Comments: Modifications to C&H Hog Farm

David Peterson, 56 Ridge Drive, Greenbrier, AR 72058, drpdrp@windstream.net, 501-679-2935

The proposed modification of coverage for the C&H Hog Farm includes a proposal to install a permanent pipeline/sprinkler system from waste storage pond 2 to fields 5-9 and the use of additional equipment that has the potential to further phosphate load fields already high in phosphate.

There are no details given about the proposed pipelines (size of pipe, capacity, above ground vs. below ground, length, waste storage in the pipeline, etc.), safety measures (automatic shutoff valves, etc.), operating protocols, or source methodology (i.e. top, bottom or agitated withdrawal). On that basis, **the proposal should be considered incomplete.**

A more **substantial reason for rejecting** the proposal is that these fields already have a level of phosphate greatly exceeding agronomic needs (10 lbs P_2O_5/ac/yr for each ton of hay, 5-10 lbs P_2O_5/ac/yr for each grazing unit). Take field 7 for instance, the 2012 application gives a concentration of 178 ppm = 356 lbs P/ac = 815 lbs P_2O_5/ac. The annual report for 2014, field 7, lists 94 ppm = 188 lbs P/ac = 432 lbs P_2O_5/ac. There is no need to increase the capacity of effluent spraying on field 7 (or the others) when there is already a 40 year agronomic supply, unless phosphate is viewed as a waste product to be dispersed into the environment. A commonly suggested P threshold level is 3-5 years of agronomic needs.

However, quite apart from the fact that field measurements of phosphate often have a high standard deviation (e.g. it is implausible that field 7 actually experienced a decline of 47% in phosphate concentration in two years), the number of computational and data errors in both the application and various reports (see below) suggests that the modification request is **incomplete** pending larger data sets and more accurate reporting.

The API (Arkansas Phosphate Index), like phosphate Indices in 48 other states, was intended to reduce CAFO runoff by statistically identifying pollution outliers – farms/fields with relatively low or moderate phosphate levels but larger than expected P loss. Farmers with fields at high risk (100 >API > 67) must reduce application rates, and are urged to implement "best management practices" (e.g. timing, fencing, buffers, etc.) to achieve a medium or lower rating (API < 67). A very high risk (PI > 100) requires no P application, and immediate remediation efforts. Thus the API has a two thresholds, API = 67 or 100.

Two questions arise:

i) Are these API thresholds appropriate for management decisions in the Buffalo National River watershed?

And, if so,

ii) What actions (or inactions) are indicted for the requested expanded spraying capabilities on fields 5-9?

“Revision of the 590 Nutrient Management Standard: Sera-17 Recommendations,” [Andrew Sharpley, et.al., 2011] has useful comments that apply to the Buffalo River Watershed, and they should be considered/resolved **before granting additional modifications** to the nutrient management plan.

- There is a point above which the risk of P loss from a field is too great to warrant application in any form

- Although there is no scientific evidence to support the use of STP (soil test P, lbs/ac) or P saturation alone to determine the risk of P loss; because P is a finite resource, states should consider establishing an upper limit of STP above which manure cannot be applied, regardless of P Index assessment

- Many P Indices force a P balance approach on individual fields at some point; however the point varies greatly and P Index values … are not tied directly to water quality

- Define P loss limits for a field based on quantitative water quality criteria for the target water body

- A P-balance approach will involve alternative technologies for manure utilization and export of manure from many farms in some watersheds.

One implication for the Buffalo River watershed is that all impacted parties need to be part of the solution to the swine CAFO water quality issue.

Current stream phosphate levels downstream from C&H

The federal designated use limit for streams is .1 mg/L total P. Accepted guidelines are:

0.01-0.03 mg/L – the level of uncontaminated lakes and streams

0.025-0.1 mg/L – level at which plant growth is stimulated

> 0.1 mg/L – accelerated growth and consequential eutrophic problems

Field tests indicate that API values at the “high” threshold (API = 67) and “very high” threshold (API = 100) correspond to concentrations of total P in runoff at approximately 1.0 and 1.6 mg P/L, far higher than the federal limit for streams (Sharpley et al, 2001). **This suggests limiting P applications when these limits are approached as may be the case in fields 5-9.**

But of course runoff from C&H is only a small part of the flow of Big Creek and the unanswered questions at this time are:

i) is dilution the pollution solution in Buffalo River tributary streams, and
ii) to what extent is C&H contributing to any problem?

For the period October 1 to December 31, 2014, 14 of 18 total P samples on Big Creek below C&H were in the "uncontaminated stream" category, with only one sample during high flows exceeding the federal standard. But 8 of 13 samples from a springs and culverts draining C&H were above the 0.03 level. None-the-less, samples drawn on Big Creek above and below C&H are not statistically different in the limited sampling so far.

