IOWA STATE UNIVERSITY
University Extension

Shawn Shouse
SW Area Extension Center
53020 Hitchcock Avenue
Lewis, Iowa 51544
Phone: 712-769-2600
FAX: 712-769-2610
E-mail: sshouse@iastate.edu

August 24, 2009

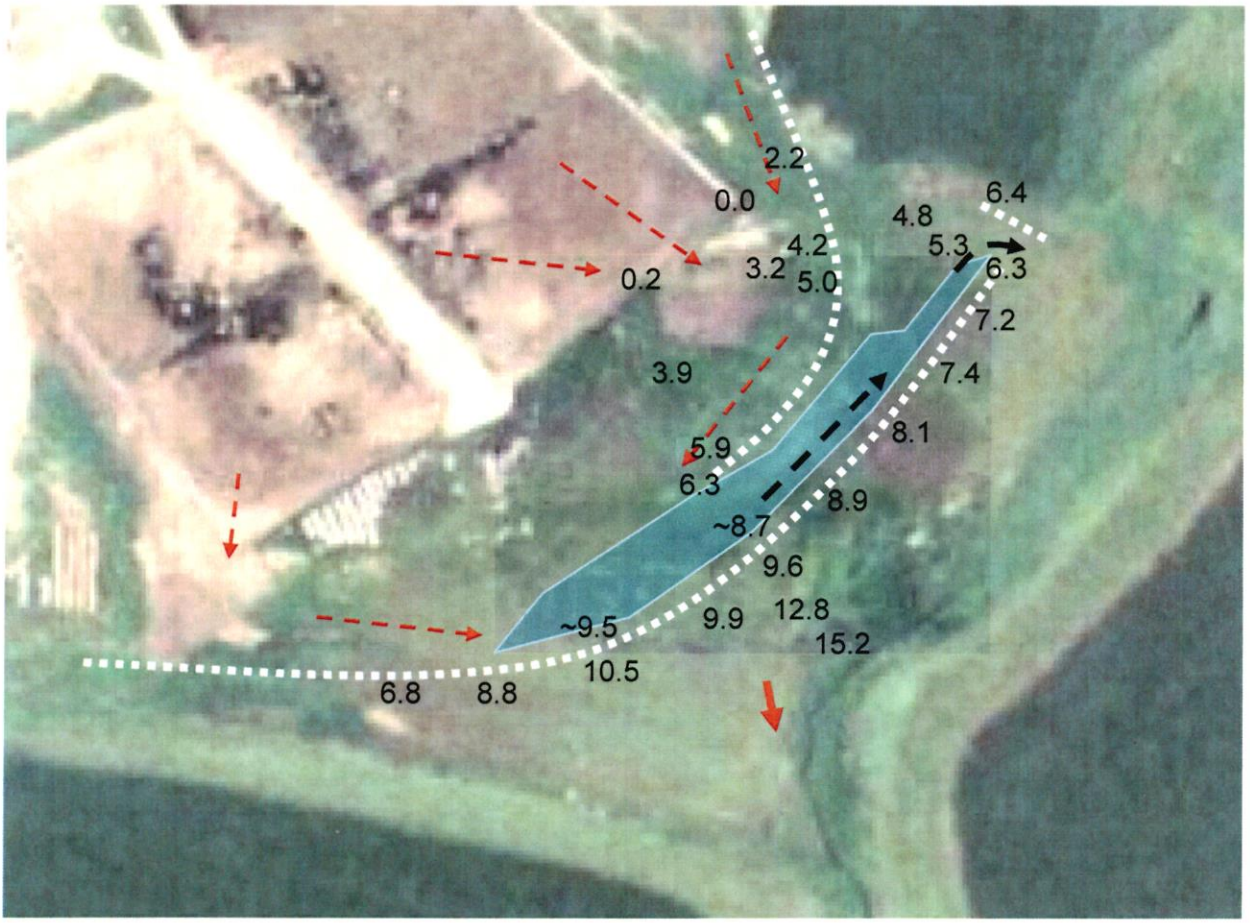
Dan Muhlbauer
3316 370th Street
Manilla, IA 51454-7537

Enclosed are more detailed descriptions and sketches for the runoff controls for your feedlot pens. These suggestions are designed to provide solids settling that meets the minimum requirement of DNR regulations for lots under 1000 head capacity. The settling basins must slow the runoff to a velocity less than 5 feet per second for at least 5 minutes. Settled solids must be cleaned out of the basins as needed to keep the basins functioning properly. I have shown further treatment for the liquid that leaves the settling basin in the form of long travel through a grassed area or planned infiltration area. While this additional treatment is not specifically required by the rules, it does provide additional protection for waters downhill below the lot and further reduces the risk of negative water quality impacts.

These suggestions are presented as concepts that would meet the general rule requirements of Iowa DNR. Note that this is sufficient only for small feedlots that do not require NPDES permits and will not utilize NRCS cost share. If you wish to pursue EQIP or state revolving loan fund assistance, you would need to follow NRCS design procedures. NRCS (Natural Resources Conservation Service) engineers or private consulting engineers may be contacted to design systems meeting NRCS specifications. Keep in mind that use of NRCS funding requires comprehensive nutrient management plans be prepared for the farming operation.

I will send two sets of these suggestions so that you have a set to keep and a set to share with your earthwork contractor, or DNR, or other consultant.

Below is a sketch of the home site feedlot settling basin as currently formed.
Feedlot runoff flow direction is shown in red dashed arrows.
Existing settling pool is shown in blue.
Existing terraces are shown in white dashes.
Settled effluent movement is shown in black dashed arrows.
Elevations below reference point (ground at SE corner post) are noted.



As you note from the settling pool and the elevations, the upper terrace does collect runoff from the east pens, but it has a slight grade to the southwest and does not hold the runoff for settling. Currently it is acting as a diversion rather than a settling basin.

