A Presentation of the 2011 IA-MN-SD Drainage Research Forum

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IOWA STATE UNIVERSITY
University Extension

SDSU Extension

Re-Saturating Riparian Buffers In Tile Drained Landscapes.

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and

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Natural Resource Ecology and Management

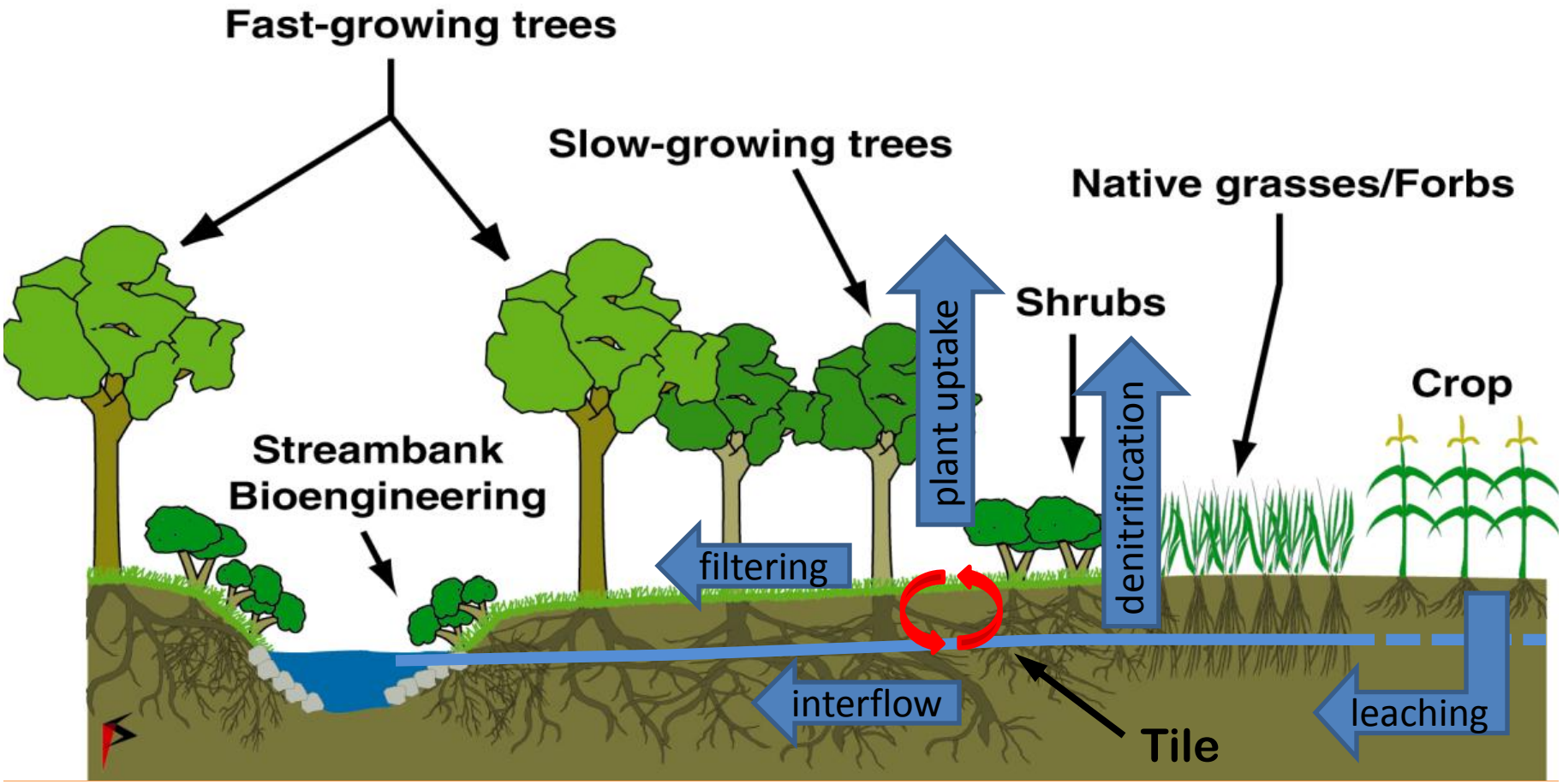
NLAE National Laboratory for Agriculture and the Environment

