Step 2. TAKE INVENTORY

A complete inventory makes for an effective NMP.

CHECKLIST FOR INVENTORY

Having the following items on hand before getting started will speed up the process. Some of this information may have been compiled for an environmental farm plan.

- ✔ Contact names for laboratory services, sources for maps or aerial photos, consulting or engineering services if you plan to engage professional services
- ✔ County soil map and report – available on the Internet at http://sis.agr.gc.ca/cansis/nsdb/detailed/on/zipfiles.html
- ✔ Topographic maps or aerial photographs for your property – a place to start for a satellite image of your farm is at http://maps.google.ca/
- ✔ Tools for measuring slope in the field – clinometer, stake and string
- ✔ Building plans for livestock facilities
- ✔ Field measuring wheel or Global Positioning System (GPS)
- ✔ Distance measurements:
  - ▶ between facilities, farms or land bases, wells (all types), surface inlets, and surface water bodies (e.g., creeks, streams, ponds, etc.)
- ✔ Field slope measurements
- ✔ Depth to saturated soil (especially if non-agricultural sourced materials are being applied)
- ✔ Location of tile outlets, buffer strips, surface inlets, wells
- ✔ Crop records – crops grown, yield, manure rate applied, fertilizer applied, soil test results
- ✔ Livestock inventory – species, size class, and type (to determine manure volume generated)
- ✔ Soil sampling equipment – soil sample probe, bucket, soil test bags/boxes
- ✔ Manure sampling equipment – solid manure:
  - ▶ fork, plywood, plastic jar that will hold 1 L (32 oz) of sample
- ✔ Manure sampling equipment – liquid manure:
  - ▶ agitation equipment in place, clean plastic pail and laboratory-supplied plastic sample jar

Begin by identifying:

- ▶ all available nutrients on your farm – manure nutrients, nitrogen credits from forage crops, cover crops or past manure applications, available soil nutrients, other off-farm nutrient sources
- ▶ any site characteristics that could impact application rates and separation distances.

This is called completing an inventory of the farm operation. It establishes a baseline to which future plans can be compared. When monitoring the actions undertaken from a completed plan, you can look to your inventory for help in determining how well the plan is working. For example, if one of the goals of the plan is to maintain soil fertility levels, then future soil test results should remain close to baseline levels.

No two farms are identical: that's why the inventory process can be simple for some farms and very detailed for others.

Avail yourself of some public resources. Soil maps can be obtained on the Internet or from your nearest office of the Ontario Ministry of Agriculture, Food and Rural Affairs. Slope information can be found on topographical maps, sometimes on soil maps, or can be measured. Drainage maps are available at municipal offices, while water well records are available from Ministry of the Environment.

Often a consultant compiles the inventory information. Nevertheless, you as farm owner/operator will need to provide input regarding crop records, e.g., preferred rotation, tillage preferences, yield goals and more.

Your inventory and NMP will only be as good as the information you put into it. In this section you'll learn how to:

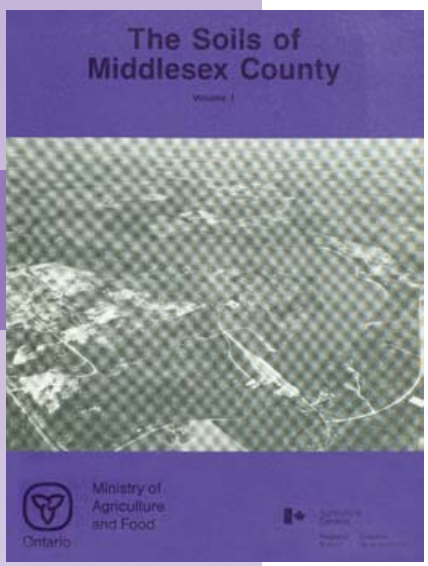
- **use and interpret soil information**
- **use soil hydrologic groups**
- **measure slope**
- **create maps for fields and farmsteads**
- **use crop inventory and yield information**
- **estimate how much manure you have**
- **take a soil sample**
- **take a manure sample.**

HOW TO USE AND INTERPRET SOIL INFORMATION

Soil maps are available for most counties in Ontario. Soils are mapped based on key properties such as surface and subsoil texture, natural drainage (before drainage tile installation), stoniness and slope. The amount of detail that can be included is limited; therefore your own experience of your farm's soils is important. Consider soil type and variability when developing your nutrient management plan.

What is meant by "soil information and interpretations"?