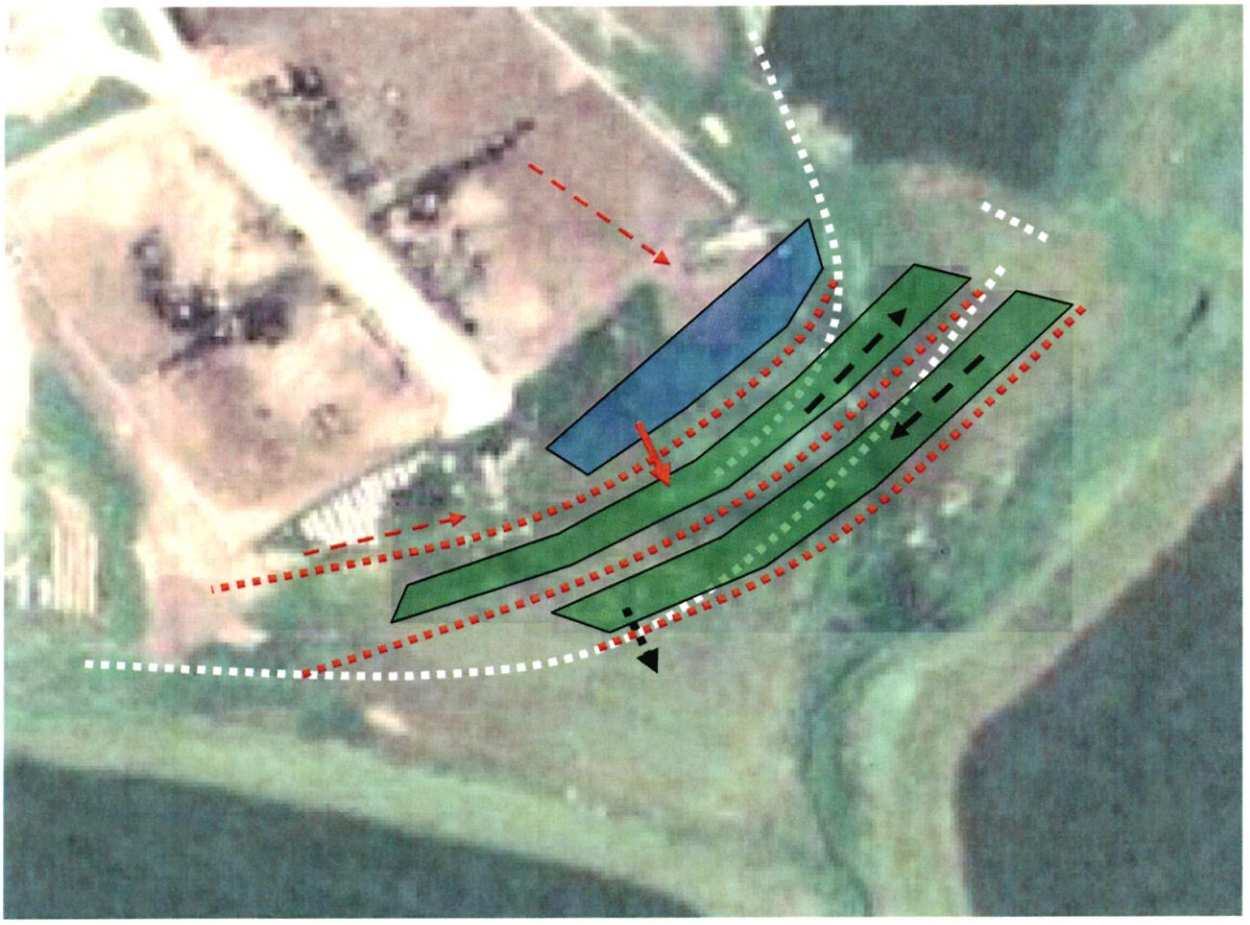
The lower terrace is graded with a low spot in the middle, approximately 3 feet lower than the east end. It is currently acting as a settling basin without a dewatering outlet. It will do a good job of settling solids, but will not drain and empty of liquid following runoff events.

What I would propose is that we re-grade the terraces so that the top terrace forms a settling basin and the lower terrace creates a filter/infiltration area that drains to the east and then back to the west below the terrace.

At the same time, I would suggest that we extend the upper terrace to collect runoff from the west pens as well. Solids could still be stored below the top terrace, but runoff water would be diverted into the settling basin.

You will notice from the elevations, and from your observation of the high water mark around the settling pool, that the outlet ends of the existing top terrace and bottom terrace are at approximately the same elevation. In order to create a top settling basin and allow maximum room for treatment, I would propose moving the low areas of both terraces up the hill about 50-60 feet. This will still allow collection of west pen runoff into the settling basin. It will set the bottom elevation of the settling basin about 4.5 to 5.0 feet below the low end of the pens. The bottom elevation of the first filter/treatment area will be about 6.5 feet below the pens, and a second filter/treatment area headed back west would have a bottom elevation about 8 feet below the pens. This would leave room for a third filter/treatment area if you wish to add it at a later time.

The sketch below shows the approximate existing terrace locations in white and the approximate modified locations in red, settling basin pool in blue and treatment areas in green.



This modification will create a settling basin pool roughly 250 feet long by 50 feet wide (12,500 square feet) to satisfy the recommended 1/35 of the drainage area (11,500 square feet).

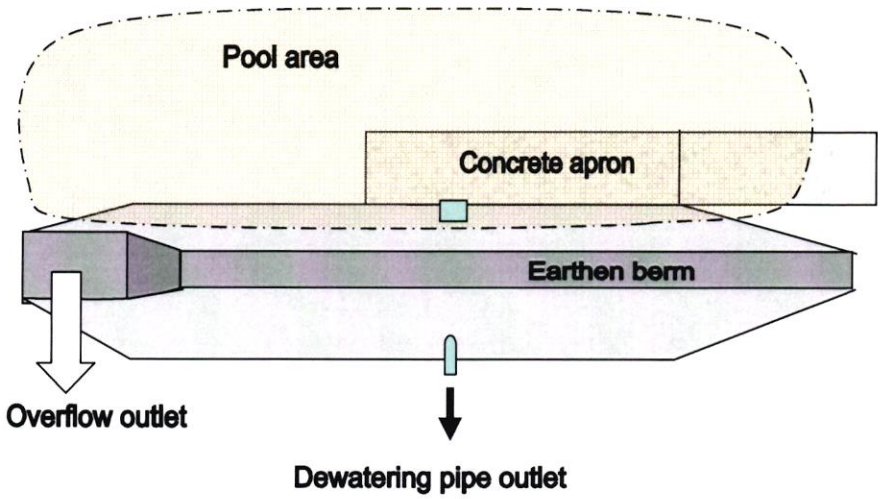
The filter/treatment areas are about 40 feet wide and 350 to 400 feet long for a total of about 0.7 acres, or about 1/13 of the drainage area. These filter/treatment areas would be built to hold water 3-6 inches deep to allow longer infiltration times

and still promote good vegetation growth. I would suggest making the overflow devices for these areas adjustable so that the liquid depth could be changed based on the performance of the soils in the treatment areas. This would also allow temporarily reducing the amount of water retained if you wanted to mow or maintain the areas.

