Denitrifying Bioreactors

Clarification and Approval as Interim BMP

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Watershed Technical Workgroup
July 19, 2018

Denitrifying Bioreactors

Clarification and Approval as Interim BMP

- 10:30 – 10:40
- Agricultural Ditch Denitrifying Bioreactors Interim BMP

  Jeff will address the 20% TN clarification asked for during last month's meeting regarding the technical appendix for the agricultural ditch denitrifying bioreactors interim BMP.

  Decision requested: Approval of the interim BMP to move forward to the WQGIT.

Denitrifying Bioreactors

Clarification and Approval as Interim BMP

- Expert Panel is assessing Denitrifying Bioreactors along with other types of ditch management
- 4/19/18 – AgWG approved BMP as interim in CAST for jurisdictions' WIP planning
- 6/7/18 – Interim report as technical appendix presented to WTWG
  - DECISION: The group agreed to approve the interim BMP to utilize in CAST for planning purposes, with the condition that the 20% reduction is correctly described
  - VA asked for clarification of what 20% applies to, NO3-N or Total N, and to ensure the calculation of benefit is correct
  - Reported units are acres treated = the area of fields draining to the technology

Denitrifying Bioreactors

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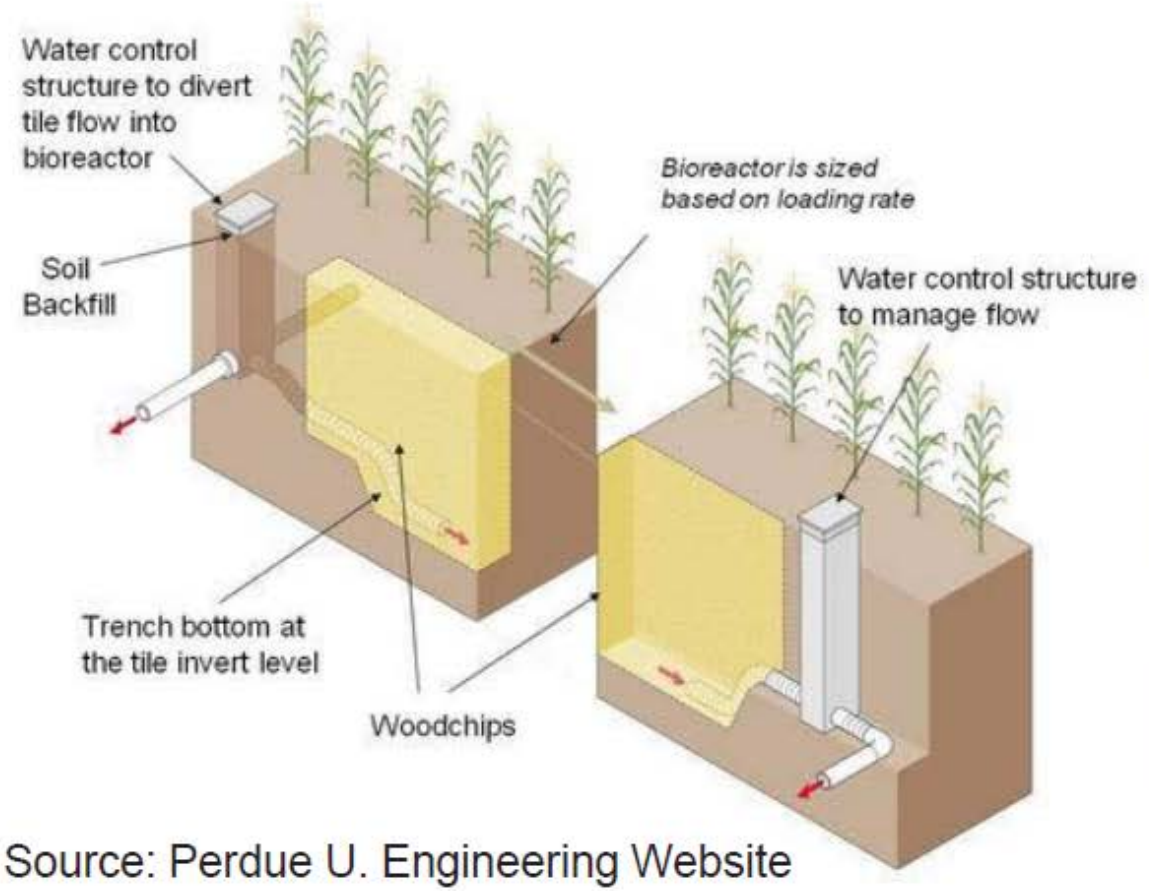
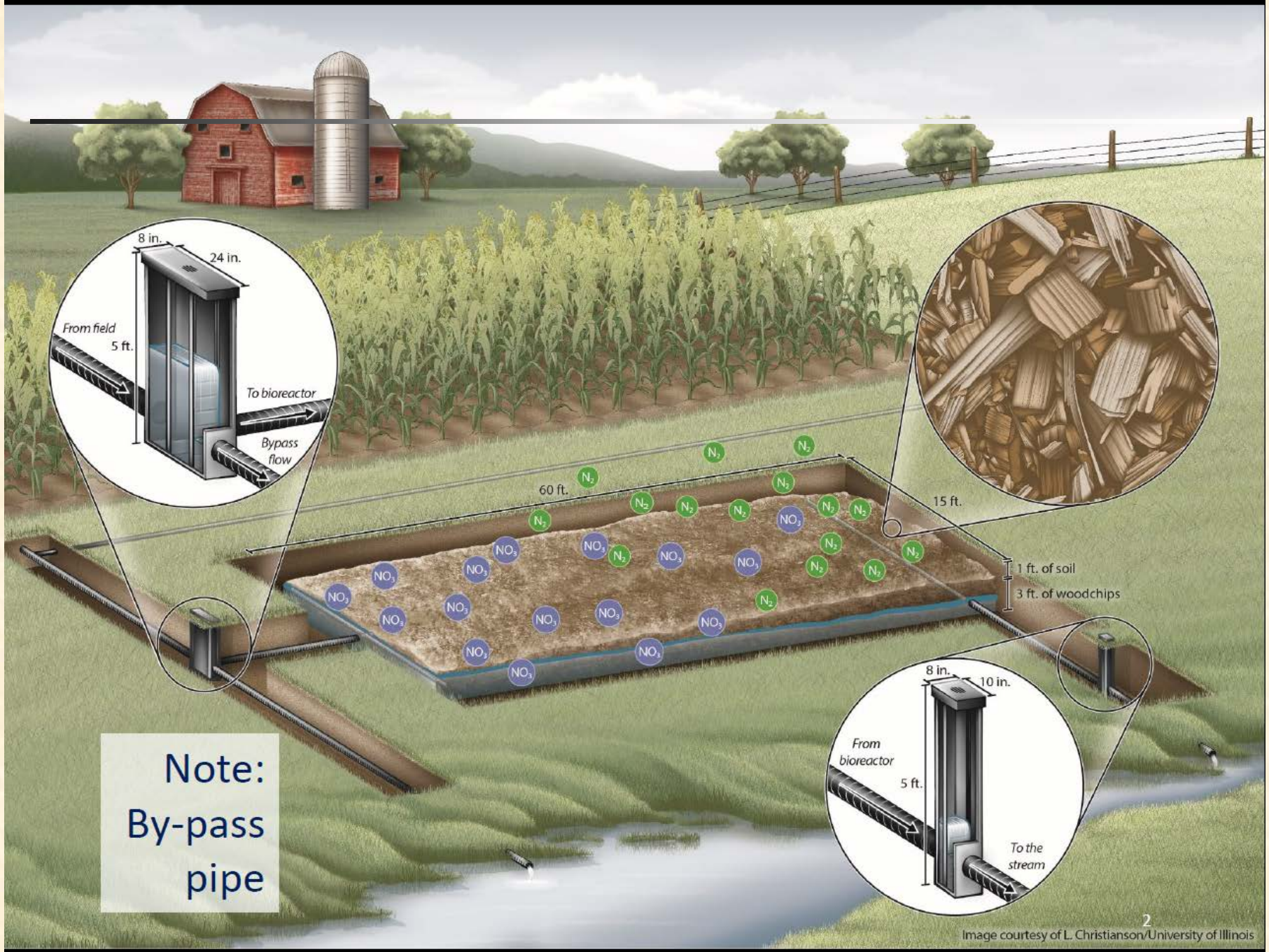


Source: Perdue U. Engineering Website

Source: Upper Susquehanna Coailition Website

NRCS Code 605: A structure that uses a carbon source to reduce the concentration of nitrate nitrogen in subsurface agricultural drainage flow via enhanced denitrification.