- soil information refers to local (county or district) soil maps and reports
- soil maps show the extent of soil types (series)
- soil interpretations are suitability or risk ratings of soil types for various uses, e.g., agricultural capability, limitations for soil management, suitability for specialty crops, erosion risk.



Soil maps and reports are essential tools for a proper inventory of your operation.

2

How can this information be useful for nutrient management planning?

- ▶ soil maps show your soil types, their properties (materials, slopes, natural drainage class, stoniness), and extent of these soils on your farm or area of concern
- ▶ soil information can provide important information on:
  - ▷ slope and erosion risk for P Index
  - ▷ hydrological groups for the N Index
  - ▷ liquid loading limits for application rates (in some cases)
- ▶ soil maps and information can also help you recognize unseen areas of your soil (subsoil and geology), the implications for soil management, and potential environmental risks

What are the limitations of this information?

- ▶ scale – most soil maps are mapped at a level of detail that is too general for intensive farm planning and development of a soil management program. Interpretations are based on experience and observation.

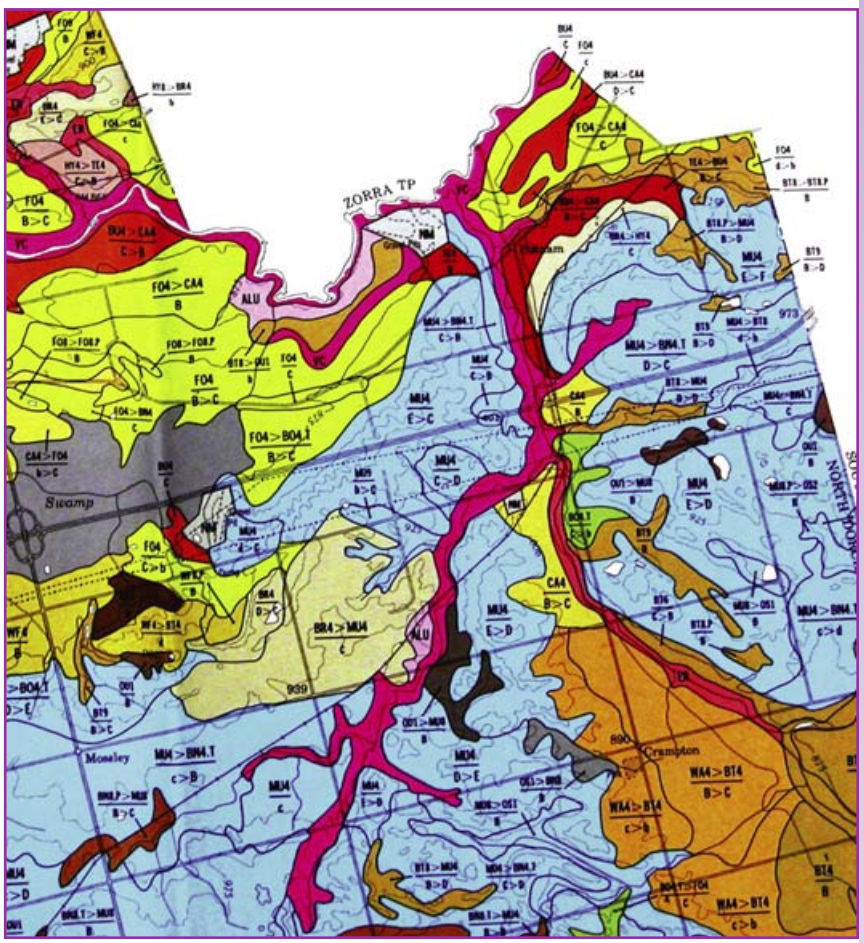
What do you do with the information on soil maps?

- ▶ property identification – use township, lots, concessions, and noticeable features like streams, woodlots, and buildings to locate property
- ▶ list – note the soil map unit codes (landscape units) on property
- ▶ soil map legend – use legend to look up soil type (e.g., Brookston clay) and soil properties of interest (slope, texture, subsoil features, natural drainage)
- ▶ soil report – if you need further information about soil properties and interpretations of your soil type, look them up in the Soil Survey Report that accompanies the soil map.

How can you obtain more soil information?

