

## STORAGE

### This chapter covers:

- why storage is necessary
- what a storage system should do
- how to properly locate your storage
- critical components of storage structure types
- how to construct a safe pesticide storage
- best management practices for storing pesticides, including fire prevention
- best management practices for transporting pesticides.

If you use pesticide products, you should have a proper pesticide storage system. Such a system would include the storage facility and the management practices required to make the system work. There are several worthy reasons for taking good care:

- safety
  - ▷ for people – children can be exposed to or ingest lethal amounts of pesticide products
  - ▷ for livestock – contamination of livestock facilities and feeds by concentrated amounts of certain pesticides can poison or kill livestock
  - ▷ for wildlife – poorly stored products can be accessible to wildlife
- security – pesticide containers could be stolen or vandalized
- fire safety – firefighters are less likely to be exposed if they know where pesticides are stored and can take appropriate precautions to contain runoff
- environmental protection
  - ▷ leaks from pesticide containers can infiltrate groundwater – 1 gram of 2,4-D can render an entire aquifer unsuitable as drinking water
  - ▷ runoff from spilled containers can contaminate any watercourse in close proximity
  - ▷ spilled pesticides such as herbicides can run off into natural areas and destroy living vegetative habitats
- practicality – storing pest control products in one safe place helps to keep inventories organized and readily accessible to certified users.

Strictly speaking, a spill is a discharge into the natural environment, from or out of a structure, vehicle, or other container, that is abnormal in quantity or quality in light of all the circumstances of the discharge.



Pesticides should be stored to protect people, livestock, wildlife, habitat, and water quality.



Leaks from improperly stored pesticides can run off to ponds and other surface waters. Buffer strips help to control agricultural runoff.

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## PRINCIPLES

Planning an effective pesticide storage system requires careful attention to several performance measures.

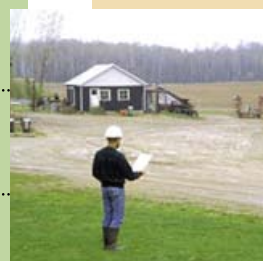
MEASURE	RATIONALE
AMOUNT STORED	<ul style="list-style-type: none"> <li>• how much storage do you need?                             <ul style="list-style-type: none"> <li>◦ less is best: fewer types and amounts to be stored translates into fewer risks of spills, leaks, fire exposure, or contamination</li> </ul> </li> </ul>
LOCATION	<ul style="list-style-type: none"> <li>• how far from environmental risks can you locate your system and still be practical?                             <ul style="list-style-type: none"> <li>◦ the closer pesticides are to water sources and natural areas, the higher the risk</li> <li>◦ shallow aquifers under porous soil materials or bedrock pose high risks for groundwater contamination</li> </ul> </li> </ul>
SUITABILITY	<ul style="list-style-type: none"> <li>• does the system suit your needs?                             <ul style="list-style-type: none"> <li>◦ systems should be accessible and affordable</li> </ul> </li> </ul>
CONTAINMENT	<ul style="list-style-type: none"> <li>• if there is a spill or leak, will it be contained in the storage?                             <ul style="list-style-type: none"> <li>◦ special considerations such as secondary containment (e.g., curbs) and materials (e.g., coatings) can prevent leakage to water sources, natural areas, and groundwater</li> </ul> </li> </ul>
WORKER SAFETY	<ul style="list-style-type: none"> <li>• is the storage safe for pesticide users?                             <ul style="list-style-type: none"> <li>◦ most exposure to pesticides occurs during transportation and filling the sprayer</li> <li>◦ storage areas should have safety and first-aid equipment readily available</li> <li>◦ ventilation is needed to prevent exposure to fumes</li> <li>◦ workers must be trained to handle products and emergencies safely</li> </ul> </li> </ul>
ANIMAL SAFETY	<ul style="list-style-type: none"> <li>• are the stored products accessible to pets, livestock, and wildlife?                             <ul style="list-style-type: none"> <li>◦ some pesticide products are acutely toxic to animals, so storage areas must be secure and located away from any animals</li> </ul> </li> </ul>
PROTECTION FROM FIRE	<ul style="list-style-type: none"> <li>• is the storage facility fireproof?                             <ul style="list-style-type: none"> <li>◦ combustion of some pesticide products or accidental mixes of products can produce toxic fumes</li> <li>◦ fire-resistant construction materials and proper storage practices of flammable products help prevent fires</li> </ul> </li> </ul>
SECURITY	<ul style="list-style-type: none"> <li>• is the storage accessible to children, thieves, or vandals?                             <ul style="list-style-type: none"> <li>◦ some pesticide products can be lethal if ingested</li> <li>◦ vandals can unknowingly or intentionally cause irreparable damage to water sources and natural areas with pesticide products</li> <li>◦ storage areas should be signed correctly, locked, and safe</li> </ul> </li> </ul>
PRODUCT INTEGRITY	<ul style="list-style-type: none"> <li>• are products stored in their original containers?                             <ul style="list-style-type: none"> <li>◦ children have died by drinking a concentrated pesticide product from pop bottles</li> <li>◦ tank-mixed or diluted products may freeze, causing leakage</li> <li>◦ wet bags lead to spills (e.g., solupaks must be kept dry)</li> </ul> </li> </ul>



Store as few pesticides as possible. Store products of different classes in separate areas of the storage facility.



Pesticide storages should be located to minimize risk of contamination of groundwater, surface water, natural habitats, livestock feeds, and human activity.



Choosing a location for your pesticide storage should include consideration of safety and environmental protection together with practicality.



Storages should be locked and signed to prevent access.

# STORAGE

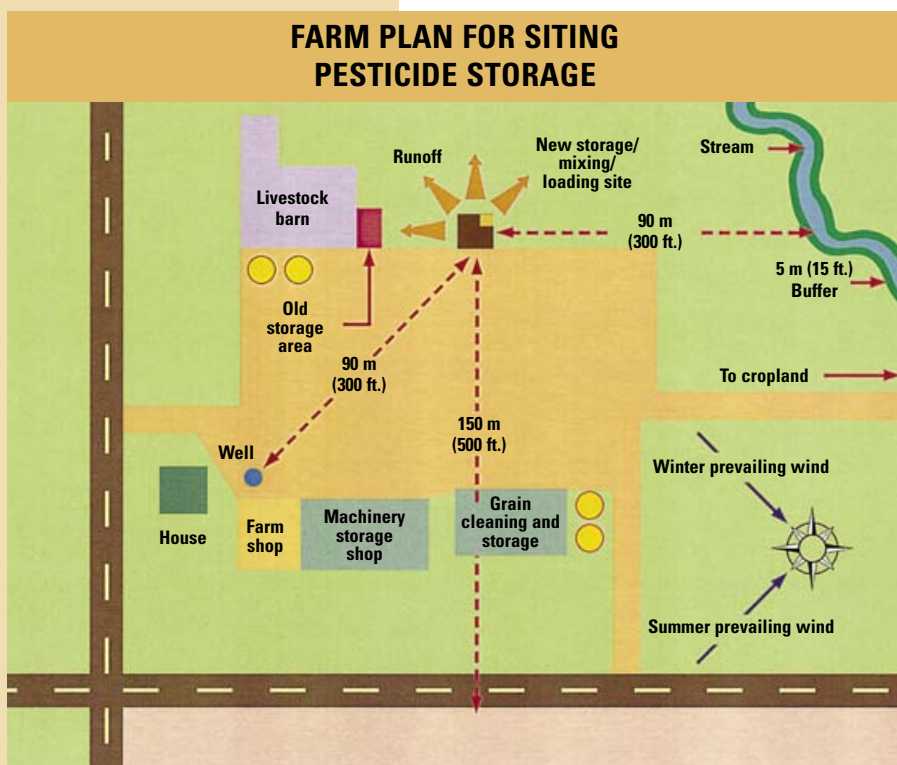
## SITE SELECTION

Select a site for pesticide storage that is practical and safe for people and the environment. The two questions to be dealt with are:

- how do you place your chemical storage so that the chance of human contact – especially accidental or unauthorized – is reduced or eliminated?
- what is the best location for your storage to minimize any environmental impact of a leak or serious spill?

