The Value of Buffers

For Pesticide Stewardship and Much More

Always read and follow label directions before buying or using a pesticide. Follow all appropriate federal, provincial, and local regulations.

Landowners, particularly farmers and ranchers, have unique opportunities to be environmental stewards of the land. Minimizing environmental impacts of pesticides and nutrients, protecting soil and water, and fish and wildlife conservation are all important components of sustainable agriculture. This brochure is intended to provide basic information on conservation buffers, their establishment, maintenance, and value.

Conservation buffers are unique in that they provide many of the benefits listed above with only a single practice. Buffers are useful in reducing sediment movement and nutrient pollution, and minimizing off-target pesticide movement by drift, water runoff or eroding soil particles.

As with all mitigation for pesticide use, it is important to always follow the label. Many pesticides have required buffer zones for certain use. Beyond label requirements, do everything possible to minimize off-target pesticide movement via spray drift, water runoff, and soil erosion.

Generally, a buffer zone is the downwind distance separating the point of direct pesticide application from the nearest boundary of a sensitive habitat. Leave a suitable buffer zone between the treatment area and adjacent sensitive areas. Buffer zones may vary depending on the method of application (i.e., aerial, field boom, air blast). Check the pesticide labels for any buffer zone requirements.

Health Canada's Pest Management Regulatory Agency has an online spray drift calculator that allows applicators to modify the labelled buffer zones specified on the product label, based on weather conditions, the category of sprayer or droplet size. In general, under all but the most adverse conditions, this calculator will reduce the required buffer distances specified on the product label, and for all applications a printout will provide a legal spray record of your application. For more information, see the Buffer Zone Calculator at http://www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/drift-derive/calculator-calculatrice-eng.php.

OFF-TARGET PESTICIDE MOVEMENT

- Pesticide **spray drift** is the unintentional movement of pesticide spray droplets to off-target sites during the spray application.
- Pesticides that reach the intended target can move with **runoff water** during storm events. This is most common with pesticides that are more water soluble or poorly adsorbed (attached) to soil particles.
- Pesticides that are strongly adsorbed to soil particles can also move if **soil erosion** occurs. Soil erosion can occur when soil blows off the land or is carried in runoff water. Soils high in clay and/or organic matter can more efficiently adsorb (hold) pesticides.

WHY IT IS IMPORTANT TO MINIMIZE OFF-TARGET PESTICIDE MOVEMENT

Pesticides are valuable tools when kept on target to control important pests. However, spray drift can injure neighbouring crops containing sensitive plants; result in illegal residues in non-target food or feed crops, or contact people, animals, or beneficial organisms or their habitats. Pesticides moving with water runoff or on eroding soils can also reach water bodies and the sediments at the bottom of water bodies, and other non-target habitats.

HOW TO KEEP PESTICIDES ON-TARGET

Always follow the label. In addition, there are many best management practices (BMPs) which help keep pesticides on-target. The best combination will be field-specific and will depend on the particular farming practices, pesticides used, application techniques, weather conditions, vulnerability of the area, and buffers. Once farming practices, pesticides, and application techniques have been chosen, the applicator must consider the pest spectrum, the weather conditions and vulnerability of the area to decide whether buffers are needed and, if so, their size and location to minimize off-target movement.

TYPES OF BUFFERS

Buffers can be permanent or flexible. Permanent buffers are areas or strips of land maintained in permanent vegetation established through natural regeneration or planting. Permanent buffers are often most effective at reducing off-target pesticide, nutrient, and soil movement with runoff water, and they provide additional environmental benefits such as wildlife habitat, where this is a desired outcome.

Permanent Within-Field Buffers

- *Grassed Waterways* – Grassed waterways are natural or constructed vegetated channels strategically placed within an agricultural field. The interception of water by a grassed waterway slows water down, which helps prevent gully and rill erosion, increases infiltration of runoff water, and traps sediment and attached pesticides.
- *Contour Buffer Strips* – Contour buffer strips are planted to perennial vegetation, alternated with cultivated strips, and strategically placed along the contour. These buffers partition larger cultivated areas into smaller strips to reduce the risk of concentrated flow, gully erosion, and pesticide runoff.

- *Vegetative Barriers* – Vegetative barriers are generally planted to perennial vegetation that is stiff stemmed, tall and dense. These buffers are placed parallel to themselves and perpendicular to the slope to disperse concentrated flow, thus increasing sediment trapping and water infiltration.
- *Wind Buffers* – Also referred to as windbreaks or shelterbelts, wind buffers consist of single or multiple rows of trees primarily intended to protect crops from high and damaging winds. Wind buffers reduce pesticide drift by lowering wind speed within treated areas and by physically intercepting drift. Windbreaks can also reduce runoff if they are planted densely and perpendicular to the slope. Wind buffers can also be installed along the field edge.

