

**Final Report
For
Advanced Manure Management Technologies For
Ontario Project**

A Project Funded
By

Cold Springs Farm
Selves Farms
Ontario Pork
Premium Pork
Ontario Pork Industry Council
Poultry Industry Council
Ontario Ministry of Agriculture and Food
Through
Healthy Futures For Ontario Program

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AMMTO

Advanced Manure Management Technologies For Ontario



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APPENDIX 5

Summary of Technologies Submitted to AMMTO for Review

Summary of Manure Management Technology Submissions Received by AMMTO

Glossary

- BOD** : Biochemical Oxygen Demand: *amount of oxygen required by microorganisms to biologically stabilize organic matter*
- DAF**: Dissolved Air Flootation: *air is bubbled into wastewater to cause solids to rise to the surface where they are skimmed off*
- ED**: Endocrine Disruptors
- GHG**: Green House Gases
- GW**: Groundwater
- HM**: Heavy Metals
- KALI**: Kongskilde Arable Land Injector: *Agrico injectors' primary toolbar*
- NPK**: Nitrogen : Phosphorus: Potassium value
- OM**: Organic Matter
- SW**: Surface Water
- TKN**: Total Kjeldahl Nitrogen: *total of ammonia and organic nitrogen*
- TS**: Total Solids: *all matter that remains as residue after evaporation at 103-105 deg. C.*
- VS**: Volatile Solids: *organic fraction of solids that are oxidized (burned off) at ~ 550 deg. C.*
- SS**: Suspended Solids: *solids passing through a membrane filter with a pore size of 1.2 um*

Technology Description	Summary of Company Claims	Additional Information
Anaerobic Based Technologies		
<p>Anergen Corp 663 Academy Drive Northbrook, Illinois, USA Phone: 847-498-4545 -- manure is screened then digested first in a mesophilic reactor (35C) then transferred to a thermophilic (55C). Solids are then separated and the liquid portion filtered to produce relatively clean water and a nutrient concentrate.</p>	<ul style="list-style-type: none"> - BOD reduction > 90% - Odour reduction > 90% - Volatile solids destruction > 80% - % Methane in digester gas > 75% - Methane eliminated: ~0.5 m3/kg of VS - Volume reduction ~60% after membrane - Nutrient rich effluent can be used as concentrated fertilizer - Nutrients can be applied uniformly and less expensively - Nutrients can be reformulated by addition of chemical fertilizers - Fly problems eliminated - Solids can be reused as bedding/compost - Weed seeds eliminated - Pathogens destroyed - Waste classified to "Class A" - GHG removed or reduced (reduced if electricity is produced) - Alternate energy source; green energy - Centralized facility possible - Suspended solids reduction > 80% 	<ul style="list-style-type: none"> - currently no installations - certain antibiotics inhibit process - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall winter or early spring applied
<p>Böhni Energie & Umwelt GmbH Industriestr. 23, 8500 Frauenfeld, Switzerland Phone: 0041 52 728-8997 -- manure is mixed with supplemental organic waste and fermented at 35-40 deg. C. Land applied after fermentation.</p>	<ul style="list-style-type: none"> - Odour reduction by 90% - Nitrate loading reduced by 70% - Methane release reduced by 70% - Pathogen destruction by 90% - Volume reduction by 3% - Alternate energy source; green energy - Improved fertilizer value of manure 	<ul style="list-style-type: none"> - not 100% pathogen free effluent - storage max. 2 months prior to treatment - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied

Technology Description	Summary of Company Claims	Additional Information
Anaerobic Based Technologies Continued		
<p>Clear-Green Biotechnologies (Bioscan Technologies) #13-1724 Quebec Ave. Saskatchewan, S7K 1V9 -- if needed, manure is pre-treated to balance pH or provide flocculation/coagulation. It is then pre-heated to 37C and then fermented. Digester effluent is then separated and the liquid fraction further filtered to extract the nutrients. Reverse osmosis or other water treatment processes can be added to further clean the water.</p>	<ul style="list-style-type: none"> - using liquid hog manure produces reduction of 40-55% - odour reduction due to VS destruction - 90% conversion of nitrogen to water-soluble ammonium decreasing leaching - 0.4-1.4 ton reduction of CO₂/ ton of manure - centralized plants can accommodate various waste streams - company offers "build, own & operate" services - producer doesn't need to worry about system - back-up energy supply produced - nutrient concentration to produce value-added fertilizer 	<ul style="list-style-type: none"> - effluent still has slight odour - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available
<p>Linde-KCA-Dresden GmbH Bodenbacher StraBe 80, 01277 Dresden, Germany Phone: +49 351 250-3124 -- many different streams available. Manure is buffered, screened if necessary, digested in 1 or 2 step processes (meso- or thermo-philic). Effluent can be dewatered and composted. Liquid portion can be further treated or used for irrigation.</p>	<ul style="list-style-type: none"> - reduction of VS from 40-60% - reduction of TS > 50% - odour reduction by 80% - methane emission reduction by 95% - reduction of ammoniacle nitrogen - green energy production - can produce pathogen free effluent - slight reduction in total phosphorous 	<ul style="list-style-type: none"> - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available
<p>RCM Digesters P.O. Box 4715, Berkeley California, USA Phone: 510-658-4466 -- various digesters available including covered lagoon digestion systems.</p>	<ul style="list-style-type: none"> - odour reduction >90% - methane reduction - pathogen reduction by 2 1/2 - 3 log - nutrient stabilization - antibiotics at normal levels didn't affect process 	<ul style="list-style-type: none"> - only a reduction in pathogens - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available
<p>RENTEC Renewable Energy Technologies, Inc. / GBU mbH 342 English Settlement Road Trenton, Ontario, K8V 5P7 Phone: 613-849-9199 -- Manure is inoculated with bacteria and enters dual-chambered fermenter such that partially digested material can't exit reactor. Mixing occurs with no moving parts.</p>	<ul style="list-style-type: none"> - treated manure can be used on crop without harming plants - nitrate to ammonium conversion by 90% - 30% increase in plant available nutrients - methane reduction to atmosphere by 100% - methane reduced by 80-90% - green energy production - mixing prompted by pressure differential; no need for moving parts - dual chamber design eliminates partially digested effluent from leaving digester 	<ul style="list-style-type: none"> - depending on quantity and type, antibiotics can negatively affect process - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available

