Environmental and Social Benefits of Woody Vegetation

Vegetation on Levees:
Information, Data, & Approaches to Inform Best Practices
Arlington, VA - May 2-3, 2023

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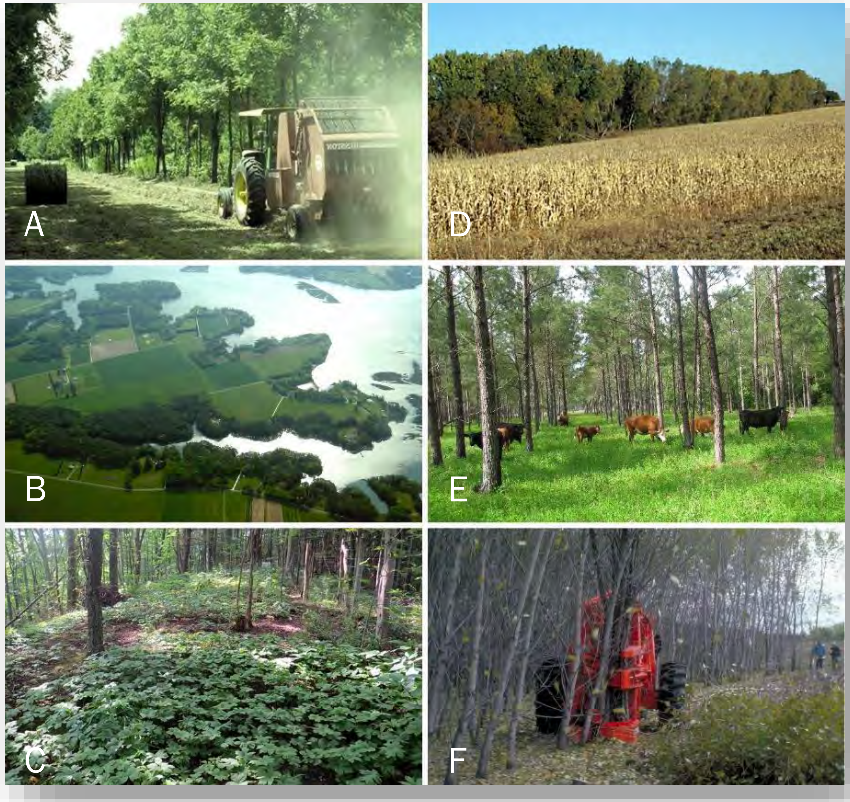
Agroforestry