- ▶ contact your local office of the Ontario Ministry of Agriculture, Food and Rural Affairs
- ▶ call the toll-free Agricultural Information Contact Centre, 1-877-424-1300
- ▶ visit the OMAFRA website at www.omafra.gov.on.ca
- ▶ contact your local conservation authority or municipal office

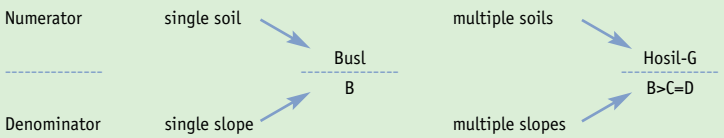
Example of a soil map and legend



SOIL SERIES	SOIL SERIES MEMBERS & DRAINAGE	USUAL SURFACE TEXTURE	SOIL MATERIAL DESCRIPTION	LANDSCAPE UNITS*	DOMINANT SOIL DRAINAGE COMPONENT	SIGNIFICANT SOIL DRAINAGE COMPONENT
Bennington (BN)	Bennington – Well Tavistock – Imperfect Maplewood – Poor	Silt loam, loam	40–100 cm of glaciolacustrine loam, silt loam and occasionally very fine sandy loam overlying clayey glaciolacustrine deposits	BN4	Well to imperfect	—
				BN6	Well to imperfect	Poor
				BN8	Poor	—
				BN9	Poor	Well to imperfect
Muriel (MU)	Muriel – Moderately well Gobles – Imperfect Kelvin – Poor	Silt loam, loam, silty clay loam	Silty clay loam, silty clay, and occasionally clay loam glacial till deposited by glaciation from the Lake Erie Basin	MU4	Moderately well to imperfect	—
				MU6	Moderately well to imperfect	Poor
				MU8	Poor	—
				MU9	Poor	Moderately well to imperfect

* landscape units are the soil map unit code found on soil maps

SOIL MAP SYMBOLS



SOIL TEXTURE ABBREVIATIONS

l	=	loam
sl	=	sandy loam
ls	=	loamy sand
cl	=	clay loam
sil	=	silt loam
s	=	sand
c	=	clay
si	=	silt

SLOPE CLASSES

A, a.....0 to 0.5% slope	Level
B, b.....0.5 to 2% slope	Level to nearly level
C, c .....2 to 5% slope	Very gently sloping
D, d.....5 to 9% slope	Gently sloping
E, e .....9 to 15% slope	Moderately sloping

Upper case = Long (>50 m) simple slopes

Lower case = Short (<50 m) complex slopes that intersect each other

HOW TO USE SOIL HYDROLOGIC GROUPS

As explained in the Principles chapter, the rate of water movement down through the soil depends on the soil's permeability. The permeability of soils with layers of contrasting textures will be determined by the most flow-restricting layer. This property of soils is summarized in the Hydrologic Soil Group (HSG), which places soils into one of four categories (A, B, C or D).

To illustrate: shallow soils over bedrock provide less protection for groundwater, because contaminants aren't filtered once they reach the fractures in bedrock. Soils with a shallow bedrock phase are considered to be one category higher in Hydrologic Soil Group than the same soil without shallow bedrock (e.g., C becomes B, or A becomes AA). The permeability of the soil also influences the aeration, so the fine-textured soils (i.e., C or D category soils) stay saturated longer and therefore have much greater denitrification potential than the coarse-textured soils.

Water percolates quickly through sandy soils (HSG A) and slowly through clay soils (HSG D).

SOIL SERIES APPROACH TO EVALUATING LEACHING RISK

MAXIMUM N INDEX VALUE RELATED TO SOIL/SITE RISK

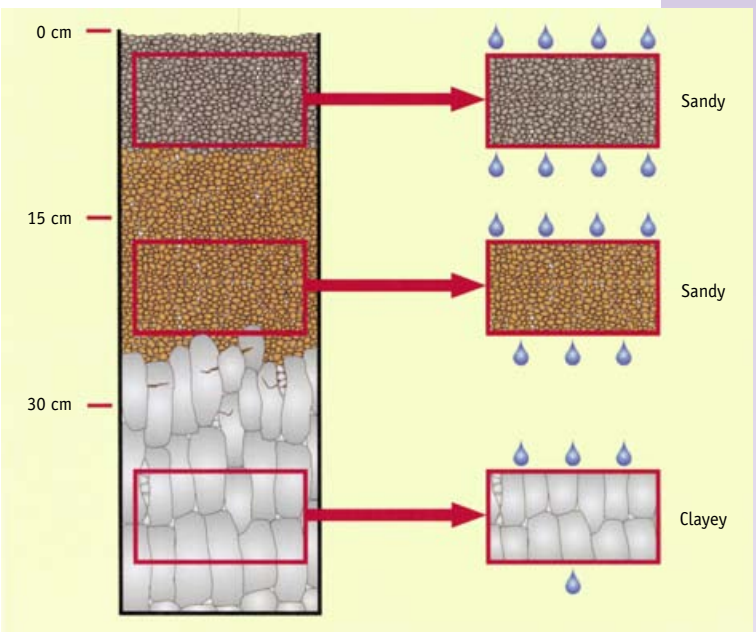
HYDROLOGIC SOIL GROUP	LEACHING RISK	MAXIMUM N-INDEX VALUE
AA	Very high	1
A	High	3
B	Medium	4
C	Low	6
D	Very low	9

