Appendix G
RAVE Model

RAVE: Relative Aquifer Vulnerability Evaluation

An on- farm scoring system to evaluate aquifer vulnerability to pesticide contamination; 2nd Ed.

Introduction
Pesticide applicators of today are faced with growing concern over the potential for pesticide contamination of ground water. Over 50% of all Montanan's and 95% of the agricultural community consume ground water as their source of drinking water. Protecting this fragile resource from pesticide contamination is imperative, because some pesticides may be harmful to humans at very low concentrations and clean- up of ground water is extremely difficult. Pesticide residues in ground water may also adversely affect sensitive crops and wildlife.

To help farmers and pesticide applicators reduce the potential for contaminating ground water with pesticides, an aquifer vulnerability scoring system; RAVE: Relative Aquifer Vulnerability Evaluation has been developed. This numeric scoring system helps individuals evaluate pesticide selection for on- site ground water contamination potential. RAVE is designed only as a guidance system and does not replace the need for safe and judicious pesticide application required in all situations.

In most cases pesticide contamination of ground water can be avoided by using common sense and following label instructions. However, some areas are particularly vulnerable to pesticide contamination and thus require special consideration prior to making an application. The use of this score card may indicate whether an alternative pesticide should be used within a given area or if the area is not suited to pesticide applications.

Several major factors in a particular area determine the relative vulnerability of ground water to pesticide contamination. Nine of these factors have been incorporated into the RAVE score card and are defined below. A Value for most of these factors can be determined by a simple on- site inspection. If a value for a particular factor is not known, contact the appropriate agency for assistance. A listing of agency contacts is provided below. Pesticide leaching potential is based on the soil persistence and mobility of a pesticide. A list of leaching potentials for some commonly used pesticides is given on pages 3- 4.

Factor Definitions

Irrigation Practice: A rating based on whether a field is flood, sprinkler or non- irrigated.

Depth to Ground Water: The distance, in vertical feet, below the soil surface to the water table.

Distance to Surface Water: The distance, in feet, from the field boundary to the nearest flowing or stationary surface water.

Percent Organic Matter: The relative amount of decayed plant residue in the soil (see soil test results, county soil survey or consult the SCS). This may be estimated by soil color; darker soil generally indicates higher organic matter (most Montana soils are < 3 %).

Pesticide Application Frequency: The number of times the particular pesticide is applied during one growing season.

Pesticide Application Method: A rating based on whether the pesticide is applied above or below ground.

Pesticide Leachability: A relative ranking of the potential for a pesticide to move downward in soil and ultimately contaminate ground water based upon the persistence, sorptive potential and solubility of the pesticide.

Topographic Position: Physical surroundings of the field to which the pesticide application is to be made. Flood plain = within a river or lake valley, Alluvial Bench = lands immediately above a river or lake valley, Foot Hills = rolling up- lands near mountains, Upland Plains = high plains not immediately affected by open water or mountains.

Sources of Information

Soils Information: (1) USDA- SCS soil survey, district offices in most county seats; (2) Montana State University (MSU) Extension Service in most county seats, State Soil Specialist in Bozeman (994- 4601); (3) MSU Department of Plant, Soil and Environmental Sciences (994- 4601).

Ground Water Information: (1) Montana Bureau of Mines and Geology in Butte (496- 4155), in Billings (657- 2938); (2) United States Geological Survey in Helena (449- 5225); (3) Montana Department of Health and Environmental Sciences, Water Quality Division (444- 2406); (4) Montana Department of Natural Resources and Conservation, Water Resource Division (444- 6601).

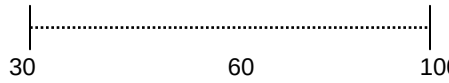
Pesticide Information: (1) Montana Department of Agriculture, Agricultural Sciences Division. Headquarters: Helena (444- 5400), Regional offices: Billings (652- 3615), Bozeman (587- 9067), Great Falls (761- 0926), Glasgow (228- 9510), Missoula (329- 1340); (2) MSU Extension Service offices in most county seats, Pesticide Specialist in Bozeman (994- 3518); (3) US EPA Montana Office in Helena 457- 2690).