A. Alley Cropping

B. Riparian Forest Buffers

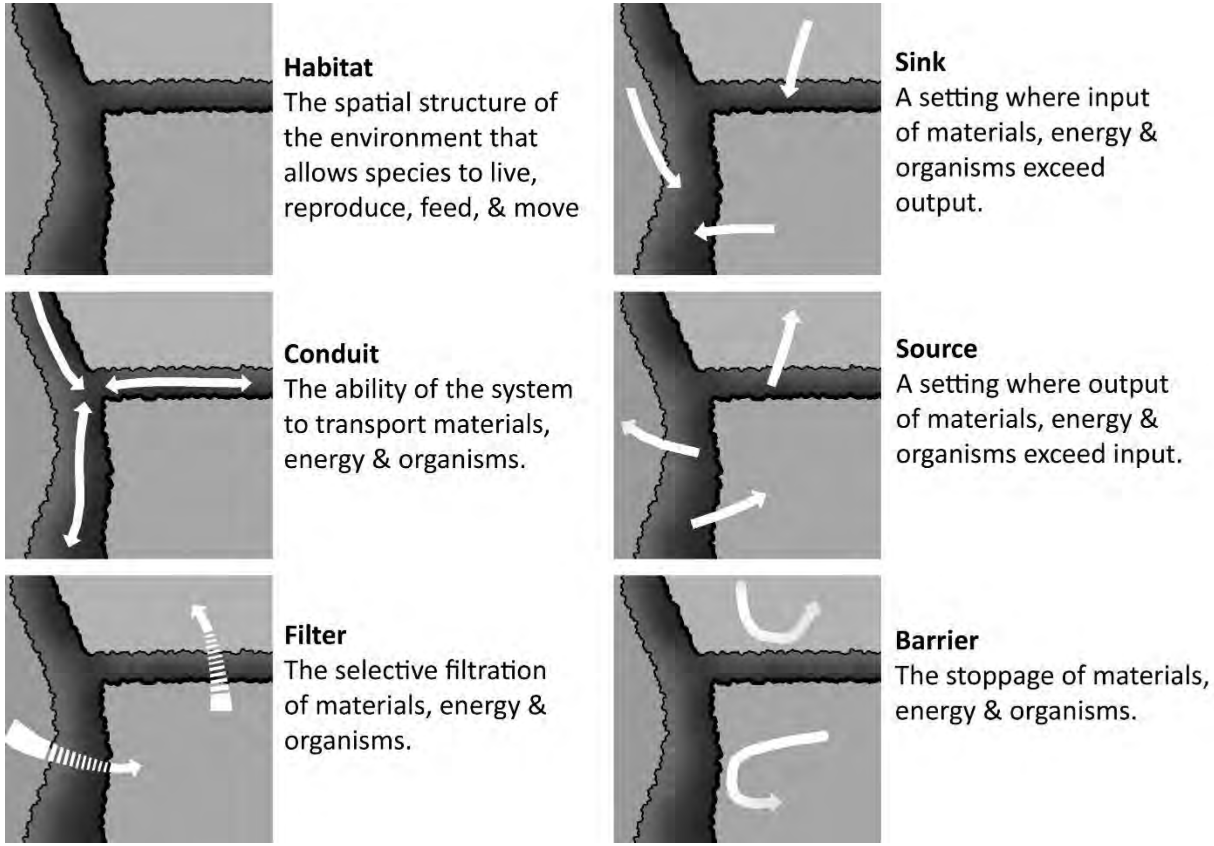
C. Forest Farming

D. Windbreaks

E. Silvopasture

F. Additional Applications

Woody Buffer Functions



Lovell et al. E. 2022

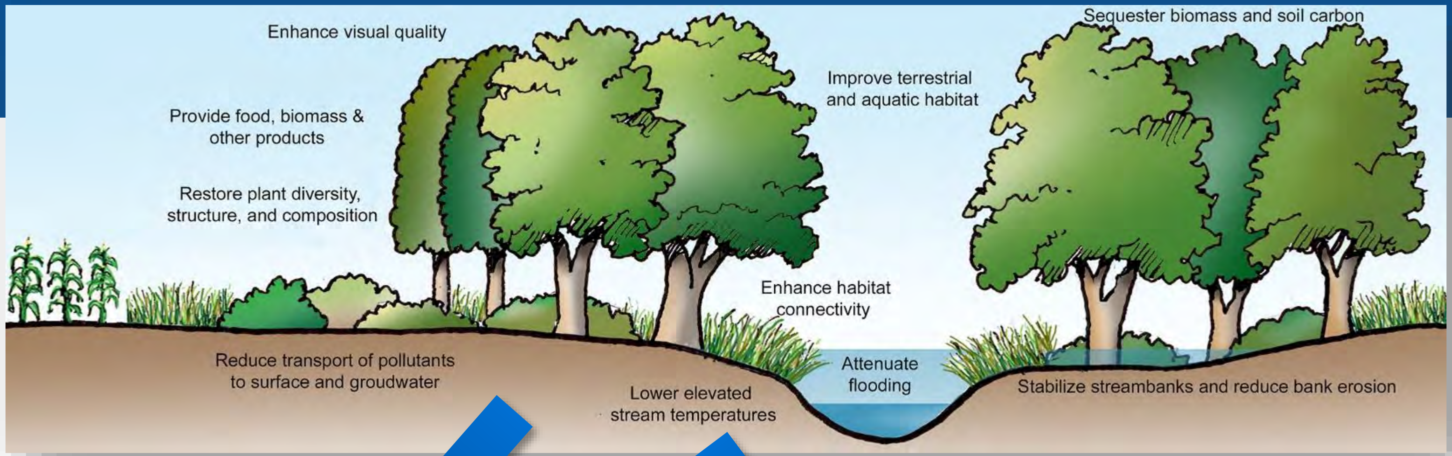
Buffer Functions

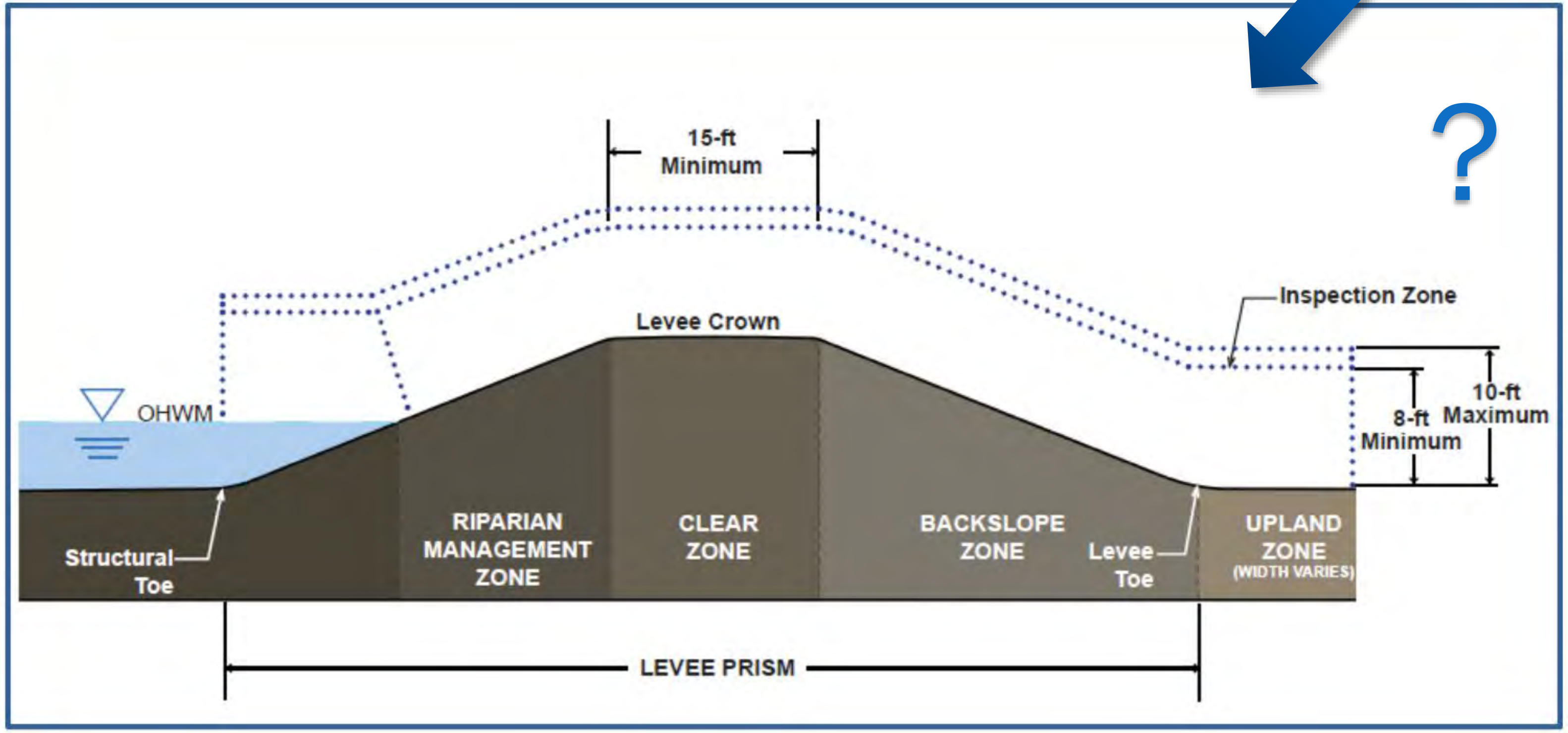
Issue and Objectives	Buffer Functions
Water Quality	
Reduce erosion and runoff of sediment, nutrients, and other potential pollutants Remove pollutants from water runoff and wind	Slow water runoff and enhance infiltration Trap pollutants in surface runoff Trap pollutants in subsurface flow Stabilize soil Reduce bank erosion
Biodiversity	
Enhance terrestrial habitat Enhance aquatic habitat	Increase habitat area Protect sensitive habitats Restore connectivity Increase access to resources Shade stream to maintain temperature
Productive Soils	
Reduce soil erosion Increase soil productivity	Reduce water runoff energy Reduce wind energy Stabilize soil Improve soil quality Remove soil pollutants

