Water Quality ***Best Management Practices for AGRICULTURAL HERBICIDES***

February 2004

In order to protect Minnesota's water resources, the Minnesota Department of Agriculture (MDA), along with the University of Minnesota Extension Service and other interested parties, has developed a set of core voluntary Best Management Practices (BMPs). The core voluntary BMPs are provided on the opposite side of this page and should be adopted when applying all agricultural herbicides in Minnesota. The BMPs may also refer to mandatory label use requirements. Always read product labels. Additional information and references accompany the BMPs.

The MDA has also developed unique voluntary BMPs (on separate pages) for the use of specific herbicides due to their presence in Minnesota's groundwater or surface water from normal agricultural use. The herbicide-specific BMPs should be adopted when using herbicides that have been, or whose breakdown products have been, frequently detected in groundwater (acetochlor, alachlor, atrazine, metolachlor and metribuzin) or those detected at concentrations of concern in surface water (acetochlor and atrazine). If the BMPs are proven ineffective, mandatory restrictions on herbicide use and practices may be required. For information on monitoring results for herbicides in Minnesota's water resources, refer to the MDA's Monitoring and Assessment webpage: http://www.mda.state.mn.us/appd/ace/maace.htm

Careful planning in the use of herbicides – as part of an Integrated Weed Management Plan – can help protect water resources from future contamination and help reduce the levels of herbicides currently in Minnesota's waters. Planning also promotes the efficient and economical use of herbicides and may result in reduced application rates that can save you money.

State and federal law can require that the use of a pesticide be limited or curtailed due to the potential for adverse impacts on humans or the environment. The Minnesota Pesticide Control Law (Minn. Stat. 18B) outlines state regulatory authority to prevent these impacts. The Minnesota Groundwater Protection Act (Minn. Stat. 103H) outlines a process that can lead to regulations on the use of herbicides frequently detected in groundwater. In addition, there are other state and federal laws that could lead to restrictions on the use of herbicides contributing to surface water impacts. Adopting these BMPs, and a cautious and respectful attitude regarding the proper use of herbicides, will help growers to maintain access to a variety of herbicides as important and diverse tools in the effort to control weeds and protect water resources.

Best Management Practices (BMPs) for herbicide use

- The purpose of voluntary BMPs is to prevent and minimize the degradation of Minnesota's water resources while considering economic factors, availability, technical feasibility, implementability, effectiveness, and environmental effects.

Integrated Weed Management

Reducing crop losses by combining *cultural*, *chemical* and *mechanical* techniques in ways that favor the crop and suppress weed populations and vigor.

See "Additional Information & References" for more details and practical examples.

- From a practical standpoint, these BMPs are intended to reduce the loss of herbicides to the environment and to encourage the efficient use of herbicides, chemistry-rotation, and non-chemical approaches to weed control as part of an Integrated Weed Management program to save costs, reduce development of herbicide resistant weeds and increase profitability.

The BMPs are provided as a series of options. Producers, crop consultants and educators should select options most appropriate for a given farming operation, soil types and geography, tillage and cultivation practices, and irrigation and runoff management. The MDA encourages development of Integrated Weed Management Plans for every Minnesota farm (see "Additional Information and References" for more information). **Always read the product label. Label use requirements and application setbacks are legally enforceable.**