Technology Description	Summary of Company Claims	Additional Information
Anaerobic Based Technologies Continued		
<p>Farm Energy P.O. Box 1479, RR#3 Petrolia Ontario, N0N 1R0 Phone: 519-764-2083 -- Water separation and anaerobic digestion of solids at mesophilic stage (39 C). Biogas stream produced for power or heat generation.</p>	<ul style="list-style-type: none"> - pathogen reduction - GHG reduction - odour reduction by 75% - thermal/electrical energy production - provides increase in available nitrogen - some phosphorous separation 	<ul style="list-style-type: none"> - not complete pathogen elimination - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available
<p>Hoffland Environmental Inc. 10391 Silver Springs Road Texas, USA, 77303-1602 Phone: 936-856-4515 -- Solids digested in a covered basin at 34-36 C. Liquids aerobically treated to remove nitrogen.</p>	<ul style="list-style-type: none"> - odour reduced completely - 95% reduction in ammoniacle nitrogen - some pathogen removal 	<ul style="list-style-type: none"> - not complete pathogen elimination - might need further insulation in Canada - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available
<p>Horton CBI Ltd. 45 Hampton Cr. NW Calgary, Alberta, T3A 5W1 Phone: 403-264-1333 -- Egg shaped anaerobic digesters that can be operated in either the thermophilic or mesophilic temperature ranges. Digester can accommodate solids concentrations as high as 8-12% and can be sized to accept waste from haulers.</p>	<ul style="list-style-type: none"> - VS reduction of 50% - methane release essentially eliminated - odour at facility contained; reduced substantially for land application - pathogen removal through thermophilic treatment 	<ul style="list-style-type: none"> - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available
<p>BioWaste Energy Canada Ltd. 100 Fullarton Street London, Ontario, N6A 1K1 Phone: 519-268-3375 -- Optimized Anaerobic Treatment process that operates in the thermophilic range (59%).</p>	<ul style="list-style-type: none"> - complete pathogen removal in both solid and liquid streams - open lagoons eliminated - zero liquid discharge (waste streams: fertilizer, water, and solids) - GHG eliminated 	<ul style="list-style-type: none"> - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available
<p>LIPP GmbH I8 route 143 sud, North Hatley, Quebec, J0B 2C0 Phone: 819-842-2565 -- Anaerobic digestion in thermophilic temperature range.</p>	<ul style="list-style-type: none"> - reduction of GHG emissions - odour reduction of up to 80% - minerals are mobilized to become more plant available 	<ul style="list-style-type: none"> - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available

Technology Description	Summary of Company Claims	Additional Information
Anaerobic Based Technologies Continued		
<p>Sharp Energy, Inc. 24684 Route 148, Tulare, California, USA, 93274 Phone: 559-688-2051</p> <p>-- Manure is pumped through an anaerobic treatment system with 3 lagoons. Biogas is collected from the first lagoon. Water from third lagoon is used for irrigation or mixed with fresh water for flushing systems.</p>	<ul style="list-style-type: none"> - provides excess water for recycling and irrigation - uses covered lagoon as digester - odour reduction by 80% - pathogen elimination - reduces BOD >99% - removes 100% of methane - green energy production - fertilizer value of effluent increased 	<ul style="list-style-type: none"> - may have problems in Ontario climate without heating anaerobic lagoon - pathogen elimination is questionable - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available
<p>Conestoga-Rovers and Associates 651 Colby Drive, Waterloo, Ontario, N2V 1C2</p> <p>Anaerobic treatment is combined with aerobic digestion and membrane filtration to produce a high quality water effluent and high solids concentrate.</p>	<ul style="list-style-type: none"> - a bio-enhancer is used in the anaerobic digestion process to improve efficiency of digestion process - significant reduction in odour - water from membrane treatment can be reused in the barn for livestock watering and barn cleaning - pathogens removed from water - volume of manure concentrate requiring land application is reduced by 80% 	<ul style="list-style-type: none"> - conceptual system design at this point and components have not yet been installed as a complete system at full scale - nutrients are mineralized and anaerobic effluent has higher potential to cause groundwater contamination if fall, winter or early spring applied - mineralized nutrients are plant available
Ambient Temperature Aerobic Systems		
<p>Bion Technologies Inc. 8899 Main St., Williamsville, New York, USA, 14221 Phone: 716-633-4674</p> <p>-- Manure moves solids to one of 3 ecoreactors to settle out solids and bacterial masses. Once the first is full, the water is drained to the aerobic bioreactor for further breakdown. Water then moves on either to irrigation, to a second bioreactor if extra storage is needed or for flushing. Soil is taken from the drained ecoreactors, cured and then sold as an organic fertilizer.</p>	<ul style="list-style-type: none"> - company will operate plant and distribute "BionSoil" - odour reduced by >90% - methane emissions reduced by >99% - phosphorous reduced by >80% - TKN reduced by >80% - land base reduction - manure handling labour reduced - reduced potential for ground and surface water contamination - potential for revenue sharing with owner - adaptable to large and small operations 	<ul style="list-style-type: none"> - excess water needs to be disinfected before pathogens 100% are eliminated
<p>Envirogain Inc. 1112 boulevard de la Rive-Sud, bur. 210, Saint-Romuald, Quebec, G6W 5M6 Phone: 418-834-2640</p> <p>-- Makes three systems from separation to full treatment.</p>	<ul style="list-style-type: none"> - nitrogen reduction by 99% - phosphorus reduction by 99% - volume reduction by 80% - reduction in GHG emissions - biosolids fertilizer produced 	<ul style="list-style-type: none"> - produces two streams (solid and liquid)

