Best Management Practices

BUFFER STRIPS

A healthy soil will not be on the move. Keeping soil covered helps keep it in place. But sometimes good cover is not enough. Intense rain events can subject even the healthiest of soils to runoff. Unimpeded runoff from nearby cropland and pasture can enter surface water and contaminate it.

Buffer strips can provide a last line of defence to protect water quality from runoff. Planted in the transitional ("riparian") areas between upland soils and bodies of water, they are strips of vegetation – usually forages or a mix of trees, shrubs and grasses. Buffer strips are not a stand-alone best management practice (BMP). Rather they should be part of an overall soil health plan of complementary BMPs for soil and cropland.

This factsheet explains their benefits, what to consider, design and planning steps, and tips for establishment and maintenance.

THE ROLE OF HEALTHY SOIL IN A CHANGING CLIMATE

Agriculture and climate are directly linked – anything that has a significant effect on our climate will influence farm production. Greenhouse gas (GHG) emissions and climate change are global concerns, and agriculture can be part of the solution.

BMPs that improve soil health can also help lower GHG emissions, reduce phosphorus loss from fields to surface water, and improve resilience to drought or excessively wet conditions. Healthy soil – an essential component of a healthy environment – is the foundation upon which a sustainable agriculture production system is built.

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Problems with degraded riparian (streambank) areas

Healthy soils in the areas alongside rivers, streams, wetlands and lakes perform vital functions such as protecting water quality and providing habitat for local fish and wildlife. These riparian areas can become degraded and less functional when impacted by poor management practices in adjacent croplands and pastures.

CROPLAND EROSION AND RUNOFF – Poor quality cropland soils are prone to erosion and runoff. Cropland runoff can deposit soil-bound nutrients and pesticides in riparian areas and streams.

COMPACTION OF RIPARIAN SOILS – Crop management and harvesting equipment as well as livestock can lead to soil compaction problems, especially when conditions are wet. This leads to reduced infiltration rates, reduced capacity for water storage, and increased runoff. The degree of livestock's impact varies with the sensitivity of the grazed riparian area, the intensity of access (i.e. number of livestock in a given space), and the duration and timing of the access. Well-managed streamside grazing areas do not exhibit this degree of degradation.

BANK EROSION – Farm traffic – whether from field equipment or grazing livestock – that regularly comes too close to the top of an unprotected streambank will cause bank failure, slumping and streambank erosion. Buffer strips help keep farming separated from surface waters.

GREENHOUSE GAS EMISSIONS – Wet and compacted riparian areas adjacent to pastures or cropland will generate more methane and nitrous oxides than those with natural vegetation or planted buffer strips.

HABITAT DEGRADATION – Without buffers, riparian areas provide insufficient cover, shade and food to sustain healthy populations of fish and wildlife.

IMPAIRED WATER QUALITY – Cropland runoff can be clean, but sometimes can contain soil (sediment), organic matter, manure, fertilizer and pesticides – all of which can impair the quality of nearby watercourses, ponds and lakes. Properly designed buffer strips can reduce this impact by helping filter out contaminants.

Some rain events are so intense that excess water will run off from cropland, even with healthy soils.

Riparian areas are the transitional areas between upland soils and bodies of water. These areas can include ravine slopes, banks, floodplains and the ecosystems found in them.