Factors to consider when choosing a storage site:

- human safety
  - ▷ pesticides should be stored and secured as far away as practical from food and water supplies – 60 metres (200 ft.) minimum from residential dwellings
- surface water and groundwater contamination
  - ▷ pesticides should be stored at a minimum distance of 90 metres (300 ft.) from surface water and wells
  - ▷ sites that slope towards watercourses pose a greater risk of contamination



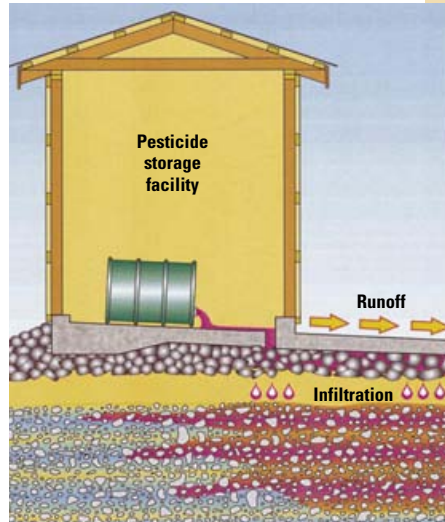
- livestock feeds
  - ▷ livestock feeds are not to be stored in the same location as pesticides, to avoid risk of contamination of feed
- wildlife habitat
  - ▷ pesticide spills can destroy habitat areas, so locate storage at least 90 metres (300 ft.) away from wetlands, woodlands, and watercourses
- access
  - ▷ distance to hydro, water, other needed utilities
  - ▷ ability to access storage with machinery if required by fire department and other emergency vehicles
- potential for future expansion
  - ▷ increased size of storage or location of handling facility beside it

Integrating minimum separation distances is the most important consideration when selecting a site for your pesticide storage.

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- ▶ soil conditions
  - ▷ clayey soils have higher potential for runoff, but a lower risk of groundwater contamination
  - ▷ the risk is higher on soils prone to groundwater contamination (shallow to bedrock, gravelly, sandy soils and all sites with high water table) – if possible, try to select a site on soils with a lower risk of contamination.

Compared to clay soils, sandy soils have large spaces between the soil particles. Water may move quickly through these pores, carrying pesticides to groundwater. The following section can help you decide on leaching potential.



Improperly stored pesticide containers are at risk of spills or leaks. Spilled pesticides in areas with high runoff rates and close proximity to natural areas can cause serious contamination. Pesticide leaks into permeable materials with shallow aquifers (e.g., fractured bedrock sites) can contaminate groundwater.

## POTENTIAL FOR PESTICIDES TO BE TRANSPORTED TO GROUNDWATER AND SURFACE WATER

You can use a soil map to help estimate the risk of pesticide contamination by determining the risk of transport of pesticide products.

There are five key site features that affect water contamination risk.



Soil maps and reports can be very useful sources of information when selecting suitable sites for pesticide storage and handling facilities.

<b>Soil texture</b>	Texture is the relative coarseness or fineness of soils. Clayey soils are more prone to runoff as water infiltrates and percolates through them slowly.
<b>Soil depth</b>	Sites with soils shallow to bedrock or to groundwater pose a higher risk of runoff and groundwater contamination. Soils with a naturally occurring high water table are classed as “Very Poor”, “Poor” or “Imperfect” in soil survey reports and map legends.
<b>Perviousness</b>	This is the relative speed at which water moves through soil. The most pervious are sandy and gravelly soils, because they are porous and have fewer charged soil particles (clay and organic matter). The more porous soils allow water to move more quickly through them to groundwater, allowing minimal opportunity for treatment or breakdown of contaminants.
<b>Slope class</b>	Slope is the elevation difference over a specified distance that is measured as a percent: 0% slope means level, whereas with a 5% slope, runoff during snowmelt and storm events would be clearly evident.
<b>Proximity</b>	Distances to watercourses, wetlands, ponds, and lakes contribute to the risk of surface water contamination from pesticide runoff.

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### Ratings for groundwater contamination potential

1 = high

2 = moderate

3 = low

4 = very low

### GROUNDWATER CONTAMINATION POTENTIAL

SOIL TEXTURE (NATURAL DRAINAGE)	DEPTH TO GROUNDWATER			
	<1 m (3 ft.)	1-5 m (3-15 ft.)	5.1-15 m (16-50 ft.)	>15 m (50 ft.)
BEDROCK WITHIN 1 m	1	1	1	1
MUCK (FAST-MODERATE)	1	—	—	—
SANDS* (FAST)	1	1	1	2
LOAMS* (MODERATE)	1	1	2	3
CLAY LOAMS* (SLOW)	1	2	3	4
CLAYS* (VERY SLOW)	1	3	4	4

### RECOMMENDED MINIMUM SEPARATION DISTANCES BETWEEN STORAGE LOCATION AND WELLS

RATING, CONTAMINATION POTENTIAL	MINIMUM SEPARATION DISTANCE	
	DRILLED WELLS	DUG OR BORED WELLS
1	>90 m (300 ft.)	>90 m (300 ft.)
2	23.1-90 m (76-300 ft.)	45.1-90 m (151-300 ft.)
3	15.1-23 m (51-75 ft.)	30.1-45 m (101-150 ft.)
4	15 m (50 ft.)**	>30 m (100 ft.)**

To judge groundwater contamination potential, take the rating from the first table and determine recommended separation distance from the second table.

For example, with a depth to groundwater of 5.1-15 metres (16-50 ft.) on a clay loam soil, the potential is “3”. This means your distance to a drilled well should be in the range of 15.1-23 metres (51-75 ft.). If the soil type is sand, with a similar depth to groundwater, the potential is “1”, or high. Here, the distance to your drilled well should be greater than 90 metres (300 ft.)

\* Sands – all sands and loamy sands (e.g., loamy fine sand)  
 Loams – sandy loam, silt loam, and loam  
 Clay Loams – silty clay loam, sandy clay loam, and clay loam  
 Clays – silty clay, sandy clay, heavy clay, and clay

\*\*Minimum distance required to be consistent with water well regulations under the Ontario Water Resources Act (Reg. 903).