- *Cross Wind Trap Strips* – Cross wind trap strips are designed to intercept sediments and reduce wind erosion rather than reducing wind speed. These strips are generally planted with herbaceous vegetation in strips perpendicular to the prevailing wind directions to intercept wind-borne sediment, nutrients and pesticides carried by sediment.
- *Herbaceous Wind Barriers* – Herbaceous wind barriers generally consist of tall grasses planted in thin rows perpendicular to prevailing wind directions to reduce wind speed and intercept wind-borne sediments carrying pesticides and nutrients.

Permanent Edge-of-Field Buffers

- *Field Borders* – A field border is a strip of permanent perennial vegetation established on the edge of a crop field. This type of buffer reduces the off-target movement of pesticides and nutrients moving with runoff water across the buffer, traps eroding soil that may contain adsorbed pesticides, and physically separates the spraying operation from adjacent non-target lands, thus reducing the potential for drift.

- *Filter Strips* – Filter strips are areas of grass or other permanent vegetation located between crop fields and a body of water and intended to reduce runoff. Filter strips are more effective at reducing concentrated flow when used in combination with vegetative barriers, level spreaders, or water bars.
- *Riparian Forest Buffers* – Also referred to as streamside management zones, forest buffers, riparian forests, and riparian management zones, riparian forest buffers are areas planted in trees and shrubs and located adjacent to streams, rivers, lakes, ponds and wetlands.

Constructed Wetlands

Constructed wetlands are not necessarily considered buffers, but they provide many similar water quality benefits and provide additional benefits when implemented in combination with buffers. For example, riparian buffers intercept shallow subsurface flow; however, nutrients and low concentrations of pesticides can be carried through the subsurface flow bypassing some buffers. Additionally, many drainage systems, for example drainage tiles, bypass buffers and may deliver subsurface drainage directly to streams. Wetlands can effectively degrade pesticides and denitrify nitrates when strategically located at the base of a drainage system, for example at tile outlets.

FLEXIBLE BUFFERS

Growers can have a significant impact on potential off-target pesticide movement through implementation of permanent buffers considering the type, location, and size. But sometimes **permanent** buffers have not been established or are not adequate for the specific application conditions.

In these cases, growers and applicators can establish a **flexible** buffer – an untreated portion of the crop or landscape large enough to minimize the chance of spray drift, water runoff, and/or soil erosion taking pesticides off-target. The size and location of flexible buffers are determined on an application-by-application basis.

Before deciding on the need for a flexible buffer, do everything possible to minimize drift, water runoff, and soil erosion. For example:

- To minimize drift, consider low-drift nozzles, drift retardants, and shields. Don't spray when winds are variable or gusty, or when conditions are completely calm. Under completely calm conditions, droplets may enter and move within an inversion (a layer of trapped air moving horizontally).
- To minimize water runoff and soil erosion, use conservation tillage practices and cover crops. In addition, use of rate controllers, avoiding application when soil is saturated, and pesticide incorporation are examples of rate, timing and placement modifications that can reduce pesticide movement.

Proximity to residential areas, sensitive crops, pollinators, and water bodies must be taken into account before application, but off-target pesticide movement should be minimized even if no sensitive areas are apparent.

With all factors considered, including environmental conditions, decide if a flexible buffer is needed, what size it should be, and where it should be located.

BUFFER DESIGN AND MANAGEMENT

Installation and management of buffers are broad topics beyond the scope of this brochure. Planting mixture, planting rate, width, and management of buffers vary depending on the objectives of the landowner and the composition of the landscape. Therefore, a technical advisor is recommended to assist landowners in properly planning and implementing buffers within an agricultural production system. In general, always consider the following when developing a conservation management plan and implementing best management practices.

Choose an Appropriate Location for Your Buffer

- Strategically place your buffer in the landscape to intercept drift and runoff.
- In sloping areas, consider the installation of buffers within treated fields. In-field contour buffer strips and vegetative barriers are most efficient at managing sheet flow and infiltration. In-field herbaceous wind barriers and cross wind traps can be effective at managing wind erosion.
- Buffers should be used at runoff points along streams, lakes or other areas which receive a significant volume of runoff directly from treated fields.
- Marginal and highly erodible land may serve as an ideal location for a buffer.