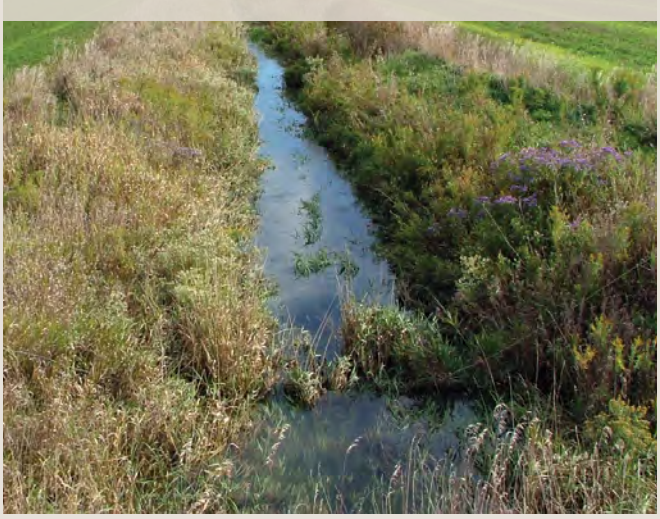
Buffer strip overview

Buffer strips can protect watercourses – including drainage channels, streams and rivers. Buffer strips can also protect lakes, ponds and wetlands. The design and function of buffer strips are very much affected by the type of surface water protected.

Buffer strips planted alongside watercourses are intended to keep agriculture and natural areas separated, and reduce the risk of cropland and pasture runoff entering surface waters.

Wide buffers sown to moisture-tolerant grasses are most suitable to protect wetlands and provide habitat to waterfowl.

Buffer strips should be designed to best match site conditions and desired functions. Narrow grassed buffers are most suitable along communal drainage channels.



Large, complex riparian areas that include ravine slopes, streambanks and floodplains may be more suitable to a combination of forage/pasture, trees and shrubs.

A suite of soil health and conservation BMPs – including buffer strips – will reduce the impact of cropland runoff on adjacent surface water quality.

Why buffer strips work

By themselves, buffer strips cannot control erosion and runoff from cropland. Much of the risk of surface runoff and concentrated flow from cropland can and should be managed in the field by soil and water conservation structures and practices. Buffer strips are one part of this soil and water conservation system – to repeat, they are the last line of defence.

Below is an example of a systems approach to erosion reduction.

A producer has a loamy field with a 5% slope. In a bare soil condition, the field can lose up to 10 tonnes/ac/yr of topsoil. With the following BMPs, soil loss can be reduced.

BMP	ESTIMATED REDUCTION IN SOIL LOSS (%)
SPRING TILLAGE	15
REDUCED TILLAGE	50
STRIP CROPPING + REDUCED TILLAGE	65
TERRACING + NO-TILL	85

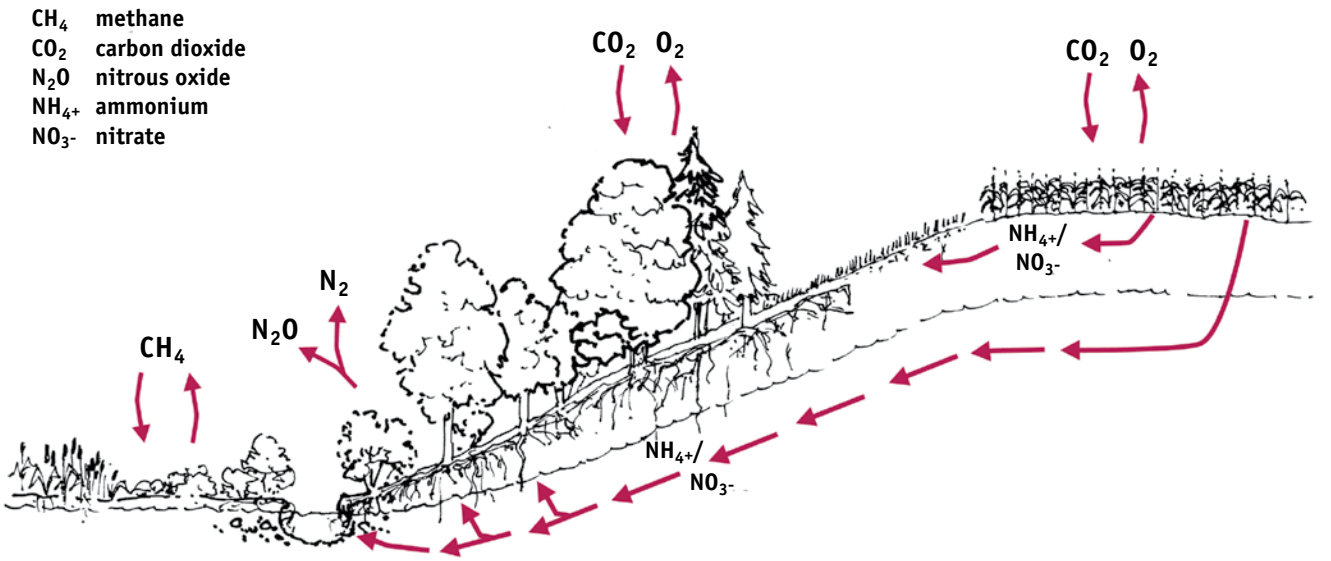
BANK STABILIZATION – Vegetated areas along banks can provide stability. Grassed setbacks will keep cropland operations back from the top of the bank. Trees and shrub roots will provide more bank stability. A minimum width of 5 metres (16 ft) is recommended.