Water Quality *Best Management Practices for All Agricultural Herbicides*

Core Practice*	Description	Benefit
1. Scout fields for weeds and match the management approach to the weed problem.	Scout for weeds, then map infestations throughout the year. Determine whether weed control will result in significant crop yield benefits. Carefully match weed control options – including non-chemical control – to weed pressures. Use herbicides only in situations where they are necessary and will be cost-effective. Use herbicides with long-lasting effect ("residual control") only in fields that have high densities of target weeds or in fields where weed information is lacking (e.g., newly rented or purchased acres). Consider post-emergent weed control alternatives.	Responding accurately to specific weed pressures, using post-emergent control and using alternative chemical and non-chemical (e.g., cultivation) controls can lower costs and prevent water resource impacts.
2. Evaluate reduced or split herbicide application rates.	Evaluate a reduced-rate herbicide program. Banding – especially in ridge-till rotations – can significantly reduce herbicide inputs. Use split applications to reduce the amount of herbicide loss in runoff during early spring rains. Consider using the lowest labeled rate in a "rate range." Start on a small area to test what works best on your farm. Be prepared for follow-up weed management including post-emergent herbicide application, rotary hoeing, or inter-row cultivation.	In many cases, banding and a carefully planned reduced-rate herbicide program can result in effective weed control, reduced costs, and a reduction in herbicide loss to the environment.
3. *For Surface Water protection*: Soil incorporate herbicides.	When the timing of application and the product label allow, incorporate herbicides to reduce runoff losses. Use a field cultivator or other implement to incorporate products to the greatest recommended depth. Easily adopted when tilling prior to planting.	Incorporated herbicide is less vulnerable to being lost in runoff and reaching nearby streams and surface tile inlets.
4. *For Surface Water protection*: Evaluate surface drainage patterns in your field and install filter strips and establish buffer zones for streams, sinkholes and tile inlets.	Work with crop consultants and other ag professionals. Study Natural Resources Conservation Service (NRCS) listings for herbicides and soil properties that can lead to herbicide losses in runoff to surface waters (rivers, streams & lakes). Consider herbicides that NRCS lists as having low loss ratings for runoff from your soils, or consider non-chemical weed control methods in sensitive areas. Then, in addition to required label setbacks or buffers, install vegetative filter strips and establish buffers along vulnerable surface waters, karst features, tile inlets and sinkholes.	Filters and buffers reduce field runoff and setbacks eliminate applications where losses are most likely. Reducing use of herbicides known to move to surface water reduces the potential for surface water contamination.
5. *For Ground Water protection:* Determine the depth to groundwater in your fields and consider protective practices in vulnerable areas.	Work with crop consultants and other ag professionals. Study Department of Natural Resources groundwater pollution sensitivity maps and Natural Resources Conservation Service (NRCS) listings for herbicides and soil properties that contribute to herbicide losses by leaching. Consider herbicides that NRCS lists as having low loss ratings for leaching from your soils, or consider non-chemical weed control methods in sensitive areas. Follow label requirements or recommendations where water tables are shallow.	Reducing herbicide use in sensitive areas reduces the potential for groundwater contamination. Adhering to label groundwater advisories and exclusions reduces aquifer pollution.
6. Rotate herbicide modes of action (chemistry).	Avoid more than two consecutive applications of herbicides with the same mode of action (chemistry) to the same field. Evaluate this practice in the context of other effective control practices in the management system (e.g., use of tank mixes with multiple modes of action; crop rotation; planned, periodic use of herbicide-resistant crops in a rotation; mechanical weed control; field scouting).	This practice serves to reduce development of herbicide resistance in weeds or weed species shifts and, in the long term, can help reduce the total annual loss of particular herbicides to water resources and the environment.
7. Consider precision application of herbicides.	Precision application of herbicides (spot spraying or use of variable rate technologies) is based on weed scouting and variation in soil properties (soil organic matter and texture). Adjust application rates according to weed pressures and soils information.	Precision applications result in less total herbicide applied when compared to broadcast applications; this means less potential loss to the environment.
8. *For Ground Water protection:* Develop an Irrigation Water Management Plan.	If you irrigate, implement a water management scheduling plan that uses a soil probe, rain gauge, daily crop water use estimations and a soil water balance worksheet.	Effective irrigation management reduces leaching of chemicals to groundwater.

***For practices related to the use of specific herbicides refer to MDA's herbicide-specific Best Management Practices. *All BMPs are available at http://www.mda.state.mn.us/appd/bmps/bmps.htm* See "Additional Information & References" for access to detailed guidance on all recommended practices.**

ADDITIONAL INFORMATION & REFERENCES

This information accompanies the State of Minnesota's voluntary Water Quality Best Management Practices (BMPs) for agricultural herbicides. The information and references are not additional BMPs; rather, they provide more detailed guidance to support a producer's management program for the proper use of all herbicides, and are provided in support of the voluntary BMPs.

