Alberta Agriculture Feasibility Study for BMP Impact Modelling
Phase 1 - Initial List of BMPs Relevant to GHG Emissions and Water Quality

BMP Category / Area	BMP	Description of BMP	Jurisdiction: Administered by:	Compliance: Legislation	Cost-Effective Implementation	Producer Recognition of BMP	Prevalent / Encouraged in Alberta	Potential for Increased Adoption of BMP	BMP Impacts - GHG Emissions: Impact Magnitude	BMP Impacts - GHG Emissions: Impact Scale	BMP Impacts - Water Quality	Specific Impacts of BMP	Funded by GF2 Stewardship Program	Funded	Market Relevance of BMP: Occurrence in sustainability program, guidelines, policy or regulation initiatives		Market Relevance of BMP: Occurrence in protocols, certifications, standards, assessment tools	GHG magnitude x Scale + Water + Funded + Market: Score	GHG Impact: Score	GHG Impact: Normalized score	Criteria 1 GHG impact and market demand: Score	Criteria 2 Water quality impact and market demand: Score	Criteria 3 GHG impact, water quality impact and market demand: Score	Score Analysis	Priority
					Phase 1 Descriptors							Phase 1 First-Level Selection Criteria					Phase 2 - Data / Documentation Requirements								
FARMSTEAD SITES																									
Livestock Yards																	Score for market relevance								
1	siting - distance to nearest surface water body	maximise distance between livestock yard and nearest surface water body		AOPA stipulates setbacks from common bodies of water when locating livestock corrals			"maintain buffer areas along edge of natural water bodies" is adopted by 76% of eligible producers (3)(ESATS adoption)		-1	1	3	Increased separation between livestock yard and surface water body reduces the risk of contamination of the water body.	AC 203 Livestock Facility and Permanent Wintering Site Relocation covers 1) construction costs to rebuild an equivalent facility or adequately sized facility in a more suitable location; 2) tear down and removal costs of the old livestock facility. 50% of max. $50,000.	1	10		14	4	-1	-1	0	4	3	Funded (for water quality impact), but negative GHG impact and moderate market relevance	
2	run-on control	run-on water is diverted away from livestock pens or corrals							0	1	3	Diversion of run-on water from livestock pens/corrals reduces the risk of contamination of water by material from the pens/corrals.	AC 202 Livestock Facility Runoff Control covers eavestroughs to collect and direct water around or away from livestock pens and manure collection areas. 50% of max. $50,000.	1	10		14	5	0	0	1	4	4	Funded (for water quality impact), but no GHG impact and moderate market relevance	
3	run-off control	runoff from livestock yards is prevented from leaving the property OR runoff is directed to a constructed runoff management facility (catch basin, wetland)					"control runoff from livestock pens" is adopted by 64% of eligible producers (3)(ESATS adoption): "control runoff from feeding areas" is adopted by 59% of eligible producers (3)(ESATS adoption)	"control runoff from livestock pens" has relatively low adoption (64%) and relatively high eligibility (62%), therefore high potential for increased uptake (4)(ESATS): "control runoff from feeding areas" has relatively low adoption (59%) and relatively high eligibility (62%), therefore high potential for increased uptake (4)(ESATS)	-1	1	3	Preventing runoff from leaving the property OR directing runoff to a constructed runoff management facility (catch basin, wetland), reduces the risk of contamination of surface water or groundwater by material from the livestock yard.	AC 202 Livestock Facility Runoff Control. 50% of max. $50,000.	1	10		14	4	-1	-1	0	4	3	Funded (for water quality impact), but negative GHG impact and moderate market relevance	
4	catch basin management	catch basin capacity to hold all upslope runoff is maintained							0	1	3	Maintaining catch basin capacity to hold all upslope runoff, reduces the risk of contamination of surface water or groundwater with material from the livestock yard.	AC 202 Livestock Facility Runoff Control covers earthwork for construction of catchment basins. 50% of max. $50,000.	1	9		14	5	0	0	1	4	4	Funded (for water quality impact), but no GHG impact and moderate market relevance	
5	floor maintenance	proper floor maintenance, e.g. floor (gleyed layer) of pen or corral is not removed during manure removal; if holes develop or the layer is removed, clay or appropriate fill material is added							0	1	1	Proper maintenance of pen/corral floors reduces the risk of contamination of surface water and groundwater by material (e.g. nitrate) from livestock pens.			10		14	2	0	0	1	2	2	Not funded, impacts water quality and moderate market impact	
FIELD SITES																									
Soil Management																									