FILTRATION OF CROPLAND RUNOFF – Grasses with stiff stems and high-density stems near the soil surface are particularly effective at filtering sediment from cropland. Note: Wider is not always better. A suite of cropland BMPs – including buffer strips – will protect soil and water resources more effectively.

FLOOD PROTECTION – During storm events, treed areas reduce the risk of flooding by storing water. Mixtures of evergreens and deciduous species will moderate the rate of runoff from snowmelt. Trees also reduce flood velocity and erosion potential.

WATER STORAGE – Buffers store moisture and release it slowly to surface waters. This helps to maintain base flow. Established trees are more effective than grassed buffers.

CARBON SEQUESTRATION – All plants fix carbon. Larger and longer-lived plants such as trees store more carbon. Carbon dioxide removal from the atmosphere helps to offset the global climate change effect from greenhouse gases.



FISH AND WILDLIFE HABITAT – Grassed buffers provide forage and cover. Planted tree buffers provide some edge habitat for mammals, beneficial birds and insects. Wider is better for this function. Buffers make ideal wildlife corridors, which are important for survival. Runoff management, shade provision and the addition of woody debris are all important for fish habitat. Buffer plantings can also provide habitat for pollinators and other beneficial insects.

NITRATE UPTAKE – Leached nitrates from cropland application will move with shallow aquifers on gradients to surface waters. Deep-rooted plants (trees and shrubs) take up more nitrate–nitrogen than grasses. In addition to minimizing runoff, this also helps to reduce greenhouse gas emissions.

Buffers offer a range of economic "products" such as livestock weight gains from pasture, and sales of hay crops and timber products.

Challenges with buffer strips

- Extensive and time-consuming planning process, involving consideration of:
  - size of the area to be protected
  - function of the buffer (bank stability, filter runoff, etc.)
  - professional design requirements for larger buffers
- Long lead time – it takes several years for tree buffers to be effective
- Loss of potentially tillable land – acres planted to buffers are acres out of production
- Required setbacks from pesticide applications – applying pesticides to the field may also kill buffer species
- Weeds not controlled in buffered area can become a weed source to the field
- Potential habitat for pests – e.g. racoons, deer, insects and diseases
- Maintenance requirements – mowing, weed control, monitoring planting performance, replacing lost trees and shrubs, pruning, check fencing, checking for bank failures and concentrated flow paths
- Seasonal fluctuation in functionality – many annual species die and perennial species go dormant over the winter, which reduces effectiveness during large melt events in winter and spring

Planted grasses and woody plants may be susceptible to herbicides applied to adjacent crops. Monitor drift and adhere to recommended setbacks to ensure buffer strip plantings are not injured.

Buffer strips are not designed to control concentrated flows from major storm events. Monitor buffers after storms. Consider drop structures and other BMPs to reduce surface runoff.