USDA 150 YEARS 1862-2012

Natural Resource Ecology and Management

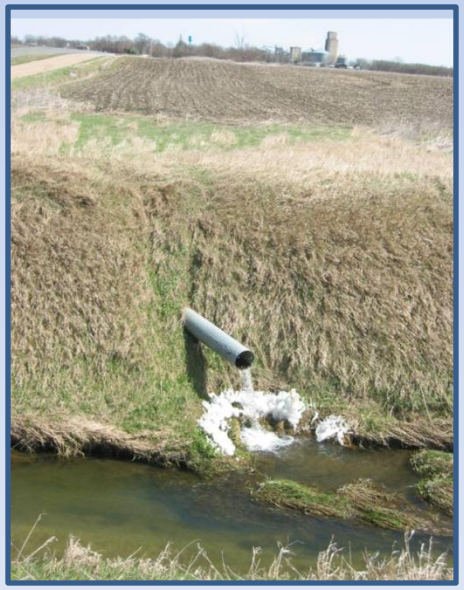
LEOPOLD CENTER

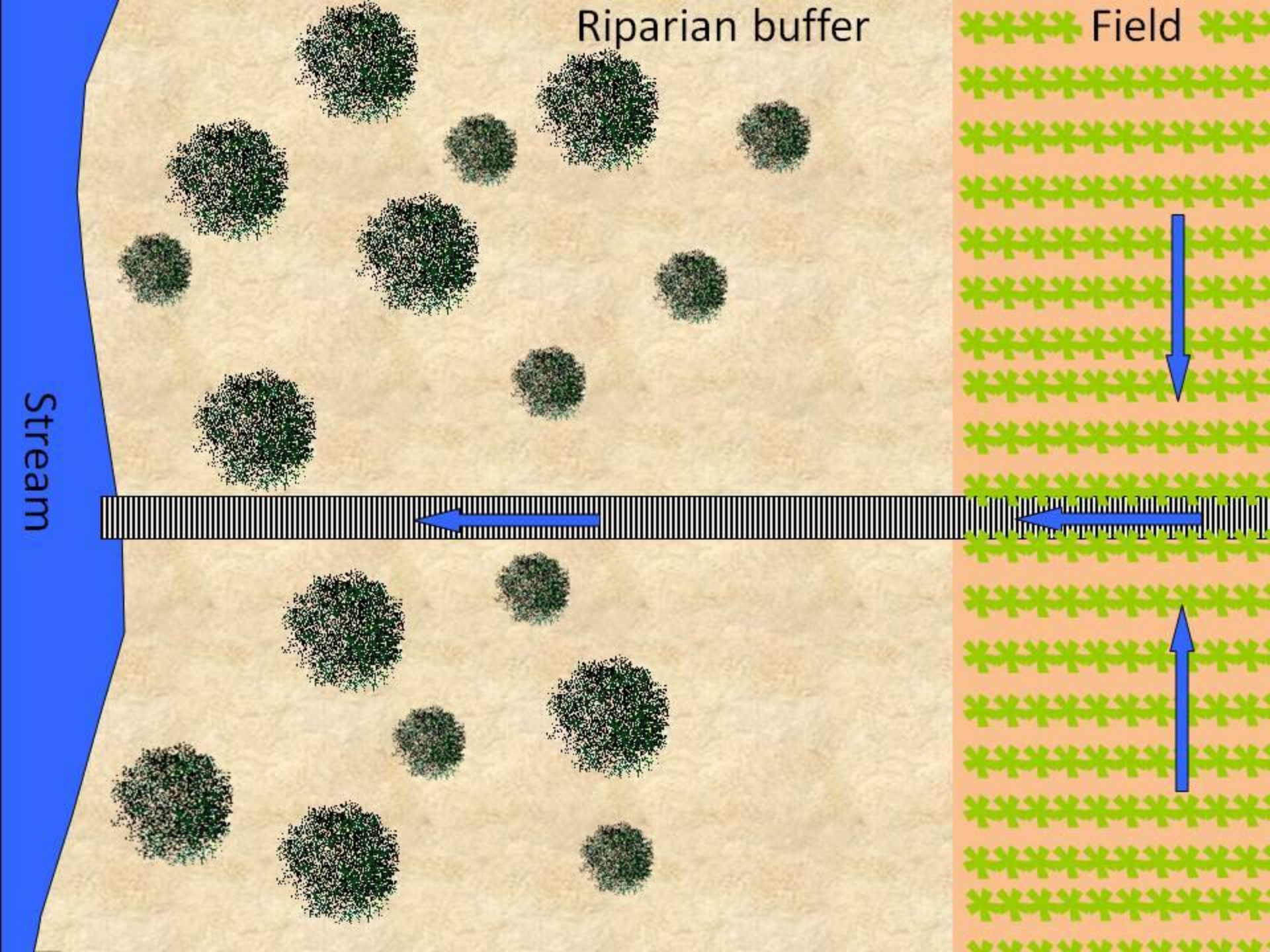
Schematic of nitrogen transformation and retention in a riparian buffer.

