Farmland Health Check-Up
Best Management Practices Selection Guide

SOIL EROSION				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Residue management	Careful management of crop residues to ensure adequate soil coverage between crops	• Covers soil surface over winter (`mulch effect') • Protects soil from raindrop impact, detachment and dislodgement • Residue cover protects soil until crop canopy closure	• At least 50% residue going into winter • At least 30% residue after planting	• Modifies soil temperatures and moisture • Provides habitat for soil life (good and bad)
Crop rotation	The successive planting of different crops on the same land. Growing the same crop from year to year (continuous soybeans) is damaging to organic matter levels and soil structure and can lead to erosion	• Improves soil resilience to degradation by improving structure and adding organic material • Protects soil from erosion and reduces the risk of compaction and crusting	• Minimum 3 different crop species • Include cover crops where possible • Avoid the same crop two years in a row (excluding perennial crops) • Include perennial crops when possible	• Breaks pest cycles • Spreads work load and equipment demand • Builds and maintains soil organic matter

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WATER EROSION				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Erosion control structures (ECS)	Designed to limit water moving across the landscape and reduce soil erosion. Common examples include grassed waterways, terraces, and water and sediment control basins (WASCoBs)	• As part of an overall soil health approach to soil management, ECS work in a soil conservation system of BMPs that protect soil and limit the rate of runoff and erosion • More specifically, most ECS will prevent channelized or concentrated runoff flow from becoming large rills and gullies • Erosion control structures will move surface runoff to subsurface drainage systems and, by strategic placement, will limit the erosive forces of runoff events	• ECS more commonly address the areas of the field where there is concentrated runoff flows. In many instances, these concentrated flow volumes can be reduced significantly by improving soil health and enhancing crop diversity. Where ECS are needed, they should be designed by an engineer or qualified erosion control/ drainage contractor • Not sure how to select the right BMP for erosion? – see page 4 and 5 in BMP booklet: *Controlling Soil Erosion on the Farm*	

Additional Practices for **WATER EROSION**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Buffer strips	A strip of permanent vegetation, usually grasses (may be a mix of trees, shrubs and grasses) planted alongside natural areas e.g. watercourse to protect them from surrounding land uses. Functions include: runoff and sediment control, streambank stabilization, biodiversity, and potential sequestration of carbon	• Buffer strip plantings complement in-field soil health BMPs by providing a last line of defence to reduce the impact of cropland runoff on natural aquatic ecosystems • Buffer strips can filter and remove contaminants in surface runoff and baseflow from cropland soils	• Leave a minimum of 3m along water courses and ditches • Wider strips provide more soil health and pollution prevention benefits	• The undisturbed soil and permanent woody vegetation will sequester carbon and reduce the emissions of key greenhouse gases, methane and nitrous oxides • Buffer strips also support biodiversity
Contour or strip cropping	Cropland is cultivated and crops are grown at right angles to the natural slope of the land to slow water and reduce soil loss. Strips of crop species may also be alternated across the field	• The contour strips act as a series of small dams to slow water movement and reduce soil detachment and movement	• See BMP booklet: *Controlling Soil Erosion on the Farm* for specifications	

Additional Practices for **WATER EROSION**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Improve drainage	Drainage removes excess soil water (gravitational water) from the soil profile using plastic tubing, or clay and/or concrete tile Improving drainage may include: installing more laterals, larger header pipes, fewer outlets, etc. When improving drainage consider the potential need for better soil structure to allow water to move to the existing drainage system	• Better drainage will improve water infiltration and reduce runoff and potential for erosion	• See BMP book *Cropland Drainage* for basics and some of the standards on the functions of subsurface drainage system • See OMAFRA Publication 29 *Drainage Guide for Ontario* for detailed specifications for design, installation, maintenance and legal requirements • Also see crop rotation, cover crops, reduce tillage, surface soil structure and subsoil compaction for suggestions for improving soil structure and internal water movement	• Improved crop growth and yield
Note: Adding organic amendments will help improve aggregate stability, which can help the soil resist water erosion. See the organic matter component for BMPs				

