

Denitrifying Bioreactors: A Cost-effective bmp to reduce nitrate.



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Woodchip Bioreactors



- Passive technology to convert Nitrate to Di-nitrogen gas.
- Edge of field
- Gravity fed
- Low maintenance
- Highly efficient

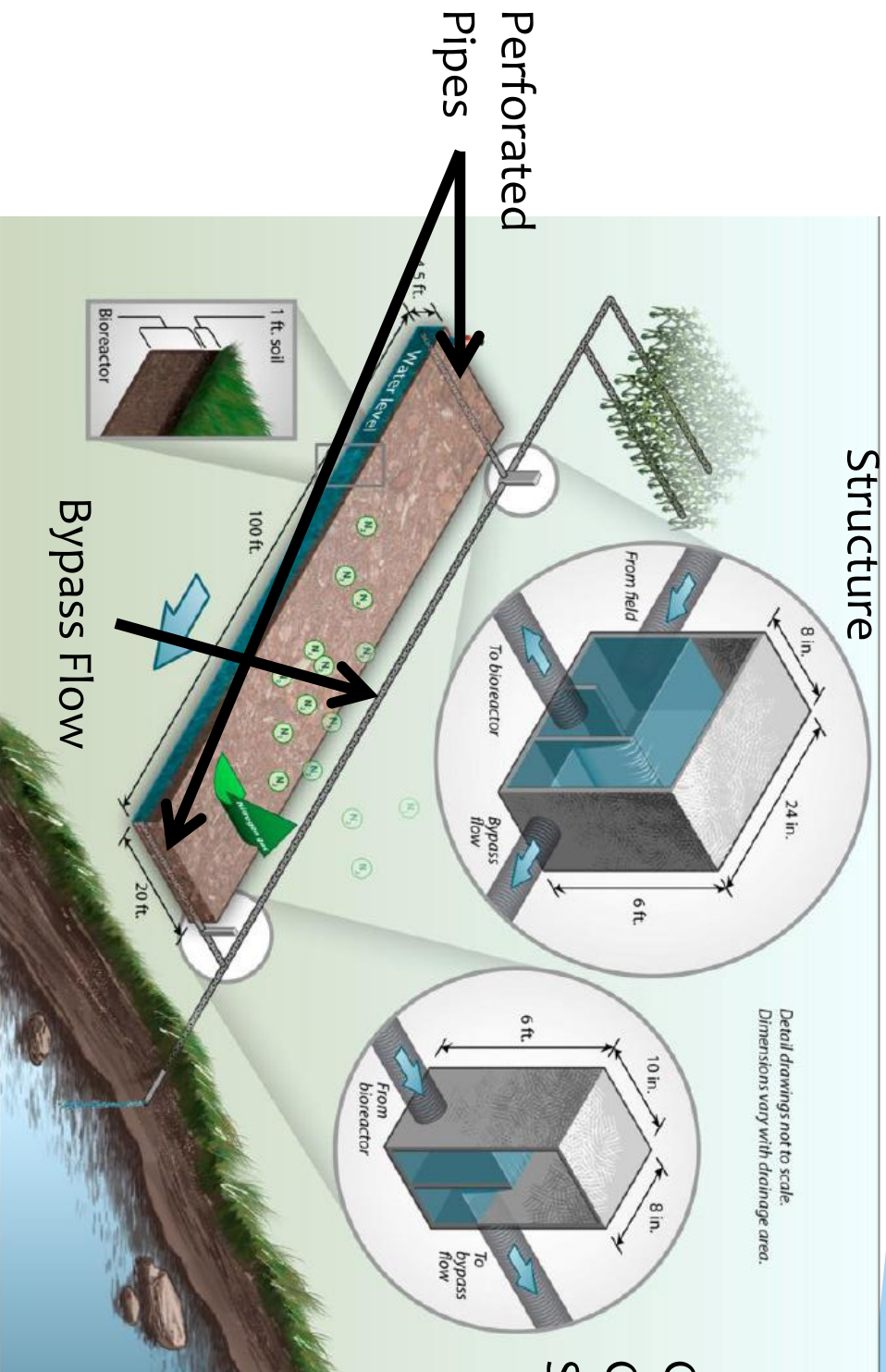


Woodchip Bioreactor Basics

Components

Diversion

Structure



Capacity
Control
Structure

Diagram by Laura Christenson



Woodchip Bioreactors



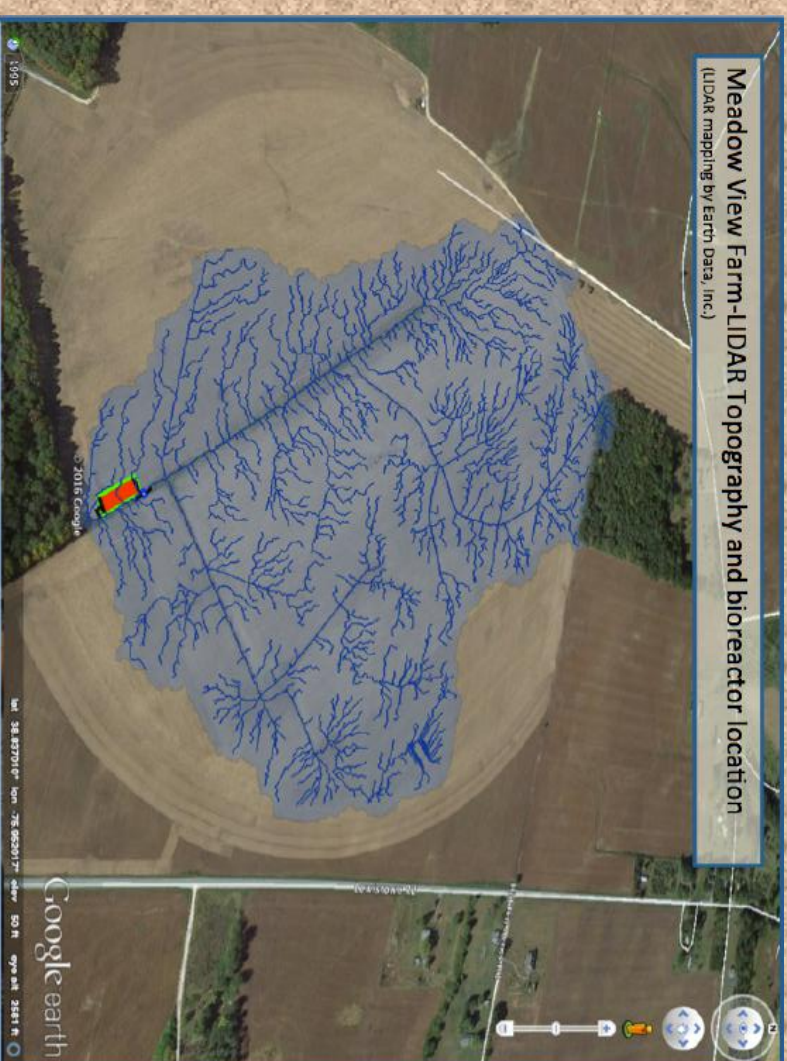
- ✓ Ridge to Reefs has installed six Bioreactors on the Eastern Shore of Maryland