6	reduced tillage practices	reduction of the amount and/or intensity of tillage				"soil erosion from wind and water" (42%) is of high concern (4) to producers (ESATS perceptions)	"use reduced tillage" is adopted by 36% of eligible producers (1)(ESATS adoption)	"use reduced tillage"has low adoption (36%) and relatively high eligibility (61%), and "loss of soil fertility" is a key issue of concern to farmers (and reduced tillage sequesters carbon), therefore very high potential for increased uptake (5)(ESATS)	3	3	3	Reduced tillage reduces net GHG emissions by reducing soil aeration, leading to slower decomposition of soil organic matter. Soil: Reduced tillage reduces the risk of tillage erosion; and reduces the risk of water and wind erosion by leaving large, stable aggregates (increasing infiltration) and by maintaining crop residue cover.			13		22	14	9	3	5	5	8	Not funded, but very high GHG impact and high market relevance	1
7	cover crops	cover crops planted for erosion protection				"soil erosion from wind and water" (42%) is of high concern (4) to producers (ESATS perceptions)	"use winter cereals in rotation" is adopted by 8% of eligible producers (1)(ESATS adoption)	"use winter cereals in rotation" has extremely low adoption (8%) and relatively high eligibility (67%), and "loss of soil fertility" is a key issue of concern to farmers, therefore very high potential for increased adoption (5)(ESATS)	1	2	3	Seeding of cover crops disturbs soil and increases oxidation of soil organic carbon (resulting in loss of soil organic carbon to the atmosphere). Cover crops may utilize some mineralized N and prevent N2O emissions (decreasing GHG emissions). Soil: Cover crops prevent soil erosion by providing leafy top growth that protects the soil in fall and winter.			12		18	7	2	1	3	5	6	Not funded, but low GHG impact and high market relevance	2
8	crop rotation, incorporating perennial or pulse crops	crop rotation incorporating perennial forages or pulse crops				"loss of soil fertility" (52%) is of high concern (4) to producers (ESATS perceptions)	"use pulse crops in rotation" is adopted by 21% of eligible producers (1)(ESATS adoption)	"use pulse crops in rotation" has low adoption (21%) and relatively high eligibility (66%), and "loss of soil fertility" is a key issue of concern to farmers, therefore high potential for increased uptake (4)(ESATS)	2	3	2	Crop rotations incorporating perennial forages reduce net GHG emissions by building up soil organic matter. Soil: Crop rotations incorporating perennial forages reduce wind and water erosion. Other: Crop rotations incorporating pulse crops reduce fertilizer needs by fixing nitrogen.			13		21	10	6	2	4	4	6	Not funded, but moderate/high GHG impact and high market relevance	3
Nutrient Management - use of 4R system																									
9	fertilizer application - source	fertilizers are in chemical forms best used by the target crop and soil							1	3	1	Using enhanced efficiency fertilizers may reduce nitrous oxide emissions.			15		21	7	3	1	4	4	5	Not funded, but low/moderate GHG impact and very high market relevance	4
10	fertilizer application - rate	fertilizer rate to match nutrient supply (considering all sources) with crop requirements			"precision farming - variable rate technology: commercial fertilizer" can reduce input costs, optimize productivity, and increase profitability (5)(ESATS)		"apply chemical fertilizer at recommended rate" is adopted by 64% of eligible producers (3)(ESATS adoption): "soil sampling fields at least once every three years" is adopted by 51% of producers (3)(ESATS adoption): "precision farming - variable rate technology: commercial fertilizer" is adopted by 31% of eligible producers (1)(ESATS	"apply chemical fertilizer at recommended rate" has relatively low adoption (64%) and relatively high eligibility (64%), therefore high potential for increased uptake (4)(ESATS): "soil sampling fields at least once every three years" has moderate adoption (51%) and high eligibility (93%), therefore high potential for increased uptake (4)(ESATS): "precision farming - variable rate technology: commercial fertilizer" has	1	3	2	Applying fertilizer at a rate matching crop requirements (1) reduces the potential for nitrous oxide emissions, and (2) reduces the potential for contamination of surface and groundwater with fertilizer nitrogen.			14		23	7	3	1	3	4	5	Not funded, but low/moderate GHG impact, positive water quality impact, and high market relevance	5
11	fertilizer application - timing	fertilizer application is timed so that nutrients will be available when crop demand is high							1	3	2	Applying fertilizer at a time when crop demand for nutrients is high (e.g. spring rather than fall) reduces the potential for (1) nitrous oxide emissions, and (2) contamination of surface and groundwater with fertilizer nitrogen.			14		24	7	3	1	3	4	5	Not funded, but low/moderate GHG impact, positive water quality impact, and high market relevance	6