WIND EROSION				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Windbreaks	Vegetative barriers that reduce wind speed and erosive capability. They usually consist of one or more rows of trees or shrubs along field edges	• Trees and shrubs slow wind movement across the field, reducing the erosive ability and carrying capacity of the wind	• Consistent, weed free tree plantings are important to achieve protection along field edges • Plan windbreak plantings to maximize the protected distance based on 10 times the height of the windbreak • See BMP Book: *Establishing Tree Cover* for specifications for windbreak design and maintenance	• Carbon sequestration with trees • Reduces desiccation of soil and crops • Creates a microclimate (warmer soil and air temperatures) • Improves yield
Wind strips	Annual grasses such as barley or cereal rye planted in strips within fields to reduce wind speed and erosive capability	• Grass strips slow wind movement across the field reducing the carrying capacity of the wind and the ability to erode soil	• Usually constructed with cereal grain or other grasses. Due to the flexibility of grass protected distance is about seven times the height • Plant wind strips close together to ensure protection • Refer to the BMP booklet: *Controlling Soil Erosion on the Farm* for more information	• Reduces desiccation of soil and crops • Creates a microclimate (warmer soil and air temperatures) • Improves yield
Note: Adding organic amendments will help improve aggregate stability, which can help the soil resist wind erosion. See the organic matter component for BMPs				

TILLAGE EROSION				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Reduce tillage depth	Adjust tillage depth to minimize soil disturbanc	Deep tillage: • Displaces more soil downslope than shallow tillage or cultivation • Can move subsoils to the surface	• Keep tillage as shallow as possible	
Use implements that move less soil	Avoid tillage implements e.g. moldboard plows, discs and twisted shovels that lift and flip soil	• Tillage implements that invert or throw soil will move more soil downslope from crest and upper slope positions • Tillage implements that lift and shatter while leaving more residue on the surface move less soil	• Use cultivators, small disks and vertical tillage to reduce tillage erosion	
Till across the slope or up the slope	Tillage passes that move soil upslope. Cross-slope tillage at right angles to the slope. Tillage aimed at following the same elevation across the slope (contour)	• Gravity works to pull soil during tillage operations down slope • Tillage direction is the key to reducing tillage erosion • Work soils across the slope, on the contour or at least upslope	• No downhill tillage	

Additional practices for **TILLAGE EROSION**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Reduce speed	Similar to tillage depth, reducing speed reduces the amount of soil disturbance	• Reducing tillage speed limits the amount of loose soil that is prone to movement due to gravity	• Tillage speed is reduced on rolling topography (slope >2%) • More level topography is less of a problem with tillage and gravity moving soil	
Reduce tillage passes	Avoid tillage where possible. Reduce the number of tillage passes. Consider the number of implements involved	With fewer passes: • Less soils is disturbed • Less soil is thrown downslope		• Soil retains resilience against structural breakdown and is more erosion resistant
Soil remediation	The mechanical replacement of eroded soil from low areas to the eroded hills and side slopes	• It restores normal soil profile features and the productive capacity of previously eroded upslope areas in cropland and, when protected from further erosion, will reduce the rate of other forms of localized degradation	• Check soil depth and map eroded areas and depositional areas • Replace a minimum of 10 cm (4 in.) of topsoil to eroded areas as mapped • Topsoil to be taken from depositional areas	• Enhanced and more consistent crop production across field

SURFACE SOIL STRUCTURE				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Crop rotation	The successive planting of different crops on the same land. Growing the same crop from year to year (continuous soybeans) is damaging to organic matter levels and soil structure.	• Improves soil resilience to degradation by improving structure and adding organic material	• Minimum 3 different crop species • Include cover crops where possible • Avoid the same crop two years in a row (excluding perennial crops) • Include perennial crops when possible • Select crops with diverse root systems • Ensure adequate biomass return (e.g. heavy rotation of soybeans and most vegetable crops do not return enough biomass to the land)	• Protects soil from erosion • Reduces the risk of compaction and crusting
Cover Crops	Cover crops are plants established to protect and enhance the soil	• Cover crops cover and protect bare soil surfaces before, after and between crops • Cover crop root systems and residues help to build seedbed structure and lower the risk of surface crusting	• Choose cover crops or cover crop mixtures with a high amount of fibrous root systems • Longer growing periods and higher seeding rates will result in more root biomass being returned to the soil	• Cover crops can add diversity to the plants growing in a field, helping to break pest cycles and supporting soil life