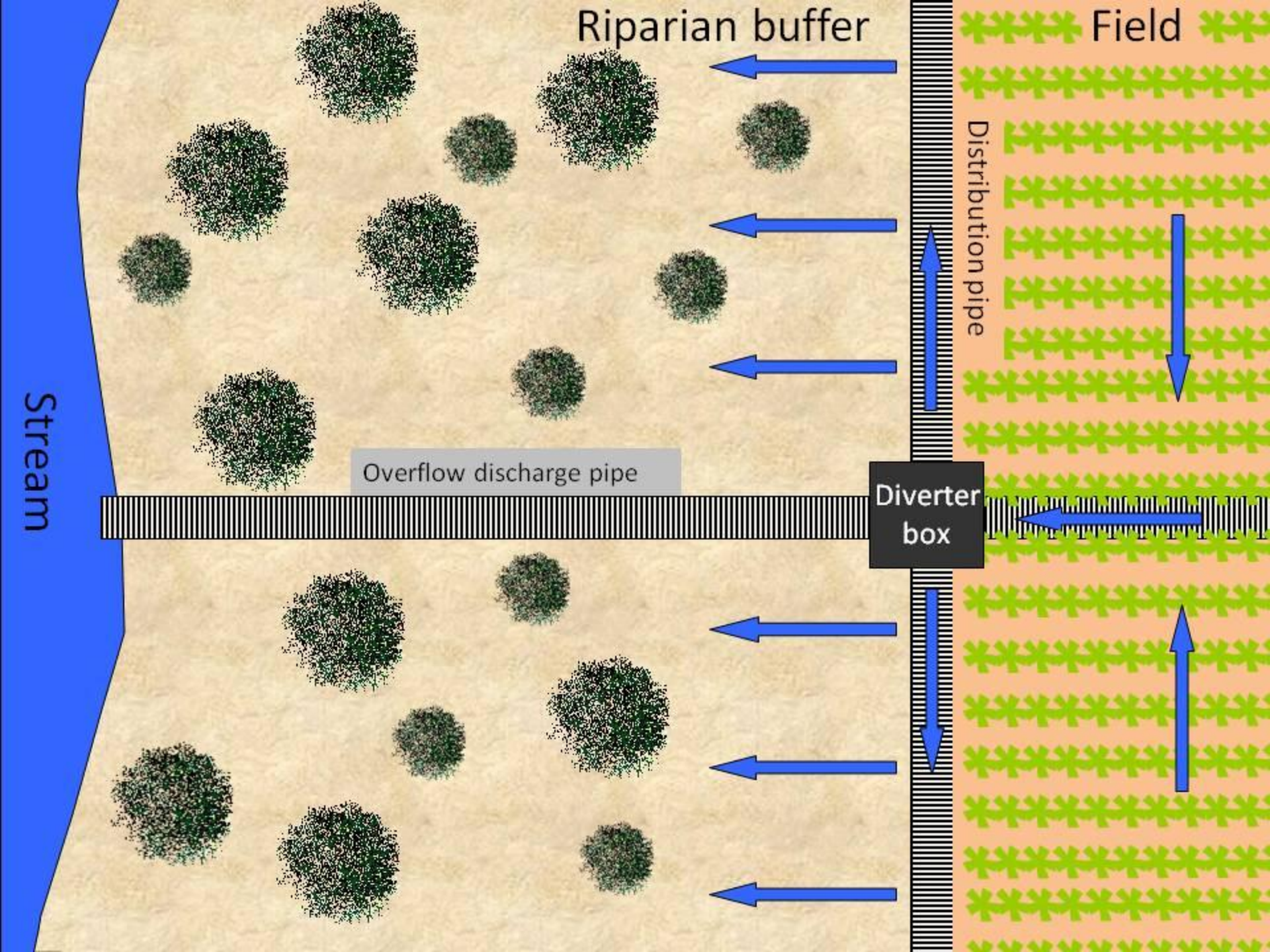


Question:

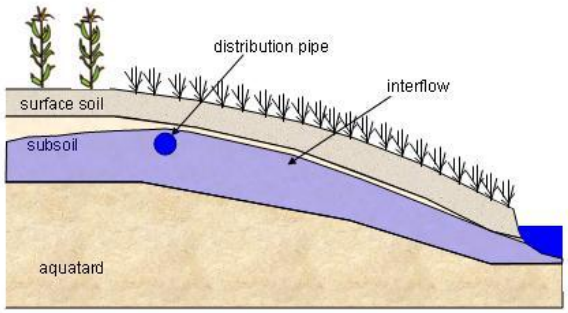
- Could reconnecting tile flow to riparian buffers remove substantial amounts of nitrate before it reaches surface waters?