These results indicate that increased phosphate loading on fields 5-9 implies increase P runoff, probably to levels that exceed federal stream guidelines. But there is not enough data to conclude that P levels on this one farm currently impair Big Creek or the Buffalo River.

Threshold Numbers for the API

The determination of allowable P loss from farm fields [i.e. thresholds] is a policy decision. However, this critical decision has instead been made by P-Index model designers…buried within the P-Index structure [Joseph Rudek, 2011, A Review of the Pennsylvania Phosphorus Index: Version 2].

It is no surprise that "recent litter applications" (e.g. 6 months) are a major contributor to phosphorus runoff concentrations – by as much as a factor of 10 for the same soil P values! But in the absence of recent applications, both total P and dissolved P are good predictors of phosphorus concentrations in runoff (R^2 = .80 in one study) [Rudek]. In essence, PI indices try to incorporate these dissimilar contributions into one model. Analysis, then gets complicated, opaque really, and the setting of thresholds becomes unsatisfying.

The threshold for a rating of very high (e.g. API >100) is not directly linked to any specific water quality standard or STP, but rather to a high percentile of actual **worst case PI values** - 20% is a common suggestion. We might cringe at the thought that our Big Creek/National River standards are derived from some worst case percentile. If this needs to be done, wouldn't the median or best 20th percentile be better targets?

API thresholds, Field 7 example

According to the 2014 Aggregate Split Application Table, the C&H application rate was 7,030 gallons/ac, with P_2O_5 content of 18.1 lbs/1000 gal, thus 127 lbs P_2O_5/acre - 12 times the agronomic need! The 2014 Aggregation table implies an API increase for the year as PI 25. If this report is accepted as approximately accurate and these high rates of application continue, the "very high" threshold could be exceeded in several years. It must be recognized that continual, long-term application of P above crop P removal rates will eventually elevate STP levels to an extent that **alternatives to application may be needed** [Using the 2010 Arkansas Phosphorus Index, Andrew Sharply, et.al.].

The API model assumes that most of the many variables are independent random variables and so the API it is **not a robust statistic**. It is also **susceptible to sincere or insincere manipulation**.

The WEP (water extractible P) concentrations during the reporting period are listed as: .31 (pond 2, 3/10/2014), .26 (9/24/2013), .23 (pond 1, 3/10/2014), reflecting routine fluctuations in pond usage. Using these values to estimate API impact as above, the numbers, assuming equivalent application rates, are: change in API = 33, 28, 25, respectively*, in reasonable agreement with the table value. Using the same numbers but changing a spring application by one day, from March 1 to February 28, increases these estimates by 24%: change in API = 41, 35, 32. Including fencing and field borders in the bmp multiplier reduces these estimates by 37%! The same data, and various concentrations, also can be used to estimate current API: API = 52, 47, 44 (medium level).

In the APT model the very small value for STP_{coef} represents the notion that once phosphorus permeates the soil it is basically immobile. Thus the very high threshold level is reached only at the very large load, STP = 706 lbs P/acre = 1615 lbs P_2O_5/ac – 161 times the yearly agronomic need. The high threshold is reached at STP = 380 lbs P/ac = 870 lbs P_2O_5/ac, which is approximately the P level reported in 2012! But phosphorous is not that immobile. According to a split-line Sharpley regression model, phosphorous concentration in runoff is about 6 times larger (3 mg/L) at the STP = 1000 level than at STP = 200 [Sharpley et al,2001, Assessing site vulnerability…]. Soil is not an indefinite storage tank for phosphorus, it just spreads the P loss over time, and ultimate runoff over time.

*Assumed variable values: MNRL = .05, TP = 55 lbs P/ac, soil erosion 1.1 ton/ac/yr, occasional flooding, rotational grazing, soil class B, STP_{coef} = .0018, slope = .03, runoff class N, runoff curve 61, bmp multiplier = 1, STP = 188 lbs P/ac.

Numbers:

The usefulness of the API depends on accurate estimates of several variables, but unfortunately there are many mistakes and/or possible misrepresentations in the initial application and periodic and annual reports.

