. These profiles are intended to aid BLM managers, workers, and the public in planning and implementing vegetation management projects. Biological methods are discussed here.

Biological methods of controlling vegetation include the use of pathogens which cause disease, and insects which consume plants. The object is to introduce and manage the natural enemies of unwanted vegetation. Grazing by domestic livestock, and cultural methods such as seeding and genetic adaptation, are also considered biological controls.

Biological Agents

Insects and pathogens may be released selectively to weaken or kill specific weeds.

Biological agents are obtained through biological control laboratories and biological control agent production facilities in Oregon. These laboratories test new, non-native organisms for both effectiveness and unintended ecosystem effects before releasing them for use as biological control agents.

Grazing

Prolonged or forced grazing of cattle and sheep may be used to control both weeds and the composition or amount of competing vegetation. This differs from the typical grazing program in that vegetation control, rather than animal weight gain or forage utilization, is the primary objective.

Cultural Methods

Seeding with a desirable groundcover is a preventive technique used on newly disturbed sites such as roadsides, rights-of-way, wildfire areas, and harvested areas. Timely seeding of beneficial grasses or fertilization of existing low brush may inhibit weeds, taller brush, and unwanted trees by stabilizing the disturbed area, crowding out the competitor, or even by emitting toxins detrimental to specific weeds.

Replanting with stock developed from genetically superior seeds may limit the need for conifer release. Tree improvement work has focused on the principal commercial tree species of the Pacific Northwest.

Taking advantage of "naturals" left undamaged on a logging site or seeded from adjoining mature stands to reforest a harvested area is another cultural method which can reduce the need to control competing vegetation.

IMPLEMENTATION

Biological Agents

Insect adults and larvae can damage weeds by feeding on seeds and leaves, girdling roots, and forming galls. Once control has been accomplished, efforts are normally made to harvest the insects for redistribution. Selective release programs have been successful in local situations to control weeds such as St. Johnswort and tansy ragwort.

Host-specific insects successfully used in the Pacific Northwest include the flea beetle and cinnabar moth on tansy ragwort, seedhead weevils on yellow starthistle, root and stem boring moth larvae on Canada thistle and Scotch broom, and seedhead flies on diffuse knapweed. A complete listing is provided in the BLM's FEIS for Vegetation Treatment on BLM Lands in Thirteen Western States.

Grazing

Livestock may be considered for vegetative control when preferred or palatable species are a significant component of the vegetation to be controlled, and when the area is large enough to support an available herd or band. Site preparation and the release of seedlings can be facilitated by grazing. Careful coordination is required to avoid conflict with range and wildlife habitat management goals.

Cattle and sheep have been effectively used to control competing vegetation in rangeland rehabilitation programs in Oregon. They have also been used effectively for conifer plantation maintenance.

Cultural

Through the genetics program, the technique of genetic adaptation is being explored. Trees with the potential for fast, early growth are selected to be used as a seed source for replanting harvested sites. Faster growth of tree seedlings may reduce or eliminate the need to control competing vegetation.

Promoting reforestation from natural seedings may be an effective preventive cultural technique in some situations. The growth of desirable advanced seedlings, protected from damage during logging, or natural regeneration from adjacent stands may reduce the need to control competing vegetation.

Uneven and multi-aged forest management may present some options for controlling vegetation. Removing selected age classes while retaining upper canopy cover may keep competitors from gaining dominance on a site since many brush species require full sunlight for optimum growth. The remaining crop trees expand to take advantage of space and resources made available by the harvest.

The terrain must be gentle in uneven-age stands to minimize soil disturbance and damage to the trees that are left. Otherwise, long-term damage caused by multiple entries could far outweigh benefits. Standards and guidelines dealing with the selection of harvest systems are included in land use plans.

ADVANTAGES

Biological Agents

These controls can be effective when target plants are numerous enough to support a viable population of insects, nematodes, or pathogens, and when adequate numbers of those biologic agents can be obtained. Often, a complex of three to five different insects is needed to control one plant species. Indications are that adverse environmental effects from these methods are minimal. These biological agents, as opposed to livestock, do not disturb the soil nor do they appear to pollute the water. Effects on non-target vegetation, wildlife, or human health have not been reported.

Grazing

The use of cattle and sheep can produce good results. In the proper mix of brush, weeds, and grasses, grazing can effectively control the vigor of undesirable vegetation. Grazing can be cost effective and may often be done in conjunction with existing range permits. On some nutrient-deficient sites, the animals can be beneficial because they convert vegetation directly into an available source of nitrogen.

Cultural

Natural seedlings undergo a rigorous natural selection process and are uniquely and specifically adapted to the site. There are usually a number of different species present, adding to diversity and increasing the chances for survival of a healthy stand. In many cases, they grow faster than planted trees.

Using advanced regeneration has the same advantages as using naturals, but their older age and larger size can give them an increased advantage over competing vegetation.

Seeding with a desired groundcover can be very cost-effective. Once a stable plant community is established, the site becomes self-sustaining.

Genetically superior seedlings not only grow faster, which may reduce the need to control competing vegetation, but may be more disease resistant and less prone to deformation.

DISADVANTAGES

Biological Agents

Because all biological control methods involve the interactions of living organisms with each other and with the physical environment, they are inherently complex. Results may be varied or slow to show effects; and if one or more critical component in the ecosystem is lacking, a specific technique may be ineffective.

If the wildlife in an area contains predators of the introduced biological agent, establishment of that agent may be correspondingly more difficult. Effective control techniques are known only for invading non-native plant species. Sometimes it is difficult to obtain the correct insect, and intensive monitoring is required for all projects.

While the introduction of host-specific insects is carefully studied and planned in advance, there is always a risk of disrupting natural ecosystems. However, no examples of extensive harm done to natural ecosystems by biological efforts to control weeds are known.

Grazing

The disadvantages of grazing are similarly associated with the complexity of management and the need for careful monitoring. Timely project administration and experienced herders or riders are needed to control the duration and intensity of use. This is particularly true with sheep movement and bedding. Over-grazing can lead to erosion and water pollution.

Conifer seedlings are susceptible to browsing or trampling damage, especially during the spring. Livestock must be strictly controlled within riparian areas or on soils subject to compaction to prevent damage to water and soil.

Water distribution and availability can limit the effectiveness of using livestock to control vegetation. The quality and quantity of forage is also critical. To achieve release or reduce unwanted vegetation, livestock must be held in some areas much longer than normal. Forced grazing can adversely affect animal weights and marketability. Experience has shown that willing operators are not plentiful.

Cultural

The principal disadvantage of using genetically adapted seedlings is the cost and time required to breed, develop, and test them. Besides favoring rapid growth, geneticists must conserve other adaptive traits such as resistance to insects, disease, and environmental extremes. Selecting for these traits may reduce the maximum possible growth rate.

For natural seedlings to be an effective means of biological control, a number of conditions must be met. Trees must produce a large seed crop; the seeds must survive depreciation by insects, birds, and mammals; the climate must be favorable for seed germination and seedling growth, and; the seeds must fall on a surface material that allows the seeds to germinate and grow. The right combination of all of these conditions does not occur every year, making cultural treatment prediction in advance difficult. More extensive vegetation treatment may be needed if natural regeneration fails to occur promptly.

Stands composed of advanced regeneration trees may be diseased, suppressed, or damaged, and not always represent a positive opportunity.

Seeding disturbed areas with a groundcover may have unwanted effects. If the seed is not from a certified source, it may be significantly contaminated by noxious weed seeds. The seeds may be non-native species selected to be aggressive and might out-compete desirable native species, thus reducing vegetative diversity. In burned or harvested areas, seeded ground vegetation may make replanting more difficult or may become competitive to natural tree seedlings that are wanted for long-term reforestation.

ENVIRONMENTAL EFFECTS

Soils and Water

The use of biological agents is not expected to adversely affect soil or water. The seeding of disturbed sites with desired species can help prevent soil erosion and benefit water quality.

The main adverse effects on soils due to grazing are compaction of wet soils from trampling and surface erosion on steep hillsides due to loss of plant cover from overgrazing. These effects, however, do not usually occur when grazing is used specifically for vegetation management.

Grazing can increase sedimentation and fecal bacteria which degrade drinking water. If riparian areas are overgrazed, increased stream temperature and channel instability may result.

Rangeland

The utilization of predators, pathogens, and parasites as natural enemies to control weeds has a very low potential to adversely affect rangeland vegetation.

Seeding with grass and legumes increases the quantity and quality of forage and can increase the land's carrying capability.

Grazing can change the ecosystem suitability of rangeland plant species. Overgrazing and distribution of livestock may damage more vegetation, particularly in riparian zones. This can directly affect wildlife and increase pressure where livestock and big game compete for forage.

Properly timed and controlled grazing can improve habitat, keeping vegetation in a succulent, highly digestible condition for a longer period of time.

Wildlife

The use of biological and cultural methods has little potential to affect wildlife directly. The potential for indirect and cumulative effects is greater and varies with the technique used.

Plants targeted for control by biological agents are usually non-native, toxic to many wildlife species, or in competition with preferred forage plants. Removing them may increase the viability of dependent wildlife species.

The effect of seeding and planting on wildlife is generally positive. It can increase deer and elk populations by improving forage, thus increasing the carrying capacity of range and forest lands.

On transitory range, temporarily opened by fire or harvesting, these effects may last for between 10 and 20 years. Transitory ranges can often produce large quantities of forage for a relatively short period of time following stand disturbance. Seeding grasses, legumes, and forbs will increase the length of time plantations provide habitat for species dependent on or preferring early seral stages. This is because invasion and dominance of a site by shrubs and other vegetation is impeded.

Grazing has the potential for direct, indirect, and cumulative effects on wildlife. The magnitude depends on the objectives, extent, and control of the activity. Potential direct effects include the displacement of resident big game by livestock, the transfer and spread of parasites and disease from livestock to wildlife, and attrition from predator control measures which may be used to protect domestic animals.

Indirect effects include changes in habitat suitability, reduction of forage on summer and winter range, and degradation of critical habitat, such as elk calving or deer fawning sites, wallows, and water access.

HUMAN HEALTH EFFECTS

Hazard

The FEIS made quantitative or numerical estimates of all known risks associated with biological controls. It also reviewed the quality of the scientific data that was used in making these risk estimates. For individual projects, site-specific quantitative estimates do not need to be calculated in order to assess project risks. But the particular characteristics of the project should be evaluated to determine whether they might expose workers or the public to risks greater than those estimated in the FEIS. Then planners must identify mitigating measures, from the FEIS or elsewhere, and determine how effective they would be.

Cattle or sheep are normally held in a plantation or confined area long enough to afford heavy utilization of feed and to generate a release effect in the crop trees. The combination of livestock numbers and duration of grazing may result in relatively high volumes of fecal matter deposited on the site. This factor, as well as the tendency for animals to concentrate in draw bottoms and adjacent to live water, creates a potential for fecal contamination of surface waters.

No hazards to human health have been identified for other biological controls and cultural methods.

Exposure

Members of the public who consume surface water downstream of biologically-controlled sites may be exposed to fecal contaminants from grazing livestock or other pollutants. Because of the relative remoteness of application sites, pathogens are not likely to contribute significantly to major municipal drinking water supplies and, therefore, larger populations are not likely to be exposed.

Risk

There is a remote possibility that fecal contamination of surface waters could result in the spread of waterborne diseases if animals were used to manage competing vegetation. Downstream monitoring will be conducted in those projects where there is a question of potential human health effects.

Quality of Information on Health Effects

Little or no information exists on the spread of waterborne pathogens from vegetation management by biological methods, nor on the incidence of human illness that could be attributed to them.

MEASURES FOR REDUCING ENVIRONMENTAL AND HUMAN HEALTH EFFECTS

1. An analysis of worker exposure to potential hazards and risks must be performed, and measures for reducing identified risks will be implemented when required by circumstances.

2. Depending on the tools which are employed, risk assessment should include the following:
   * Potential for physical dangers such as falls; sprains; falling snags; cuts; and poisonous plants, snakes, or insects.

   * Possibility of exposure to exhaust gases, vapors when mixing fuel, dust, or temperature extremes.

3. Appropriate training, scheduled rest breaks, protective clothing, and equipment and tool maintenance and repair can reduce the incidence of injuries.

4. Adhere to state and federal laws, and to the BLM Safety Management Operational Guidance (Manual 1112, Handbooks 1 and 2).

5. Have onsite: first-aid equipment, communications, and someone trained in first aid.

6. When implementing integrated pest management programs, follow BLM Manual 9014 for the use of biological control agents of pests on public lands. All BLM uses of biological control organisms will be in cooperation with the Oregon State Biological Control Agent Release Proposal; other agencies such as the Animal and Plant Health Inspection Service (APHIS) which permits interstate transportation of agents, and the USDA Agriculture Research Service which often is the source of biological control agents; and adjacent landowners.

7. Project planners will inform downstream water users who could be directly affected by biological contamination of surface water.

8. Existing direction found in BLM Manual 4100, BLM Rangeland Monitoring Handbook H-1734-2, and BLM Manual 7000 for Soil and Watershed Management provides for protection of resources during livestock grazing. Standards and guidelines in land use plans address local conditions and measures necessary to minimize impacts on soils and vegetation caused by trampling of livestock.

9. Livestock will be strictly controlled in the vicinity of wetlands and riparian areas to prevent trampling and the compaction of wet soils, water contamination, and destruction of riparian vegetation and banks. Specific management direction for protecting riparian areas, wetlands, and special status species plants is given in land use plans such as RMPs and individual activity plans. Management techniques can include fencing, herding, sale distribution, and herd adjustment.

10. Strict control of livestock is required to prevent damage to desired vegetation. In addition to fencing the upslope water developments, supervision is also required to keep livestock from concentrating in wet areas and overgrazing.

11. Stock tanks and methods to ensure animal movement and dispersal within the treatment area should be employed when necessary.

12. Consideration must be given to potential impacts on downstream domestic water users, and water quality monitoring requirements must be incorporated into project plans.

13. The consequences of using genetically-adapted seedlings selected for fast, early growth will be evaluated for their long-term effect on the diversity of natural forest and range ecosystems. The evaluation should occur as part of the genetics program.

14. For bioagents, post units with project description signs, in both English and Spanish, at least 24 hours prior to treatment, and leave signs in place a minimum of 30 days.

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MANAGING COMPETING AND UNWANTED VEGETATION

PRESCRIBED FIRE TREATMENT

There are five primary methods for managing and treating competing and unwanted vegetation: manual, mechanical, biological, prescribed fire, and herbicides. These profiles are intended to aid BLM managers, workers, and the public in planning and implementing vegetation management projects. Prescribed fire is discussed here.

Fire can be used to reduce hazardous fuels, prepare sites for seeding or planting, rejuvenate forage for wildlife and domestic livestock, maintain fire-dependent species and ecosystems, control insects and diseases, and maintain or enhance habitat for special status species. This discussion is limited to the use of prescribed fire as a method to control competing and unwanted vegetation.

IMPLEMENTATION

The most common prescribed burning techniques are broadcast burning, pile burning, and underburning.

Broadcast burning is the burning of material scattered over an open area such as a clearcut. Broadcast burns are usually ignited with handheld drip torches, although helitorches are becoming more widely used. A helitorch is a device suspended from a helicopter that drips flaming jellied gasoline. Helitorches are used where it is necessary to ignite an area rapidly, or when ignition by workers on foot is not safe. Rapid ignition makes it possible to burn at higher fuel moistures, which reduces the danger of fire escaping.

Mechanical pretreatment is often done in combination with broadcast burning. Brush or saplings may be cut and scattered prior to burning. Logging residues may be crushed and compacted to reduce fire intensity and rate of spread. Unmerchantable material may be yarded from the unit by skidders or cable-logging machinery.

Pile burning of forest residues is done after yarding and piling unmerchantable material into piles or windrows. Piling is done by hand or with a tread rubber-tired tractor.

Generally, windrows are burned in the fall after snowfall or rain to minimize the risk of escaped fires and air pollution. The most commonly used devices for igniting piles are handheld drip torches and packets containing a gel that thickens gasoline. The jellied gasoline is put into plastic bags, placed inside the piled slash, and ignited electronically.

Underburning is burning beneath a forest canopy to reduce woody debris, create sites for natural regeneration, reduce fuel loading, set back unwanted vegetation, or to encourage the growth of desirable forage and browse species. The handheld drip torch is used to ignite an underburn. Underburning is done when the air temperature is relatively cool and there is sufficient wind to dissipate convective heat, which would otherwise damage the overstory.

Relatively high duff/litter moisture contents are prescribed to limit consumption of the forest floor.

In deciding whether to burn and which technique to use, the quantity, type, distribution, and moisture contents of the burnable material are of primary importance. Temperature, wind, humidity, and topography (e.g., ruggedness, elevation and slope) must also be considered. Predictions must be made of the likely pattern and extent of smoke dispersed, the flame length, and rates of fire spreading.

ADVANTAGES

Wildfire plays an important role in natural ecosystems; when prescribed fire can mimic the critical aspects of wildfire behavior, it can produce similar effects. Fire may be the only effective method to maintain or restore threatened and endangered plants and overall plant communities which depend on periodic wildfire disturbance for perpetuation. With careful selection of burning conditions, prescribed fires can take advantage of the beneficial effects of fire while minimizing damage wildfire often causes.

Prescribed fire is effective on steep slopes where other methods are difficult or impossible, and can be less expensive than other methods.

DISADVANTAGES

Selectivity is difficult to achieve consistently with fire. Also, burning may cause conditions that encourage the invasion of the treated site by other unwanted plants. Both of these effects depend on the heat tolerance, vigor, sprouting ability, seed sensitivity of individual plant species, and the duration and intensity of the fire.

Soil can be damaged and water quality degraded. Smoke from prescribed burning reduces air quality, and the possible escape of a prescribed fire is always a serious consideration. Other potential problems associated with this method are discussed below under environmental and human health effects.

ENVIRONMENTAL EFFECTS

Soil and Water

Prescribed fire can affect many components of the soil ecosystem: organic matter, especially the surface layers, nutrient capital and cycling; microorganisms, and erosion. Some of these potential effects are interconnected.

Loss of organic matter is the most serious fire effect. Soil fertility, stability, and water storage may be reduced. Some of the nutrients stored in woody plants, litter, duff, and soil are released as gases during burning; and additional nutrients may be drained from the ashes in subsequent rainfall. This organic matter also cushions the force of raindrop impact and binds soil particles together. When the organic matter is lost, the mineral soil is more susceptible to dislodging by rainfall and downslope movement as surface erosion. At the same time, less water soaks into the soil, and water storage capability may be reduced.

Soil organisms may be directly killed by fire especially those in the surface organic matter. Soil can be sterilized by persistently high soil temperatures, which are generally present under fuel concentrations such as slash piles. Changes in soil nutrients, moisture, and temperature pattern following a fire may indirectly alter soil plant animal communities.

The potential for prescribed burning to cause these adverse effects on soil productivity depends on the fuel and weather conditions under which burning takes place. Soil moisture, fuel quantities and moisture content, air temperature, humidity, and wind are all factors considered in burning prescriptions to reduce fire intensity and consumption of organic material.

Site conditions further influence the potential damage from the burning of organic matter. Sites with steep slopes and/or low inherent organic content are most vulnerable to damage. Single-grained soils derived from granitic material or volcanic ash are most susceptible to surface erosion following burning.

Prescribed burning, if sufficiently hot, can produce hydrophobic (unwettable) soils which contribute to increased sedimentation, leaching nutrients from ashes, and increased runoff during storms.

Air Quality

Prescribed burning has a direct effect on air quality. Districts in western Oregon must comply with state air quality standards. Average annual emissions are expected to decline significantly due to a decline in acres burned and reductions in the amount of biomass consumed per burned acre. Visibility in Class I lands (wilderness and major recreation areas) will be protected from July through Labor Day.

Vegetation

Variations in the timing and intensity of fire modify its effects on vegetation. Direct effects are limited to the time when burning takes place, but may last longer if soil fertility and biology is altered or if undesirable plants become established in response to fire.

Where the organic layer is consumed by fire, numerous plants adapted to germinating on exposed mineral soils may become established. Among adapted species are important conifer trees such as ponderosa pine, lodgepole pine, and Douglas-fir. Some undesired brush or tree species, however, are equally or better adapted on specific sites. This includes red alder and a number of weeds. The seeds of some ceanothus and manzanita are stored in the soil and will germinate abundantly upon heating. Tanoak may resprout vigorously from below the soil surface. Increases in these species may adversely affect timber or forage production objectives and require further treatment.

Productivity may be increased after site preparation if desired species can be quickly re-established and occupy the disturbed site to the exclusion of undesired plants.

Wildlife and Rangeland

Variations in the timing and intensity of fire modify its effects on wildlife habitat. Prescribed burning plans need to provide for protection and maintenance of large fallen logs and snags. These are important habitat components that can be consumed by fire.

Fire can be used to reduce accumulations of slash, improving access for some animals. Burning can stimulate the growth of plants eaten by big game, other wildlife species, and by livestock. Forage improvement and meadow restoration are highly dependent on prescribed burning to clear unpalatable vegetation and prepare seedbeds for more palatable growth.

Many types of vegetation are closely linked in their development to the influence of fire. The use of fire to create more of the "edge effect" is superior to any other treatment method. There is increased richness of flora and fauna in these transition zones where two plant communities or successional stages meet and mix.

Scenery and Recreation

Prescribed burning can temporarily reduce scenic quality. The magnitude of the change depends on how well the treatment blends with the natural character of a landscape.

Reductions in air quality and visibility from prescribed burning can adversely effect both developed and dispersed recreation.

HUMAN HEALTH EFFECTS

The risk of any effect on human health from vegetation treatment is based on two factors:

* Hazardous characteristics of the tool that could cause illness or injury.
* When and how people would be exposed to these hazardous characteristics.

The FEIS made quantitative or numerical estimates of all known risks associated with each vegetation management technique and method. It also reviewed the quality of the scientific data that was used in making these risk estimates. For individual projects, site-specific quantitative estimates need not be calculated to assess project risks. Rather, particular characteristics of the project should be identified that might expose either workers or the public to greater risks than those estimated in the FEIS. Then planners must identify mitigating measures, from the FEIS or elsewhere, and qualitatively describe how effective they would be in reducing exposure.

Hazard

Both fire and smoke from prescribed burning can pose health hazards.

Short-term health effects of smoke may include eye and throat irritation, coughing, and shortness of breath in thick smoke. People could be asphyxiated by prolonged entrapment in heavy smoke.

The components of forest fire smoke are fairly well-known but the amounts produced vary considerably, depending on fuel moisture and fire temperature. Hazards include gases (carbon monoxide, carbon dioxide, and nitrogen oxides), tiny airborne particles, and chemicals that may enter the lungs on the surface of those particles.

Tiny particulates can be inhaled deeply into the lungs and deposited there, along with attached chemicals. Particulates may be irritating themselves and associated chemicals, such as aldehydes, are acute irritants. Other components, such as polyaromatic hydrocarbons (PAH) are known carcinogens. The most potent PAH has been demonstrated to increase in potency when mixed with particulates.

Additional toxic compounds may be released when herbicide-treated vegetation is burned. As there is great variety in the chemical composition of herbicides, the potential for toxins being released from burning treated vegetation is addressed in the individual Herbicide Profiles (Attachment C).

The specific toxic agent in smoke from burning poison oak has been responsible for a large number of workers being incapacitated for a considerable period of time.

When a burn escapes and becomes a wildfire, severe burns and fatalities may result. Human habitat may also be lost.

Exposure

Worker exposure to fire depends on the number of prescribed burns and the acreage per burn.

Public exposure to fire depends on the number of escaped burns that become wildfires. This exposure from prescribed burning should be rare given normal precautions.

Particulate concentration has generally been used to estimate exposure to smoke. Besides measuring the actual particles, the concentrations of attached chemicals may be estimated proportionally. The gases produced by fire, on the other hand, decompose or are diluted rapidly. Although not a factor in off-site exposure, people in close contact with burning operations may be exposed to these gases.

Direct measurements of the concentration of particulate matter in the air have been made in communities located near areas of forest slash burns. These studies represent estimates of the maximum likely exposures of population centers to smoke components.

Smoke exposure for workers on prescribed fire would be much greater than for the general public. No direct measurements of worker exposures have been made, and no reliable procedure for estimating these exposures is available.

Workers on prescribed burns are exposed to additional hazards. Those who prepare sites by piling slash or cutting brush and small trees are exposed to injuries similar to those doing manual vegetation treatment. Workers who manually light burn areas would be exposed to diesel oil and gasoline, as well as to the effects of smoke and fire.

Risk

Prescribed burning has some risk of causing wildfire from escapement, and can cause physical injury to workers from the work involved or from chemical or particulate effects from smoke. Effects from the smoke exposure are expected to be short term. Workers are at particular risk when prescribed fires escape.