Applied Weed Research

University of Minnesota Applied Weed Science Research program (assistance with *general weed and herbicide information*, *mode of action*, *crop injury*, *pesticide trials* and links to many other helpful sources of information) http://appliedweeds.coafes.umn.edu/

"Herbicide Resistant Weeds" (helpful information on *rotating chemistries & herbicide modes of action*) J.L. Gunsolus, 1999, U of M, http://www.extension.umn.edu/distribution/cropsystems/DC6077.html

Pesticide Use

Minnesota Department of Agriculture: *Best Management Practices for pesticide use* http://www.mda.state.mn.us/appd/bmps/bmps.htm; *Pesticide sales and use* information http://www.mda.state.mn.us/appd/pesticides/pesticideuse.htm; *Plant pest survey* information http://www.mda.state.mn.us/pestsurvey/default.htm; and *Integrated pest management information* http://www.mda.state.mn.us/ipm/default.htm

Natural Resources Conservation Service (NRCS) offices (offers access to a helpful document on *integrated weed management* entitled *"Protecting Wisconsin's Resources through Integrated Weed Management"* and includes the *"Minnesota Insert"*); the same publication (without the insert) can be obtained at http://ipcm.wisc.edu/pubs/pdf/Int_Weed.pdf Additional helpful information is available at http://www.mn.nrcs.usda.gov/technical/ecs/pest/pest.htm

Iowa State University Extension Service (descriptions of ways in which farmers have saved money in herbicide costs and reduced herbicide use while effectively managing weeds), see *"Eight Ways to Reduce Pesticide Use,"* at http://www.pme.iastate.edu/resources/default.htm (publication #IPM 59).

University of Wisconsin-Extension (information on *development and implementation of a reduced-rate herbicide program*) http://ipcm.wisc.edu/pubs/pdf/a3563-reduced01.pdf

Soils & Water

Local SWCD offices (assistance with *water table information*, *soil maps*, *groundwater and surface water maps*) http://www.bwsr.state.mn.us/directories/index.html

Minnesota Department of Natural Resources (information for some areas of the state for identifying *water table depth*, *groundwater pollution sensitivity, karst features*) http://www.dnr.state.mn.us/waters/groundwater_section/mapping/index.html

Natural Resources Conservation Service (NRCS) (assistance with *water table information*, *soil maps*, identification of *vulnerable soils* in your county, *pest and weed management planning*) http://www.mn.nrcs.usda.gov/ and click on "Technical Resources." To locate offices for local assistance, click on "Find a Service Center" For information on protective filter strips, go to http://www.mn.nrcs.usda.gov/technical/ecs/agron/crp/cp21.doc

University of Minnesota Extension Service offices (assistance with *Integrated Weed Management Plan development* and implementation, and *soils and water information*) http://www.extension.umn.edu/offices/ See also Extension Bulletin "Tillage Best Management Practices for Water Quality Protection in Southeast Minnesota," BU-07694-S (2002) http://www.extension.umn.edu/distribution/cropsystems/DC7694.html

University of Minnesota Extension Service (assistance with *irrigation water management plans*) at http://www.extension.umn.edu/distribution/cropsystems/DC1322.html Also see the University of Wisconsin's irrigation decision support and record-keeping software "WISDOM" http://ipcm.wisc.edu/apps/wisdom/default.htm

Minnesota Department of Agriculture (information about *pesticide management programs, monitoring and assessment of water resources for pesticide impacts, pesticide use and sales, Best Management Practices*) http://www.mda.state.mn.us/appd/ace/pestmgmt.htm

ADDITIONAL INFORMATION & REFERENCES

Integrated Weed Management

Use one or more of the following strategies to help you cost effectively manage weeds while protecting the environment. Develop an Integrated Weed Management Plan in consultation with the local University of Minnesota Regional Extension Educators, Natural Resources Conservation Service and Soil & Water Conservation District personnel, certified crop advisors and local crop consultants.

