Agriculture, Pêcheries et Alimentation
Québec

ON-FARM POULTRY

COMPOSTING GUIDE

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TABLE OF CONTENTS

FOREWORD

The purpose of this document is to provide poultry operations interested in on-farm poultry composting with the necessary information to build and maintain a composting site.

This guide is exclusively for poultry producers who wish to compost their dead animals on their farm. Producers who decide to build a compost site must obtain a *permis d'atelier d'équarrissage* (dismembering plant permit), in the *compostage* (composting) category, and respect the regulation in effect.

The *Regulation respecting food* (R.S.Q., c. P-29, r. 1) was modified on December 30, 2004 to give producers access to this method of disposing of dead poultry.

All on-farm poultry composting projects must comply with the specifications in this guide. In addition to containing technical information on the composting method and the regulatory requirements to satisfy in order to guarantee the quality of the final product, this guide includes a blueprint of a composting unit adapted to the climatic conditions in Quebec. This blueprint complies with the Building Code and the environmental requirements that must be respected by the producer, namely biosecurity and prevention of ground contamination. Producers can adapt this guide to their operations, but must ensure the protection of human health, livestock and the environment.

This method offers poultry producers an interesting alternative to disposing of their dead animals, and at the same time to produce useful compost for their operations.

ON-FARM POULTRY COMPOSTING GUIDE

INTRODUCTION

The methods for disposing of and eliminating dead animals authorized by the *Regulation respecting food* (R.S.Q., c. P-29, chapter 7) for the original possessor are:

1. Incineration in a facility that complies with the provisions in the *Environment Quality Act* and its regulations.
2. Collection by the holder of a permit to operate a dismembering plant or the holder of a permit to salvage inedible meat.
3. Burial on the site of the agricultural operation of the original possessor of the dead animal, in compliance with certain conditions.
4. Composting, by the agricultural producer holder of a composting permit, of his dead poultry on the site of the agricultural operation of the original possessor of the dead animal.

Non-compliant disposal or elimination of dead animals is a violation of the regulation. It also increases the risk of environmental contamination and endangers human health as well as livestock biosecurity.

WHY COMPOST DEAD CHICKENS?

The advantages of composting over other recognized methods include:

- the agricultural operation being free to dispose of its dead poultry;
- access to a non-polluting, biosecure disposal method;
- an alternative method to dispose of dead animals;
- reclaiming waste by turning it into fertilizing compost.

COMPOSTING: ORIGIN AND PROCESS

Composting consists of thermophilic aerobic bacteria converting organic nitrogenous matter (such as manure and carcasses) and carbonaceous matter (such as straw and wood chips) into humic acids, bacterial biomass and organic residue (compost).

When the humidity and oxygenation conditions and the nutrient requirements of the micro-organisms responsible for composting are right, the micro-organisms multiply, transform the organic matter and release heat, water vapour and carbon dioxide (CO_2) as metabolic by-products.

The composting process was experimentally adapted in 1988 by Dr. Dennis Murphy of the University of Maryland to compost dead poultry.

This process involves mixing specific amounts of poultry carcasses, litter, carbon sources and water. The primary composting substrate is soiled litter, which provides the necessary nitrogen and carbon for microbial growth. Given that the carcasses also produce a great deal of nitrogen, straw or wood chips add carbon to balance out the carbon-to-nitrogen ratio and to promote ventilation.

In order to properly compost, the aerobic micro-organisms need specific volumes of certain elements:

1. **Oxygen:** Adding porous matter (straw or wood chips) to the compost mix favours oxygenation. Turning over and mixing the elements also adds oxygen and helps to attain the necessary temperature for destroying most of the pathogens. Compacting the substrate mass contributes to reducing the percentage of oxygen, an essential element in this process. A minimum of 5% of oxygen is required.

2. **Water:** The thermophilic micro-organisms required for the composting process live in wet environments. The composting mix should ideally have the consistency of a wet sponge, with 40% to 60% humidity. Most of this water comes directly from the dead poultry. If the humidity reaches 80%, the concentration of oxygen becomes insufficient and the process slows down However, if there is only 15% or 20% humidity, which is a rare case, the micro-organisms die due to a lack of water, and the composting process slows down again. When composting dead poultry, water must always be measured and added in moderation. Remember that it is easier to add water than to remove it.

3. **Nitrogen and carbon:** Nitrogen is necessary for the protein synthesis of the micro-organisms, while carbon provides a source of energy. These two elements are important and their proportions must be adequate. Composting is most optimal when the carbon-to-nitrogen ratio is 30:1. Acceptable C/N ratios vary between 15:1 and 40:1. However, the composting process will still take place if the C/N radio is between 10:1 and 50:1, which in the end makes it a biological process quite tolerant of errors.

The mix must consist of one part carcasses, two parts soiled litter, 0.1 parts straw or wood chips, and 0.25 parts water, based on weight rather than volume. This mix will have a C/N ratio of 23:1 and a humidity level of close to 55%.

Matter	Relative quantity
Carcasses	1
Soiled litter	2-3
Straw or wood chips	0.1
Water	0-0.5

The composting process occurs in two steps and transforms the carcasses into organic waste in approximately 14 days. The first step takes place in the "primary bin": this bin is filled based on the daily mortality. The "ingredients" are added in successive layers and the composting mixture begins producing heat after two to three days, which rapidly disintegrates the carcasses. The weight/volume ratio of the different ingredients must be determined at the outset in order to standardize the process for the farm. Therefore, each ingredient must be weighed and its volume measured. Water can always be added as needed, but sparingly. Once the primary bin is full and the temperature has reached between 55ºC and 65ºC and remained so for 72 hours, you must wait for the substrate temperature to drop 15ºC before transferring the mix to the "secondary bin." At that time, the mix will have been composting for at least seven to 10 days in the primary bin after the final layer was added. It can take up to a maximum of three months before the mix is transferred.

Mixing and ventilating the composting pile in the second step of the composting process restarts the process and ensures that the bone waste completely disintegrates. The temperature should again reach between 55ºC and 65ºC for a minimum of 72 hours.

The dead poultry must be removed from the livestock buildings as soon as possible and appropriately placed in the primary bin the same day. This reduces the risks of spreading disease and of predators, and can quickly activate the compost's heating cycle if the poultry is still warm.

On-farm poultry composting must be limited to farms when poultry mortality rate is normal. This method of composting cannot be used on farms with a very high mortality rate following a disease, accident or other incident. Note that whenever a named disease is involved, the

opinion of a person competent in veterinary medicine will be required to authorize composting the poultry in question. The same applies to any other abnormal situation that would require the producer to dispose of a large quantity of dead birds. The authorized staff from the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ) and the Ministère de l'Environnement du Québec (MENV) can intervene at any time to demand rectification of the composting process, and even prohibit the composting of a dead animal.

Poultry must be composted on the farm where they died. This precaution limits the risks of propagating pathogens from farm to farm.