12	fertilizer application - placement	fertilizer is placed where the crop can access nutrients most effectively							1	3	2	Placement of fertilizer for optimal crop access (e.g. banding, injection) reduces the potential for nitrous oxide emissions. Placement of fertilizer for optimal crop access (e.g. banding, injection) reduces the potential for contamination of surface and groundwater with fertilizer nitrogen.			14		23	7	3	1	3	4	5	Not funded, but low/moderate GHG impact, positive water quality impact, and high market relevance	7
Manure Use and Management																									
13	application rate based on testing and book values	manure application rate is based on manure nutrient content determined by manure analysis (preferred), or is based on "book value" manure nutrient content					"manure application based on P or N & P" is adopted by 33% of eligible producers (1)(ESATS adoption): "sampling and analyzing the manure for nutrient content" is adopted by 35% of eligible producers (1)(ESATS adoption)	"manure application based on P or N & P" has low adoption (33%) and moderate eligibility (43%), therefore high potential for increased uptake (4)(ESATS): "sampling and analyzing the manure for nutrient content" has low adoption (35%)and moderate eligibility (42%), therefore high potential for increased uptake (4)(ESATS)	2	2	3	Matching manure nutrient levels to crop demand reduces the risk of excess nutrients (1) adversely affecting water quality through contamination with nitrate/bacteria, and (2) becoming a source of nitrous oxide emissions			14		22	9	4	2	4	5	7	Not funded, but moderate GHG impact, positive impact on water quality, and high market relevance	8
14	application method - conventionally tilled land	manure is injected or incorporated immediately after application (preferred), or broadcast and incorporated soon afterwards		AOPA stipulates incorporation of manure within 48 hours of application to cultvated land (exceptions apply)		"odour from manure spreading on land" (17%) is of very low (1) concern to producers (ESATS perceptions)	"incorporate manure after applying" is adopted by 51% of eligible producers (3)(ESATS adoption): "applying liquid manure" is adopted by 33% of eligible producers (1)(ESATS adoption)		2	2	3	Injection or immediate incorporation of manure reduces the risk of excess nutrients (1) adversely affecting water quality through contamination with nitrate/bacteria, and (2) becoming a source of nitrous oxide emissions; and (Water Quality - nutrient loss) reduces the risk of nitrogen and phosphorus losses through runoff/leaching. Non-GHG airborne emissions - ammonia loss: injection or immediate incorporation of manure reduces the risk of ammonium nitrogen loss to the air through volatilization.			13		20	9	4	2	4	5	7	Not funded, but moderate GHG impact, positive impact on water quality, and high market relevance	9
15	timing of application for plant needs	manure is applied in the spring, just prior to or during active plant growth							2	2	2	Application of manure close to the time of the crop's greatest demand for nutrients, reduces the risk of excess nutrients (1) adversely affecting water quality through contamination with nitrate/bacteria, and (2) becoming a source of nitrous oxide emissions, and (Water Quality - nutrient loss) reduces the risk of nutrient losses through surface runoff.			14		23	8	4	2	4	4	6	Not funded, but moderate GHG impact, positive impact on water quality, and high market relevance	10
16	setback distance for manure application in proximity to water bodies	a setback distance is implemented between manure application and water bodies		AOPA stipulates setbacks from common bodies of water when manure is applied			"avoid applying manure close to waterways to minimize nutrient runoff" is adopted by 78% of eligible producers (3)(ESATS adoption): "maintain buffer areas along edge of natural water bodies" is adopted by 76% of eligible producers (3)(ESATS adoption)		1	1	3	Leaving a buffer zone between manure application and water bodies (lakes, streams, wells) reduces the risk of water contamination by nitrate, phosphate, ammonia, bacteria, organic matter, by intercepting contaminants; and (Water Quality - nutrient loss) reduces the risk of nutrient losses through surface runoff.			12		16	6	1	1	3	5	6	Not funded, but low GHG impact and positive impact on water quality, and high market relevance	11
17	composting of manure	manure is composted (to destroy pathogens)		AOPA regulates the siting and operation of facilities that compost livestock manure without additives					1	1	1	Manure composting stabilizes volatile nitrogen into large protein particles, reducing nutrient loss and therefore water pollutants. Non-GHG airborne emissions - odour: manure composting reduces odour during land application of manure			11		16	4	1	1	3	3	4	Not funded, but low GHG impact and positive impact on water quality, and high market relevance	?