Additional Practices for **SURFACE SOIL STRUCTURE**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Reduced tillage	**Minimum till** Using the minimum amount of tillage to achieve a seedbed and manage residue. This is achieved by tillage decisions rather than a particular implement **Zone/Strip Till** Concentrating tillage within a narrow band while maintaining the rest of the surface undisturbed **No-till** Planting crops without disturbing the soil through tillage	• Conventionally tilled soils are subjected to disturbance and accelerated organic matter decomposition which contributes to developing poor soil structure • Minimize the number of passes as each pass breaks apart soil aggregates opening them up to oxidation • Shallow tillage, use care as implements such as the disk apply downward pressure and can cause a hard layer if used at the same depth each time	**Reduced Till** • 1 to 2 passes after wheat or corn • Achieves more than 30% residue cover after planting **Zone/Strip Till** • Disturbs less than 30% of the soil surface **No-Till** • Soil is minimally disturbed for seed placement only	• Soils under reduced or no-till fix more carbon, release fewer GHGs, • Fewer trips over the fields, less fuel

Additional Practices for **SURFACE SOIL STRUCTURE**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Add organic amendments	An organic soil amendment is any suitable organic material added to a soil to increase soil organic matter levels and to improve its physical properties, such as water retention, permeability, water infiltration, drainage, aeration and structure. The goal is to provide a better growth environment for crop roots.	• Add organic matter to feed and support soil life • It is the life in the soil e.g. bacteria that secrete materials that glue and stabilize soil aggregates	• Calculate how much organic amendment will be needed to improve organic matter level to achieve a higher assessment value and then work out a timeframe to achieve this level of improvement	• Organic amendments also contain nutrients N, P and K and micronutrients
Timely tillage	Adjust schedules to ensure soil moisture conditions are suitable to avoid smearing and clod formation.	• Soils need to be friable (workable) before tilling • Tillage on soils where soil moisture is too high results in smearing, and the formation of clods that in turn result in more tillage operations	• Dig to tillage and/or planter depth to determine soil moisture level • Till or plant when the soil is fit at the working depth	

SUBSURFACE COMPACTION				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Reduce loads in wagons, trailers, and other implements	Decrease loads to reduce compaction potential i.e. half loaded carts	• Axle weight influences depth and severity of compaction • Lower axle weights in manure tankers or grain buggies will reduce the pressure on soils, thereby reducing the risk of compaction	• Keep axle loads at 5 tons or less	
Tires: radials, duals and tire inflation	Tire type, arrangement and inflation pressure can reduce the pressure exerted on the soil by the load carried	• Aim for a longer footprint with radial tires and lower inflation pressure to reduce depth of compaction • Increase the width of the footprint with dual tires to reduce the depth of compaction	• Radial tires • Use duals when appropriate • Follow manufacturers' guidelines for warranty but tire inflation less than 10 psi is the target	

Additional Practices for **SUBSURFACE COMPACTION**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Keep traffic off the field	Reducing the number of passes with implements. Load equipment on the headlands, field lanes or on roads to reduce in field compaction	• Keeps heavy loads out of the field, reducing the compaction potential • Keep equipment with heavy loads out of fields when possible, including nurse tanks for manure or water, load trucks at field headlands, field lanes etc. • Even light equipment can cause compaction with multiple passes		