Directions for Use of the RAVE Score Card

The RAVE score card can be completed in a matter of minutes. On a separate sheet of paper write down the appropriate value for each of the nine factors listed on the score card. For example; at a sprinkler irrigated site the "Irrigation Practice Factor" would be assigned a value of 7. Once all of the factors have been assigned a value, total all values. This total

should then be compared to the Score Card Interpretation Scale to determine the relative vulnerability of ground water to contamination by an individual pesticide. Higher scores indicate higher vulnerability of ground water to pesticide contamination. If a high score is received, select an alternative pesticide and compare the results.

Score Card Interpretation Scale



30 60 100

Low Concern High Concern

THE RAVE SCORE CARD

DEPTH TO GROUND WATER:		
*2-10 ft	20	
10- 25 ft	12	
25-50 ft	5	
> 50 ft	0	_____
DISTANCE TO SURFACE WATER:		
1-100 ft	5	
100- 500 ft	3	
> 500 ft	2	_____
TOPOGRAPHIC POSITION:		
Floodplain	15	
Alluvial bench	10	
Rolling foothill	5	
Upland plain	2	_____
SOIL TEXTURE:		
Gravelly	15	
Sandy	15	
Loamy	10	
Clayey	5	_____
PERCENT SOIL ORGANIC MATTER:		
0- 1%	5	
**1- 3%	3	
> 3%	2	_____
IRRIGATION PRACTICE:		
Flood irrigated	10	
Sprinkler irrigated	7	
Non- irrigated	2	_____
PESTICIDE APPLICATION FREQUENCY:		
> 1/year	5	
1/year	2	_____
PESTICIDE APPLICATION METHOD:		
Soil applied	5	
Foliar applied	2	_____
PESTICIDE LEACHING INDEX:		
***High	20	
Moderate	10	
Low	5	_____

Total ALL Rankings for the field and pesticide in question here:

* If water table < 2 feet deep, applications should probably not be made
** If unknown, use this value
*** See Table 1 for pesticide leaching index

Interpretation of RAVE Scores

The RAVE score card rates aquifer vulnerability on a scale of 30 to 100 for individual application sites and pesticides. Higher values indicate high vulnerability of ground water to contamination by the pesticide used in the evaluation. Those values greater than or equal to 65 indicate a potential for ground water contamination. In such instances alternative pesticides should be sought which have a lower leaching potential. Scores of 80 or greater indicate that pesticide applications should not be made at this location unless an alternative product greatly reduces the score. Scores between 45 and 64 indicate a moderate to low potential for ground water contamination and scores less than 45 indicate a low potential for ground water contamination by the pesticide in question. Even in such cases, careful use of pesticides and following label instructions is imperative to protect ground water.

Table 1. Commonly used pesticides, an example trade name and relative pesticide leaching potentials. Chemicals bolded have been found in ground water in Montana (Adapted from McBride et al., 1989.)

Pesticide	Leachability
Insecticides	
acephate (Orthene)	low
aldicarb (Temik)	high
aldrin	low
azinphos-methyl (Guthion)	low
carbaryl (Sevin)	low
carbofuran (Furadan)	high
chlorpyrifos (Lorsban)	low
diazinon	low
dimethoate (Cygon)	med
disulfoton (Di- Syston)	low
endosulfan (Thiodan)	low
esfenvalerate (Asana XL)	low
fenvalerate (Pydrin)	low
fonofos (Dyfonate)	med
lindane	med
malathion (Cythion)	low
methamidophos (Monitor)	high
methidathion (Supracide)	med
methomyl (Lannate, Nudrin)	med
methyl parathion (Penncap-M)	low
parathion	low
permethrin (Ambush, Pounce)	low
phorate (Thimet, Rampart)	med
terbufos (Counter)	low
tralomethrin (Scout- Xtra)	low
trichlorfon (Dylox, Proxol)	high
vitavax (Lindane & Thiram)	med
Fungicides	
Benalaxyl	low
benomyl (Benlate, Tersan 1991)	low
captan	low
chlorothalonil (Bravo, Daconil)	low
copper hydroxide (Kocide, Champion)	low
mancozeb (Dithane, Manzate, Penncozeb)	low
maneb	low
metalaxyl (Ridomil)	high
PCNB (Terraclor)	low
propiconazole (Tilt)	med
sulfur (Magnetic 6, Thiolux)	low
thiophanate methyl (Topsin M)	low
thiram	low
triadimefon (Bayleton)	med
triforine	low