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SURFACE WATER CONTAMINATION POTENTIAL			
SOIL TEXTURE (NATURAL DRAINAGE)	TOPOGRAPHY (LAND SLOPE)		
	LEVEL <2%	SLOPING 2-5%	HILLY >5%
MUCK (FAST-MODERATE)	3	—	—
SANDS* (FAST)	4	4	3
LOAMS* (MODERATE)	3	3	2
CLAY LOAMS* (SLOW)	2	2	1
CLAYS* (VERY SLOW)	1	1	1

Ratings for surface water contamination potential

- 1 = high
- 2 = moderate
- 3 = low
- 4 = very low

Slope of land in direction of the surface water source and type of soil determine surface water contamination potential. These tables can assist you in judging this potential.

RECOMMENDED MINIMUM SEPARATION DISTANCE BETWEEN STORAGE LOCATION AND SURFACE WATER SOURCES	
SURFACE WATER CONTAMINATION POTENTIAL	MINIMUM SEPARATION DISTANCE
1	>150 m (>500 ft.)
2	60.1-150 m (201-500 ft.)
3	30.1-60 m (101-200 ft.)
4	30 m (100 ft.)

To judge surface water contamination potential, take rating from the upper table and determine recommended separation distance from the lower table.

For example, the recommended separation distance for a sandy loam soil with 2-5% slope is 30.1-60 metres (101-200 ft.) between the pesticide storage and the surface water source.

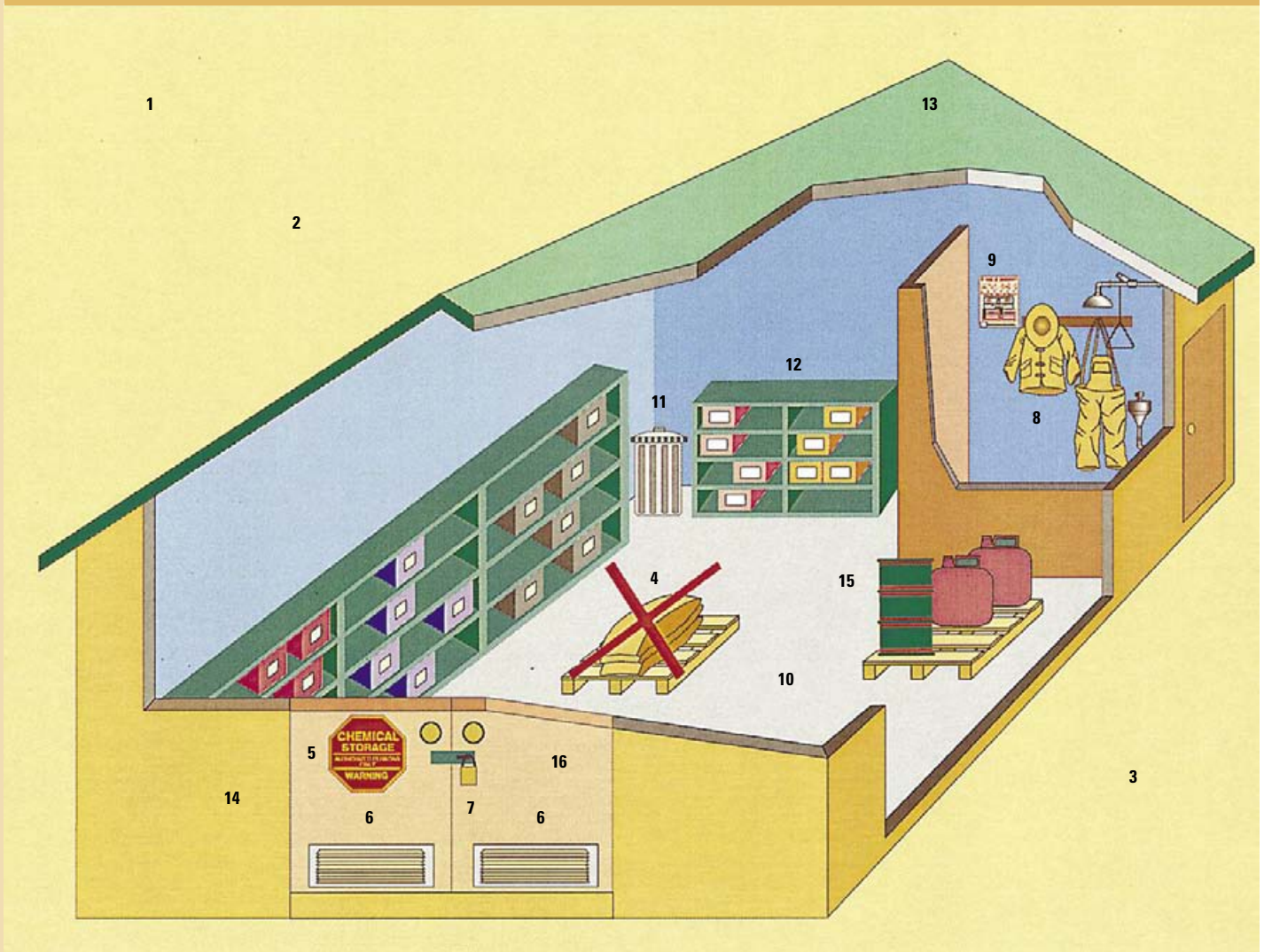
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## STRUCTURES

Here are the performance requirements for a pesticide storage. In some jurisdictions, these items are legal requirements.

### PERFORMANCE CRITERIA FOR PESTICIDE STORAGE



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## CHECKLIST

- ✓ 1. **FOOD AND LIVESTOCK KEPT AWAY** – pesticides must be stored in such a manner that the pesticide will not come into contact with food or drink intended for human or animal consumption.
- ✓ 2. **PRODUCTS STORED SAFELY AND SECURELY** – pesticide products must be stored in such a way that the health and safety of any person are not impaired.
- ✓ 3. **ENVIRONMENTAL PROTECTION** – stored products must not contaminate the environment or other pesticides. Site storage away from surface water and natural areas.
- ✓ 4. **ONLY PESTICIDES ALLOWED IN STORAGE** – pesticide storages must only be used for the storage of pesticides.
- ✓ 5. **SIGN ON DOORS** – a Chemical Storage Warning sign must be permanently affixed to or adjacent to the outside of each entrance leading into the storage area.
- ✓ 6. **VENTILATION** – the storage should be ventilated to the outside atmosphere. Either natural ventilation or mechanical ventilation may be used to exhaust fumes from the storage, and improve air quality.
- ✓ 7. **LOCKED DOORS** – the door must be locked to prevent theft and unauthorized entry.
- ✓ 8. **PROTECTIVE CLOTHING AND RESPIRATORY EQUIPMENT AREA** – these must be readily available and stored so that they do not become contaminated, e.g., in an adjacent room or a nearby building. Protective clothing and respiratory equipment includes: chemical-resistant gloves and apron, long-sleeved shirt and pants or coveralls, boots, waterproof hat, goggles, face shields, and respirators.
- ✓ 9. **CONTINGENCY PLAN** – emergency telephone numbers must be displayed in a permanent place close to a telephone. Numbers should include hospital, ambulance, physician, poison control centre, spills action centre, fire department, police, and the Ministry of the Environment.
- ✓ 10. **FLOOR IS IMPERMEABLE, CURBED, AND SEALED** – the storage area should have a floor that does not allow material to leak into or through it. It should NOT have floor drains of any sort. Many operators use sealed concrete. In order to contain any spills, there should also be a curb around the entire floor perimeter of the storage facility. The curb should be adequate to contain 110% of the largest containment vessel or 10% of the aggregate volume of all containers, whichever is the larger of the two. A curb height of 50-100 mm (2-4 in.) is usually adequate.
- ✓ 11. **ABSORBENT MATERIALS AVAILABLE** – materials such as sawdust, soil, and kitty litter should be available for a spill cleanup.
- ✓ 12. **SEPARATED BY PESTICIDE TYPE** – the area should be set up so that herbicides are stored separately from insecticides and fungicides.
- ✓ 13. **STRUCTURE AND PESTICIDES KEPT DRY** – the storage should be kept dry and secure to protect the stored chemicals. Moisture can cause some packaging material to rupture and split, or labels to become difficult to read.
- ✓ 14. **FIREWALLS** – if the pesticide storage facility is constructed within another building, the interior separation walls of the pesticide storage should have a fire resistance rating of not less than one hour. The primary entrance to the storage area should be from the outside.
- ✓ 15. **PRODUCTS KEPT OFF FLOOR USING PALLETS** – keep containers off the floor with pallets to maximize the space available for containment of a spill.
- ✓ 16. **DOOR SIZES ADEQUATE** – make sure you consider the size of the doors so that bulk pesticides may be stored.