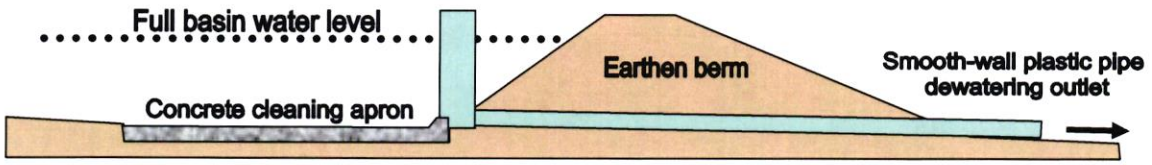
Creating the settling basin will not be difficult and could probably be done with a simple hand level to guide the terrace construction. The treatment areas are large and must be flat to within an inch or two. If you are willing to install this suggested system, I would be happy to help you flag and create the flat areas needed for filtering and treatment.

The general cross section of the settling basin is shown below.

Settling basin basic components (top view)



Settling basin dewatering outlet (cross-section view)

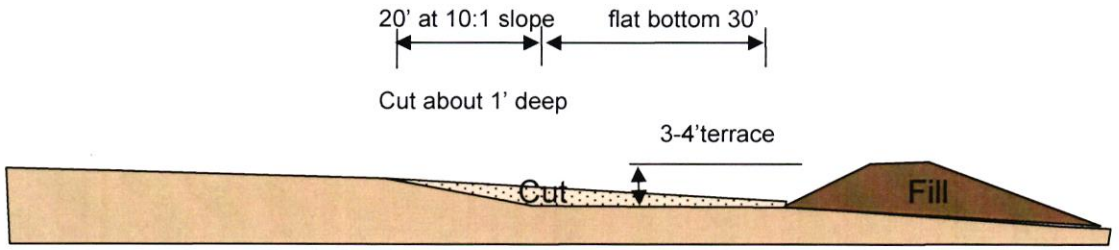


I would recommend a basin liquid depth of 2 feet when the basin reaches the overflow depth. An overflow spillway at 24 inches high around the west end of the settling basin dam would allow very large rainfall events to pass through the basin when the dewatering outlet cannot keep up.

The east end of the settling basin would approximately align with the east fence line of the pens. The revised terrace would follow a level contour line across the hillside to the west for about 250 feet and then slope back up toward the southwest corner of the pens to collect runoff exiting the pens at that point. As the terrace moves up the slope to the west, it can be reduced in size. Once above the pool waterline, the terrace only needs to be large enough to divert the runoff water (2 feet high would be sufficient).

The pool area would be formed by cutting a flat bottom about 30 feet wide into the hillside above the terrace. Upslope from this flat bottom, the cut can be sloped upward at a 10:1 slope for another 20-30 feet where it will meet the existing soil grade.

Settling basin cross-section



The basin bottom could slope very slightly toward the outlet box, but not more than about 6 inches of slope from one end to the outlet.

The outlet tube would release the water immediately on the other side of the basin berm. If you choose to install the filter/treatment areas, then I would strongly recommend building an outlet box for the settling basin that has outlet control. This would allow you to "dose" the liquid out into the treatment areas after additional solids have settled and the initial rainfall on the treatment area has largely infiltrated. This will increase the effectiveness of the treatment areas. I would help you design and build the outlet box. It would probably be a simple drop box (like a square riser pipe) that has 2 or 3 operable drain holes at different heights to allow draining part or all of the retained water from the basin. The box would probably be roughly one foot square and 4 feet tall. I would recommend an 8" drain pipe leaving the box.

We can visit some more about how you envision cleaning the solids from the settling basin. If you plan to use a front end loader, then the concrete access ramp would be very beneficial. If you plan to use an excavator, then the ramp may be optional.

The filter/treatment areas will have a cross-section much like the settling basin except that they will only hold water to a depth of 6 inches and would have entirely flat bottoms. The terraces would not need to be more than 2 feet tall on the upslope side. Making the terraces fairly low and wide may make maintenance and potential mowing easier. Transferring flow from the east end of the upper treatment area to the

lower area could be done through a riser pipe and tile line. I would suggest a 10" Tee (Hickenbottom or equivalent) with a non-perforated riser that extends high enough to generate a liquid depth of about 4-6 inches in the treatment area. For maximum flexibility, the riser could be constructed to just reach the ground surface in the treatment area with multiple extensions that could be added to adjust the liquid depth in the 0 to 6 inch range. The depth chosen can be determined after observing the infiltration characteristics of the treatment area after grass establishment.

The tee would be attached to 10" non-perforated drainage pipe that would direct flow into the second treatment area. In the event that the drain tube would become plugged with vegetation, it would be wise to have a low spot in the end of the treatment area berm to serve as an emergency overflow to prevent damage to the primary berm. This overflow area would only need to be six inches lower than the rest of the berm and 8 to 10 feet wide.

A similar outlet structure would be built at the west end of the lower treatment area releasing the overflow water on the ground surface.

Below is a sketch of the feedlot site at David's.
Feedlot runoff flow direction is shown in red dashed arrows.
The primary settling basin is shown in blue.
The secondary settling basin is shown in blue hash lines.
Settling basin dewatering outlets are shown with solid red arrows.
Settled effluent movement is shown in black dashed arrows.

The total runoff area for the pens is about 310,000 square feet. Using a pool area of 1/35th of the drainage area, 310,000/35 equals approximately 8,900 square feet of pool surface when the basin is full to the overflow level. Your existing upper basin measures about 180 feet long by 60 feet maximum width when the liquid is to its maximum level. This corresponds to an estimated surface area of 8600 square

feet. Currently, the lowest spot around the upper basin is at the west end of the berm. But the middle of the berm is within a couple inches of this elevation. The berm is at significant risk of damage from overflow at the middle of the berm. I would recommend adding some additional fill to the middle of the berm so that the entire berm is at least one foot higher than the overflow area around the west end of the berm. With this modification and a little more cleaning of accumulated solids on the uphill side of the basin, I think you will achieve the required basin area to meet the rule requirement for solids settling in the upper basin.