Soils shallow to bedrock (<3") move up one risk level; A soils with shallow bedrock become AA

Source: Publication 29 – *Drainage Guide for Ontario*

SOIL GROUP	FINAL INFILTRATION RATE (mm/hr)
A	8 – 12
B	4 – 8
C	1 – 4
D	0 – 1

Source: U.S. Soil Conservation Service, *National Engineering Handbook: Hydrology,* Section 4 (1972)



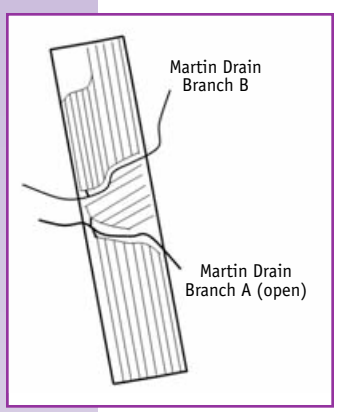
The illustration on the right shows how the clay layer slows the movement of water in loam soil. The water can move laterally through the loam but not downward through the clay layer.

HOW TO MEASURE SLOPE

Rod and level

Using a rod and level is the most accurate method for measuring slope. Surveyors and professional engineers use these tools.

Topographic map or soil maps



These maps are great tools to estimate slope, a good place to start. Topographic maps show intervals of 3 metres (10 ft) or less, depending on scale. Intervals of 10 feet are not helpful in flat areas. When using a soil map, the soil unit slopes are in a range. In a nutrient management plan, the most conservative estimate of slope should be used (e.g., a local 5% knoll should be used – even if most of the slope is only 3%).

A tile drainage installation map for M&M farm as provided by the contractor indicates the location of municipal drains, systematic tile lines, header tiles and outlets.

Stake and string

1. Cut one stake to 5 feet and the other to 12 feet; acquire string level.
2. Make a 4-ft mark on the 5-ft stake and notch the 12-ft stake at 1-ft intervals from the 5-ft mark to the 12-ft mark.
3. Cut 110 feet of string. Mark the 100-ft point.
4. Place 5-ft stake at the top of slope and long stake at bottom of slope to be measured.
5. Tie string to both stakes at the 4-ft mark.
6. Move string up the lower stake until level – difference beyond 4 feet is the rise and the 100-ft string is the run.
7. Use the following formula to determine slope: RISE (FT) ÷ RUN (FT) X 100 = SLOPE %

Use fence posts or the top strand of wire as a guide when using a clinometer to estimate slope.

Clinometer

Clinometer

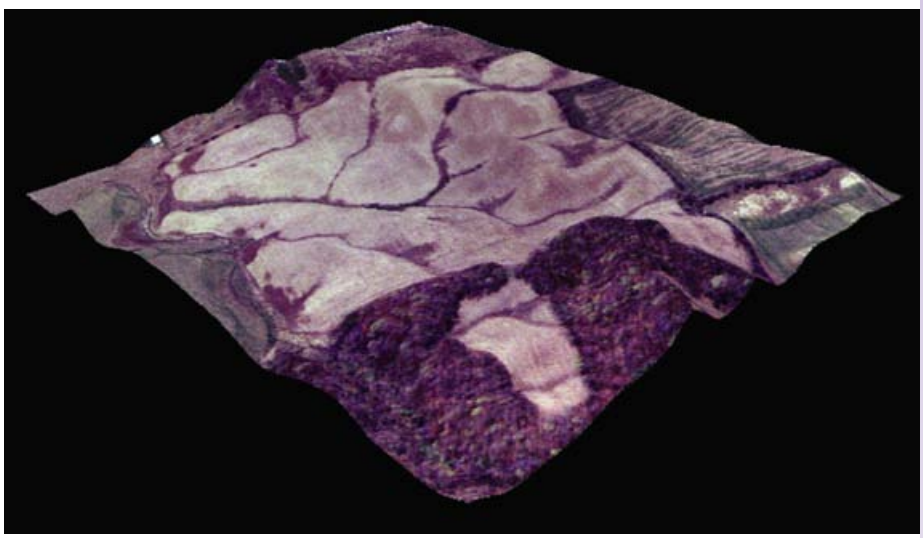
A clinometer is a slope angle and height meter. When using a clinometer, you must consider the height from which your partner is measuring and measure to that same height (i.e., eye-level to eye-level). Aim the instrument at the object by raising or lowering it until the hairline is sighted against the point to be measured. At the same time, the position of the hairline against the scales gives the reading.