- ✓ **Develop an Integrated Weed Management Plan for your field(s) –** The MDA encourages the development of Integrated Weed Management plans for every Minnesota farm (*see opposite side of this page for additional information and references)*. Start slow if you like…try the practices on a few fields and build from there!

- ✓ **Document recent chemical use.** This information is important when planning for rotating herbicide chemistries and establishing reduced rate programs.

- ✓ **Introduce a post-harvest cover crop, introduce a small grain or perennial forage**, and rotate among a wider variety of crops to disrupt weed life cycles and control weeds while using fewer chemicals.

- ✓ **Don't assume that more is better!** It may cost more to achieve 100% elimination of weeds than is gained through increased yield. Work with a crop consultant to determine the economic level of injury your field can sustain with reduced or no herbicide use.

- ✓ **Proper application timing.** Apply herbicides under optimal environmental conditions and at the appropriate time of year, crop growth stage, and weed growth stage specified on the label. Doing so can reduce the availability of herbicides for runoff or leaching.

- ✓ **Use a rotary hoe, harrow or cultivator** as part of integrated approaches to weed control. Mechanical weed control can reduce herbicide program costs and reduce herbicide environmental impacts.

- ✓ **Consider planned, periodic use of herbicide-resistant (HR) crops** into cropping sequences, but don't rely on this technology to solve all weed problems. HR crops should be considered as part of a planned rotation of herbicide chemistries (to avoid the buildup of herbicide resistant weeds or weed species shifts).

- ✓ **Apply herbicides as split applications** to reduce the amount of herbicide on the soil surface during periods of higher rainfall intensities.

- ✓ **Work with your local crop consultant and regional Extension Educators** to determine where reduced rates or alternative weed control practices can be introduced.

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Water Quality ***Best Management Practices for ATRAZINE***

February 2004

The Minnesota Department of Agriculture (MDA) has developed voluntary Best Management Practices (BMPs) to address the presence of atrazine and its breakdown products in Minnesota's groundwater and surface water from normal agricultural use (see reverse side of page for atrazine-specific BMPs). If the BMPs are proven ineffective, mandatory restrictions on herbicide use and practices may be required. The BMPs may also refer to mandatory label use requirements. Always read product labels. For information on monitoring results for atrazine and other pesticides in Minnesota's water resources, refer to the MDA's Monitoring and Assessment webpage: http://www.mda.state.mn.us/appd/ace/maace.htm

Example trade names for products and package mixtures containing atrazine. List is not all-inclusive and can change with the introduction of new products; always check the label, or consult MDA's product registration database at http://state.ceris.purdue.edu/doc/mn/statemn.html and search for Active Ingredient.*

Atrazine is an active ingredient in:		
Aatrex	Degree Xtra	Lariat
Atrazine	Expert products	Leadoff
Axiom AT	Field Master	Liberty ATZ
Basis Gold	FulTime products	Lumax
Bicep II products	Guardsman	Marksman
Buctril + atrazine	Harness Xtra	Moxy + atrazine
Bullet	Keystone products	Shotgun
Cinch products	Laddok	

* Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement is implied.

The atrazine BMPs are companions to a set of core BMPs for use with all agricultural herbicides. Herbicide-specific BMPs have also been developed for use with acetochlor, alachlor, metolachlor and metribuzin. If you use any of these herbicides in the production of crops, be sure to consult each herbicide-specific BMP prior to applying these herbicides. State and federal law can require that the use of a pesticide be limited or curtailed due to the potential for adverse impacts on humans or the environment.

Information about ATRAZINE

- Atrazine is a Restricted Use Pesticide that can only be purchased and applied by properly licensed or certified individuals. All pre-mixes and tank mixes containing atrazine are also Restricted Use Pesticides.

