INVENTORY OF ENVIRONMENTAL TECHNOLOGIES FOR THE HOG INDUSTRY

APPENDIX C: Classification Document

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1. INTRODUCTION

The purpose of developing a classification system for the inventory is to facilitate ease of access to existing information about hog manure management technologies. The development of a classification system must, of necessity, ensure its relevance to the end user. End users may include producers, producer associations, agriculture extension workers, regulatory bodies and others.

Also of importance in considering classification of technologies is the likelihood of combining individual technologies to form complete manure treatment systems. While the classification system will identify potentially suitable components, it will be the responsibility of the end user to ensure that combined components will form a compatible system based on information provided in the inventory or follow-up with technology proponents themselves. A properly designed classification system will facilitate the identification of components for proposed systems.

2. CATEGORIES FOR CLASSIFICATION

A number of categories have been proposed for classification of technologies. These are listed below:

I. Classification according to **application area** being addressed by technology
- Feeding modifications (additives to reduce nitrogen and phosphate levels; to make minerals more available for plant use; genetic changes in pigs to enhance ability to digest nutrients, especially phosphorous)
- Building design (ventilation, dust control, exposure of manure to air, use of bedding to reduce ammonia emissions)
- Manure storage
- Manure application
- Soil capacities for manure loading (agronomic practices assessing capacity of different soil types to absorb differing nutrient concentrations, vulnerability of aquifers and surface water systems to nutrient pollution)
- Manure processing and end products (e.g. compost, anaerobic/aerobic digestion; artificial wetlands)

II. Classification according to **economic criteria**. Classes may be according to overall cost of the technology (including initial capital costs as well as operating costs):
- Low cost solutions applicable to small farms
- High cost alternatives more suitable for intensive livestock operations
  according to:
- Cost per sow or per pig
  according to:
- Short versus long term benefits/costs compared with current management costs
  or according to:
  - Revenue potential from sales of marketable end products of the treatment process.

III. Classification according to **environmental issue(s) / objectives** addressed:
- Air quality (including odour; NH_3 emissions; greenhouse gas emissions)

- Water quality (surface and ground water; reduction of build-up of excess nutrients, especially nitrogen and phosphorous that can affect water quality, pathogen treatment)
- Soil quality (especially regarding manure disposal; examining alternative crops and cropping methods to utilise excess nutrient levels (esp. N, P, K and heavy metals); impact of manure on soils, pathogen treatment)

IV. Classification according to **limiting criteria** for technologies

- Geography (land and water capabilities)
- Land availability (e.g. minimum acreage for spreading; land requirements to install technology)
- Other soil, land or water conditions (e.g. possible contamination with pathogens or other non-nutrient factors)
- Climatic limitations
- Necessary infrastructure prior to installation
- Requirements for retrofitting
- Water, energy, utility requirements to operate technology
- Existing regulations / manure control laws / approvals to use end products requiring compliance - what may be viable in one jurisdiction may not be permitted in another
- Economic requirements of producers (cost to producer or revenue generator)
- Social acceptance / public opinion
- Distance from markets (transportation factors and proximity to human settlements)

V. Classification according to **technology type**

- Additive
- Solid / liquid separator
- Manure handling and spreading
- Complete manure management system
- Odour control (e.g. covers, ozonation)
- Solids management
- Liquids management
- Digestion processes
- End product enhancement / commercialisation (e.g. compost, blending with forestry, municipal or other agricultural wastes, electricity generation)

A subcategory may be **the process** involved. For example:

- Biological treatment
- Mechanical treatment
- Thermal treatment
- Chemical treatment
- Physical-chemical treatment
- Combined processes

VI. Classification according to **stage of development** of technology
- Conceptual - more basic research required
- Development - technical feasibility established
- Prototype - testing of technology
- Field trials - testing of technology in real world conditions; business plan, marketing strategy, financing needs still to be addressed; commercial feasibility established
- Market launch - full commercialisation has been achieved

VII. Classification according to **end products** (or value / marketability of end products)
- Land application (including compost, fertilisers and soil additives)
- Useful gases (e.g. methane for electricity generation)
- Useful liquids (e.g. flush water recycling)
- End products with no particular use
- Animal refeeding
- Other end uses

Classification according to this category would identify both complete systems as well as components that, when installed together, lead to the production of the desired end product.