Buffer strips: making them work

DESIGN

One of the most important steps for planning an effective buffer strip is to select the most suitable design. Buffer strip design should be based on the functions needed, the site conditions, water volumes, and your preferences. Consider the following criteria before you select a design.

Function

Functions include: runoff protection, bank stabilization, habitat enhancement, etc. Desired function affects width, cover types, and special features or concerns. Conduct an on-site assessment to ensure that key problems are being addressed.

As a setback and for some sediment control, a buffer strip on flat, clayey intensive cropland will probably be narrow and grassed.

Width

Width is a key design factor. Wider buffers are more effective at filtering contaminants, encouraging infiltration and providing diversity of habitat.

Effective width varies with soil type, slope, and adjacent watershed size, function and cover type.

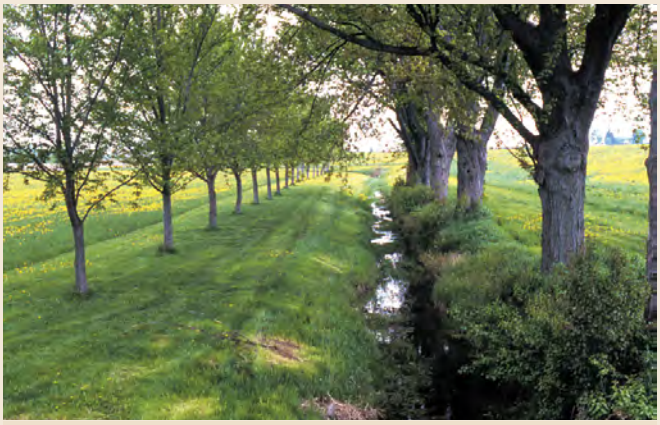
Width alone will rarely replace the benefit of upland soil and water conservation BMPs. Nor will width help with concentrated flow of runoff to riparian areas. Erosion control experts view buffer strips as last-ditch efforts to control cropland erosion.

Flow management

Buffer strips are intended to manage sheet flow from adjacent land use. They are not meant to manage concentrated or channel flow. Concentrated flow is faster and will cut a deeper channel if unmanaged (i.e., gully). In these situations, consider using rock chutes or drop structures to safely carry the concentrated water to the receiving water.

Erosion control for streambanks and shorelines

Buffer strip designs should account for any necessary bank or shoreline stabilization work. The nature and extent of the problems (including seepage) should be determined in the site assessment.



Select trees and shrubs for buffer strip plantings based on: suitability to local soil and climate conditions, flood tolerance, growth rate, wildlife value and economic value.

Plants for buffer strip establishment

Buffer strips can be planted to grass, forbs, shrubs and trees. Select plants according to their function and also their suitability to local site conditions, including climate, soil, soil drainage, soil pH and risk of flooding.

Grasses for buffer strips should have as many of the following features as possible: dense branching, upright stems that remain erect in winter to trap sediment in runoff, strong rooting systems, and useful as grazing or harvesting forage.

How to plan a buffer strip project

The most effective buffer strip projects are planned. With the principles and functions of buffer strips in mind, take the time to plan projects carefully.

Step 1. Assess existing conditions in your riparian area(s), e.g. instream conditions, water quality and vegetation quality.

Draw a map showing soil types, slopes, existing vegetation, adjacent croplands, and other riparian and natural areas. Complete a grazing management plan if appropriate.

Step 2. Predict the benefits of a well-maintained, planted buffer strip.

Put your list of desired benefits together with other related management goals and objectives.

Contact your Conservation Authority to discuss risk assessment and identify opportunities. Select functions for the buffer strips. Talk to neighbours.

Step 3. Assess upslope conditions on the farm.

Ask yourself whether additional soil and water conservation BMPs would enhance the effectiveness of your buffer strip(s).

Step 4. Examine and select options.

