

# Formed Concrete Manure Storage Structures Training



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The Iowa Department of Natural Resources (DNR) has prepared this training to assist responsible parties in complying with the requirements for constructing concrete manure storage structures. This document is intended solely as guidance, cannot be used to bind the DNR, and is not a substitute for reading and following applicable statutes and regulations.

# Training on Formed Structures

- Engineers who design them
- Contractors who build them
- Producers who use them
- Consultants who prepare construction permit applications
- Geologic consultants, well drillers and others

# Reason for Training

- Interest in educating the multiple parties involved
- Want all contractors on the same page
- Help everyone know and understand the rules
- Want concrete structures to last
- Concentrating on deep-pit barns

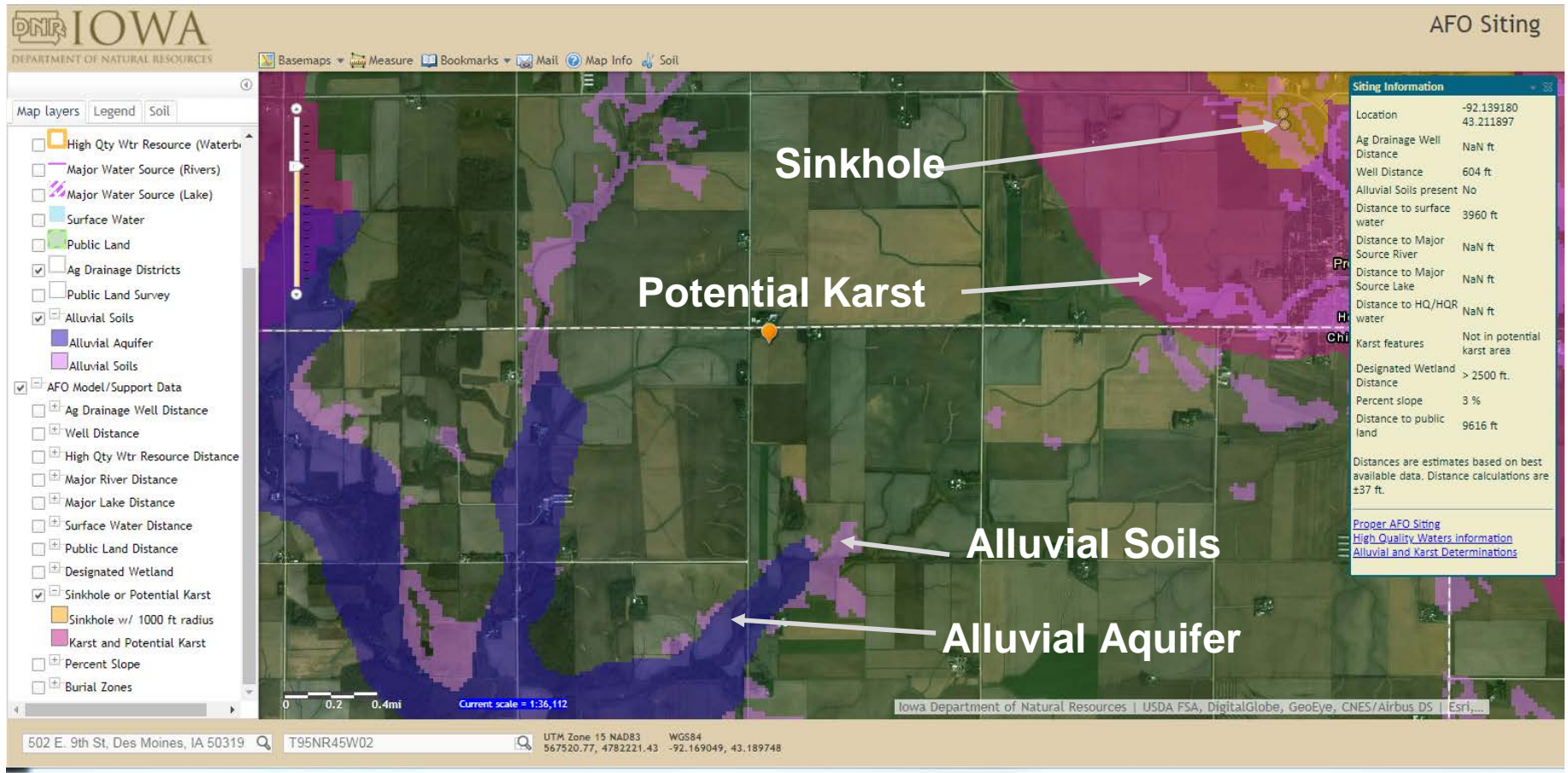
# Will Discuss

- Planning
  - AFO Siting Atlas—A useful and required tool
  - Soil Types—Why they have requirements
- Before Construction Begins (Construction Design Statement or CDS)
- During Construction (Footings, concrete pours)
- Common Pitfalls
  - Subgrade preparation
  - Concrete
  - Pumpouts