Livestock Wintering Sites																									
18	no/controlled direct access to surface water sources	Direct access of cattle to surface water bodies is prevented (preferred), or controlled				"bank erosion from livestock access" (24%) is of low concern (2) to producers (ESATS perceptions)	"manage livestock access to water bodies used as a water source" is adopted by 60% of eligible producers (3)(ESATS adoption): "protect riparian areas from grazing to prevent overuse" is adopted by 69% of eligible producers (3)(ESATS adoption)		0	1	3	Prevention or control of livestock access to water bodies reduces the risk of water contamination with nitrates, phosphates, ammonia, bacteria, organic matter.	AC 101 Riparian Area Fencing and Management. 70% of max. $50,000. AC 102 Year-Round / Summer Watering Systems covers year-round remote watering systems, which reduce build-up and off-site transport of manure nutrients and pathogens, increasing protection of water bodies and riparian areas. 50% of max. $30,000.	1	10		14	5	0	0	1	4	4	Funded (for water quality impact), but no GHG impact and moderate market relevance	
19	proximity of livestock wintering sites to groundwater well heads	separation is maximized between livestock wintering sites and groundwater well heads					"choose wintering site to avoid manure contamination of water" is adopted by 87% of eligible producers (4)(ESATS adoption)		0	0	1	Maximal separation between livestock wintering sites and groundwater well heads reduces the risk of well water contamination with nitrates and bacteria.	AC 102 Year-Round / Summer Watering Systems covers year-round remote watering systems, which reduce build-up and off-site transport of manure nutrients and pathogens, increasing protection of water sources and riparian areas. 50% of max. $30,000.	1	10		14	3	0	0	1	2	2	Funded (for water quality impact), but no GHG impact and moderate market relevance	
20	distance to water bodies/sources	separation is maximized between livestock wintering sites and water bodies and water sources		AOPA stipulates setbacks from common bodies of water when locating livestock wintering sites			"maintain buffer areas along edge of natural water bodies" is adopted by 76% of eligible producers (3)(ESATS adoption)		0	0	3	Maximal separation between livestock wintering sites and water bodies/sources reduces the risk of water contamination with nitrates, phosphates, ammonia, bacteria, organic matter.	AC 102 Year-Round / Summer Watering Systems covers year-round remote watering systems, which reduce build-up and off-site transport of manure nutrients and pathogens, increasing protection of water bodies and riparian areas. 50% of max. $30,000.	1	10		14	5	0	0	1	4	4	Funded (for water quality impact), but no GHG impact and moderate market relevance	
21	run-on management	potential for run-on water to flow on to the livestock wintering site is absent (preferred), or controlled by run-on diversions							1	1	2	Prevention or control of run-on water flowing on to the livestock wintering site reduces the risk of water contamination with nitrates, phosphates, ammonia, bacteria, organic matter.	AC 202 Livestock Facility Runoff Control covers eavestroughs to collect and direct water around or away from livestock pens and manure collection areas. 50% of max. $50,000.	1	10		14	5	1	1	2	3	4	Funded (for water quality impact), but low GHG impact and moderate market relevance	
22	drainage management	drainage from livestock wintering sites is managed by use of an effective catch basin (preferred) or filter strip, and is contained					"control runoff from feeding areas" is adopted by 59% of eligible producers (3)(ESATS adoption)		1	1	2	Management of drainage (by catch basin or filter strip) from livestock wintering sites reduces the risk of water contamination with nitrates, phosphates, ammonia, bacteria, organic matter.	AC 202 Livestock Facility Runoff Control covers earthwork for construction of catchment basins. 50% of max $50,000.	1	10		14	5	1	1	2	3	4	Funded (for water quality impact), but low GHG impact and moderate market relevance	