Technology Description	Summary of Company Claims	Additional Information
Ambient Temperature Aerobic Systems Continued		
<p>Rosenberg International Inc. / FWB Technologies 1117 Ste-Catherine St. West, Suite 714-715, Montreal, Quebec, H3B 1H9 Phone: 514-497-3111 -- Manure is seeded with micro-organisms and sent to FWB digesters. After a >300 day retention time in aerobic reservoir, manure has been transformed into water and algae.</p>	<ul style="list-style-type: none"> - TKN and Phosphorous consumed by organisms - odours reduced by 100% - 100% reduction in land base requirements - reduces greenhouse gas emissions - produces 95% reusable water and 5% algae - adaptable to large and small operations - treatment uses mostly existing infrastructure - labour reduction of manure handling 	<ul style="list-style-type: none"> - excess water needs to be disinfected before pathogens are 100% eliminated - needs 300 day retention time
<p>Aleksander Grujic 210 Rachel St. E. #1A, Montreal, Quebec, H2W 1E3 Phone: 514-845-9788 -- Manures are treated using anaerobic digestion prior to being passed through constructed wetlands planted with phragmites and typha.</p>	<ul style="list-style-type: none"> - pathogen reduction/elimination depending on AD - up to 95% BOD removal - up to 90% SS and 31-56% VS removal - removal of total N, NH4, NO3, and TP of 70-90% - reduce GHG emissions 	<ul style="list-style-type: none"> - require anaerobic or other pre-treatment followed by solids removal prior to wetland
<p>SARC International / Little River Pond Mills Box 1327, 301 Hwy #2 North, Assiniboia, Saskatchewan, S0H 0B0 Phone: 888-766-3645 -- Particle-based, biological contactor induces total pond circulation and aeration. Solid/liquid separation, nutrient recovery and UV exposure.</p>	<ul style="list-style-type: none"> - eliminates odour 100% - methane reduced up to 100% - 100% pathogen kill - reduce ammoniacle nitrogen up to 100% - can apply liquid directly to crops - ability to adjust nitrogen/phosphorous balance 	<ul style="list-style-type: none"> - pathogen kill potential should be verified
<p>Patz Sales Inc. 340 Sidney St., P.O. Box 430, Trenton, Ontario, K8V 5R6 Phone: 613-394-3161 -- Process consists of a mechanical separator, aeration of the liquid portion in a lagoon or storage tank and application of the liquid via a pulsator irrigation system.</p>	<ul style="list-style-type: none"> - 50% of phosphorus concentrated to 20% of original volume - drastically reduces odour - reduces methane by 75% - reduces need for large lagoons - less land base required in most cases - reduced run-off concerns - no soil compaction 	<ul style="list-style-type: none"> - some pathogen decline should occur but should be confirmed

Technology Description	Summary of Company Claims	Additional Information
Autothermophilic Aerobic Digestion Technology		
<p>TAO Corporation #1072, Daean-ri, Hyungup-myun, Wonju-City, Kangwondo, Korea, 220-841 Phone: +82 33 763-4196 -- Manure is sprayed with phototrophic bacteria in barns and then moves on to a mixing and aeration process. There the bacteria generate temperatures of 50-60 C. After a hydraulic retention time of 4 days effluent is in form of a liquid organic fertilizer.</p>	<ul style="list-style-type: none"> - odour reduced >90% - volume reduction >30% - pathogens eliminated 100% - liquid organic fertilizer produced - antibiotics and medication do not affect process - produces fertilizer with 3x higher N:P:K content than manure - over 100 units in operation; batch and cont. 	<ul style="list-style-type: none"> - must have >5% solids in manure - sizes range from 3-6 tons/day per unit
<p>International Bio Recovery Corporation 52 Riverside Drive, North Vancouver, British Columbia, V7H 1T4 Phone: 604-924-1023 -- Enhanced Autogenous Thermophilic Aerobic Digestion (EATAD) process converts produce/organic wastes to produce solid and liquid biological fertilizer during aerobic digestion. Waste stream is digested at 55 to 80 C for 60 to 100 hours.</p>	<ul style="list-style-type: none"> - 100% removal of pathogens - 100% reduction in methane (GHG) - end products are converted to slow release fertilizer reducing leaching capability - odour over 90% reduced - volume reduction by 88% - centralized facility - readily useable for co-digestion of other organic/food wastes 	
Advanced Land Application Technology		
<p>Agrico Canada Ltd. 2896 Slough Street, Unit 6, Mississauga, Ontario, L4T 1G3 Phone: 905-672-5700 -- Soil injection method using a GPS guided controller. Intended application rates are georeferenced to controller. Pump RPM constantly fluctuates with speed and GPS reference to provide correct rate. Tank is not vacuum-sealed and manure is screened and chopped prior to injection.</p>	<ul style="list-style-type: none"> - dramatic reduction of nutrient runoff - up to 97% reduction of odour after application - computer can apply within 5% of desired rate across width of toolbar - could be used to inject in growing crop with some modifications -reduces water contamination through georeferenced maps - special soil injector tills and injects reducing number of passes over fields - reduced labour since company does all manure handling - variable rate application on the go based on yield map 	<ul style="list-style-type: none"> - does not change manure characteristics - no pathogen kill - no value added to manure, but may increase nutrient availability to crop
<p>Nuhn Industries Ltd. RR# 1, Box 160, Seberingville, Ontario, N0K 1X0 -- soil injection method.</p>	<ul style="list-style-type: none"> - reduced odours after application 	<ul style="list-style-type: none"> - no pathogen kill - no value added to manure - does not change manure characteristics