8 in.
24 in.
From field
5 ft.
To bioreactor
Bypass flow
60 ft.
15 ft.
1 ft. of soil
3 ft. of woodchips
8 in.
10 in.
From bioreactor
5 ft.
To the stream
Note:
By-pass
pipe
2
Image courtesy of L. Christianson/University of Illinois

Denitrifying Bioreactors

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- Dr. Laura Christianson, Department of Crop Sciences, University of Illinois

Summary

- Midwest: 25-45% total load reduction for tile drainage bioreactors
- Addy et al., Meta-analysis: (given scenario assumptions)
  - Beds: 34% load reduction mean (not including by-pass flow)
  - Sawdust walls: 5% load reduction (*are there better values for walls?*)
- Peer-reviewed for CPB:
  - Rosen and Christianson: tile-drainage bioreactors: 24% total load reduction
  - Christianson et al. (2017):
    - Sawdust wall: >90% concentration reduction
    - In-ditch: 65% concentration reduction (*are there better values for in-ditch bioreactors?*)
      - Ditch-diversion: 25% load reduction
- Needs:
  - Monitoring: Need flow and concentration (including by-pass flows)
  - Better accounting for different kinds of bioreactors (tile bioreactors vs. in-ditch bioreactors vs. ditch diversion bioreactors vs. sawdust walls)

Denitrifying Bioreactors

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- The reference material for the recommendation of 20% load reduction refers to nitrate (NO3-N), not Total N
- Efficiencies in the model are associated with Total N, not nitrogen species
- Recommendation is to make conversion of 20% effectiveness – as has been done with several other BMPs – and apply that as interim model credit. Ensure the Expert Panel clearly documents species benefit versus Total N benefit
- Approval as interim BMP for WIPs with those clarifications/actions?

Vegetated Subsurface Outlet/Saturated Buffer

Technical Appendix and Approval as Interim BMP

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Vegetated Subsurface Outlet/Saturated Buffer

Technical Appendix and Approval as Interim BMP

- 10:40 – 10:55
- Saturated Buffers Interim BMP

  Jeff will present the technical appendix for the saturated buffers interim BMP to the workgroup.

  Decision requested: Approval of the interim BMP to move forward to the WQGIT.

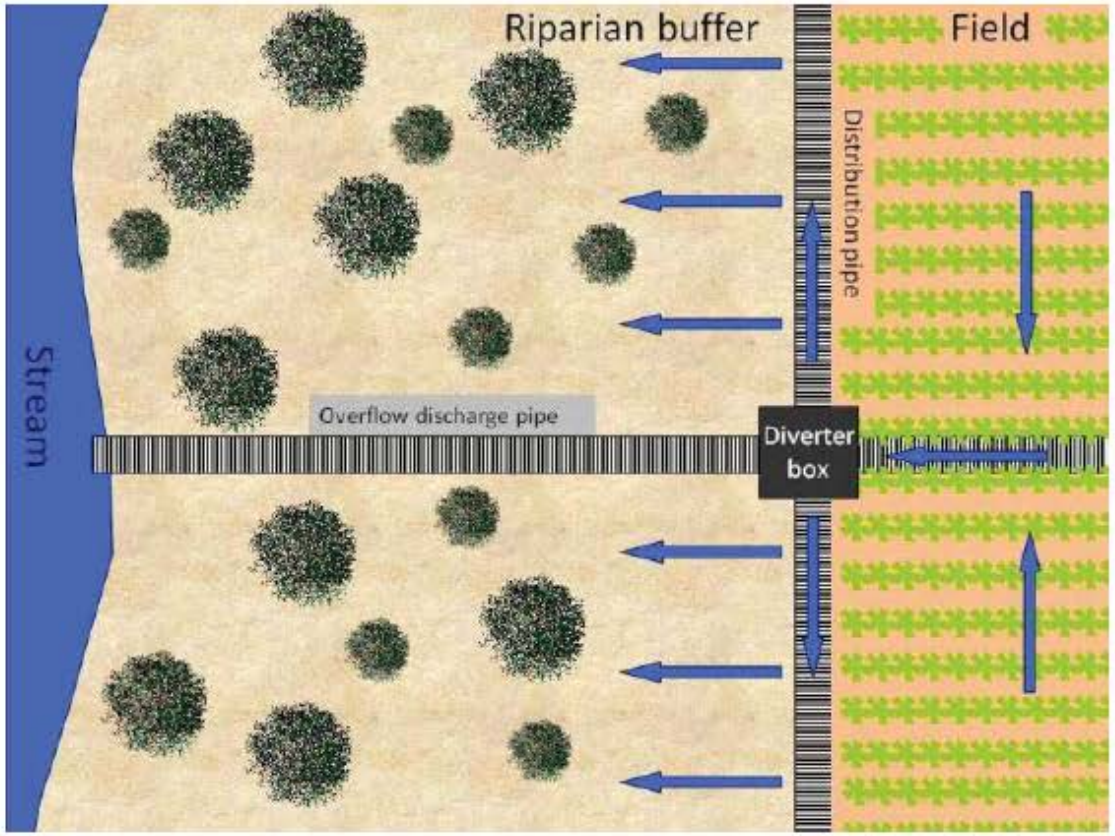
Vegetated Subsurface Outlet/Saturated Buffer