# AFO Siting Atlas – A Useful Tool

- Online public map used to site confinement buildings
- Contains much useful information
- Required in construction permit process
- Visit the [AFO Siting Atlas](#)
- Look for your site
  - Turn on Alluvial Soils layer in left margin **(Pink and Purple)**
    - soils deposited by running water
    - often located in floodplains
  - If your site is in Alluvial Soils you must contact DNR

# Proposed site – Showing Alluvial Soils, Alluvial Aquifer, Potential Karst and Sinkhole



# Refute Alluvial Soils or Submit Flood Plain Determination

If site is in alluvial soils

- To refute soils classification, a Soil Expert documents site is not in alluvial soils. Not often refuted. OR
- Submit Flood Plain Determination to DNR in Des Moines.
  - Find form and instructions at [www.iowadnr.gov/floodplain](http://www.iowadnr.gov/floodplain)
  - Submit as early as possible
  - Include future barns on initial determination
  - DNR will determine if site is in flood plain and if you can build
- Statewide Flood Maps being updated
  - Will be regulatory in a few years for many counties
  - A layer on AFO Siting Atlas

# Alluvial Aquifers

- If proposed deep-pit barn is in an Alluvial Aquifer (**Purple**)
  - It is in alluvial soils
  - Same rules apply
- Proposing a bedded barn (bedding-pack cattle or swine)
  - Floor must be minimum 5-inches thick reinforced concrete and
  - Have minimum of 5 feet of low perm soil between floor bottom and alluvial aquifer
- Soil study required to confirm (similar to karst )



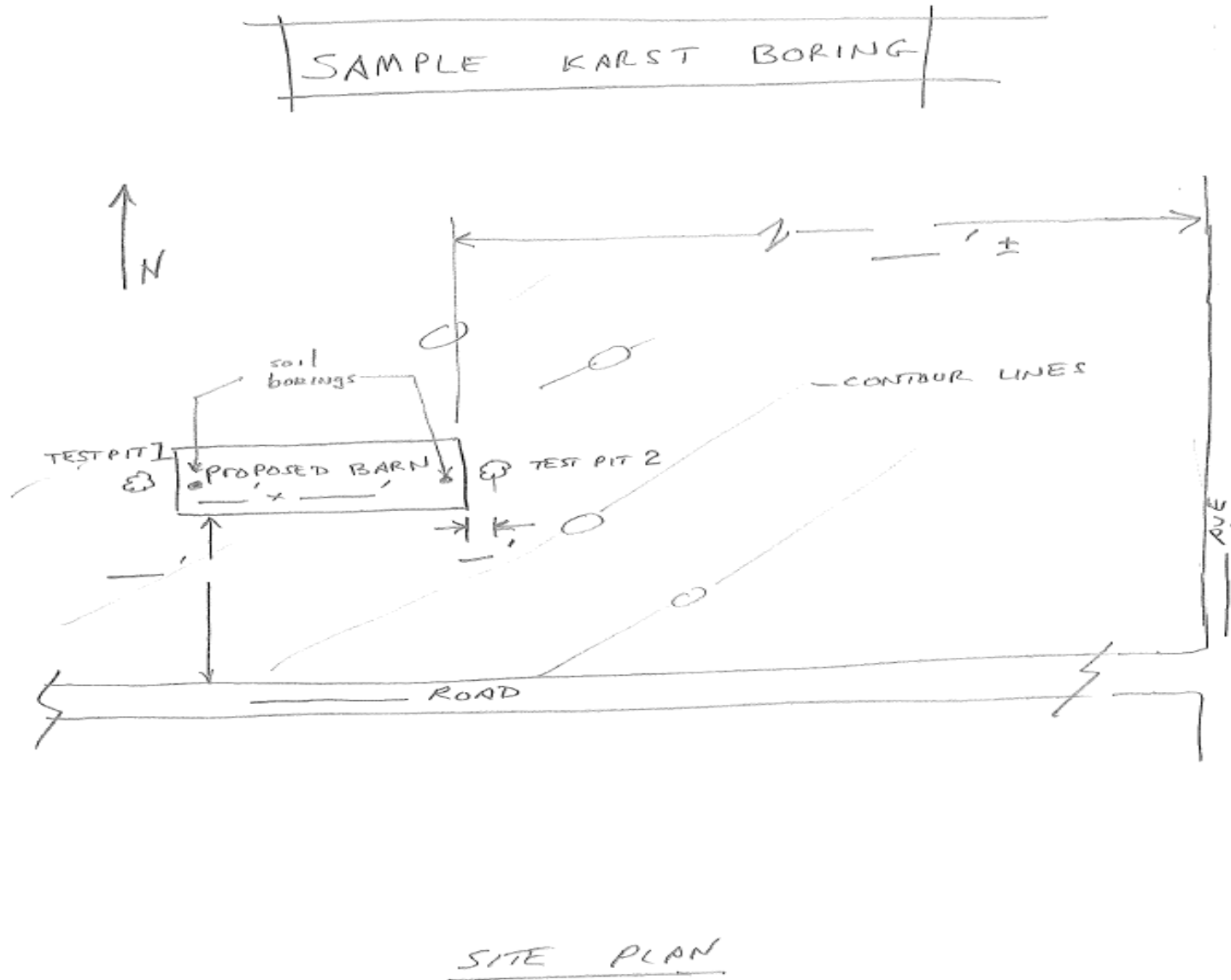
# What is Karst Terrain?