Pesticide	Leachability
Herbicides	
acifluorin (Blazer)	low
acrolein (Magnacide H)	high
alachlor (Lasso EC)	med
ametryn	med
amitrole (Amitrole T)	med
atrazine (AAtrex)	high
benefin (Balan)	low
bentazon (Basagran)	med
bromacil (Hyvar)	high
bromoxynil (Butricil)	low
butylate (Sutan+)	low
chloramben (Amiben)	high
chlorsulfuron (Glean)	high
clopyralid (Stinger, Curtail)	high
cyanazine (Bladex)	med
cycloate (Ro- Neet)	med
dalapon	high
desmedipham (Betanex)	low
dicamba (Banvel)	high
diclofop (Hoelon)	low
difenzoquat (Avenge)	low
diuron (Karmex)	med
endothall (Des- I- Cate, Herbicide 273)	low
EPTC (Eptam, Eradicane)	med
ethalfluralin (Sonalan)	low
ethofumesate (Nortron)	high
fenoxaprop (Whip)	low
fenoxaprop- P- ethyl (Cheyenne, Puma)	low
fluazifop- P- butyl (Fusilade 2000)	low
Fosamine Ammonium (Krenite)	low
Glufosinate ammonium (Finale)	low
glyphosate (Roundup)	low
hexazinone (Velpar)	high
imazamethabenz-methyl (Assert)	high
imazapic (Plateau)	high
imazapyr (Arsenal)	high
MCPA	high
MCPA amine (Weedar)	high
MPCA ester	low
MCPA ester (Curtail M)	high
MCPP	high
metolachlor (Dual)	med
metribuzin (Sencor, Lexone)	high
metsulfuron methyl (Ally)	high
MSMA (Daconate)	low
oryzalin (Surflan)	low

Modified RAVE Model

USERS GUIDE

for the

VEGETATION MANAGEMENT RISK ASSESSMENT

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RAVE: Relative Aquifer Vulnerability Evaluation
(as adapted from Montana Department of Agriculture,
Environmental Management Division)

INTRODUCTION

To help pesticide applicators reduce the potential for contaminating groundwater with pesticides, an aquifer vulnerability scoring system--Relative Aquifer Vulnerability Evaluation (RAVE)--was developed by the Montana Department of Agriculture. This numeric scoring system helps individuals evaluate pesticide selection for on-site groundwater contamination potential. RAVE is designed only as a guidance system and does not replace the need for safe and judicious pesticide application in all situations.

In many cases pesticide contamination of groundwater can be avoided by using common sense and following label instructions. However, some areas are particularly vulnerable to pesticide contamination and require special consideration prior to making an application. The use of this score card may indicate whether an alternative pesticide should be used within a given area or if the area is not suited to pesticide applications.

Several major factors determine the relative vulnerability of groundwater in a particular area to pesticide contamination. Nine of these factors have been incorporated into the enclosed RAVE score card and are defined below. A value for most of these factors can be determined by a simple on-site inspection. If a value for a particular factor is not known, then the appropriate agency should be contacted. A listing of agency contacts is provided. Pesticide leaching potential is based on the persistence and mobility of a pesticide in the soil. A list of leaching and surface runoff potentials for herbicides used in vegetation management is given on the attached table.

FACTOR DEFINITIONS

Depth to Groundwater: Distance in vertical feet below the soil surface to the water table.

Soil Texture: Soils predominantly gravel, sand, loam, or clay.