The primary settling basin requires a dewatering outlet. I would suggest a non-perforated riser pipe or box type outlet with an operable weep hole at the bottom. Using this type of outlet, we can selectively hold or release the storage volume from the settling basin to the lower basin and treatment area. As with the home site, I would be happy to help you design the outlet for manual control. I would recommend a 6" outlet pipe from the basin. As was mentioned in my previous letter, either the Agri-Drain pond box outlet or a home-made outlet box or riser pipe would be satisfactory. The top of the riser box or pipe or stoplogs would be set about 6 inches below the elevation of the overflow spillway around the west end of the basin berm.

The secondary settling basin immediately below the primary basin is approximately the same size as the upper basin. The maximum pool area currently measures approximately maximum 55 feet wide and maximum 185 feet long for an estimated surface area of 8,100 square feet. This pool is limited by the low spot near the middle of the basin berm. I would suggest raising the middle of the berm to allow the full pool to the overflow around the east end of the berm. This will allow the liquid depth to increase by about 15 inches and the pool surface area to increase to about 11,000 square feet.

The existing dewatering outlet in the second basin is a perforated riser pipe. The top of the riser pipe is about one foot below the existing low spot near the middle of the basin berm, and about two feet below the overflow elevation at the east end of the berm. At the time of my measurements, the silt level at the outlet riser and residual pool level in the basin was 2.4 feet below the top of the riser pipe, giving an existing maximum liquid depth of 3.4 feet and a potential liquid depth of 4.4 feet after berm repair. Additional solids accumulation could be removed to get even more liquid depth and volume. The outlet pipe has a surface daylight outlet point in the crop field approximately 60 feet south of the toe of the basin berm and approximately 8 feet below the top of the riser pipe.

Assuming the maximum top basin depth to be approximately 4 feet, and the maximum lower basin depth to be approximately 5 feet, I would estimate the total available settling basin volume for both basins at about 30,000 cubic feet. This should allow you to temporarily hold the runoff from a 1.25-inch rain on the feedlot. National weather service data and monitoring for the past 2 years at our research farm indicates that this would allow total capture of about 85-90% of the 90 yearly rainfall events, and overflow from about 10 rainfall events per year. Controlled outlets on the basins would allow you to release this settled liquid slowly to the down-slope treatment area.

Down slope from your settling basins, you have a grassed channel that carries the settled effluent about 1200 feet to the receiving small stream. The first 900 feet of

this grassed channel is well shaped and maintained. The final 250 – 300 feet is channelized so that additional infiltration and filtering is not likely.

As a first option, I would suggest releasing the settled liquid from the settling basins slowly to this grassed channel. I would try perhaps ¼ of the basin volume at a time, dosed once or twice a day. The goal would be to determine dose size and timing that would allow the liquid to infiltrate into the soil of the grassed channel without reaching the stream. In the best scenario, this allows dewatering of the settling basins with no discharge to the stream. Large rainfall events and chronic rainfall periods will surpass the storage volume of the basins and the infiltration capacity of the grassed channel, so discharge will still occur at some times when rainfall and stream flow are high. Time will tell if this management plan provides sufficient protection for the stream.

If the grassed channel proves to be inadequate for secondary treatment and infiltration of the effluent, other options could be considered if the crop land owner/manager is willing to work with you. Extending the outlet pipe from the lower settling basin to release the settled liquid into a constructed infiltration/treatment area would be possible. Field slope near the current settling basin outlet is too steep to provide an effective treatment area. Redirecting the outlet point to lower slope ground south or west of the existing outlet would be more practical. Treatment area similar to the one planned for the home place could be built. I would prefer to wait and see if this more expensive and complicated option is necessary. Perhaps after harvest we could scout the field for a suitable site for potential treatment area development.

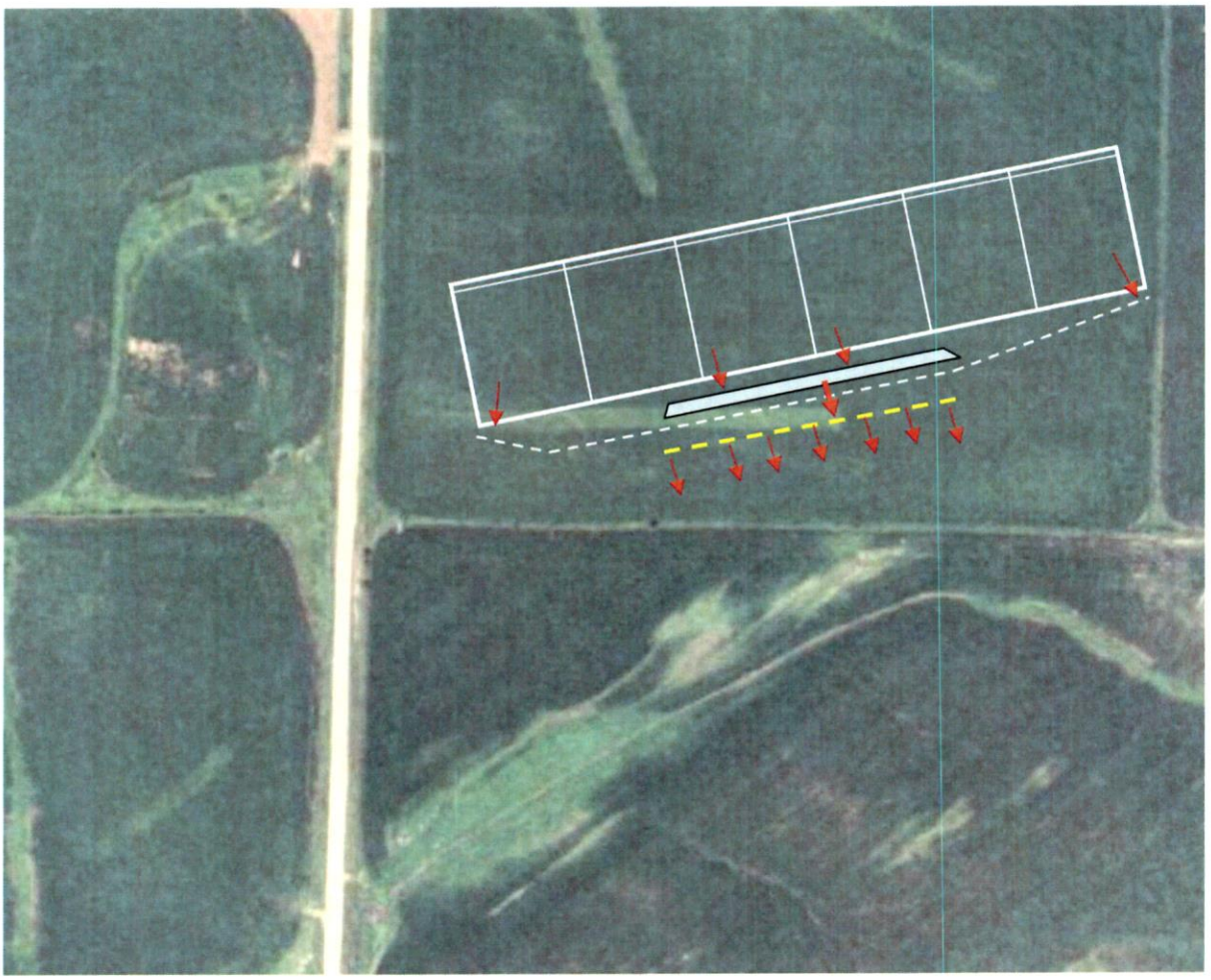
Your new north site is built at the top of the landscape so that clean water diversion is simple and you have ample room below the feedlot for solids settling and secondary treatment. Here is an approximate layout on aerial photo of the field. Exact location is not yet available on aerial photos.