Which BMPs will do the job? Do the advantages outweigh the disadvantages? Which options require approvals, permits and technical assistance? Which agencies offer financial assistance?

Step 5. Design and implement.

Seek technical advice from a Conservation Authority and other agencies and from experienced landowners. Obtain permits and approvals where necessary.

Create an action plan – outline your resources, your time, and a schedule of activities. Remember that the project can be phased in over several years.

Step 6. Maintain, monitor and evaluate.

Maintain planted vegetation by watering at critical periods, sampling the soil, fertilizing, pruning or clipping, replacement and weed control. Confirm survival rates of planted grasses, shrubs and trees. Look for washouts and rills cutting across the buffer strip. Determine if the project is fulfilling its intended benefits. Assess whether additional BMPs would improve its effectiveness.

NARROW AND WIDE BUFFER STRIP DESIGNS

DESIGN TYPE	NARROW BUFFER	WIDE BUFFER
DESCRIPTION	• narrow grassed buffers established along drains	• wide grassed buffers (5–50 metres or 16–164 ft) established along/around natural areas • used for forage harvest or grazing
FUNCTIONS	• setback of farm operations or grazing from top of bank • ditch bank stabilization • some sediment and nutrient filtering	• setback of cropland management from bank or shore • setback of livestock grazing from most of the riparian area • forage management – cropland not lost to production • livestock grazing – delayed grazing until late summer or fall as part of Grazing Management Plan • sediment, pesticide and nutrient filtering • wildlife habitat for mammals, field bird species, amphibians and pollinators
SUITABLE FOR:	• municipal and other open drains in flat, intensively cropped areas (e.g. clay plains) • intensively grazed areas where livestock have been excluded and tree plantings are not suitable (e.g. tiles are invaded by tree roots) • small, shallow and deep-channel streams • lakeshores and ponds	• most riparian areas and site conditions • most suited to waterfowl nesting areas (wetlands, lakes, ponds, large rivers) • livestock operations that use forages or graze
NOT SUITABLE FOR:	• slopes >10% • slope >5% with no BMPs for soil and water conservation on the upland areas • natural riparian areas • cold-water fisheries • deep ravines with broad floodplains	• very steeply sloping, narrow ravines • intensively managed cropland – horticulture and field crops • cropland in areas with no local market for forages

DESIGN TYPE	NARROW BUFFER	WIDE BUFFER
DESIGN CONSIDERATIONS	• width: minimum of 3 metres (10 ft) for most situations • should be 5–10 metres (16–33 ft) if used as a pesticide application setback • severe bank and shore erosion should be managed • concentrated flow needs to be diverted and controlled with erosion control structures	• should be 5–50 metres (16–164 ft) wide – buffer width should be compatible with forage harvest equipment • greater widths are most suited to managed grazing areas • species mixtures should be for forage, grazing or dual purpose • later-maturing species would be best for wildlife habitat • severe bank and shore erosion plus concentrated flow should be managed

Narrow grassed buffers are suitable for municipal drains and will provide bank stabilization and some runoff filtering functions.

Wide buffers are more suitable to larger watercourses and wetlands and will provide extensive filtering capabilities and enhanced wildlife and pollinator habitat.

Establishing buffer strips

HOW TO ESTABLISH GRASSED BUFFERS

Layout

✓ Sketch buffer strip plan on map or aerial photograph.

✓ Stake out buffer width in fall or early spring – use widths that are multiples of the widest piece of equipment to be used to establish planting.

✓ Tie in fencerows and natural areas where possible.

✓ Consider setting aside odd-shaped areas where site features or land use changes.

Site preparation

✓ Monitor soil fertility more closely in established forage stands.

✓ Remember recommended separation distances from riparian areas if manure is to be applied prior to stand establishment.

✓ Regarding tillage:

- consider size of the area to be protected
- leave deep furrow at edge of field along outside length of buffer to slow any runoff from adjacent cropland
- ensure that all perennial weeds (e.g. quackgrass) are controlled, since many warm-season grasses can't compete with them
- establish a level, firm seedbed, as with any forages.