The risks to workers who are preparing sites for broadcast burning are comparable to those described for manual vegetation treatment.

The public is not likely to incur serious injury from prescribed burning actions, although there is some indication that individuals may experience long-term health effects if exposed to smoke concentrations greater than state air quality standards.

Quality of Information on Health Effects

There is information available on the incidence of escaped prescribed burns and resulting injuries. However, information on the effects of smoke from prescribed burning is poor. While some smoke concentrations resulting from slash burning have been measured, most conclusions must be extrapolated from studies of air pollution from other burning activities.

MEASURES FOR REDUCING ENVIRONMENTAL AND HUMAN HEALTH EFFECTS

1. An analysis of worker exposure to potential hazards and risks must be performed. Measures for reducing the risk will be implemented when required by circumstances.

2. Depending on the tools and equipment which are employed, risk assessment should include the following:

   * Potential for exposure to smoke and temperatures, and to physical dangers including falls; sprains; falling snags; cuts; and poisonous plants, snakes, or insects.

   * Possibility of exposure to exhaust gases, vapors when mixing fuel, dust, or temperature extremes.

3. Appropriate training, scheduled rest breaks, protective clothing, and equipment and tool maintenance and repair can reduce the incidence of injuries.

4. Adhere to state and federal laws (including the Clean Air Act and Oregon Smoke Management Plan), to the best available technologies applicable to reduce smoke, and to the BLM Safety Operational Guidance (Manual 1112, Handbooks 1 and 2).

5. Plan to have first-aid equipment and communications onsite and also someone trained in first aid.

6. A written, site-specific prescribed burning plan must be approved by an authorized officer. It must include:

   * A description of the site and project objectives. This can include site preparation, hazard reduction, and big game habitat improvement.

   * Expected results, expressed quantitatively. Reduction of fuel loading, the number of planting sites, or the stimulation of forage production are typical objectives.

   * Weather and fuel moisture criteria needed to achieve project objectives.

   * Human Health Risk Management Plan.

   * Plans for site monitoring to determine when above criteria have been met.

   * Location of fire breaks, hose lays, and other physical elements required to conduct the project.

   * An assessment of the possibility of escaped fire and an estimate of possible consequences. Measures which would be taken if this occurs must be spelled out.

   * A plan for notifying regulatory and cooperating agencies and the public.

   * Measures for managing smoke. Identify roads, airports, communities, residences, recreation and scenic areas requiring protection.

   * Procedures for patrol and mop-up.

   * Measures for monitoring the project and evaluating the results.

7. The guidelines for preventing soil damage will be followed. Avoid burning more litter and duff than needed to meet the project's objectives. This will protect the physical and nutrient properties of soil. Extreme care must be used when burning on steep slopes and granitic or volcanic soils, which are highly erodible.

8. Adhere to the guidelines for protection of water quality. Leave an unburned buffer of vegetation along streams to reduce sedimentation. Limit the intensity of the burn adjacent to intermittent streams.

9. Follow the guidelines for protecting air quality. Protect visibility and overall air quality in Class I areas, particularly during periods of high public visitation (July through Labor Day). Comply with state and local air-quality regulations.

10. The burning of vegetation which has been treated with herbicides will adhere to guidelines as disclosed in the specific Herbicide Profiles (Attachment C). Otherwise, burning of herbicide-treated vegetation will not be done within six months of being treated with herbicides.

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MANAGING COMPETING AND UNWANTED VEGETATION

HERBICIDE TREATMENTS

There are five primary methods for managing and treating competitive and unwanted vegetation: manual, mechanical, biological, prescribed fire, and herbicides. These profiles are intended to aid BLM managers, workers, and the public in planning and implementing vegetation management projects. Methods using herbicides are discussed here.

Herbicides may be used to control competing and unwanted vegetation in a variety of BLM programs. These herbicides kill plants by disrupting biochemical growth processes in a number of different ways.

All herbicides considered for use are registered by the U.S. Environmental Protection Agency (EPA). Registration includes EPA's determination that when used in the proper manner, the herbicide will not present an unreasonable risk of adverse effects to humans or to the environment. Registration is based on test data submitted by the manufacturer of the herbicide to EPA. Some persons question the validity and adequacy of the test data. Similarly, some question the adequacy of the standards used to determine "unreasonable risk."

Treatments must comply with the manufacturers' label restrictions and agency administrative directions.

The herbicide as applied may include other chemicals called inerts, in addition to the active herbicide chemical. Inert and carrier ingredients are chemicals added to the active ingredient to make the herbicide more effective when sprayed. While inerts do not have plant-killing properties, they increase herbicide effectiveness by improving solubility or the ability of the chemical to stick to plants or to penetrate protective layers on plant surfaces. Adjuvants are sometimes added to limit unintended drift of a mixture when being sprayed.

The mixture of active ingredients and other chemicals is called the herbicide formulation. Manufacturers consider the ingredients of this mix proprietorial information to be withheld from their competitors. The inert ingredients have, however, been disclosed to the EPA which categorized them based on known potential for human health effects.

Herbicides are usually applied as liquids mixed with water or oil carriers. A few herbicides are applied in solid form, usually as granules placed on the soil surface to be absorbed by plant roots.

Listed below are the formulations of herbicides which can be considered for use in vegetation management projects in western Oregon:

Asulam	Atrazine
Dicamba	Glyphosate
Hexazinone	Picloram
Triclopyr	2,4-D

The behavior of each herbicide and its formulations, as well as its effects on target plants and the environment, including human health, are different. Specific herbicide information profiles are provided in Attachment C. The purpose of this discussion is to describe agency procedures and characteristics common to all herbicides.

IMPLEMENTATION

Districts will actively seek opportunities to reduce past reliance on herbicides. Herbicides will be employed only when other methods would be ineffective in meeting management objectives or would unreasonably increase costs.

Site-specific environmental, biological, sociological, and economic factors must be considered. The basic elements of site analysis, strategy selection, and design of herbicide projects are:

1. Management objectives, required mitigation measures, and anticipated resource output.

2. Potential for adverse worker and public health effects.

3. Risk of unacceptable environmental damage.

4. Feasibility of the project, including logistical considerations such as the availability of funding, people, time, and equipment.

5. Potential to develop strategies which will make future applications of herbicides unnecessary. This can be accomplished by incorporating modifications to "pest" habitat or by complementing the natural processes of some ecosystems.

Techniques

Generally, there are four application techniques for herbicides:

1. Aerial application, using helicopter or fixed wing aircraft.

2. Mechanical equipment, using truck-mounted or truck-towed wand or boom sprayers.

3. Backpack equipment, generally a pressurized container with an agitation device.

4. Hand application by injection, daubing cut surfaces, or application of granular formulations to the soil.

ADVANTAGES

The range of selectivity possible with the use of herbicides is wide. Some applications can target specific or even individual plants. Other applications can kill all vegetation on a site. The length of time a herbicide can control the growth of competing vegetation also varies.

Some herbicides will kill only above ground vegetation; others will kill underground root systems to reduce resprouting. Some remain temporarily active in the soil to reduce reinvasion of the target plants.

Most herbicide applications do not greatly disturb the soil or its protective organic cover. With aerial application, large areas may be treated quickly with a small labor force. This is a particular advantage for treatments using selective herbicides to release conifers because differences in dormancy between conifers and broadleaf plants allow a short time period for controlling broadleafs without damaging conifers.

Direct application costs may be low although indirect costs such as mitigating measures reduce cost-effectiveness compared with other methods. Relatively few workers should be exposed to the potential health effects of the herbicides when they are applied in accordance with the safety precautions required in the Vegetation Management FEIS and Record of Decision. Aerial application is not limited in feasibility or economics by inaccessibility or rugged terrain nearly as much as the ground application methods.

Truck-mounted mechanical spray equipment has advantages similar to aerial application in timing, cost, low soil disturbance, and worker exposure. It is, however, a system limited primarily to treatment of roadsides and flat areas where there is access.

Hand application systems have a common set of advantages: targeting of individual unwanted plants is greater than with aerial and mechanical application; therefore, effects on nontarget organisms and other elements of the environment can be reduced.

DISADVANTAGES

Herbicides introduce foreign chemical substances into the forest environment. The reactions of these chemicals, whether onsite or off-site, can cause a variety of undesired effects. The principal causes of off-site effects are spray drift and water contamination.

Both direct and indirect effects on health and on the environment can adversely affect non-target organisms, including humans. These effects are unique for each herbicide and are discussed in individual herbicide information profiles.

Selectivity and off-site effects vary among herbicide application methods. The size of the treatment swath, the speed of application, and the ruggedness of the terrain involved are factors affecting the ability to control herbicide placement. Spray nozzle designs can produce spray droplets which reduce drift. Drift control additives are also available. Spray control is difficult in aerial applications because the equipment produces wide swaths at rapid speeds. Spraying from truck-mounted equipment is somewhat more controllable. While human-held applicators are best able to direct herbicides to individual plant targets, more workers are potentially exposed.

ENVIRONMENTAL EFFECTS

While general principles of biochemistry and physics govern the interaction of any herbicide with components of the environment, each herbicide is a distinct chemical with its own particular properties. The profiles in Attachment C describe how each herbicide may affect the environment, and the general dynamics and range of potential environmental effects are described below.

Soil

Persistence and Mobility: Though much of the herbicide falls on foliage, the soil is also a major receptor with any application method.

Factors determining the persistence of herbicides in the soil include the chemical properties of each agent, the weather, and the properties of the soil.

Soils high in clay and organic matter may retard or in some instances prevent the leaching of herbicides by providing sites for adhesion onto the surface of a soil particle, which is called adsorption. Soils with low pH tend to increase adsorption of herbicides; the degree of adsorption varies depending on the herbicide used. Conversely, abundant rainfall increases the possibility of herbicide movement by leaching or runoff.

The buildup of chemicals in the soil is a potential cumulative effect from the use of herbicides. This can occur if repeated applications occur before residues from the previous application decompose. An application of herbicide for release might follow a herbicide application for site preparation within two to eight years. Repeated applications within a single year, however, would be extremely rare. Over the course of a timber rotation more than three applications to the same area would also be rare. There may be a greater potential for buildup of herbicides in rights-of-way, roadsides, and rangeland where repeated treatments might occur. Preventive and nonchemical corrective methods should be used to limit the need for repeated treatments.

The persistence of the specific herbicide used and its susceptibility to water transport, local climatic conditions, and the rate and frequency of application determine the potential for buildup of residues in the soil.

Microorganisms and Decomposition: Soil and the forest floor constitute an active biological system that decomposes herbicides. Most herbicide decomposition occurs as soil microorganisms metabolize or decompose the chemical in the soil or organic matter. The environmental and human health effects of some decomposition products are not completely known.

Warmer temperatures during periods of adequate moisture generally favor decomposition by microbes; most herbicides appear to persist longer in cold, arid climates.

The direct effects on soil microorganisms of herbicide contact and metabolism have varied widely in experiments. Harmful effects on microbial populations have occurred in some cases; while in other cases, the herbicide has stimulated the organisms.

Use of herbicides results in a pulse of dead organic matter on the site. The nutrient capital of the site remains essentially intact, although redistribution in the soil and remaining vegetation depends on the rate of decomposition of organic matter by soil microorganisms.

Water

Herbicides may directly contact surface water via aerial drift, accidental spills, or surface runoff. Herbicides may indirectly affect surface waters by reducing riparian zone vegetation, leading to increased water temperatures and the loss of channel stability.

Unsprayed buffers are left adjacent to live streams, lakes, and wetlands to reduce the possibility of direct contamination. No indirect effects on water quality due to the loss of riparian vegetation are expected with the use of these buffers.

Major factors influencing herbicide movement from an upland site to surface or groundwaters include the herbicide's relative solubility in water, its resistance to adsorption by soil and organic matter, and its ability to persist intact until it reaches a water source. Mobility will be discussed in the information profiles for each available herbicide.

Of the four application methods, the aerial application of herbicides poses the highest hazard for surface water contamination. A relatively high concentration can result for brief periods from direct application or drift. Wet, marshy areas generally contain higher levels of herbicides for longer periods of time than do upland areas.

If applied to ephemeral stream channels, herbicides or their decomposition products may move into surface waters when rainfall occurs.

In addition to chemical mobility, other factors can influence herbicide activity underground and result in groundwater contamination. For example, if soil microorganisms that decompose herbicides are absent, as in water-saturated soils, herbicides may persist longer than they would in unsaturated soils.

Accidental spills are another way herbicides can enter surface and groundwaters. Potential cumulative and synergistic effects include increased sedimentation, changes in the quantity and timing of peak flows, and chemical contamination of surface and groundwater. This potential must be considered for the entire watershed involved.

Non-target Organisms

Risk: Both the inherent toxicity of a substance and the amount of exposure determine health effects. Animals can be exposed by being sprayed directly or by coming in contact with vegetation, other animals, soil, or water that has been contaminated. Spray mist droplets or vapors can be inhaled. Animals can drink water contaminated by herbicides and eat treated vegetation. Herbicides that are applied in granular form could be eaten.

Herbicides available for use have shown relatively low acute toxicity in studies with laboratory animals. There is very little research and data for forest wildlife species or for livestock. Extrapolation from laboratory animals to forest and range animals involves broad assumptions and considerable variation in estimates of effects.

Sublethal effects of herbicide contact may occur for individual animals or for whole populations. Such exposure may reduce the animal's ability to avoid predation or to reproduce successfully.

Most of the available herbicides are soluble in water but not in fat, a fact which diminishes the tendency for herbicide to accumulate in the bodies of exposed animals, including terrestrial and aquatic wildlife and livestock.

Information needed in a site-specific environmental analysis to assess risk to wildlife includes:

* Inventories and life histories of the wildlife species found in the project area.

* Effects of the herbicide on target and non-target plant species.

* Environmental fate of the herbicide.

Wildlife and Livestock: The potential exists for effects from herbicide application on both wildlife and livestock and their common habitat.

Plant species composition and distribution can be changed by herbicides. A direct effect might be the reduction of an animal's food source when forage plants are killed. The loss of vegetative hiding cover or migration in search of new forage could increase the vulnerability of a species to predation. Broad-spectrum herbicides affect many more wildlife habitats than selective substances.

Conversely, herbicides can improve the quality of forage for grazing animals by suppressing weeds or less palatable species. Seeding of desirable species may be required to achieve lasting results of a positive nature.

Variation in the diversity of vegetation can produce subtle changes in the numbers and kinds of wildlife that use an area. For example, treated brush species may be defoliated immediately, directly affecting wildlife which use it for forage or cover. The woody stems may continue to provide some nesting cover until they decompose, however.

Cumulative effects may occur when herbicides persist in vegetation, soil, or water. Highly mobile or migratory wildlife species may be at greater risk because they can move from one treatment area to another and be repeatedly exposed.

Invertebrates and Microorganisms: Little is known about the effects of herbicides on insects and other invertebrates that are part of the food chain.

Soil microorganisms have shown a wide range of responses to herbicide exposure in experiments. Some populations have increased, using the herbicide as an energy source. Others have declined when exposed to herbicides. Both wildlife species and their vegetative habitat may be affected if nutrient cycling performed by the soil microorganisms is altered by herbicides.

Aquatic Animals: The likelihood of exposing fish to toxic concentrations of herbicides from routine applications is low. Flowing water rapidly dilutes herbicide chemicals; in general, concentrations are reduced below levels with an observable effect in brief periods of time and distance after they are introduced. Mitigation measures, such as the use of no-spray buffer strips along live waters, are designed to prevent entry of biologically significant quantities into the water. Excessive amounts may be introduced when there is an accidental spill or when unpredicted precipitation occurs during or just after herbicide application.

Compared with levels of herbicide which have had toxic effects on fish in laboratory experiments, concentrations measured during herbicide projects are thought to pose a low probability of reaching toxic levels.

Laboratory studies conducted on other aquatic organisms often show toxic effects at 1/10 to 1/100 of the concentration which can harm fish. Therefore, while fish species may not suffer direct toxic effects from a particular application, it is possible that their food sources could be reduced or eliminated.

Scenery

Landscapes which are varied in appearance and are viewed by many visitors are most sensitive to impact from changes. Most areas treated by herbicides for release or site preparation have already been visually affected by timber harvest. There can be an adverse effect on visual quality, however, in using herbicides to control vegetation along roads.

HUMAN HEALTH EFFECTS

This is a discussion of the possible human health effects associated with the application of herbicides. It describes the principles that govern both quantitative and qualitative risk assessment.

Risk Assessment

In this process, risk is the likelihood of illness or injury based on the results of hazard and exposure evaluation. Hazard is the characteristic of an object or substance that can inflict injury or illness. Exposure is the opportunity to receive a dose, which is the amount of a potentially harmful substance actually encountered by an organism. How much, how long, and how often people are exposed all influence risk.

Risk assessment can be approached from two perspectives--quantitative or qualitative--which are each complementary and provide useful information. The BLM FEIS and ROD used both quantitative (through USFS FEIS Appendix D) and qualitative analyses (through USFS FEIS Appendix H) to estimate the human health risks of alternatives. Acceptance of the qualitative risk assessment, Appendix H, is recognized in the Final ROD for the BLM's FEIS.

Quantitative risk assessment estimates the risk of human health effects in terms of numeric probability. Data on toxicity gathered from scientific research is combined with probable exposure quantities that would occur during both routine herbicide application and worst-case accident scenarios to produce an estimate of potential risk.

Qualitative evaluation looks at the adequacy, completeness, and uncertainty of the toxicity data in the quantitative risk assessment. From this, an estimate of its reliability is made. Ratings were assigned in the FEIS based upon evaluation of the data, methodology, conclusions, and consistency among available scientific studies.

The quantitative estimates need not be calculated when doing risk assessment for site-specific projects. Instead, planners must evaluate the project to determine circumstances which might expose either workers or the public to risks greater than those described in the FEIS. Then, mitigation measures (from the FEIS and elsewhere) must be applied and their effectiveness estimated.

It is important to keep in mind, however, that each herbicide is a distinct chemical with its own particular properties. The individual Herbicide Profiles (Attachment C) describe the kinds of toxic effects possible, the dose that might produce health effects, and the likelihood of such exposures occurring in typical operations.

Hazard

Conclusions about the toxic properties of herbicides are drawn from poisoning incidents, laboratory studies of human volunteers, studies of effects in animals, and studies of disease occurrence in human populations linked to known chemical exposures.

Toxic effects from the active ingredient or the inerts in the herbicide formulation may be caused by a single dose or from a series of doses received over time. They can also occur from a combination of the active ingredient and another substance. This could include another herbicide, a carrier, or an inert used in the herbicide formulation.

Incidents of poisoning have shown that herbicides, including those available for use on forests, may cause severe, immediate reaction when received in high enough doses. Such doses, however, are usually the result of an accidental or suicidal ingestion of concentrate. Even in these cases, the herbicides have rarely been fatal. Reported immediate effects from operational exposure have been less severe. Effects have included nausea, dizziness, or reversible neuropathy.

Longer term effects might include permanent damage to the nervous system, a reduction of reproductive success, damage to developing offspring, and the production of heritable mutations. Damage to the liver, kidneys and other organs, damage to the function of the immune system, and cancer might also occur.

Studies of toxic effects to reproductive systems have concentrated on females. The BLM is uncertain whether those herbicide ingredients identified as reproductive toxins may also affect male workers who are exposed.

The effects mentioned above have been shown for a number of the available herbicides in laboratory animal studies. It is, therefore, assumed that they might occur at some dose levels in humans. This assumption is supported by suggestive evidence from studies of occupational exposure.

There are no available human studies establishing heritable mutations associated with the use of herbicides. Laboratory studies constitute the best information on mutagenic potential; none exist for some of the herbicides.

Risk analysis made a worst case assumption that these herbicides can cause mutation. Herbicides found to pose the most significant risk of cancer are believed to be most likely to cause mutation in worst-case situations.

The BLM gave the EPA a list of all herbicide formulations permitted for use by the FEIS. The EPA was asked to identify formulations containing inerts for which data demonstrated or suggested adverse health effects. The ester formulations of 2,4-D and triclopyr, which contain kerosene, were cited. Diesel oil, used as a herbicide carrier, is similar to kerosene in chemical structure and was similarly classified.

For all other inerts and carriers, the EPA did not have data which, in its judgement, demonstrated or suggested toxicity to humans. The two categories included in this finding are: a) chemicals for which there are data supporting a general finding of safety; and b) chemicals for which the EPA found no evidence in its data of toxicity, and no similarity to other chemicals with evidence of toxicity. Others disagree with these EPA findings. They maintain that for some inerts other than kerosene and diesel data exist which demonstrate or suggest toxicity to humans.

For information on inert ingredients in herbicide formulations and their effects, see the individual Herbicide Profiles (Attachment C).

Synergistic effects are consequences which are different from and can be more severe than the sum of those predicted for each element, i.e., one plus one can equals three. One ingredient, for instance, may be a cancer initiator, another a cancer promoter. Likewise, a solvent may dry the skin, allowing enhanced passage of another ingredient across the skin into the body.

It is not known whether the various ingredients in a herbicide formulation can act synergistically to produce toxic effects. Toxicity testing of formulated herbicide products has been limited. Without more complete testing, the possibility that the formulation is more toxic than the tested active ingredient can neither be discounted nor assumed.

Exposure

Two human populations, workers and the general public, may be exposed during herbicide applications.

Workers, especially mixer-loaders and backpack sprayers, are directly involved in treatment operations. They can be exposed to herbicides by contact with spray, splashing, spins, leaking equipment, or by entering treated areas.

Forest visitors and nearby residents may be exposed to herbicide drift, to vegetation with herbicide residues, and to accidental spraying. They could also eat berries or fish, or drink water contaminated with herbicide residues.

Exposures and resulting doses for key workers and for possible public contact were estimated for routine operating conditions and conceivable worst-case accidents. Because no analysis of herbicide spraying could consider every contingency, typical situations and worst-case scenarios were used to model exposures.

For example, the highest plausible accidental dose to the public for most herbicides would be from drinking water from a pond which has been seriously contaminated by a truck spill. This scenario was used for each herbicide considered in the FEIS to calculate potential exposure.

Risk

Risk analysis performed for the FEIS estimated the probability of receiving a dose that would exceed the margin of safety from herbicides in both typical forestry operations and when accidents occur.

Both the toxicity of the chemical and the amount, duration, and frequency of exposure are taken into account when determining the margin of safety. A single dose received by a worker spilling spray over the entire upper body, for instance, may cause less adverse health effects than repeated exposures to lesser amounts of herbicide.

Margins of safety compare the predicted exposure and dose to the largest dose that had no health effect in laboratory animal studies. The categories for exposure and associated margins of safety are as follows:

Exposure Risk	Calculated Margin of Safety
High	Less than 10
Moderate	Between 10 and 100
Low	Between 100 and 1,000
Negligible	Greater than 1,000

Information packages for each herbicide indicate the margin of safety for each type of possible health effect.

Quality of Information on Health Effects

A separate analysis evaluated the quality of data that had been used to estimate toxicity, human health risks, and margins of safety. This analysis rated the data for each herbicide (chemical)/health effect combination based on the number of studies, the scientific quality of the studies, and the consistency of the results. Some of the data did not meet current scientific standards. The overall quality of the data for each health effect was categorized for its reliability as a predicator of dose and effect. During the public comment period, evidence was presented which, if subsequently substantiated, would suggest the risk is higher than the calculated margin of safety indicates.

Risk to the Public and Workers

Only people who are actually exposed to herbicides by being in or near an area where herbicides are, or have been recently applied, or who are involved in an accident, are at risk.

In general, the greatest risk is for backpack sprayers followed by aerial mixer/loaders and hack-and-squirt workers.

The risks that were calculated did not consider mitigation measures to protect workers and the public. The protection measures listed below were designed to reduce the risks identified in the risk assessment. With these extra restrictions and precautions in effect, exposure of workers and of the general public and the risk of adverse effects may be reduced below the levels indicated in the FEIS.

Cumulative Effects

Members of the general public are not likely to receive repeated exposures to the same herbicide due to the remoteness of most treatment units, the widely-spaced timing of treatments, and the use of a variety of herbicides. Workers, especially herbicide applicators, are at a higher risk of repeated exposure.

Most vegetation treatments employ only one herbicide, but combinations are sometimes used. These mixtures require approval by the EPA, which recommends adding the predicted effects of the herbicides together.

It is possible that two or more herbicide chemicals may interact to cause a health effect greater than expected from adding the health effects of each separate chemical together; this enhanced interaction is another form of synergism, which was described above. Factors that influence the potential for synergistic effects from separate herbicide exposures include the persistence and routes of degradation of the herbicide chemicals in the environment and in the human body. Synergism is unlikely from exposure to herbicides applied in separate projects because herbicide residues do not persist in the human body for long periods of time, nor are they persistent for long on treated sites. Conclusive examples of synergism involving the herbicides approved for use in the FEIS have not been documented but cannot be discounted as a possible occurrence.