There are also orientation compasses that have slope indicators.

Hand-held GPS unit

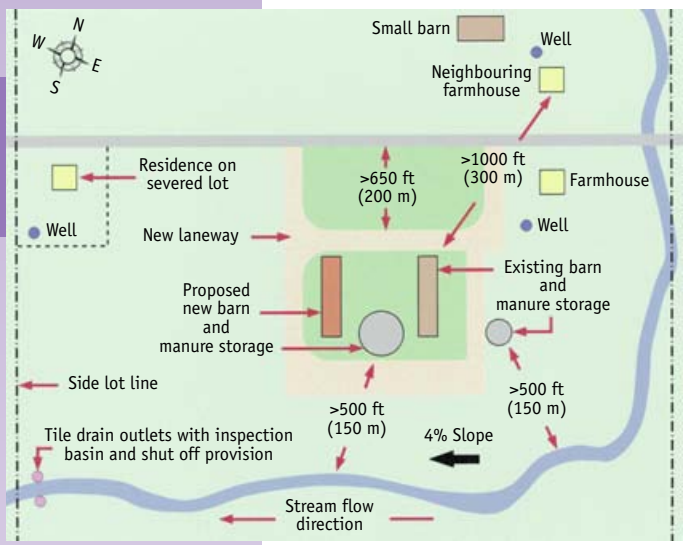
Some global positioning systems (GPS) predominantly used to provide site-specific soil testing and field coordinates can also estimate slope. If an elevation measurement is taken at two points with a known distance between the two, then elevation can be calculated.

The accuracy of a GPS unit is usually within a metre. Thus, the greater the slope distance, the more accurate this system.



Geographic Information Systems or GIS maps can show precise detail and integrate several layers of information.

HOW TO CREATE MAPS



Farmstead sketch

Maps are documents that are easy to read and follow. A farm map will allow a person unfamiliar with the property to be oriented quickly. A map can be hand-drawn and simple or can be layered over an aerial photograph.

For our purposes, we're defining "sketch" and "map" as follows. A sketch is a hand-drawn aerial depiction that is not necessarily to scale. A map is an aerial depiction that is drawn to scale or is based on existing maps or aerial photos.

FARMSTEAD

A farmstead sketch should include the following:

- ▶ north direction arrow
- ▶ property identifier (i.e., home farm), lot, concession, municipality
- ▶ road names, municipal boundaries if applicable, neighbours, and other local features
- ▶ permanent, temporary and proposed livestock facilities
- ▶ locations of:
  - ▷ surface water
  - ▷ tile inlets and catchbasins
  - ▷ wells (includes gas, oil, test and water wells)
  - ▷ municipal wells and adjacent private wells
  - ▷ other non-agricultural land uses (i.e., woodlots, wetlands)
  - ▷ flow paths and physical barriers.

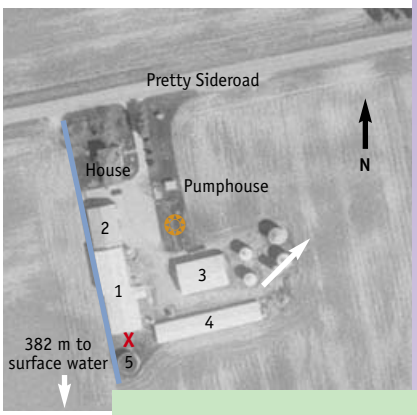
If you're expanding and applying to a municipality for a building permit with Minimum Distance Separation (MDS) information, the sketch should show:

- ▶ dimensions of all livestock housing and manure storage facilities
- ▶ setback distances between facilities, lot lines, adjacent neighbours' residences.