- Atrazine can travel (seep or leach) through soil and can enter groundwater used as drinking water. Users are advised not to apply atrazine to sand and loamy sand soils where the water table (groundwater) is close to the surface and where these soils are very permeable. Atrazine and its breakdown products have been frequently detected in Minnesota groundwater beneath areas with coarse-textured soils.

- Atrazine can also be lost to surface water through field runoff, and has been found at concentrations of concern in Minnesota surface waters. Atrazine is toxic to aquatic invertebrates, and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas.

- Atrazine is a photosynthesis inhibiting herbicide that manages weeds through a particular mode of action (chemistry). When used in an Integrated Weed Management (IWM) Plan, its use should be considered jointly with other photosynthesis inhibiting herbicides. Use of herbicides with different modes of action (e.g., plant growth regulators, pigment inhibitors or sulfonylurea herbicides), alone or in tank mixes, may be desirable in an IWM Plan to effectively control weeds while protecting the environment.

Certain soils, regions and watersheds are more vulnerable to losses of atrazine. Sensitive areas include those with highly permeable geologic material, highly erodible soils or seasonally high water tables (including areas with drain tiles). Note that portions of every Minnesota county may include one or more of these conditions.

Contact your Natural Resources Conservation Service or Soil & Water Conservation District for further information on specific soil and water resource conditions on and near your farm. Then work with crop consultants and educators to select and adopt the Best Management Practices that are appropriate for your field and farm.

The BMPs are provided as a series of options. Producers, crop consultants and educators should select options most appropriate for a given farming operation, soil types and geography, tillage and cultivation practices, and irrigation and runoff management. The MDA encourages development of Integrated Weed Management Plans for every Minnesota farm (see "Additional Information and References" for more information). **Always read the product label. Label use requirements and application setbacks are legally enforceable.**

Water Quality *Best Management Practices for ATRAZINE*

To be used in conjunction with MDA's core "BMPs for All Agricultural Herbicides"

Atrazine-Specific Practice*	Description	Benefit
1. Adopt the core "BMPs for All Agricultural Herbicides" when applying atrazine.	MDA's core "BMPs for All Agricultural Herbicides" are designed as the baseline set of options to mitigate or prevent losses of herbicides to water resources. The core BMPs are available at http://www.mda.state.mn.us/appd/bmps/bmps.htm	Adoption of core BMPs with those specific for atrazine and adherence to mandatory label use requirements and application setbacks result in opportunities for multiple water quality protection benefits.
2. Limit total atrazine use per year to 0.8 lbs of active ingredient per acre on coarse-textured soils by using premixes and tank mixes.	This practice is especially important on coarse-textured soils (e.g., where sand, loamy sand or sandy loam soil textural classifications make up more than 25% of the field). These soils are common in central Minnesota, but are also present in many other locations.	Effective weed control for many small-seeded broadleaf weeds can be obtained using premixes and tank mixes with low atrazine content. Lower rates mean less potential loss to water resources.
3. *For Southeast Minnesota:* Limit total atrazine use per year to 0.8 lbs of active ingredient per acre on all soils *except* on medium and fine textured soils, where a total of 1.0 lb of active ingredient per year can be used for pre-emergence weed control.	This practice is important on any soils in the following ten counties in southeastern Minnesota with karst geology and features: *Dakota, Dodge, Fillmore, Goodhue, Houston, Mower, Olmsted, Rice, Wabasha and Winona.* The slightly higher rate of atrazine for pre-emergence applications on medium- and fine-textured soils is allowed to maintain efficacy of early season weed control and reduce potential losses from leaching and runoff.	Effective weed control for many small-seeded broadleaf weeds can be obtained using premixes and tank mixes with low atrazine content. Lower rates mean less potential loss to water resources.
4. Evaluate surface drainage patterns in your field, then identify points where surface runoff leaves the field and consider protective practices in vulnerable areas, including tile inlets, wells and sinkholes; follow label requirements for application setbacks and planted buffers.	Work with crop consultants and other ag professionals. Identify and implement appropriate label-required setbacks and planted buffers for your farm. Atrazine, and premixes or tank mixes containing atrazine, may not be applied within 66 feet of the points where runoff enters perennial or intermittent streams and rivers, within 200 feet around natural or impounded lakes and reservoirs, or within 50 feet of wells or sinkholes. Setbacks or buffers could also be adopted around surface inlets on tile-drained fields for further water quality protection benefits.	Protects vulnerable wells, sinkholes, streams, rivers, lakes and reservoirs from atrazine impacts.
5. Adopt conservation tillage practices appropriate for your farm's topography and in SE Minnesota karst areas.	Conservation tillage controls soil erosion that can contribute to losses of atrazine attached to soil particles during field runoff events and from fields with tile drain surface inlets. It also helps slow movement of water across the landscape when atrazine is dissolved in runoff water. Consult your Natural Resources Conservation Service and Soil & Water Conservation District offices for current tillage guidelines.	Controlling loss of soil and runoff helps reduce atrazine losses to surface waters.
6. Rotate use of atrazine (and metribuzin and other photosynthesis inhibiting herbicides) with herbicides from a different chemical class.	Evaluate this practice in the context of other effective control practices in the management system (e.g., use of tank mixes with multiple modes of action; crop rotation; planned, periodic use of herbicide-resistant varieties in a rotation; mechanical weed control; field scouting). Determine which crop in the rotation is in greatest need of photosynthesis inhibiting herbicides, and reserve their use for that crop.	With time, this practice will reduce development of herbicide resistant weeds or weed species shifts, and means less annual availability of these herbicides for loss to the environment.