Sensitivity

Unusually sensitive individuals may experience effects even when applications are well within the safety margin. Mitigation measures call for public warning for visitors and nearby residents who are particularly susceptible. Sensitive forest workers will be assigned to other tasks.

Children can be particularly susceptible to herbicides for physiological reasons including smaller body size, incompletely functioning immune systems, rapidly dividing cells which increase susceptibility to cancer, thinner bloodbrain barriers, and immature reproductive systems.

MEASURES FOR REDUCING ENVIRONMENTAL AND HUMAN HEALTH EFFECTS

Planning and Notification Measures

1. Submit any proposal for use of herbicides and their formulations for clearance review at state office and Washington office levels as provided by the ROD.

2. Individual districts will provide guidance for large and complex projects, as appropriate. This will be in the form of BLM Application Handbooks, Project Safety Plans, Environmental Monitoring Plans, Public Contact Plans, or Law Enforcement Plans. This is where specific requirements for equipment standards, training and quality control, and safety needs are identified for project implementation. Special measures such as spray drift control technology, water monitoring standards, calibration of equipment, and onsite weather limitations will be prescribed. These documents define coordination needs with support organizations and facilities.

3. Downstream water users and adjacent landowners who could be directly affected by herbicide drift, stream transport, or an accidental spill will be notified (normally 15 days) prior to the application.

Conducting Risk Assessment

1. An analysis of worker exposure to potential hazards and risks must be performed. Measures for reducing the risk will be implemented when required by circumstances.

2. Depending on the tools and equipment which are employed, risk assessment should include the following:

   * Potential for exposure to smoke and temperatures, herbicides, and to physical dangers including falls; sprains; falling snags; cuts; and poisonous plants, snakes, or insects.

   * Possibility of exposure to exhaust gases, vapors when mixing fuel, dust, temperature extremes, or herbicide volitization or drift.

Considering Hypersensitive People

1. For proposed herbicide applications, public notification will request that people who know or suspect that they are hypersensitive to herbicides contact the BLM to determine appropriate risk management measures. Hypersensitive individuals includes children, as well as adults who have known sensitivities.

2. Workers (both BLM and contract) who know they are hypersensitive to herbicides will not be detailed on application projects. Workers who display symptoms of hypersensitivity to herbicides during application will be removed from the project.

3. Appropriate training, scheduled rest breaks, protective clothing, and equipment and tool maintenance and repair can reduce the incidence of injuries.

Guidelines to Follow

1. Follow guidelines in the BLM Safety Management Operational Guidance (Manual 1112, Handbooks 1 and 2), and BLM Manual 9011-1 on Chemical Pest Control. The 1112 Manual discusses basic safety rules, including storage, transportation, and disposal safety aspects. In project planning, identify references and publications to aid in worker safety training. Plan to have first-aid equipment and communications onsite and also someone trained in first aid.

2. Adhere to state and federal laws, including the labelling instructions of the EPA.

3. The BLM Vegetation Management Program Implementation Standards and Guidelines (being revised to incorporate provisions of this ROD) will be used to define responsibilities and personnel needs, training, and experience needed for large scale aerial or ground application projects. The revised standards and guidelines will meet or exceed BLM Manual 9011-1.

4. Herbicides will be applied in accordance with BLM Handbook H-9011-1 (Chemical Pest Control). This identifies the authority for BLM use of herbicides (the Federal Insecticide, Fungicide, and Rodenticide Act) and establishes the objectives and responsibilities of managers on all administrative levels. It describes the requirements for environmental documentation, safety planning, training, organizing, conducting, and reporting of pesticide use projects. It defines standards for storage facilities, posting and handling, accountability, and transportation; and outlines procedures for spill prevention and cleanup, and identifies container disposal requirements. Also described is the requirement for a post-treatment evaluation report and the pesticide-use report.

Restrictions on Herbicides and Inerts:

1. The herbicides amitrole, diuron, fosamine, dalapon, diquat, MSMA, and ammonium sulfamate will not be used in the vegetation management program.

2. Diesel oil will not be used in herbicide applications, except as an adjuvant (not to exceed 5 percent of spray mixture).

3. Kerosene will not be used in herbicide applications, except as an inert ingredient in the formulations of 2,4-D and triclopyr.

4. Only herbicide formulations that contain inerts recognized as generally safe by the EPA, or which are of a low priority for testing by the EPA will be used. Use of other inerts (identified by EPA as a high priority for testing or those that have been shown to be hazardous, such as List 1 and 2 inerts) requires full assessment of human health risks incorporated into the NEPA analysis and decisionmaking process.

Watershed Protection Measures (Including Required Buffers)

1. Areas used for mixing herbicides and cleaning equipment shall be located where any accidental spillage will not run into surface waters or result in groundwater contamination. Whenever practicable, mixing areas and heliports will not be located within watersheds which provide domestic municipal drinking water or which supply fish hatcheries or irrigation needs.

2. Precautions will be taken to assure that equipment used for storage, transport, mixing, or application will not leak herbicides into water or soil.

3. Buffers are required along streams, open water, and wetlands. Local conditions may require an expansion of the minimum widths given below. The buffer width for lakes and wetlands is wider than streams because of the high water table surrounding these areas. Large quantities of herbicides can be flushed by a rise in the water table. There is also less opportunity for chemical dilution and mixing in lakes and wetlands than in flowing streams.

Buffers are determined by the possible modes of chemical transport to surface waters (direct application, drift, overland flow, subsurface leaching, and mobilization in ephemeral stream channels), as well as protection of riparian vegetation.

<u>Buffers should be designed to</u>:

* Prevent direct application to open water. Truck-mounted spray rigs will have an on/off switch inside the vehicle which the driver can operate at stream crossings.

* Reduce drift into surface water. The acceptable amount of drift reaching surface waters will be determined for each proposed project based on the sensitivity of the water body, including the rate of flow and the nature and amount of downstream use. Operational considerations, including topography, existing vegetation, environmental conditions, and mode of application will be incorporated into the establishment of buffer strips. The buffers will be marked prior to spraying to be visible to applicators in aircraft, in vehicles, or on the ground.

* The following unsprayed widths will be maintained and may need to be expanded depending on local conditions.

  - For aerial application, 200 feet horizontal distance around wetlands and lakes.

  - For aerial application, 100 feet along all flowing streams (Class I through IV).

  - For other than aerial application, maintain a buffer dependent upon the application techniques and site-specific factors such as slope, soil, climate, and risk of contamination.

* The following factors will be considered in project-level analyses and may result in expansion of the buffer widths:
  a) Possibility of significant rainfall within the next 60 days.
  b) Topography adjacent to surface water.
  c) Soil infiltration capacity.
  d) Amount of groundcover.
  e) Flow obstructions that retard overland flow.
  f) Herbicide persistence and mobility.
  g) Value of the water for fisheries and domestic, municipal, industrial, and agricultural uses.

* Reduce the risk of subsurface leaching and mobilization due to a rising water table. Considerations include:
  a) Depth of water table.
  b) Soil permeability.
  c) Possibility of a rise in the water table.
  d) Leaching within the 60 days following application.
  e) Herbicide mobility and persistence.
  f) Downstream water use.

* Minimize the introduction of herbicide chemicals into ephemeral streams. Consider the time since the last rainfall, the chance of significant rainfall in the 60 days following herbicide application, soil moisture, slope, downstream water use, and the mobility and persistence of the herbicide.

* Protect riparian vegetation from the toxic effects of the applied herbicides. Considerations include:
  a) Value of the riparian vegetation for stream channel stability and stream shading.
  b) Availability of large woody debris input for fish habitat and to support the aquatic food chain.
  c) Value of riparian vegetation for terrestrial wildlife.
  d) Toxicity of the herbicide to riparian plant and animal species.

4. Appropriate management of streamsides along dry Class IV streams will be determined during the project-level environmental assessment. Predicted rainfall, downstream uses and values, vegetative and soil conditions, and wildlife habitat will be evaluated.

Precautions for Aerial Herbicide Application

1. Aircraft operators will shut off herbicide applicators during turns and while over open water, residences, and sensitive sites.

2. Drift of herbicide vapors or sprays will be minimized to within the prescribed buffer strip boundaries. The goal is to optimize droplet size to meet control requirements and to reduce risk of contamination due to drift. For aerial applications, fine droplets will be kept to a minimum by techniques such as:
   a) Reducing boom pressure.
   b) Increasing orifice size.
   c) Orienting nozzles parallel to the ground.
   d) Using specialized boom and nozzle designs.
   e) Thickening the spray mixture by addition of various foaming agents, thickening polymers, or invert emulsion carriers.

3. Specific direction on drift control measures, calibration, and characterization of aircraft is contained in BLM's Chemical Pest Control Handbook H-9011-1 (5/25/88) and the Safety Management Operational Guidance Manual 1112 (Handbooks 1 and 2). Current technology in aircraft and guidance systems, aerial delivery systems, aerial spray models, aerial calibration, microsite weather, and quality control is provided to BLM personnel in training sessions.

Monitoring Requirements

1. Exposure monitoring will be required for both workers and the public for all herbicide application projects. Pertinent details will be documented, including herbicides used, land area treated, date and times of applications, people involved, and mitigation measures followed.

2. Monitoring must be planned as an integral part of the overall vegetation management project. Monitoring will be conducted as described in the ROD and BLM Manual H-9011-1. Monitoring of a spray operation will be conducted to determine if mitigation measures are being observed, are effective in maintaining water quality, and are in compliance with state water quality standards and pesticide label requirements. The potential for contamination of aquifers used by fish or for municipal water or irrigation will be considered in the project level environmental assessment.

Protective Clothing and Worker Protection

1. Protective clothing will be worn by all workers (both BLM employees and contract workers). This protection is especially important for those site-specific situations where the MOS is less than 100 and for workers involved in herbicide mixing, loading, backpack applications, and hack-and-squirt applications.

2. Specific equipment will be available for the use of all backpack or hand-and-squirt applications involving glyphosate, dicamba, triclopyr, atrazine, or 2,4-D. The equipment (e.g., overpants and jacket or coveralls, hood, unlined gloves, face shields, and goggles) will be made from material impervious to the herbicides involved. Whether disposable or reusable equipment is used, its use must comply with manufacturer's recommended directions. Workers may elect to use all or some of the equipment; however, impervious gloves and rubber boots (which may be the responsibility of the worker to purchase), as well as any special equipment specified by the herbicide label or material safety data, will be required to be worn.

3. Care will be taken to avoid skin contact with herbicides, diesel oil and kerosene. If contact does occur, affected skin areas should be promptly washed with soap and water, and soaked clothing will be changed.

4. For all herbicide application projects, sufficient supplies of uncontaminated water and soap would be onsite to facilitate washing of exposed workers, in the event of accidental contact with herbicides.

5. Prior to beginning herbicide treatment, each worker will be provided with Treatment Method Information packages and Herbicide Profiles (Attachment C) specific to the proposed treatment. Contractors shall ensure that their employees have been informed of the risks in a language they can understand. Each worker shall sign a statement indicating review of the material and agreeing to work on the project as assigned, or requesting reassignment.

General

1. Post units with project description signs, in both English and Spanish, at least 24 hours prior to treatment, and leave signs in place a minimum of 30 days.

2. Utilize a pilot vehicle when transporting more than 120 gallons of herbicide concentrate or 2,000 gallons of mix on forest roads within municipal, fish hatchery, or

irrigation supply watersheds. Truck drivers will be briefed on all haul route hazards, defensive driving, and the project safety plan, and the Spill Incident Response Plan.

3. Herbicides will be applied within the prescribed environmental conditions stated on the label, in the environmental assessment, and in issued permits. This includes considerations of wind speed, relative humidity, air temperature, herbicide persistence, and time since the last rainfall when determining the timing of applications in relation to drift reduction.

4. Pesticide Applicator Licensing and Training will be used as a quality control measure. The BLM will utilize the programs administered by the Department of Agriculture in Oregon, and the Pesticide Certification Training School sponsored by the BLM. Training and testing of applicators covers laws and safety, protection of the environment, handling and disposal, pesticide formulations and application methods, calibration of devices, use of labels and data sheets, first aid, and symptoms of pesticide exposure. For non-BLM employees, valid state certification is required.

5. Material Safety Data Sheets will be posted at storage facilities and in vehicles, and will be made available to workers. These provide physical and chemical data, fire or reactivity data, specific health hazard information, spill or leak procedures, instructions for worker hygiene, and special precautions.

6. The burning of vegetation which has been treated with herbicides will adhere to guidelines as disclosed in the specific Herbicide Profiles (Attachment C). Otherwise, burning of herbicide-treated vegetation will not be done within six months of being treated with herbicides.

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ATTACHMENT C

HERBICIDE PROFILES

Asulam

PESTICIDE FACT SHEET

U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT
U.S. DEPARTMENT OF ENERGY, BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Forest Service, the Bureau of Land Management, and the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions for the herbicide asulam and its formulations. Unless otherwise stated, the toxicity data presented in this fact sheet refer to the active ingredient, asulam. When included, data on formulated products will be specifically identified. A list of definitions is included in Section VIII of the fact sheet.

I. BASIC INFORMATION

COMMON NAME: Asulam

CHEMICAL NAME: methyl sulfanilylcarbamate

COMMON PRODUCT NAMES: Asulox®

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use"

FORMULATIONS: Commercial asulam products generally contain one or more inert ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the U.S. Environmental Protection Agency (EPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52 FR 13305). The intent of this policy is the regulation of inert ingredients. EPA's strategy for the implementation of this policy included the development of four lists of inerts based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3 and inerts of minimal concern were placed on List 4.

For pesticides containing List 1 inerts, the EPA has given the pesticide registrant the opportunity to reformulate the product to remove the List 1 inerts. If the registrant chooses not to reformulate the product, then the List 1 inerts must be identified on the product label. For List 2 inerts, the EPA is monitoring ongoing testing and gathering existing information on the potential adverse effects of these chemicals to determine if further regulatory action is required. The EPA has no particular regulatory plans for List 3 and List 4 inerts. The Forest Service will incorporate new data on inerts into updated fact sheets as it becomes available.

The commercial asulam product consists of the soluble concentrate/liquid of the sodium salt of asulam; the formulation also contains inert ingredients which are not identified.

Asulox®: asulam (36.2%) and inert ingredients (63.8%)

RESIDUE ASSAY METHODS: Colorimetry, thin-layer chromatography and high-performance liquid chromatography methods are available for residue assay.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND, RIGHT-OF-WAY USES: post-emergent control of target plants in non-crop areas such as rights-of-way, and forestry uses such as Christmas tree plantations, site preparation, reforestation, and conifer release

OPERATIONAL DETAILS:

TARGET PLANTS: Asulam is used to control broadleaf weeds, perennial grasses, and nonflowering plants.

MODE OF ACTION: Asulam is readily absorbed by plants after emergence. It is taken up either by roots or leaves and moves to other parts of the plant. Asulam interferes with the process of cell division and expansion in the growing tissues of the plant.

METHOD OF APPLICATION: surface and aerial spray and spot treatment

USE RATES: 2.9 to 6.7 pounds active ingredient per acre

SPECIAL PRECAUTIONS:

Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.

TIMING OF APPLICATION: Apply to actively growing immature plants. Bracken should be in full frond prior to treatment. Apply after tree bud break and hardening or firming of new tree growth.

DRIFT CONTROL: Do not allow careless application or spray drift. Do not permit spray or spray drift to contact desirable plants.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: Residues of asulam in the soil may carry over through more than one growing season.

ADSORPTION: Asulam does not adsorb well to soil. However, most of asulam's degradation products will bind to the soil. Under flooded conditions the amount of bound asulam degradation residues will decrease. Soils with higher organic matter content will more likely adsorb asulam.

PERSISTENCE AND AGENTS OF DEGRADATION: Bacterial activity degrades asulam in the soil. If the soil is not flooded, asulam will degrade to half its original concentration in one to several days. Under flooded conditions, degradation rates decrease. Asulam is less persistent during cooler and dryer months.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Asulam may degrade to the following compounds: sulfanilamide, sulphanilate, p-phenolsulphonate, and benzene-1,2,4-triol. Other degradation products may include 4-N-acetylasulam, 4-N-acetylsulfanilamide, methyl (phenylsulfonyl)carbamate, phenylsulfonamide, methyl(4-N-acetylaminophenylsulfonyl)carbamate, sulfanilic acid, phenylsulfonic acid. No information is available on the environmental effects of these compounds.

WATER:

SOLUBILITY: Asulam dissolves poorly in water. The sodium salt of asulam (the commercial form) dissolves very well in water.

POTENTIAL FOR LEACHING INTO GROUND-WATER: Asulam has the potential to contaminate ground-water. Asulam is mobile to very mobile in sand, loamy soil, loam and clay loam soil. Both asulam and its degradation products will leach through the soil. Further studies are required by EPA.

SURFACE WATERS: No studies have been submitted to the EPA on the possibility of surface-water contamination by asulam. Due to its solubility in water and mobility in soil, asulam could be transported into surface waterbodies.

AIR:

VOLATILIZATION: The commercial formulation of asulam does not evaporate easily.

POTENTIAL FOR BY-PRODUCTS FROM BURNING OF TREATED VEGETATION: no information available

IV. ECOLOGICAL EFFECTS

NON-TARGET TOXICITY:

SOIL MICROORGANISMS: Asulam has not been tested for effects on soil microorganisms.

PLANTS: Broadleaf weeds, perennial grass and nonflowering plants may be injured by exposure to asulam.

AQUATIC ANIMALS: Asulam is slightly toxic to practically non-toxic to aquatic animals. The Environmental Protection Agency is requiring additional studies on the effects of asulam on invertebrates and cold water fish. It is slightly toxic to practically nontoxic to invertebrates. Asulam and its formulations have not been tested for chronic effects in aquatic animals. Acute toxic level:

species	LC50	
water flea	27 ppm	(Table II, Aq[illegible])
warm water fish	>180 ppm	(Table II, Aquatic)
crustaceans	>100 ppm	(Table II, Aquatic)

TERRESTRIAL ANIMALS: Asulam is of very limited toxicity to birds and mammals. It is relatively non-toxic to honey bees. Asulam and its formulations have not been tested for chronic effects in terrestrial animals. Acute toxic level:

species	LD50	
birds	>1600 mg/kg	(Table II, Avian)

species	LC50	
birds	45,000 ppm	(Table II, Avian)
bees	1.28% mortality at 36.26 µg/bee	

THREATENED AND ENDANGERED SPECIES: Asulam may be a hazard to endangered species if it is applied to areas where they live.

V. Toxicology Data

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: Asulam has not been adequately tested for its acute oral toxicity. The Environmental Protection Agency requires a new acute oral rat study to be submitted.

ACUTE DERMAL TOXICITY: Asulam has not been adequately tested for its acute dermal toxicity. The Environmental Protection Agency requires a new acute dermal rabbit study to be submitted.

PRIMARY IRRITATION SCORE: In laboratory tests in rabbits, asulam was not an irritant to unabraded skin at doses up to 9400 mg/kg (Toxicity Category III, Table I, Skin irritation).

PRIMARY EYE IRRITATION: In laboratory tests in rabbits, asulam was a mild eye irritant (Toxicity Category III, Table I, Eye irritation). It caused conjunctival irritation which cleared in one week but did not cause corneal or iris irritation.

ACUTE INHALATION: Asulam has not been adequately tested for its acute inhalation toxicity. The Environmental Protection Agency requires a new acute inhalation rat study (or additional data from the existing study) to be submitted.

CHRONIC TOXICITY:

CARCINOGENICITY: Asulam's potential for causing tumors (oncogenicity) has not been determined. Asulam caused thyroid and adrenal tumors in rats. The Environmental Protection Agency requires that a study with mice be repeated.

DEVELOPMENTAL: Studies with asulam in pregnant rats (at doses up to 1500 mg/kg per day) and rabbits (at doses up to 750 mg/kg per day) indicated no evidence of teratology (birth defects).

REPRODUCTION: A two-generation reproduction study in rats did not show any adverse effects on fertility or reproduction at a dose of 1000 ppm but showed fewer live births per litter at higher doses. The Environmental Protection Agency states that asulam has not been shown to impair reproductive ability.

MUTAGENICITY: Asulam did not have a mutagenic effect (the ability to cause genetic damage) in one test. The EPA requires two additional mutagenicity tests to be completed.

The data reported above are results of animal studies which the Environmental Protection Agency has evaluated in support of the registration of asulam. These data are used to make inferences relative to human health.

HAZARD: Asulam's acute oral, dermal, and inhalation toxicity have not been fully determined; therefore the hazard of acute human exposure is not known. Asulam is not an irritant to the skin and is a minor irritant to the eyes. Based on results of the animal studies, asulam poses a possible risk of causing cancer at high doses; this effect is under study. Asulam does not affect reproductive ability or have any effect on the health of fetuses. Subchronic dog studies indicate that low exposure levels may cause an increase in the weight of the thyroid. Asulam may accumulate in blood and fat of exposed animals. No cases of long term health effects in humans have been reported due to asulam exposure.

VI. Human Health Effects

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Asulam causes only mild irritation, tearing and redness to the eyes which clears up within a week. There are no reported cases of asulam poisoning.

CHRONIC TOXICITY:

REPORTED EFFECTS: There are no reported cases of long-term health effects in humans due to asulam or its formulations.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: No information is available on the safety of reentering areas after asulam treatment. Do not rotate with any crop which is not registered for use with asulam for one year following the last application of this chemical. Do not graze or feed foliage from treated areas to livestock.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCT: no information available

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Exposure to formulated products will produce health effects similar to those of the active and inert ingredients.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: no information available

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: Asulam may be formulated with other herbicides. The other chemicals (with combined product names) are atrazine (Candex), paraquat (Talent), dalapon (Target), and diuron (Tartan). **The information in this fact sheet only applies to asulam.** Consult other fact sheets for specific information on the other herbicides.

HEALTH RISK MANAGEMENT PROCEDURES: The Forest Service has evaluated health effects data in the development of both pesticide background statement documents and environmental impact statements for pesticide use on forest lands. These health effects evaluations have taken into consideration the potential for both worker and public exposure from Forest Service operations. This information has been used in assessing health risks and consequently in formulating protective measures to reduce risk to forest workers and to the public. Section VII of this fact sheet, Safety Precautions, provides guidance for the safe handling and use of asulam.

VII. Safety Precautions

SIGNAL WORD AND DEFINITION:

CAUTION - AVOID CONTACT WITH SKIN, EYES, OR CLOTHING

PROTECTIVE PRECAUTIONS FOR WORKERS: Workers may reenter treated areas without delay. Wear appropriate protective clothing and equipment during cleanup activities. Use NIOSH/MSHA approved respirator for pesticide mist when handling spills or leaks, or when airborne concentrations are high. When handling, use chemical resistant gloves, protective clothing, and safety glasses.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES): If swallowed, give 2-3 glasses of water or milk to conscious and alert persons; then induce vomiting. If inhaled, move person to fresh air. If not breathing, administer cardiopulmonary resuscitation or artificial respiration. If breathing is difficult, administer oxygen. In case of swallowing or inhalation of asulam, get medical attention. If on skin, wash with plenty of soap and water. Remove contaminated clothing and shoes. If in eyes, hold eyelids open and flush with water for 15 minutes. If skin or eye irritation persists, get medical attention. **In case of emergency, call your local poison control center for advice.**

HANDLING, STORAGE, AND DISPOSAL: Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited. Store at temperatures above 20° F. Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. Triple rinse the empty container. Puncture the container and dispose of in a sanitary landfill or by incineration if permitted.

EMERGENCY (SPILL) HAZARDS AND PROCEDURES: In case of a large spill or leak, dike spills using absorbent or impervious materials such as sand or clay. Recover and contain as much free liquid as possible. Recover remaining spilled material as appropriate. Collect and contain contaminated absorbent and dike material for disposal. Absorb small spills on sand or vermiculite. Place contaminated material in appropriate container for disposal. If spilled on the ground, the affected area should be removed to a depth of one or two inches and placed in an appropriate container for disposal. Do not flush material to public sewer systems or any waterways. Ensure adequate decontamination of tools and equipment following cleanup. **In case of a large spill, call CHEMTREC at 1-800-424-9300 for advice.**

VIII. Definitions

adsorption - the process of attaching to a surface

carcinogenicity - ability to cause cancer

dermal - of, or related to, the skin

ecotoxicology - the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

ecotoxicological - related to the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

formulation - the form in which the pesticide is supplied by the manufacturer for use

half-life - the time required for half the amount of substance to be reduced by natural processes

herbicide - a substance used to destroy plants or to slow down their growth

LC50 - the concentration in air, water, or food which will kill approximately 50% of the subjects

LD50 - the dose which will kill approximately 50% of the subjects

leach - to dissolve out by the action of water

mg/kg - milligrams of the substance per kilogram of body weight

µg - microgram (ten-thousandths of a gram)

microorganisms - living things too small to be seen without a microscope

mutagenicity - ability to cause genetic changes

non-target - animals or plants other than the ones which the pesticide is intended to kill

ppm - parts per million parts

residual activity - the remaining amount of activity as a pesticide

volatility - the tendency to become a vapor at relatively low temperature

IX. Additional Reading

Final Environmental Impact Statement. Managing Competing and Unwanted Vegetation. Forest Service, U.S. Department of Agriculture, Portland, OR, 1988.