Additional Practices for **SUBSURFACE COMPACTION**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	• **Rationale**	**Principles**	**Additional Benefits**
Controlled traffic	Limit traffic to keep compaction within known areas, such as established traffic lanes and tram line for spraying	• Lanes for traffic are established and the wheels of all machinery and equipment that passes stays on the tracks • Compaction is limited to the lanes provided • This means the crop grows in soil that hasn't been packed by machinery traffic	Examples: • Tram lines in cereal crops are used for machinery traffic such as sprayers and fertilizer applications • Ridge tillage, all machinery runs in the valleys between the ridges, and doesn't track in the ridge itself • Raised beds used in some horticultural crops such as tomatoes are also a form of controlled traffic	

Additional Practices for **SUBSURFACE COMPACTION**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Improve drainage	Drainage removes excess soil water (gravitational water) from the soil profile using plastic tubing, or clay and/or concrete tile. Improving drainage may include: installing more laterals, larger header pipes, fewer outlets, etc. When improving drainage consider the potential need for better soil structure to allow water to move to the existing drainage system.	• Better drainage will improve water infiltration and reduce runoff and potential for erosion	• See BMP book: *Cropland Drainage* for basics and some of the standards on the functions of subsurface drainage system • See OMAFRA Publication 29 *Drainage Guide for Ontario* for detailed specifications for design, installation, maintenance and legal requirements • Also see the sections on **crop rotation, cover crops, reduce tillage, surface soil structure and subsoil compaction** for suggestions for improving soil structure and internal water movement	• Improved crop growth and yield

Additional Practices for **SUBSURFACE COMPACTION**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Improve soil structure	See section on **surface soil structure**	• Stable aggregates resist soil compaction • See section on **surface soil structure**		
Keep off fields when the soil is not fit	See section on **timely tillage**	• Wet soils are more prone to compaction e.g. soil particles can pack more tightly under moist conditions	• Dig to tillage and/or planter depth to determine soil moisture level • Till or plant when the soil is fit at the working depth	

ORGANIC MATTER				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Crop rotation	The successive planting of different crops on the same land. Growing the same crop from year to year (continuous soybeans) is damaging to organic matter levels and soil structure and can lead to erosion.	• Improves soil resilience to degradation by improving structure and adding a variety of organic material	• Minimum 3 different crop species • Include cover crops where possible • Avoid the same crop two years in a row (excluding perennial crops) • Include perennial crops when possible	• Breaks pest cycles • Protects soil from erosion and reduces the risk of compaction and crusting
Cover Crops	Cover crops are plants established to protect and enhance the soil.	• Cover crops are often grown when there is no crop present, returning roots and above ground biomass to maintain soil organic matter while protecting the soil surface	• While every bit helps, cover crops with a longer growing period will return more to the soil • Select cover crops with high biomass production	• Stabilizes soil structure
Add organic amendments	Suitable organic material is added to soil to increase soil organic matter levels. The goal is to provide a better growth environment for crop roots.	• Often it is difficult to grow enough residue or cover crop to replace the organic matter (OM) lost through tillage operations • The best method to increase soil organic matter is to add organic amendments	• Organic amendment additions need to match OM losses to maintain soil OM levels	• Also improves soil physical properties, such as water retention, permeability, water infiltration, drainage, aeration and structure

Additional Practices for **ORGANIC MATTER**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**

Reduced tillage	**Minimum till**
	Using the minimum amount of tillage to achieve a seedbed and manage residue. This is achieved by tillage decisions rather than a particular implement
	
	Zone/Strip Till
	Concentrating tillage within a narrow band while maintaining the rest of the surface undisturbed
	
	No-till
	Planting crops without disturbing the soil through tillage
		• Conventional soils are subjected to disturbance, structural breakdown and accelerated organic matter decomposition
		• Soils under reduced or no-tillage are not disturbed, are more resilient to degradation and are more healthy – more drought resistant, are richer in soil life, fix more carbon, release fewer greenhouse gases
			• Mulch tillage has at least 30% cover
			• To be considered no-till, the soil is undisturbed, and so residue cover for:
			  • Corn: 40% at planting;
			  • Beans: 30% and;
			  • Cereals: >80%
			• Strip/No-till disturbs less than 30% of the soil surface	