- “Land formations having karst formations that exhibit surface and subterranean features of a type produced by the dissolution of limestone, dolomite or other soluble rock and characterized by closed depressions, sinkholes or caves”
- Found in eastern Iowa
- **Deep Pink** on DNR Siting Atlas

# Upgraded Concrete Standards Required in Potential Karst – Chap 65.15(14)c

- Soil Exploration Study
  - Two soil borings or test pits **located** at each structure.
    - Locate borings within footprint
    - Locate test pits just outside footprint
  - Try to reflect lay of the land (highest and lowest point across site)
- Minimum: continuous 5-foot thick layer of low perm soil between bottom of formed structure floor and karst bedrock. Borings or pit bottoms must be at least 5 feet below pit floor.
- Can substitute 2-foot thick engineered clay liner for 5 feet native soil
- Minimum: 5-inch thick reinforced concrete floor
- Can refute Karst terrain if
  - New soil boring or existing well log (within 200 feet)
  - Shows minimum of 25 feet between bottom of pit floor and bedrock

# Need Detailed Site Plan of Soil Borings



# Boring or Test Pit Logs

PROJECT \_\_\_\_\_

DRILLER \_\_\_\_\_

I.A. LICENSE # \_\_\_\_\_  
(IF APPLICABLE)

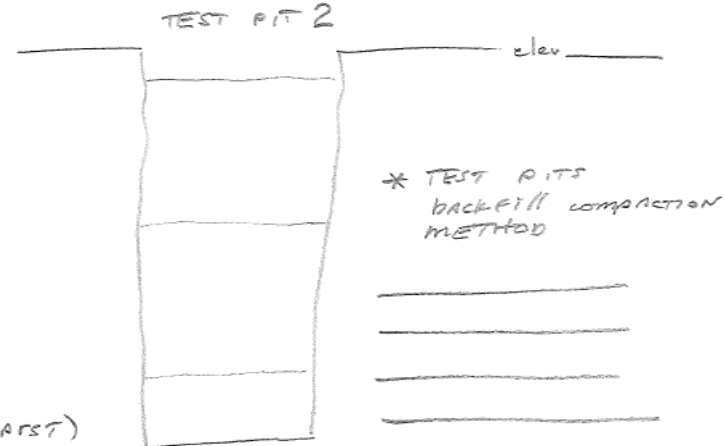
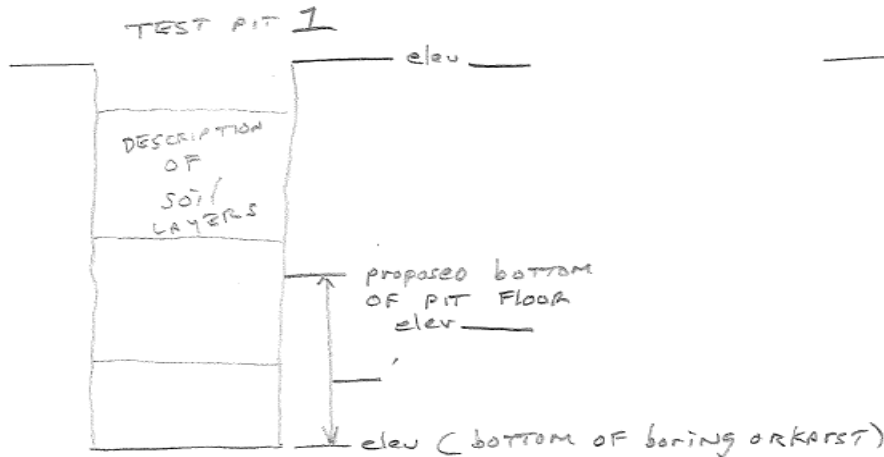
PURPOSE: EXPLORE FOR KARST BEDROCK AND SUITABLE CLAY (LOW PERM) MATERIAL BETWEEN BOTTOM OF PROPOSED CONCRETE PIT FLOOR AND KARST BEDROCK

RESULTS: IN OUR OPINION THE \_\_\_\_\_ CLAY IS CONSIDERED LOW PERM SOIL AND IS SUITABLE MATERIAL AND THERE IS A MIN. OF 5 FEET OF CONTINUOUS LOW PERM SOIL BETWEEN BOTTOM OF PIT FLOOR AND KARST BEDROCK

\_\_\_\_\_  
SIGNATURE

\_\_\_\_\_  
NAME

\_\_\_\_\_  
DATE



# Information on Soil Borings or Test Pits

- Need specific site plan with proposed building
- Elevations tied to borings, building, driller
- Credentials of driller or soil expert (PE, NRCS, Certified well driller)
- Description of soils and low perm soil opinion
- Proposed elevation of bottom of manure storage floor on logs
- Statement of 5 feet of low perm soil separation distance
- The 5 feet must be continuous

# Engineered Clay Liner

If 5 feet of low perm soil is not present...