Final Environmental Impact Statement. Vegetation Management for Reforestation. Forest Service, U.S. Department of Agriculture, California, 1989.

Final Environmental Impact Statement. Vegetation Management in the Coastal Plain/Piedmont. Forest Service, U.S. Department of Agriculture, Atlanta, GA. Management Bulletin R8-MB-23, 1989.

Guidance for the Reregistration of Pesticide Products Containing Asulam as the Active Ingredient. Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency, Washington, DC, 1987.

Pesticide Fact Sheet: Asulam. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/FS-88-057, PB88-199815, 1988.

X. Toxicity Categories

Tables of Categories of Toxicity

Table I: Human Hazards

Category	Signal word	Route of administration		
		Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/l)
I	DANGER Poison	0-50	0-200	0-0.2
II	WARNING	>50-500	>200-2000	>0.2-2.0
III	CAUTION	>500-5000	>2000-20,000	>2.0-20
IV	none	>5000	>20,000	>20

40 CFR 162.10 (h) (1), July 3, 1975

Table I: Human Hazards (continued)

Category	Hazard	
	Eye irritation	Skin irritation
I	corrosive: corneal opacity not reversible within 7 days	corrosive
II	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV	no irritation	mild or slight irritation at 72 hours

40 CFR 162.10 (h) (1), July 3, 1975

Table II: Ecotoxicological Categories

Mammalian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Dietary):

ppm	
<50	very highly toxic
50-500	highly toxic
501-1000	moderately toxic
1000-5000	slightly toxic
>5000	practically non-toxic

Aquatic Organisms:

ppm	
<0.1	very highly toxic
0.1-1	highly toxic
>1-10	moderately toxic
>10-100	slightly toxic
>100	practically non-toxic

Insecticides, Brooks, H.L. et al. (1973) Cooperative Extension Service, Kansas State University, Manhattan, Kansas

For more information on asulam contact your local Forest Service, Bureau of Land Management, or Bonneville Power Administration office.

January 1992

Prepared by Information Ventures, Inc. under U.S. Forest Service Contract Number 53-3187-104.

Atrazine

Pesticide Fact Sheet

U.S. Department of Agriculture, Forest Service
U.S. Department of the Interior, Bureau of Land Management
U.S. Department of Energy, Bonneville Power Administration

This fact sheet is one of a series issued by the Forest Service, the Bureau of Land Management, and the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions for the herbicide atrazine and its formulations. Unless otherwise stated, the toxicity data presented in this fact sheet refer to the active ingredient, atrazine. When included, data on formulated products will be specifically identified. A list of definitions is included in Section VIII.

I. Basic Information

COMMON NAME: atrazine

CHEMICAL NAME: 6-chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine

COMMON PRODUCT NAMES: AAtrex®, Atratol®, Atrazine

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "Restricted Use" due to ground water concerns

FORMULATIONS: Commercial atrazine products generally contain one or more inert ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the U.S. Environmental Protection Agency (EPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52 FR 13305). The intent of this policy is the regulation of inert ingredients. EPA's strategy for the implementation of this policy included the development of four lists of inerts based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3 and inerts of minimal concern were placed on List 4.

For pesticides containing List 1 inerts, the EPA has given the pesticide registrant the opportunity to reformulate the product to remove the List 1 inerts. If the registrant chooses not to reformulate the product, then the List 1 inerts must be identified on the product label. For List 2 inerts, the EPA is monitoring ongoing testing and gathering existing information on the potential adverse effects of these chemicals to determine if further regulatory action is required. The EPA has no particular regulatory plans for List 3 and List 4 inerts. The Forest Service will incorporate new data on inerts into updated fact sheets as it becomes available.

The contents of three atrazine formulations are listed below.

Atrazine 4L: atrazine (43%), and inert ingredients (57% including 10% ethylene glycol and 0.1% formaldehyde)

Atratol 90: atrazine (85.5%), related compounds (4.5%), and inert ingredients (10%)

AAtrex 80W: atrazine (76%), related compounds (4%), and inert ingredients (20%)

RESIDUE ASSAY METHODS: Ultraviolet spectrophotometric and gas chromatographic methods are available for residue assay.

II. Herbicide Uses

REGISTERED FORESTRY, RANGELAND, RIGHT-OF-WAY USES: control of broadleaf and grassy weeds in rangeland, selective weed control in conifer reforestation, and non-selective control of plants in non-crop land such as rights-of-way

OPERATIONAL DETAILS:

Target groups: Atrazine is used to control grasses and broadleaf weeds.

Mode of action: Atrazine is absorbed mostly by roots and also by leaves of plants. It moves up through the plant, and builds up in the margins of the leaves. Atrazine acts by inhibiting photosynthesis in plants. Plants which are sensitive to atrazine do not metabolize (or break down) atrazine. Tolerant plants metabolize atrazine to hydroxyatrazine and amino acid conjugates. Hydroxyatrazine is then broken down further by dealkylation and hydrolysis.

METHOD OF APPLICATION: ground or aerial spray

USE RATES: 1-10 pounds of active ingredient/acre

SPECIAL PRECAUTIONS:

Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.

TIMING OF APPLICATION: Atrazine is applied before or after plant growth begins. After growth begins, it should be applied when weeds are young and actively growing.

DRIFT CONTROL: Do not apply under windy conditions. Do not use near desirable trees, shrubs, or plants.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: Atrazine is active in the soil for about 5 to 7 months.

ADSORPTION: Atrazine is adsorbed by soils; how much is adsorbed depends on the type of soil. It is not adsorbed as easily by soils with low clay and organic matter content. Under certain soil conditions, atrazine may not stay adsorbed.

PERSISTENCE AND AGENTS OF DEGRADATION: Atrazine is persistent in the soil. It persists longer under dry and cold conditions. Soil microorganisms break down atrazine. Sunlight may also break down atrazine to a small degree. A small amount of atrazine may volatilize (evaporate) at high temperatures. Detectable amounts of atrazine are not usually found below the upper foot of soil.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: The main breakdown product of atrazine in soil is hydroxyatrazine. Hydroxyatrazine does not move easily in the soil. Deisopropylated atrazine and deethylated atrazine have also been found.

WATER:

SOLUBILITY: Atrazine dissolves in water.

POTENTIAL FOR LEACHING INTO GROUND-WATER: Atrazine can move easily in soil. It may leach into ground-water. Atrazine has been found in ground-water samples.

SURFACE WATERS: Atrazine in runoff may pollute surface water. To prevent water pollution, do not mix, load, or use atrazine within 50 feet of any well or sink hole. Do not apply atrazine directly to water or wetlands.

AIR:

VOLATILIZATION: Atrazine evaporates to only a small degree.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: information not available

IV. ECOLOGICAL EFFECTS

NON-TARGET TOXICITY:

SOIL MICROORGANISMS: The effect of atrazine on microorganisms is small.

PLANTS: Atrazine is toxic to many plants. Resistant plants can metabolize or break down atrazine to compounds less toxic to plants.

AQUATIC ANIMALS: Atrazine is moderately to slightly toxic to fish. Atrazine accumulates (builds up) in fish to a small degree. Atrazine is slightly toxic to toxic to amphibian eggs and tadpoles. It is toxic to aquatic invertebrate animals. Atrazine and its formulations have not been tested for chronic effects in aquatic animals. Acute toxic level:

species	LC50	
fish	4.3 to 76 ppm	(Table II, Aquatic)

TERRESTRIAL ANIMALS: Atrazine is slightly toxic to practically non-toxic to birds. Dietary LC50s for quail and pheasants are greater than 5,000 ppm. The toxicity to mammals is low. Atrazine is practically non-toxic to bees. Atrazine and its formulations have not been tested for chronic effects in terrestrial animals. Acute toxic level:

species	LD50	
mammals	750 to 3,080 mg/kg	(Table II, Mammalian)
birds	940 to >2,000 mg/kg	(Table II, Avian)

THREATENED AND ENDANGERED SPECIES: Atrazine may be a hazard to endangered species if it is used in areas where they live.

V. TOXICOLOGY DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: In tests in male and female rats, the acute oral LD50 was 2,850 mg/kg. (Toxicity Category III, Table I, Oral)

Acute dermal toxicity: The acute dermal (skin) LD50 was 7550 mg/kg in rabbits. (Toxicity Category III, Table I, Dermal)

Primary irritation score: In laboratory tests in rabbits, atrazine was not an irritant. (Toxicity Category IV, Table I, Skin irritation)

Primary eye irritation: In laboratory tests in rabbits, atrazine was an eye irritant. (Toxicity Category II, Table I, Eye irritation)

Acute inhalation: In laboratory tests in rats, the LC50 was greater than 167 milligrams per liter for 1 hour. (Toxicity Category IV, Table I, Inhalation)

CHRONIC TOXICITY:

Carcinogenicity: Atrazine was not carcinogenic in an 18 month laboratory study in mice at 82 ppm in the diet. The Environmental Protection Agency is requiring additional studies.

Developmental: A laboratory study in pregnant rats fed a diet including up to 1,000 ppm atrazine indicated no evidence of teratology. When atrazine was injected three times during pregnancy at a dose level of 800 mg/kg or higher, it was toxic to rat embryos. The Environmental Protection Agency is requiring additional studies.

Reproduction: The potential for adverse effects on fertility has not been determined at this time. The Environmental Protection Agency is requiring additional studies.

Mutagenicity: Most laboratory tests for mutagenicity (the ability to cause genetic damage) were negative. The Environmental Protection Agency is requiring additional studies.

The data reported above are results of animal studies which the Environmental Protection Agency has evaluated in support of the registration of atrazine, or which have been evaluated by the Forest Service. These data are used to make inferences relative to human health.

HAZARD: Based on the results of animal studies, atrazine probably does not cause cancer, birth defects or genetic damage. There is not enough information available at this time to determine whether atrazine has any effect on fertility or reproduction. There have been no reported cases of long term health effects in humans due to atrazine exposure.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

Reported effects: No adverse effects have been reported in man.

CHRONIC TOXICITY:

Reported effects: No long term effects have been reported in man.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: Persons both coming in contact with plants which have just been treated with atrazine and eating treated berries or vegetables could experience some ill effects. Drinking water from a pond immediately after an accidental spill could cause adverse health effects.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCT: Some atrazine formulations contain ethylene glycol, crystalline silica, or formaldehyde. Ethylene glycol may cause birth defects. Swallowing large amounts of ethylene glycol can cause kidney damage. Crystalline silica can cause silicosis and lung fibrosis, if inhaled over a long period. It may cause respiratory tract cancer. Formaldehyde is moderately toxic, and is a skin, eye and respiratory irritant. It may cause genetic damage, and is considered to be a carcinogen. Some formulations also contain carriers which are considered to be nuisance dusts. Breathing high dust levels for long periods may affect lung function.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Formulated products are not expected to be more toxic than atrazine.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: no reported contaminants

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: Some atrazine formulations also contain other herbicides, such as metolachlor, simazine, cyanazine, or alachlor. **The information in this fact sheet only applies to atrazine.** Consult other sources for information on any other herbicide.

HEALTH RISK MANAGEMENT PROCEDURES: The Forest Service has evaluated health effects data in the development of both pesticide background statement documents and environmental impact statements for pesticide use on forest lands. These health effects evaluations have taken into consideration the potential for both worker and public exposure from Forest Service operations. This information has been used in assessing health risks and consequently in formulating protective measures to reduce risk to forest workers and to the public. Section VII of this fact sheet, Safety Precautions, provides guidance for the safe handling and use of atrazine.

VII. Safety Precautions:

Signal Word and Definition:

CAUTION - HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN.

Protective Precautions for Workers: Do not breathe vapors or spray mist. Avoid contact with eyes, skin or clothing. Wear long sleeved shirts and long pants, or the equivalent. Use chemical resistant gloves and waterproof boots. Use a face shield or goggles for mixing and loading operations. Wash thoroughly after handling. Remove and wash clothing before reuse.

Medical Treatment Procedures (Antidotes): There is no specific antidote; treat symptoms. For exposure to the eyes, flush with plenty of water. If irritation persists, get medical attention. For exposure to the skin, wash with soap and water. Get medical attention. If atrazine is inhaled, remove victim to fresh air. If victim is not breathing, give artificial respiration. Get medical attention. **In case of emergency, call your local poison control center for advice.**

Handling, Storage, and Disposal: Atrazine is stable for 3 years under normal storage conditions. It is only slightly sensitive to the effects of light and extreme temperatures. Do not contaminate water, food or animal feeds by storage, disposal, or cleaning of equipment. Wastes should be disposed of according to Federal, State and local rules. Consult product label for more information.

Emergency (Spill) Hazards and Procedures: Wear chemical safety glasses or goggles, rubber gloves, waterproof boots, long-sleeved shirt, long pants, hat, and a NIOSH-approved dust or pesticide respirator. For dry spills, use clean shovel to place material into a clean, dry container for later disposal. For liquid spills, take up with sand or other absorbent material and place into a container for later disposal. Dike large liquid spills for later disposal. **In case of a large spill, call CHEMTREC at 1-800-424-9300 for advice.**

VIII. Definitions

adsorption - the process of attaching to a surface
avian - of, or related to, birds
dermal - of, or related to, skin
ecotoxicology - the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.
ecotoxicological - related to the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.
formulation - the form in which the pesticide is supplied by the manufacturer for use
half-life - the time required for half the amount of substance to be reduced by natural processes
herbicide - a substance used to destroy plants or to slow down their growth
LC50 - the concentration in air, water, or food which will kill approximately 50% of the subjects
LD50 - the dose which will kill approximately 50% of the subjects
leach - to dissolve out by the action of water
mg/kg - milligrams of the substance per kilogram of body weight
microorganisms - living things too small to be seen without a microscope
mutagenicity - ability to cause genetic changes
non-target - animals or plants other than the ones which the pesticide is intended to kill
persistence - tendency of a pesticide to remain active after it is applied
ppm - parts per million parts
residual activity - the remaining amount of activity as a pesticide
volatility - the tendency to become a vapor at relatively low temperature

IX. Additional Reading

Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation. Pacific Northwest Region. Forest Service, U.S. Department of Agriculture, Portland, Oregon. 1988.

Final Environmental Impact Statement. Vegetation Management in the Coastal Plain/Piedmont. Forest Service, U.S. Department of Agriculture, Atlanta, Georgia. Management Bulletin R8-MB-23, 1989.

Final Environmental Impact Statement. Vegetation Management for Reforestation. Forest Service, U.S. Department of Agriculture, San Francisco, California. 1989.

Pesticide Background Statements. Volume I. Herbicides. Forest Service, U.S. Department of Agriculture. Agriculture Handbook No. 663, 1984.

Guidance for the Reregistration of Pesticide Products Containing Atrazine as the Active Ingredient. Office of Pesticide Programs, Environmental Protection Agency, Washington, D.C. 1983.

X. Toxicity Categories

Tables of Categories of Toxicity

Table I: Human Hazards

Category	Signal word	Route of administration		
		Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/l)
I	DANGER Poison	0-50	0-200	0-0.2
II	WARNING	>50-500	>200-2000	>0.2-2.0
III	CAUTION	>500-5000	>2000-20,000	>2.0-20
IV	none	>5000	>20,000	>20

40 CFR 162.10 (h) (1), July 3, 1975

Table I: Human Hazards (continued)

Category	Hazard	
	Eye Irritation	Skin Irritation
I	corrosive: corneal opacity not reversible within 7 days	corrosive
II	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV	no irritation	mild or slight irritation at 72 hours

40 CFR 162.10 (h) (1), July 3, 1975

Table II: Ecotoxicological Categories

Mammalian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Dietary):

ppm	
<50	very highly toxic
50-500	highly toxic
501-1000	moderately toxic
1000-5000	slightly toxic
>5000	practically non-toxic

Aquatic Organisms:

ppm	
<0.1	very highly toxic
0.1-1	highly toxic
>1-10	moderately toxic
>10-100	slightly toxic
>100	practically non-toxic

Insecticides, Brooks, H.L. et al. (1973) Cooperative Extension Service, Kansas State University, Manhattan, Kansas

For more information on atrazine contact your local Forest Service, Bureau of Land Management, or Bonneville Power Administration office.

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2,4-D

PESTICIDE FACT SHEET

U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT
U.S. DEPARTMENT OF ENERGY, BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Forest Service, the Bureau of Land Management, and the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions for the herbicide 2,4-D and its formulations. Unless otherwise stated, the toxicity data presented in this fact sheet refer to the active ingredient, 2,4-D. When included, data on formulated products will be specifically identified. A list of definitions is included in Section VIII of the fact sheet.

I. BASIC INFORMATION

COMMON NAME: 2,4-D

CHEMICAL NAME: 2,4-Dichlorophenoxyacetic acid

Herbicides containing 2,4-D use the amine salt or ester forms of the compound. Unless otherwise noted within the text of this fact sheet, "2,4-D" refers collectively to the acid, salt, amine, and ester forms. The amine and ester forms may differ in health-related activity and environmental fate and effects from the parent 2,4-D acid. Known differences are indicated in the text.

COMMON PRODUCT NAMES: Hi-Dep®, Weedar® 64, Weed RHAP A-4D®, Weed RHAP A,

PESTICIDE CLASSIFICATION: herbicide and plant growth regulator

REGISTERED USE STATUS: "General Use"

FORMULATIONS: Commercial 2,4-D products generally contain one or more inert ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the U.S. Environmental Protection Agency (EPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52 FR 13305). The intent of this policy is the regulation of inert ingredients. EPA's strategy for the implementation of this policy included the development of four lists of inerts based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3 and inerts of minimal concern were placed on List 4.

For pesticides containing List 1 inerts, the EPA has given the pesticide registrant the opportunity to reformulate the product to remove the List 1 inerts. If the registrant chooses not to reformulate the product, then the List 1 inerts must be identified on the product label. For List 2 inerts, the EPA is monitoring ongoing testing and gathering existing information on the potential adverse effects of these chemicals to determine if further regulatory action is required. The EPA has no particular regulatory plans for List 3 and List 4 inerts. The Forest Service will incorporate new data on inerts into updated fact sheets as it becomes available.

The contents of two 2,4-D formulations are listed below.

Weedar® 64 (liquid): dimethylamine salt of 2,4-D (46.8%) and inerts (53.2%)

HiDep® (liquid): dimethylamine salt of 2,4-D (33.2%) and diethanolamine salt of 2,4-D (16.3%), plus ethylene glycol (10%) and other inerts (40.3%)

RESIDUE ASSAY METHODS: Spectrophotometry and gas liquid chromatography of derivatives with electron capture detection are available for residue assay.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND, RIGHT-OF-WAY USES: conifer release, noxious and poisonous weed control, range improvement, right-of-way maintenance, site preparation, aquatic weed control, general weed control, thinning, timber management, wildlife habitat improvement, range management, research and engineering, recreation management, firebreak management, and nursery stand improvement

Operational Details:

Target plants: 2,4-D is used to control broadleaf weeds, grasses and other monocots, woody plants, aquatic weeds, and nonflowering plants.

Mode of action: 2,4-D is a plant-growth regulator that stimulates nucleic acid and protein synthesis and affects enzyme activity, respiration, and cell division. It is absorbed by plant leaves, stems, and roots and moves throughout the plant. It accumulates in growing tips.

Method of application: aerial and ground spraying, lawn spreaders, cut surface treatments, foliar spray, basal bark spray; injection

Use rates: Use at a rate of 0.475 to 3.8 pounds active ingredient per acre.

Special Precautions:

Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.

Timing of application: Apply when weeds are small and actively growing and prior to bud stage. Perennial weeds should be near the bud stage, but not flowering at application. Biennial species should be in the seedling to rosette stage. Tree root-collar injections should be made during the growing season.

Drift control: 2,4-D has the potential to drift from the target site and damage desirable plants. Apply as near to the target as possible. Do not apply on windy days or when wind is blowing toward desirable plants. Use coarse sprays to minimize drift. Do not apply with hollow cone-type insecticide or other nozzles that produce fine spray droplets. Decrease pounds of pressure at the nozzle tips. Increase the volume of spray mix per acre.

III. Environmental Effects/Fate

Soil:

Residual soil activity: 2,4-D may remain active for one to six weeks in the soil.

Adsorption: Over time, 2,4-D will bind to organic matter in soil. Soil high in organic matter will bind 2,4-D the most readily.

Persistence and agents of degradation: 2,4-D is not persistent in soil. At its highest application rate it persists for 30 days in soil. 2,4-D is rapidly degraded in soil, especially by soil microorganisms. It degrades more rapidly under warm, moist conditions. It is also taken up from the soil by target plants. Some forms of 2,4-D will evaporate from the soil. 2,4-D will degrade to half of its original concentration in several days.

Metabolites/degradation products and potential environmental effects: In soil, 2,4-D may be metabolized by microbes in steps to 2,4-dichlorophenol and 4-chlorophenol and then ultimately to harmless forms.

Water:

Solubility: The 2,4-D acid form, the oil-soluble amine salt and low-volatile ester do not dissolve well in water. Other amine salts dissolve very well in water.

Potential for leaching into ground-water: 2,4-D has only limited potential to contaminate ground-water. 2,4-D ranges from being mobile to highly mobile in sand, silt, loam, clay loam, and sandy loam. However, it is unlikely to be a ground-water contaminant due to the rapid degradation of 2,4-D in most soils and rapid uptake by plants. Most reported 2,4-D ground-water contamination has been associated with spills or other large sources of 2,4-D release.

Surface waters: Maximum concentrations of 2,4-D applied to surface water are reached in one day. 2,4-D residues dissipate rapidly, especially in moving water. 2,4-D residues may be detected in still water after 6 months. Do not apply 2,4-D directly to water or wetlands such as swamps, bogs, marshes, and potholes except as specified for certain aquatic uses. Do not contaminate water when dispos[illegible] of equipment wash waters.

Air:

Volatilization: The tendency of 2,4-D to evaporate is dependent on the chemical form used. Forms with the least tendency to evaporate include the acid, inorganic salt, amines and long chain esters; the oil-soluble amines are least volatile. These forms may be used near desirable vegetation if spray drift is prevented. Other ester formulations evaporate readily and should not be used near desirable vegetation.

Potential for by-products from burning of treated vegetation: The burning of vegetation treated with 2,4-D has not generated detectable 2,4-D byproducts in the field.

IV. Ecological Effects

NON-TARGET TOXICITY:

SOIL MICROORGANISMS: 2,4-D has no effect on microorganisms at recommended field application rates. At higher levels, 2,4-D suppresses soil fungi and nitrogen-fixing algae.

PLANTS: 2,4-D is highly toxic to many nontarget plants.

AQUATIC ANIMALS: 2,4-D forms range from being practically nontoxic to highly toxic to fish and aquatic invertebrates. 2,4-D amine salt forms are generally nontoxic to fish. Those compounds most toxic to fish include the 2,4-D ester formulations, N-oleyl-1,3-propylenediamine salt, and the N,N-dimethyl-oleyl-linoleylamine. Those 2,4-D compounds that are most toxic to invertebrates are the ester and dimethyl amine formulations. Acute toxic level:

species	LC50	
invertebrates	0.1 to > 100 ppm	(Table II, Aquatic)
amphibians	8 to > 346 ppm	(Table II, Aquatic)
fish	0.3 to 2840 ppm	(Table II, Aquatic)

TERRESTRIAL ANIMALS: 2,4-D forms range from being practically nontoxic to moderately toxic to birds. The 2,4-D butyl ester is practically nontoxic to birds on both a short and long term basis. 2,4-D is relatively nontoxic to honey bees. The ester formulations are the least toxic to insects. Mammals have moderate sensitivity to 2,4-D exposure. Acute toxic level:

species	LD50	
birds	472 to >2000 mg/kg	(Table II, Avian)
mammals	639 to >5000 mg/kg	(Table II, Mammalian)

THREATENED AND ENDANGERED SPECIES: Improper use of 2,4-D may kill or damage sensitive plant species. Animals may be affected by the loss of this vegetation. 2,4-D may be a hazard to endangered species if it is applied to areas where they live.