Page 12 from *Conservation Buffers: Design Guidelines for Buffers, Corridors, and Greenways*

Issue and Objectives	Buffer Functions
Economic Opportunities	
Provide income sources Increase economic diversity Increase economic value	Produce marketable products Reduce energy consumption Increase property values Provide alternative energy sources Provide ecosystem services
Protection and Safety	
Protect from wind or snow Increase biological control of pests Protect from flood waters Create a safe enviroment	Reduce wind energy Modify microclimate Enhance habitat for predators of pests Reduce flood water levels and erosion Reduce hazards
Aesthetics and Visual Quality	
Enhance visual quality Control noise levels Control air pollutants and odor	Enhance visual interest Screen undesirable views Screen undesirable noise Filter air pollutants and odors Separate human activities
Outdoor Recreation	
Promote nature-based recreation Use buffers as recreational trails	Increase natural area Protect natural areas Protect soil and plant resources Provide a corridor for movement Enhance recreational experience

Levee Environment



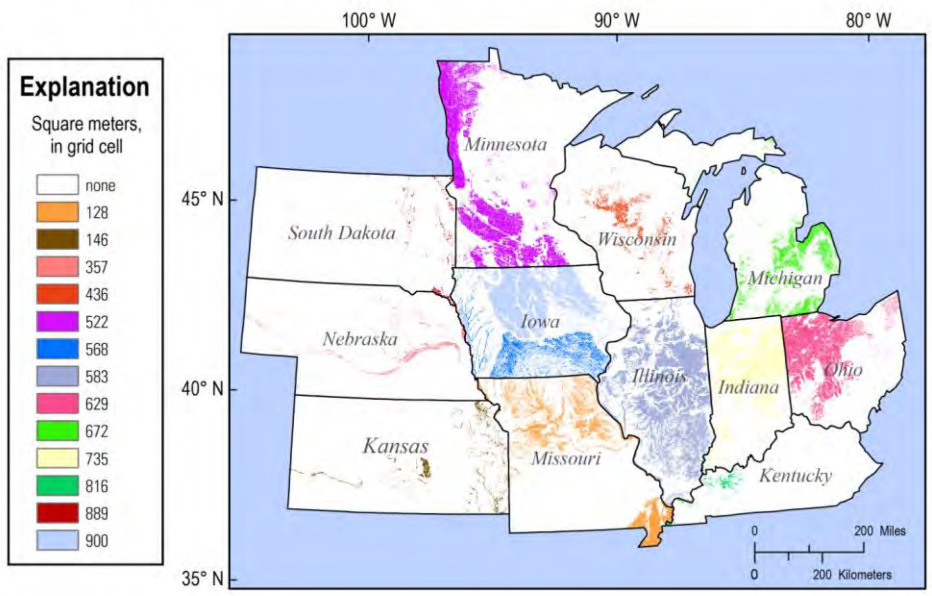


Pierce County Public Works Surface Water Management www.piercecountywa.org/water

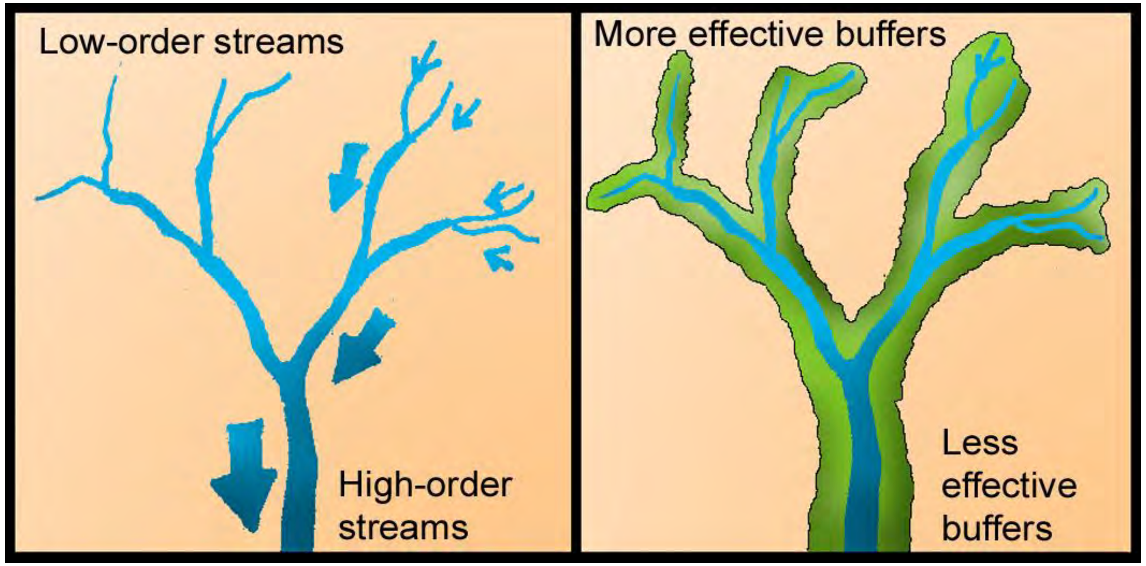