- Can construct a 2-foot thick clay liner to meet upgraded concrete standards in karst terrain
- A P.E. must submit plans
- A P.E. must certify construction

# Filling Out Construction Design Statement (CDS)

- CDS is a DNR form for rectangular concrete pits with lateral bracing (beams and slats)
- It's used to select the correct options
  - For rebar size and spacing
  - Based on backfilling the structure walls and vehicle loading near walls
  - If in doubt, be conservative

# Filling Out Construction Design Statement (CDS)

- Be sure building dimensions are correct and match application
- Address type of pit fan placement and location
  - If using transitions - they cannot be plastic and
  - You must submit a detailed drawing which must be approved
- Address site water supply and water line entry into barns
  - (Water lines cannot penetrate a manure storage structure below maximum liquid level)
- Sign the CDS and drain tile certification



# You have received a permit or approval for a **Deep Pit Barn**



# or a Concrete Reception Pit for your **Slurry Store**



*ISU photo*

# Or the Floor Slab or Reception Pit for a **Precast Panel System**





# Or the Floor Slab for your **Precast Post-Tensioned tank**



# Things to Do...Before Digging

- Apply for a Storm Water permit
  - If disturbing more than 1 acre and
  - The site will likely discharge to a water source
- Verify with Owner
  - Placement and orientation of barn(s)
  - Distance to R.O.W and wells
- Obtain all required permits (local building and flood plain permits; and well drilling, septic tank, road entrance and water withdrawal permits, etc.)
- **Read your DNR permit.** Item #4 has permit conditions.
- Copy construction certification forms and give to contractor(s)
- DNR provides construction certification forms with the permit

# Start of Construction

## Excavating the Deep Pit to Subgrade

- This is the official start of construction
  - Topsoil stripping or general levelling **is not** considered construction
  - Filling and compacting **is** construction
- May install tiles to lower groundwater before permit is issued
- All pits must have a perimeter tile around the footing to an outlet – unless a PE certifies the pit floor is above the high groundwater table
- Do not need perimeter tile for bedded barns, slurry store or at-grade structures

# Perimeter Tiles to Lower Groundwater

- Must either
  - Connect to an existing tile, OR
  - Daylight to ditch or down the hill, OR
  - Connect into a sump with an operating sump pump.
- **Cannot** just dead end a tile into a riser and monitor it
- Must also
  - Have a sampling port (riser pipe) and a tile shutoff valve, if not daylighted on property
  - Reroute all active encountered tiles and allow them to drain
  - Contact the County Engineer if a County tile is encountered

Perimeter Tile Riser Pipe – Must have a sump pump **or** continue to ditch **or** existing tile