Sample farmstead map

As we proceed through the steps, we'll present a case study farm to shed some light on the thought and decision-making process that a farmer may go through to complete a nutrient management plan. The case study cannot possibly cover all of the options or decisions that could be part of a plan, but does attempt to follow the process.

Our case study is a hog operation in southwestern Ontario, the details of which have been borrowed from an actual farm. Names and locations have been changed to "protect the innocent."



FARMSTEAD MAP LEGEND

Location: Home Farm, Lot 1, Conc. 10, Somewhere County

- **1** = Sow barn, 45′ x 110′
- **2** = Equipment shed, 45′ x 60′
- **3** = Equipment shed, 45′ x 75′ under-barn manure storage
- **4** = Finishing barn, 30′ x 135′ under-barn manure storage
- **5** = Uncovered 30′ x 12′ manure storage
- **X** = Catchbasin (goes to municipal drain)
- = Drilled capped well
- = Lot line
- = Slope direction

A farmer recently expanded to 100 sows farrow-to-finish. He realizes that his land base is limited and as a result is surveying his neighbours to find someone interested in a manure agreement.

LOCATION: Somewhere County, 2850 crop heat unit area.

ANNUAL MANURE PRODUCTION: 688,720 gallons (MSTOR 2005).

OWNED LAND: 44 workable acres, systematically tiled; 990 ft to nearest neighbour to the west; 1000 ft to nearest neighbour (hamlet) to the east.

LIQUID MANURE STORAGE: Open circular tank (12'x 30').

FIELD

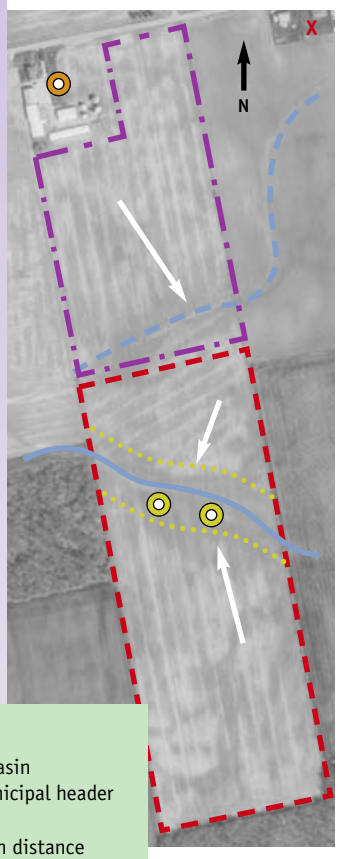
Your field sketch should identify the following:

- ▶ lot and concession; municipal roll number
- ▶ sections of field being managed differently
- ▶ tile drains
- ▶ tile outlets and surface water inlets
- ▶ surface water within 150 metres (500 ft) of the field
- ▶ non-agricultural land uses (i.e., schools, cemetery)
- ▶ private wells and municipal wells within 100 metres (330 ft) of a field boundary.

Some field sketches and maps are most useful during application when the applicator (yourself or someone hired) can see where materials will and will not be applied. Some sketches will have separation distances highlighted. Some of the distances could include:

- ▶ setback distances required from all wells
  - ▷ 90 metres (300 ft) from all known wells where a field is receiving biosolids (non-agricultural source material)
  - ▷ 15 metres (50 ft) from drilled wells
  - ▷ 30 metres (100 ft) from all other wells near where manure is being applied

- ▸ minimum depth to saturated soil conditions at time of application
  - ▷ areas of a field where deep rutting occurs would be considered saturated
  - ▷ 30 cm (1 ft) depth of unsaturated soil is required for fields where biosolids are applied and is easiest to find from soil maps
  - ▷ if a soil map shows poorly drained soils, this would indicate risk of saturated soil in the 30–60 cm (1–2 ft) range, while a soil map that indicates imperfectly drained soils would suggest a risk of saturated soils in the 60–90 cm (2–3 ft) range
  - ▷ saturated soil depth can also be determined by digging test holes
- ▸ direction of maximum sustained field slope
- ▸ direction of maximum sustained field slope within 150 m (500 ft) of watercourses
- ▸ setback distances from surface water (established by the minimum separation distance and/or the phosphorus index)
- ▸ location of all permanently vegetated buffer zones.



Sample field map

LOCATION: L14 C10 Somewhere County, 2850 crop heat units.