VIII. Classification according to **human resource requirements**
- Level of training required to operate technology
- Time required to operate technology
- Human resources cost to operate technology

IX. **Nature of end products.** End products would be characterised according to physical characteristics that a technology user may wish to achieve. These may be:
- Stability (tendency for degradation and odour emissions)
- Biodegradable carbon content (related to stability and important in relation to the overtaxing of soil oxygen resources)
- Safety (i.e. degree of disinfection accomplished)
- Form (liquid, solid or dried solid)
- Presence or absence of Nitrogen and Phosphorous, potassium, trace elements, organic value (humic acids), organi-minerals

Alternatively, classification of manure by physical characteristics of end products may follow the classification developed by the United States Environmental Protection Agency (EPA Document CFR 40 – 503 (1993)):

- Class A - dried, disinfected and previously stabilised for all land disposal situations
- Class B - liquid, free of easily degradable organic carbon and pathogens but retaining nutrients and humic substances, applicable to all liquid applications
- Class C - liquid, no pathogens, degradable carbon reduced, applicable to land with some restrictions
- Class D – unadulterated raw manure

X. **Efficacy** of the technology, examples being:

- Level of biodegradable carbon remaining after treatment
- Liquid, solid or gaseous end product
- Level of nitrogen remaining after treatment
- Level of phosphorous remaining after treatment
- Amount of leakage (gas, liquids) during the treatment process

XI. Classification by **producer preference** to determine a **total system** for a specific operation:

- Capacity to solve social concerns
- Capacity to address current and emerging environmental issues
- Capacity to improve the degree of integration of the operation with crop production
- Capacity to minimize operational expenses related to manure management
- Capacity to ensure compliance with regulations

6. ORGANISATION OF CATEGORIES

Consultation with a national panel of professionals involved with hog manure management affirmed the validity of all of the above categories. Suggestions were made for mechanisms to develop a classification system that will be both manageable and relevant to a wide range of interests (including pork producers, government agencies, innovators, and extension workers, to name a few).

The overwhelming suggestion of this panel concerned the purpose of classification being to facilitate access to information according to the various needs of potential users of the inventory. The most appropriate means of doing this would be to devise a classification system that incorporates as many levels of categorisation as possible.

This would most easily be accomplished through the development of a computerised database system for the inventory. Such a database would be capable of being

sorted/filtered from various points of entry. The primary points of entry / major classification categories for searching the database should be:

- According to **region**. Provincial and municipal regulations will determine the feasibility of using a particular technology in any given region. Producers would quickly shortlist relevant technologies for their jurisdiction.
- According to **cost**. Filtering according to cost will shortlist technologies that are financially feasible for a given producer.
- According to the **objectives to be fulfilled by the technology**. By specifying a category of interest, such as water quality, odour control, soil application issues, barn management, or marketable end products, relevant technologies will again be selected.

Users of the inventory would select responses in the above three categories in order to create a shortlist of relevant technologies. The above three entry points to the database would then be used to select only those technologies of interest to a given user of the inventory.

Having created a shortlist of inventories, other categories could be applied to further refine the search for a technology appropriate to the user of the inventory. This next set of categories could include all of those listed above plus any others that may come to light with time. An advantage of utilising a computer database for classification would be the ability to undertake custom searches using any combination of categories listed above. As such, the classification system would cater to a wide diversity of interests, including:

- Producers seeking appropriate technologies for their operation, environmental concerns, local regulations, budget, level of human resources, etc.
- Federal, provincial or municipal authorities investigating the availability of solutions to land and water issues
- Technology innovators seeking current technologies that would complement their own technologies (e.g. the developer of a biogas generation system would benefit by teaming with a manure digestion technology to create a complete system) would use the classification system to identify compatible technologies to assemble complete treatment systems
- Designers of barns and infrastructure seeking technologies to incorporate in design
- Agriculture extension workers, producer associations, consultants, and other distributors of information would benefit from a flexible and effective classification system in addressing needs of clients.

6. COMPARISON OF TECHNOLOGIES

Due to limited numbers of hog manure treatment technologies currently in demonstration and commercial phases, quantitative assessments of technology efficacy, reliability,

sustainability and other operational elements are rare. As technologies are demonstrated and research and monitoring programs are established to test them, a body of information will accumulate that permits comparison of technologies.
As data become available, results should be used to provide comparisons of similar technologies. This could be accomplished by establishing a rating process based on results of a third party verification process. Such results would be of use to potential users of these technologies.

7. LIMITATIONS OF A CLASSIFICATION SYSTEM

The primary limitation to the proposed classification system will be in terms of identifying technologies that are relevant to the characteristics of a given hog operation and specific land, water, and social conditions applicable to any one operation. The user of a system will be able to select a fairly detailed subsection of the complete inventory for review. The final decisions as to a technology's the suitability to specific conditions is beyond the scope of any classification system.

8. RECOMMENDATIONS AND CONCLUSION

There are numerous criteria that can be employed for classifying hog manure management technologies. While all of these categories have some validity, the ability to classify and sort technologies according to multiple sets of criteria will be of greater benefits than to classify according to a single category.

In keeping with the recommendation to develop a multi-layered classification system, a further recommendation is made to develop a computer database using information gathered through the inventory process. This database will allow for layered classifications with innumerable combinations. Such a system will appeal to a wide range of potential users of an inventory.

A further recommendation concerns the establishment of a third party review panel for technologies. The results of such reviews will be useful in making technical comparisons of similar technologies within the inventory. It is important that any review be unbiased, especially when comparing technologies at different stages of development or intended for partial, rather than full, treatment. A matrix could be developed to assure that these sorts of bias do not result in down-rated evaluations in such cases.

MEMBERS OF REVIEW PANEL FOR TECHNOLOGY CLASSIFICATION

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