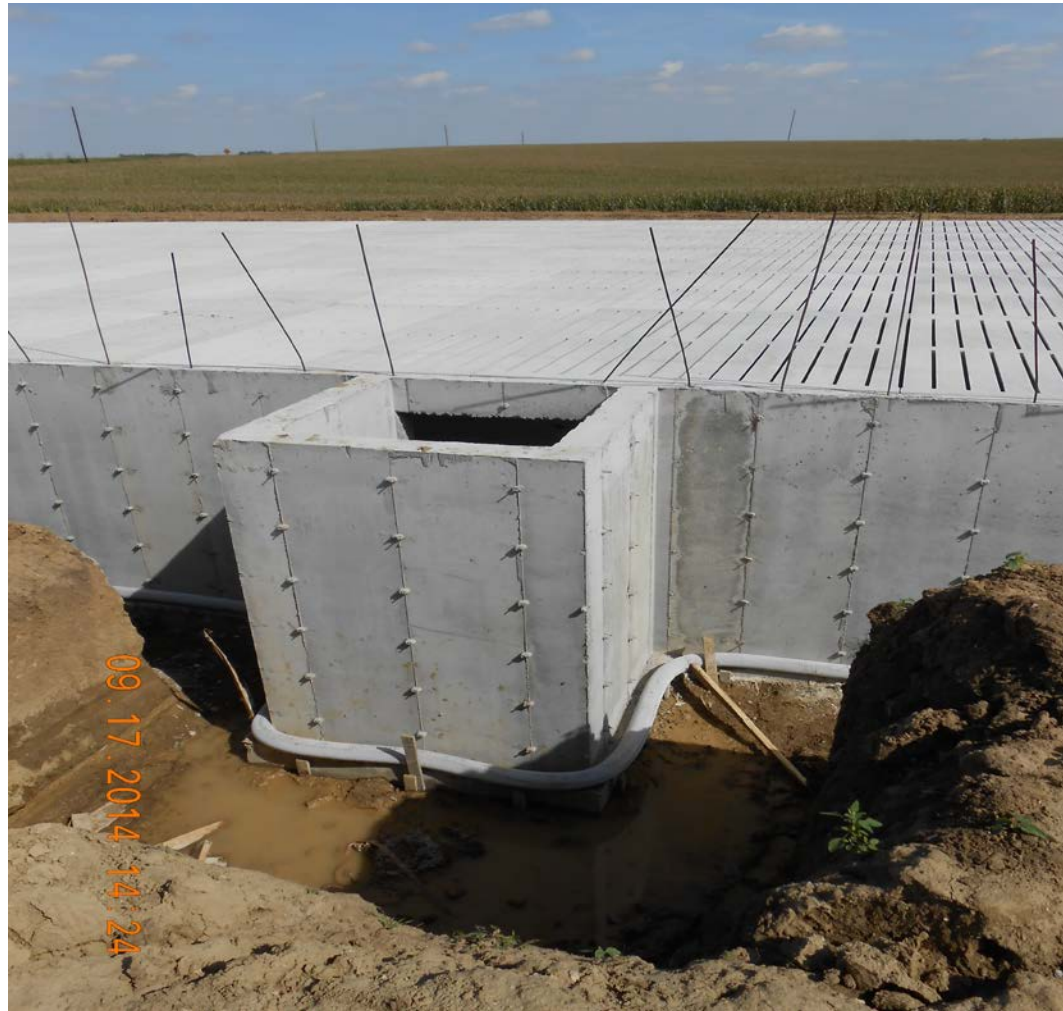


# Tile Shutoff and Observation Port





# Perimeter Tile in Filter Sock – Does not require pea gravel backfill – but good idea



# Form-a-Drain – Popular but not tall enough for thickened footings



# Form-a-Drain Broken – Plastic is fragile





# Things to Watch Out for During Construction

- Remember: Call DNR before your first concrete pour
- Next: Common concerns prior, during and after concrete is poured

Floor ready to pour. Did you call DNR?  
Rebar splices should be staggered.