Black elevation numbers shown are at the corners of the lot and along a line about 60 feet south of the feedlot pens (at the edge of the existing bean field) and straight out from pen partition fences. White elevation numbers are high (H) and low (L) points along the line.

Proposed diversion terrace and settling basin berm is shown in white dashed line. West end diversion terrace can follow a graded contour to the basin. East diversion terrace will require cutting a channel approximately 2 feet deep to cross a ridge or alternatively bowing farther south into the crop field in order to follow a graded contour to the basin.

Approximate low spots in fence line where runoff exits pens shown in red

Settling pool shown in blue and outlet through gated pipe in yellow

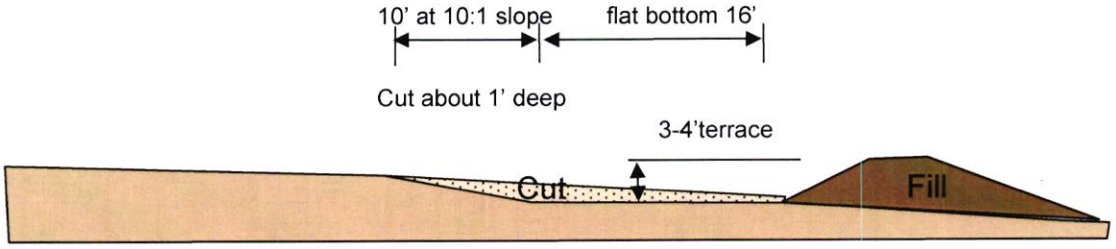


The feedlot pen area measures approximately 220 feet by 1160 feet for an area of approximately 255,000 square feet. At $1/35^{th}$ of the drainage area, the settling basin pool should be at least 7300 square feet when full to the overflow level. I have shown a proposed settling basin pool approximately 20 feet wide by 400 feet long. A long, narrow basin would be easier to clean with a backhoe if a suitable loader for driving into the basin is not available or if weather conditions do not favor driving in the basin. Long, narrow basins are more expensive to equip with concrete cleaning ramps for loader access. If you would prefer a more square basin, we could re-draw the basin accordingly. A basin 50 feet wide by 150 feet long would serve the same purpose.

The area below the settling basin is on a fairly uniform 5-8% slope. The travel distance down slope through the field and along a grassed channel would be about 1100 feet to the road ditch. We would need to make sure that settled feedlot effluent does not enter any terrace or waterway drainage riser pipes. After the flow crosses the road, it passes through a pasture in what would likely be classified as a water of the state.

My suggestion would be to use a gated irrigation pipe to distribute the settled effluent from the settling basin along the back side of the settling basin terrace and let it flow down slope in the crop field. The pipe gates could be adjusted as needed to encourage uniform flow less likely to cause channeling and gullies in the field. At some point down the slope, the flow would start to come together into channels, and will channelize when it reaches the grassed waterway in any case. If the liquid from the storage volume of the basin is dosed in small amounts into the field, infiltration can be increased and the likelihood of flow reaching the road ditch reduced. With an average depth of 2 feet, the settling basin should hold the runoff from a ¾ inch rain on the feedlot.

Settling basin cross-section



These cross-section dimensions will actually give a larger basin pool surface area than minimum requirement calculated above because the pool will back up onto the ground surface above the cut area. Storage volume will also be larger than calculated above. I don't think you want the bottom much less than 16 feet wide to allow cleaning when dry with a box scraper and tractor. The cut and fill pattern for the basin berm can be consistent along the length if you let the berm curve and follow the land contour. Alternatively, you can make the berm straight, and the cut depth will be greater over the ridge areas than in the valleys. I think either method is acceptable as the existing land elevation is consistent to within two feet in the area we plan for the basin.

The basin dewatering outlet would be similar to the ones described for the other two settling basins. Again, having outlet control to dose the crop area with small doses of settled liquid will maximize infiltration and minimize discharges to the road ditch.

The gated irrigation pipe method of flow distribution will give the best low-cost approach for attempting to use the crop field as a treatment/infiltration area. If this proves to be inadequate, a graded flat treatment/infiltration area could be developed immediately below the settling basin berm. One or more treatment cells could be built much like the ones described for the home place lot. I would be inclined to try the gated pipe first, but keep the possibility of the constructed infiltration/treatment area as a back-up plan if the field infiltration does not prove suitable. If needed, a

treatment/infiltration area of 1 to 1.5 acres would be a good target. Long and narrow strips (similar in cross-section to the settling basin) would be easiest to grade flat without deep excavation.