Technology Description	Summary of Company Claims	Additional Information
Advanced Land Application Continued		
<p>HARCO AG EQUIPMENT RR#4, 5808 Hwy 89, Harriston, Ontario, N0G 1Z0 Phone: 519-338-3946</p> <p>-- Soil injection method that injects manure up to 8 inches deep using coulters openings. Portable holding tanks are used to spread manure up to 5 miles from storage.</p>	<ul style="list-style-type: none"> - reduces odour after application - nutrient runoff reduced - can seed directly after manure addition without additional tillage - can inject into grassland/pasture without damaging crop - can apply manure to growing crop - increases application window - portable storage tank increases distances of fields that can be injected 	<ul style="list-style-type: none"> - does not change manure characteristics - no pathogen kill - no value added to manure
<p>Patz Sales Inc. 340 Sidney St., P.O. Box 430, Trenton, Ontario, K8V 5R6 Phone: 613-394-3161</p> <p>-- Process consists of a mechanical separator, aeration of the liquid portion in a lagoon or storage tank and application of the liquid via a pulsator irrigation system.</p>	<ul style="list-style-type: none"> - 50% of phosphorus concentrated to 20% of original volume - drastically reduces odour - reduces methane by 75% - reduces need for large lagoons - less land base required in most cases - reduced run-off concerns - no soil compaction 	<ul style="list-style-type: none"> - no pathogen kill
Membrane Technology		
<p>Rondeau Anaerobic Inc. 17946 Lakeshore, Morpeth, Ontario, N0P 1X0 Phone: 519-674-1555</p> <p>-- Vibratory and shearing processes allows water to pass and retains high solids fraction as nutrient rich concentrate.</p>	<ul style="list-style-type: none"> - eliminates most odour in permeate - can recover >80% of water - volume reduction - pathogens eliminated by 100% in liquid - produces nutrient rich concentrate 	<ul style="list-style-type: none"> - odour not eliminated in concentrate - no conversion of nutrients in any way - not much land base reduction - two streams to deal with
Solid/Liquid Separation Technology		
<p>ATD Waste Systems Inc. 3095 West 24th Ave, Vancouver, British Columbia, V6L 1R7 Phone: 604-736-4493</p> <p>-- Solids are separated and liquids passed through an ammonia stripper and scrubber. Solids are dried and air passed through a biofilter. Liquids are then sterilized using UV. Any remaining ammonia or potassium is extracted using a zeolyte ion exchange tower. Used zeolyte is sold as a soil amendment.</p>	<ul style="list-style-type: none"> - 100% reduction in land base requirements - all nutrients retained in dry fertilizer product - water is reused in barns - GHG reduced by >98% - lagoons eliminated - indoor odour reduction - pathogens eliminated in solids and liquids - odour reduction through use of biofilter - ammonia is stripped and extracted - revenue from fertilizer, GHG credits and zeolyte 	<ul style="list-style-type: none"> - no full scale operations - disinfection by UV - need system to handle recovered water

Technology Description	Summary of Company Claims	Additional Information
Solid/Liquid Separation Technology Continued		
<p>David Bromley Engineering Suite 300, 1207 Pacific Blvd., Vancouver, British Columbia, V6Z 2R6 Phone: 604-834-3945 -- Treatment through coagulation/flocculation, sedimentation, filtration and disinfection using chlorine or ozone.</p>	<ul style="list-style-type: none"> - 95% separation of TSS - 95% reduction in phosphorus - 99.9% pathogen removal - significant colour improvement - 75-90% reduction in land requirements 	<ul style="list-style-type: none"> - still two streams to deal with
<p>DRYVAC CANADA LTD. 30 Hyland Crescent, Port Perry, Ontario, L9L 1R8 Phone: 905-9854025 -- Manure can be pretreated to increase solids retention in the filter press where water is removed. Excess water is boiled off using heat and vacuum. Separate processes for treatment of water can be added.</p>	<ul style="list-style-type: none"> - odour eliminated - GHG emissions reduced - 100% reduction of land base requirements - pathogens eliminated by 100% - revenue generated from sale of dry fertilizer - reduces volume and weight by up to 80% 	<ul style="list-style-type: none"> - water needs to be treated separately - two waste streams generated
<p>F.D. Deskins, Inc. 23 fairway Drive, Alexandria, Indiana, USA, 46001Phone: 254-749-4576 -- Activated polymer is added to manure slurry and flocs and solids are filtered out on the Deskins media filter. Solids collect on top of filter and dry within 3-5 days.</p>	<ul style="list-style-type: none"> - non-mechanical separation system - odour and GHG elimination through capture of VS and TS - elimination of atmospheric ammonia emissions - reduction in land base requirements - total phosphorous reduced by 76% - TKN reduced by 62% - >50% reduction in manure solids - elimination of anaerobic lagoons - system easily expanded - flexible to address reg. requirements (phosphorous, pathogens, etc) 	<ul style="list-style-type: none"> - no pathogen kill
<p>Kyte Centrifuge Sales & Consulting 4901 Morton Road, New Bern, North Carolina, USA, 28562 Phone: 252-633-4826 -- Solid bowl basket centrifuge of relatively simple design.</p>	<ul style="list-style-type: none"> - Suspended solids removal by 70-85% - some nitrogen and phosphorous removal with solids removal 	<ul style="list-style-type: none"> - no pathogen kill
<p>Slegers Engineering Inc. 649 Third street, London, Ontario, N5E 2C1 Phone: 519-671-0236 -- Mechanical separation</p>	<ul style="list-style-type: none"> - reduced land application area (for flush systems) - reduced odour - reduced water use if re-used. 	<ul style="list-style-type: none"> - no pathogen kill - two waste streams generated