Choose an Appropriate Buffer Width

- The proper buffer width depends on many factors. Slope of the land, distance to water and other sensitive areas, financial and land ownership constraints, likely pesticide and nutrient load, and adjacent vegetation are among the considerations. Remember that width cannot compensate for a poor quality buffer.
- If possible, install buffers at least 15 meters wide and no less than10 meters wide. This is necessary to protect wetlands and streams under most conditions; however, a narrow buffer is better than no buffer at all.
- Wider buffers (≥ 30 m) should be used where necessary – the goal is always to minimize sediment, nutrient and pesticide transport in water.
- Wider buffers (≥ 25 m) should be used if wildlife habitat is a management objective or a desirable byproduct of buffers.

Choose an Appropriate Planting Mixture

- Conservation buffers can be planted to perennial herbaceous vegetation (usually grasses or legume-grass mixtures), shrubs, and trees. A combination of all three is often best, with grasses closest to cropped land and trees and shrubs closest to streams. In-field buffers will sometimes only include perennial ground plants/non-woody species.
- Choose species and varieties adapted to the local climate, site conditions and soil types. Landowner objectives and landscape context should also be considered when choosing planting mixtures.
- Native plant species are preferred when available and economical. Invasive and potentially weedy plants must be avoided.

- When installing perennial grass buffers, strong stemmed species should be used. These grasses form a dense stand above ground and a deep root system under ground. The dense above ground stand reduces runoff and increases infiltration. The root system intercepts subsurface flow and provides habitat for pesticide-degrading microorganisms.
- If pesticide retention and wildlife habitat are both desired outcomes, a buffer planted to a native grass and legume mixture is preferable. However, planting rates vary depending on the primary objective. Grasses and legumes should be planted at higher rates to address water quality, lower rates to provide optimal wildlife habitat, and moderate rates to address both water quality and wildlife habitat. Sites being planted for wildlife habitat may need to be pre-treated for removal of invasive, exotic species that are not wildlife friendly (fescue, johnsongrass, bermudagrass, kudzu, etc.) Such pre-treatments may need to be repeated until the undesired plant community is eliminated or at least controlled to the point of allowing successful establishment of wildlife friendly plants.
- Woody species should be considered when subsurface flow is a concern. The deep root systems also provide a carbon source for microorganisms, facilitating denitrification and pesticide degradation.
- A variety of buffers can be used in combination. Woody buffers established adjacent to bodies of water are often used in conjunction with grass buffers adjacent to crop fields to improve buffer efficiency.

Maintain Your Buffers

- Manage the land to maintain and encourage shallow sheet flow and water infiltration. New techniques have been developed to address concentrated flow, for example, strategically positioned level spreaders, small berms or "water bars" constructed to redirect flow across buffers, and vegetative barriers located perpendicular to flow to redirect flow and slow velocity.

- Equipment traffic should be limited on buffers. Heavy equipment can compact soils and create ruts, reducing infiltration and encouraging concentrated flow.
- Manage buffer vegetation communities. Natural successional processes tend towards hardwood dominated plant communities. Therefore, early successional grass/broadleaf buffers must be managed periodically to maintain the intended plant community. Furthermore, actively growing vegetation is more biologically active, absorbing and degrading pesticides, and supplying carbon for microbial activity. Use native, local species to advantage; for example, native drought resistant varieties should be considered for plantings in dry areas.
- Where appropriate for the species mix, vegetation can be managed by mowing, implementing rotational grazing, disking, and prescribed fire.
- Mowing provides weed control and can encourage some grass species to tiller and produce a more dense vegetation layer on the soil surface. Mowing too short can limit the ability of the vegetation to reduce flow.
- Livestock grazing should be limited and used only under optimal soil conditions. Overgrazing can result in soil compaction, reduced grass heights, injured woody species, streambank degradation and direct water contamination.
- Prescribed fire and light disking are management practice options when wildlife habitat is a desirable outcome of buffers. Fire and disking are generally used to impede succession, maintain the native herbaceous community, and retain a desired level of bare ground for small mammals and ground nesting birds such as the northern bobwhite. In order to have some wildlife and pollinator friendly habitat always present during buffer management, try to manage areas on a rotational basis whereby all the buffers are not treated entirely or exactly the same every year. This will result in some buffers being in different stages of plant growth than others. Caution should be used when managing vegetation in areas of high erosion potential.
- When using tillage equipment in fields, do not till too close to the buffer. Steep-sided buffers are more subject to degradation.

ADDITIONAL BENEFITS OF BUFFERS

As discussed, buffers are important for minimizing off-target pesticide movement via spray drift, water runoff, or soil erosion. However, pesticide management is not the only benefit of buffers. Buffers help to maintain the function and integrity of natural ecosystems by protecting soil and water quality and improving wildlife habitat. Buffers influence the structure, composition, and beauty of the surrounding landscape when used as part of a conservation management system.