Treatment/infiltration areas work best when soil properties allow good infiltration rates. Careful construction using minimum excavation and taking care to avoid soil compaction is important. Any compaction should be corrected to the extent possible with deep tillage prior to seeding. Berm areas should be seeded with a good quality terrace or waterway mix. Adding Reed canarygrass to the mix for the treatment area will help the grass stand survive repeated flooding and wet spots. I would suggest 5-6 pounds per acre added to the grass mix.

Again as a reminder, a well designed settling basin will meet the legal requirement for solids settling only if it is properly maintained. Make sure solids are removed frequently and the outlet is functioning properly to dewater the basin after runoff events.

Once runoff water passes through the settling basin, larger manure solids should be removed. However, this settled feedlot effluent still contains nutrients and organic matter and organisms which could cause a water quality violation if it reaches a water of the state.

As you plan your feedlot improvements, I would suggest that you develop and implement an operation and maintenance plan for the feedlot. More details and links to additional information were contained in my earlier letter.

As you look at these suggestions, please feel free to ask about modifications or more details. I would be happy to make modifications that would make this plan work better in your livestock operation.

Shawn Shouse

Shawn Shouse
ISU Extension Ag Engineering Field Specialist

Olson, Dan P [DNR]

From: Shouse, Shawn C [EXTAG] [sshouse@iastate.edu]
Sent: Thursday, August 27, 2009 9:14 AM
To: Olson, Dan P [DNR]; Shouse, Shawn C [CO SW]
Cc: Stipe, Dan [DNR]
Subject: RE: Dan Muhlbauer letter

Dan,
Good points. If we were to use the draw area at the home place, we would have to restrict our use to the lower half of the draw to maintain the 1250 foot separation distance.

At the south place, I agree that we should try to channel nearly all of the second settling basin overflow to the treatment area. We can do this by using a fairly large outlet pipe.

Shawn

From: Olson, Dan P [DNR] [mailto:Dan.Olson@dnr.iowa.gov]
Sent: Wednesday, August 26, 2009 1:51 PM
To: Shouse, Shawn C [CO SW]
Cc: Stipe, Dan [DNR]
Subject: FW: Dan Muhlbauer letter

Shawn,

I wanted to follow up with a couple of thoughts.

Dan Muhlbauer indicated this morning that he would be willing to tile out the ditch to the south of the middle lot to provide more area for treatment/infiltration. If that is considered at some point, there are 2 points to be aware of. To be separate lots under Iowa regulations, the lots (including all manure control structures) must be more than 1250 feet apart. Extending the treatment area at the middle lot to the west south west may cause the south and middle lots to be within 1250 feet of each other. Also, it would be important to use non-perforated tile under the infiltration area.

We also need to consider overflows at the middle lot. I agree with the direction you are heading (dedicated treatment area away from the existing waterway) but am thinking about the fate of any effluent that may overflow the berm of the second SSB. I would assume that the overflow from the 10 or so events that the SSB's would not contain would be intended to flow, via pipe, to the infiltration area and, potentially, overflow from there. That seems reasonable to me. My concern would be with an overflow over the second berm that would run down the existing waterway. It seems to me that, at the least, the Muhlbauer's will want carefully maintain the water way to ensure that it is not channelized. Give me a call if you want to discuss this one further.

Dan Olson, ESS
IDNR, ESD, FSB, FO4

From: Stipe, Dan [DNR]
Sent: Wednesday, August 26, 2009 12:33 PM
To: Shouse, Shawn C [EXTAG]
Cc: Olson, Dan P [DNR]; Manz, Alison [DNR]
Subject: RE: Dan Muhlbauer letter

Shawn,
I have asked Dan Olson to consider this his highest priority. The meeting today was very beneficial. Thank you.

Dan Stipe

Dan J. Stipe, Environmental Program Supervisor
Iowa DNR Field Office #4
1401 Sunnyside Lane
Atlantic, Iowa 50022
Work Phone (712)243-1934
Fax # (712)243-6251
dan.stipe@dnr.iowa.gov

"There is no substitute for enthusiasm."

From: Shouse, Shawn C [EXTAG] [mailto:sshouse@iastate.edu]
Sent: Wednesday, August 26, 2009 10:01 AM
To: Stipe, Dan [DNR]
Subject: Dan Muhlbauer letter

Dan,
Attached is a copy of the letter to Dan Muhlbauer. Let me know if you have any problems with the file.

Shawn Shouse

Shawn Shouse
Field Specialist-Ag Engr, Iowa State Univ. Extension
ISU Extension Ctr, 53020 Hitchcock Ave., Lewis, IA 51544
ph 712-769-2650, fax 712-769-2610, sshouse@iastate.edu
http://www.extension.iastate.edu/ag/fsae/ae4.html

Olson, Dan P [DNR]

From: Khosravi, Reza [DNR]
Sent: Thursday, August 27, 2009 9:00 AM
To: Olson, Dan P [DNR]; Petitti, Paul [DNR]
Cc: Stipe, Dan [DNR]
Subject: RE: Dan Muhlbauer letter

I forwarded Shawn's plan to Paul yesterday for his review. He got back to me this morning with a good impression of Shawn's plan. I also reviewed it myself and came to the same conclusion. We believe Shawn has done a good job considering what the owner wants to do at this stage.

From: Olson, Dan P [DNR]
Sent: Wednesday, August 26, 2009 4:04 PM
To: Khosravi, Reza [DNR]; Petitti, Paul [DNR]
Cc: Stipe, Dan [DNR]
Subject: RE: Dan Muhlbauer letter

Thank you.

Dan Olson, ESS
IDNR, ESD, FSB, FO4

From: Khosravi, Reza [DNR]
Sent: Wednesday, August 26, 2009 3:57 PM
To: Olson, Dan P [DNR]
Cc: Petitti, Paul [DNR]
Subject: RE: Dan Muhlbauer letter

Dan: Paul is going to review review Shawn's proposal and plans as soon as he can. I will inform you of our views. Any communication with Shawn will be shared with you. Take care.

From: Olson, Dan P [DNR]
Sent: Wednesday, August 26, 2009 1:46 PM
To: Khosravi, Reza [DNR]
Cc: Hessenius, Kenneth [DNR]; Stipe, Dan [DNR]; Manz, Alison [DNR]; Shouse, Shawn C [CO SW]; David Muhlbauer
Subject: FW: Dan Muhlbauer letter
Importance: High

Reza,

Alison Manz, Dan Stipe, and I met with Dan, Dave, & Patti Muhlbauer, Even Vermeer, and Shawn Shouse this morning to discuss their plans for improved controls. A copy of Shawn's letter to the Muhlbauer's describing his proposal is attached. It is our (FO4's) opinion that, subject to the following comments, the proposed concepts appear to be workable. I would like your opinion on the technical aspects of the proposed controls. I have copied Shawn Shouse on this e-mail so you can contact him directly if you need more details. I would appreciate being kept in the loop as well.