Residue management	Careful management of crop residues to ensure adequate soil cover between crops	• Mulched soils are cooler and moister, reducing the rate of soil organic matter (SOM) decomposition • Crop residues add organic plant materials to the soil	• At least 50% residue going into winter • At least 30% residue after planting	

SOIL LIFE				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Crop Rotation	The successive planting of different crops on the same land. Growing the same crop from year to year (continuous soybeans) is damaging to organic matter levels and soil structure and results in less diversity of soil life.	• Changing crops and tillage systems modifies the seedbed habitat and food sources for soil life, which leads to more diversification	• Minimum 3 different crop species • Include cover crops where possible • Avoid the same crop two years in a row (excluding perennial crops) • Include perennial crops when possible	
Cover Crops	Cover crops are plants established to protect and enhance the soil. Planting crops, including grasses, legumes, and forbs, for seasonal cover and other conservation purposes (See Natural Resources Conservation Services (NRCS) *National Handbook of Conservation Practices*, 2014)	• Growing roots release root exudates, complex sugars and carbohydrates that support a wide variety of organisms • Cover crops provide cover for soil life and buffer changing soil temperatures	• Longer growing periods for cover crop result in larger root biomass and more support for soil life	

Additional Practices for **SOIL LIFE**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**

Reduced tillage	**Minimum till**
	Using the minimum amount of tillage to achieve a seedbed and manage residue. This is achieved by tillage decisions rather than a particular implement
	
	Zone/Strip Till
	Concentrating tillage within a narrow band while maintaining the rest of the surface undisturbed
	
	No-till
	Planting crops without disturbing the soil through tillage
		• Soil life is concentrated in the upper 10 cm of the soil profile and is intimately associated with roots and soil pores
		• Reducing tillage disrupts the habitat less while keeping more residue in place to shade and protect the soil
			• Mulch tillage has at least 30% cover
			• To be considered no-till, the soil is undisturbed, and so residue cover for:
			  • Corn: 40% at planting;
			  • Beans: 30% and;
			  • Cereals: >80%
			• Strip/No-till disturbs less than 30% of the soil surface	

Additional Practices for **SOIL LIFE**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Residue management	Careful management of crop residues to ensure adequate soil coverage between crops.	• Leaving crop residues in place or ensuring there is enough residue cover for the soil, reduces moisture loss, provides food and modifies soil temperatures • Temperature modification is important • The residue prevents rapid temperature fluctuations	• At least 50% residue going into winter • At least 30% residue after planting	
Adjust soil pH	Soil pH is adjusted, using either liming agents or acidifying materials, to make soils more neutral	• Most crops, crop nutrients and soil life forms are more productive under neutral pH conditions	• Soil pH is monitored with regular soil tests • Liming material is applied to raise pH where needed	

SOIL CHEMISTRY				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Soil test	The nutrient status of the soil, as indicated by analysis of a representative soil sample	Applying what the crop needs based on a soil test will: •improve crop biomass •monitor soil nutrient levels • assure optimum yields • protect the environment	• Sample every 3 to 5 years • Use good sampling procedures e.g. no more than 25 acres represented by 1 sample, sample at the same time of year • Track and compare results over time	
Adjust soil pH	Soil pH is monitored and adjusted	• Most crops, crop nutrients and soil life forms perform better under neutral pH conditions • Soil pH is monitored with regular soil tests • Liming material is applied to raise pH where needed	• Sample every 3 to 5 years • Use good sampling procedures e.g. no more than 25 acres represented by 1 sample, sample at the same time of year • Track and compare results over time	

Additional Practices for **SOIL CHEMISTRY**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	• **Rationale**	**Principles**	**Additional Benefits**
Apply the right rate of fertilizer	Match fertilizer application rate(s) to meet crop need based upon soil test results and approved fertility recommendations	• Selecting nutrient application rates without regard to residual nutrient levels or actual crop needs risks over-applying or under- applying nutrients • Over-application increases the risk of nutrient loss from the site by runoff, erosion, leaching and subsurface drainage	• Soil test and verify crop needs to select application rate • Follow rates that do not result in a "BMP red flag" in NMAN (nutrient management software)	
Sample organic materials before application	Test organic materials like manure or compost in order to make informed adjustments to fertilizer applications	• Not accounting for these nutrients risks the selection of fertilizer application rates in excess of crop needs	• Have manure and biosolids analyzed for nutrient content • Account for these contributions when interpreting soil test and selecting application rates for inorganic fertilizers	