CONSTRUCTION OF A COMPOSTING UNIT

A composting unit must be built on a site protected from surface runoff, melting snow and flooding. The following minimum distances must be respected:

AOR: Agricultural Operations Regulation

GCR: Groundwater Catchment Regulation

- 15 metres from a lake, river, swamp, marsh, pond and watercourse (section 6 of AOR);
- 30 metres from any groundwater catchment work (section 29 of GCR);
- Outside the bacteriological protection area of a groundwater catchment site, where the water is considered vulnerable or where the DRASTIC vulnerability index is equal to or greater than 100 over any portion of that area (section 29 of GCR);
- Outside the shoreline, the boundaries of which are defined by municipal by-law, and outside the 20-year flood elevations of a watercourse or lake (Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains).

Leachate from the composting bins must be collected in a special pit and treated before being used. Using it to moisten the compost pile can treat it. Composting must be done on a waterproof concrete platform with sleeper walls or that is inclined in order to prevent rainwater or melting snow from infiltrating the bin and to keep the leachate inside the unit. The structure must have a roof with a cornice to prevent rainwater and melting snow from infiltrating the unit.

The other points to consider are the unit size, its location on the farm, the type of building and the materials to be used. Please note that two types of bins are necessary: a primary bin for the first cycle of composting, and a secondary bin for the secondary cycle.

Size: The volume of all the primary bins is calculated using a formula that takes into account the farm's production capacity, the weight of mature birds and the daily mortality rate. The volume of all the secondary bins will be equal to or larger than that of all the primary bins.

The dimensions of the primary and secondary bins can be as follows: 57" x 57" x 98" (1.5 m x 1.5 m x 2.5 m), or a volume of 197.8 cu. ft. (5.6 m^3). These dimensions can be modified based on the farm's needs and the equipment available. However, the depth and width of the bins must not exceed 71" (1.8 m) and 98" (2.5 m), respectively. Ideally, the dimensions of the primary bins should be established so that the average daily mortality rate equals a row of carcasses in the bin.

The dimensions of the composting unit must take into account the size of the machinery used. An oversized composting unit more than 57" high (1.5 m) will be ineffective; in addition, the temperature of the pile could rise above 70°C and lead to spontaneous combustion in the unit, which can cause a fire.

A minimum of two primary bins and two secondary bins are required to operate a composting site. Therefore, the dimensions of the bins must be adjusted based on this limitation and other characteristics of the farm.

Practically speaking, it is important to ensure that the structure façade provides easy access to the bins. Therefore, it is better to have several, separate small bins than one very large one.

When calculating the number of bins to build, consider an additional volume of carcasses to compost in the winter, given that the composting process can be slowed due to the cold.

Appendices 2 to 5 provide information on livestock as well as an approximate composting volume and number of necessary bins, based on the farm type and production capacity.

Location: A well-managed composting unit gives off little odour. The site must be properly drained, provide easy access to the mixers and spreaders, and be accessible year-round. Its location must comply with all regulations in effect.

Foundation: To ensure that the unit stands up to Quebec's climate and to prevent any infiltration of liquid, the composting unit must be built on a floating concrete slab with a well-drained perimeter. The walkways leading to the composting unit can be of concrete or a bed of stone chips. The land around the unit must be kept clean.

Materials: Materials resistant to rot and organic acids must be used.

Roof: Composting must be done under a shelter because the process has to be carefully controlled. The roof protects the composting pile from rain and snow. It is recommended that the roof exceed the floor area and that it have eavestroughs to prevent any water from entering the unit.

Storage (input/output): It is necessary to include a storage space for input (straw, litter) and for the compost produced. This compost must be protected from bad weather.

Services: It is necessary to include access to running water on the site in order to be able to add water to the composting mix and to clean the equipment and the unit.

It would be beneficial to install an electrical circuit to provide adequate lighting for working when it is dark and using a pump to empty the leachate catchment well.

Protection against scavengers: The perimeter of the composting units must be protected by fences to prevent predators (birds and mammals) from accessing the carcasses.

Appendix 7 presents a detailed plan of a composting unit. Note that the height of the shelter and the unit width must be adapted to the equipment used, subject to compliance with the recommendations for the maximum dimensions.

STARTING THE COMPOSTING UNIT

Procedure and materials

1. In the bottom of the primary bin, add 12" (30 cm) of soiled litter with 40% humidity. This warm litter will provide the necessary bacteria and heat to the substrate to begin the composting process. The litter also absorbs excess water to a certain extent. The base layer should not be placed in the bottom of the bin too far in advance (a few days at the most), because the microbial activity will slow down as the oxygen and humidity escape.

   Other compostable products can also be used, such as hay, ground corn stalks and cobs, dried grass, empty bean pods, sawdust, corn silage, wood chips, and even mature compost. Any other matter whose C/N ratio is compatible with the composting recipe and the farm's biosecurity can be used.

   If you are raising birds in cages or on laths, manure can be mixed into one of these substrates. However, soiled litter is more practical because once the matters are mixed (dejections and chips), the percentage of humidity is more consistent.

   All the authors agree that sawdust is a material with a strong tendency to compact, and as a result, create anaerobic conditions that do not favour composting.

2. Soiled litter is the best matter since it has a good capacity for retaining oxygen and water, but it is acceptable to add some straw.

3. The carcasses are then added in rows. They must be placed side by side and must not touch. The carcasses must never be placed less than 12" (30 cm) from the edge of the bin because they will not properly compost due to lower temperatures in this area, especially in colder months. The bin must be designed so that no more than one row of carcasses can be added per day. Avoid layering rows of carcasses in the same day. If more than one layer must be added to the bin the same day, the farm requires a second primary bin.

   Warm carcasses begin composting more quickly than cold carcasses.

4. The carcasses must then be covered with litter with 40% to 45% humidity. If the litter is too dry, you must add water. At this point, water must always be added sparingly and be accurately measured. At first, it is best to abstain from adding water and simply observe the start of the process. You can always adjust the percentage of water if composting does not begin. The layer of litter must be twice as thick as the layer of carcasses. Keep in mind that the percentage of humidity is a critical factor in composting.

5. After laying down the first row of carcasses and covering it with soiled litter, the next row is ready to be prepared. The substrate mass must not be more than 69" (1.9 m), otherwise the temperature of the composting pile could exceed 70ºC, and spontaneous combustion could occur. If this happens, the temperature must be reduced quickly. To do this, remove the substrate from the bin, spread it on the ground (8"-10" or 20-20 cm thick) a good distance from buildings and residences and saturate it with water.

   It is important to keep in mind that the main problem lies in starting the composting unit. When the temperature begins to climb, the process generally continues on its own, if all the ingredients are there in the proper proportions.

6. Once all the layers have been placed, the last row of carcasses must be covered with a thick layer of litter. This layer, called the final covering layer, consists of clean litter (wood chips). Do not cover the substrate mass with soiled litter or immature compost because large insect populations will develop.

7. Depending on the size of the bin and the mortality rate, the filling period can vary.

8. The temperature must be measured every day. If it drops by 15°C after reaching between 55°C and 65°C for 72 hours (at least 7-10 days after the final covering layer), it is time to place the substrate into the secondary bin. It is important to move the substrate from one bin to another in order to mix it and properly ventilate it. It also helps ingredients decompose more quickly. Changing bins is very important for ensuring more complete decomposition of the carcasses, especially if their average weight is more than 4 lbs. (2 kg).