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The storage and handling requirements will change with each farm operation.

The **size** of the storage building will be determined by:

- ▶ type and quantity of pesticides stored
- ▶ size of containers typically used
- ▶ formulation – liquid or dry.

It is uncertain what form future pesticides will take. The current trend is toward more concentrated forms of materials. Highly concentrated formulations should require less – possibly unheated – space. The use of large containers, such as drums or bulk storage, may have to be considered.

**Storage cabinets** can be used for storing small volumes. Whether they're constructed, prefabricated or modified cabinets (e.g., freezers), they must meet many of the design criteria of the larger free-standing storages.

**Free-standing storages** are either:

- ▶ *farm-built* – suggestions follow on how to approach the construction of your own facility: pay particular attention to floor characteristics
- ▶ *prefabricated* – in order to save time, growers may choose a ready-made unit designed to meet pesticide storage requirements.

**Storage within, or attached to, another building** is also an option. A few guidelines are provided on the following pages.

**Storage size requirements can be reduced if you store only what is needed.**



One end of a used fibreglass fuel tank was attached to a seamless concrete floor (with 150 mm [6 in.] curb) to create this unique pesticide storage. Total material cost was \$185.



Use only freezers that you do not intend to use for food.

## COMPARING STORAGE TYPES

TYPE	PROS	CONS
STORAGE CABINET	<ul style="list-style-type: none"> <li>• movable</li> <li>• may be low cost</li> </ul>	<ul style="list-style-type: none"> <li>• limited size</li> </ul>
PREFABRICATED	<ul style="list-style-type: none"> <li>• convenient</li> <li>• generally competitive costs</li> <li>• designed for this purpose</li> </ul>	<ul style="list-style-type: none"> <li>• not always available in all regions</li> </ul>
FARM-BUILT	<ul style="list-style-type: none"> <li>• build to size needed</li> <li>• low cost if built by farmer</li> </ul>	<ul style="list-style-type: none"> <li>• difficult to construct quality floor, i.e., sealed</li> </ul>
STORAGE WITHIN BUILDING	<ul style="list-style-type: none"> <li>• makes use of some of the existing walls</li> <li>• may be less cost</li> </ul>	<ul style="list-style-type: none"> <li>• risk to other stored items</li> <li>• fire hazard potential</li> <li>• removes that portion of building from original use</li> </ul>

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## STORAGE CABINET

### HORIZONTAL

- ▶ old freezers, equipped with locks and signs, serve as a good storage
- ▶ refrigerant must be removed by a licensed contractor
- ▶ ventilation is recommended at a specification of 1 ft.<sup>2</sup> of ventilation intake/exit area to each 100 ft.<sup>3</sup> of storage
  - ▷ two screened 4 in. PVC pipes, vented to the outside, at either end of the cabinet and at about 1 foot off the ground will provide enough ventilation for the average-sized freezer, 2 x 5 x 2.5 ft.
- ▶ to prevent freezing, use two low-wattage light bulbs, e.g., 40 watt, in parallel circuits (so there's less chance that both will fail at once)

### VERTICAL

- ▶ a closet-sized (2 x 3 x 7 ft.) cabinet will be adequate for some operations
- ▶ install a vent pipe(s) to the outside to prevent a buildup of vapours
- ▶ should have an impervious floor with a curb to contain spills
- ▶ should be signed and locked
- ▶ two single low-wattage bulbs (e.g., 40 watt) should prevent freezing

**Remember to place locks and signs on all storage facilities.**



**Vertical cabinets can make suitable storages, provided they are vented, locked, and will contain leaks.**

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It took \$1,040 in materials and \$400 in labour to construct this pesticide storage, which uses a septic tank as a leakproof base.



This farm-built free-standing pesticide storage was constructed according to recommended design criteria. Cost: \$4,000.

### FARM-BUILT FREE-STANDING

#### PROS

- can be built to meet your specific requirements, e.g., floor area, layout
- usually less costly if you build yourself
- flexibility in choice of materials, e.g., steel floor vs. concrete floor

#### CONS

- may be difficult to build a proper floor on-site
- quality of construction of components, e.g., concrete floor may be inferior to precast slabs
- portability – usually difficult to move to another location
- requires time to plan and construct on site

A farm-built storage can be a good choice. Before starting on this project, contact your local municipality regarding local design criteria and a building permit. Here are some key considerations:

- layouts – shelving, insulated cabinet, anteroom (worker safety area)
- floor area requirements
- floor types and design details – impervious concrete/steel, including curbs and spill containment
- wall types and construction – i.e., stud wall/steel-clad, all steel, or concrete block
- insulation vs. non-insulation – heating methods if insulated, i.e., some chemicals must be kept from freezing
- ventilation criteria – natural ventilation or mechanical ventilation
- a concrete ramp can be built with a finished elevation equal to the top of the curb.

# STORAGE

## LAYOUT AND STORAGE SPACE

- ▶ storage needs mostly depend on the size and number of pesticide storage containers
- ▶ keep different pesticide products separate, e.g., insecticides and herbicides
- ▶ shelves should not be >150 cm (60 in.) above the floor
- ▶ to prevent contamination, shelves should not be less than curb height
- ▶ shelf width should not exceed 45 cm (18 in.) and should have a 5 cm (2 in.) lip around the perimeter to contain spills
- ▶ aisle width should be a minimum of 60 cm (24 in.)
- ▶ total design should account for storage of empty containers, water sinks, safety showers, and anteroom for storage of personal protection equipment