Soil Quality

Buffers reduce soil losses due to erosion and protect productive topsoil. The vegetation of buffers provides a source of organic matter to improve soil quality, soil carbon for microbial energy facilitating denitrification and degradation of pesticides, and additional nitrogen when legumes are included. Riparian buffers stabilize the soil on stream and river banks and reduce the risk of flooding.

Water Quality and Aquatic Habitat

Conservation buffers slow water runoff, trap sediments and enhance infiltration; thereby trapping nutrients, pesticides, pathogens and heavy metals. This in turn reduces the potential for sedimentation which interferes with feeding and reproduction of fish, and eutrophication (i.e., over-enrichment with nutrients) of water bodies.

Riparian forest buffers reduce water temperature through shading, reducing the release of phosphorus which causes eutrophication, and increasing oxygen levels which are needed to support many species of game fish such as trout and salmon. Riparian buffers stabilize stream banks and provide habitat and food for micro-invertebrates, macro-invertebrates and fish where the buffer meets the water.

Wildlife Habitat

Conservation buffers have tremendous potential to create and enhance wildlife habitat, particularly in agricultural dominated landscapes. Buffers protect biodiversity by providing food along with nesting, brooding, loafing, thermal, and escape cover. Bird abundance, bird diversity, nest density and reproduction all increase in agricultural landscapes where buffers have been established. Buffers planted to native grasses and legumes provide significant habitat for grassland birds. Strips of shrubby and herbaceous vegetation provide important escape cover for small mammals in agricultural landscapes. Woody and herbaceous buffers provide cover and additional food resources for wildlife. NOTE: The location of buffers must be carefully considered where wildlife is unwanted due to potential crop loss or pathogen contamination of certain crops (e.g. leafy vegetables).

Riparian forest buffers are one of the most productive habitats in all regions of the country. Wildlife species diversity and density are high in these habitats. The aquatic insect and fish habitat provided by riparian forest buffers offer additional food resources for wildlife species requiring both aquatic and upland environments. Riparian forest buffers planted to bottomland hardwood species can provide optimal habitat for squirrels and other species. Riparian forest buffers installed in conjunction with herbaceous/shrubby buffers provide habitat for wild turkey.

Buffers also act as a corridor enabling wildlife to safely move from one habitat area to another. This in turn protects the local habitat, increases genetic diversity of species, and maintains stable wildlife populations.

Pollinators

Native pollinators are critical for fruit/seed production of many crops. Buffers containing a diverse plant community, properly managed to allow flowering, can provide a constant source of food and habitat for pollinators. For example, buffers planted to native grasses and legumes provide a diverse plant community that can support native pollinators throughout the growing season. Even undisturbed areas of bare ground within buffers provide important habitat for pollinators such as ground nesting solitary bees. Remember that, when buffers are used to prevent drift from pesticides that have pollinator precautions, native pollinators may be impacted within the buffer.

ECONOMIC CONSIDERATIONS

Installation and maintenance costs along with the economic consequences of taking crop land out of production must be considered when planning your conservation management system. Permanent buffers can increase farm value through soil and water protection. Keeping soil, nutrients, and pesticides in-place also maintains crop yield potential. Cost-share programs and funding from provincial organizations may be available to offset costs of conservation practices. Furthermore, some buffers can generate additional income through tree harvest or haying. Hunting and fishing leases could also provide additional income if wildlife habitat is an objective of buffers and is incorporated throughout the landscape and production system. If used as part of a comprehensive conservation system, buffers make good use of marginal and highly erodible land with limited agricultural production value and potential.

CONCLUSION

Buffers have the potential to assist landowners with economic and environmental sustainability when used in conjunction with appropriate land and crop management techniques, including crop residue and winter cover crop management, nutrient and pesticide management, and precision technologies. When integrated with other best management practices, buffers help keep pesticides and nutrients where they belong. But buffers are never a substitute for responsible pesticide selection, use, and disposal – they are a tool to minimize off-target movement of pesticides while providing numerous other environmental benefits.

A FEW OF THE MANY RESOURCES ON BUFFERS

1. Buffer Zone Calculator. 2012. Health Canada, Pest Management Regulatory Agency.
http://www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/drift-derive/calculator-calculatrice-eng.php

2. Buffer Strips: Common Sense Conservation. USDA-NRCS.
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/newsroom/features/?cid=nrcs143_023568

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This publication can be downloaded from the following website:

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www.syngenta.ca/stewardship

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