V. Toxicology Data

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: In tests in male and female rats with the dimethylamine salt of 2,4-D, the acute oral LD50 was 1100-4650 mg/kg (Toxicity Category III). The diethanolamine salt of 2,4-D was in the range of Toxicity Category III-IV. The butoxyethyl, isooctyl, and isobutyl esters of 2,4-D were in the range of Toxicity Category III. The isopropyl ester of 2,4-D was in the range of Toxicity Category II. (See Table I, Oral)

ACUTE DERMAL TOXICITY: The acute dermal (skin) LD50 of the dimethylamine salt of 2,4-D was >2000 mg/kg in rabbits (Toxicity Category III). The diethanolamine salt of 2,4-D was in the range of Toxicity Category III-IV. The isooctyl, isobutyl, isopropyl, and butoxyethyl esters of 2,4-D were all in the range of Toxicity Category III. (See Table I, Dermal)

PRIMARY IRRITATION SCORE: In laboratory tests in rabbits, the dimethylamine salt of 2,4-D had a primary irritation score of 0.11-1.48 and was a minimal irritant (Toxicity Category III-IV). The diethanolamine salt of 2,4-D was in the range of Toxicity Category III-IV. The isopropyl and butoxyethyl esters of 2,4-D were all in the range of Toxicity Category III. (See Table I, Skin Irritation)

PRIMARY EYE IRRITATION: In laboratory tests in rabbits, the dimethylamine and diethanolamine salts of 2,4-D were severe eye irritants (Toxicity Category I). The isopropyl and butoxyethyl esters of 2,4-D were in the range of Toxicity Category III. (See Table I, Eye Irriation)

ACUTE INHALATION: In laboratory tests with rats, the dimethylamine and diethanolamine salts of 2,4-D did not cause deaths at the highest doses tested (Toxicity Category > II). The diethanolamine salt of 2,4-D was in the range of Toxicity Category III-IV. The isopropyl and butoxyethyl esters of 2,4-D were in the range of Toxicity Category III. (See Table I, Inhalation)

CHRONIC TOXICITY:

CARCINOGENICITY: In two year dietary tests in mice and rats, 2,4-D was not oncogenic (tumor causing). Toxic effects in the animals' kidneys were seen at low dosages in these tests. Additional studies are underway on the carcinogenicity of 2,4-D.

DEVELOPMENTAL: Laboratory tests of 2,4-D in pregnant rats demonstrated no evidence of teratologic effects (birth defects). At the highest dose tested (75 mg/kg/day), rat fetuses showed delayed bone formation. An additional test in rabbits is required by the Environmental Protection Agency. Some other studies have shown evidence of toxic effects to fetuses, but no birth defects.

REPRODUCTION: A two-generation reproduction study in rats did not show any adverse effects on fertility or reproduction at doses up to 80 mg/kg/day of 2,4-D. A reduction in rat pup weight was seen when the parents were exposed to as little as 20 mg/kg/day.

MUTAGENICITY: 2,4-D was not mutagenic (able to cause genetic damage) in most of the studies reviewed by the Forest Service. However, the Environmental Protection Agency requires studies to be submitted to them on the mutagenicity of 2,4-D.

The data reported above are results of animal studies which the Environmental Protection Agency has evaluated in support of the registration of 2,4-D, or which have been evaluated by the Forest Service. These data are used to make inferences relative to human health.

HAZARD: Based on the results of animal studies with 2,4-D, direct contact of the eyes to some 2,4-D formulations may cause irreversible eye damage. Some 2,4-D formulations may cause skin irritation. Skin exposure to 2,4-D may affect the nervous system. At occupational exposure levels, 2,4-D has limited potential to pose a risk to human fertility, reproduction, or the development of off-spring. Exposure to 2,4-D has limited potential to cause cancer, although this risk is still being evaluated.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Nervous system damage has resulted from absorption of 2,4-D through the skin. This damage to the nerves may be irreversible. Prolonged inhalation may cause dizziness, burning in chest or coughing. Large doses of 2,4-D have caused digestive distress and effects on the neuromuscular system. Ingestion of large quantities of 2,4-D formulations has led to death within 1 to 2 days of poisoning. Poisoning by lower doses of 2,4-D has led to symptoms, such as neuro-muscular problems, that lasted for several months after ingestion. Existing medical conditions such as asthma or skin lesions may be aggravated.

CHRONIC TOXICITY:

REPORTED EFFECTS: Long-term exposure to 2,4-D has been reported to cause liver, kidney, digestive, muscular, or nervous system damage. Symptoms may include weakness, fatigue, headache, dizziness, loss of appetite, nausea, eye and nasal irritation, skin irritation, hypertension, and slowed heart rate.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: To keep residues of 2,4-D out of meat or milk, do not graze dairy cattle on treated areas for 7 days after application. Also, do not cut hay for 30 days and do not slaughter meat animals for 3 days. Contact with dried residues on vegetation is not expected to be hazardous.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCT: Inert ingredients found in 2,4-D products may include ethylene glycol, methanol, sequestering agents, petroleum hydrocarbons, and surfactants. Ethylene glycol is moderately toxic to humans; it may cause tearing, anesthesia, headache, cough, respiratory stimulation, nausea or vomiting, pulmonary, kidney and liver changes. Methanol is moderately toxic to humans; it may cause damage to the optic nerve, tearing, headache, cough, difficult breathing, other respiratory effects, nausea, or vomiting.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Some commercially-formulated 2,4-D products have LD50s which are much higher than the 2,4-D acid. This indicates that these formulations may have considerably less acute toxicity than the acid form. However, exposure to these formulated products may have other health effects similar to those reported for 2,4-D alone or for inert ingredients in commercial formulations.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: Some 2,4-D formulations may be contaminated with halogenated dibenzo-p-dioxins (but not TCDD), dibenzofurans, or N-nitrosamines. Dibenzodioxins and dibenzofurans may cause disorders of the skin, blood and gastrointestinal tract; they may also cause headaches, numbness, birth defects, or fetal toxicity. Nitrosamines are carcinogenic.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: 2,4-D is also available in commercial formulations containing other herbicide ingredients. Approximately 1500 products containing 2,4-D are registered with the U.S. EPA for general use. Some of the herbicides combined with 2,4-D include: 2,4-DP, picloram, dicamba, mecoprop, MSMA, DMA, prometon, clopyralid, and MCPP. **The information in this fact sheet only applies to 2,4-D.** Consult other fact sheets for information on the other herbicides.

HEALTH RISK MANAGEMENT PROCEDURES: The Forest Service has evaluated health effects data in the development of both pesticide background statement documents and environmental impact statements for pesticide use on forest lands. These health effects evaluations have taken into consideration the potential for both worker and public exposure from Forest Service operations. This information has been used in assessing health risks and consequently in formulating protective measures to reduce risk to forest workers and to the public. Section VII of this fact sheet, Safety Precautions, provides guidance for the safe handling and use of 2,4-D.

VII. Safety Precautions

SIGNAL WORD AND DEFINITION:

Weedar® 64 and Hi-Dep®: **DANGER** - MAY BE FATAL IF ABSORBED THROUGH THE SKIN. CAUSES PERMANENT EYE DAMAGE.

PROTECTIVE PRECAUTIONS FOR WORKERS: 2,4-D is considered "highly toxic" due to its hazard to the eyes. Workers should wear goggles or a face shield, protective gloves, and protective clothing when handling 2,4-D products. Avoid breathing vapor or spray mist. Use a NIOSH/MSHA approved respirator for protection from pesticide mists. Under emergency conditions, workers should wear a positive-pressure self-contained breathing apparatus. When mixing or loading 2,4-D, workers should wear chemical-resistant gloves. Gloves should be washed with soap and water before removal. Remove contaminated clothing and wash before reuse. Workers should wash thoroughly with soap and water before eating, drinking or using tobacco. Individuals with skin lesions, disease, or sensitivity should avoid contact with 2,4-D. No delay after spray has dried is necessary before workers can reenter the treated area. There is some uncertainty as to 2,4-D's reproductive and developmental effects. As a precaution, therefore, the Forest Service advises that female workers should not be employed in backpack or hack-and-squirt applications of 2,4-D.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES): If on skin wash promptly with soap and water; rinse thoroughly if irritation develops. Get medical attention. In case of eye contact, immediately hold eyelids open and flush eyes with plenty of water for 15 minutes. Get medical assistance at once. If swallowed, promptly drink plenty of milk, egg white, gelatin solution, or water; do not drink alchoholic beverages. If person is conscious, induce vomiting. Get medical attention at once. If inhaled move victim to fresh air and apply respiration if necessary. **In case of emergency, call your local poison control center for advice.**

HANDLING, STORAGE, AND DISPOSAL: The mixing and loading of spray mixtures into the spray equipment must be carried out on an impervious pad such as a concrete slab or plastic sheeting large enough to catch any spilled material. Improper disposal of excess herbicide, spray mixture, or rinse water is a violation of Federal law and may contaminate ground-water. Do not discharge effluent containing 2,4-D into lakes, streams, ponds, estuaries, oceans, public waters, or sewer systems. Do not apply directly to water.

EMERGENCY (SPILL) HAZARDS AND PROCEDURES: If spills occur, contain the spill by using an absorbent material such as sand, earth or synthetic absorbent. Dike large spills using absorbent or impervious materials such as sand or clay. If spilled on the ground, the affected area should be removed to a depth of one or two inches. Dispose of the contaminated absorbent material and earth by placing in a plastic bag and following disposal instructions on the label. **In case of a large spill, call CHEMTREC at 1-800-424-9300 for advice.**

VIII. Definitions

adsorption - the process of attaching to a surface
avian - of, or related to, birds
basal treatment - applied to the stem of a plant just above the soil
carcinogenicity - ability to cause cancer
dermal - of, or related to, the skin
ecotoxicology - the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.
ecotoxicological - related to the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.
formulation - the form in which the pesticide is supplied by the manufacturer for use
half-life - the time required for half the amount of substance to be reduced by natural processes
herbicide - a substance used to destroy plants or to slow down their growth
LC50 - the concentration in air, water, or food which will kill approximately 50% of the subjects
LD50 - the dose which will kill approximately 50% of the subjects
leach - to dissolve out by the action of water
mg/kg - milligrams of the substance per kilogram of body weight
microorganisms - living things too small to be seen without a microscope
mutagenicity - ability to cause genetic changes
non-target - animals or plants other than the ones which the pesticide is intended to kill
persistence - tendency of a pesticide to remain in the environment after it is applied
ppm - parts per million
residual activity - the remaining amount of activity as a pesticide
volatility - the tendency to become a vapor at relatively low temperature

IX. Additional Reading

Final Environmental Impact Statement. Managing Competing and Unwanted Vegetation. Forest Service, U.S. Department of Agriculture, Portland, OR, 1988.

Final Environmental Impact Statement. Vegetation Management for Reforestation. Forest Service, U.S. Department of Agriculture, California, 1989.

Final Environmental Impact Statement. Vegetation Management in the Coastal Plain/Piedmont. Forest Service, U.S. Department of Agriculture, Atlanta, GA. Management Bulletin R8-MB-23, 1989.

Guidance for the Reregistration of Pesticide Products Containing 2,4-Dichlorophenoxyacetic Acid (2,4-D) as the Active Ingredient. Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/RS-88-115, 1988.

Pesticide Background Statements. Volume I. Herbicides. Forest Service, U.S. Department of Agriculture, Agriculture Handbook Number 633, 1984.

Pesticide Fact Sheet: 2,4-Dichlorophenoxyacetic Acid. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/FS-88-114, 1988.

X. Toxicity Categories

Tables of Categories of Toxicity

Table I: Human Hazards

Category	Signal word	Route of administration		
		Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/l)
I	DANGER Poison	0-50	0-200	0-0.2
II	WARNING	>50-500	>200-2000	>0.2-2.0
III	CAUTION	>500-5000	>2000-20,000	>2.0-20
IV	none	>5000	>20,000	>20

40 CFR 162.10 (h) (1), July 3, 1975

Table I: Human Hazards (continued)

Category	Hazard	
	Eye irritation	Skin irritation
I	corrosive: corneal opacity not reversible within 7 days	corrosive
II	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV	no irritation	mild or slight irritation at 72 hours

40 CFR 162.10 (h) (1), July 3, 1975

Table II: Ecotoxicological Categories

Mammalian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Dietary):

ppm	
<50	very highly toxic
50-500	highly toxic
501-1000	moderately toxic
1000-5000	slightly toxic
>5000	practically non-toxic

Avian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Aquatic Organisms:

ppm	
<0.1	very highly toxic
0.1-1	highly toxic
>1-10	moderately toxic
>10-100	slightly toxic
>100	practically non-toxic

Insecticides, Brooks, H.L. et al. (1973) Cooperative Extension Service, Kansas State University, Manhattan, Kansas

For more information on 2,4-D contact your local Forest Service, Bureau of Land Management, or Bonneville Power Administration office.

January 1992

Prepared by Information Ventures, Inc. under U.S. Forest Service Contract Number 53-3187-104.

Dicamba

Pesticide Fact Sheet

U.S. Department of Agriculture, Forest Service
U.S. Department of the Interior, Bureau of Land Management
U.S. Department of Energy, Bonneville Power Administration

This fact sheet is one of a series issued by the Forest Service, the Bureau of Land Management, and the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions for the herbicide dicamba and its formulations. Unless otherwise stated, the toxicity data presented in this fact sheet refer to the active ingredient, dicamba. When included, data on formulated products will be specifically identified. A list of definitions is included in Section VIII of the fact sheet.

I. Basic Information

COMMON NAME: dicamba

CHEMICAL NAME: 3,6-dichloro-2-methoxybenzoic acid

COMMON PRODUCT NAMES: Banvel®, Banex®, Trooper®

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use"

FORMULATIONS: Commercial dicamba products generally contain one or more inert ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the U.S. Environmental Protection Agency (EPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52 FR 13305). The intent of this policy is the regulation of inert ingredients. EPA's strategy for the implementation of this policy included the development of four lists of inerts based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3 and inerts of minimal concern were placed on List 4.

For pesticides containing List 1 inerts, the EPA has given the pesticide registrant the opportunity to reformulate the product to remove the List 1 inerts. If the registrant chooses not to reformulate the product, then the List 1 inerts must be identified on the product label. For List 2 inerts, the EPA is monitoring ongoing testing and gathering existing information on the potential adverse effects of these chemicals to determine if further regulatory action is required. The EPA has no particular regulatory plans for List 3 and List 4 inerts. The Forest Service will incorporate new data on inerts into updated fact sheets as it becomes available.

The contents of three dicamba formulations are listed below.

Banvel: dimethylamine salt of dicamba (48.2%), dimethylamine salts of related acids (12%), and inert ingredients (39.8%)

Banvel CST: Dimethylamine salt of dicamba (13.3%), dimethylamine salts of related acids (3.3%), and inert ingredients (83.4%, including 30% ethylene glycol)

Banvel SGF: sodium salt of dicamba (23.15%), sodium salts of related acids (5.79%), and water (71.06%)

RESIDUE ASSAY METHODS: Electron capture gas chromatography methods are available for residue assay.

II. Herbicide Uses

REGISTERED FORESTRY, RANGELAND, RIGHT-OF-WAY USES: control of annual and perennial broadleaf weeds, brush, and vines in rangeland and non-cropland areas

OPERATIONAL DETAILS:

TARGET PLANTS: Dicamba is used to control broadleaf weeds, brush and vines.

MODE OF ACTION: Dicamba is absorbed by leaves and roots, and moves throughout the plant. In some plants, it may accumulate in the tips of leaves. Dicamba acts as a growth regulator. Some plants can metabolize or break down dicamba.

Method of application: ground or aerial broadcast, band treatment, basal bark treatment, cut surface treatment, spot treatment or wiper

Use rates: 0.25 to 8 pounds per acre

Special Precautions:

Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.

Timing of application: Dicamba should generally be applied during periods of active plant growth. Spot and basal bark treatments can be applied when plants are dormant, but should not be done when snow or water prevent application directly to the ground.

Drift control: Do not apply dicamba where it may move down in the soil or be washed along the soil surface to roots of desirable plants. Do not apply when air currents could carry spray to desirable plants. Leave buffer zones between area to be treated and desirable plants. Do not apply near desirable plants on days when the temperature is likely to exceed 85 degrees F. Do not apply from aircraft when desirable plants are growing near the area to be treated. Avoid fine sprays.

III. Environmental Effects/Fate

Soil:

Residual soil activity: Dicamba is active in the soil.

Adsorption: Dicamba is not adsorbed by most soils. It is highly mobile in most soils.

Persistence and agents of degradation: Dicamba is moderately persistent in soil. It has a half-life of 1 to 6 weeks in soil. Dicamba is broken down by soil microorganisms. The break-down is slower at low temperatures and with low soil moisture. Dicamba breaks down faster in organic soils than in clay or sand.

Metabolites/degradation products and potential environmental effects: The main metabolite or break-down product of dicamba in soil is 3,6-dichlorosalicylic acid.

Water:

Solubility: Dicamba is slightly soluble in water.

Potential for leaching into ground-water: Dicamba can leach into ground-water.

Surface waters: Dicamba has been found in ground-water and surface water. Keep dicamba out of lakes, streams, ponds, irrigation ditches and domestic water.

Air:

Volatilization: Dicamba is relatively volatile. It can evaporate from leaf surfaces, and may evaporate from the soil.

Potential for by-products from burning of treated vegetation: no information available

IV. Ecological Effects

Non-target Toxicity:

Soil microorganisms: Dicamba is almost non-toxic to microorganisms.

Plants: Dicamba is toxic to many broadleaf plants and to conifers. It does not injure most grasses.

Aquatic animals: Dicamba is slightly toxic to fish and amphibians. It is practically non-toxic to aquatic invertebrates. Dicamba does not accumulate or build up in aquatic animals. Dicamba and its formulations have not been tested for chronic effects in aquatic animals. Acute toxic level:

species	LC50	
invertebrates	>100 ppm	(Table II, Aquatic)
amphibians	>10 ppm	(Table II, Aquatic)
fish	>10 ppm	(Table II, Aquatic)

Terrestrial animals: Dicamba and its formulations are slightly toxic to mammals. Dicamba and its formulations are practically non-toxic to birds. Dicamba is not toxic to bees. It does not accumulate or build up in animals. Dicamba and its formulations have not been tested for chronic effects in terrestrial animals. Acute toxic level:

species	LD50	
birds	673 to 2,000 mg/kg	(Table II, Avian)
mammals	566 to 3,000 mg/kg	(Table II, Mammalian)

Threatened and endangered species: Use patterns of dicamba do not present any problem to endangered species.

V. Toxicology Data

Acute Toxicity:

Acute oral toxicity: In tests in rats, the acute oral LD50 was 2.74 grams per kilogram. (Toxicity Category III, Table I, Oral)

Acute dermal toxicity: The acute dermal (skin) LD50 was greater than 2,000 mg/kg in rats. (Toxicity Category IV, Table I, Dermal)

PRIMARY IRRITATION SCORE: In laboratory tests, dicamba was a slight skin irritant. (Toxicity Category IV, Table I, Skin irritation)

PRIMARY EYE IRRITATION: In laboratory tests in rabbits, dicamba was corrosive. (Toxicity Category I, Table I, Eye irritation)

ACUTE INHALATION: In laboratory tests in rats, the acute inhalation LC50 was greater than 200 milligrams per liter. (Toxicity Category IV, Table I, Inhalation)

CHRONIC TOXICITY:

CARCINOGENICITY: Dicamba showed no evidence of carcinogenicity in dogs (at dose levels up to 50 ppm in the diet for 2 years), mice (at up to 10,000 ppm in the diet for 14 to 19 months), or rats (at up to 500 ppm in the diet for 2 years).

DEVELOPMENTAL: Laboratory studies with dicamba in pregnant rats and rabbits indicated no evidence of teratology (birth defects).

REPRODUCTION: A three-generation reproduction study in rats did not show any adverse effects on fertility or reproduction at doses up to 25 mg/kg per day.

MUTAGENICITY: Dicamba was negative in tests for mutagenicity (the ability to cause genetic damage).

The data reported above are results of animal studies which the Environmental Protection Agency has evaluated in support of the registration of dicamba or which have been evaluated by the Forest Service. These data are used to make inferences relative to human health.

HAZARD: Based on the results of animal studies, dicamba does not cause birth defects, cancer or genetic damage, and has little or no effect on fertility or reproduction. There have been no reported cases of long term health effects in humans due to dicamba exposure

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Effects of exposures to dicamba included muscle cramps, difficult breathing, nausea, vomiting, skin rashes, loss of voice, swollen neck glands, coughing and dizziness.

CHRONIC TOXICITY:

REPORTED EFFECTS: There are no reported cases of long term health effects in humans due to dicamba or its formulations.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: The exposure levels a person could receive from these sources, as a result of routine operations, are below levels shown to, cause harmful effects in laboratory studies.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCT: Inert ingredients found in dicamba formulations include water and ethylene glycol. Water is not toxic. If swallowed, ethylene glycol may cause kidney damage. Other inert ingredients have not been identified.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: The formulated products are generally less toxic than dicamba itself.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: Traces of 2,7-dichlorodibenzo-p-dioxin (up to 50 parts per billion) are formed during production of dicamba.

Some dicamba products formulated with dimethylamine may be contaminated with less than 1 ppm of dimethylnitrosamine. The risks from dicamba products contaminated with dimethylnitrosamine are considered to be very small.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: Some dicamba formulations also contain other herbicides such as 2,4-D and atrazine. **The information in this fact sheet does not pertain to other pesticides.** Please consult other fact sheets for specific information on other herbicides.

HEALTH RISK MANAGEMENT PROCEDURES: The Forest Service has evaluated health effects data in the development of both pesticide background statement documents and environmental impact statements for pesticide use on forest lands. These health effects evaluations have taken into consideration the potential for both worker and public exposure from Forest Service operations. This information has been used in assessing health risks and consequently in formulating protective measures to reduce risk to forest workers and to the public. Section VII of this fact sheet, Safety Precautions, provides guidance for the safe handling and use of dicamba.

VII. SAFETY PRECAUTIONS

SIGNAL WORD AND DEFINITION:

WARNING - CAUSES EYE IRRITATION. HARMFUL IF SWALLOWED.

PROTECTIVE PRECAUTIONS FOR WORKERS: Do not get in eyes, on skin, or on clothing. Avoid breathing spray mist. Wash thoroughly after handling.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES): There is no specific antidote for dicamba; treat symptoms. For exposure to the skin, wash with soap and water. For exposure to the eyes, flush with water for 15 minutes and get medical attention. If inhaled, remove victim to fresh air. Apply artificial respiration if victim is not breathing; get medical attention. If swallowed, drink 1 to 2 glasses of water, and induce vomiting. Get medical attention. **In case of emergency, call your local poison control center for advice.**

HANDLING, STORAGE, AND DISPOSAL: Dicamba is stable under normal storage conditions. Store in the original container in a well ventilated area separately from fertilizer, animal feeds and food. Do not contaminate water, food, or feeds by storage or disposal. Dispose of wastes on site or at an approved waste disposal facility.

EMERGENCY (SPILL) HAZARDS AND PROCEDURES: Dike or contain spill. Absorb liquid with absorbent material such as sawdust. Place material in container for later disposal. **In case of a large spill, call CHEMTREC at 1-800-424-9300 for advice.**

VIII. Definitions

adsorption - the process of attaching to a surface

avian - of, or related to, birds

basal treatment - applied to the stem of a plant just above the soil

broadcast - apply over an entire area

carcinogenicity - ability to cause cancer

dermal - of, or related to, the skin

ecotoxicology - the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

ecotoxicological - related to the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

formulation - the form in which the pesticide is supplied by the manufacturer for use

half-life - the time required for half the amount of substance to be reduced by natural processes

herbicide - a substance used to destroy plants or to slow down their growth

LC50 - the concentration in air, water, or food which will kill approximately 50% of the subjects

LD50 - the dose which will kill approximately 50% of the subjects

leach - to dissolve out by the action of water

microorganisms - living things too small to be seen without a microscope

mg/kg - milligrams of the substance per kilogram of body weight

mutagenicity - ability to cause genetic changes

non-target - animals or plants other than the ones which the pesticide is intended to control

persistence - tendency of a pesticide to remain active after it is applied

ppm - parts per million parts

residual activity - the remaining amount of activity as a pesticide

volatility - the tendency to become a vapor at relatively low temperature

IX. Additional Reading

Final Environmental Impact Statement. Managing Competing and Unwanted Vegetation. Forest Service, U.S. Department of Agriculture, Portland, OR, 1988.

Final Environmental Impact Statement. Vegetation Management in the Coastal Plain/Piedmont. Forest Service, U.S. Department of Agriculture, Atlanta, GA. Management Bulletin R8-MB-23, 1989.