## FLOORS

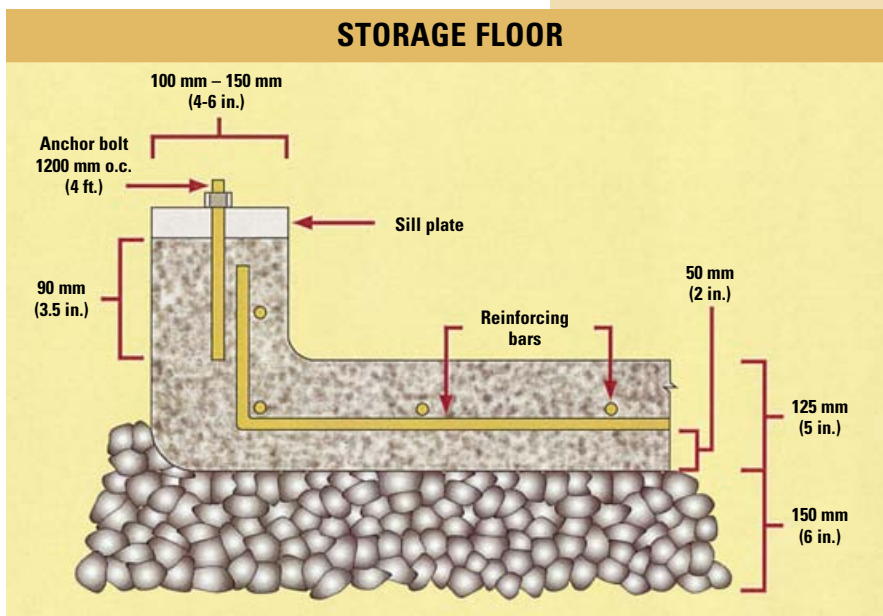
- ▶ subbase should be well-drained and compacted
- ▶ floors must be impervious, with no drains, a 5-10 cm (2-4 in.) curb, easily cleaned and skid-proof
- ▶ materials can be steel or concrete
- ▶ concrete floors should be 10 cm (4 in.) minimum thickness
- ▶ concrete floors should have reinforcing rods 600 mm (24 in.) o.c. in both directions and bent up into the concrete curb
- ▶ concrete floors should have 25 MPa (3,500 psi) compressive strength, 5% air entrainment, and low water content
- ▶ steel floors should be heavy-gauge metal with epoxy coating

## WALLS

- ▶ wall structure can be constructed of wood or steel studs, posts, cement blocks, or poured concrete
- ▶ wall cladding may be galvanized steel, painted steel, board, or brick
- ▶ keep number of windows to a minimum to restrict access; place steel bars over windows to eliminate entry

**o.c. = on-centre**

**MPa = megapascals**



The pesticide storage floor should be at least 10 cm (4 in.) thick with a 5-10 cm (2-4 in.) curb.

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### HEATING AND INSULATION

- ▶ where climate and pesticide type necessitate, add insulation and/or heating
- ▶ the entire storage may be insulated and heated, or an insulated cabinet may be used to store pesticides susceptible to freezing – lightbulbs will provide heat for the cabinet
- ▶ storage temperature ranges from 4-32°C (40-90°F)
- ▶ insulate with a minimum of R-20 insulation for walls and R-30 for ceiling
- ▶ use electric or hot water heat
  - ▷ AVOID FLAMES OF ANY SORT – they could ignite volatile and flammable gases from leaking pesticide containers
  - ▷ heaters should be controlled by a thermostat
  - ▷ use only armoured cabling and new equipment intended for dust-laden environments

### PROTECTION FROM FREEZING

- ▶ if storage area is uninsulated, provision must be made to protect susceptible chemicals from freezing
- ▶ some chemicals will crystallize or become deactivated, making them unfit for spraying
- ▶ further, freezing causes water-based liquids to expand their volume by 10%, causing ruptures of containers
- ▶ a well-insulated cabinet can be heated with two low-wattage light bulbs, provided stored items do not contact bulbs



A well-insulated frost-free cabinet located inside a pesticide storage can be heated with two low-wattage light bulbs.

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## NATURAL VENTILATION

- ▶ ventilation is required to remove fumes, as well as excess heat and humidity
- ▶ requires inlet and exhaust system
- ▶ for unheated or uninsulated storages, provide at least .55 m<sup>2</sup> (6 ft.<sup>2</sup>) (total inlet and exhaust area) per 9 m<sup>2</sup> (100 ft.<sup>2</sup>) of building floor area
- ▶ a typical natural ventilation system could be:
  - ▷ sidewall soffit air intakes, 10 cm (4 in.) x building length (both sides): gable-end soffit intakes, 10 cm (4 in.) x building width (both ends)
  - ▷ screened windows and openings in doors can also be used for extra ventilation in hot weather (openings should be secured with steel bars)
  - ▷ all air intakes should be bird, bee and rodent proofed by placing a wire screening over the intake and exhaust openings
  - ▷ hinged baffle boards can be used to reduce ventilation during cold weather

## MECHANICAL VENTILATION

- ▶ if heated and insulated, the goal should be ¼ to ½ air changes per minute
  - ▷ a 20-25 cm (8-10 in.) diameter exhaust fan will normally do the job
- ▶ for a 3 x 3 m (10 x 10 ft.) building – the inlet size should be 225-450 cm<sup>2</sup> (35-70 in.<sup>2</sup>) to attain an inlet velocity of 250 m/min. (800 ft/min.) for the ¼ and ½ air changes per minute respectively
- ▶ ideally the outside air would enter building through a narrow slot along one side of building with the fan on the other side
- ▶ install a switching system so that the fan can be operated manually prior to entry
- ▶ fan should be operated by a timer, thereby removing stale air on a regular basis

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## CONSTRUCTION

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The steps required to build your own storage are described in this section. Remember, the local building inspector must be contacted first regarding municipal requirements and a building permit.

## FLOOR

There are three options for constructing pesticide storage floors:

- ▶ reinforced concrete floor – done on-site
- ▶ reinforced concrete floor – prefabricated
- ▶ steel floor.

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## REINFORCED CONCRETE FLOOR, DONE ON-SITE

### PROS

- floor can be done on-site by farmer or contractor
- concrete floor can be formed to one's desires, e.g., lip height, dimensions

### CONS

- must be properly designed and constructed or severe cracking will occur
- not portable if concrete poured in place
- if floor is not adequately sealed, chemicals can penetrate floor and contaminate it
- susceptible to frost/freezing action below the slab

## REINFORCED CONCRETE FLOOR – PREFABRICATED

### PROS

- often higher quality than concrete floors poured on-site
- can be portable

### CONS

- limited to availability of features, e.g., dimensions, lip height
- prefabricated floors not available in all regions

## STEEL FLOOR

### PROS

- usually built by steel fabricator to farmer's specifications; thus, no floor construction on farm
- chemicals do not penetrate steel floor
- not susceptible to frost action below floor
- can easily be removed from storage and/or be replaced

### CONS

- steel fabricators may not be readily available
- storage must be designed and constructed to allow for installation of the one-piece steel floor
- susceptible to corrosion – surface should be protected with an epoxy coating

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## HOW TO CONSTRUCT A REINFORCED CONCRETE FLOOR

After deciding on the location and size of the building, begin by removing the topsoil and all organic debris.

1. Prepare a base with 150 mm (6 in.) of compacted 2 cm ( $\frac{3}{4}$  in.) crushed stone on which to build the floating concrete slab.



**Step 1 Prepare base.**

2. Build forms for the cement that will give a continuous 5-10 cm (2-4 in.) curb around the perimeter of the slab, including doors and adjoining rooms. If possible, place curb as part of a continuous pour with the base, thereby eliminating the need for a joint between the floor and the curb. Anchor bolts should be set in the curb to secure the bottom plate to the cement.