Hay Yields

A ton of hay contains about 10 lbs of phosphate, so the amount of exported hay is integral to estimating the rate of phosphate build up in the soil. The average hay yield in Newton County, the state of Arkansas, and the United States is about 2 tons/ac (USDA yearly report - 2007, 2012). The initial C&H application gives a “target” value of 6.5 tons/ac (North Dakota Bermudagrass) and ADEQ supports this with a “target” value for Bermudagrass of 8 tons/ac (NRCS Part 651). The high yield targets found in university studies are only obtainable with select hybrids, adequate moisture and application levels of Nitrogen fertilizer far higher (~300 lbs/ac) than actual application rates from liquid swine waste on C&H. So what is in a typical C&H hay field, and how do yields actually compare to the “targets”? (NRCS 651 also lists tall fescue at 3.5 tons/ac, and Timothy at 2.5 tons/acre as targets)

To avoid **the appearance of cherry picking data**, why not use actual data from 2014 farm output? It is easy enough to count exported bales of hay and rotational/continual grazing units. 1 ton of hay is approximately 2.2 round bales.

Recently, there has been a switch of product targets on C&H from hay to rotational or continuous grazing. This is an important change because grazing cattle remove much less phosphate per hay ton than hay exportation. A yield of 6 tons/ac could support a density of 2-3 units/acre. This would imply a grazing herd of 1260-1890 units on the farm. One C&H report showed continuous grazing at less than .75 units/ac (fields 3,9,10,15,17) and then >.75 on the year-end report.

Actual data on herd size and total unit grazing days would allow a much needed, **reasonably accurate estimate of yearly phosphorous removal via agricultural product.**

C**onversion factors, inconsistent data, incorrect or missing data, inconsistent number reporting** – a few examples

- The **most glaring error** is contained in the document, "C&H Hog Farms, Inc. Frequently Asked Questions, Permit No. ARG590001, AFIN 51-00164 page 3, item 5. The Arkansas Phosphorus Index itself is miss-stated, leaving out the multiplying factor of 100/1.8 = 55.6. The example offered has STP = 1000 ppm = 2000 lbs/ac (correct units), giving a contribution to 2000 x .0018 x 55.6 = 200. This directly contradicts the example's intended direction of illustration, "will contribute 1.8 points to the Phosphorus Index. An error for sure but it betrays lack of farm awareness: 1000 ppm for STP would be a stupendous load not likely to be seen even on the worst managed farm, and a factor that could not be ignored with any PI.
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- The **conversion factor** for soil test P (ppm-lbs/ac) is 2 in the original application and 1.33 in the 2/25/2015 final report. The discrepancy could be due to a change from a 6" to a 4" soil test or a typo when compiling the spreadsheets, but in any case, which of the columns are correct?

- Field 7 is listed as 150 ac on 2/17/2012, 64.3 acres on 4/3/2014; 79.8 acres on F1- WUSS. In the aggregate split application the indicated acreage is 44, 79, 56 in the last three columns.

- The 2014 aggregate sheet indicates a 2,368,000 gallon application total, the 2014 annual report lists 2,614,000 gal, the 2014 summer revision lists 3,210,000 gal. The initial 2012 application projected 2,090,000 gal.

CONCLUSIONS:

1. The application is incomplete.
2. Several variables used in the API have a large variance, perhaps intrinsically. This makes the non-robust API statistic difficult to use in setting thresholds.
3. According to SERA experts, the API allows STP build-up, resulting, in some cases in the necessity of other management plans that augment P removal.
4. API values are not directly correlated to watershed water quality.
5. Current STP values in field 7 (and likely 5-9 as well) greatly exceed agronomic needs and are approaching high API levels. There is no strong need to invest in pipeline equipment that may be unneeded and might, through overuse by convenience or cost concerns, contribute to the P loading problem.

6. P runoff control is a watershed issue that should involve all impacted parties before substantial changes in nutrient management plans. Managing P pollution at a 20th percentile worst case level may not be best management practice for a national river.

Arkansas Phosphorous index: API = 55.6 x P Source Potential x P Transport Potential x BMPs Multiplier
P Source Potential = {WEP_{coef} x [WEP + $MNRL_{coef}$ x (TP - WEP)]} + STP_{coef} x STP
P Transport Potential = Soil Erosion Index + Soil Runoff Index + Flooding Index + Application Method Index + Timing Index
BMPs Multiplier = (1 – eff1)(1-eff2)….(1-eff9), where the various eff_ numbers reflect the effectiveness of various conservation practices
55.6 is a normalizing factor used to make the "very high" threshold level equal 100

From:	drpdrp@windstream.net
To:	Water Draft Permit Comments; drpdrp@windstream.net
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Attachments:	Comments, 2015.docx

I have attached my comments on the proposed modifications, deadline April 17.

I have backed up my comments with fairly detailed verifications, if they are in error I would appreciate a reply, or better, a discussion with a staff member. There are multiple numerical errors, not just typos, serious errors that could impeded effective regulation no matter what side of the issue a person is on.

David Peterson, Ph. D. mathematics
56 Ridge Drive
Greenbrier, AR 72058
501-679-2935