***For core practices and for practices related to the use of other specific herbicides, visit MDA's Best Management Practices webpage at *http://www.mda.state.mn.us/appd/bmps/bmps.htm* See "Additional Information & References" for access to detailed guidance on all recommended practices.**

- Metolachlor belongs to the class of "chloracetamide herbicides" that manage weeds through a similar mode of action (chemistry). Other herbicides in this class include acetochlor and alachlor. Herbicides in this class should be considered in the context of an Integrated Weed Management (IWM) Plan. All chloracetamide herbicides have similar potential to contaminate water resources.

The BMPs are provided as a series of options. Producers, crop consultants and educators should select options most appropriate for a given farming operation, soil types and geography, tillage and cultivation practices, and irrigation and runoff management. The MDA encourages development of Integrated Weed Management Plans for every Minnesota farm (see "Additional Information and References" for more information). **Always read the product label. Label use requirements and application setbacks are legally enforceable.**

Water Quality *Best Management Practices for METOLACHLOR*

To be used in conjunction with MDA's core "BMPs for All Agricultural Herbicides"

Metolachlor-Specific Practice*	Description	Benefit
1. Adopt the core "BMPs for All Agricultural Herbicides" when applying metolachlor.	MDA's core "BMPs for All Agricultural Herbicides" are designed as the baseline set of options to mitigate or prevent losses of herbicides to water resources. The core BMPs are available at http://www.mda.state.mn.us/appd/bmps/bmps.htm	Adoption of core BMPs with those specific for metolachlor and adherence to mandatory label use requirements and application setbacks result in opportunities for multiple water quality protection benefits.
2. Determine your soil's texture and organic matter content, then limit metolachlor application rates to the indicated label recommendation.	The practice is especially important for metolachlor (and other chloracetamide herbicides). Weed control with metolachlor is sensitive to differences in soil organic matter and texture. Limit unnecessary and costly use of metolachlor and protect the environment by carefully reviewing the label and adjusting the application rate to match your soil organic matter content and soil texture.	Proper metolachlor application rates mean cost-effective use and efficient weed control with minimal risk of water resource impacts.
3. When using metolachlor herbicides, choose products with "s-metolachlor" listed as the registered active ingredient.	The active ingredient "s-metolachlor" is considered a reduced risk for water resource impacts because a lesser amount of the product is needed to achieve the same level of weed control as that achieved with the active ingredient "metolachlor."	Use of products containing "s-metolachlor" at recommended label rates can mean fewer potential impacts to water resources.
4. Adopt conservation tillage practices appropriate for your farm's topography and in SE Minnesota karst areas.	Conservation tillage controls soil erosion that can contribute to losses of metolachlor attached to soil particles during field runoff events and from fields with tile drain surface inlets. It also helps slow movement of water across the landscape when metolachlor is dissolved in runoff water. Consult your Natural Resources Conservation Service and Soil & Water Conservation District offices for current tillage guidelines.	Controlling loss of soil and runoff helps reduce metolachlor losses to surface waters.
5. Rotate use of metolachlor (and acetochlor, alachlor and other chloracetamide herbicides) with herbicides from a different chemical class.	Evaluate this practice in the context of other effective control practices in the management system (e.g., use of tank mixes with multiple modes of action; crop rotation; planned, periodic use of herbicide-resistant varieties in a rotation; mechanical weed control; field scouting). Determine which crop in the rotation is in greatest need of chloracetamide herbicides, and reserve their use for that crop.	With time, this practice will reduce development of herbicide resistant weeds or weed species shifts, and means less annual availability of these herbicides for loss to the environment.