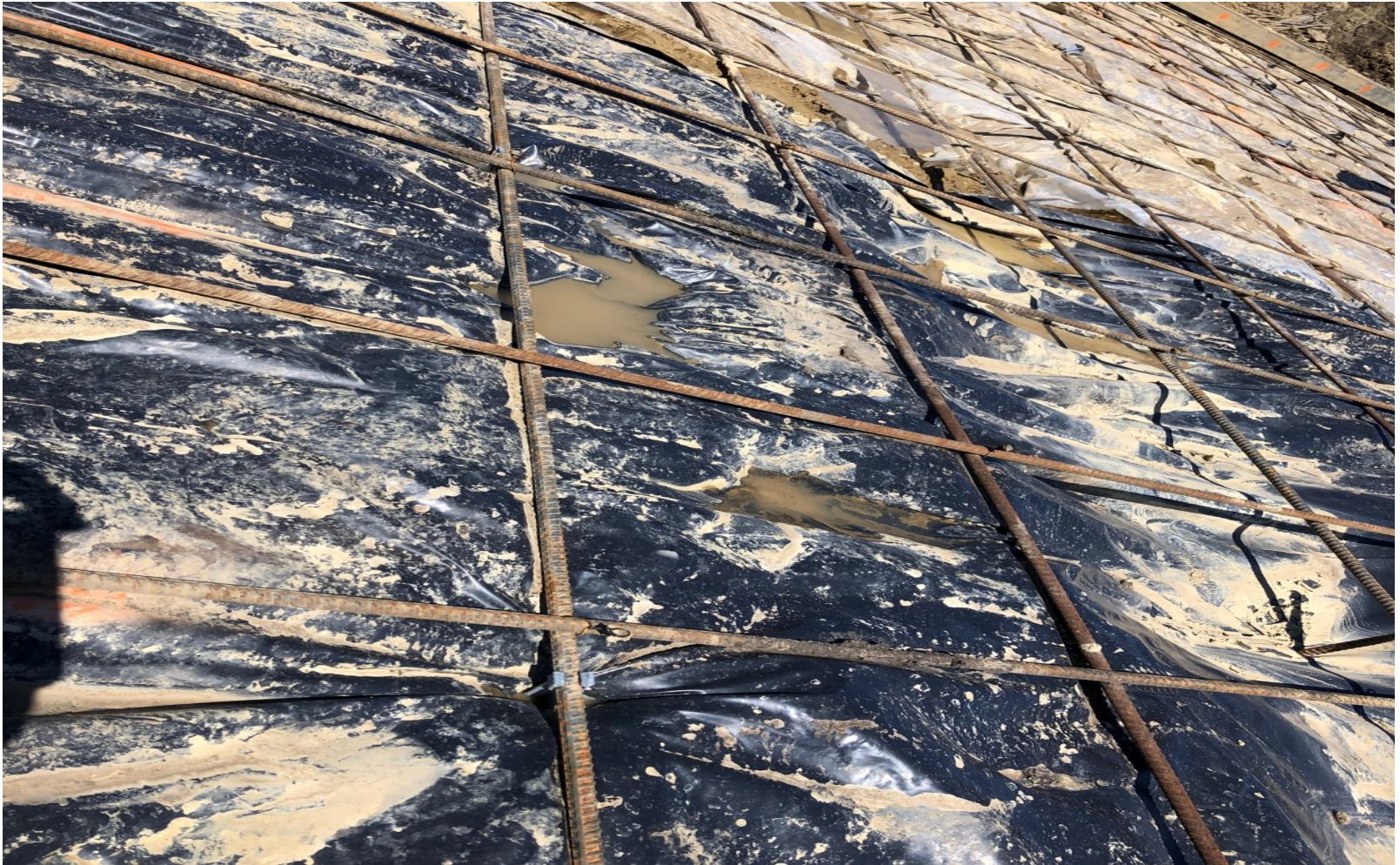


This floor is not ready to pour





# Simply Adding Plastic underneath Will Not Fix It





Rebar mat not supported, no waterstop at bulkhead and dirt in ready mix



Appears concrete was too wet when poured





Vertical bars were likely stabbed into dirt. Not allowed



Vinyl Waterstop is best Waterstop.  
Waterstop should be on manure  
side of rebar





Waterstop Exposed. Check waterstop before forms are secured.



Waterstop centered in wall and on correct side of rebar





Bentonite Roll Waterstop Allowed – but must be used properly. Black roll is too close to wall forms





# Assumed this Was Fixed



# Don't Forget to Cure Floor Slab





# Some Shrinkage Cracks are Normal – Many can be prevented



# Crack Prevention

- Proper curing
  - Compound
  - Wet coverings
  - Soaker hose
- Proper mix and lower slump
- Avoid hot and windy days



# This Crack – Should be cleaned out and sealed



“L” Bars Left Out to Access Floor Options. Need to drill and anchor new dowels.



Allow slab to gain strength before driving on it. Recommend one week.





# Looks like a Successful Pour





# Recap Floor Pour

- Notify DNR [Field Office](#) 3 days before floor pour
- Correct grade and size of rebar (check CDS)
- Correct spacing of rebar
- Support rebar on chairs
- Stagger rebar splices
- Rebar free of mud
- Vibrate all concrete
- Install wall “L” bars. No stabbing bars into dirt.
- Install water stop if vinyl is used
- Cure concrete
- Correct concrete mix
- Don't drive on floor too soon

# Wall Pour Checklist

- Keyway cleaned out
- PVC waterstops clean and supported
- Spray form oil on forms before setting forms
- Seal off large voids in bottom of form
- Keep bars off face of forms
- Check CDS for size and spacing of rebar
- Use keyway and PVC waterstop at vertical construction joints
- Rebar free of mud
- Vibrate concrete but not excessively
- Wall height > 12 feet requires a P.E.
- Water lines cannot go through pit wall below manure level