- ✓ We have tied them in to different types of water sources
 - ✓ **Drain tiles**
 - ❖ Drag-line ditches
 - ❖ Ponds



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RTR staff have installed 6 bioreactors

Dick Edwards-Oakland View Farm

Bill Mason- Mason's Heritage Farm

Dean Vorhees, Burrsville

Hutchison Brothers-Franklinville Farm,

Hutchison Brothers- Bradbury Farm,

Ed Fry, Fair Hill Farm



Dick and Jan Edwards,
Scott and Jill Youse



Bobby Hutchison



Bill Mason

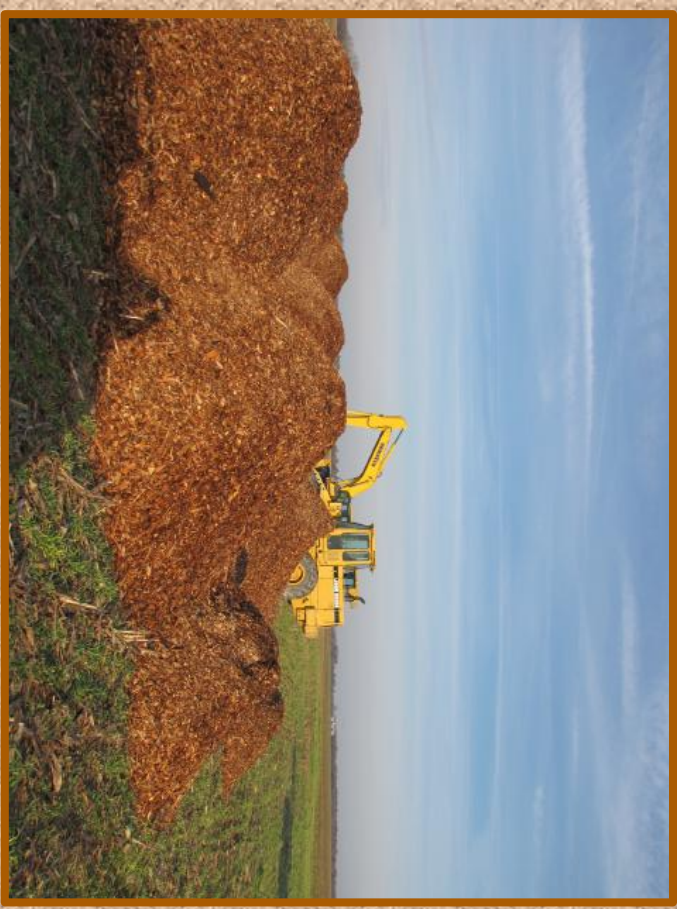


Ed and Marian Fry

Oakland View Farm, Ridgely, MD NO3 (mg/l)