Additional Practices for **SOIL CHEMISTRY**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Apply the right rate of organic materials	Consider the total nutrient (inorganic and organic forms of N and P) contribution of organic materials (like manure or compost) and adjust application rates to prevent over application	• Application rates of organic materials should be based upon the nutrient analysis • Application rates for organic materials must consider the fact that some of the nutrients in the organic materials are not available at the time when the crop requires them • Some nutrients, such as organic nitrogen, become available later in the growing season, after the growing season or in subsequent years	• Limit the manure application rate to provide no more than two-thirds or three-quarters of the N requirement of the crop	

PHOSPHORUS				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Soil test	The nutrient status of the soil, as indicated by analysis of a representative soil sample	Applying what the crop needs based on a soil test will: •improve crop biomass •monitor soil nutrient levels • assure optimum yields • protect the environment	• Sample every 3 to 5 years OR once at the same timing in the rotation cycle • Use good sampling procedures e.g. no more than 25 acres represented by 1 sample, sample at the same time of year • Track and compare results over time manually or with the aid of NMAN as a record keeper	
Limit Phosphorus (P) application rate	Review soil test results to determine whether the field has high levels of phosphorus that may limit fertilizer and manure applications.	• Soils with high P levels are at a greater risk of P loss i.e. if erosion happens more P is lost and higher P levels will trend towards having higher P concentration in the soil water solution • Research has shown little response to additional phosphorus when soil test values are above 30	• See chart page 84, BMP Book: *Nutrient Management Planning* OR • Avoid "BMP flags" in the NMAN Field Management Plan	

Additional Practices for **PHOSPHORUS**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Reduce water erosion	Prevent water erosion through the use of cover crops, residue management and erosion control structures to ensure that soil stays within that field	• Eroded sediments will carry significant amounts of phosphorus and may enter surface water	• See **water erosion** section	
Apply Phosphorus (P) in the spring	Apply phosphorus in the spring as close to planting as possible to reduce the chance of loss through erosion	• Phosphorus soil applied outside of the cropping season is at greater risk of loss due to increased probability of water runoff, erosion, etc.	• Apply phosphorus in the spring or during the growing season prior to crop maturity	

Additional Practices for **PHOSPHORUS**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Maintain a buffer from surface water	A strip of permanent vegetation, usually a mix of trees, shrubs and grasses along the side of a watercourse and edge of a field with many functions which include: runoff sediment and volume retention and reduction, streambank stabilization, diversification, wildlife habitat and food source, and potential sequestration of carbon	• Buffer strips can filter and remove contaminants in surface runoff and baseflow from cropland soils	• Leave a minimum of 3m along water courses and ditches • Wider strips provide more soil health and off-site impact reduction benefits • Buffer strips are only a portion of a conservation system and should be combined with other actions such as residue management, maintaining appropriate separation distances from watercourses and active flowpaths (e.g. low draws and other areas that have direct runoff connectivity to the watercourse)	

PHOSPHORUS				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Maintain appropriate separation distance from surface inlets (e.g. catch basins, stand pipes) during nutrient applications	Band or inject phosphorus containing nutrient materials (e.g. fertilizer, manure)	• Banding or injecting will minimize phosphorus that is at the soil surface and will reduce the potential of loss to surface flow	• See chart page 84, BMP Book: *Nutrient Management Planning* OR • Avoid "BMP flags" in the NMAN Field Management Plan for appropriate separation distances for nutrients based on runoff potential, soil fertility and material and method of application • Combine this with other conservation practices such as residue management	