23	feeding site and bedding site location	feeding sites and bedding sites are frequently moved throughout the wintering season							-1	1	2	Frequent movement of feed, bedding and/or shelter disperses animals and minimizes manure build-up, thus reducing the risk of water with nitrates and bacteria. Soil - compaction: frequent movement of feed, bedding and/or shelter disperses animals and minimizes soil compaction.			11		14	3	-1	-1	1	4	3	Not funded, positive water quality impact and negative GHG impact, and high market relevance	
Pest Management																									
24	distance of pesticide application from water bodies/sources	distance is maximized between pesticide application and water bodies and water sources					"maintain a 10m buffer from water wells when applying pesticides" is adopted by 94% of eligible producers (5)(ESATS adoption): "maintain a 10m buffer from water bodies when applying pesticides" is adopted by 79% of eligible producers (3)(ESATS adoption)		0	1	2	Maximal distance (buffer zone) between pesticide application and water bodies/sources reduces the risk of water contamination with pesticide. Non-GHG airborne emissions - drift contamination from chemical application: maximal separation between pesticide application and environmentally sensitive areas reduces the risk of water contamination with pesticide.			12		14	4	0	0	2	4	4	Not funded, positive water quality impact, no GHG impact, high market relevance	
25	pesticide drift minimization	pesticide application is avoided in high winds, and/or drift prevention methods are used							0	1	2	Spray drift reduction methods during pesticide application reduce the risk of water contamination with pesticide. Non-GHG airborne emissions - drift contamination from chemical application: spray drift reduction methods during pesticide application reduce the risk of contamination of neighbouring properties and environmentaly sensitive areas with pesticide.			13		15	4	0	0	2	4	4	Not funded, positive water quality impact, no GHG impact, high market relevance	
26	rinsate disposal	proper procedures are followed to dispose of rinsate contaminated with pesticide							0	1	1	Following proper procedures to dispose of pesticide-contaminated rinsate reduce the risk of water contamination with pesticide.			13		15	3	0	0	2	3	3	Not funded, positive water quality impact, no GHG impact, high market relevance	
Water Bodies																									
27	restoration of wetlands	wetlands that have been drained are restored							1	1	2	Restoration of wetlands (1) improves water quality by filtering water and reducing contaminants, and (2) offsets GHG emissions through wetland plants sequestering carbon in the soil. Soil - erosion: wetland restoration reduces the risk of soil erosion due to flooding, by storing runoff water and releasing it slowly downstream.	AC 104 Wetland Restoration. 70% of max. $50,000.	1	13		18	6	1	1	3	4	5	Funded, positive water quality impact, low GHG impact, high market relevance	12
28	use of buffer zones for field crops	buffer zones are established and maintained between field crops and riparian areas					"maintain buffer areas along edge of natural water bodies" is adopted by 76% of eligible producers (3)(ESATS adoption)		1	1	3	Buffer zones between field crops and riparian areas improve water quality by intercepting contaminants (nitrate, phosphorus and sediment) leaving the field. Soil - erosion: buffer zones between field crops and riparian areas protect water bodies from flooding and soil erosion. Riparian health: buffer zones between field crops and riparian areas reduce the risk of reduced riparian health.			12		16	6	1	1	3	5	6	Not funded, positive water quality impact, low GHG impact, high market relevance	13
29	manage livestock access to water bodies and riparian areas (e.g. provide off-site watering)	livestock access to water bodies and riparian areas is prevented or limited				"bank erosion from livestock access" (24%) is of low concern (2) to producers (ESATS perceptions)	"manage livestock access to water bodies used as a water source" is adopted by 60% of eligible producers (3)(ESATS adoption): "time grazing to avoid vulnerable times of the year for riparian areas" is adopted by 71% of eligible producers (3)(ESATS adoption): "protect riparian areas from grazing to prevent overuse" is adopted by 69% of eligible producers (3)(ESATS adoption)	"time grazing to avoid vulnerable times of the year for riparian areas" has good adoption (71%) and moderate eligibility (59%), and moderate levels of concern regarding loss of riparian areas, therefore high