9. The temperature should theoretically rise to between 55°C and 65°C in a few days. Some factors that prevent the substrate mass from adequately heating up again include delaying moving the substrate to the secondary bin, poor ventilation, or too much humidity (>60%).

10. Based on the daily temperature readings of the composting substrate, you will notice a second drop in temperature after 7 to 21 days. The complete composting cycle takes approximately 60 days. The substrate will reduce by approximately 30% to 40% in volume, because a large amount of carbon escapes in the form of carbon dioxide. If parts of the carcasses are still visible after the first mixing, cover the compost with approximately 12" (30 cm) of clean litter. You can mix the substrate pile as often as you like. If there are no further climbs in temperature, then the material has stabilized.

11. The substrate will then be ready to be removed from the secondary bin and taken to the storage location. This location must be waterproof and protect the compost from bad weather. It will be stored at this location until it is spread in the field.

    The compost can also be used as a source of carbon to compost new carcasses.

    The C/N ratio of the compost is 20:1 to 25:1.

12. It is essential to keep a daily register of the composting process. The information to record includes the date of the operations, the number of animals buried, their age, their weight, any diseases, the daily air temperature (minimum and maximum), the daily substrate temperature (average of 5 readings), the substrate humidity level (average of 5 readings), the quantities of the materials and water added, the quantity of compost produced, and the name of the person in charge.

QUALITY OF COMPOST PRODUCED

Although the content of the fertilizers in the farm compost can vary based on the initial ingredients, the age of the compost and the final storage method, documents on the composition of compost indicate the following values:

Humidity:	12.4 to 46.1%
Total nitrogen:	0.86 to 2.85%
P2O5:	2.25 to 4.51%
K2O:	1.13 to 2.76%

It is risky to determine an efficiency factor for nitrogen, since it varies based on the maturity of the compost (org. N content, min. N).

The farm compost is spread directly over the field, the same as manure.

It is essential to carry out chemical analyses (nitrogen-N, phosphorus-P, potassium-K) and microbiological analyses (pathogen) of the compost to characterize it. This will make it possible to apply the agronomic management principles of crop fertilization when spreading amendments and ensure that the compost was adequately hygienized. Although the regulation provides for sampling every five years, it is recommended to take samples every two or three years, depending on the crop. It is an agronomist's responsibility to make recommendations on spreading compost.

Farm compost must be stabilized and hygienized before being spread in the field. It must not contain any identifiable poultry carcass parts and must have undergone a thermophilic phase during composting. It must be spread exclusively on the land of the farm where it was produced.

Also, for preventive reasons, it is prohibited to spread this farm compost on pastures, vegetable crops or any other crops destined for human consumption whose harvested part is in contact with the ground or the farm compost. A period of 30 days must be respected before harvesting any hay or cereal destined for animal consumption. It is prohibited to use this compost as animal litter.

This product can, however, be considered "all-purpose" if it complies with the norms of the *Fertilizers Act*, which defines the maximum content of fecal coliforms and pathogens.

IMPACT ON THE ENVIRONMENT

Composting must not:

- produce excessive odours;
- encourage the multiplication of flies;
- attract vermin, predatory birds and animals, or domestic animals.

Problems associated with rodents, flies and other predators, as well as odour and percolation problems are very limited when composting units are properly installed and well-managed. Its concrete slab, roof, rigid structure and surrounding fence prevent animals from accessing the unit. Most insect larvae are destroyed at 46°C, which is well below the temperatures reached during the process (54°C to 71ºC).

BIOSECURITY ON THE FARM

Any practice used to discard poultry carcasses that puts the farm at risk of disease transmission must be prohibited. Composting must satisfy the minimum biosecurity requirements.

By the very nature of its process, composting produces temperatures that kill bacteria and viruses. However, the process is an approximate one and it is impossible to obtain a 100% guarantee in terms of biosecurity. All precautions must be taken to maximize its effectiveness.

Method of operation: The composting units on the farm are used to eliminate carcasses associated with normal mortality at specific operations. It is prohibited to accept birds from another farm, or to use this process to discard an excessive number of birds following massive death due to exceptional circumstances. It is strictly prohibited to compost birds that died from a named disease or that meet other exclusion criteria, unless authorized by a competent authority.

Unit management: The two-step composting process ensures that all the tissues on the carcasses are exposed to high temperatures. Negligent management of the bins considerably reduces the effectiveness of the composting process and increases the risks of contamination. Any action that does not comply with the prescribed method must be avoided.

Structure: Using good materials and precise construction techniques are guarantees for success. Good structure design will minimize defects due to composting operations and will help keep the substrate in the bin.

Cleaning: It is important to ensure that all the tools and equipment used to handle the dead birds and the substrate are properly cleaned to prevent contaminants from disseminating into the environment or other work places. It is recommended to use tools specifically for this job, but regardless, cleaning must never be neglected.

PROBLEMS RELATED TO COMPOSTING

Insects and pathogenic organisms

It is important to start off with well-designed, well-built units. Complying with the two steps of composting (primary and secondary) is essential to limiting the proliferation of undesirable organisms. A well-built unit will contain all the substrate to be composted; insect larvae, viruses, protozoons, bacteria, etc. will be destroyed by the combined action of heat and duration. Most often, the temperatures prescribed are not reached near the walls of the bins. Therefore, undesirable organisms can survive if they are in these areas. Insect larvae can move to avoid very high temperatures. These organisms will survive if the compost is not moved to the other bin and mixed.

Partially filling the bin can sometimes result in poor composting. If the carcasses are placed along or in contact with the bin walls, putrefaction will occur, which will produce odours and cause insects to multiply.

Insects are generally found in the upper layer of the composting substrate (first 4" to 6" or 10 to 15 cm) or at the base of the pile along the structure. The presence or absence of insects, especially those associated with decomposition, is a good sign of the status of the process.

Certain problems involving the presence of insects when spreading the compost in the field were noted. However, these problems occurred when too much compost was spread or when the carcasses had not fully decomposed. No such problems were indicated when properly decomposed compost was used in reasonable amounts.

Other elements to monitor

Composting is a biological process. For all these processes, the outcome depends on whether the needs of the micro-organisms are satisfied.

Composting units that give off foul smells, leak, have many flies, attract predators, do not heat or still have carcass residues at the end of the process have not met the biological requirements of the micro-organisms.

The most common errors include:

1. **Too much water added**. When in doubt, do not add any water. Too much water transforms the composting mass into an anaerobic environment that results in foul smells and percolation. Excess water cannot be removed.
2. **Uncovered carcasses**. It is essential to cover the carcasses as quickly as possible with a 6" (15 cm) layer of manure, litter or compost. Otherwise, the carcasses will be exposed to

predators and flies and will give off foul smells.

3. **Insufficient mixing**. The process involves two steps so that composting can occur normally. Piles that are not turned and transferred contain insect pupae on the perimeter, where the temperature is lowest.