Additional Practices for **PHOSPHORUS**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Place P below the soil surface	Band or inject phosphorus containing nutrient materials (e.g. fertilizer, manure)	• Banding or injecting will minimize phosphorus that is at the soil surface and will reduce the potential of loss to surface flow	• Take care to ensure that macropore flow is disrupted • Application on land with tile drainage • See Page 130, BMP Book: *Manure Management*	
Apply organic amendments (nutrients) to living crops	Side dressing manure in corn Application of organic amendments to recently harvested forage or pasture Application of a low rate of organic amendments to living cover crop that will overwinter	• Actively growing crops like corn and forage will take up a portion of the nutrients applied • Living crops slow water movement across the soil surface, reducing losses and enhancing infiltration of water	• Low rates of application • Cover crop applications–cover crop will overwinter i.e. winter cereals • Follow appropriate separation distances • See page 83 BMP Book: *Nutrient Management Planning* for appropriate separation distances based on runoff potential and material and method of application	

Additional Practices for **PHOSPHORUS**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Surface apply phosphorus (P) on shallow slopes	Broadcast phosphorus containing nutrient materials (e.g. fertilizer and manure) only on fields with gentle slopes	• The risk of runoff increases with slope • Surface applied materials on cropland with a high risk of runoff have a greater potential to contaminate surface water	• Do not surface apply phosphorus containing materials on fields with a slope greater than 5%	
Incorporate P within 24 hours	Surface applied phosphorus containing nutrient materials e.g. fertilizer, manure etc. is incorporated within 24 hours or less	• Reduce the time that nutrients are exposed on the soil surface to prevent losses during a runoff event (e.g. thunderstorm)	• Incorporation within 24 hours or less • Immediate incorporation is best • Does not require full inversion tillage	
Apply only to land with 30% residue cover (low runoff potential)	If surface applying phosphorus containing nutrient materials in a low runoff potential area, ensure that applications are only made on soils with 30% residue cover or more	• Residue cover protects the soil and slows water movement • Cover enhances water infiltration, helping to carry the nutrients into the soil and reducing erosion losses to surface water	• Combine 30%+ residue cover with shallow slopes and ensure no surface inlets exist if surface application is a must	

Additional Practices for **PHOSPHORUS**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Do not spread in the winter	Avoid winter spreading of fertilizer, manure and other organic amendments	• Spreading of nutrients in winter, whether manure or fertilizer, is not recommended due to the high potential for loss of nutrients to surface water • During the winter months, no crop is in place to absorb the surface applied nutrients • Fast melting snow or rain on frozen soil will tend to carry surface applied nutrients away from the field	• Winter application is not a best management practice • • See page 108, BMP book: *Manure Management* for contingency conditions	

Additional Practices for **PHOSPHORUS**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Modify surface inlet design	Replacing or modifying standard surface inlets (e.g. hickenbottoms with inlet designs that lengthen temporary ponding times or further filter the drainage water	• Surface inlets that increase runoff ponding time or encourage filtering of the runoff water can reduce phosphorus and total soluble solids concentrations in drainage water leaving a field		• This practice would be most valuable if the farmer was modifying or replacing an existing inlet as opposed to adding new inlets (e.g. add hickenbottom sock, or replace hickenbottom with the Livingston et al type inlet • One challenge is plugging, but may not be a problem with better soil health and/or drainage

NITROGEN				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Apply the right rate of fertilizer	Match fertilizer application rate(s) to meet crop need based upon soil test results and approved fertility recommendations. For a number of field crops OMAFRA recommendations use both fertilizer cost and expected yield to inform recommendations.	• Selecting nutrient application rates without regard to residual nutrient levels or actual crop needs risks over-applying or under- applying nutrients Over-application increases the risk of nutrient loss from the site by runoff, erosion, leaching and subsurface drainage	• Soil test and verify crop needs to select application rate • Follow rates that do not result in a "BMP red flag" in NMAN (nutrient management software)	
Soil test	The nitrogen status of the soil at the time of sampling. The nitrate soil test is a separate sample and testing procedure from basic soil fertility tests and requires appropriate handling	Applying what the crop needs based on a soil test will: • Support profitable yields • Protect the environment	• Soil samples are taken pre sidedress to inform sidedress application decisions in certain crops (e.g. corn) • Samples should be taken to a depth of 30 cm, kept cool and analyzed immediately or frozen for transport to the lab	