Water Quality

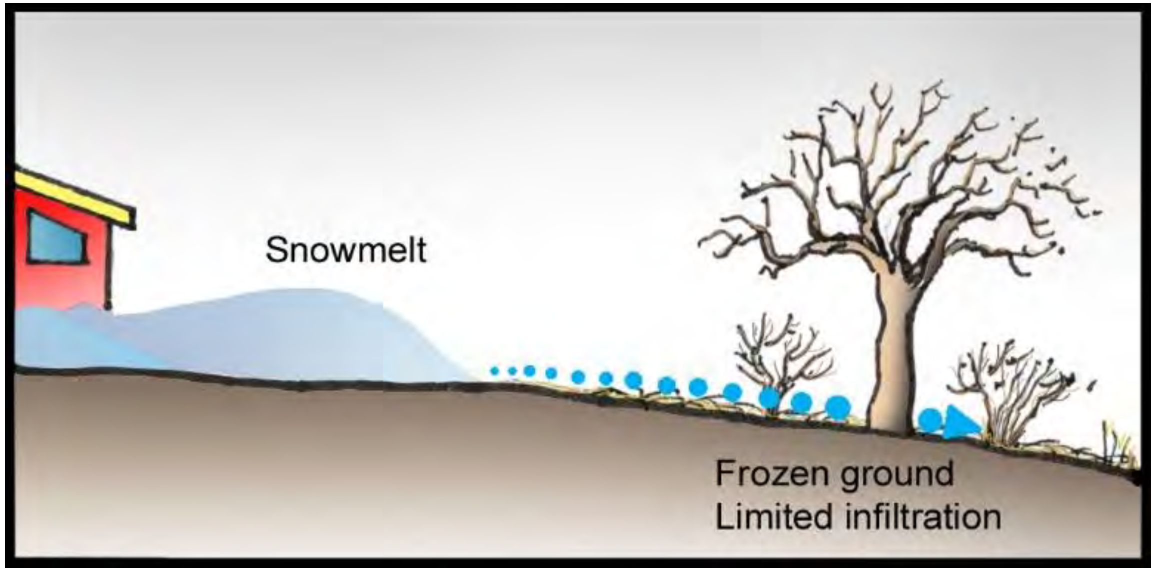
- Watershed
- Physiographic
- Temporal

Estimates of Subsurface Tile Drainage Extent for 12 Midwest States, 2012



http://dx.doi.org/10.5066/F7W37TDP



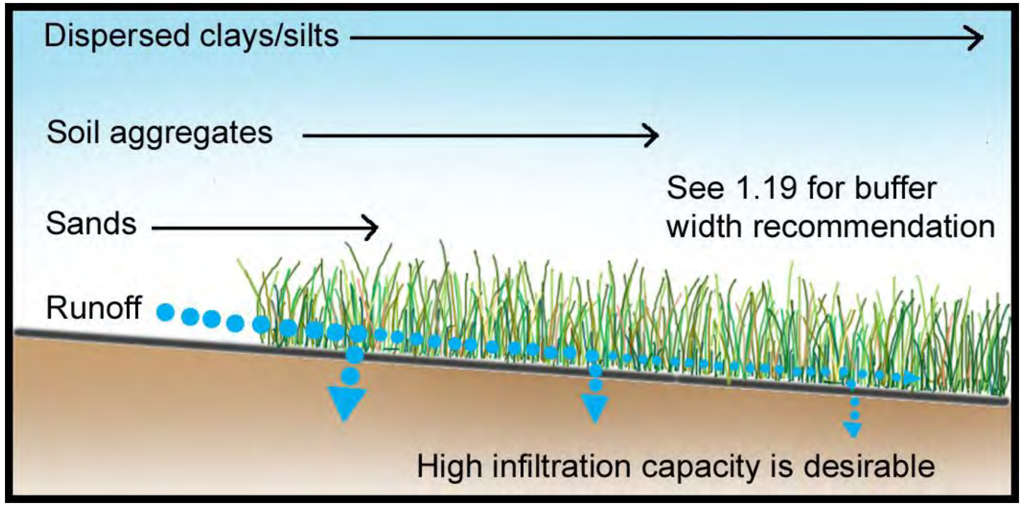


Sediment

~75% or more removal

Dosskey et al. 2001, Mankin et al. 2007

- High stem density
- High infiltration
- Maintenance



23% –96% In-stream sediment from bank erosion

Zaimes et al. 2004, Willet et al. 2012 ,Palmer et al. 2014

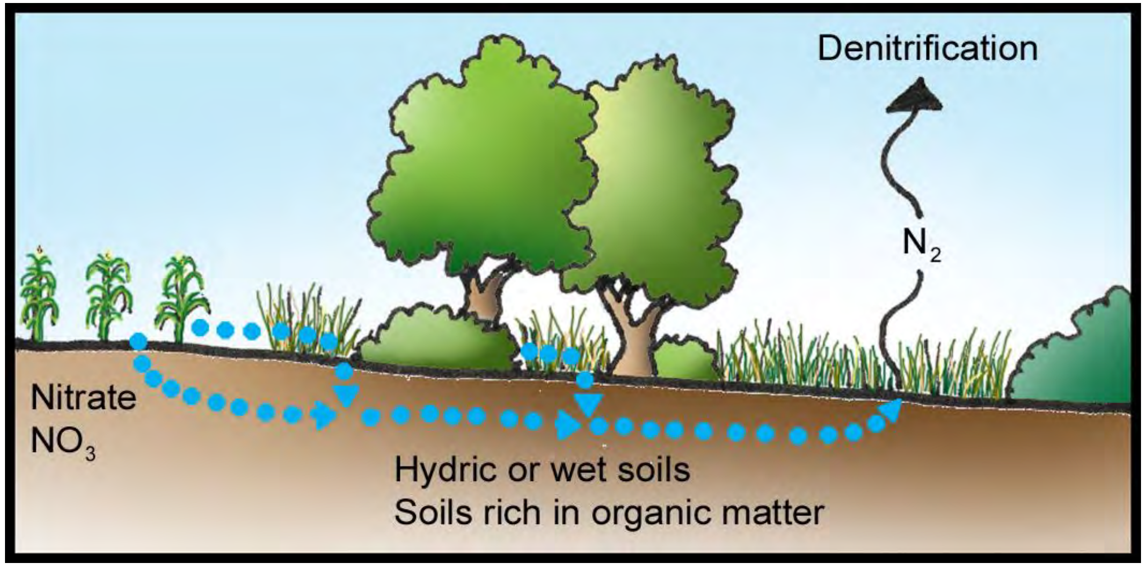
- Root reinforcement
- Mixed plant forms
- Tolerant of inundation
- Toppling considerations