**Step 2 Build forms.**

3. Pour the cement to a depth of about 5 cm (2 in.), then add #10 ( $\frac{1}{2}$  in.) reinforcing rods @ 60 cm (24 in.) o.c. in both directions and bend up into the concrete curb. Pour the rest of the cement floor to a total depth of 125 mm (5 in.), and fill the curb forms. Use 25 MPa (3500 psi) concrete with 5% air entrainment. Use a float to finish the cement surface to minimize coarse surface texture.



**Step 3 Use float to finish poured floor.**

4. Sealing the floor is recommended. (See next page.)



**Step 4 Seal the floor with approved concrete-sealer product.**



# STORAGE

## PROTECTIVE COATINGS FOR FLOORS (CONCRETE SEALING PRODUCTS)

PRODUCT	FORM	APPLICATION
BOILED LINSEED OIL AND MINERAL SPIRITS	<ul style="list-style-type: none"> <li>• 50% liquid mixture</li> </ul>	<ul style="list-style-type: none"> <li>• two applications necessary</li> <li>• variable performance</li> <li>• requires reapplication every one to three years</li> </ul>
EPOXY	<ul style="list-style-type: none"> <li>• two-package system of a resin and a curing agent               <ul style="list-style-type: none"> <li>◦ some are solids; others are solution coatings</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• follow manufacturer's directions for application procedures, proper temperatures, and duration of coating</li> </ul>
URETHANE	<ul style="list-style-type: none"> <li>• coatings that cure by reacting with moisture in the air               <ul style="list-style-type: none"> <li>◦ require dry conditions to avoid cracking</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• careful surface preparation is required</li> <li>• recoating is difficult when sanded</li> <li>• multiple coats necessary to get even seal</li> </ul>
POLYESTER/VINYLESTER	<ul style="list-style-type: none"> <li>• two- or three-part systems with resin, catalyst, and promoter</li> <li>• range of materials from solids to liquids</li> </ul>	<ul style="list-style-type: none"> <li>• sprayed, brushed or rolled on</li> <li>• apply in five coats to properly coat floor</li> </ul>
POLYUREAS	<ul style="list-style-type: none"> <li>• two-part compounds (see urethane)</li> </ul>	<ul style="list-style-type: none"> <li>• hot mix gun, where materials mix under pressure at nozzle – dry in 15 seconds</li> <li>• multiple layers needed to get 15-45 mil finish</li> </ul>
VINYLS	<ul style="list-style-type: none"> <li>• highly viscous resins</li> </ul>	<ul style="list-style-type: none"> <li>• sprayed onto dry surfaces</li> <li>• fast drying (30 min.)</li> <li>• multiple coats required</li> </ul>
CHLOROSULFONATED POLYETHYLENE	<ul style="list-style-type: none"> <li>• Hypalon</li> </ul>	<ul style="list-style-type: none"> <li>• requires fill coat of grout or mortar plus a primer</li> <li>• four 2-mil coats are required of product</li> </ul>
HYDRAULIC CEMENTS	<ul style="list-style-type: none"> <li>• dry powder mix of cement, sand, and catalyst</li> </ul>	<ul style="list-style-type: none"> <li>• applied as slurry</li> <li>• forms crystalline growth that fills cracks and voids</li> <li>• seals concrete from liquids</li> </ul>

# STORAGE

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## WALLS AND ROOF CONSTRUCTION CHECKLIST

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### WALLS

- ☑ Base plate needs to be secured to poured floor curb with anchor bolts.
- ☑ Place 12 x 150 mm (1/2 x 6 in.) bolt every 1200 mm (4 ft.) o.c.
  - follow local building codes for stud wall construction.
- ☑ 38 x 89 mm (2 x 4 in.) for studs at 40-60 cm (16-24 in.) o.c. are recommended.
- ☑ Walls don't have to be insulated, but check pesticide labels for freezing risks.
- ☑ For metal-clad buildings, use 28-gauge corrugated steel.
- ☑ No interior sheathing required except for walls adjacent to anteroom.
- ☑ Windows provide natural light in storage area
  - secure storage by placing steel bars over windows.
- ☑ Install a large entry door, i.e., double door, to allow entry with forklift if necessary.

### ROOF

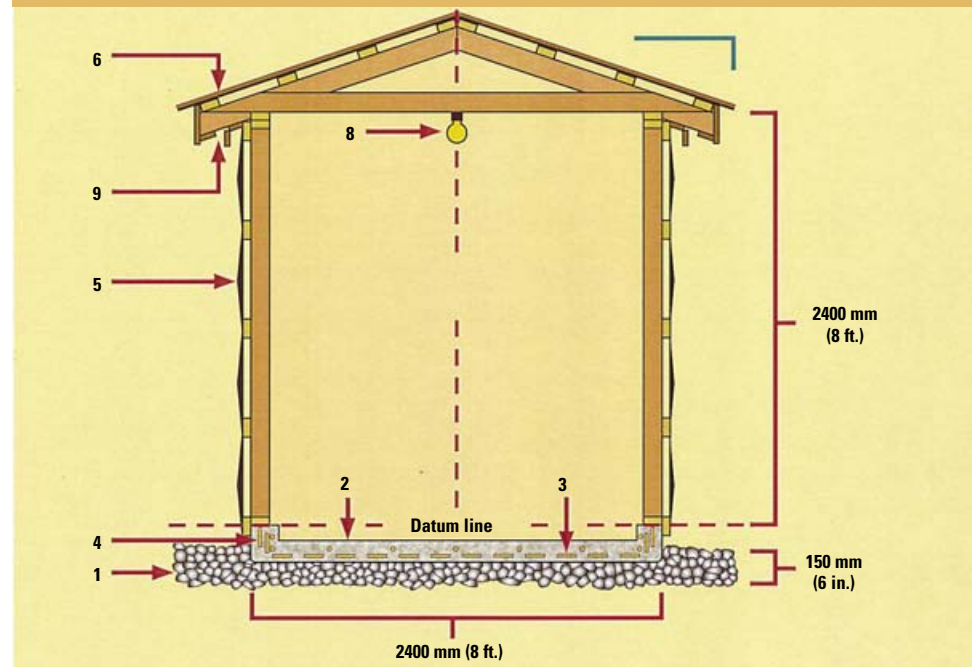
- ☑ Follow local building code to ensure proper structural adequacy for live and dead roof loads.
- ☑ For steel-clad (28-gauge corrugated), use simple rafters or roof truss, with nailing girts.
- ☑ For asphalt-shingled roof, use light-coloured asphalt shingles nailed to 12 mm (1/2 in.) exterior-sheathing plywood.



**The base plate needs to be secured to the poured floor curb with anchor bolts.**

# STORAGE

## PLAN FOR FARM-BUILT FREE-STANDING PESTICIDE STORAGE – CROSS-SECTIONAL VIEW



### STRUCTURAL FEATURES

1. **BASE** – remove topsoil and prepare base with 150 mm (6 in.) depth compacted granular fill (Granular A).
2. **FLOOR** – floating concrete slab 125 mm (5 in.) thick and curb 90 mm (3½ in.) high formed in one placement. Use 25 MPa (3500 psi) concrete with 5% air entrainment. Curb height is continuous around perimeter of slab (includes doorways and common walls of anteroom).
3. **REINFORCING RODS** – #10 (½ in.) diameter at 600 mm (24 in.) o.c. both directions and bent up into concrete curb.
4. **ANCHOR BOLTS** – 12 x 150 mm (½ x 6 in.) at 1,200 mm (4 ft.) o.c. to secure base plate.
5. **WALLS** – non-insulated stud wall construction (check local building codes). Also, 28-gauge corrugated steel cladding applied vertically on the outside walls. No interior sheathing required except for the common walls between anteroom and storage area (see 12).
6. **ROOF** – check local building codes for local live loads and dead loads to assure structural adequacy of rafters/trusses at a given spacing.