4. **Incorrect ingredient proportions**. The ingredient types and proportions are important. For example, using an insufficient proportion of substrate with carbon can lead to a dense, anaerobic mix that will poorly compost. It should be noted that when transferring to the secondary bin, wood chips, straw or litter can be added if the mix is too wet, or water if the mix is too dry.

5. **Improper layering**. Layers that are poorly done, too thin or too thick will hinder the composting process. Avoid putting the carcasses in direct contact with the unit's structure because it will cause putrefaction. Leave at least 12" (30 cm) on the sides of the bins and between the rows of carcasses, which must not be touching.

6. **Unit too impervious**. Spacing the pieces of wood in the walls approximately 3/8" (1 cm) apart is an effective way to make up for the lack of ventilation in the composing mass.

USEFUL DEFINITIONS

Aerobic bacteria: Micro-organisms that develop when in contact with air (oxygen). By extension, the term can also be used to designate a phase in the process in which the presence of air or oxygen is detected (antonym: anaerobia – that lives in the absence of air or oxygen).

Compost: Organic matter that has undergone a chemical transformation, through the action of aerobic micro-organisms, with an elevation of temperatures. Dark brown in colour and rich in humus, compost looks and smells like potting soil.

Composting: Controlled, accelerated decomposition process (ventilation, temperature, humidity, etc.) of putrescible waste, in the presence of aerobic bacteria, which turns it into a stable, humus-rich product called compost.

Humus: Fraction of the organic matter that remains in the ground after the decomposition of plant and animal waste.

pH: Degree of acidity or alkalinity of an environment given on a scale of 1 to 14, 1 being very acidic, 14 very alkaline, and 7 being neutral.

Leachate: Liquid that has percolated through a mass of solid matter by extracting certain matter or soluble elements in the process.

APPENDIX 1

Composting Register

Farm name: _____

Person in charge: _____ **Year:** _____

Date	Time	Animals added No./weight Disease	Substrate added Type Weight/vol. kg/litres	Water added Volume Litres	Temperature Ambient air min./max. ºC	Temperature Substrate (average of 5 readings) ºC	Hydrometer Substrate (average of 5 readings) %	Compost produced Weight/vol. kg/litres	Observations

APPENDIX 2

Estimated volume and number of composting bins for a hatching egg farm

Production capacity (number of birds per period)	Primary bins			Secondary bins		
	Necessary volume		Number of bins*	Necessary volume		Number of bins*
	cu. ft.	m3		cu. ft.	m3	
6,000	395.5	11.2	2	395.5	11.2	2
12,000	791.0	22.4	4	791.0	22.4	4
18,000	1186.6	33.6	6	1186.6	33.6	6
24,000	1582.1	44.8	8	1582.1	44.8	8
30,000	1977.6	56.0	10	1977.6	56.0	10
36,000	2373.1	67.2	12	2373.1	67.2	12

* Calculations are based on the following dimensions: 57" x 57" x 98" (1.5 m x 1.5 m x 2.5 m), or a volume of 197.8 cu. ft. (5.6 m^3). These dimensions can be adjusted based on the farm's needs, provided that the depth and width of the units does not exceed 69" (1.8 m) and 98" (2.5 m), respectively.

APPENDIX 3

Estimated volume and number of composting bins for a broiler chicken farm

Production capacity (number of birds per period)	Primary bins			Secondary bins		
	Necessary volume		Number of bins*	Necessary volume		Number of bins*
	cu. ft.	m3		cu. ft.	m3	
20,000	197.8	5.6	2**	197.8	5.6	2**
40,000	395.5	11.2	2	395.5	11.2	2
60,000	593.2	16.8	3	593.2	16.8	3
80,000	791.0	22.4	4	791.0	22.4	4
100,000	988.8	28.0	5	988.8	28.0	5
120,000	1186.6	33.6	6	1186.6	33.6	6

* Calculations are based on the following dimensions: 57" x 57" x 98" (1.5 m x 1.5 m x 2.5 m), or a volume of 197.8 cu. ft. (5.6 m^3). These dimensions can be adjusted based on the farm's needs, provided that the depth and width of the units does not exceed 69" (1.8 m) and 98" (2.5 m), respectively.

** In normal conditions, a minimum of two primary bins and two secondary bins are required to operate a composting site. In a case such as this, the dimensions of the bins must be adjusted accordingly.

APPENDIX 4

Anticipated mortality for different livestock

Production capacity (number of birds per period)	Mortality rate/ Production cycle (%)	Production cycle duration (days)	Average weight at slaughter		Average weight of dead birds	
			lbs.	kg	lbs.	kg
Laying hen	14	440	4.0	1.8	1.3	0.58
Female chicken broiler breeder	11	300	7.0	3.2	2.6	1.17
Female broiler breeder pullet	5	140	4.3	1.95	1.5	0.69
Breeding pullet (comm.)	5	140	2.9	1.3	0.97	0.44
Broiler chicken	5	45	4.4	2.0	5.1	2.3
Roaster	8	80	7.9	3.6	7.9	3.6
Turkey	6	98	16.1	7.3	8.8	4.0
Male turkey	9	133	24.9	11.3	17.0	7.7

APPENDIX 5

Size of primary and secondary bins per 1,000 birds

Type of livestock	Bin capacity for 1,000 birds		No. of birds in standard flock	Total size of bins for a standard flock		Number of bins (197.8 cu. ft. or 5.6 m3) for a standard flock
	cu. ft.	m3		cu. ft.	m3	
Laying hen	2.5	0.07	65,000	162.4	4.6	2
Female chicken broiler breeder	5.3	0.15	8,500	45.9	1.3	2
Female broiler breeder pullet	3.2	0.09	16,000	49.4	1.4	2
Breeding pullet (comm.)	2.1	0.06	70,000	148.3	4.2	2
Broiler chicken	9.9	0.28	52,000	515.6	14.6	3
Roaster	15.9	0.45	39,000	618.0	17.5	4
Turkey	17.7	0.50	36,000	635.7	18.0	3
Male turkey	33.9	0.96	24,000	812.2	23.0	4

APPENDIX 6

Risk Assessment

1) Construction of composting bins and safety of operations

Element	Low risk	Low to moderate risk	Moderate to high risk	High risk
Size of composting bin	The capacity of the primary and secondary bins exceeds the needs at the peaks of mortality.	The primary and secondary bins can only accommodate 75% of the carcasses at the peaks of mortality.	The primary and secondary bins can only accommodate 50% of the carcasses at the peaks of mortality.	The primary and secondary bins cannot accommodate 50% of the carcasses at the peaks of mortality.
Roof and floor design	The site has a roof that protects the bins from rain, even gusts, and there is an impervious floor. The materials are adapted for this type of building.	The site has a roof that does protect the bins from gusts of rain, but there is an impervious floor. The materials are of good quality.	The site has a roof that does protect the bins from gusts of rain and the floor is not impervious. The materials are of questionable quality.	The site does not have a roof that protects the bins from rain or an impervious floor. The materials are of poor quality.
Fire protection	The site has access to fire equipment, has running water and is fire-resistant.	The site has access to fire equipment, but does not have running water.	The site has running water, but does not have fire equipment and is not fire-resistant.	The site does not have access to fire equipment, has no running water, and is not fire-resistant.
Equipment biosecurity	The site is equipped with tools for this job and they are thoroughly cleaned.	There are no specific tools, but the ones used are thoroughly cleaned on a regular basis.	There are no specific tools. The tools used are cleaned to a certain extent when possible.	No attention is given to cleaning.
Operations biosecurity	Only the birds that died on the farm that do not meet any exclusion conditions are put in to compost.	Birds are brought from other farms to be composted.	Birds that died from a named disease are put in to compost.	No attention is given to the origin of the birds or the diseases they may carry.

