APPENDIX E – Ground Water Analysis

Rating Groundwater Vulnerability to Herbicide Contamination, base on the RAVE: Relative Aquifer Vulnerability Evaluation (Montana State University Extension Service, 1990. MDA Technical Bulletin 90-01A)

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 below.

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).

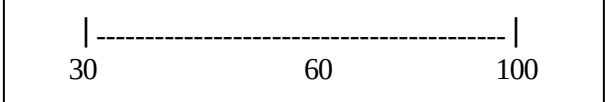
Ground Water Information: (1) Montana Bureau of Mines and Geology in Butte (496-4155), in Billings (657-2938); (2) United States Geological Survey in Helena (449-5225); (3) Montana Department of Health and Environmental Sciences, Water Quality Division (444-2406); (4) Montana Department of Natural Resources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



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 notbe 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.

Herbicides

chlorsulfuron (Glean)	high
clopyralid (Stinger, Curtail)	high
dicamba (Banvel)	high
glyphosate (Roundup)	low
hexazinone (Velpar)	high
imazapic (Plateau)	high
imazapyr (Arsenal)	high
metsulfuron methyl (Ally)	high
picloram (Tordon)	high
sulfometuron methyl (Oust)	med
triclopyr (Garlon)	med
2,4-D	high
2,4-D amine (Curtail)	high
2,4-D ester (Curtail M)	high

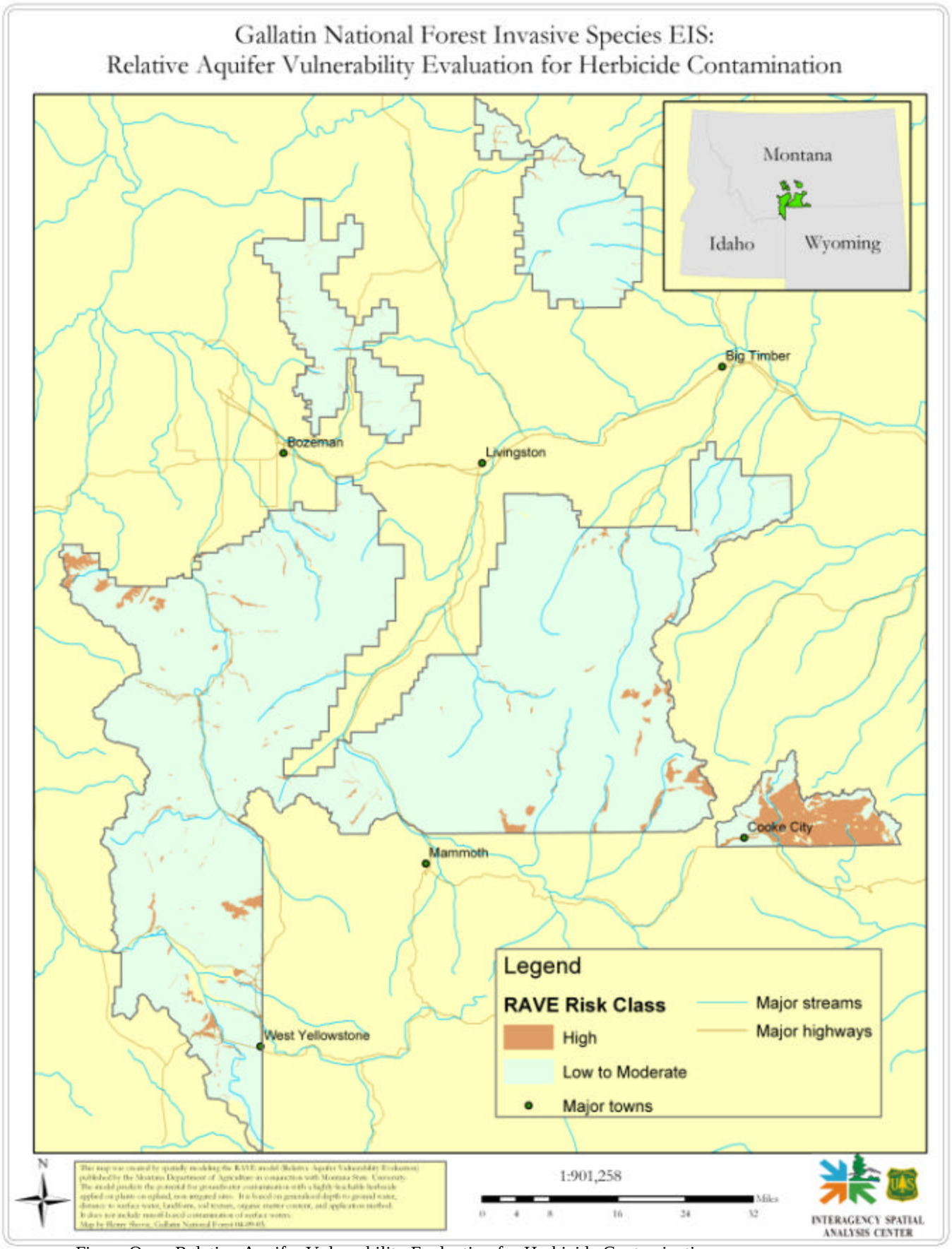


Figure One. Relative Aquifer Vulnerability Evaluation for Herbicide Contamination

