Geologic Investigations for Animal Waste Storage Structures

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Which sites need an investigation?

- All of them (to some degree).
- Intensity of investigation depends on:
  - Level of planning
  - Geologic complexity of the site
  - Type of structure
NRCS Policy

An investigation is required for any conservation practice, practice component, or structure that involves significant ground construction activity.

Objectives of geologic investigations

- Determine and describe:
  - site stratigraphy
  - material properties and quantities
  - groundwater conditions
  - potential impacts of proposed structure(s)
Levels of Investigation

- Reconnaissance
- Preliminary
- Detailed (for design)
- Construction or As-built

Site Investigation
Examples of questions to ask about the site and proposed structure

- Will the foundation be adequate to support the structure?
- Can on-site materials be used in building the structure?
- What are the ground water conditions?
- Is bedrock near the surface?
- Are there geologic hazards at the site?
Collect and review existing data:

- Soils, topographic and geologic maps
- Well logs, aerial photos, mineral and water quality reports
- Location of wells and underground utilities
- Previous reports that may describe the site conditions

Geologic maps
Make a site visit during which:

- Assess geomorphic setting:
  - What landforms make up the site?
  - Topography and drainage
  - Soil and/or rock materials exposed
  - Note other factors that can affect suitability
Check-out local conditions from any exposures available:

- Road cuts
- Streambank exposures
- Rock outcrops

Manure storage structures
Roofed storage structures

Unlined Storage - Geologic Considerations

1. Permeability
2. Depth to Bedrock
3. Ground Strength
4. Depth to Water Table
5. Distance to Well
Shallow Aquifers

In-Ground Storage

- Unlined (As Is)
- Engineered Soil
- Flexible Membranes
- Concrete Liner

Cheaper ⇒ More Expensive
Problems: manure storage & groundwater

- Potential for water well contamination.
- Potential for uplift pressure against soil liner or concrete.
- Potential contamination of groundwater by seepage from structure.
- Potential for undetected springs.

1. All soil below grade are low permeability, \( k < 10^{-6} \text{ cm/s} \)

- Plasticity index, PI > 15
- Dry density, \( \gamma_d \geq 90 \% \text{ Std Proctor} \)
- Natural water content \( \leq 90 \% \)
- Fines (clay) content (< 200 sieve) \( \geq 20\% \)
2. Depth to bedrock (any kind) at grade is > 2 ft.

Flow Through Rock Fractures
5. Distance to well meets regs.
Geologic Considerations --
Engineered Soil Liners

1. Same as for unlined, plus:
2. Perched water
3. Borrow material
4. Soil amendments

2. Perched Water Table
Control Perched Water and Seepage Zones

• Interceptor drains
• Relief drains
• Curtain Drains
• Outlet (gravity or pumping)

3. Borrow for Liner

• Reasonable haul distance
• Quantity - 150% of design needs
• Quality - meets perm. values
• Construction workability
• Moisture ≤ 90% saturation
• No de-watering of borrow site
4. Need for Soil Amendments

- Sandy soil - use bentonite
- Flocculated soil - use dispersants:
  - Polyphosphates
  - Soda ash ($\text{Na}_2\text{CO}_3$)
  - Salt ($\text{NaCl}$)

Geologic Considerations - Membrane Liner Storage

1. Water table
2. Puncture
3. Excavation type
Location of Water Table

- Seasonal high W. T. > 2 ft below grade
- Uplift pressure damages membranes

Above Ground Storage

- Steel Tanks
- Concrete Tanks
Other possible on-site problems

• Will erosion be a problem?
• Will sediment be a problem?
• Are there soft, compressible soils?
• Are there unstable slopes?

Are there slope stability problems?

(Unstable natural slopes or problem soils in foundation or cutbanks)
Equipment for Investigations
• Shovel, soil auger, measuring tape and notebook
Backhoe, excavator or bulldozer

- Backhoes can be used effectively to about 12 ft; some as deep as 16 ft.
- Benching the test pit allows for deeper sampling.

(Caution: use shoring or bench sidewalls)

Drilling is an option where depths or materials exceed limit of backhoes.
Flight auger and hollow-stem auger
Soil sampling:

• Collect samples of soils to be used for soil liner and earthen embankments.
• Sample foundation soils under concrete structures.
• Clean 5-gallon plastic buckets make good sample containers.
• Collect enough representative material for all testing.

Soil sampling:

• If bearing strength is suspect, collect undisturbed samples of weakest soil in foundation of concrete structures.
• Samples may be trimmed from a pedestal or sampling tube can be pushed into the horizon.
Other Siting Considerations

• Culture Resources
  – Known Native Americans
  – Check with local NRCS office
  – Local Knowledge

• On-Site Burial Pits
  – Hazardous Waste
  – Mortalities
  – Landfill material

Call before you dig!
Questions?