Final Environmental Impact Statement. Vegetation Management for Reforestation. Forest Service, U.S. Department of Agriculture, San Francisco, California. 1989.

Guidance for the Reregistration of Pesticide Products Containing Dicamba as the Active Ingredient. Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/RS-83-018, 1988.

Pesticide Background Statements. Volume I. Herbicides. Forest Service, U.S. Department of Agriculture, Agriculture Handbook Number 633, 1984.

Pesticide Fact Sheet: Dicamba. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC. 1988.

X. Toxicity Categories

Tables of Categories of Toxicity

Table I: Human Hazards

Category	Signal word	Route of administration		
		Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/l)
I	DANGER Poison	0-50	0-200	0-0.2
II	WARNING	>50-500	>200-2000	>0.2-2.0
III	CAUTION	>500-5000	>2000-20,000	>2.0-20
IV	none	>5000	>20,000	>20

40 CFR 162.10 (h) (1), July 3, 1975

Table I: Human Hazards (continued)

Category	Hazard	
	Eye Irritation	Skin Irritation
I	corrosive: corneal opacity not reversible within 7 days	corrosive
II	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV	no irritation	mild or slight irritation at 72 hours

40 CFR 162.10 (h) (1), July 3, 1975

Table II: Ecotoxicological Categories

Mammalian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Dietary):

ppm	
<50	very highly toxic
50-500	highly toxic
501-1000	moderately toxic
1000-5000	slightly toxic
>5000	practically non-toxic

Avian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Aquatic Organisms:

ppm	
<0.1	very highly toxic
0.1-1	highly toxic
>1-10	moderately toxic
>10-100	slightly toxic
>100	practically non-toxic

Insecticides, Brooks, H.L. et al. (1973) Cooperative Extension Service, Kansas State University, Manhattan, Kansas

For more information on dicamba contact your local Forest Service, Bureau of Land Management, or Bonneville Power Administration office.

January 1992

Prepared by Information Ventures, Inc. under U.S. Forest Service Contract Number 53-3187-104.

Glyphosate

PESTICIDE FACT SHEET

U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT
U.S. DEPARTMENT OF ENERGY, BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Forest Service, the Bureau of Land Management, and the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions for the herbicide glyphosate and its formulations. Unless otherwise stated, the toxicity data presented in this fact sheet refer to the active ingredient, glyphosate. When included, data on formulated products will be specifically identified. A list of definitions is included in Section VIII of the fact sheet.

I. BASIC INFORMATION

COMMON NAME: glyphosate

CHEMICAL NAME: N-(phosphonomethyl)glycine

COMMON PRODUCT NAMES: Roundup®, Rodeo®, Accord®

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use"

FORMULATIONS: Commercial glyphosate products generally contain one or more inert ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the U.S. Environmental Protection Agency (EPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52 FR 13305). The intent of this policy is the regulation of inert ingredients. EPA's strategy for the implementation of this policy included the development of four lists of inerts based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3 and inerts of minimal concern were placed on List 4.

For pesticides containing List 1 inerts, the EPA has given the pesticide registrant the opportunity to reformulate the product to remove the List 1 inerts. If the registrant chooses not to reformulate the product, then the List 1 inerts must be identified on the product label. For List 2 inerts, the EPA is monitoring ongoing testing and gathering existing information on the potential adverse effects of these chemicals to determine if further regulatory action is required. The EPA has no particular regulatory plans for List 3 and List 4 inerts. The Forest Service will incorporate new data on inerts into updated fact sheets as it becomes available.

The contents of three glyphosate formulations are listed below.

Rodeo: glyphosate (53.5%) and water (46.5%)

Accord: glyphosate (41.5%) and water (58.5%)

Roundup: glyphosate (41%), polyethoxylated tallowamine surfactant (15%) and water (44%)

RESIDUE ASSAY METHODS: Gas/liquid chromatography and high performance liquid chromatography methods are available for residue assay.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND, RIGHT-OF-WAY USES: planting site preparation, conifer release, forest nurseries, rights-of-way and facilities maintenance, and noxious weed control

OPERATIONAL DETAILS:

TARGET PLANTS: Glyphosate is used to control grasses, herbaceous plants including deep rooted perennial weeds, brush, some broadleaf trees and shrubs, and some conifers. Glyphosate does not control all broadleaf woody plants. Timing is critical for effectiveness on some broadleaf woody plants and conifers.

MODE OF ACTION: Glyphosate applied to foliage is absorbed by leaves and rapidly moves through the plant. It acts by preventing the plant from producing an essential amino acid. This reduces the production of protein in the plant, and inhibits plant growth. Glyphosate is metabolized or broken down by some plants, while other plants do not break it down. Aminomethylphosphonic acid is the main break-down product of glyphosate in plants.

METHOD OF APPLICATION: aerial spraying; spraying from a truck, backpack or hand-held sprayer; wipe application; frill treatment; cut stump treatment

USE RATES: 0.3 to 4.0 pounds of active ingredient per acre

SPECIAL PRECAUTIONS:

Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.

TIMING OF APPLICATION: Apply after leaves expand fully but before fall color change.

DRIFT CONTROL: Do not allow careless application or spray drift. Do not permit spray or spray drift to contact desirable plants.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: Glyphosate is not generally active in the soil. It is not usually absorbed from the soil by plants.

ADSORPTION: Glyphosate and the surfactant used in Roundup are both strongly adsorbed by the soil.

PERSISTENCE AND AGENTS OF DEGRADATION: Glyphosate remains unchanged in the soil for varying lengths of time, depending on soil texture and organic matter content. The half-life of glyphosate can range from 3 to 130 days. Soil microorganisms break down glyphosate. In tests, the surfactant in Roundup has a soil half-life of less than 1 week. Soil microorganisms break down the surfactant.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: The main breakdown product of glyphosate in the soil is aminomethylphosphonic acid, which is broken down further by soil microorganisms. The main breakdown product of the surfactant used in Roundup is carbon dioxide.

WATER:

SOLUBILITY: Glyphosate dissolves easily in water.

POTENTIAL FOR LEACHING INTO GROUND-WATER: The potential for leaching is low. Glyphosate and the surfactant in Roundup are strongly adsorbed to soil particles. Tests show that the half-life for glyphosate in water ranges from 35 to 63 days. The surfactant half-life ranges from 3 to 4 weeks.

SURFACE WATERS: Studies examined glyphosate and aminomethylphosphonic acid (AMPA) residues in surface water after forest application in British Columbia with and without no-spray streamside zones. With a no-spray streamside zone, very low concentrations were sometimes found in water and sediment after the first heavy rain. Where glyphosate was sprayed over the stream, higher peak concentrations in water always occurred following heavy rain, up to 3 weeks after application. Glyphosate and AMPA residues peaked later in stream sediments, where they persisted for over 1 year. These residues were not easily released back into the water.

AIR:

VOLATILIZATION: Glyphosate does not evaporate easily.

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Major products from burning treated vegetation include phosphorus pentoxide, acetonitrile, carbon dioxide and water. Phosphorus pentoxide forms phosphoric acid in the presence of water. None of these compounds is known to be a health threat at the levels which would be found in a vegetation fire.

IV. ECOLOGICAL EFFECTS

NON-TARGET TOXICITY:

SOIL MICROORGANISMS: Glyphosate and the surfactant have no known effect on soil microorganisms.

PLANTS: Contact with non-target plants may injure or kill plants.

AQUATIC ANIMALS: Glyphosate is no more than slightly toxic to fish, and practically non-toxic to aquatic invertebrate animals. It does not build up (bioaccumulate) in fish. The Accord and Rodeo formulations are practically non-toxic to freshwater fish and aquatic invertebrate animals. The Roundup formulation is moderately to slightly toxic to freshwater fish and aquatic invertebrate animals. Glyphosate and its formulations have not been tested for chronic effects in aquatic animals. Acute toxic level:

Rodeo and Accord

species	LC50	
fish	>1,000 ppm	(Table II, Aquatic)
water flea	930 ppm	(Table II, Aquatic)

Roundup

species	LC50	
fish	5 to 26 ppm	(Table II, Aquatic)
invertebrates	4 to 37 ppm	(Table II, Aquatic)

TERRESTRIAL ANIMALS: Glyphosate is practically non-toxic to birds and mammals. It is practically non-toxic to bees. Glyphosate and its formulations have not been tested for chronic effects in terrestrial animals. Acute toxic level:

species	LD50	
bobwhite quail	3850 mg/kg	(Table II, Avian)
bee	>100 micrograms/bee	

THREATENED AND ENDANGERED SPECIES: Glyphosate may be a hazard to endangered species if it is applied to areas where they live.

V. TOXICOLOGY DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: In tests in male and female rats, the acute oral LD50 was 4320 mg/kg. (Toxicity Category III, Table I, Oral)

ACUTE DERMAL TOXICITY: The acute dermal (skin) LD50 was equal to or greater than 794 mg/kg in female rabbits, and 5010 mg/kg in male rabbits. (Toxicity Category III, Table I, Dermal)

PRIMARY IRRITATION SCORE: In laboratory tests in rabbits, glyphosate was not an irritant. (Toxicity Category IV, Table I, Skin irritation)

PRIMARY EYE IRRITATION: In laboratory tests in rabbits, glyphosate was a mild eye irritant. (Toxicity Category III, Table I, Eye irritation)

ACUTE INHALATION: The requirement for an inhalation study was waived by the Environmental Protection Agency.

CHRONIC TOXICITY:

CARCINOGENICITY: The Environmental Protection Agency has concluded that glyphosate should be classified as a compound with evidence of non-carcinogenicity for humans. This conclusion is based on the lack of convincing carcinogenicity evidence in adequate studies in two animal species

DEVELOPMENTAL: Laboratory studies with glyphosate in pregnant rats (at dose levels up to 3500 mg/kg per day) and rabbits (at dose levels up to 350 mg/kg per day) indicated no evidence of teratology (birth defects).

REPRODUCTION: A three-generation reproduction study in rats did not show any adverse effects on fertility or reproduction at doses up to 30 mg/kg per day.

MUTAGENICITY: Glyphosate was negative in all tests for mutagenicity (the ability to cause genetic damage).

The data reported above are results of animal studies which the Environmental Protection Agency has evaluated in support of the registration of glyphosate. These data are used to make inferences relative to human health.

HAZARD: Based on the results of animal studies, glyphosate does not cause genetic damage or birth defects, and has little or no effect on fertility, reproduction, or development of offspring. There is not enough information available at this time to determine whether glyphosate causes cancer. There have been no reported cases of long term health effects in humans due to glyphosate exposure.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Most incidents reported in humans have involved skin or eye irritation in workers after exposure during mixing, loading or application of glyphosate formulations. Nausea and dizziness have also been reported after exposure.

Swallowing the Roundup formulation caused mouth and throat irritation, pain in the abdomen, vomiting, low blood pressure, reduced urine output, and in some cases, death. These effects have only occurred when the concentrate was accidentally or intentionally swallowed, not as a result of the proper use of Roundup. The amount swallowed averaged about 100 milliliters (about half a cup).

CHRONIC TOXICITY:

REPORTED EFFECTS: There are no reported cases of long term health effects in humans due to glyphosate or its formulations.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: The exposure levels a person could receive from these sources, as a result of routine operations, are below levels shown to cause harmful effects in laboratory studies.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCT: Inert ingredients found in Roundup include water and a surfactant (poly ethoxylated tallowamines). The surfactant is an eye irritant and skin irritant. Water is non-toxic. The only inert ingredient in Rodeo or Accord is water.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: The Roundup formulation is moderately toxic, and may cause skin irritation and eye irritation. Since Accord and Rodeo contain water as the only inert ingredient, health effects would be the same as for glyphosate.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: Glyphosate contains the contaminant N-nitroso glyphosate (NNG) at 0.1 ppm or less. The potential for NNG to cause cancer is unknown. However, no effects attributable to NNG were seen in tests of glyphosate. The EPA has not assessed the health risks of NNG because exposure is practically non-existent. 1,4-Dioxane, a known cancer-causing agent, is a common constituent of ethoxylated surfactants. 1,4-Dioxane is non-detectable in the Roundup formulation.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: Some formulations of glyphosate also contain other herbicides, such as 2,4-D, and dicamba. **The information in this fact sheet only applies to glyphosate.** Consult other fact sheets for information on the other herbicides.

HEALTH RISK MANAGEMENT PROCEDURES: The Forest Service has evaluated health effects data in the development of both pesticide background statement documents and environmental impact statements for pesticide use on forest lands. These health effects evaluations have taken into consideration the potential for both worker and public exposure from Forest Service operations. This information has been used in assessing health risks and consequently in formulating protective measures to reduce risk to forest workers and to the public. Section VII of this fact sheet, Safety Precautions, provides guidance for the safe handling and use of glyphosate.

VII. SAFETY PRECAUTIONS:

SIGNAL WORD AND DEFINITION:

Roundup: **WARNING** - CAUSES EYE IRRITATION. HARMFUL IF SWALLOWED. MAY CAUSE SKIN IRRITATION.

Rodeo: **CAUTION** - MAY CAUSE EYE IRRITATION. MAY BE HARMFUL IF INHALED.

Accord: **CAUTION** - MAY CAUSE EYE IRRITATION.

PROTECTIVE PRECAUTIONS FOR WORKERS: Avoid contact with eyes, skin or clothing. Avoid breathing vapors or spray mist. Wash thoroughly with soap and water after handling.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES): There is no specific antidote for glyphosate; treat symptoms. For exposure to the eyes, flush with plenty of water for at least 15 minutes. Get medical attention. For exposure to the skin, flush skin with plenty of water. **In case of emergency, call your local poison control center for advice.**

HANDLING, STORAGE, AND DISPOSAL: Glyphosate is corrosive to unlined steel and galvanized steel. Do not mix, store or apply glyphosate in galvanized steel or unlined steel containers or spray tanks. Glyphosate is stable under normal storage conditions for at least 5 years. Wastes should be disposed of in a landfill approved for pesticide disposal or according to Federal, State and local rules. Do not contaminate water, food, animal feeds or seed by storage.

EMERGENCY (SPILL) HAZARDS AND PROCEDURES: Spills that soak into the ground should be dug up and put in plastic lined metal drums for disposal. Spills on floors or other hard surfaces should be contained or diked. An absorbent clay should be used to soak up the spill. The contaminated absorbent should be put in plastic lined metal drums. Drums of contaminated soil or absorbent should be disposed of in a landfill approved for pesticide disposal or according to Federal, State and local rules. Do not contaminate water, food, animal feeds or seed by disposal. **In case of a large spill, call CHEMTREC at 1-800-424-9300 for advice.**

VIII. DEFINITIONS

adsorption - the process of attaching to a surface

avian - of, or related to, birds

carcinogenicity - ability to cause cancer

dermal - of, or related to, the skin

ecotoxicology - the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

ecotoxicological - related to the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

formulation - the form in which the pesticide is supplied by the manufacturer for use

frill treatment - a frill of overlapping axe cuts is made through the bark of a tree, and the injured surface is painted or sprayed with herbicide

half-life - the time required for half the amount of substance to be reduced by natural processes

herbicide - a substance used to destroy plants or to slow down their growth

LC50 - the concentration in air, water, or food which will kill approximately 50% of the subjects

LD50 - the dose which will kill approximately 50% of the subjects

leach - to dissolve out by the action of water

mg/kg - milligrams of the substance per kilogram of body weight

microorganisms - living things too small to be seen without a microscope

mutagenicity - ability to cause genetic changes

non-target - animals or plants other than the ones which the pesticide is intended to kill or control

persistence - tendency of a pesticide to remain in the environment after it is applied

ppm - parts per million

residual activity - the remaining amount of activity as a pesticide

volatility - the tendency to become a vapor at relatively low temperature

IX. Additional Reading

Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation. Pacific Northwest Region. Forest Service, U.S. Department of Agriculture, Portland, Oregon. 1988.

Final Environmental Impact Statement. Vegetation Management in the Coastal Plain/Piedmont. Forest Service, U.S. Department of Agriculture, Atlanta, Georgia. Management Bulletin R8-MB-23, 1989.

Final Environmental Impact Statement. Vegetation Management for Reforestation. Forest Service, U.S. Department of Agriculture, San Francisco, California. 1989.

Pesticide Background Statements. Volume I. Herbicides. Forest Service, U.S. Department of Agriculture. Agriculture Handbook No. 663, 1984.

Pesticide Fact Sheet: Glyphosate. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/FS-88-124, 1986.

Registration Standard for Pesticide Products Containing Glyphosate as the Active Ingredient. Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/RS-86-156, 1986.

X. Toxicity Categories

Tables of Categories of Toxicity

Table I: Human Hazards

Category	Signal word	Route of administration		
		Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/l)
I	DANGER Poison	0-50	0-200	0-0.2
II	WARNING	>50-500	>200-2000	>0.2-2.0
III	CAUTION	>500-5000	>2000-20,000	>2.0-20
IV	none	>5000	>20,000	>20

40 CFR 162.10 (h) (1), July 3, 1975

Table I: Human Hazards (continued)

Category	Hazard	
	Eye irritation	Skin irritation
I	corrosive: corneal opacity not reversible within 7 days	corrosive
II	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV	no irritation	mild or slight irritation at 72 hours

40 CFR 162.10 (h) (1), July 3, 1975

Table II: Ecotoxicological Categories

Mammalian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Dietary):

ppm	
<50	very highly toxic
50-500	highly toxic
501-1000	moderately toxic
1000-5000	slightly toxic
>5000	practically non-toxic

Avian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Aquatic Organisms:

ppm	
<0.1	very highly toxic
0.1-1	highly toxic
>1-10	moderately toxic
>10-100	slightly toxic
>100	practically non-toxic

Insecticides, Brooks, H.L. et al. (1973) Cooperative Extension Service, Kansas State University, Manhattan, Kansas

For more information on glyphosate contact your local Forest Service, Bureau of Land Management, or Bonneville Power Administration office.

January 1992

Prepared by Information Ventures, Inc. under U.S. Forest Service Contract Number 53-3187-104.

Hexazinone

Pesticide Fact Sheet

U.S. Department of Agriculture, Forest Service
U.S. Department of the Interior, Bureau of Land Management
U.S. Department of Energy, Bonneville Power Administration

This fact sheet is one of a series issued by the Forest Service, the Bureau of Land Management, and the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions for the herbicide hexazinone and its formulations. Unless otherwise stated, the toxicity data presented in this fact sheet refer to the active ingredient, hexazinone. When included, data on formulated products will be specifically identified. A list of definitions is included in Section VIII of the fact sheet.

I. Basic Information

COMMON NAME: hexazinone

CHEMICAL NAME: 3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione

COMMON PRODUCT NAMES: Velpar®, Velpar® ULW, Velpar® L, Pronone® 10G

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General use"

FORMULATIONS: Commercial hexazinone products generally contain one or more inert ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the U.S. Environmental Protection Agency (EPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52 FR 13305). The intent of this policy is the regulation of inert ingredients. EPA's strategy for the implementation of this policy included the development of four lists of inerts based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3 and inerts of minimal concern were placed on List 4.

For pesticides containing List 1 inerts, the EPA has given the pesticide registrant the opportunity to reformulate the product to remove the List 1 inerts. If the registrant chooses not to reformulate the product, then the List 1 inerts must be identified on the product label. For List 2 inerts, the EPA is monitoring ongoing testing and gathering existing information on the potential adverse effects of these chemicals to determine if further regulatory action is required. The EPA has no particular regulatory plans for List 3 and List 4 inerts. The Forest Service will incorporate new data on inerts into updated fact sheets as it becomes available.

The contents of four hexazinone formulations are listed below.

Velpar (water-soluble powder): hexazinone (90%) and inerts (10%)

Velpar L (water-dispersable liquid): hexazinone (25%), ethanol (40-45%), and other inerts (30-35%)

Velpar ULW (soluble granules): hexazinone (75%) and inerts (25%)

Pronone 10G (granules): hexazinone (10%) and inerts (90%)

RESIDUE ASSAY METHODS: Gas/liquid chromatography, high performance liquid chromatography, and mass spectrometry are available for residue assay.

II. Herbicide Uses

REGISTERED FORESTRY, RANGELAND, RIGHT-OF-WAY USES: forestry use on Christmas tree plantations, conifer nurseries, conifer release, forest plantings; terrestrial food crop use on pastures, rangeland, and fallowland; terrestrial nonfood crop use on rights of way and industrial and facility sites

OPERATIONAL DETAILS:

TARGET PLANTS: Hexazinone is used to control broadleaf weeds, grasses, and woody plants.

Mode of action: Hexazinone inhibits photosynthesis. It is readily absorbed through leaves and roots and moves in an upward direction through the plant.

Method of application: aerial broadcast; basal soil treatment; undiluted spot treatment; tree or brush injection

Use rates: Use 0.45 to 12 pounds active ingredient per acre. Do not use on gravelly or rocky soils, exposed subsoils, clay knobs, sand, or sandy soil with 85% or more sand. Use the higher amounts on soil with more clay or organic matter.

Special Precautions:

Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.

Timing of application: Apply after ground thaws; broadcast application in the spring; best performance when application is followed by rainfall and warmer temperatures; do not apply to saturated soils. In low-moisture areas can be applied in fall before snow fall.

Drift control: Prevent drift of spray to desirable plants. Use directional spray equipment to prevent contact with conifer foliage if application is after bud break. Do not apply within three times the height or canopy diameter (whichever is greater) of desirable trees.

III. Environmental Effects/Fate

Soil:

Residual soil activity: Hexazinone may remain in the soil at low concentrations for up to three years after application.

Adsorption: Hexazinone is only minimally adsorbed to soil but is highly adsorbed to the leaf-litter layer. Adsorption may be related to some chemical characteristics of the soil. Organic matter content of the soil does not affect hexazinone adsorption.

Persistence and agents of degradation: Hexazinone is persistent in soil. In the field, it degrades to one half of its initial concentration in 1 to 6 months. Degradation rate depends on weather conditions and soil type. Hexazinone may persist longer in areas with more leaf litter and during cooler weather. Hexazinone is broken down primarily by soil microorganisms. Hexazinone may also be degraded by light exposure.

Metabolites/degradation products and potential environmental effects: Hexazinone will release carbon dioxide upon breakdown. Carbon dioxide is a normal and harmless atmospheric component. No information is available on the possible effects on the environment of other metabolites of hexazinone found in the soil: these include 3-cyclohexyl-1-methyl-6-methylamino-1,3,5-triazine-2,4(1H,3H)-dione; 3-(4-hydroxycyclohexyl)-6-(dimethylamino)-1-methyl-1-(1H,3H)-dione; and the triazine trione.

Water:

Solubility: Powder and granule formulations dissolve well in water. The liquid formulation disperses in water.

Potential for leaching into ground-water: Hexazinone is persistent and mobile in soils and therefore could contaminate ground-water. It is not likely to leach beyond the root zone, however.

Surface waters: Hexazinone does have some potential to move through buffer zones and into surface streams. However, hexazinone degrades rapidly in natural waters.

Air:

Volatilization: Hexazinone does not evaporate easily.

Potential for byproducts from burning of treated vegetation: The burning of hexazinone-treated wood does not create additional toxic byproducts (compared to the burning of untreated wood).

IV. Ecological Effects

Non-Target Toxicity:

Soil microorganisms: Hexazinone is not toxic to fungi, nitrifying bacteria, or other soil microorganisms at normal use rates.

Plants: Hexazinone is highly toxic to many nontarget plants.

Aquatic animals: Hexazinone is practically nontoxic to fish, freshwater invertebrates and mollusks, and is slightly toxic to crustaceans. No toxicity studies have been reported for amphibians. No chronic studies have been reported for aquatic organisms. The liquid and solid carriers in two commercial hexazinone formulations were found to be of extremely low toxicity to fish. Acute toxic level:

species	LC50	
crustaceans	78 to >1000 ppm	(Table II, Aquatic)
fish	>274 to >505 ppm	(Table II, Aquatic)

species	EC50	
invertebrate	145.3 ppm	(Table II, Aquatic)
mollusks	>320 ppm	(Table II, Aquatic)

The destruction of stream-side vegetation should be avoided as it may adversely affect the habitat of some aquatic animals.

TERRESTRIAL ANIMALS: Hexazinone is practically nontoxic to birds and is relatively nontoxic to insects. Toxicity to mammals is also minimal. Acute toxic level:

species	LD50	
bees	> 60 μg/bee	
birds	2,258 mg/kg	(Table II, Avian)
mammals	1,690 mg/kg	(Table II, Mammalian)

When hexazinone is ingested by animals, it is broken down into metabolites which are rapidly excreted in the urine and feces. Hexazinone does not accumulate in the tissues of exposed animals.

THREATENED AND ENDANGERED SPECIES: Hexazinone may be a hazard to endangered species if it is applied to areas where they live.