Technology Description	Summary of Company Claims	Additional Information
Solid/Liquid Separation Technology Continued		
<p>Patz Sales Inc. 340 Sidney St., P.O. Box 430, Trenton, Ontario, K8V 5R6 Phone: 613-394-3161 -- Process consists of a mechanical separator, aeration of the liquid portion in a lagoon or storage tank and application of the liquid via a pulsator irrigation system.</p>	<ul style="list-style-type: none"> - 50% of phosphorus concentrated to 20% of original volume - drastically reduces odour - reduces methane by 75% - reduces need for large lagoons - less land base required in most cases - reduced run-off concerns - no soil compaction 	<ul style="list-style-type: none"> - no pathogen kill
<p>Lystek International Inc. Suite 107, 279 Weber St. North, Waterloo, Ontario, N2J 3H8 Phone: 519-880-2170 -- Manure is partially dewatered and digested to produce pumpable biosolids. High solids fraction is dried further and treated in pyrolysis process to produce gases that can be used as an energy source.</p>	<ul style="list-style-type: none"> - reduces storage volume by >90% - reduces odour - end product is inert ash - pathogens eliminated - power and steam generation 	<ul style="list-style-type: none"> - no full scale operations - process not very well defined
Composting		
<p>Global Repair (Sittler's Manufacturing) 33 Bellefair Avenue, Toronto, Ontario, M4L 3T7 Phone: 416-686-3690 -- Offer composting knowledge and equipment.</p>	<ul style="list-style-type: none"> - pathogens eliminated as they are killed in the composting process - 50% reduction in manure volume - odour reduced from spreading applications - nutrients become 98% stable - GHG sink (absorbs 16-42% of GHG) 	
<p>Transform Compost Systems #201 33230 Old Yale Road, Abbotsford, British Columbia, V2S 2J5 Phone: 604-504-5666 -- Composting systems (turners).</p>	<ul style="list-style-type: none"> - claim manure sterilization (100% pathogen kill) - volume reduction by 30-50% - reduction of GHG emissions - reduced groundwater contamination 	
<p>MPL Industries Ltd. 61 Hammer Street, East, Barrie, Ontario, L4M 6V3 Phone: 705-721-4475 -- In-vessel composting system with pelletization process</p>	<ul style="list-style-type: none"> - in-vessel composter - will produce organic-mineral and 100% natural fertilizers 	<ul style="list-style-type: none"> - not much data available

Technology Description	Summary of Company Claims	Additional Information
Pelletizing		
<p>MPL Industries Ltd. 61 Hammer Street, East, Barrie, Ontario, L4M 6V3 Phone: 705-721-4475 -- In-vessel composting system with pelletization process</p>	<ul style="list-style-type: none"> - in-vessel composter - will produce organic-mineral and 100% natural fertilizers - compost is pelletized 	<ul style="list-style-type: none"> - not much data available
<p>Feeco International Inc. 3913 Algoma Rd., Green bay, Wisconsin, USA, 54311 Phone: 815-332-7050 -- Manure from a dewatering mechanism is granulated and dried at temps of >100 deg C.</p>	<ul style="list-style-type: none"> - reduction of odours - processes biosolid into a dry, granular fertilizer - can be fortified with chemicals to produce a balanced NPK fertilizer - volume reduced by 75% 	
<p>First American Scientific Corporation 5333 - 176th Street, Surrey, British Columbia, V3S 0L5 Phone: 800-561-8656 -- Process pulverizes manure using high frequency shock waves. Pulverized manure can be pelletized.</p>	<ul style="list-style-type: none"> - provides 100% pathogen kill - volume reduction by >80% when pelletized - can mix various natural products to create desired levels of nutrients - pelletization process is an option 	
Additives Feed or Manure		
<p>American Eco-Systems Inc. P.O. Box 109, 125 9th Ave, Wellman, Indiana, USA, 52356 Phone: 800-433-2999 - Product is poured into plugs once per week or can be used as a pit additive</p>	<ul style="list-style-type: none"> - odour reduction of 95% - phosphorous reduction of ~40% - enhances nutrient availability of manure - manure additive 	<ul style="list-style-type: none"> - antibiotics in quantities larger than 10% of manure reduce effectiveness of product - no pathogen kill
<p>Enviro-Science Laboratories Inc. 8250 Ross Street, Vancouver, British Columbia, V5X 4C6 Phone: 604-327-4645 - Product is poured by hand onto wetted manure surface.</p>	<ul style="list-style-type: none"> - 50% reduction in ammonia and therefore odour - increases plant available nitrogen - eliminates need for agitation equipment - reduces ground water contamination - reduces methane production - reduces and reverses slurry build-up 	<ul style="list-style-type: none"> - manure with an excess of medications or antibiotics will negatively affect product - no pathogen kill
<p>Distributors Processing Inc. 17656 Ave 168 Porterville, CA, 93257 USA Phone: 217-644-3034 ¹- Yucca plant based product used to decrease ammonia levels and odour in manure. - feed additive and manure additive available</p>	<ul style="list-style-type: none"> - feed and manure additives available - 40-50% reduction in ammonia - increases biological activity in stored manure which reduces solids and BOD - sold under the name of Micro Aid - some independent University studies were conducted to verify results 	<ul style="list-style-type: none"> - when fed as a feed additive it reduces the ammonia in the excreted manure