2) Operation of the composting unit

Element	Low risk	Low to moderate risk	Moderate to high risk	High risk
Training of people involved	Everyone involved in the composting process has received solid training.	The people working regularly on the site have been trained.	The people working regularly on the site have received limited trained.	No one involved in the composting process has been trained.
Composting procedures	The composting recipe and procedures are written down and the person operating the composting site is familiar with them.	The recipe and procedures are written broadly, but are incomplete.	The person operating the site knows the recipe and procedures, but almost never respects them.	The person operating the site does not know the recipe or the procedures.
Addition of micro-organisms to the composting mix	Micro-organisms are added through a double layer of warm, soiled litter with 40% to 60% humidity or through active compost.	Micro-organisms are added through a double layer of dry, soiled litter or a thinner layer of moist soiled litter.	Micro-organisms are added through less than a double layer of soiled litter or through old dry litter.	Micro-organisms are not added.
Placement of carcasses	The carcasses are never placed less than 12" (30 cm) from the unit walls or from the top of the substrate pile.	The carcasses are never placed less than 12" (30 cm) from the walls, but are sometimes left uncovered.	The carcasses are sometimes placed less than 12" (30 cm) from the walls and are sometimes left uncovered.	No attention is given to the placement of carcasses. They are often placed along the walls or left uncovered.
Covering the carcasses	The carcasses are covered daily, including the final covering, according to the procedure.	The carcasses are not always covered every day.	The carcasses are covered every day, but are not done so according to procedure.	The carcasses are not covered every day and are not done according to procedure.
Measuring water content	The substrate water content is measured every day with a moisture meter, according to procedure.	The water content is estimated based on touch, and a moisture meter is not used.	The water content is estimated based on sight.	The water content is not estimated.

2) Operation of the composting unit

Element	Low risk	Low to moderate risk	Moderate to high risk	High risk
Measuring temperature	The temperature is measured every day, according to procedure, and the temperature cycle complies with guidelines.	The temperature is measured according to procedure, but the temperature cycle does not match the guidelines.	The temperature is measured occasionally and the temperature cycle does not match the guidelines.	The temperature is never measured, never reaches the critical threshold of 55ºC, or exceeds the hazard threshold of 70ºC.
Turning of the substrate mass	The substrate in the primary bin is composted for at least 7 to 10 days after the final layer is placed and the temperature reaches between 55ºC and 65ºC.	The temperature in the primary bin reaches the recommended level, but the substrate is turned less than 7 days after the final layer is placed.	The temperature does not reach the recommended level and begins to drop.	Only one primary bin is available; the substrate is turned too soon and the temperature is not measured.
Height of substrate mass	The substrate mass in any bin is never higher than 71" (1.8 m).	The height of one of the substrate masses varies and sometimes exceeds 71" (1.8 m).	The height of one of the substrate masses often exceeds 71" (1.8 m).	The substrate mass in any bin is higher than 71" (1.8 m).
Ventilation of substrate	The substrate is turned using a "cascade" method to properly ventilate it.	The substrate is turned on time, but care is not taken to properly ventilate it.	The substrate is turned and ventilated only after odours and insects are detected.	The substrate is never turned or ventilated.
Presence of flies, vermin and odours	Never.	Occasionally.	Usually.	Always.
Register	A complete daily register is kept, in compliance with the recommendations in the guide.	A register is kept, but is incomplete.	A register is occasionally kept by memory.	No register is kept.

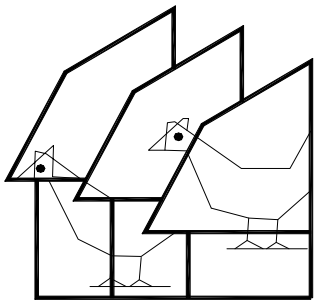
3) Placement of compost

Element	Low risk	Low to moderate risk	Moderate to high risk	High risk
Storage location	The compost is stored in an impervious location away from flood-prone areas.	The compost is stored in a location that is not completely impervious or in a flood-prone area.	The compost is stored in a location where it is sometimes exposed to inclement weather.	The compost is not protected.
Compost characterization	Annually.	Every two years.	Every three to five years.	Never.
Amount of compost spread and levels	Levels satisfy cultivation needs, based on a fertilization plan, with a soil test.	Standard, non-excessive application, with soil test.	Standard, non-excessive application, with no soil test.	Excessive application with no soil test.
Time of spreading	Based on a fertilization plan; never spread in damp conditions.	Based on the plant stage, with an attempt to avoid damp conditions.	Based on practicality (when emptying), trying as much as possible to avoid damp conditions.	Based on practicality, with no concern given for conditions.
Location of spreading	Spread in accordance with standards and in compliance with distances to water sources, etc.	Spread in accordance with standards on distances to water sources.	Quite often spread too close to water sources.	No consideration is given when spreading compost.