V. TOXICOLOGY DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: In tests in male rats, the acute oral LD50 of hexazinone was 1690 mg/kg (Toxicity Category III, Table I, Oral). The Environmental Protection Agency requires an additional test in female rats in order to fully evaluate the acute toxicity of hexazinone.

ACUTE DERMAL TOXICITY: The acute dermal (skin) LD50 was > 5278 mg/kg in male rabbits (Toxicity Category IV, Table I, Dermal).

PRIMARY IRRITATION SCORE: In laboratory tests in rabbits, hexazinone was a low-level irritant (Primary Irritation Score 0.5 - 1.5; Toxicity Category IV, Table I, Skin irritation).

PRIMARY EYE IRRITATION: In laboratory tests in rabbits, hexazinone was a severe eye irritant, causing corneal opacity and corrosion (Toxicity Category I, Table I, Eye irritation).

ACUTE INHALATION: In laboratory tests in male rats, the acute inhalation LC50 was > 7.48 mg/l (Toxicity Category IV, Table I, Inhalation).

CHRONIC TOXICITY:

CARCINOGENICITY: In laboratory tests with male and female rats, hexazinone was not an oncogen (did not cause cancer) up to the highest dose tested (125 mg/kg). A study in mice is being reevaluated by the Environmental Protection Agency.

DEVELOPMENTAL: Laboratory tests with hexazinone in pregnant rats indicated no evidence of teratology (birth defects) at dose levels up to 100 mg/kg. Although higher doses did produce developmental effects, the Environmental Protection Agency concludes that hexazinone is not a teratogen.

REPRODUCTION: A three-generation rat study indicated no evidence of reproductive effects of hexazinone except for decreased weight of rat pups at the highest dose tested (125 mg/kg). The Environmental Protection Agency has requested further information on this study.

MUTAGENICITY: Three of four tests of hexazinone's mutagenicity (the ability to cause genetic damage) were negative. The Environmental Protection Agency concluded that hexazinone is not a mutagen.

The data reported above are results of animal studies which the Environmental Protection Agency has evaluated in support of the registration of hexazinone. These data are used to make inferences relative to human health.

HAZARD: Based on the results of animal studies, hexazinone can cause permanent eye damage. Exposure may cause reversible irritation of the eyes, nose and skin. Hexazinone does not cause cancer or genetic damage; it is not cumulatively toxic and does not pose a risk to fertility, reproduction, or development of offspring.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: Hexazinone has not been reported to have caused any deaths or hospitalized cases. Inhalation of hexazinone dust caused vomiting after 24 hours in one reported incident.

CHRONIC TOXICITY:

REPORTED EFFECTS: There are no reported cases of long-term health effects in humans due to hexazinone exposure.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: To prevent residues of hexazinone in meat or milk, do not graze domestic animals on treated areas within 30 days after treatment.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCT: Specific toxicity information is not available for every inert ingredient (due to trade secret restrictions for the formulations). However, the material safety data sheet for Velpar® does not list any inert ingredients that are hazardous.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: Direct contact of the eyes with liquid hexazinone formulations will have corrosive effects and could cause irreversible eye injury.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: No toxic contaminants have been found in hexazinone.

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: Hexazinone is not commercially formulated with other herbicides.

HEALTH RISK MANAGEMENT PROCEDURES: The Forest Service has evaluated health effects data in the development of both pesticide background statement documents and environmental impact statements for pesticide use on forest lands. These health effects evaluations have taken into consideration the potential for both worker and public exposure from Forest Service operations. This information has been used in assessing health risks and consequently in formulating protective measures to reduce risk to forest workers and to the public. Section VII of this fact sheet, Safety Precautions, provides guidance for the safe handling and use of hexazinone.

VII. SAFETY PRECAUTIONS:

SIGNAL WORD AND DEFINITION:

Velpar® L and Velpar® ULW: **DANGER** - CAUSES EYE DAMAGE

Velpar®: **WARNING** - MAY IRRITATE EYES, NOSE, THROAT AND SKIN

Pronone® 10G: **CAUTION**

PROTECTIVE PRECAUTIONS FOR WORKERS: To avoid eye damage, all mixers, loaders and applicators should wear protective goggles, face shields, or safety glasses. Avoid contact with skin and clothing. Workers performing hand tasks should delay entry into treated areas until sprays have dried. Workers performing other tasks should wear protective eye equipment if entering treated areas before sprays have dried. All exposed workers should wash thoroughly with soap and water after handling and should remove and wash contaminated clothing before reuse.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES): In case of contact, flush skin and eyes with plenty of water; for eyes, get medical attention and flush with water for at least 15 minutes. If inhaled, bring affected individual to fresh air. If breathing is difficult, give oxygen; if not breathing, give artificial respiration. If swallowed, immediately give 2 glasses of water and induce vomiting. Never give anything by mouth to an unconscious person. Call a physician. **In case of emergency, call your local poison control center for advice.**

HANDLING, STORAGE, AND DISPOSAL: The powdered form of the material may form explosive mixtures under severe dusting conditions. The liquid is flammable and its vapor forms an explosive mixture with air. Heating can release vapors which can be ignited. Do not dispose of wastes or container wash water into surface water or sanitary sewer systems. Remove nonusable solid material and/or contaminated soil, for disposal in an approved and permitted landfill. Dispose of emptied bag in a sanitary landfill or by incineration. Bags may be burned if allowed by state and local authorities. If burned, stay out of smoke.

EMERGENCY (SPILL) HAZARDS AND PROCEDURES: Dike spills and prevent liquid from entering sewers, waterways or low areas. Soak up liquid with sawdust, sand, oil dry, or other absorbent material—shovel or sweep up. If spill area is on ground near valuable plants or trees, remove top 3 inches of soil after initial cleanup. Use appropriate personal protective equipment during clean up, including protection for the eyes. **In case of a large spill, call CHEMTREC at 1-800-424-9300 for advice.**

VIII. DEFINITIONS

adsorption - the process of attaching to a surface
basal treatment - applied to the stem of a plant just above the soil
broadcast application - applied over an entire area
carcinogenicity - ability to cause cancer
dermal - of, or related to, the skin
EC50 - the concentration which will cause a toxic effect in 50% of the subjects
ecotoxicology - the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

ecotoxicological - related to the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

formulation - the form in which the pesticide is supplied by the manufacturer for use

herbicide - a substance used to destroy plants or to slow down their growth

LC50 - the concentration in air, water, or food which will kill approximately 50% of the subjects

LD50 - the dose which will kill approximately 50% of the subjects

leach - to dissolve out by the action of water

mg/kg - milligrams of the substance per kilogram of body weight

microorganisms - living things too small to be seen without a microscope

mutagenicity - ability to cause genetic changes

non-target - animals or plants other than the ones which the pesticide is intended to kill

persistence - tendency of a pesticide to remain in the environment after it is applied

ppm - parts per million parts

residual activity - the remaining amount of activity as a pesticide

volatility - the tendency to become a vapor at relatively low temperature

IX. Additional Reading

Final Environmental Impact Statement. Managing Competing and Unwanted Vegetation. Forest Service, U.S. Department of Agriculture, Portland, OR, 1988.

Final Environmental Impact Statement. Vegetation Management for Reforestation. Forest Service, U.S. Department of Agriculture, California, 1989.

Final Environmental Impact Statement. Vegetation Management in the Coastal Plain/Piedmont. Forest Service, U.S. Department of Agriculture, Atlanta, GA. Management Bulletin R8-MB-23, 1989.

Guidance for the Reregistration of Pesticide Products Containing Hexazinone as the Active Ingredient. Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/RS-88-081, 1988.

Pesticide Fact Sheet: Hexazinone. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/FS-88-082, 1988.

X. Toxicity Categories

Tables of Categories of Toxicity

Table I: Human Hazards

Category	Signal word	Route of administration		
		Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/l)
I	DANGER Poison	0-50	0-200	0-0.2
II	WARNING	>50-500	>200-2000	>0.2-2.0
III	CAUTION	>500-5000	>2000-20,000	>2.0-20
IV	none	>5000	>20,000	>20

40 CFR 162.10 (h) (1), July 3, 1975

Table I: Human Hazards (continued)

Category	Hazard	
	Eye Irritation	Skin Irritation
I	corrosive: corneal opacity not reversible within 7 days	corrosive
II	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV	no irritation	mild or slight irritation at 72 hours

40 CFR 162.10 (h) (1), July 3, 1975

Table II: Ecotoxicological Categories

Mammalian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Dietary):

ppm	
<50	very highly toxic
50-500	highly toxic
501-1000	moderately toxic
1000-5000	slightly toxic
>5000	practically non-toxic

Aquatic Organisms:

ppm	
<0.1	very highly toxic
0.1-1	highly toxic
>1-10	moderately toxic
>10-100	slightly toxic
>100	practically non-toxic

Insecticides, Brooks, H.L. et al. (1973) Cooperative Extension Service, Kansas State University, Manhattan, Kansas

For more information on hexazinone contact your local Forest Service, Bureau of Land Management, or Bonneville Power Administration office.

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Picloram

PESTICIDE FACT SHEET

U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT
U.S. DEPARTMENT OF ENERGY, BONNEVILLE POWER ADMINISTRATION

This fact sheet is one of a series issued by the Forest Service, the Bureau of Land Management, and the Bonneville Power Administration for their workers and the general public. It provides information on forestry and land management uses, environmental and human health effects, and safety precautions for the herbicide picloram and its formulations. Unless otherwise stated, the toxicity data presented in this fact sheet refer to the active ingredient, picloram. When included, data on formulated products will be specifically identified. A list of definitions is included in Section VIII of the fact sheet.

I. BASIC INFORMATION

COMMON NAME: picloram

CHEMICAL NAME: 4-amino-3,5,6-trichloropicolinic acid

COMMON PRODUCT NAMES: Tordon®, Grazon®, Access®, Pathway®

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: All formulations that may be broadcast on soil or foliage are classified as "Restricted Use" pesticides. Sale and use of these pesticides are limited to licensed pesticide applicators or their employees, and only for uses covered by the applicator's certification. This is due to picloram's mobility in water, combined with the extreme sensitivity of many important crop plants to damage.

FORMULATIONS: Commercial picloram products generally contain one or more inert ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the U.S. Environmental Protection Agency (EPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52 FR 13305). The intent of this policy is the regulation of inert ingredients. EPA's strategy for the implementation of this policy included the development of four lists of inerts based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3 and inerts of minimal concern were placed on List 4.

For pesticides containing List 1 inerts, the EPA has given the pesticide registrant the opportunity to reformulate the product to remove the List 1 inerts. If the registrant chooses not to reformulate the product, then the List 1 inerts must be identified on the product label. For List 2 inerts, the EPA is monitoring ongoing testing and gathering existing information on the potential adverse effects of these chemicals to determine if further regulatory action is required. The EPA has no particular regulatory plans for List 3 and List 4 inerts. The Forest Service will incorporate new data on inerts into updated fact sheets as it becomes available.

The contents of two picloram formulations are listed below.

Tordon K: picloram, as the potassium salt (24.4%) and inert ingredient(s) (75.6%) including water and dispersing agents

Grazon PC: picloram, as the potassium salt (24.4%) and inert ingredient(s) (75.6%) including water and dispersing agents

RESIDUE ASSAY METHODS: Gas/liquid chromatography and reverse phase high performance liquid chromatography methods are available for residue assay.

II. HERBICIDE USES

REGISTERED FORESTRY, RANGELAND, RIGHT-OF-WAY USES: Picloram is used to prevent regrowth of woody plants in rights-of-way, such as along roads and power lines. On rangelands, it is used to control noxious weeds and brush. In forestry, picloram is used to control unwanted trees and to prepare sites for planting trees. It is also used to control plants on non-crop industrial/facility sites.

OPERATIONAL DETAILS:

TARGET PLANTS: Picloram is used to control broadleaf plants, brush, conifers and broadleaf trees.

MODE OF ACTION: Picloram is absorbed through plant roots, leaves and bark. It moves both up and down within the plant, and accumulates in new growth. It acts by interfering with the plant's ability to make proteins and nucleic acids. Picloram is metabolized or broken down by plants into carbon dioxide, oxalic acid, 4-amino-2,3,5-trichloropyridine and 4-amino-3,5-dichloro-6-hydroxypicolinic acid.

METHOD OF APPLICATION: broadcast or spot treatment as foliar (leaf) or soil spray; basal spot treatment; tree injection; frill treatment; stump treatment; basal bark treatment; low-volume dormant stem spray; by air as broadcast or low volume dormant spray

USE RATES: The amount to be applied depends on the type of plant to be killed, and the formulation of picloram used.

Picloram, triisopropanolamine salt: 0.27 to 2.16 pounds acid equivalent per acre (lb ae/A)

Picloram, isooctyl ester: used for basal bark treatment only

Picloram, potassium salt: 1.0 to 8.5 lb ae/A

SPECIAL PRECAUTIONS:

Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.

TIMING OF APPLICATION: Picloram can be applied from spring through three weeks before the first frost. It should not be applied on snow or frozen ground. Basal treatments can be applied throughout the year. Tree injection should not be done during periods of heavy sap flow.

DRIFT CONTROL: Do not allow careless application or spray drift. Do not permit spray or spray drift to contact desirable plants.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: Picloram can stay active in soil for a moderately long time, depending on the type of soil, soil moisture and temperature. It may exist at levels toxic to plants for more than a year after application at normal rates.

ADSORPTION: Picloram chemically attaches to clay particles and organic matter. If the soil has little clay or organic matter, picloram is easily moved by water.

PERSISTENCE AND AGENTS OF DEGRADATION: Long-term build-up of picloram in the soil generally does not occur. Break-down caused by sunlight and microorganisms in the soil are the main ways in which picloram disappears in the environment. Picloram will dissipate more quickly in warm, wet weather. Alkaline conditions, fine textured clay soils, and a low density of plant roots can increase the persistence of picloram.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: Carbon dioxide is the major end-product of the break-down of picloram in the soil. Carbon dioxide is a gas normally found in the air. The relatively small amount from picloram break-down would not be expected to have any harmful effect on the environment.

WATER:

SOLUBILITY: Picloram dissolves readily in water.

POTENTIAL FOR LEACHING INTO GROUND-WATER: Picloram can leach into ground-water under certain soil and weather conditions.

Picloram leaches more easily in soils which have low organic content or are very sandy. Picloram movement is greatest for soils with low organic matter content, alkaline soils, and soils which are highly permeable, sandy, or light-textured. Where the water table is very shallow, picloram may leach into ground-water. Picloram should not be applied to any surface which would allow direct pollution of ground-water.

SURFACE WATERS: Picloram can be carried by surface run-off water. To prevent water pollution, picloram spray drift or run-off should not be allowed to fall onto banks or bottoms of irrigation ditches, or water intended for drinking or household use. Picloram should not be applied directly to water or wetlands, such as swamps, bogs, marshes or potholes.

AIR:

VOLATILIZATION: Picloram does not evaporate easily.

POTENTIAL FOR BY-PRODUCTS FROM BURNING OF TREATED VEGETATION: More than 95% of picloram residue is destroyed during burning. Although by-products from burning plants treated with picloram have been identified in the laboratory, they have not been identified in the field.

IV. Ecological Effects

Non-Target Toxicity:

Soil microorganisms: Picloram has very low toxicity to soil microorganisms at up to 1,000 parts per million.

Plants: Picloram is highly toxic to many non-target plants. Most grasses are resistant to picloram. Picloram is active in the soil and can pass from soil into growing plants. It can move from treated plants, through the roots, to nearby plants. Spray drift may kill plants some distance away from the area being treated. Irrigation water polluted with picloram may damage or kill crop plants.

Aquatic animals: Picloram is moderately to slightly toxic to freshwater fish, and slightly toxic to aquatic invertebrate animals; it does not build up in fish. The formulated product is generally less toxic than picloram. Picloram and its formulations have not been tested for chronic effects in aquatic animals. Acute toxic level:

species	LC50	
fish	4.0 to 24.0 ppm	(Table II, Aquatic)
invertebrates	10.0 to 68.3 ppm	(Table II, Aquatic)

Terrestrial animals: Picloram is almost non-toxic to birds. It is relatively non-toxic to bees. Picloram is low in toxicity to mammals; animals excrete most picloram in the urine, unchanged. The formulated product is generally less toxic than picloram. Picloram and its formulations have not been tested for chronic effects in terrestrial animals. Acute toxic level:

species	LD50	
birds	>2,000 mg/kg	(Table II, Avian)
mammals	>950 to 8,200 mg/kg	(Table II, Mammalian)

48 hour contact toxicity to bees = 14.5 micrograms per bee

Threatened and endangered species: Picloram may be a hazard to endangered plants when used on pastures, rangeland and forests. Picloram may be a hazard to some endangered invertebrates if it is applied to areas where they live. It is not expected to be a hazard to other endangered animals or birds.

V. Toxicology Data

Acute Toxicity:

Acute oral toxicity: In tests in male rats, the acute oral LD50 was greater than 5,000 mg/kg (Toxicity Category IV) In tests in female rats, the acute oral LD50 was 4012 mg/kg. (Toxicity Category III; See Table I, Oral)

Acute dermal toxicity: The acute dermal (skin) LD50 was greater than 2,000 mg/kg in rabbits. (Toxicity Category III, Table I, Dermal)

Primary irritation score: In laboratory tests in rabbits, picloram was not an irritant. (Toxicity Category IV, Table I, Skin irritation)

Primary eye irritation: In laboratory tests in rabbits, picloram was a moderate eye irritant. (Toxicity Category III, Table I, Eye irritation)

Acute inhalation: In laboratory tests in rats, the acute LC50 was greater than 0.035 milligrams/liter. (Toxicity Category I, Table I, Inhalation)

Chronic Toxicity:

Carcinogenicity: The potential for causing tumors (oncogenicity) has not been determined at this time. The Environmental Protection Agency is presently requiring that the mouse and rat oncogenicity tests be repeated.

Developmental: A study in rats indicated no evidence of teratology (birth defects). The Environmental Protection Agency is presently requiring repeat or additional teratology studies in rats and rabbits.

Reproduction: A multi-generation reproduction study in rats did not show any adverse effects on reproduction at doses up to 150 mg/kg per day. The Environmental Protection Agency is currently requiring an additional two-generation reproduction study in rats.

Mutagenicity: Picloram was negative in two tests for mutagenicity (the ability to cause genetic damage).

The data reported above are results of animal studies which the Environmental Protection Agency has evaluated in support of the registration of picloram. These data are used to make inferences relative to human health.

Hazard: Based on the results of animal studies, picloram does not cause genetic damage or birth defects, and has little or no effect on fertility or reproduction. There is not enough information available at this time to determine whether picloram causes cancer. There have been no reported cases of long term health effects in humans due to picloram exposure.

VI. Human Health Effects

Acute Toxicity (Poisoning):

Reported effects: A few cases of eye and skin irritation have been reported in workers exposed to picloram formulations.

Chronic Toxicity:

Reported effects: There are no reported cases of long term health effects in humans due to picloram or its formulations.

Potential for adverse health effects from contacting or consuming treated vegetation, water or animals: The exposure levels a person could receive from these sources, as a result of routine operations, are below levels shown to cause harmful effects in laboratory studies.

Potential for adverse health effects from inert ingredients contained in the formulated product: Inert ingredients found in picloram may include water, wetting agents, sequestrants, and petroleum solvents. Water is not toxic. Wetting agents and sequestrants are not very toxic, so they have little effect on the toxic hazard of the product. Some wetting agents and sequestrants may be eye or skin irritants. Some petroleum solvents may increase the amount of pesticide absorbed through the skin. Petroleum solvents may be a toxic hazard if the pesticide is swallowed.

Health effects of exposure to formulated products: No serious health effects in humans have been verified. A few cases of eye irritation and skin irritation from exposure to picloram formulations have been reported.

Health effects associated with contaminants: Picloram, when commercially produced, is contaminated with trace amounts of hexachlorobenzene (HCB). Although HCB may cause cancer in humans, the U.S. Environmental Protection Agency considers the risk from the small amount of HCB present in picloram to be small.

Health effects associated with other formulations: Some formulations of picloram also contain the herbicides 2,4-D or triclopyr. **The information in this fact sheet does not apply to 2,4-D or triclopyr.** Please consult other fact sheets for information on the other herbicides.

Health risk management procedures: The Forest Service has evaluated health effects data in the development of both pesticide background statement documents and environmental impact statements for pesticide use on forest lands. These health effects evaluations have taken into consideration the potential for both worker and public exposure from Forest Service operations. This information has been used in assessing health risks and consequently in formulating protective measures to reduce risk to forest workers and to the public. Section VII of this fact sheet, Safety Precautions, provides guidance for the safe handling and use of picloram.

VII. Safety Precautions:

Signal word and definition:

WARNING - CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY - HARMFUL IF INHALED OR ABSORBED THROUGH SKIN

Protective precautions for workers: Do not get picloram in eyes or on clothing. Wear goggles, face shield or safety glasses when handling picloram. Avoid contact with skin. Wash thoroughly with soap and water after handling picloram. After using picloram, remove and wash clothing before reuse. Do not drink picloram solution. Avoid breathing spray mist.

Medical treatment procedures (antidotes): No specific antidote to picloram is known; treat symptoms. For exposure to the eyes, flush with plenty of water for at least 15 minutes. Get medical attention. For exposure to the skin, wash with plenty of soap and water. Get medical attention if irritation persists. **In case of emergency, call your local poison control center for advice.**

Handling, storage, and disposal: Picloram is stable under normal storage conditions for at least 2 years. Do not ship or store with food, animal feeds, drugs or clothing. Dispose of by burying in non-crop land away from water supplies, or dispose of in a landfill approved for pesticides in accordance with applicable Federal, state and local regulations.

Emergency (spill) hazards and procedures: Absorb spills in inert material such as sand or sawdust. For large spills, dike area to contain spill; consult manufacturer for clean-up. **In case of a large spill, call CHEMTREC at 1-800-424-9300 for advice.**

VIII. Definitions

adsorption - the process of attaching to a surface

avian - of, or related to, birds

basal treatment - applied to the stem of a plant just above the soil

broadcast - apply over an entire area

carcinogenicity - ability to cause cancer

dermal - of, or related to, skin

dispersing agent - a surface-active substance added to keep fine particles separated

dormant spray - a spray applied to stems or trunks when plants are in an inactive state

ecotoxicology - the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

ecotoxicological - related to the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

formulation - the form in which the pesticide is supplied by the manufacturer for use

frill treatment - a frill of overlapping axe cuts is made through the bark of a tree, and the injured surface is painted or sprayed with herbicide

herbicide - a substance used to destroy plants or to slow down their growth

LC50 - the concentration in air, water, or food which will kill approximately 50% of the subjects

LD50 - the dose which will kill approximately 50% of the subjects

leach - to dissolve out by the action of water

mg/kg - milligrams of the substance per kilogram of body weight

microorganisms - living things too small to be seen without a microscope

non-target - animals or plants other than the ones which the pesticide is intended to kill

persistence - tendency of a pesticide to remain active after it is applied

ppm - parts per million parts

residual activity - the remaining amount of activity as a pesticide

sequestrant - a substance used to stabilize a formulation

volatility - the tendency to become a vapor at relatively low temperature

wetting agent - a substance which causes liquids to make better contact with treated surfaces

IX. Additional Reading

Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation. Pacific Northwest Region. Forest Service, U.S. Department of Agriculture, Portland, Oregon. 1988.

Final Environmental Impact Statement. Vegetation Management in the Coastal Plain/Piedmont. Forest Service, U.S. Department of Agriculture, Atlanta, Georgia. Management Bulletin R8-MB-23, 1989.

Final Environmental Impact Statement. Vegetation Management for Reforestation. Forest Service, U.S. Department of Agriculture, San Francisco, California. 1989.

Guidance for the Reregistration of Pesticide Products Containing Picloram as the Active Ingredient. Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/RS-88-132, 1988.

Pesticide Background Statements. Volume I. Herbicides. Forest Service, U.S Department of Agriculture. Agriculture Handbook No. 663, 1984.

Pesticide Fact Sheet: Picloram. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC. EPA Publication No. 540/FS-88-133, 1988.