Technical Appendix and Approval as Interim BMP

- Expert Panel is assessing Saturated Buffers along with other types of ditch management
- Documentation for interim credit being presented at Agriculture Workgroup today, 7/19/18
- BMP as interim to be discussed at Monday's WQGIT meeting as informational-only briefing = definition + recommended effectiveness + requirements for modeling

Vegetated Subsurface Outlet/Saturated Buffer

Technical Appendix and Approval as Interim BMP



Source: Bruce Atherton, NRCS

Source: FarmWeekNow.com

NRCS Code 739: A water control structure and subsurface distribution pipe capable of diverting drainage system discharge to create an elevated zone of soil saturation.

Vegetated Subsurface Outlet/Saturated Buffer

Technical Appendix and Approval as Interim BMP

- BMP Definition:
  - This BMP represents the edge-of-field treatment for tile-drained cropland areas through practices that reduce nitrogen pollutant loads by diverting tile-line flow to a subsurface, perforated distribution pipe used to divert and spread drainage system discharge to a vegetated area to increase soil saturation.

Vegetated Subsurface Outlet/Saturated Buffer

Technical Appendix and Approval as Interim BMP

- Model Simulation:
  - Hydrologically connecting tile flow to an edge-of-field vegetated buffer encourages denitrification of nitrate-N in the tile water through typical biological processes that occur in a soil environment that underlies perennial vegetation – subsoil of a buffer – before exiting into a receiving water body, such as a ditch or stream.
  - A portion of the nitrate-N in the tile water may be subject to uptake by the vegetation in the buffer.

Vegetated Subsurface Outlet/Saturated Buffer

Technical Appendix and Approval as Interim BMP

- Effectiveness:
  - o "Ag Ditch Management Expert Panel recommends 20% efficiency "for total nitrogen" load per acre, to be used for planning purposes only – conservative estimate subject to change"
  - o One acre of buffer area treats 10 upslope acres of representative land use and cropping system
- Measurement to be submitted:
  - o Length of saturated buffer or area of saturated buffer, all applicable CAST geographies
- References listed

Vegetated Subsurface Outlet/Saturated Buffer

Technical Appendix and Approval as Interim BMP

- As with Denitrifying Bioreactors, the 20% efficiency is considering just NO3-N, not Total N
- Area of upland benefit of Saturated Buffers greater than riparian forest and grass buffers
  - Efficiencies for forest and grass buffers apply to 4 upland acres
- As references:
  - Riparian forest buffer efficiencies = 65%, 31%, 19% on the coastal plain (dissected uplands, uplands, lowlands); default width = 35’; narrow buffer width = 10’ – 34’
  - Riparian grass buffer efficiencies = 46%, 21%, 13% on the coastal plain (dissected uplands, uplands, lowlands); requirement to submit length and width for progress reporting

Vegetated Subsurface Outlet/Saturated Buffer

Technical Appendix and Approval as Interim BMP

- Essentially, model credit method is very similar to buffers
- There's additional credit for landuse coversion

Vegetated Subsurface Outlet/Saturated Buffer

Technical Appendix and Approval as Interim BMP

- Recommendation is to make conversion of interim efficiency to accommodate Total N – as has been done with several other BMPs – and apply that as interim model credit + ensure the Expert Panel clearly document species benefit versus Total N benefit
- Approval as interim BMP for WIPs with those clarifications/actions?