Appendix 7

Farm composting unit blueprint

ON-FARM POULTRY COMPOSTING UNIT



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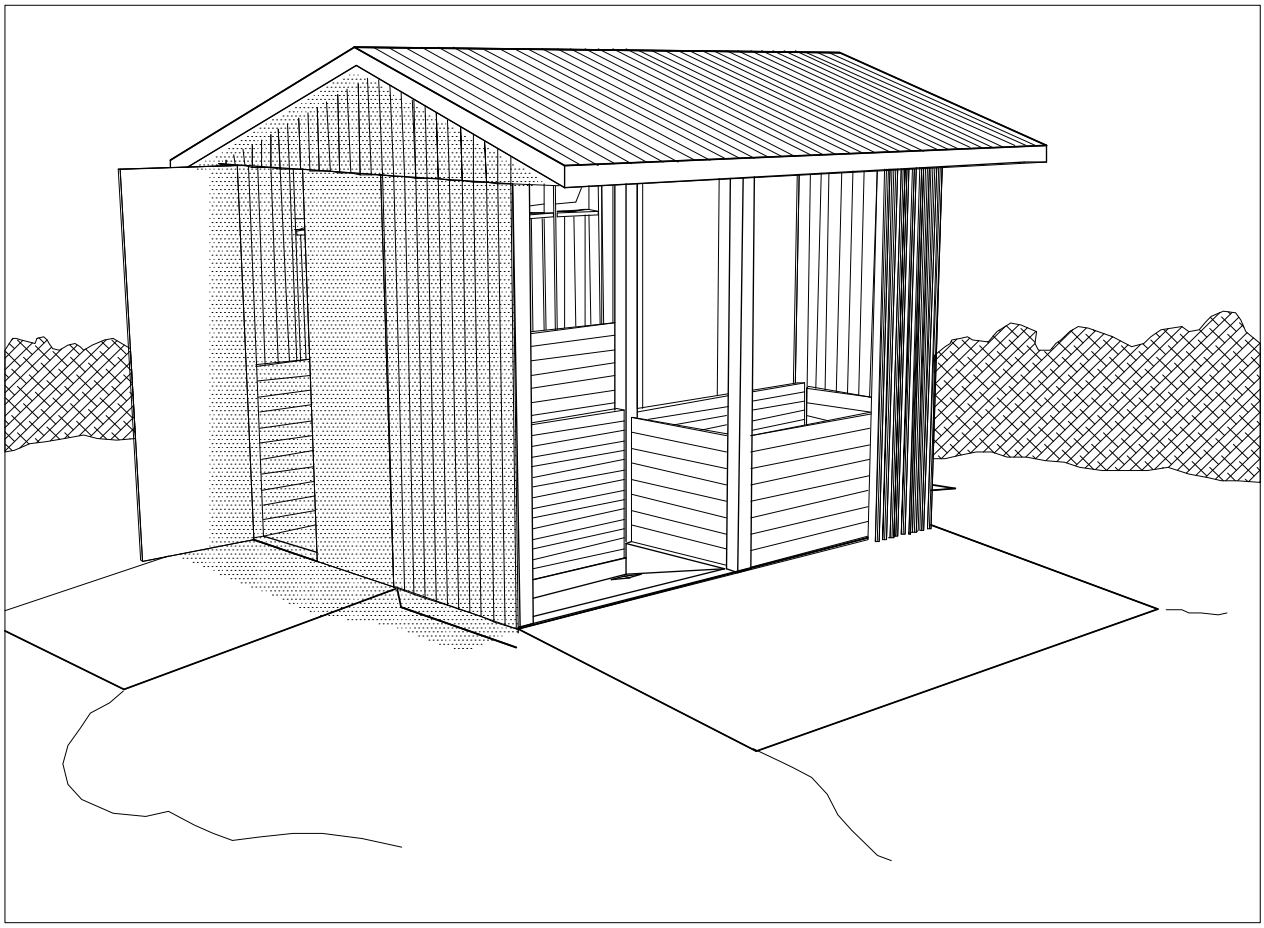
G. GINGRAS[1], R. JONCAS[2], A. ALAIN[3], S. CARTIER[4]

COMPLETE INSTRUCTIONS



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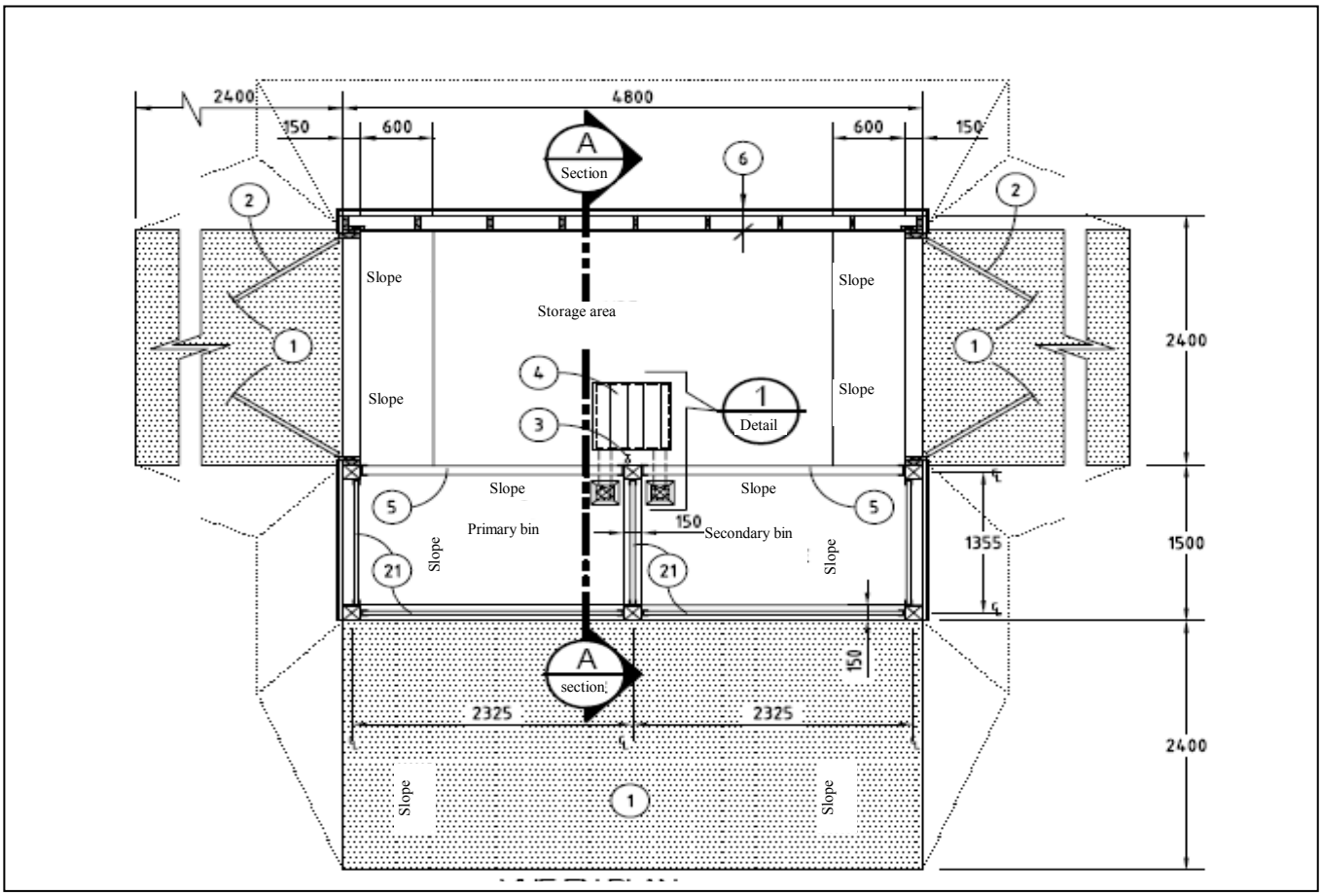
4. S. CARTIER, agricultural technician, Direction de l'environnement et du développement durable



LEGEND

1- ACCESS TO COMPOSTING UNIT: 3.9" (100MM) CONCRETE SLAB WITH LATTICE OR 5.9" (150MM) THICK BED OF CRUSHED STONES

2- DOOR, 129.9" (3300 MM) HIGH

3- WATER INLET WITH HEATING WIRE

4- PUMPING MANHOLE 23.6" X 23.6" X 17.7" (600 X 600 X 450 MM) COVERED WITH 1½" X 5½" (38 X 140MM) PRESSURE-TREATED PLANKS WITH 0.23" (6MM) HOLES