X. Toxicity Categories

Tables of Categories of Toxicity

Table I: Human Hazards

Category	Signal word	Route of administration		
		Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/L)
I	DANGER Poison	0-50	0-200	0-0.2
II	WARNING	>50-500	>200-2000	>0.2-2.0
III	CAUTION	>500-5000	>2000-20,000	>2.0-20
IV	NONE	>5000	>20,000	>20

40 CFR 162.10 (H) (1), JULY 3, 1975

Table I: Human Hazards (continued)

Category	Hazard	
	Eye irritation	Skin irritation
I	CORROSIVE: CORNEAL OPACITY NOT REVERSIBLE WITHIN 7 DAYS	CORROSIVE
II	CORNEAL OPACITY REVERSIBLE WITHIN 7 DAYS; IRRITATION PERSISTING FOR 7 DAYS	SEVERE IRRITATION AT 72 HOURS
III	NO CORNEAL OPACITY; IRRITATION REVERSIBLE WITHIN 7 DAYS	MODERATE IRRITATION AT 72 HOURS
IV	NO IRRITATION	MILD OR SLIGHT IRRITATION AT 72 HOURS

40 CFR 162.10 (H) (1), JULY 3, 1975

Table II: Ecotoxicological Categories

Mammalian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Dietary):

ppm	
<50	very highly toxic
50-500	highly toxic
501-1000	moderately toxic
1000-5000	slightly toxic
>5000	practically non-toxic

Avian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Aquatic Organisms:

ppm	
<0.1	very highly toxic
0.1-1	highly toxic
>1-10	moderately toxic
>10-100	slightly toxic
>100	practically non-toxic

Insecticides, Brooks, H.L. et al. (1973) Cooperative Extension Service, Kansas State University, Manhattan, Kansas

For more information on picloram contact your local Forest Service, Bureau of Land Management, or Bonneville Power Administration office.

January 1992

Prepared by Information Ventures, Inc. under U.S. Forest Service Contract Number 53-3187-104.

Triclopyr

Pesticide Fact Sheet

U.S. Department of Agriculture, Forest Service
U.S. Department of the Interior, Bureau of Land Management
U.S. Department of Energy, Bonneville Power Administration

This fact sheet is one of a series issued by the Forest Service, the Bureau of Land Management, and the Bonneville Power Administration for their workers and the general public. It provides information on forest and land management uses, environmental and human health effects, and safety precautions for the herbicide triclopyr and its formulations. Unless otherwise stated, the toxicity data presented in this fact sheet refer to the active ingredient, triclopyr. When included, data on formulated products will be specifically identified. A list of definitions is included in Section VIII of the fact sheet.

I. Basic Information

COMMON NAME: triclopyr

CHEMICAL NAME: [(3,5,6-trichloro-2-pyridinyl)oxy]-acetic acid

COMMON PRODUCT NAMES: Garlon®, Grazon®

PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use"

FORMULATIONS: Commercial triclopyr products generally contain one or more inert ingredients. An inert ingredient is anything added to the product other than an active ingredient. Because of concern for human health and the environment, the U.S. Environmental Protection Agency (EPA) announced its policy on toxic inert ingredients in the Federal Register on April 22, 1987 (52 FR 13305). The intent of this policy is the regulation of inert ingredients. EPA's strategy for the implementation of this policy included the development of four lists of inerts based on toxicological concerns. Inerts of toxicological concern were placed on List 1. Potentially toxic inerts/high priority for testing were placed on List 2. Inerts of unknown toxicity were placed on List 3 and inerts of minimal concern were placed on List 4.

For pesticides containing List 1 inerts, the EPA has given the pesticide registrant the opportunity to reformulate the product to remove the List 1 inerts. If the registrant chooses not to reformulate the product, then the List 1 inerts must be identified on the product label. For List 2 inerts, the EPA is monitoring ongoing testing and gathering existing information on the potential adverse effects of these chemicals to determine if further regulatory action is required. The EPA has no particular regulatory plans for List 3 and List 4 inerts. The Forest Service will incorporate new data on inerts into updated fact sheets as it becomes available. The contents of two triclopyr formulations are listed below.

Garlon 3A: triclopyr (44.4%), and inert ingredients (55.6%) including water, emulsifiers, surfactants, and ethanol (1%)

Garlon 4: triclopyr (61.6%), and inert ingredients (38.4%) including kerosene

RESIDUE ASSAY METHODS: Gas/liquid chromatography methods are available for residue assay.

II. Herbicide Uses

REGISTERED FORESTRY, RANGELAND, RIGHT-OF-WAY USES: control of woody plants and broadleaf weeds on rights-of-way, non-crop areas, non-irrigation ditch banks, forests, wildlife openings, rangeland and permanent grass pastures

OPERATIONAL DETAILS:

Target plants: Triclopyr is used to control woody plants and broadleaf weeds.

Mode of action: Triclopyr acts by disturbing plant growth. It is absorbed by green bark, leaves and roots and moves throughout the plant. Triclopyr accumulates in the meristem (growth region) of the plant.

Method of application: ground or aerial foliage spray, basal bark and stem treatment, cut surface treatment, tree injection

Use rates: 0.25 to 9 pounds acid equivalent per acre

SPECIAL PRECAUTIONS:

Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.

TIMING OF APPLICATION: For foliar treatment, apply triclopyr during active plant growth. Basal bark and cut surface treatments can be done at any time of year. Dormant stem application can only be done when trees and brush are dormant.

DRIFT CONTROL: Apply triclopyr only when there is little or no hazard of spray drift. Do not allow spray to come in contact with broadleaf crops. Spray only when wind speed is low. Avoid fine spray, which may drift.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: Triclopyr is active in the soil, and is absorbed by plant roots.

ADSORPTION: Triclopyr is adsorbed by clay particles and organic matter particles in soil.

PERSISTENCE AND AGENTS OF DEGRADATION: Microorganisms degrade triclopyr rapidly; the average half-life in soil is 46 days. Triclopyr degrades more rapidly under warm, moist conditions.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: 3,5,6-Trichloro-2-pyridinol is the major initial product of degradation. It has a half-life of 30 to 90 days, and degrades to carbon dioxide and organic matter.

WATER:

SOLUBILITY: moderate to low

POTENTIAL FOR LEACHING INTO GROUND-WATER: The potential for leaching depends on the soil type, acidity and rainfall conditions. Triclopyr should not be a leaching problem under normal conditions since it binds to clay and organic matter in soil. Triclopyr may leach from light soils if rainfall is very heavy.

SURFACE WATERS: Sunlight rapidly breaks down triclopyr in water. The half-life in water is less than 24 hours.

Do not allow triclopyr to pollute irrigation ditches or water used for irrigation or domestic use.

AIR:

VOLATILIZATION: very low

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Information is not currently available.

IV. ECOLOGICAL EFFECTS

NON-TARGET TOXICITY:

SOIL MICROORGANISMS: Triclopyr is slightly toxic to practically non-toxic to soil microorganisms.

PLANTS: Triclopyr is toxic to many plants. Even very small amounts of spray may injure some plants.

AQUATIC ANIMALS: Triclopyr is low in toxicity to fish. The ester form of triclopyr, found in Garlon 4, is more toxic, but under normal conditions, it rapidly breaks down in water to a less toxic form. Triclopyr does not accumulate in fish. Triclopyr is slightly toxic to practically non-toxic to invertebrates. Triclopyr and its formulations have not been tested for chronic effects in aquatic animals. Acute toxic level:

species	LC50	
trout	117 ppm	(Table II, Aquatic)
bluegill	148 ppm	(Table II, Aquatic)
daphnia	1,140 ppm	(Table II, Aquatic)

TERRESTRIAL ANIMALS: Triclopyr is slightly toxic to mammals. In mammals, most triclopyr is excreted, unchanged, in the urine. Triclopyr and its formulations have very low toxicity to birds. Triclopyr is non-toxic to bees. Triclopyr and its formulations have not been tested for chronic effects in terrestrial animals. Acute toxic level:

species	LD50	
mammals	310-713 mg/kg	(Table II, Mammalian)
ducks	1,698 mg/kg	(Table II, Avian)
bees	>60 micrograms/bee	

In eight day dietary studies in birds, the LC50 ranged from 2,935 to greater than 5,000 ppm.

THREATENED AND ENDANGERED SPECIES: Triclopyr may be a hazard to endangered plant species if it is used in areas where they live. The hazard to endangered animal species has not been determined.

V. TOXICOLOGY DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: In tests in rats, the acute oral LD50 was 630 to 729 mg/kg. (Toxicity Category III, Table I, Oral)

ACUTE DERMAL TOXICITY: The acute dermal (skin) LD50 was greater than 2,000 mg/kg in rabbits. (Toxicity Category III, Table I, Dermal)

PRIMARY IRRITATION SCORE: In laboratory tests, triclopyr was a slight to moderate irritant. (Toxicity Category III to IV, Table I, Dermal Inhalation)

Triclopyr

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PESTICIDE CLASSIFICATION: herbicide

REGISTERED USE STATUS: "General Use"

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OPERATIONAL DETAILS:

TARGET PLANTS: Triclopyr is used to control woody plants and broadleaf weeds.

MODE OF ACTION: Triclopyr acts by disturbing plant growth. It is absorbed by green bark, leaves and roots and moves throughout the plant. Triclopyr accumulates in the meristem (growth region) of the plant.

METHOD OF APPLICATION: ground or aerial foliage spray, basal bark and stem treatment, cut surface treatment, tree injection

USE RATES: 0.25 to 9 pounds acid equivalent per acre

SPECIAL PRECAUTIONS:

Always read all of the information on the product label before using any pesticide. Read the label for application restrictions.

TIMING OF APPLICATION: For foliar treatment, apply triclopyr during active plant growth. Basal bark and cut surface treatments can be done at any time of year. Dormant stem application can only be done when trees and brush are dormant.

DRIFT CONTROL: Apply triclopyr only when there is little or no hazard of spray drift. Do not allow spray to come in contact with broadleaf crops. Spray only when wind speed is low. Avoid fine spray, which may drift.

III. ENVIRONMENTAL EFFECTS/FATE

SOIL:

RESIDUAL SOIL ACTIVITY: Triclopyr is active in the soil, and is absorbed by plant roots.

ADSORPTION: Triclopyr is adsorbed by clay particles and organic matter particles in soil.

PERSISTENCE AND AGENTS OF DEGRADATION: Microorganisms degrade triclopyr rapidly; the average half-life in soil is 46 days. Triclopyr degrades more rapidly under warm, moist conditions.

METABOLITES/DEGRADATION PRODUCTS AND POTENTIAL ENVIRONMENTAL EFFECTS: 3,5,6-Trichloro-2-pyridinol is the major initial product of degradation. It has a half-life of 30 to 90 days, and degrades to carbon dioxide and organic matter.

WATER:

SOLUBILITY: moderate to low

POTENTIAL FOR LEACHING INTO GROUND-WATER: The potential for leaching depends on the soil type, acidity and rainfall conditions. Triclopyr should not be a leaching problem under normal conditions since it binds to clay and organic matter in soil. Triclopyr may leach from light soils if rainfall is very heavy.

SURFACE WATERS: Sunlight rapidly breaks down triclopyr in water. The half-life in water is less than 24 hours.

Do not allow triclopyr to pollute irrigation ditches or water used for irrigation or domestic use.

AIR:

VOLATILIZATION: very low

POTENTIAL FOR BYPRODUCTS FROM BURNING OF TREATED VEGETATION: Information is not currently available.

IV. ECOLOGICAL EFFECTS

NON-TARGET TOXICITY:

SOIL MICROORGANISMS: Triclopyr is slightly toxic to practically non-toxic to soil microorganisms.

PLANTS: Triclopyr is toxic to many plants. Even very small amounts of spray may injure some plants.

AQUATIC ANIMALS: Triclopyr is low in toxicity to fish. The ester form of triclopyr, found in Garlon 4, is more toxic, but under normal conditions, it rapidly breaks down in water to a less toxic form. Triclopyr does not accumulate in fish. Triclopyr is slightly toxic to practically non-toxic to invertebrates. Triclopyr and its formulations have not been tested for chronic effects in aquatic animals. Acute toxic level:

species	LC50	
trout	117 ppm	(Table II, Aquatic)
bluegill	148 ppm	(Table II, Aquatic)
daphnia	1,140 ppm	(Table II, Aquatic)

TERRESTRIAL ANIMALS: Triclopyr is slightly toxic to mammals. In mammals, most triclopyr is excreted, unchanged, in the urine. Triclopyr and its formulations have very low toxicity to birds. Triclopyr is non-toxic to bees. Triclopyr and its formulations have not been tested for chronic effects in terrestrial animals. Acute toxic level:

species	LD50	
mammals	310-713 mg/kg	(Table II, Mammalian)
ducks	1,698 mg/kg	(Table II, Avian)
bees	>60 micrograms/bee	

In eight day dietary studies in birds, the LC50 ranged from 2,935 to greater than 5,000 ppm.

THREATENED AND ENDANGERED SPECIES: Triclopyr may be a hazard to endangered plant species if it is used in areas where they live. The hazard to endangered animal species has not been determined.

V. TOXICOLOGY DATA

ACUTE TOXICITY:

ACUTE ORAL TOXICITY: In tests in rats, the acute oral LD50 was 630 to 729 mg/kg. (Toxicity Category III, Table I, Oral)

ACUTE DERMAL TOXICITY: The acute dermal (skin) LD50 was greater than 2,000 mg/kg in rabbits. (Toxicity Category III, Table I, Dermal)

PRIMARY IRRITATION SCORE: In laboratory tests, triclopyr was a slight to moderate irritant. (Toxicity Category III to IV, Table I, Dermal Inhalation)

PRIMARY EYE IRRITATION: In laboratory tests in rabbits, triclopyr was a slight eye irritant. (Toxicity Category III, Table I, Eye irritation)

ACUTE INHALATION: In a laboratory test in rats, exposure to 5.34 ppm for 1 hour caused no adverse effects. (Toxicity Category III, Table I, Inhalation)

CHRONIC TOXICITY:

CARCINOGENICITY: Laboratory tests in mice and rats fed up to 30 mg/kg per day for 2 years did not show any evidence of carcinogenicity.

DEVELOPMENTAL: Laboratory studies with triclopyr in pregnant rats (at dose levels up to 200 mg/kg per day) and rabbits (at dose levels up to 100 mg/kg per day) indicated no evidence of teratology (birth defects). In pregnant rats at the 200 mg/kg per day dose level, there were signs of mild toxicity to the fetus.

REPRODUCTION: A three-generation reproduction study in rats did not show any adverse effects on fertility or reproduction at doses up to 30 mg/kg per day.

MUTAGENICITY: Triclopyr was negative in several laboratory tests for mutagenicity (the ability to cause genetic damage), but was weakly positive in a test in rats.

The data reported above are results of animal studies which have been evaluated by the Forest Service. These data are used to make inferences relative to human health.

HAZARD: Based on the results of animal studies, triclopyr does not cause birth defects or cancer, and has little or no effect on fertility, or reproduction. Triclopyr is mildly fetotoxic. There is not enough information available to determine whether triclopyr causes genetic damage. There have been no reported cases of long term health effects in humans due to triclopyr exposure.

VI. HUMAN HEALTH EFFECTS

ACUTE TOXICITY (POISONING):

REPORTED EFFECTS: no reported effects

CHRONIC TOXICITY:

REPORTED EFFECTS: no reported effects

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM CONTACTING OR CONSUMING TREATED VEGETATION, WATER OR ANIMALS: The exposure levels a person could receive from these sources, as a result of routine operations, are below levels shown to cause harmful effects in laboratory studies.

POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM INERT INGREDIENTS CONTAINED IN THE FORMULATED PRODUCT: Inert ingredients found in triclopyr products may include water, petroleum solvents, kerosene, surfactants, emulsifiers, and methanol. Water is not toxic. Methanol, kerosene and petroleum solvents may be a toxic hazard if the pesticide is swallowed. Surfactants and emulsifiers are generally low in toxicity.

HEALTH EFFECTS OF EXPOSURE TO FORMULATED PRODUCTS: The formulated products are generally less toxic than triclopyr. Garlon 3A is a skin irritant and a severe eye irritant.

HEALTH EFFECTS ASSOCIATED WITH CONTAMINANTS: no known major contaminants

HEALTH EFFECTS ASSOCIATED WITH OTHER FORMULATIONS: Some formulations of triclopyr also contain the herbicides 2,4-D or picloram. **The information in this fact sheet does not apply to 2,4-D or picloram.** Please consult other sources for information on these herbicides.

HEALTH RISK MANAGEMENT PROCEDURES: The Forest Service has evaluated health effects data in the development of both pesticide background statement documents and environmental impact statements for pesticide use on forest lands. These health effects evaluations have taken into consideration the potential for both worker and public exposure from Forest Service operations. This information has been used in assessing health risks and consequently in formulating protective measures to reduce risk to forest workers and to the public. Section VII of this fact sheet, Safety Precautions, provides guidance for the safe handling and use of triclopyr.

VII. SAFETY PRECAUTIONS:

SIGNAL WORD AND DEFINITION:

Grazon ET - **CAUTION** - HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN.

Garlon 4 - **CAUTION** - HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN.

Garlon 3A - **WARNING** - CAUSES EYE DAMAGE AND SKIN IRRITATION; HARMFUL IF SWALLOWED.

PROTECTIVE PRECAUTIONS FOR WORKERS: Avoid contact with eyes, skin, or clothing. Avoid contamination of food. Wash thoroughly after handling. For Garlon 3A, wear goggles or face shield and rubber gloves when handling. For Garlon 4 and Grazon ET, avoid breathing mists or vapors. Remove and wash contaminated clothing before reuse.

MEDICAL TREATMENT PROCEDURES (ANTIDOTES): There is no specific antidote known; treat the symptoms. If swallowed, get medical attention. For exposure to the skin, flush with plenty of water. Get medical attention if irritation persists. For eye exposure to Garlon 3A, flush with plenty of water for at least 15 minutes. Get medical attention. **In case of emergency, call your local poison control center for advice.**

HANDLING, STORAGE, AND DISPOSAL: Avoid contact with eyes, skin or clothing. Do not ship or store with food, animal feeds, drugs or clothing. Triclopyr formulations are combustible. Do not use or store near heat or open flame. Do not cut or weld container. Triclopyr is stable for at least 2 years under normal storage conditions. Do not contaminate water by disposal. Dispose of this pesticide according to Federal, state or local procedures.

EMERGENCY (SPILL) HAZARDS AND PROCEDURES: Dike large spills. Keep the spill out of streams and water supplies. Absorb small spills with sand or other inert material. Bury material from small spills of Garlon 4 in an approved landfill. Bury material from small spills of Garlon 3A in non-crop area away from water supplies. For large spills, contact the manufacturer for instructions. Observe all local, State and Federal rules for disposal. **In case of a large spill, call CHEMTREC at 1-800-424-9300 for advice.**

VIII. DEFINITIONS

adsorption - the process of attaching to a surface

avian - of, or related to, birds

carcinogenicity - ability to cause cancer

combustible - able to burn

dermal - of, or related to, skin

ecotoxicology - the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment

ecotoxicological - related to the study of the effects of environmental toxicants on populations of organisms originating, being produced, growing, or living naturally in a particular region or environment.

formulation - the form in which the pesticide is supplied by the manufacturer for use

half-life - the time required for half the amount of substance to be reduced by natural processes

herbicide - a substance used to destroy plants or to slow down their growth

LC50 - the concentration in air, water or food which will kill approximately 50% of the subjects

LD50 - the dose which will kill approximately 50% of the subjects

leach - to dissolve out by the action of water

meristem - growth region in plants

mg/kg - milligrams of the substance per kilogram of body weight

microorganisms - living things too small to be seen without a microscope

mutagenicity - ability to cause genetic changes

non-target - animals or plants other than the ones which the pesticide is intended to control

persistence - tendency of a pesticide to remain active after it is applied

ppm - parts per million parts

residual activity - the remaining amount of activity as a pesticide

volatility - the tendency to become a vapor at relatively low temperature

IX. ADDITIONAL READING

Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation. Pacific Northwest Region. Forest Service, U.S. Department of Agriculture, Portland, Oregon. 1988.

Final Environmental Impact Statement. Vegetation Management in the Coastal Plain/Piedmont. Forest Service, U.S. Department of Agriculture, Atlanta, Georgia. Management Bulletin R8-MB-23, 1989.

Final Environmental Impact Statement. Vegetation Management for Reforestation. Forest Service, U.S. Department of Agriculture, San Francisco, California. 1989.

Pesticide Background Statements. Volume I. Herbicides. Forest Service, U.S. Department of Agriculture. Agriculture Handbook 663, 1984.

X. Toxicity Categories

Tables of Categories of Toxicity

Table I: Human Hazards

Category	Signal word	Route of administration		
		Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/l)
I	DANGER Poison	0-50	0-200	0-0.2
II	WARNING	>50-500	>200-2000	>0.2-2.0
III	CAUTION	>500-5000	>2000-20,000	>2.0-20
IV	none	>5000	>20,000	>20

40 CFR 162.10 (h) (1), July 3, 1975

Table I: Human Hazards (continued)

Category	Hazard	
	Eye Irritation	Skin Irritation
I	corrosive: corneal opacity not reversible within 7 days	corrosive
II	corneal opacity reversible within 7 days; irritation persisting for 7 days	severe irritation at 72 hours
III	no corneal opacity; irritation reversible within 7 days	moderate irritation at 72 hours
IV	no irritation	mild or slight irritation at 72 hours

40 CFR 162.10 (h) (1), July 3, 1975

Table II: Ecotoxicological Categories

Mammalian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Acute Oral):

mg/kg	
<10	very highly toxic
10-50	highly toxic
51-500	moderately toxic
501-2000	slightly toxic
>2000	practically non-toxic

Avian (Dietary):

ppm	
<50	very highly toxic
50-500	highly toxic
501-1000	moderately toxic
1000-5000	slightly toxic
>5000	practically non-toxic

Aquatic Organisms:

ppm	
<0.1	very highly toxic
0.1-1	highly toxic
>1-10	moderately toxic
>10-100	slightly toxic
>100	practically non-toxic

Insecticides, Brooks, H.L. et al. (1973) Cooperative Extension Service, Kansas State University, Manhattan, Kansas

For more information on triclopyr contact your local Forest Service, Bureau of Land Management, or Bonneville Power Administration office.

January 1992

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List of Formulations That Do Not Contain Inert Ingredients on EPA Lists 1 or 2

Active Ingredient	Chemical Company	Product Name	EPA Registration No.
Asulam		Inert ingredients are not identified.	
Atrazine	Dupont	Atrazine 4L	352-490
	Ciba-Geigy	AAtrex 80w	100-439
	Ciba-Geigy	AAtrex 90	100-585
	Ciba-Geigy	AAtrex 4L	100-497
	Ciba-Geigy	Atratol 90	100-622
2,4-D	Rhone-Poulenc Ag.	Aqua-Kleen	264-109AA
	Rhone-Poulenc Ag.	Weedar 64	264-2
	Rhone-Poulenc Ag.	Weedar 64A	264-143
	Platte Chemical	Clean Crop Amine 4 2,4-D Weed Killer	34704-5 & 34704-120
	Platte Chemical	Clean Crop Low Vol 4 Ester Weed Killer	34704-124
	Cornbelt Chemical	Weed Pro 4# Amine	10107-31
	Cornbelt Chemical	Weed Pro 4# Low Vol Ester 2,4-D	10107-27
	Cornbelt Chemical	Weed Pro 6# Low Vol Ester 2,4-D	10107-40
	PBI/Gordon	Turf Hi-Dep	2217-703
	PBI/Gorbon	Dymec	2217-633
Dicamba	Sandoz	Banvel Herbicide	55947-1
	Sandoz	Banvel 4S	55947-4
	Sandoz	Banvel 4WS	55947-18
	Sandoz	Banvel CST	55047-32
Dicamba + 2,4-D	Sandoz	Weedmaster	55947-24
	PBI/Gordon	Brush Killer 4-41	2217-644
	PBI/Gordon	Brush Killer 10-5-1	2217-543
Glyphosate	Monsanto	Accord	524-326
	Monsanto	Rodeo	524-343
	Monsanto	Roundup	524-308
Glyphosate + 2,4-D	Monsanto	Landmaster	524-351
	Monsanto	Campaign	524-351
	Monsanto	Landmaster II	524-376
	Monsanto	E-Z-Ject	524-435
Hexazinone	Dupont	Velpar	352-378
	Dupont	Velpar ULW	352-450
	Dupont	Velpar L	352-392
Picloram	Dow	Tordon 2K	464-333
	Dow/Elanco	Tordon 22K	62719-6
	Dow/Elanco	Tordon K	62719-17
	Dow/Elanco	Grazon PC	820002
Picloram + 2,4-D	Dow/Elanco	Tordon 101	62719-5
	Dow/Elanco	Tordon 101R	62719-31
	Dow/Elanco	Tordon RTU	62719-31
Triclopyr	Dow/Elanco	Garlon 3A	62719-37
	Dow/Elanco	Garlon 4	62719-40
	Dow/Elanco	Remedy	62719-70

NOTE: Other formulations of the above chemicals (i.e., not on EPA's list 1 or 2 for inert ingredients) that become available and are cleared through the BLM Washington Office will be considered for use on BLM administered lands. (February 1991)

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