If the area is already established in sod and is not to be used for grazing or forage, leave it.

Planting

✓ Broadcast (only for tillage method).

✓ Use hand-held, tractor-mounted or ATV-mounted broadcast seeders.

✓ Follow guidelines in OMAFRA *Agronomy Guide* for seeding rate.

✓ Harrow or cultivate lightly to increase soil–seed contact.

✓ Drill grass and legume seeds as well as cereal nurse crops.

✓ Ensure proper weed control.

✓ Calibrate drill to ensure proper depth, penetration, residue control and slot closure.

✓ Broadcast straw mulch on erodible areas during establishment period – under-seeding or direct seeding is more feasible in wider buffer designs OR use nurse crops to help with establishment.

Maintenance of grassed buffers

✓ Control weeds:

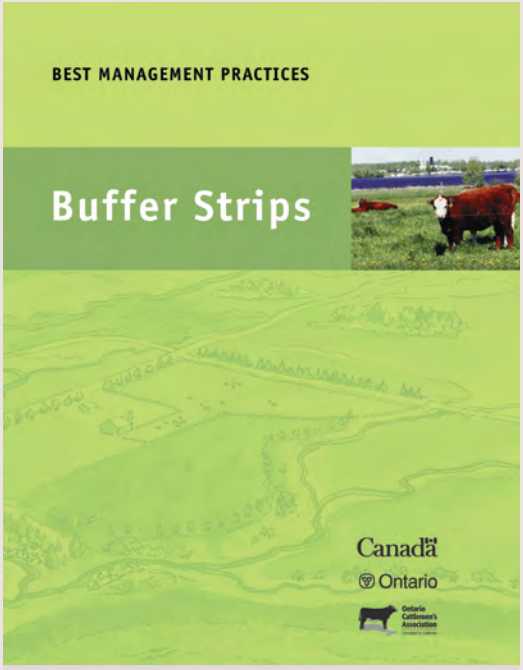
- control weeds during the first year of establishment
- if you choose to clip, avoid loss of desired grasses by clipping before weeds reach 30 cm (12 in.)
- for some species mixtures, regular mowing and the maintenance of fertility levels will help ensure stand composition.

Buffer strips as with other natural or non-crop areas are sources of weeds and other pests – consider pest pressures from these areas as part of a pest monitoring program.

✓ Monitor for effectiveness:

- during first year, check strip for rills and washouts after snowmelt and rain events
- repair and replant damaged areas
- prevent future problems in damaged areas with BMPs for soil and water conservation such as drop structures (e.g. rock chute or drop pipe inlet) OR
- create diversion trenches, deep dead-furrows or small berms to divert small runs of concentrated flow from damaging the buffer strip.

Monitor buffer strips for effectiveness. Look for concentrated flows of runoff. Consider other soil and water conservation BMPs to help manage cropland runoff.



For information on how to establish buffers, see *Buffer Strips,* a BMP booklet.

For more information

ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS

Many sources of supplementary information are available.

Below are some suggestions to get you started. Most can be found online at **ontario.ca/omafra** or ordered through ServiceOntario.

- Publication 811, *Agronomy Guide for Field Crops*
- Publication 611, *Soil Fertility Handbook*

Best Management Practices Series

- *Buffer Strips*
- *Controlling Soil Erosion on the Farm*
- *Cropland Drainage*
- *Establishing Tree Cover*
- *Fish and Wildlife Habitat Management*
- *Field Crop Production*
- *Managing Crop Nutrients*
- *Soil Management*

Environmental Farm Plan (4th ed.) and EFP Infosheets

- #15, *Soil Management*
- #16, *Managing Nutrients in Growing Crops*
- #17, *Use and Management of Manure*
- #18, *Horticultural Production*
- #19, *Field Crop Production*

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