5- PARTITION: PARTS MEASURING 3½" X 3½" X 84.6" (89 X 89 X 2150MM), STACKED UP TO 53" (1350MM)

6- BACK WALL COMPONENTS:
- EXTERIOR FINISH, PLANKS OR GALVANIZED STEEL PLATE
- HORIZONTAL LATHS 1½" X 2½" TO 15.7" (38 X 64 TO 400MM) O.C.
- WALL PLATES 1½" X 5½" TO 23.6" (38 X 140 TO 600MM) O.C.
- INTERIOR FINISH, 1½" X 5½" (38 X 140MM) PRESSURE-TREATED HORIZONTAL PLANKS

7- 1½" X 5½" (38 X 140MM) PRESSURE-TREATED SILL PLATE WITH ANCHOR BOLT

8- DOUBLE WALL PLATE, 1½" X 5½" (38 X 140MM)

9- ½" (15MM) VENTILATED PLYWOOD SHEET ON HINGE

10- FLOOR COMPONENTS:
- 6" (150MM) CONCRETE SLAB, 30 MPa WITH 4" X 4" (102 X 102MM) METAL LATTICE
- POLYETHYLENE 150 um
- 18" (450MM) SAND OR GRAVEL COMPACTED IN SUCCESSIVE LAYERS OF 4"-6" (100-150MM) AT 95% OF MODIFIED PROCTOR

11- COATED PERIMETER DRAIN, 4" (100MM) ∅

12- CRUSHED STONE FILL, ¾" (19MM) ∅

13- 5½" X 5½" (140 X 140MM) PRESSURE-TREATED POST

14- 1½" X 7.2" (38 X 184MM) BEAM ON EACH SIDE OF THE COLUMN WITH M12 BOLT AND WASHERS, 2" (50MM) ∅

15- GALVANIZED STIRRUP

16- RAFTER, 1½" X 5½" TO 23.6" (38 X 140 TO 600MM) O.C.

17- 3 COMPOUND BEAMS, 1½" X 5½" (38 X 140MM)

18- 1½" X 5½" X 29½" (38 X 140 X 750MM) TRUSS BLOCK WITH M12 BOLT AND WASHERS, 2" (50MM) ∅

19- ROOF COMPONENTS:
- GALVANIZED STEEL PLATE
- LATH 1½" X 3½" TO 23.6" (38 X 89 TO6400MM) O.C.
- RAFTER, 1½" X 5½" TO 23.6" (38 X 140 TO 600MM) O.C.

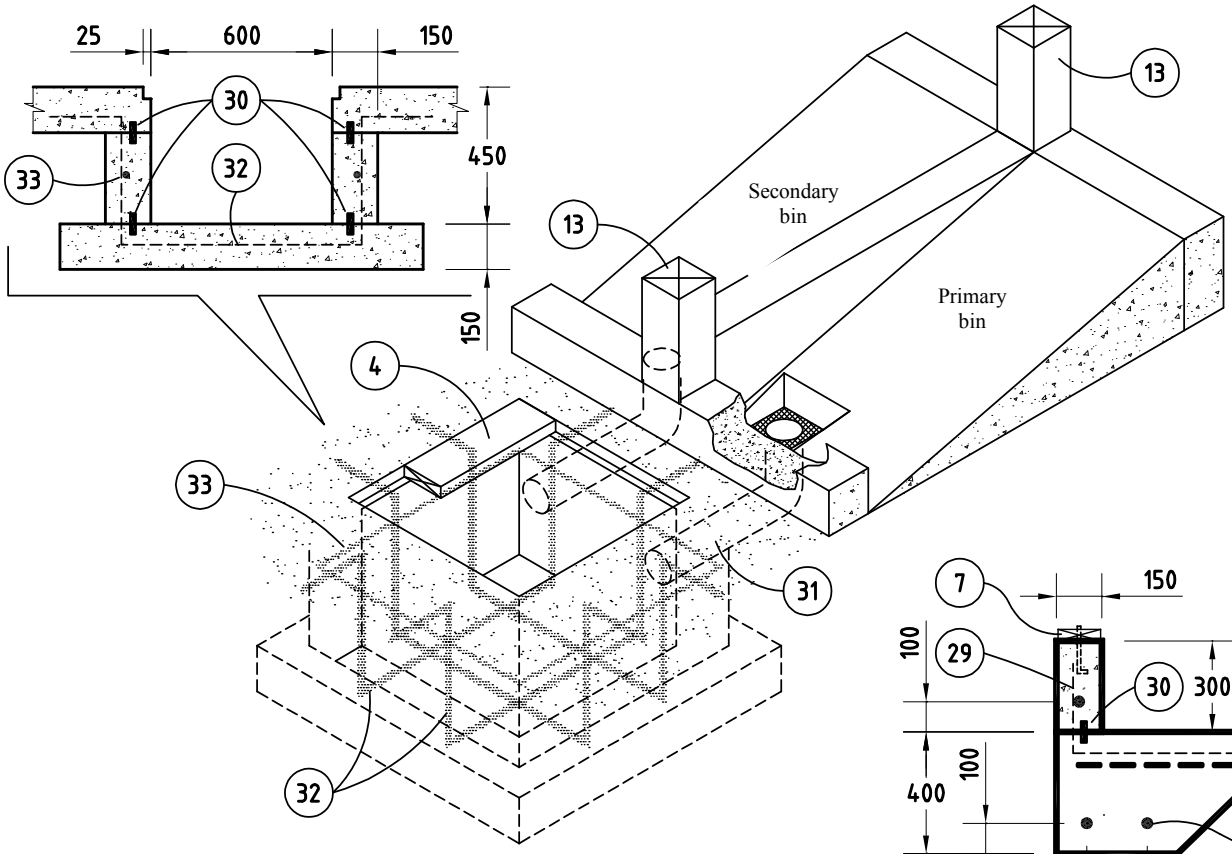
20- TARPAULIN OR DOOR

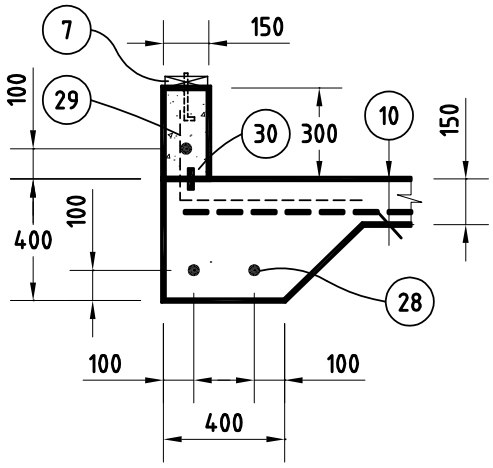
21- PARTITION: 1½" X 5½" (38 X 140MM) PRESSURE-TREATED PLANKS, STACKED

22- BELOW THE FREEZING PLANE

23- STEEL GUIDE SECURED TO THE POSTS WITH LAG BOLTS

24- ASSEMBLY: STEEL PLATE ¼" (6.3MM) THICK WITH FOUR STEEL ANGLE IRONS 1½" X 1½" X ¼" THICK (38 X 38 X 6.3MM THICK), SOLDERED.