**Roof Types** – simple rafter or roof truss with nailing girts and 28-gauge corrugated steel cladding

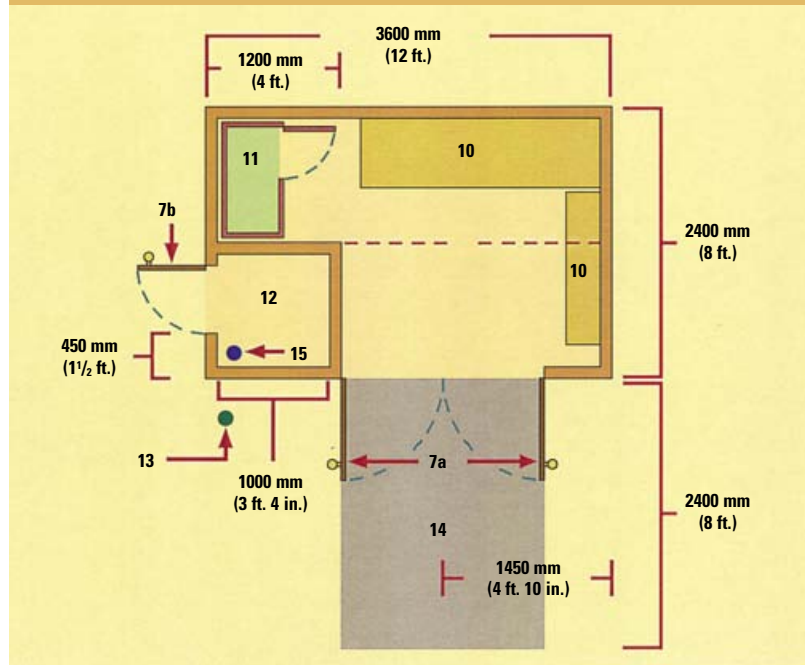
– asphalt shingles nailed to 12 mm (½ in.) D.F. exterior sheathing plywood

**NB:** light-coloured roofing preferred to reduce heat buildup.

7. **DOORS** – 7(a) 2-900 x 2,000 mm (36 x 80 in.) and 7(b) 600 x 2,000 mm (24 x 80 in.) outward opening exterior-type galvanized steel doors, or wood doors with exterior metal cladding attached for improved resistance against vandalism, rodent/pest damage, and weathering.
8. **LIGHTING** – light fixtures (pigtail type) with 60 watt bulb mounted onto bottom chord of roof truss or rafter. One bulb per room.

# STORAGE

## PLAN FOR FARM-BUILT FREE-STANDING PESTICIDE STORAGE – AERIAL VIEW



9. **VENTILATION** – sidewall soffit air intakes, both sides, 100 mm (4 in.) clear width x building length. Gable-end soffit intakes, both ends, 100 mm (4 in.) clear width x rafter length. All air intakes should be bird- and rodent-proofed with a 90 mm (3½ in.) hinged closure flap. In the closed position, the closing flap dimension will allow a 12 mm (½ in.) opening for winter ventilation.
10. **STORAGE RACKS** – should be constructed above the top of the curb (datum line) so that in the event of an accidental spill or leak, the container is not in direct contact with the floor.
11. **FROST PROTECTION** – if chemicals are stored that are susceptible to freezing, an insulated cabinet 600 x 900 x 1,200 mm (2 x 3 x 4 ft.), or sized to suit, should be constructed and heated with two low-wattage electric bulbs.

### OTHER FEATURES

12. **ANTEROOM** – with hooks or shelves or lockers for the storage of respirators, disposable gloves, coveralls, goggles, first-aid supplies, personal gear, etc. Anteroom must be sealed off from the adjoining pesticide storage area (e.g., for the common wall, use a sill gasket between top of raised concrete curb and the stud wall plate). Internal walls to continue in height to the underside of the roof and should include a vapour barrier and internal sheathing. Caulk all seams to ensure air isolation from the pesticide storage room. Size of room to be 1,200 x 1,200 mm (4 x 4 ft.) or to suit. The anteroom will utilize the sidewall and gable-end soffits for continuous ventilation.
13. **FROST-FREE WATER HYDRANT** – to be located outside the building. A backflow valve/siphon preventer (self-draining type) to be installed on discharge end of hydrant.
14. **AN OPTIONAL CONCRETE RAMP** (broom finish) – can be formed with a finished elevation equal to the top of the curb. This feature would facilitate loading/unloading of storage with a front-end loader.
15. **FIRE EXTINGUISHER** – should be of the ABC type, and should be located in close proximity to but not in the pesticide storage building.

# STORAGE



Prefabricated storages are portable and ready-to-use.

## PREFABRICATED FREE-STANDING

These are available in precast concrete, steel and wood.

TYPE	COST
<p><b>Precast concrete</b> – a range of available sizes (40-100 sq. ft.)</p> <p>8 ft. 4 in. x 5 ft. 6 in. 7 x 12 ft.</p>	<p>\$2,000-\$2,500 \$4,000-\$5,000</p>
<p><b>Steel</b> – range of sizes available (can be customized)</p> <p>10 ft. x 8 ft. Steel – woodframe, steel-clad, 8 x 8 ft.</p>	<p>\$5,000-\$6,000 \$2,000-\$3,000*</p>
PROS	CONS
<ul style="list-style-type: none"> <li>• can be delivered to site ready to use – no construction time, planning, etc.</li> <li>• acceptable storages meet requirements of the Pesticides Act</li> <li>• prefabricated storage costs can be competitive with on-farm constructed units</li> <li>• portable – easily moved to another site (in most cases)</li> </ul>	<ul style="list-style-type: none"> <li>• must accept storage as designed, i.e., size, materials, etc.</li> <li>• shipping charges can be high, especially for heavy units shipped a long distance</li> </ul>

## OTHER STORAGE TYPES

TYPE	COST
Wood frame, steel-clad 8 x 10 ft.	\$3,500-\$4,000
OMAFRA Plan – 8 x 12 ft.	\$2,500-\$3,500
Cabinet – old freezer with refrigerant removed	\$400*
Former fuel storage	\$400-\$500**
Septic tank conversion	\$1,500-\$1,800**

\*Assembly not included in this price for these storage units.

\*\*A cost for farmer labour has been incorporated.

# STORAGE

## WHAT TO LOOK FOR IN PURCHASING A PREFABRICATED STORAGE

Refer to farm-built free-standing pesticide storage design criteria that are described on pages 22 to 25. Key considerations are:

- ▶ human safety
- ▶ a floor design that provides containment
- ▶ adequate ventilation
- ▶ sufficient floor area
- ▶ make sure that it meets the requirements of the pesticide legislation before you buy.