Technology Description	Summary of Company Claims	Additional Information
Additives Feed or Manure Continued		
<p>Organic Biotech Systems Inc. P.O. Box 67005, 2150 Burnhamthorp Road West, Mississauga, Ontario, L5L 3A0 Phone: 905-608-2237 -- Product is added directly into liquid manure pits or outside lagoons. Product also useful to stimulate microbial activity in anaerobic digesters.</p>	<ul style="list-style-type: none"> - claim nitrogen uptake to plant can be increased by up to 192% - slightly increases plant phosphorus uptake - adds nutrient value to soil - organic solid build-up reduced by ~50% - odours reduced by 70-80% - will work for anaerobic lagoons and aerobic digesters 	<ul style="list-style-type: none"> - growth tests actually done on a slightly different product - no pathogen kill
<p>Hydra-Logic Systems Inc. 210 Sauder Road, Barrie, Ontario, L4N 9A2 -- Product added to manure pits or lagoons.</p>	<ul style="list-style-type: none"> - reduces/eliminates odours in barns and lagoons - increases biological activity - lagoon water can be used for irrigation 	<ul style="list-style-type: none"> - no pathogen kill
<p>Planistics Management Ltd. Suite 329, 5525 West Boulevard, Vancouver, British Columbia, V6M 3W6 Phone: 605-731-0596 -- Product added to lagoons to activate aerobic microorganisms. Product can also be added to feed allowing aerobic bacteria to develop freely.</p>	<ul style="list-style-type: none"> - reduction/elimination of ammonium production - 100% odour control - enhanced nitrogen levels in manure - product is totally organic - increased nutrient availability for plants - large customer base -severe reduction of pathogenic organisms 	<ul style="list-style-type: none"> - antibiotics, growth enhancers or some aggressive cleaners as well as long straw can inhibit the effects of aerobic microorganisms
<p>Super-F Inc. 7260 Honore-Vaillancourt, MONTREAL, Quebec, H1E 2S2 Phone: 514-648-1285 -- Product can be sprayed on manure in barn or added to manure pits or lagoons.</p>	<ul style="list-style-type: none"> - manure liquefied - odours neutralized 100% - GHG reduction by >95% - barn air cleaner for employees and animals - non toxic product 	<ul style="list-style-type: none"> - no pathogen kill

Technology Description	Summary of Company Claims	Additional Information
Additives Feed or Manure Continued		
<p>SHAC Environmental Products Box 73 Medicine Hat, Alberta, T1A 7E5 Phone 8088-5334446 -- SHAC Manure Digester is a manure storage additive that stimulates microbial activity. The product is formulated from lignite coal and water that under goes a process to unlock properties of the coal beneficial to promoting microbial activity in manure. The Manure Digester product contains activated carbon produced from the coal that ties up toxins present in manure. Nutrients and minerals present in the processed coal provide a food source for manure bacteria.</p>	<ul style="list-style-type: none"> - reduction of odours and gases from stored manure - total removal of solids - reduction of ammonia - reduction of phosphate - volatile fatty acid reduction - chemical oxygen demand reduction - increase in total plant available nitrogen 	<ul style="list-style-type: none"> - ammonia likely converted to nitrate by aerobic bacteria or released to atmosphere as nitrogen gas - phosphorus is conserved in microbial degradation and has no volatile form so total phosphorus can not be reduced - phosphorus may precipitate from liquid and settle to bottom of tank but total phosphorus will remain constant regardless of treatment
Pyrolysis		
<p>Renewable Oil International, LLC 1391 Normandy Crescent, Ottawa, Ontario, K2C 0N4 Phone: 613-852-6161 -- Solid manure is heated in an oxygen-depleted environment to produce energy rich vapours. Vapours are removed and condensed to form oil that can be used as a liquid fuel. Char is expelled and can be sold as charcoal.</p>	<ul style="list-style-type: none"> - odours and GHGs are eliminated - possible 100% reduction in land base requirements for nutrient application - pathogens eliminated - process is self-sufficient 	<ul style="list-style-type: none"> - nutrients and organic matter not recycled through agricultural production
<p>JF BioEnergy Inc. #201-33555 South Fraser Way, Abbotsford, British Columbia, V2S 2B8 Phone: 604-556-3547 -- Manure is dried and then subjected to 300 deg. C temperatures in an oxygen-absent retorts for a residence time of 20-45 min depending on material. Energy rich vapours are produced. Vapours are removed and condensed to form oil that can be used as a liquid fuel. Char is expelled and can be sold as charcoal.</p>	<ul style="list-style-type: none"> - all methane used in process - can produce green energy and sell oil - eliminates pathogens - process is self-sufficient - possible reduction of land base requirements of 100% 	<ul style="list-style-type: none"> - nutrients and organic matter not recycled through agricultural production