***For core practices and for practices related to the use of other specific herbicides, visit MDA's Best Management Practices webpage at *http://www.mda.state.mn.us/appd/bmps/bmps.htm* See "Additional Information & References" for access to detailed guidance on all recommended practices.**

The BMPs are provided as a series of options. Producers, crop consultants and educators should select options most appropriate for a given farming operation, soil types and geography, tillage and cultivation practices, and irrigation and runoff management. The MDA encourages development of Integrated Weed Management Plans for every Minnesota farm (see "Additional Information and References" for more information). **Always read the product label. Label use requirements and application setbacks are legally enforceable.**

Water Quality *Best Management Practices for METRIBUZIN*

To be used in conjunction with MDA's core "BMPs for All Agricultural Herbicides"

Metribuzin-Specific Practice*	Description	Benefit
1. Adopt the core "BMPs for All Agricultural Herbicides" when applying metribuzin.	MDA's core "BMPs for All Agricultural Herbicides" are designed as the baseline set of options to mitigate or prevent losses of herbicides to water resources. The core BMPs are available at http://www.mda.state.mn.us/appd/bmps/bmps.htm	Adoption of core BMPs with those specific for metribuzin and adherence to mandatory label use requirements and application setbacks result in opportunities for multiple water quality protection benefits.
2. Limit total metribuzin rate, including amounts in premixes and tank mixes: **- on sand soils to no more than 0.4 lbs active ingredient per acre per year.** **- on loamy sands and sandy loams to no more than 0.5 lbs active ingredient per acre per year.**	Following these application limits is especially important on coarse-textured and irrigated soils (where sand, loamy sand or sandy loam soil textural classifications make up more than 25% of the field). These soils are common in central Minnesota, but are also present in many other locations.	By reserving metribuzin for use on the crop/weed association most in need of its effectiveness (e.g., during the potato year of a corn-bean-potato or bean-potato rotation) – and by limiting its annual application rate – environmental losses are minimized.
3. Rotate use of metribuzin (and atrazine and other photosynthesis inhibiting herbicides) with herbicides from a different chemical class.	Evaluate this practice in the context of other effective control practices in the management system (e.g., use of tank mixes with multiple modes of action; crop rotation; planned, periodic use of herbicide-resistant varieties in a rotation; mechanical weed control; field scouting). Determine which crop in the rotation is in greatest need of photosynthesis inhibiting herbicides, and reserve their use for that crop.	With time, this practice will reduce development of herbicide resistant weeds or weed species shifts, and means less annual availability of these herbicides for loss to the environment.

***For core practices and for practices related to the use of other specific herbicides, visit MDA's Best Management Practices webpage at *http://www.mda.state.mn.us/appd/bmps/bmps.htm* See "Additional Information & References" for access to detailed guidance on all recommended practices.**