LAND BASE: 44 workable acres owned, systematically tiled. North field: 20 acres, no surface water. South field: 24 acres, open municipal drain with maximum slope of 3% on north side and 5% on south side. 990 ft to nearest neighbour to the west; 870 ft to nearest neighbour (hamlet) to the east.

PHYTASE USED IN FEED RATION: 20% phosphorus reduction.

SOIL SERIES: Muriel silty clay loam.

SOIL HYDROLOGIC GROUP: C.

ROTATION: corn/corn–soybean rotation with manure applied to fields yearly (fall and/or spring) depending on crop. Fall plowing occurs after corn harvest; mulch till occurs in spring on soybean residue.

Crop inventory

NORTH FIELD: 20 acres, continuous corn with average corn yield 130 bu/ac. Manure applied with drag hose at 7,000 gallons every fall after corn harvest – injected or surface-applied and plowed within 12 hours.

SOUTH FIELD: 24 acres, corn (2005) – soybean (2006) rotation with average soybean yield 42 bu/ac. Manure applied at 5,000 gallons/acre (soybeans) or 7000 gal/ac (corn) every spring after planting (pre-emerge) using drag hose injection system for corn or surface-applied on soybeans.

CROP INVENTORY AND YIELDS

You must have accurate crop and yield information to develop an effective nutrient management plan. You'll need to know:

- ► crop rotation
- ► average yield (5-year average to cover weather impact)
  - ▷ crop yields are important because they help determine fertilizer recommendations for a given crop
  - ▷ yield also helps estimate the nutrients removed from the field – in nutrient management planning, when soil fertility levels are high, application rates are determined by matching rates with nutrients removed by the crop
  - ▷ for crops such as corn silage, haylage etc., it is recommended that a "typical" wagonload be weighed and the number of loads counted in order to establish yield potential
- ► management variations across the field (zones or areas treated differently due to poorer or better than average yield)
- ► previous crop (are there any nitrogen credits?)
- ► how much manure was applied to that field from previous applications
- ► predominant soil series
- ► field soil test results
- ► commercial fertilizer applied or planned.

Crop yield is variable across most fields – due to moisture conditions, slope position and changes to soil quality. Crop yield monitors and weigh wagons can be used with conventional harvest equipment to pinpoint variation in crop yield within mapped fields.

CALCULATING MANURE VOLUME

Calculation of manure production is an important factor when determining storage capacity, application rates, timing and contingency planning. Choose from several methods to determine how much manure is produced.

MSTOR is part of the nutrient management software package that helps you calculate:

- how much manure is produced (based on average manure produced per animal per day)
- additional water usage (e.g., milking centre washwater, cleaning water, loafing areas)
- additional water from rainfall for uncovered storages
- calculates volume or capacity of existing storages and dimensions for new storage requirements.

MSTOR is available from the Ontario Ministry of Agriculture, Food and Rural Affairs.

The challenge for most producers when determining total manure volume is to account for all sources of contaminated liquids that are or should be stored with manure.

Manure storage sizing data is based on the parameters in the chart below.

DAILY MANURE PRODUCTION				
ANIMAL TYPE	NUMBER IN BARN	AVERAGE WEIGHT PER ANIMAL (LB)	CUBIC FEET OF MANURE PER LB PER DAY	CUBIC FEET OF MANURE PRODUCED PER DAY
	x	x	x	=

Actual records should be used where manure volume is measured on a regular basis. (See format in the Record-Keeping section on page 96.) Documentation from a custom applicator or broker is useful because payment is generally on the volume of manure moved from the storage.

HOW TO TAKE SOIL SAMPLES

A fundamental part of any nutrient management plan is knowing how much nutrient is present in the soil to start with. Only then can a plan be developed to properly manage the nutrients that have been generated on-farm, as well as nutrients that are being imported onto the property as biosolids or commercial fertilizer.

Soil testing is really a four-step process:

- collecting a representative sample from each field or section
- sending the samples to an accredited laboratory for analysis to determine the levels of available nutrients
- incorporating the analytical results into a nutrient management plan
- keeping a record of results, to determine if soil test levels are increasing, decreasing or being maintained over time.

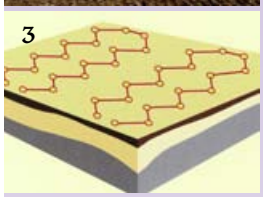
As part of your nutrient management plan, test soils from all farms and fields in your operation. Analyses should be done by an Ontario-accredited laboratory.