Outside of wall – Just as important as inside face when curing



# Remember to use PVC waterstop on vertical joints



# Honeycombing Needs Repair





Large voids at base of wall. Perhaps ready mix too dry or poor vibrating



If pouring pump out pit separate –  
need keyway, epoxied dowels and waterstop





# Prefer pumpout pits poured with wall





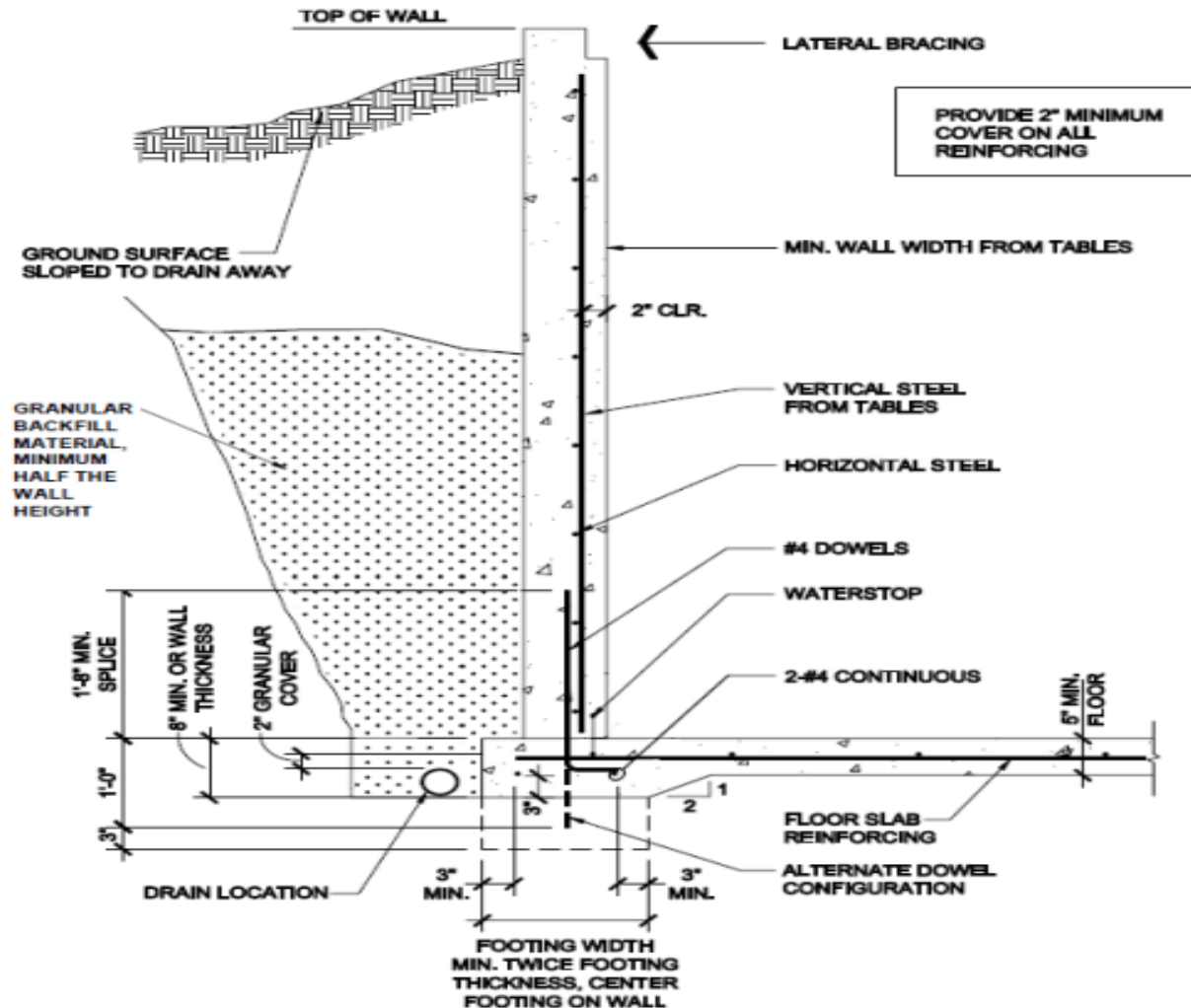
# Constructing a new pit to tie into old pit wall

- Needs approved design sketch
- Existing walls need to be power brushed off and clean
- Apply Bonding agent to old concrete
- Waterstop
- Doweled and epoxied rebar into old wall or floor

Check for proper slab size to obtain minimum width footing ledge



# Permit now includes a Wall Detail Certification – Complete and Submit





# All Trying to Achieve This



Not this



11/20/2015 10:34



# Or This





# After Concrete Pit Completion

- Once floor and walls are constructed, and walls are backfilled, DNR says pit is complete and can authorize use
- Place columns, set beams, set slats, and grout beams and slats before backfilling walls
  - Provides necessary lateral bracing for the upper walls
  - Withstands backfill pressures
- Important—To keep groundwater lowered
- Recommend—Clean out pit when building is up; Patch or repair anything suspect in the pit (honeycomb, cracks, etc.)
- Good idea—Remove interior wall form ties; Patch each tie hole with tar or grout

# Columns and Beams

- Columns must be set on a thickened floor slab
- Proper location of the thickened floor slab is critical as columns are generally not very big and the beams should rest on a full 6 inches of good concrete
- No minimum ledge. However slats should rest on a minimum of 3 inches of good concrete and beams on 4 inches at the wall
- Careful not to drill through floor slab while supporting column forms

Round columns do not provide the most ledge support, so they need to be built accurately





# Cold and Hot Weather

- DNR rules require adhering to American Concrete Institute cold and hot weather concrete provisions
- Cold weather tips:
  - Heated water in ready mix
  - Air entrainment
  - More cement
  - Cover concrete
  - Admixtures
  - Fill pits with water to prevent frost heave if left empty over the winter

Frost Heave. Fill pits with a few feet of water if heading into winter



# Pit Fan on top of pumpout – Typical installation





# Pit fan on Plastic Transition – Plastic not allowed



# Pit fan on stainless steel transition





# Stainless transitions only type allowed





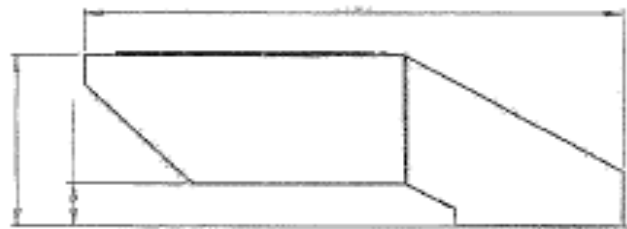
# Stainless Steel transition designs need to be approved