Percent Organic Matter: The relative amount of decayed plant residue in the soil may be estimated by soil color; darker soil generally indicates higher organic matter (most National Forest soils are less than 3 percent).

Topographic Position: Physical surroundings of the field where the pesticide application is to be made. Flood Plain = within a river or lake valley; Alluvial Bench = lands immediately above a river or lake valley; Foot Hills = rolling uplands near mountains; Upland Plains = high plains not immediately affected by open water or mountains.

Distance to Surface Water: Distance in feet from treatment boundary to the nearest flowing or stationary surface water.

Annual Precipitation: Over 60" annual precipitation, 30-60" annual precipitation, less than 30" annual precipitation on the treatment site.

Pesticide Application Frequency: Number of times the particular pesticide is applied during one growing season.

Pesticide Application Method: Whether the pesticide is applied above or below ground.

Pesticide Leachability: A relative ranking of the potential for a pesticide to move downward in soil and ultimately contaminate groundwater. The ranking is based upon the persistence and mobility of the pesticide.

DIRECTION FOR USE OF THE RAVE SCORE CARD

The RAVE score card can be completed in a matter of minutes. On a separate sheet of paper, write down the appropriate value for each of the nine factors listed on the score card. Once all of the factors have been assigned a value, the values should be totaled.

THE RAVE SCORE CARD

Depth to Groundwater:
*2-10 ft. 20
10-25 ft. 12
25-50 ft. 5
> 50 ft. 0 ___

Soil Texture:
Gravelly 15
Sandy 15
Loamy 10
Clayey 5 ___

Percent Soil Organic Matter:
0-1% 5
**1-3% 3
>3% 2 ___

Topographic Position:
Flood Plain 15
Alluvial Bench 10
Rolling Foothill 5
Upland Plain 2 ___

Distance to Surface Water:
0-100 ft. 5
100-500 ft. 3
> 500 ft. 2 ___

Annual Precipitation:
> 60" 5
30-60" 2
<30" 0 ___

Pesticide Application Frequency:
> 1/year 5
1/year 2
< 1/year 1 ___

Pesticide Application Method:
Soil Applied 5
Foliar Applied 2 ___

***Pesticide Leaching Potential:**
Large 20
Medium 10
Small 5 ___

Total all Rankings for the Site and Pesticide in Question here: _____ = RAVE Score.

* If the watertable is less than 2 feet deep, then applications should probably not be made.
** If unknown, use this value.
*** See attached Table (Herbicides and their Properties) for the leaching potential for the pesticide in question.

INTERPRETATION OF RAVE SCORES

Higher numbers indicate high vulnerability of groundwater to contamination by the herbicide used in the evaluation. RAVE scores greater than or equal to 65 indicate a potential for groundwater contamination. In such instances, alternative pesticides should be sought which have a lower leaching potential. Score of 80 or greater indicate that pesticide applications should not be made at this location with the proposed product. Scores between 45 and 65 indicate a moderate to low potential for groundwater contamination and scores less that 45 indicate a low potential for groundwater contamination by the pesticide in question. Even in such cases, it is imperative to use pesticides carefully with strict adherence to label instructions to protect groundwater.

Note: Some products such as the sulfonylurea's are used in very small quantities. In cases where less than 1/2 pound AI per acre is applied, it would be reasonable to reduce the final RAVE score by 2-5 points.