General:
We recommended installing concrete pads in all of the settling structures to facilitate proper cleaning and maintenance. The Muhlbauer's did not seem to object.

Middle Lot (Dan's or Home Place):
Dan Muhlbauer indicated that the tile outfall that had elevated levels of ammonia & e-coli at the middle lot is from his clean water diversion. Clean water is collected in a structure above the lot and flows under the lot and current impoundment. It is possible that perforated tile was used under the feedlot. Muhlbauer's are looking into this and, if that is the case, the perforated tile will be replaced with non-perforated tile.

South Lot (David's):
I was not comfortable with using a widened flat waterway that still received drainage from the surrounding crop area as the infiltration gallery. Shawn will be sending another proposal (anticipated by next Monday) that will use the existing basins for solids settling (as described) but will add a dedicated vegetated area for further treatment / infiltration of effluent from the SSB's.

Dan Olson, ESS
IDNR, ESD, FSB, FO4

From: Stipe, Dan [DNR]
Sent: Wednesday, August 26, 2009 12:28 PM
To: Olson, Dan P [DNR]
Subject: FW: Dan Muhlbauer letter
Importance: High

Highest priority. Thank you.

Dan J. Stipe, Environmental Program Supervisor
Iowa DNR Field Office #4
1401 Sunnyside Lane
Atlantic, Iowa 50022
Work Phone (712)243-1934
Fax # (712)243-6251
dan.stipe@dnr.iowa.gov

"There is no substitute for enthusiasm."

From: Shouse, Shawn C [EXTAG] [mailto:sshouse@iastate.edu]
Sent: Wednesday, August 26, 2009 10:01 AM
To: Stipe, Dan [DNR]
Subject: Dan Muhlbauer letter

Dan,
Attached is a copy of the letter to Dan Muhlbauer. Let me know if you have any problems with the file.

Shawn Shouse

Shawn Shouse
Field Specialist-Ag Engr, Iowa State Univ. Extension
ISU Extension Ctr, 53020 Hitchcock Ave., Lewis, IA 51544
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IOWA STATE UNIVERSITY
University Extension

Shawn Shouse
SW Area Extension Center
53020 Hitchcock Avenue
Lewis, Iowa 51544
Phone: 712-769-2600
FAX: 712-769-2610
E-mail: sshouse@iastate.edu

September 1, 2009

Dan Muhlbauer
3316 370th Street
Manilla, IA 51454-7537

Enclosed are more detailed descriptions for a revised plan for your south site (David's place) following our discussion about the questionable treatment and infiltration capacity of the current grassed channel.

Based on aerial photos and topographic maps, and on your suggestion following visual assessment of the field, I am going to suggest establishing a treatment/infiltration area in the southeast corner of the field along the road. This should allow us to utilize suitable soils and favorable land slopes and should also allow easy observation of the treatment area condition and operation.

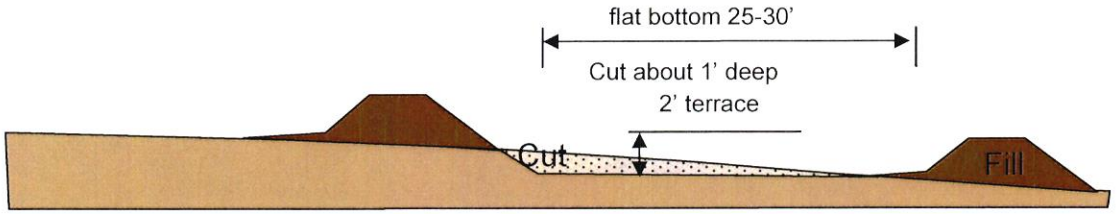
Prior to construction, I would return to do more detailed measurement on the site to determine actual locations and shapes of the individual treatment area cells. The sketches in this letter are based on assumptions I'm making from contour lines on the topographic map.

I will send two sets of these suggestions to you and will also email a set to Dan Stipe and Dan Olson so they can review and share with DNR staff.

At your south site (David's place) the total runoff area for the pens is about 310,000 square feet. With the contributing area of the settling basins, the drainage area is roughly 350,000 square feet. Using experience from our treatment/infiltration area at the ISU Armstrong Research Farm along with recommendations from other research projects, I would suggest sizing the treatment/infiltration area for a surface area of approximately ¼ of the drainage area (roughly 80,000 square feet). I have shown an area on the aerial photo of about 200 feet by 400 feet.

The individual treatment cells would be laid on a contour across the landscape to allow minimum disturbance of the topsoil. Cross section of the individual cells would attempt to create cells with no more than one-two feet of cut or fill. Assuming a land slope of 4 percent or less, a typical cross section might look like the diagram below.