1. Material: 304 Stainless Steel

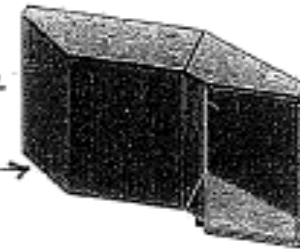
2. Thickness: 18ga (.050)

3. Row Size:

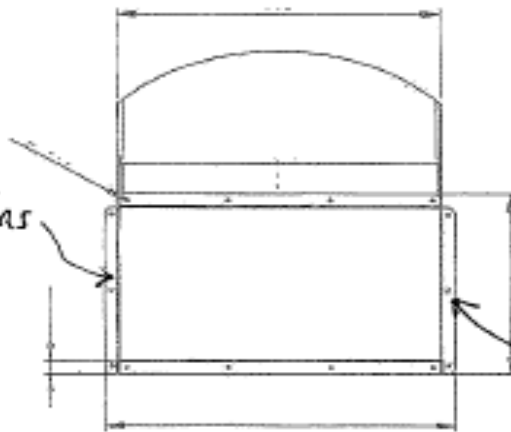
4. Weight: Lbs



STAINLESS STEEL CONSTRUCTION



ADEQUATE NUMBER OF ANCHORS

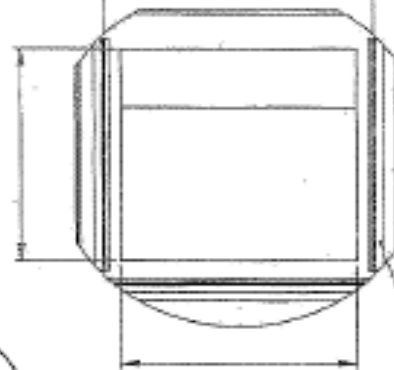


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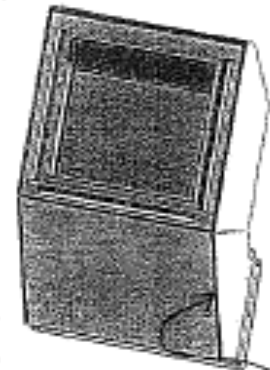
- 12ga Stainless Steel Sliders welded in place of except top

APPLY SEALANT TO FLANGE

Fan OD Width



Sliders Spot Welded in place 3 places top remains open



SEAL WELD UP TO MAXIMUM MANURE LEVEL

# Transition opening in wall



# Pit fan install checklist

- Extra rebar around opening in wall
- Clean off wall
- Use all anchors
- Proper sealant
- Tighten properly
- Perhaps some guard posts



# Backfill cannot be solid waste



# Can't Burn Solid Waste either



# Quiz

- What strength concrete is required in footings?  
3000 pound
- What strength concrete is required in floors?  
4000 pound
- Can you sub fibermesh or Helix for wire mesh?  
No
- Can you use wire mesh in floor if manure is 3 feet deep?  
Yes
- Is Fiberglass rebar allowed?  
No
- What is the minimum footing thickness?  
8"



# Quiz cont.

- If you have a 12"-thick wall how thick must footing be?  
12"
- Do columns require a thickened footing?  
Yes
- Does the DNR CDS apply to round tanks?  
No
- If you needed a #8 bar but only had #4 bars, how many would it take to replace the #8 bar?  
4
- Describe a method where adding water to the truck will not affect concrete strength?  
Adding more cement to maintain the w/c ratio

# Other Construction Reminders

- Cannot run a water line through pit wall below the maximum liquid level or up through the floor
- Keep a copy of Storm Water Plan on site
- Keep CDS and CDS Certification forms on site. Contractor should ask for these upon arrival
- Properly dispose of all solid waste
- Cannot burn construction debris on site
- Cannot put toilet or laundry waste into a deep pit. Obtain septic tank permits through the County
- Load-out room pits and reception pits for slurry stores need to follow these rules

# More Reminders

- Remember: Call the DNR [Field Office](#) before pouring
- Take photos. Helps everyone
- Check rebar tags for proper grade
- Notify DNR Field Office if you discover an abandoned well
- Perimeter tile cannot simply dead end into riser. It must have an outlet or sump pump
- Remember: Manure does not seal cracks

# Don't Build in a Floodplain







# IOWA DEPARTMENT OF NATURAL RESOURCES

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LEADING IOWANS IN CARING FOR OUR NATURAL RESOURCES

[www.iowadnr.gov/afo](http://www.iowadnr.gov/afo)

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