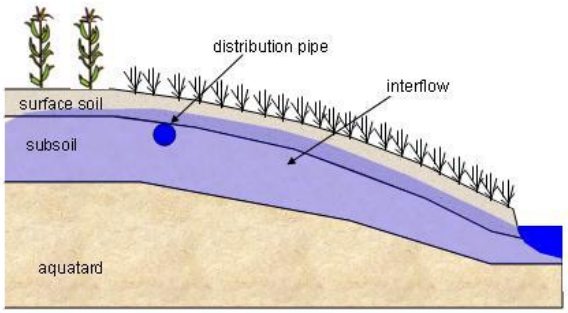

Riparian buffer
Field
Stream


Riparian buffer
Field
Distribution pipe
Stream
Overflow discharge pipe
Diverter box

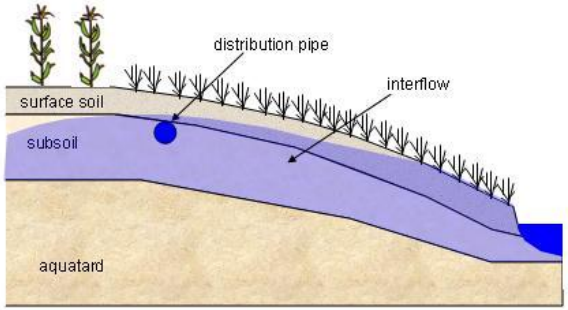