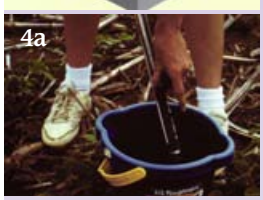
The most recent soil test results serve as a benchmark or starting point for measuring the effectiveness of nutrient applications and cropping practices. Samples taken every three years or at the same point in the crop rotation and time of year will provide a comparison to the benchmark samples. GPS reference points or detailed maps can help you reduce sample variability by ensuring soil samples are taken from the same field location each time the field is sampled.

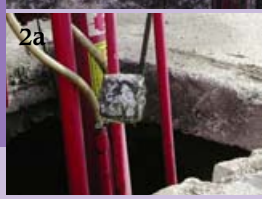
The ideal time to sample is before the nutrient applications occur. In a corn–soy–wheat rotation, the samples can be taken after the wheat crop before nutrient applications to the corn crop. In a rotation that includes forages, soil should be sampled when the forage crop ends (plowed down or sprayed). It's best to develop a rhythm or pattern of sampling each field at a particular point in the rotation, i.e., September after wheat harvest or in the fall after the soybean harvest.

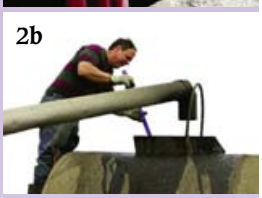
Here is how to obtain the actual samples.

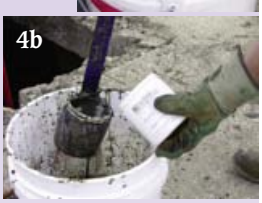
1. Take only 6-inch soil cores. A consistent depth is important.
2. A minimum of one core per acre should be collected from random points over the field area. The recommended maximum sampling area is 25 acres (10 ha) to account for variation in soil fertility within and between fields.
3. Use a zig-zag pattern across the field, avoiding previous starter fertilizer bands if possible.
4. Use clean plastic pails and take the time to break up lumps of soil.
5. Place thoroughly mixed samples directly into clean sample bag in the field.
6. Label samples according to field name to be used in your nutrient management plan.











HOW TO TAKE MANURE SAMPLES

One of the least desirable tasks on the farm – manure sampling and testing – is one of the most profitable! Analysis will give a tangible depiction of the amount of nutrients available.

You need to know the nutrient content of each type of manure generated or received because of the variability of livestock manure from farm to farm. Livestock genetics, feed ingredients, type of bedding, and amount of washwater or other liquid used can affect the amount of N, P and K in the manure.

Take a new sample each time the storage is emptied for several years until you are satisfied that results are consistent. This will also help create a database of the nutrient content generated in your farm operation.

Analysis should include total nitrogen, ammonium nitrogen, phosphorus, potassium and dry matter content. Copper and zinc analysis are also useful for operations supplementing these micronutrients in the ration.

Here is how to sample liquid manure.

1. Agitate manure storage thoroughly.
2. Collect random sub-samples of manure from various depths in the storage. The sampling should take place while the storage is being emptied (i.e., every 10 loads or every 30–60 minutes from a drag hose pump).
3. Use a clean plastic pail to collect samples.
4. Mix 10–20 sub-samples thoroughly in a larger pail and transfer a small sample to a plastic jar (supplied by laboratory). Fill jar only half full to allow room for gas buildup.
5. Store in a cool place until sending the sample to the lab.
6. Consider taking another sample when applying to a different field to document the analysis for each field.

Here is how to sample solid manure.

1. Samples of solid manure can be taken from the spreaders during application or from the top, middle and bottom of the storage.
2. On concrete or clean plywood surface, take sub-samples (a forkful) of manure from several different loads throughout the application or from the different areas of storage.
3. Chop and mix the sub-samples together using a fork or shovel.
4. Divide the larger sample into four equal parts and discard three.
5. Continue to mix and subdivide until you have a sample that will fit into a plastic sample jar holding one-half litre.
6. Place sample jar into a plastic bag and ship to lab as per liquid sample.
7. Repeat sampling procedure if a portion of the manure will be applied to a different field.
8. Each storage system (or areas within the same storage with different dry matter contents) should have its own sample taken to reflect dry matter and specific nutrient content.

Ship or deliver immediately to the laboratory! Manure samples should be stored in a cool place until then. Try to schedule shipping or delivery to the lab on a weekday to ensure immediate processing. Sending samples through the post office is not recommended.