Technology Description	Summary of Company Claims	Additional Information
Pyrolysis Continued		
<p>IMPEX Group of Companies Inc. 10927 Oxbow Drive, RR#3, Komoka, Ontario Phone: 519-471-6809</p> <p>-- Manure is pumped into a pyrolytic reactor that provides a 900 C oxygen free environment that causes organic matter to change to a gaseous state. The gases are removed from the reactor by vacuum and passed through a condenser that separates the gaseous mixture into water, oil and fuel gases. The fuel gases and oil can be used to fuel the pyrolysis process.</p>	<ul style="list-style-type: none"> - 95% reduction in methane released to the atmosphere - manure converted to nitrogen free ash so nitrate loading to groundwater is eliminated - odour from manure reduced by 100% - manure volume reduced by 100% - potential revenue from pyrolytic gases and oils produced - no land required for manure spreading - ash has potential for use as a mineral supplement in the manufacturing of animal feed 	<ul style="list-style-type: none"> - if ash is not used for animal feed or in the cement industry it will have to be applied to agricultural land - if ash is applied to agricultural land and phosphorus is the limiting nutrient then the same land base will be required as for raw manure because phosphorus is conserved during the pyrolysis process
<p>Lystek International Inc. Suite 107, 279 Weber St. North, Waterloo, Ontario, N2J 3H8 Phone: 519-880-2170</p> <p>-- Manure is partially dewatered and digested to produce pumpable biosolids. High solids fraction is dried further and treated in pyrolysis process to produce gases that can be used as an energy source.</p>	<ul style="list-style-type: none"> - reduces storage volume by >90% - reduces odour - end product is inert ash - pathogens eliminated - power and steam generation 	<ul style="list-style-type: none"> - no full scale operations - process not very well defined - system is still in development stages
<p>Graveson Energy Management (GEM) Ontario Representative - 1329958 Ontario 200 6th Ave. West, Owen Sound, Ontario N4K 6H5</p> <p>'- Thermal cracking technology that converts organic materials to syn gas in less than 1 second.</p>	<ul style="list-style-type: none"> - clean syn gas gas produced with zero emmissions - only 8-10 % ash residue from the process - ash contains some carbon energy that can be reclaimed - system suited for large scale operations only - minimum system size is 60,000 tonnes annually 	

Technology Description	Summary of Company Claims	Additional Information
Miscellaneous Technologies		
Housing/Thermal Treatment		
<p>A.I. Engineering Services 4458 Bathurst Street, Toronto, Ontario, M3H 3S2 Phone: 416-398-5746 -- Barn designed to remove manure via plumbing system. Solids are separated and the liquid thermally treated using water vapour injection.</p>	<ul style="list-style-type: none"> - eliminates odour in and around barn - allows for multi-level wean-finish barns - pigs have higher growth rates - volume of water reduced by 4-5 times - pathogen kill can be factored in 	<p>- very few details provided</p>
Electrocoagulation		
<p>Hydra-Static Systems Inc. 210 Sauder Road, Barrie, Ontario, L4N 9A2 Phone: 705-735-9535 -- Manure is screened and solids pressed. Filtrate is passed through H-S reactor before DAF process. Ozonation of liquid can be added.</p>	<ul style="list-style-type: none"> - odour eliminated from liquid - TKN reduced by 58.6% - plant available P reduced by 90.3% - pathogens can be eliminated via ozone - 70-80% reduction in land application volume 	<ul style="list-style-type: none"> - pathogens still exist in sludge product - P ends up in solids stream and still has to be managed
Kinetic Disintegration		
<p>First American Scientific Corporation 5333 - 176th Street, Surrey, British Columbia, V3S 0L5 Phone: 800-561-8656 -- Process pulverizes manure using high frequency shock waves. Pulverized manure can be pelletized.</p>	<ul style="list-style-type: none"> - provides 100% pathogen kill - volume reduction by >80% when pelletized - can mix various natural products to create desired levels of nutrients - pelletization process is an option 	

Technology Description	Summary of Company Claims	Additional Information
Miscellaneous Technologies		
Tile Drain Ammonia Filter		
<p>ENPAR Technologies Inc. 449 Laird Road, Unit 12, Guelph, Ontario, N1G 4W1 Phone: 518-836-6155</p> <p>-- Runoff is gravity fed through tile drains to an ammonia filter cartridge located in an interceptor basin.</p>	<ul style="list-style-type: none"> - reduces nitrogen loading in discharge to surface waters - used filter material can be land applied as a slow release nitrogen fertilizer 	<ul style="list-style-type: none"> - no pathogen kill
Electrolytic Treatment		
<p>ENPAR Technologies Inc. 449 Laird Road, Unit 12, Guelph, Ontario, N1G 4W1 Phone: 518-836-6155</p> <p>-- Electrical current is passed through manure slurry using two electrodes.</p>	<ul style="list-style-type: none"> - decrease in coliform bacteria - odour reduction >85% - stabilization of manure 	<ul style="list-style-type: none"> - decrease in bacterial count likely due to natural decline that results over time
In-Ground Electrochemical Treatment		
<p>ENPAR Technologies Inc. 449 Laird Road, Unit 12, Guelph, Ontario, N1G 4W1 Phone: 518-836-6155</p> <p>-- Electrodes are inserted in ground to produce an electrical current fence. Groundwater moves through field and nitrates are converted to N₂.</p>	<ul style="list-style-type: none"> - converts dissolved nitrate and ammonia to nitrogen gas - can convert nitrate in-ground - operate independent of temperature and concentration 	<ul style="list-style-type: none"> - no pathogen kill
Electrochemical Ammonia Treatment		
<p>ENPAR Technologies Inc. 449 Laird Road, Unit 12, Guelph, Ontario, N1G 4W1 Phone: 518-836-6155</p> <p>-- Liquids pass through ion exchange column where ammonia is removed. During regeneration of the column, ammonia is converted to N₂.</p>	<ul style="list-style-type: none"> - converts 98% ammonia from filtrate effluent into nitrogen gas - system is independent of temperature, pH and nutrient balance - can control nitrogen loading 	<ul style="list-style-type: none"> - no pathogen kill