Induced interflow



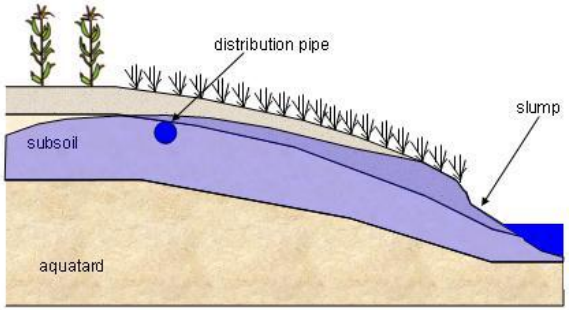
a) Enhanced uptake



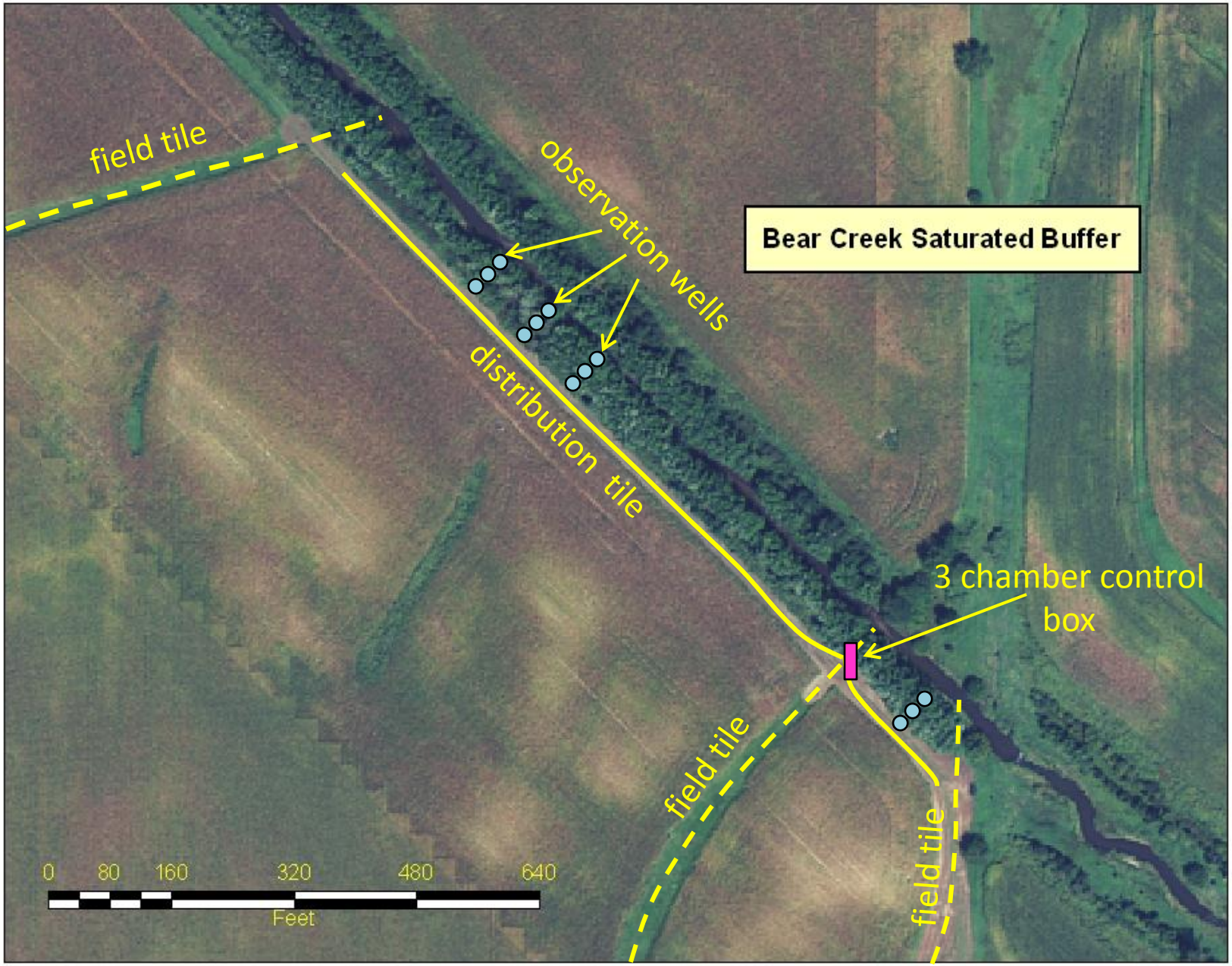
b) Enhanced denitrification



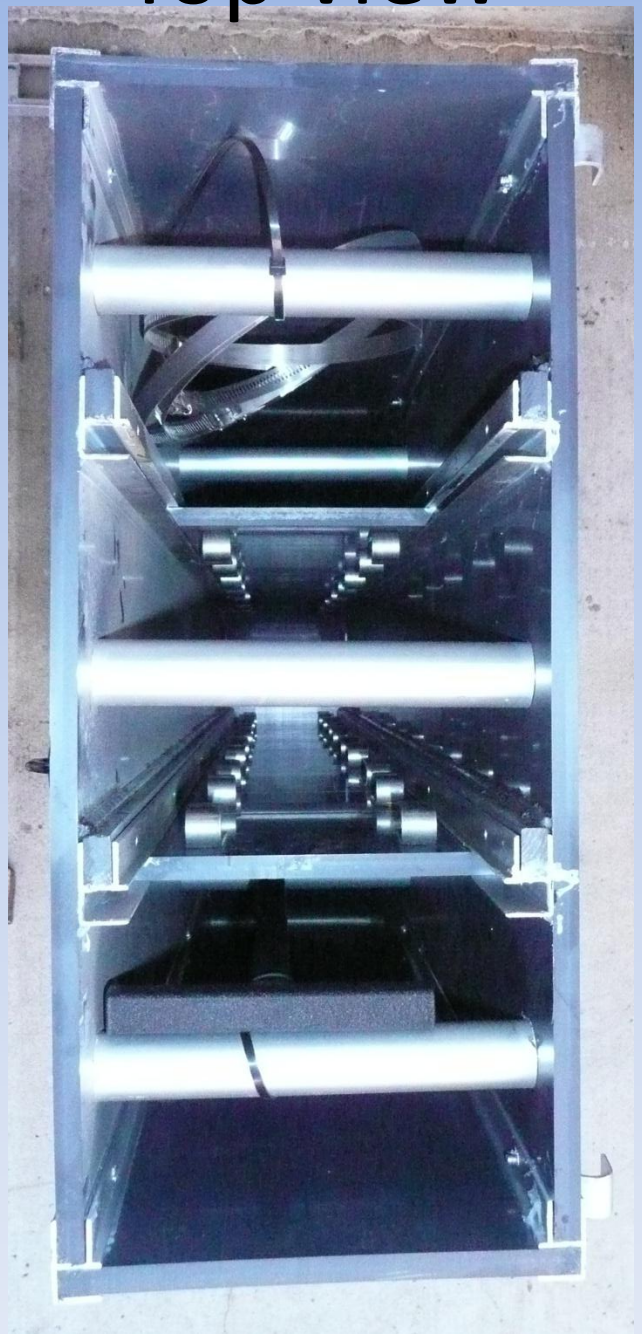