potential for increased uptake (4)(ESATS): "protect riparian areas from grazing to prevent overuse" has good adoption (69%) and moderate eligibility (61%), and moderate levels of concern regarding loss of riparian areas, therefore high potential for increased uptake (4)(ESATS)	0	1	3	Preventing or limiting livestock access to water bodies and riparian areas reduces the risks of water contamination and nutrient buildup in the water body / riparian area. Riparian health: preventing or limiting livestock access to water bodies and riparian areas reduces the risk of reduced riparian health (loss of riparian habitat and vegetation)	AC 101 Riparian Area Fencing and Management. 70% of max. $50,000. AC 102 Year-Round / Summer Watering Systems. 50% of max. $30,000	1	11		14	6	0	0	2	5	5	Funded, positive water quality impact, no GHG impact, high market relevance	14
Trees, Shelterbelts, Woodlots, Bush																									
30	presence of field shelterbelts	multi-row, healthy, diverse stands of trees and shrubs, or existing native woody windbreaks, that shelter fields					"retain bush or native grassland" is adopted by 79% of eligible producers (3)(ESATS adoption) "trees for agriculture purposes" is adopted by 81% of eligible producers (4)(ESATS adoption)		2	1	0	Soil - erosion: field shelterbelts reduce soil erosion by wind. GHG Emissions - C sequestration: field shelterbelts sequester atmospheric carbon.	AC 105 Shelterbelt Establishment. 50% of max. $10,000.	1	10		21	4	2	1	2	1	2	Funded, low GHG impact, moderate market relevance	
31	minimal human and animal impacts	human and animal impacts on shelterbelts and woodlots are minimized							0	1	0	Soil - erosion: minimizing human and animal impacts on field shelterbelts reduces soil erosion by wind. GHG Emissions - C sequestration: minimizing human and animal impacts on field shelterbelts sequesters atmospheric carbon.			10		21	1	0	0	1	1	1	Not funded, no GHG or water quality impact, moderate market relevance	
32	presence and management of natural and planted woodlots	woodlots are managed according to a sustainable management plan; with a variety of woodland species, without soil or water quality damage, without signs of insect or disease damage on trees, without access by livestock					"retain bush or native grassland" is adopted by 79% of eligible producers (3)(ESATS adoption): "manage grazing to encourage natural rejuvenation of understory" is adopted by 68% of eligible producers (3)(ESATS adoption): "manage grazing for wildlife habitat" is adopted by 60% of eligible producers (3)(ESATS adoption): "trees for agriculture purposes" is adopted by 81% of eligible producers (4)(ESATS adoption)		1	1	1	Woodlots (1) sequester atmospheric carbon, and (2) contribute to stabilizing wetlands and water bodies, and improve water quality by filtering and removing contaminants from water. Soil - erosion: woodlots increase the water holding capacity of soil (regulating water flows), and reduce the risk of water and wind erosion.			10		20	3	1	1	2	2	3	Not funded, positive water quality impact and low GHG impact, moderate market relevance	
Agricultural Waste Management																									
33	recycle oil, rubber, plastics	oil, rubber and plastics are taken to the appropriate recycling facility				"proper disposal of agricultural waste" (58%) is of very high concern (5) to producers (ESATS perceptions)	"recycle oil, rubber, plastics" is adopted by 41% of eligible producers (2)(ESATS adoption)	"recycle oil, rubber, plastics" has low adoption (41%) and moderate eligibility (65%), and farmer concern over "proper disposal of agricultural waste" is high, therefore very high potential for increased uptake (5)(ESATS)	0	1	1	Recycling oil, rubber and plastics reduces the risk of water contamination.	AC 303 Used oil and Lubricant Storage covers purchase of used oil storage tanks, which facilitate accumulation of quantities of used oil that can be sold for recycling. 50% of max. $2,000. AC 304 Plastic Rollers [Agricultural Waste Management] covers purchase of plastic roller units, which can be used to roll and compact agricultural sheet plastics, enabling convenient storage and transportation, and potential sale to a recycler given sufficient quantity. 70% of max. $5,000.	1	9		15	3	0	0	1	2	2	Funded, positive impact on water quality, moderate market relevance	