Additional Practices for **NITROGEN**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Reduce water erosion	Prevent water erosion through the use of cover crops, residue management and erosion control structures to ensure that soil stays within that field	Eroded sediments and water will carry nitrogen and may enter surface water	See **water erosion** section	Use of cover crops will also scavenge residual nitrogen and help to prevent loss.
Apply Nitrogen (N) in the spring	Apply nitrogen in the spring as close to planting or in a growing crop (sidedress) as possible to reduce the chance of loss through erosion	Nitrogen applied outside of the cropping season is at greater risk of loss due to increased probability of water runoff, erosion, leaching etc.	Apply nitrogen in the spring or during the growing season prior to crop maturity	
Adjust nitrogen fertilizer rates based on nitrogen contribution from organic sources	Reduce the rate of fertilizer nitrogen according to the estimated value of available nitrogen contributed by applied organic amendments	Application of manure, compost, biosolids or cover crops can provide a significant nitrogen contribution to the following crop	Applying a full nitrogen rate without consideration of organic amendment nitrogen contributions may result in over-application	

Additional Practices for **NITROGEN**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Maintain a buffer from surface water	A strip of permanent vegetation, usually a mix of trees, shrubs and grasses along the side of a watercourse and edge of a field with many functions which include: runoff sediment and volume retention and reduction, streambank stabilization, diversification, wildlife habitat and food source, and potential sequestration of carbon	Buffer strips can filter and remove contaminants in surface runoff and baseflow from cropland soils	• Leave a minimum of 3m along water courses and ditches • Wider strips provide more soil health and off-site impact reduction benefits • Buffer strips are only a portion of a conservation system and should be combined with other actions such as residue management, maintaining appropriate separation distances from watercourses and active flowpaths (e.g. low draws and other areas that have direct runoff connectivity to the watercourse)	

Additional Practices for **NITROGEN**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Maintain appropriate separation distance from surface inlets (e.g. catch basins, stand pipes) during nutrient applications	Keep nutrient materials (e.g. fertilizer, manure) away from the edges of inlets or surface water areas like ditches or streams to avoid loss of nitrogen	Nutrient containing materials – (e.g. manure, fertilizer) can readily lose nutrients like nitrogen under rainfall or spring melt conditions, especially if close to surface water or drainage elements that channel water to surface water	• See chart page 84, BMP Book: *Nutrient Management Planning* OR • Avoid "BMP flags" in the NMAN Field Management Plan for appropriate separation distances for nutrients based on runoff potential, soil fertility and material and method of application • Combine this with other conservation practices such as residue management	

Additional Practices for **NITROGEN**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Do not spread in the winter	Avoid winter spreading of fertilizer, manure and other organic amendment.	• Spreading of nutrients in winter, whether manure or fertilizer, is not recommended due to the high potential for loss of nutrients to surface water • During the winter months, no crop is in place to absorb the surface applied nutrients • Fast melting snow or rain on frozen soil will tend to carry surface applied nutrients away from the field	• Winter application is not a best management practice • See page 108, BMP book: *Manure Management* for contingency conditions	

Additional Practices for **NITROGEN**				
Best Management Practice based on Farmland Health Challenge	**BMP Description**	**Rationale**	**Principles**	**Additional Benefits**
Apply organic amendments (nutrients) to living crops	Side dressing manure in corn Application of organic amendments to recently harvested forage or pasture Application of a low rate of organic amendments to living cover crop that will overwinter	• Actively growing crops like corn and forage will take up a portion of the nutrients applied • Living crops slow water movement across the soil surface, reducing losses and enhancing infiltration of water	• Low rates of application • Cover crop applications–cover crop will overwinter i.e. winter cereals • Follow appropriate separation distances • See page 83 BMP Book: *Nutrient Management Planning* for appropriate separation distances based on runoff potential and material and method of application	