c) Surface discharge

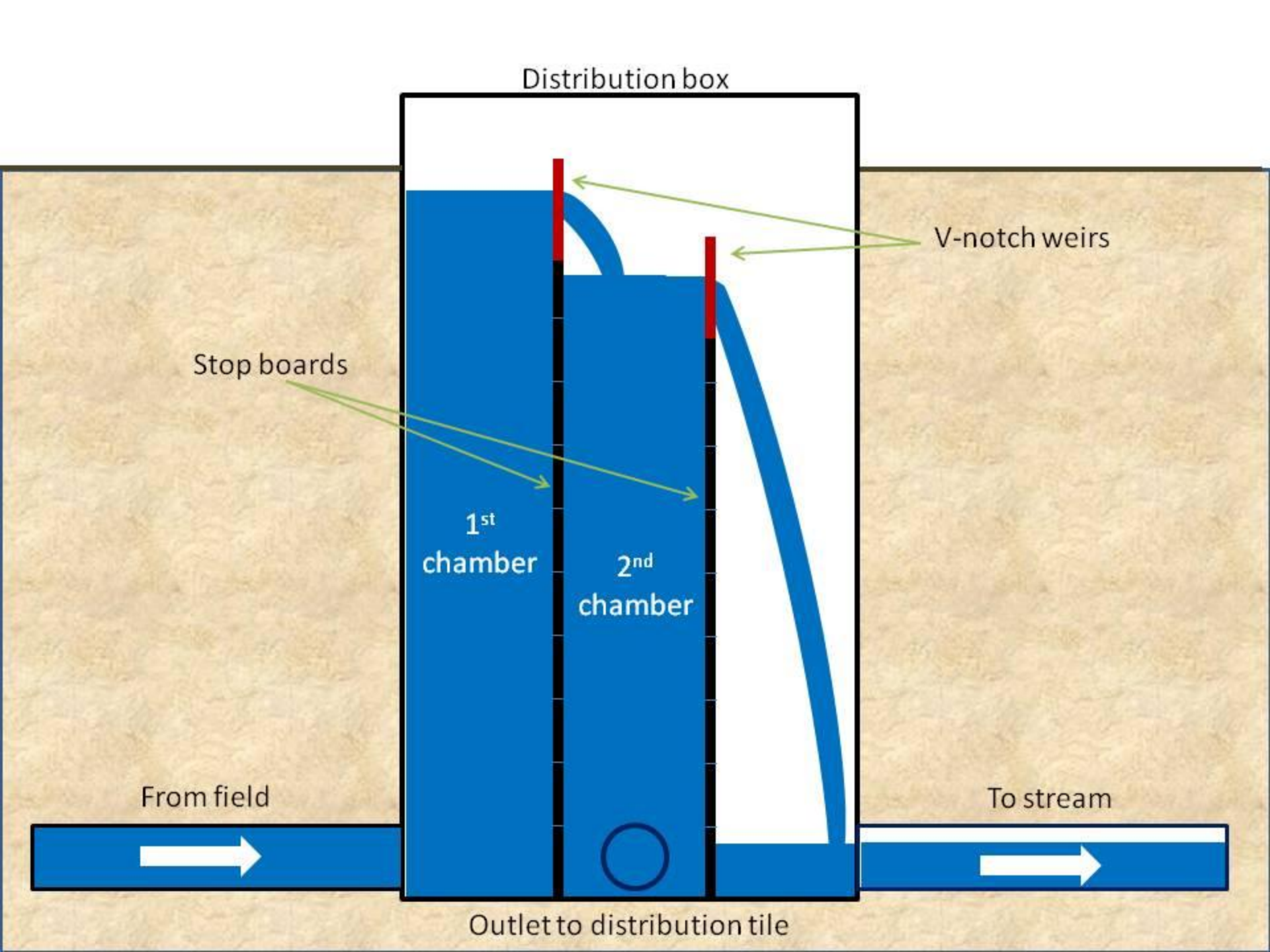


d) Channel slumping

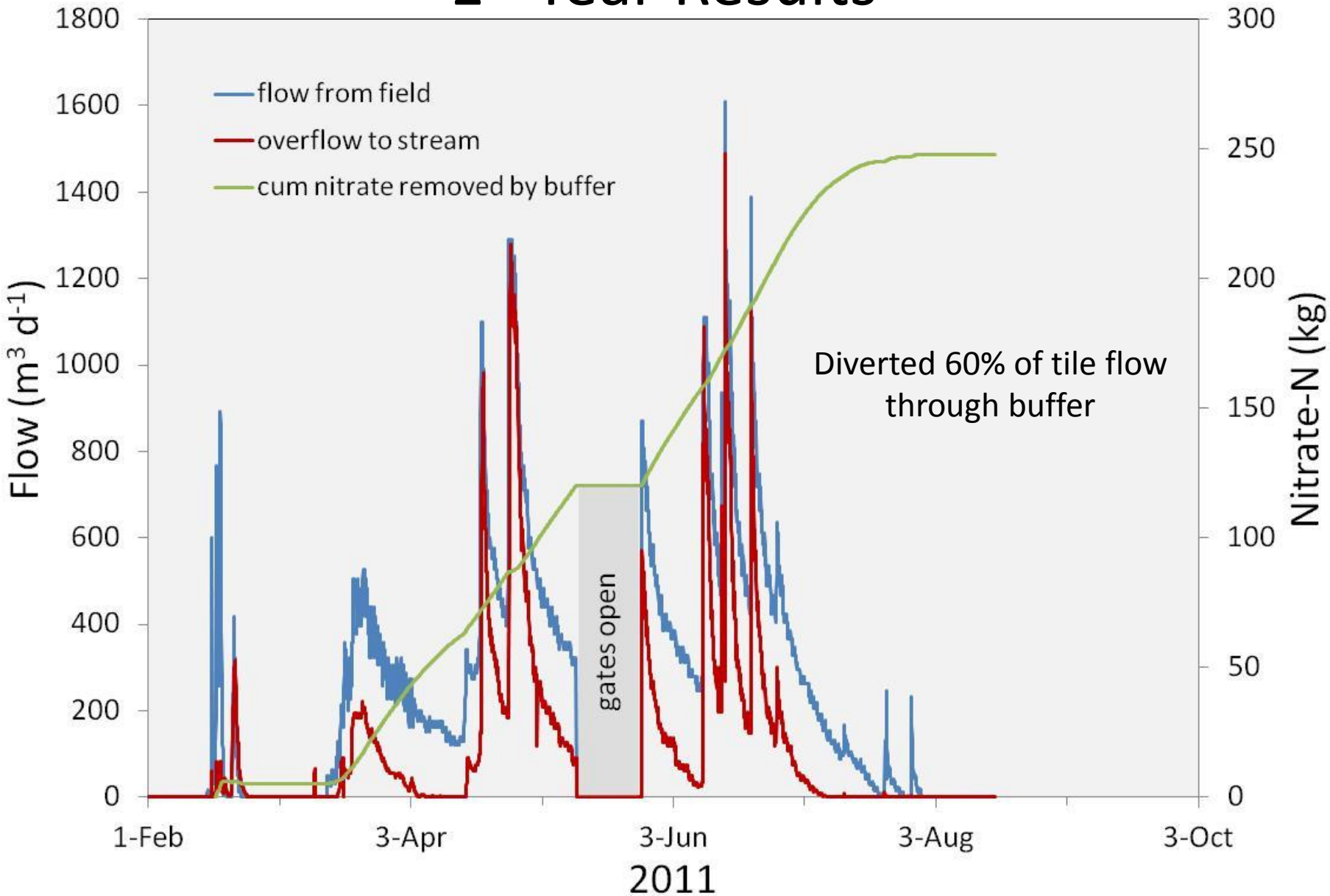

Bear Creek Saturated Buffer
field tile
observation wells
distribution tile
3 chamber control box
field tile
field tile
0 80 160 320 480 640
Feet

Top view




Distribution box
V-notch weirs
Stop boards
1st chamber
2nd chamber
From field
To stream
Outlet to distribution tile