Treatment cell cross-section

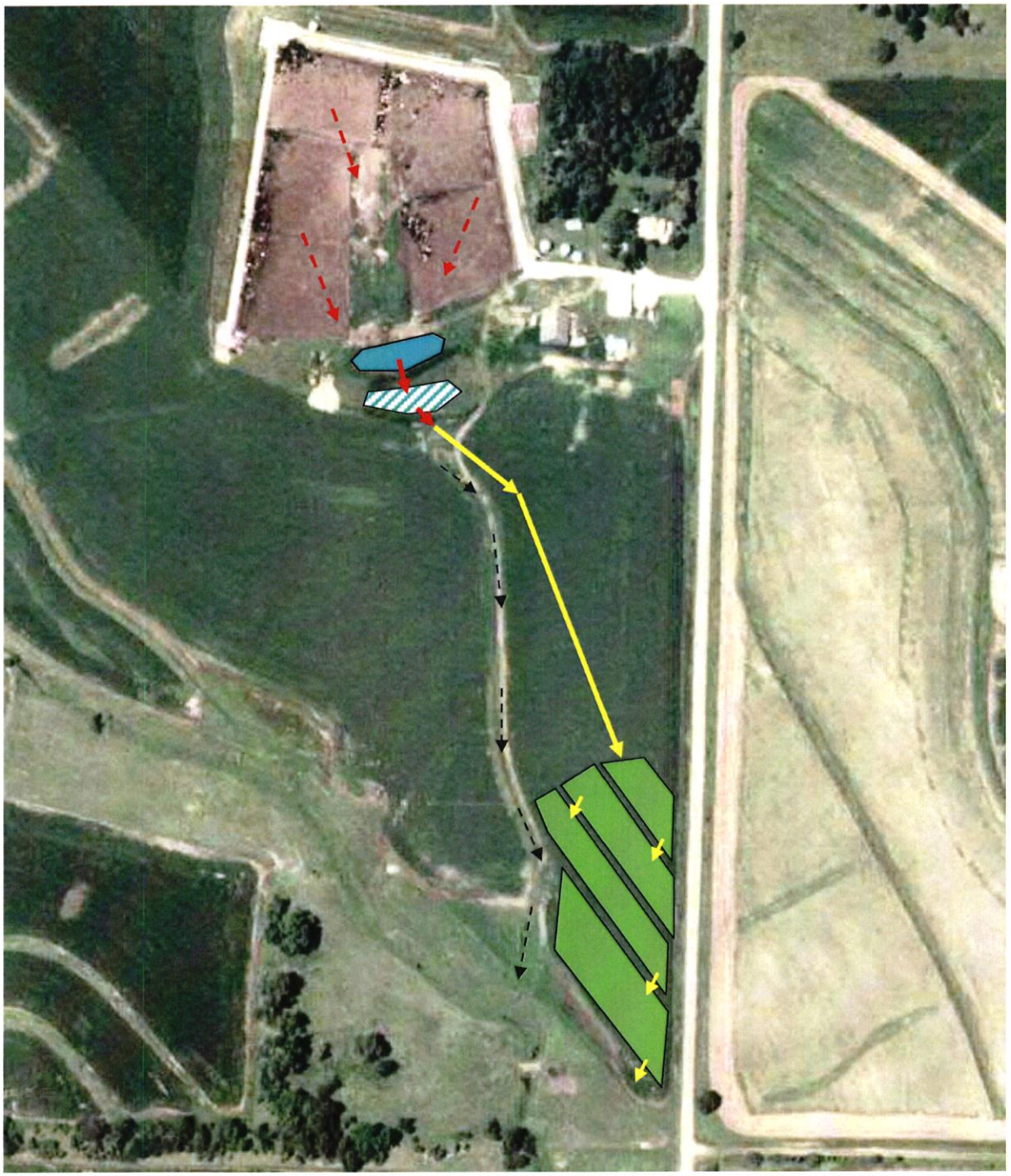


The filter/treatment areas will hold water to a depth of 4-6 inches and will have entirely flat bottoms. The terraces would not need to be more than 2 feet tall on the upslope side. Making the terraces fairly low and wide may make maintenance and potential mowing easier. Transferring flow from one treatment area to the next lower area could be done through a riser pipe and tile line. I would suggest a 10" Tee (Hickenbottom or equivalent) with a non-perforated riser that extends high enough to generate a liquid depth of about 4-6 inches in the treatment area. For maximum flexibility, the riser could be constructed to just reach the ground surface in the treatment area with multiple extensions that could be added to adjust the liquid depth in the 0 to 6 inch range. The depth chosen can be determined after observing the infiltration characteristics of the treatment area after grass establishment.

The tee would be attached to 10" non-perforated drainage pipe that would direct flow into the second treatment area. In the event that the drain tube would become plugged with vegetation, it would be wise to have a low spot in the end of the treatment area berm to serve as an emergency overflow to prevent damage to the primary berm. This overflow area would only need to be six inches lower than the rest of the berm and 8 to 10 feet wide.

A similar outlet structure would be built at the east end of the lower treatment area releasing the overflow water on the ground surface in a location least likely to cause channeling or erosion.

Feedlot runoff flow direction is shown in red dashed arrows.
The primary settling basin is shown in blue.
The secondary settling basin is shown in blue hash lines.
Settling basin dewatering outlets are shown with solid red arrows.
Previous settled effluent movement (now overflow only) black dashed arrows.
New settled effluent transfer pipe is shown in yellow arrows
Treatment/infiltration area is shown in green



Transfer of the lower settling basin outlet discharge to the treatment area will be through a non-perforated corrugated plastic drain line. It is not practical to size this transfer line to carry the peak flow expected during extreme rainfall events. I would suggest using 10" non-perforated drainage tube. Pending more accurate elevation measurement, I think the transfer line can be run at a grade of 0.5 to 1.0 percent. The outlet structure in the secondary settling basin should be designed to accommodate the full flow expected in the transfer line. This flow can come into the open top of the outlet structure. One or more smaller dewatering holes located at the bottom of the outlet structure (and perhaps also at intermediate depths) will allow complete dewatering of the settling basin to the treatment area at times you determine to be suitable for additional water in the treatment area. Again, pond outlet boxes from Agri-Drain or home-made outlet boxes would be suitable. I will work with you on design if you wish.

The soils in the treatment area are a combination of Marshall silty clay loam and Colo-Ackmore-Judson complex. Both of these soil map units have relatively good internal drainage which should help with infiltration and vegetation support.

My previous letter described suggested improvements to the settling basins including a dewatering outlet in the primary basin and berm improvements on both basins.

Diverting the settling basin effluent from the vast majority of rainfall events to the treatment area will allow better maintenance of the existing grassed waterway. Reduced total drainage area and reduced frequency of concentrated flow should allow the waterway to better handle overflow from the secondary settling basin when the outlet structure and transfer line cannot keep up. Based on our experience, I believe this will only happen with one or two of the heaviest rainfall events each year.

Again as a reminder, a well designed settling basin will meet the legal requirement for solids settling only if it is properly maintained. Make sure solids are removed frequently and the outlet is functioning properly to dewater the basin after runoff events. As discussed at our August 26 meeting, diverting pen runoff around your manure stockpile will reduce the amount of manure solids accumulating in the settling basin and minimize the amount of water re-absorbed into the stockpile.

As you look at these suggestions, please feel free to ask about modifications or more details. I would be happy to make modifications that would make this plan work better in your livestock operation.

Shawn Shouse

Shawn Shouse
ISU Extension Ag Engineering Field Specialist