DETAIL "2"

SLAB NOT TO SCALE

LEGEND

25- LAG BOLT, 1½" (38MM) LONG, ¼" (6.3MM) ∅

26- HOLE IN THE POST FOR THE BOLT

27- ANCHOR BOLT IN EACH POST, 4" (100MM) LONG, 0.4" (100MM) ∅

28- HORIZONTAL REINFORCING BAR 9'8" X 49'2" (3 X 15M)

29- VERTICAL REINFORCING BAR 49'2" (15M) EVERY 23.6" (600) O.C.

30- GASKET (SEE SHEET 20734 "JOINT POUR LIEU D'ENTREPOSAGE EN BÉTON ARMÉ, DES FUMIERS" – FRENCH ONLY)

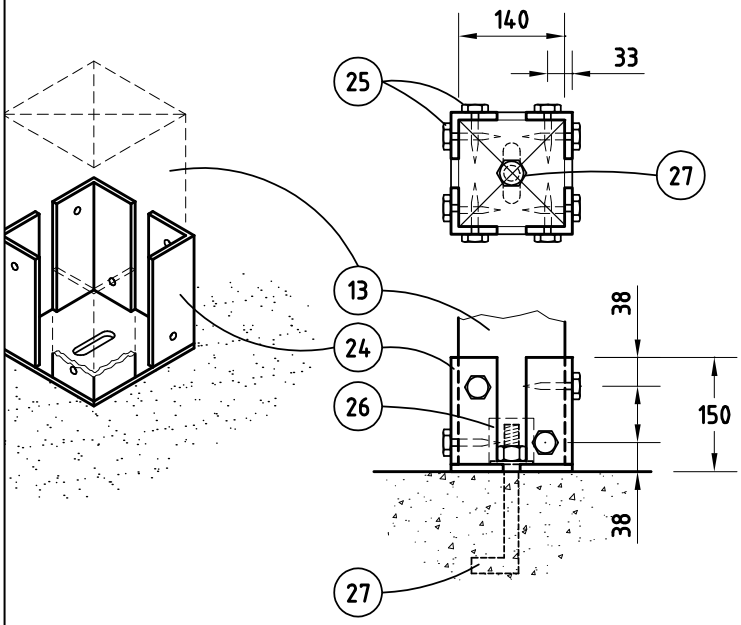
31- HEADER, 0.4" (100MM) ∅

32- TWO ANCHOR BARS IN BOTH DIRECTIONS

33- HORIZONTAL REINFORCEMENT

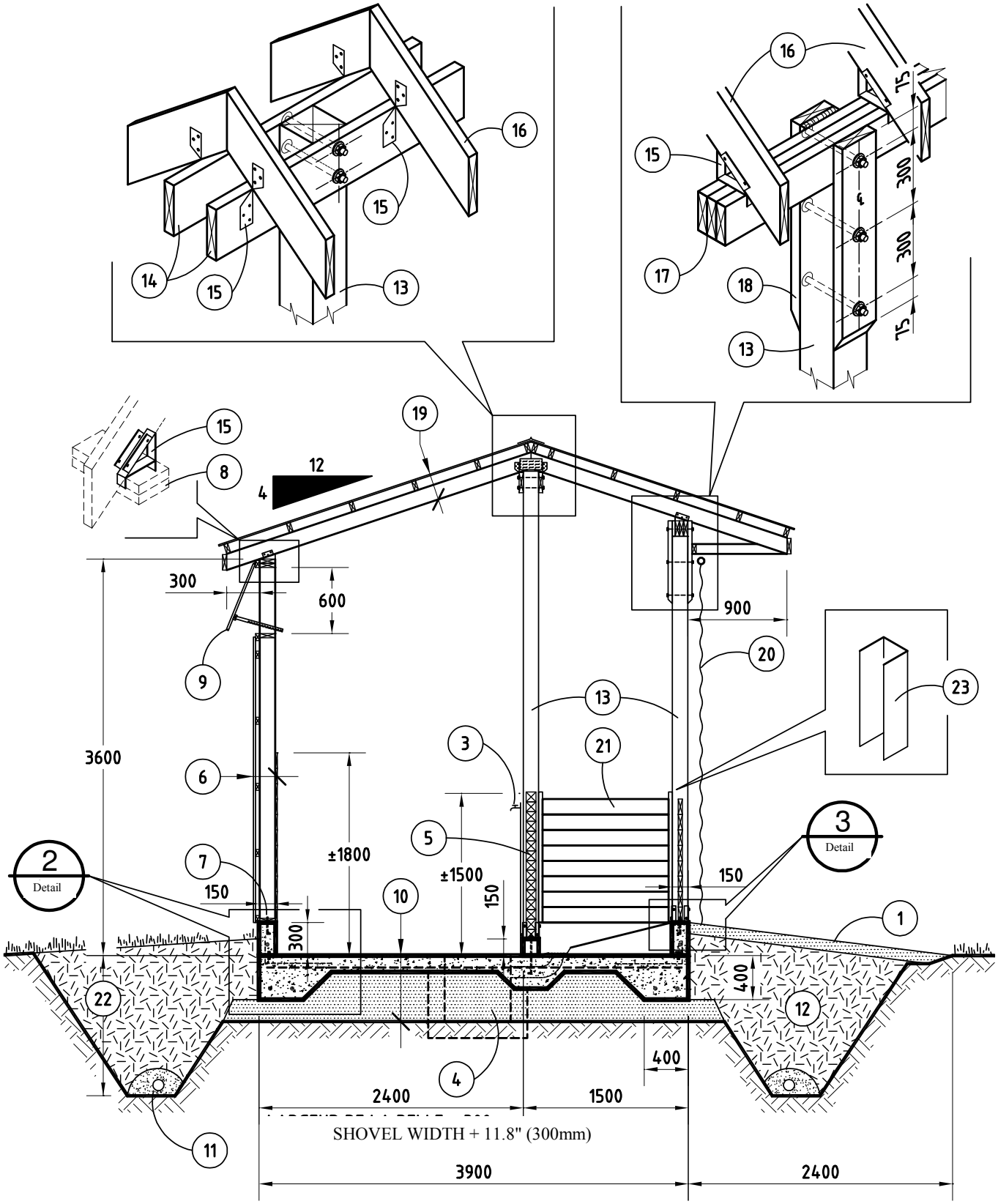
THIS DOCUMENT IS A STANDARD SHEET OF AN AGRICULTURAL STRUCTURE. IT MAY BE NECESSARY TO ADAPT IT TO SPECIFIC CONDITIONS. IN THIS CASE, ENGINEER'S APPROVAL IS RECOMMENDED.

UNLESS OTHERWISE INDICATED, ALL THE DIMENSIONS ARE PROVIDED IN INCHES AND MILLIMETERS.



DETAIL "3"

ANCHORING NOT TO SCALE



AA CROSS-SECTIONAL VIEW

(NOT TO SCALE)

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