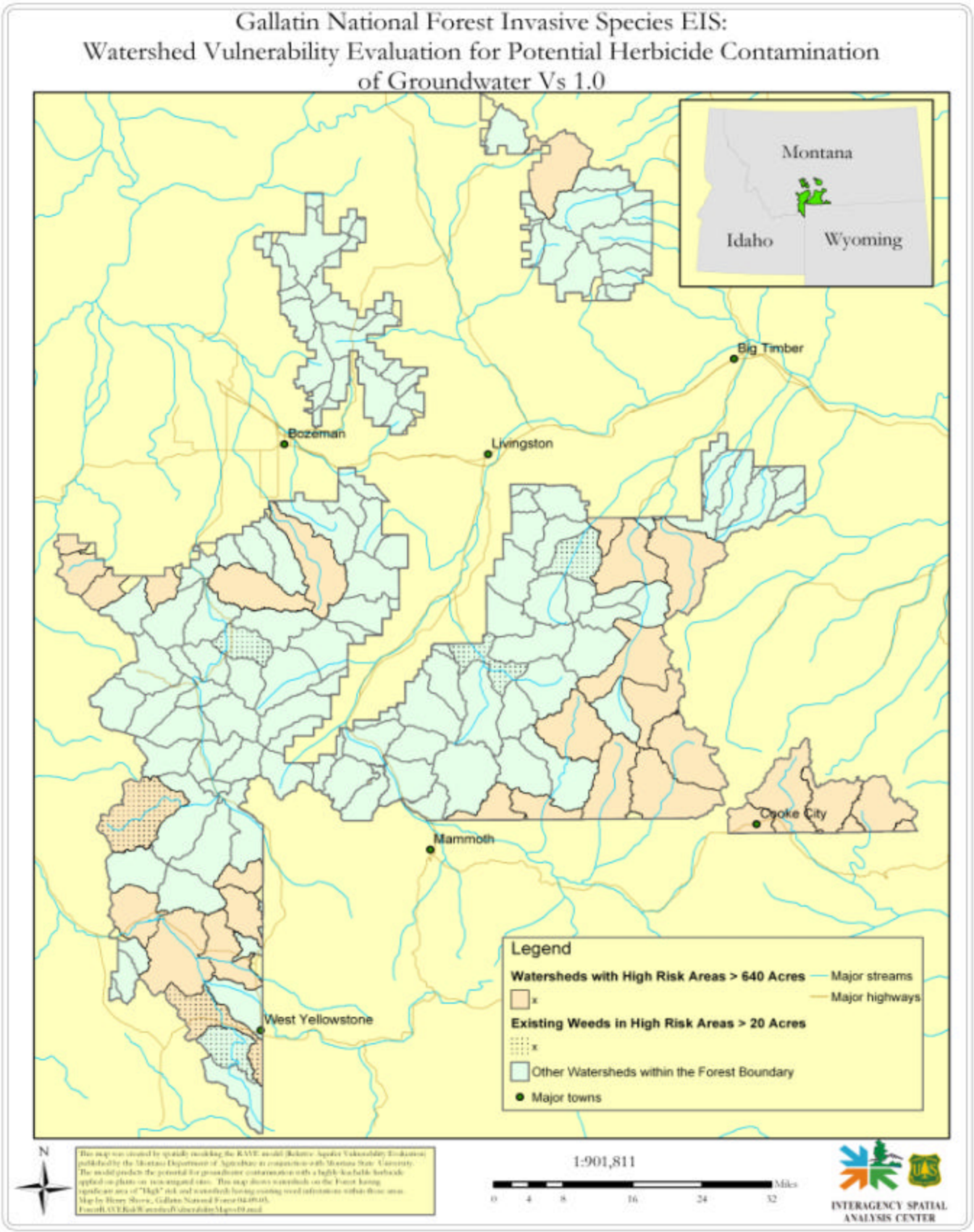


Figure Two. Watershed Vulnerability Evaluation for Potential Herbicide Contamination of Groundwater