| Date | Box 1 | Box 2 | Reduction % |
|----------|-------|-------|-------------|
| 8/20/14 | 16.20 | 0.00 | 100% |
| 8/28/14 | 18.20 | 0.00 | 100% |
| 9/5/14 | 14.40 | 0.00 | 100% |
| 9/11/14 | 48.70 | 0.00 | 100% |
| 9/17/14 | 19.50 | 0.00 | 100% |
| 9/23/14 | 10.90 | 0.00 | 100% |
| 10/8/14 | 5.10 | 0.00 | 100% |
| 10/16/14 | 5.30 | 0.00 | 100% |
| 10/23/14 | 0.90 | 0.00 | 100% |
| 11/7/14 | 3.80 | 0.00 | 100% |
| 11/21/14 | 1.30 | 0.00 | 100% |
| 11/25/14 | 18.20 | 0.00 | 100% |
| 12/11/14 | 5.80 | 0.00 | 100% |
| 1/15/15 | 4.30 | 0.00 | 100% |
| 1/22/15 | 8.20 | 0.00 | 100% |
| 1/29/15 | 15.10 | 0.00 | 100% |
| 2/4/15 | 10.10 | 0.45 | 96% |
| 2/12/15 | 4.89 | 0.00 | 100% |
| 2/25/15 | 2.34 | 0.00 | 100% |
| 3/10/15 | 2.46 | 0.31 | 88% |
| 3/17/15 | 10.64 | 0.58 | 95% |
| 3/25/15 | 5.22 | 0.15 | 97% |
| 3/31/15 | 3.08 | 0.06 | 98% |
| 4/10/15 | 0.10 | 0.01 | 90% |
| 4/16/15 | 1.34 | 0.01 | 99% |
| 4/22/15 | 0.08 | 0.02 | 81% |