## STORAGE WITHIN ANOTHER BUILDING

This can be a practical option for some growers. The steps for construction criteria for location are the same as other storage types.

Make sure you ventilate to the outdoors and have an outside entrance to the storage area.

One difference to keep in mind is that a firewall must be constructed between the storage area and the remainder of the building. Firewalls are designed to slow the spread of fire from one area to another. When pesticide storages are built as part of an existing structure, they require at least a one-hour rating. However, refer to your provincial or state building code for proper specifications.

**Examples** of interior wall construction having a minimum one-hour fire rating include:

1. **2 x 4 in. wood studs @ 16 in. o.c.**  
4.5 mm ( $\frac{3}{16}$  in.) asbestos cement board over 9.5 mm ( $\frac{3}{8}$  in.) gypsum wallboard (both faces)
2. **2 x 4 in. wood studs @ 16 in. o.c.**  
two layers of 12.7 mm ( $\frac{1}{2}$  in.) gypsum wallboard with joints taped and filled (both faces)
3. **2 x 4 in. wood studs @ 16 in. o.c. with absorptive material**, i.e., mineral fibre processed from rock or slag with a mass of at least 1.22 kg/m<sup>2</sup> (0.25 lb./ft.<sup>2</sup>) and completely filling cavity wall, 15.9 mm ( $\frac{5}{8}$  in.) special fire-resistant type X gypsum board with joints taped and filled (both faces)
4. **140 mm (5½ in.) hollow concrete blocks (normal weight aggregate)** – this can be a practical option for some growers. The steps for construction and criteria for location are the same as other storage types.



**This prefabricated storage meets the requirements for safety, size, and environmental protection.**



**Built-on storages require ventilation to the outside, an outdoor entrance, and proper firewalls.**

## STORAGE

### TEMPORARY STORAGE

A temporary storage can be set up outside for large bulk containers that are weather-proof. The area must be fenced, have a warning sign posted, and be secure enough to deny access to unauthorized persons. They may also be stored on a transport trailer. Make sure that the site is not a hazard to wells or watercourses in case of a spill. These should not be used for permanent storage of pesticide products.

### WORKER SAFETY AREA

People who handle pesticides on a regular basis need a worker safety area or anteroom. The size of the safety area and the equipment required depends on the number of workers and the types of products handled. The area should be close to the storage and mixing/loading facility and provide things like:

- emergency showers
- eye flush fountains
- up-to-date pesticide first-aid kits
- spill cleanup kits
- Material Safety Data Sheets (MSDS)
- personal protection equipment.

If the worker safety area is in the same building where pesticides are stored, a separate room (ventilated separately to the outside) with a separate outside exit door must be provided so that personnel do not have to go through the storage area to enter or exit the worker safety area.

### EMERGENCY SHOWERS AND EYEWASH

- locate adjacent to storage and handling facilities
- place in easily accessible area with no obstacles
- water capacity: for showers – 10-30 gpm  
for eyewash – 2-5 gpm



Transport trailers – if properly locked and signed – may serve as temporary storages.



# STORAGE

## STORAGE PRACTICES

Observe and comply with the following management practices when planning a pesticide storage facility for your farm:

- ▶ store all pesticides in their original labelled containers
- ▶ keep containers properly labelled
- ▶ monitor the condition of containers and check for leaks
- ▶ minimize quantity of pesticides stored – at most, buy only what you need for each season
- ▶ keep an inventory of your stock to inform emergency response personnel in case of fire or other emergency – make sure the inventory is accessible but away from pesticide storage
- ▶ prepare a written spill emergency/contingency plan, plus an emergency contact list, and locate in an accessible location on the farm
- ▶ make available absorbent material (such as dry sawdust, soil, or kitty litter) in sufficient quantity to clean up any spills or leaks from containers
- ▶ put a clean plastic bag around any damaged bag – close it securely and label it with all pertinent information.

## EMERGENCY PREPARATION

### EMERGENCY CONTACT LIST

Prepare and post a list of who to call in an emergency.

<b>Farm manager</b>	( _____ ) _____
<b>Assistant farm manager</b>	( _____ ) _____
<b>Family physician</b>	( _____ ) _____
<b>Alternate family physician</b>	( _____ ) _____
<b>Ambulance</b>	( _____ ) _____
<b>Emergency response team</b>	( _____ ) _____
<b>Fire chief</b>	( _____ ) _____
<b>Regulatory agency</b>	( _____ ) _____
<b>Law enforcement officials</b>	( _____ ) _____
<b>Spills Action Centre</b>	( _____ ) _____
<b>Poison Information Centre</b>	( _____ ) _____
<b>Hospital</b>	( _____ ) _____



**Do not store pesticides in any container that was previously used for food or drinks.**



**Prepare a written spill emergency/contingency plan plus an emergency contact list. Keep it in an accessible location on the farm.**



## STORAGE

### EMERGENCY RESPONSE PLAN / SPILLS CONTINGENCY PLAN

Your plan should contain the following information:

- ▶ emergency contact list
- ▶ directions to site
- ▶ name, address
- ▶ site plan
- ▶ inventory, quantity and location of pesticides
- ▶ location of emergency equipment and supplies
- ▶ location of personal protection equipment
- ▶ labels and MSDS sheets for all pesticides, plus manufacturers' emergency numbers
- ▶ local reporting procedures for spills.

In an emergency, the local fire department would benefit if it had information on your storage location and the products normally stored in it. The fire chief will appreciate your interest in his/her department's safety in the event of a fire, and can help with site and fire plans.

Send copies to: facility, house of owner/operator, fire department, and police.

### PESTICIDE FIRES IN STORAGE AREAS

A fire in a pesticide storage area can be extremely dangerous. There is the hazard of the fire itself, plus the additional danger of pesticide poisoning and contamination. The resulting smoke may contain toxic fumes, and water used to control the fire may become contaminated, posing an environmental threat if not contained.

Prepare for the possibility of a fire. You will have a greater chance of reducing health hazards and environmental contamination.

If a fire occurs, the priority is to get everybody out and notify the fire department. Do not take unnecessary risks in fire-fighting. It is wiser to wait for the fire department than to risk being poisoned or injured.

Refer to the *EFP Contingency Plan* publication and the *Grower Pesticide Safety Course* manual for further details.



Emergency tubes are weather-proof storage containers for emergency plans.

# STORAGE

## STORAGE DURING TRANSPORTATION

The purpose of the legislation surrounding the transport of pesticides is to ensure human safety and prevent spills. Check with local authorities to ensure that you adhere to transportation requirements of related legislation.

In summary:

- ▶ be certain that anyone transporting pesticides is trained in safety procedures, shipping documents, and the use of placards
- ▶ lock pesticides in the trunk or storage area of the vehicle, and not in the cab or passenger area – if the pesticide cannot be locked securely, an authorized person must stay with the vehicle
- ▶ observe all restrictions on pesticide quantities (e.g., warning sign on vehicles transporting in excess of 500 litres)
- ▶ place a warning sign that states **Chemical Storage – Authorized Persons Only** on an unattended, parked vehicle that contains pesticides
- ▶ keep pesticides separate from other products
- ▶ report all accidents that represent a danger to humans, property, or the environment.



**Spills and human safety are a concern when transporting pesticides. Take the necessary precautions.**