1st Year Results



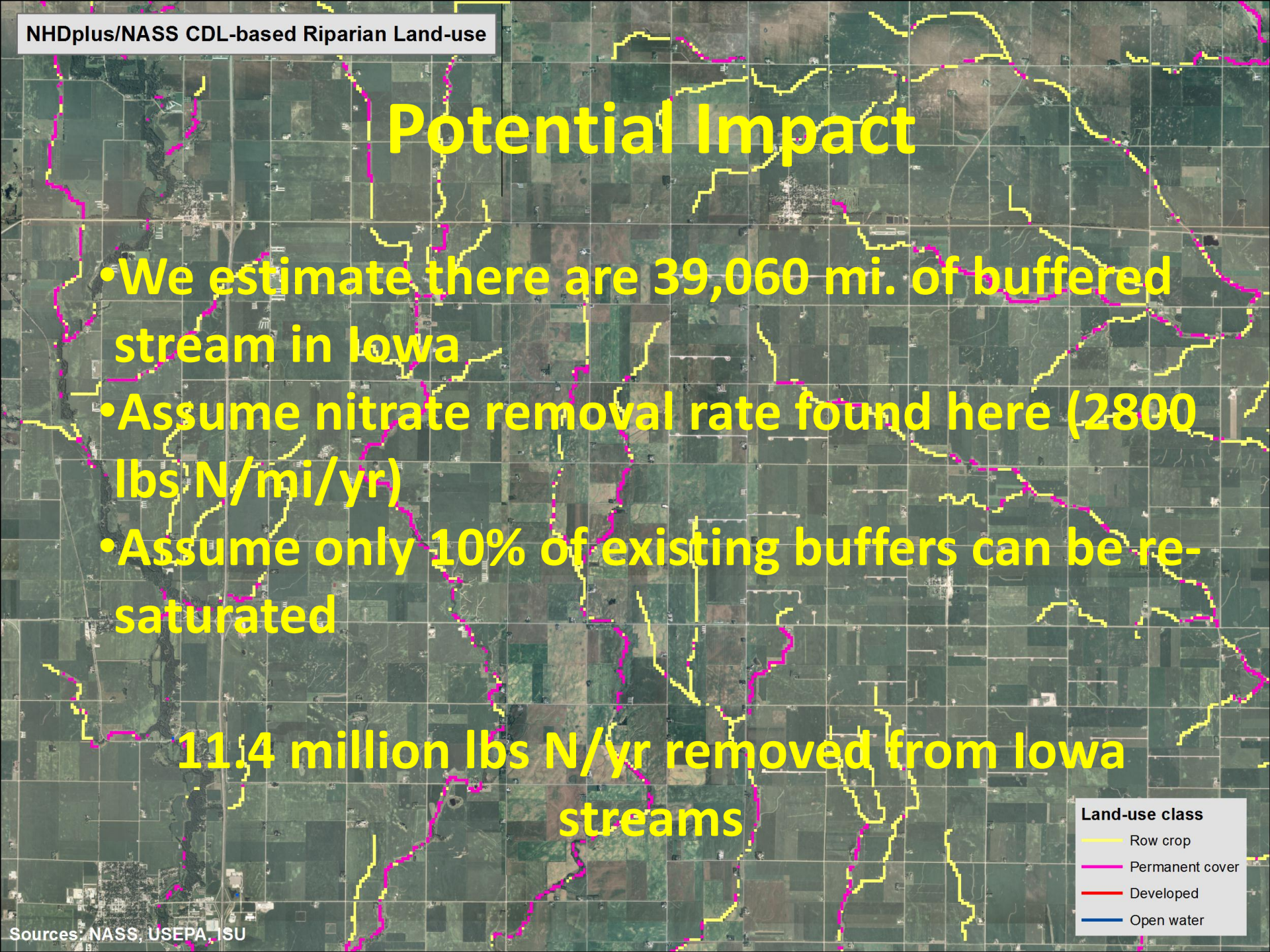
Fate of Nitrate in Buffer

Transect #	Well #	Distance from tile (m)	Date - 2011									
			28-Feb	17-Mar	20-Apr	3-May	19-May	3-Jun	16-Jun	28-Jun	14-Jul	26-Jul
			---------- NO_3 (mg N L^{-1}) ----------									
1	01	5.7	7.9	8.9	8.1	8.0	8.2	7.7	13.1	7.2	8.2	7.7
1	02	12.7	< 0.3	0.5	< 0.3	1.6	1.4	4.8	3.6	2.4	3.8	5.5
1	03	18.[illegible]	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
2	04	5.7	< 0.8	1.4	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
2	05	12.9	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
2	06	21.4	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
3	07	6.6	4.[illegible]	[illegible]	4.8	2.5	2.[illegible]	[illegible]	[illegible]	[illegible]	3.1	4.6
3	08	14.1	< 0.3	< 0.3	< 0.3	< 0.3	0.7	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
3	09	22.9	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
4	10	6.0	1.8	1.3	3.7	2.5	1.9	2.9	4.4	3.1	5.1	2.5
4	11	14.1	5.1	< 0.3	0.8	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
4	12	22.2	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
	Field		9.8	9.3	10.1	11.0	11.6	10.9	11.8	11.1	13.0	11.9
	Bear Creek		7.1	7.2	9.4	10.2	10.5	12	13.1	12.3	9.2	4.6

100% of the nitrate was removed in the buffer

Economics

- For this example, 1000 ft of 4 in. distribution tile would cost $303 @ $0.33 per foot.
- The control box for tile drainage diversion would cost $1000 installed. Another $100 would be required for design work.
- Assuming a 20yr life expectancy for the system at 4% interest would add about $700 in opportunity cost.
- Thus, the total cost of the installation would be $2103 over 20 yr or $105.15 per year.
- 1st year nitrate removal at Bear Cr. was 550 lbs.
- This gives a cost of $0.19 lbs^{-1} nitrate-N removed.
- Compared to constructed wetlands ($1.32/lbs) and fall planted cover crops ($3.08/lbs).



Potential Impact

- We estimate there are 39,060 mi. of buffered stream in Iowa
- Assume nitrate removal rate found here (2800 lbs N/mi/yr)
- Assume only 10% of existing buffers can be re-saturated

11.4 million lbs N/yr removed from Iowa streams

Summary

- 1st year shows re-saturating riparian buffers can remove all the nitrate that is diverted into them.
- We were able to divert about 60% of the flow from a tile draining about 50 ac of field
- The cost of the practice is comparable to other N removal practices
- Practice shows potential of preventing > 11 million lbs of N from entering IA streams each year
- Currently expanding study by re-saturating 3 new sites in each of IA, IL, and IN (CIG – ADMC).

Thank you

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