Bioreactor Data

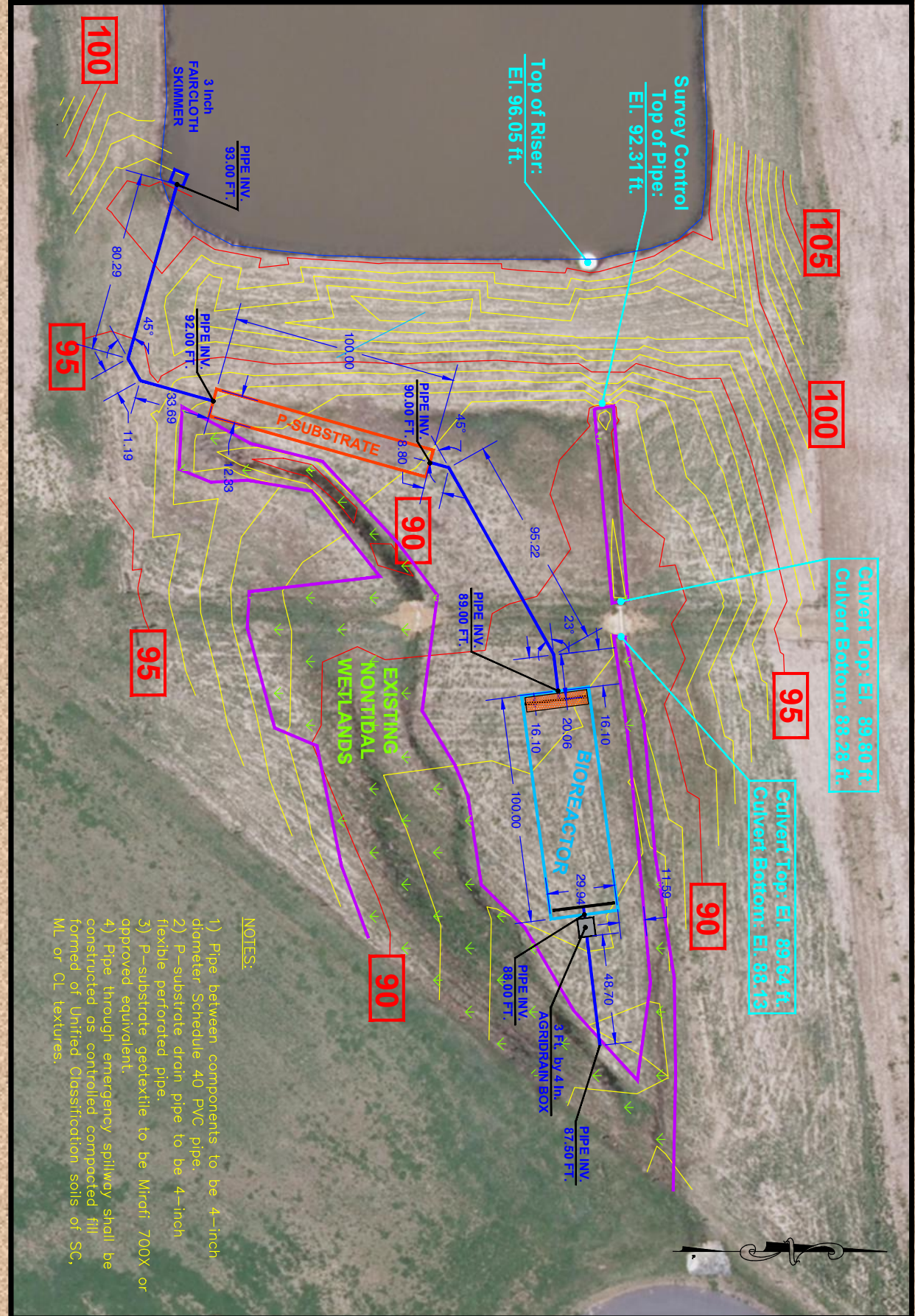


Mason's Heritage Farm, Ruthsburg, MD NO3 (mg/l)

| Date | Box 1 | Box 2 | Reduction |
|----------|-------|-------|-----------|
| 8/8/14 | 28.56 | 0.00 | 100% |
| 8/14/14 | 9.00 | 0.00 | 100% |
| 8/20/14 | 7.80 | 0.00 | 100% |
| 8/28/14 | 5.80 | 0.00 | 100% |
| 10/16/14 | 14.30 | 0.00 | 100% |
| 10/23/14 | 6.10 | 0.00 | 100% |
| 11/21/14 | 26.90 | 0.00 | 100% |
| 11/25/14 | 26.20 | 0.00 | 100% |
| 12/4/14 | 7.60 | 0.00 | 100% |
| 12/11/14 | 11.00 | 0.00 | 100% |
| 12/19/14 | 7.20 | 0.00 | 100% |
| 12/23/14 | 11.10 | 0.00 | 100% |
| 1/2/15 | 8.40 | 0.00 | 100% |
| 1/9/15 | 6.40 | 0.00 | 100% |
| 1/15/15 | 9.50 | 0.00 | 100% |
| 1/22/15 | 10.40 | 0.00 | 100% |
| 1/29/15 | 10.30 | 0.00 | 100% |
| 2/4/15 | 9.00 | 0.00 | 100% |
| 2/12/15 | 8.80 | 0.20 | 98% |
| 2/25/15 | 9.10 | 0.00 | 100% |
| 3/10/15 | 5.20 | 0.20 | 96% |
| 3/17/15 | 8.00 | 0.00 | 100% |
| 3/25/15 | 9.50 | 0.00 | 100% |
| 3/31/15 | 9.40 | 0.00 | 100% |
| 4/10/15 | 9.00 | 0.00 | 100% |
| 4/16/15 | 9.30 | 0.00 | 100% |
| 4/22/15 | 10.20 | 0.00 | 100% |

Bioreactor Data





- NOTES:**
- 1) Pipe between components to be 4-inch diameter Schedule 40 PVC pipe.
 - 2) P-substrate drain pipe to be 4-inch flexible perforated pipe.
 - 3) P-substrate geotextile to be Mirafi 700X or approved equivalent.
 - 4) Pipe through emergency spillway shall be constructed as controlled compacted fill formed of Unified Classification soils of SC, ML or CL textures.



CONSTRUCTION LAYOUT
 Water Quality Enhancement Project
 Fry Farm
 Kent County, Maryland


SUSTAINABLE SCIENCE LLC
 Ecological Engineering Services
 410 S. Second Street
 Denton, Maryland 21622
 Phone: (410) 924-4316
 www.sustainable-science.com

| | |
|----------------|----------------------|
| SCALE: | 1 inch = 40 feet |
| DRAWN BY: | A. McCullough |
| DATE: | August 5th, 2015 |
| LAST REVISION: | September 23rd, 2015 |
| SS PROJECT NO: | 15007 |
| SHEET NUMBER | 1 OF 1 |

Phosphorus-sorbing Filter under construction



Once the woodchips are in, we cover them with a porous filter cloth and then cover in dirt.



100% Completed P sorbing filter and woodchip bioreactor
fed by a Faircloth Skimmer

Outlet

Woodchip bioreactor

P- sorbing Filter

Faircloth Skimmer