Technology Description	Summary of Company Claims	Additional Information
Miscellaneous Technologies Continued		
Covers		
<p>Summergreen Systems Ltd., 92 Railway Street, Seaforth, Ontario, N0K 1W0 Phone: 519-527-2470 -- Fabric air domes and floating covers, lagoon liners and liquid containment cells to contain manure, bio-gasses and liquids.</p>	<ul style="list-style-type: none"> - 99% odour control using Geo Air Dome - 89% odour control using floating covers - 20-25% more storage in tanks (volume reduction via rain elimination) 	<ul style="list-style-type: none"> - no change in actual manure characteristics - covers eliminate rain water which essentially reduces net volume of manure requiring land application
<p>Layfield Geosynthetics & Industrial Fabrics Ltd. Unit 53, 8600 Keele Street, Concord, Ontario, L4K 4H8 Phone 905-761-9123 - Negative air pressure floating covers, lagoon liners, and compressed air agitation systems.</p>	<ul style="list-style-type: none"> - odour reduction during manure storage - vendor indicates that cover reduces ammonia losses by 40% during manure storage - covers designed to withstand long term UV exposure 	<ul style="list-style-type: none"> - covers eliminate rain water which essentially reduces net volume of manure requiring land application - negative air pressure may result in continuous stripping of ammonia and actually result in ammonia losses equivalent to open tank - air mixing will result in some ammonia stripping
<p>Encon Covers 12 Aviation Blvd., St. Andrews Manitoba, R1A 3N5 Phone: 204-338-2514 -- Negative air pressure covers. Covers are an impervious plastic membrane that rests on the surface of the stored liquid manure. A patented fastening system is used to retain the cover. A slight vacuum is maintained under the cover which allows atmospheric pressure to maintain the cover tight to the surface of the liquid manure.</p>	<ul style="list-style-type: none"> - used to eliminate odours from stored manures - keeping manure covered conserves nitrogen and the manure ends up with a phosphorus to nitrogen ratio closer to plant growth requirements - conservation of nitrogen in manure reduces need for commercial nitrogen fertilizer which consumes considerable energy to produce - reduction in greenhouse gas emissions - potential to recover ambient methane produced during storage of the manure 	<ul style="list-style-type: none"> - continuous evacuation of air under the cover to maintain a negative pressure may result in the release of nitrogen and methane to the atmosphere unless scrubbed from the vacuum system - negative pressure may increase release of gases from manure to evacuation air stream
Aeration		
<p>SARC International / Little River Pond Mills Box 1327, 301 Hwy #2 North, Assiniboia, Saskatchewan, S0H 0B0 hone: 888-766-3645 -- Particle-based, biological contactor induces total pond circulation and aeration. Solid/liquid separation, nutrient recovery and UV exposure.</p>	<ul style="list-style-type: none"> - eliminates odour 100% - methane reduced up to 100% - 100% pathogen kill - reduce ammoniacle nitrogen up to 100% - can apply liquid directly to crops - ability to adjust nitrogen/phosphorous balance 	<ul style="list-style-type: none"> - pathogen decline will likely not be 100% - aerobic conditions will provide some pathogen destruction due to aerobic microbial activity

Technology Description	Summary of Company Claims	Additional Information
Miscellaneous Technologies Continued		
Evaporation		
<p>Severn Trent Services - Samsco 18 Cote Avenue, Goffstown, New Hampshire, USA, 03045 Phone: 603-668-7111 -- Liquid manure is pre-treated using digestion or solid/liquid separation. Liquid stream is evaporated using a gas-fired evaporator.</p>	<ul style="list-style-type: none"> - 94% volume reduction of liquid stream - end permeate is pathogen free - end product is concentrated organic fertilizer 	
Constructed Wetlands		
<p>Aleksander Grujicic 210 Rachel St. E. #1A, Montreal, Quebec, H2W 1E3 Phone: 514-845-9788 -- Manures are treated using anaerobic digestion prior to being passed through constructed wetlands planted with phragmites and typha.</p>	<ul style="list-style-type: none"> - pathogen reduction/elimination level depends on anaerobic treatment type (mesophilic or thermophilic) - up to 95% BOD removal - up to 90% SS and 31-56% VS removal - removal of total N, NH₄, NO₃, and TP of 70-90% - reduce GHG emissions 	<ul style="list-style-type: none"> - require anaerobic or other pretreatment and solids removal prior to wetland - thermophilic anaerobic treatment will provide greater level of pathogen reduction - residence time in wetland will affect level of pathogen decline.
<p>Aqua Treatment Technologies 24B Nihan Drive, St. Catherines, Ontario, L2N 1L2 Phone: 905-327-4571 -- Liquid manure is pretreated using a septic tank for solids removal prior to treatment in the Aqua wetland biofilter system. The wetland system is a pulsed flow vertical wetland system.</p>	<ul style="list-style-type: none"> - treatment of solids free liquid phase of manure for odour reduction, bacteria reduction and BOD reduction - indicator ecoli reduction from 10,000 - 100,000 to 0 - 100 colony forming units (CFU) - phosphorus reduction from 30 mg/L to 2 mg/L 	<ul style="list-style-type: none"> - require effective solids removal prior to wetland treatment or sand filter will plug - potential for biological plugging of sand filter depending on organic loading