HERBICIDES AND THEIR PROPERTIES

Common Name	Trade Name	Solubility In Water	Soil Sorption Index	Half Life in Soil	Surface Runoff	Leaching
Herbicide	Name	PPM	Koc	Days	Potential	Potential
AMITROLE	Amizole, Weedazol	280,000	100	14	Medium	Medium
ATRAZINE	Atrazine, AAtrex	33	100	60	Medium	Large
BROMACIL	Hyvar X	815	32	90	Medium	Large
CHLORSULFURON	Glean, Telar	300 (pH-5) 28,000 (pH-7)	f(pH)	30-Acid Soil 30+ -Alkaline	Small	Large
CLOPYRALID	Stinger, Curtail	Very Soluble	~~1.4~~ 6.0 (AVG) (RANGES TO 60)	20	Small	Large
2,4-D (ESTER)	Several Names	900	~~1,000~~ E 100 (ESTIMATED)	10	Medium	Small
2,4-D (AMINE)	Several Names	890	20	10	Small	Medium
DICAMBA	Banvel	4,500	2	14	Small	Large
DICHLOBENIL	Casoron	25	224	30	Medium	Medium
DIURON	Karmex, Diuron	42	480	60	Large	Medium
GLYPHOSATE	Roundup	12,000	24,000	30	Large	Small
HEXAZINONE	Velpar	33,000	54	60	Small	Large
IMAZAPYR	Arsenal, Chopper	15,000	5 E	90	Small	Large
MEFLUIDIDE	Embark 2-S	566,000	--	2	Medium	Small
METSULFURON METHYL	Escort	.109 mg/ml	f(pH)	120	Medium	Large
PICLORAM	Tordon 22K	430	16	90	Small	Large
PROMETON	Pramitol	750	300	120	Large	Large

- - Continued - -

Common Name	Trade Name	Solubility In Water	Soil Sorption Index	Half Life in Soil	Surface Runoff	Leaching
Herbicide	Name	PPM	Koc	Days	Potential	Potential
SIMAZINE	Princep, Simazine	3.5	138	75	Medium	Large
SULFOMETURON	Oust	10 (pH-5) 5,300 (pH-7)	f(pH) f(pH)	60 60	Medium Large	Medium Large
TEBUTHIURON	Spike	2,300	80	360	Small	Large
TRICLOPYR	Garlon 4, Turflon	430	780	46	Large	Medium
TRIFLURALIN	Treflan	0.3	7,000	60	Large	Small

SOURCE: Wyoming Weed Control Series, No. 1, Herbicides and Their Properties and Applications, College of Agriculture. B-442.1, University of Wyoming, Laramie, Wyoming.

Utah Weed Control Handbook, 1991, Cooperative Extension Service, EC 301, Utah State University Logan, Utah.

DEFINITIONS

COMMON NAME - Refers to an active ingredient without naming a specific product.

TRADE NAME - Typical name or names by which the ingredient is marketed.

SOLUBILITY IN WATER - This is the solubility of the pure active ingredient, not the formulated product. A large number means highly soluable. A small number means low solubility. Generally, herbicides with solubilities of 1 PPM or less will tend to stay near the soil surface and be washed off in sediment.

SOIL SORPTION INDEX - The Koc measures the tendency of the herbicide to be strongly attached, by chemical or physical bonds, to soil particle surfaces. The higher Koc values (1000) have a stronger attachment to soil and a lesser tendency for the herbicide to move except with sediment movement. "E" = Estimate value w/probable error values of 3X to 5X for Koc.

HALF-LIFE IN SOIL - The time required for herbicides in soils to be degraded so their concentration decrease by one-half. Herbicide degredation can be described fairly accurately by assuming that each successive elapsed half-life will decrease the herbicide concentration by half. A period of two half-lives will reduce a soil concentration to one-fourth the initial amount. The numbers given should only be used as relative indicators of persistence. These half-lives are for herbicides in the interior of the soil and generally refer to chemical or microbiological degradation. Herbicides deposited on the surface or deposited on plant or crop litter surfaces, which remain there generally show half-lives of only a few days or less under these conditions.

RUNOFF POTENTIAL - A large rating means the herbicide has a high tendency to move with sediment in runoff. A small rating means the herbicide has a low potential.

LEACHING POTENTIAL - This indicates the tendency of an herbicide to move in solution with water and leach below the root zone into deep perculation. A rating of large means the chemical has a high potential for leaching.

Supplemental Table Herbicides and their Properties (for use with RAVE Scorecard)						
Common Name	**Trade Name**	**Solubility in Water (ppm)**	**Soil Sorption Index (Koc)**	**Half Life in Soil (days)**	**Surface Runoff (Loss) Potential**	**Leaching Potential**
Chlorsulfuron	Telar	300 (pH 5) 28,000 (pH7)	40 @ pH 7 (average)	30 for acid soil 30+ for alkaline soil	Small	Large
Clopyralid	Curtail, Transline, Stinger, Reclaim, Lontrel	1,000 (acid) 300,000 (salt)	1.4	20	Small	Large
2,4-D (amine)	2,4-D, Aqua-Kleen,	890	20	10	Small	Medium
2,4-D (ester)	Barrage, Weedone	900	100 (estimated)	10	Medium	Small
Glyphosate	Roundup Pro, Roundup Ultra, Rodeo, GlyPro, Accord, Glyphomax, Touchdown	12,000	24,000	30	Large	Small
Imazapic	Plateau, Cadre, Plateau Eco-Paks	2,200	10-267 (depends on soil type)	31-410 (176.25 average)	Small	Medium
Metsulfuron methyl	Escort	548 @ pH 5 2,790 @ pH 7 213,000 @ pH 9	37 @ pH 7	120	Medium	Large
Picloram	Tordon, Grazon PC, Tordon K, Tordon 22	430	16 - average for the K salt (17-160 range)	90	Small	Large
Quinclorac	Paramount	64	13-54	18-176	Variable, depends on soil type	Medium
Triclopyr	Garlon products	430	780	46	Large	Medium

Source: McCrea, J. 2001. Supplemental Table for RAVE.

Cited References

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Appendix H
Minimum Requirement Decision Guide

Process Outline

Step 1: Determine if any administrative action is *necessary*

First, describe the situation that may prompt action and describe why it is a problem or issue.

Then, answer the following questions to determine if administrative action is necessary in wilderness:

A. Options Outside of Wilderness - Is action necessary within wilderness?

B. Valid Existing Rights or Special Provision of Wilderness Legislation - Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of the Section 4(c) prohibited uses?

C. Requirements of Other Legislation - (ESA, ARPA, NHPA, Dam Safety Act, Clean Air Act, etc.) - Is action necessary to meet the requirements of other laws?

D. Other Guidance - Is action necessary to conform to direction contained in agency policy, unit and wilderness management plans, species recovery plans, or agreements with tribal, state and local governments or other federal agencies?

E. Wilderness Character - Is action necessary to preserve one or more of the qualities of wilderness character including: ***untrammeled, undeveloped, natural, outstanding opportunities for solitude or a primitive and unconfined type of recreation***, or unique components that reflect the character of this wilderness area?

F. Public Purposes of Wilderness - Is action necessary to support one or more of the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Step 1 Conclusion: Is Administrative Action Necessary?
If action is necessary, proceed to Step 2 to determine the minimum activity which least impacts the wilderness resource and character.

Step 2: Determine the *minimum* activity

A. Description of Alternative Action - For each alternative, describe what methods and techniques will be used, when the action will take place, where the action will take place and what mitigation measures are necessary.

Alternatives considered should include one with the use of the suggested prohibited equipment or facilities, one with none of the Section 4 (c) prohibitions, and, if possible one with a mix of prohibited and non-prohibited uses. Alternatives should be "feasible" and creative.

B. **Alternative Comparison -** For each alternative, describe effects based on:

- Wilderness Character

-Untrammeled
-Undeveloped
-Natural
-Outstanding Opportunities for Solitude or a Primitive and Unconfined Type of Recreation
-Other unique components that reflect the character of this wilderness

- Heritage and Cultural Resources
- Maintaining Traditional Skills
- Special Provisions
- Economics and Time constraints
- Additional wilderness-specific criteria

- Safety of personnel, visitors, and contractors

➢ Include mitigation (timing, location, frequency, design standards, etc.)

Step 2 Decision: What is the Minimum Activity?

➢ Identify the selected alternative.
➢ Describe the rationale for selecting this alternative, based on law and policy criteria. Include documentation of Safety criterion, if appropriate**.**
➢ Describe any monitoring and reporting requirements.

Approvals and NEPA analysis - Follow agency guidelines.

Reporting – Follow agency requirements.