Nitrogen

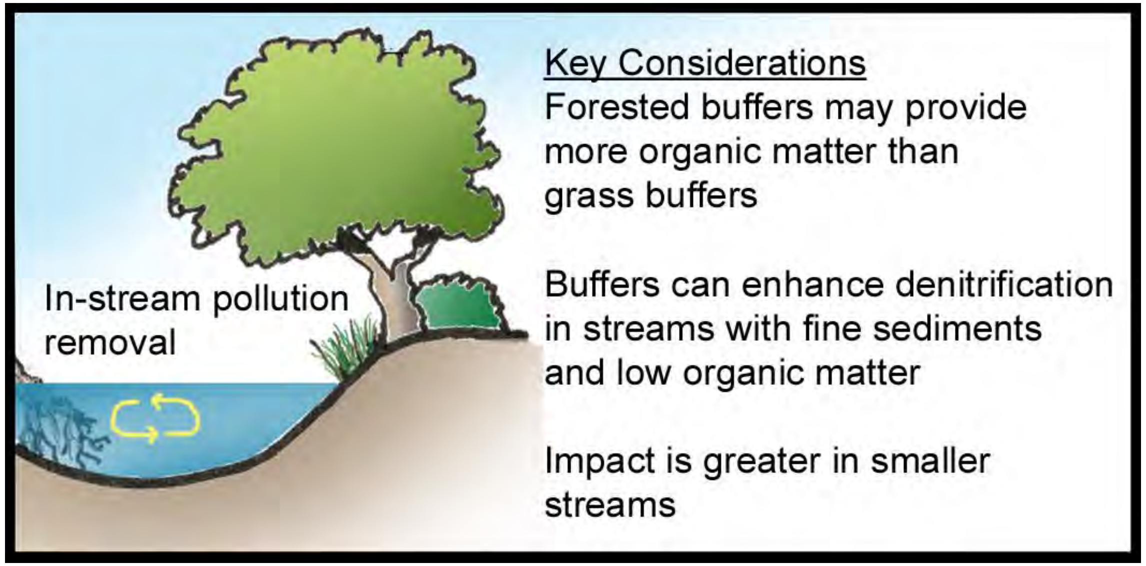
Up to 50% nitrate removal

Dosskey et al. 2001, Mankin et al. 2007, King et al. 2016

Plant Uptake
Denitrification

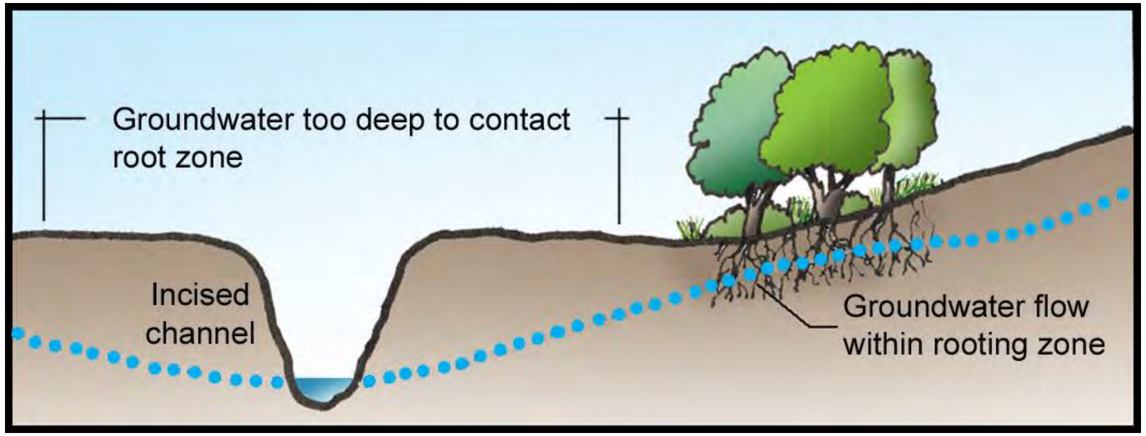


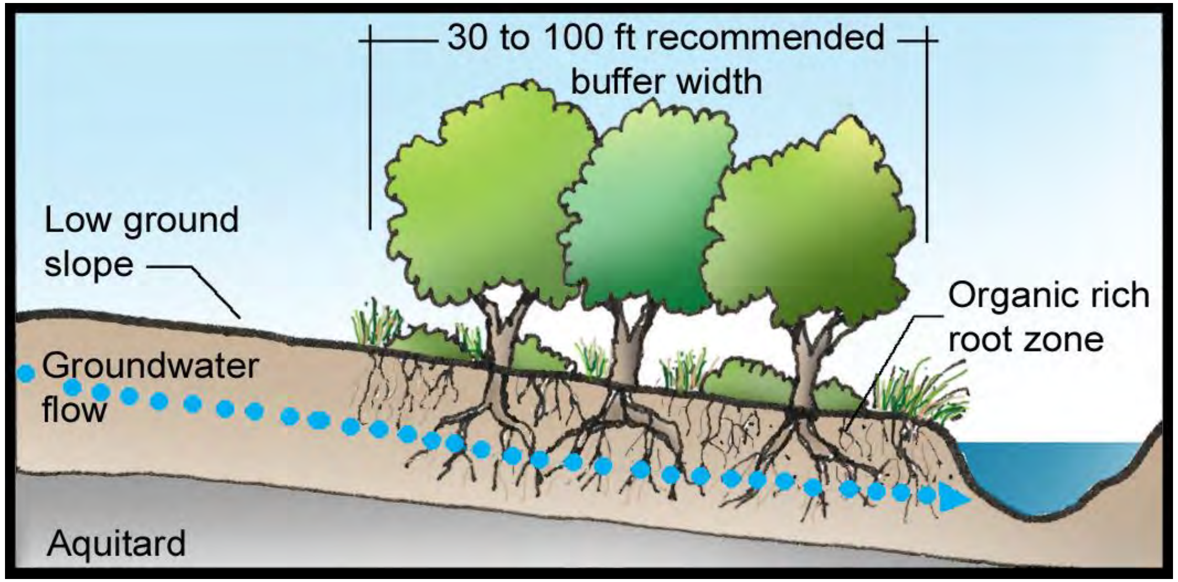
- Hydric soils
- High infiltration
- Rich organic matter
- Higher evapotranspiration



Nitrogen

- Shallow groundwater





Buffers for Shallow Groundwater Pollution

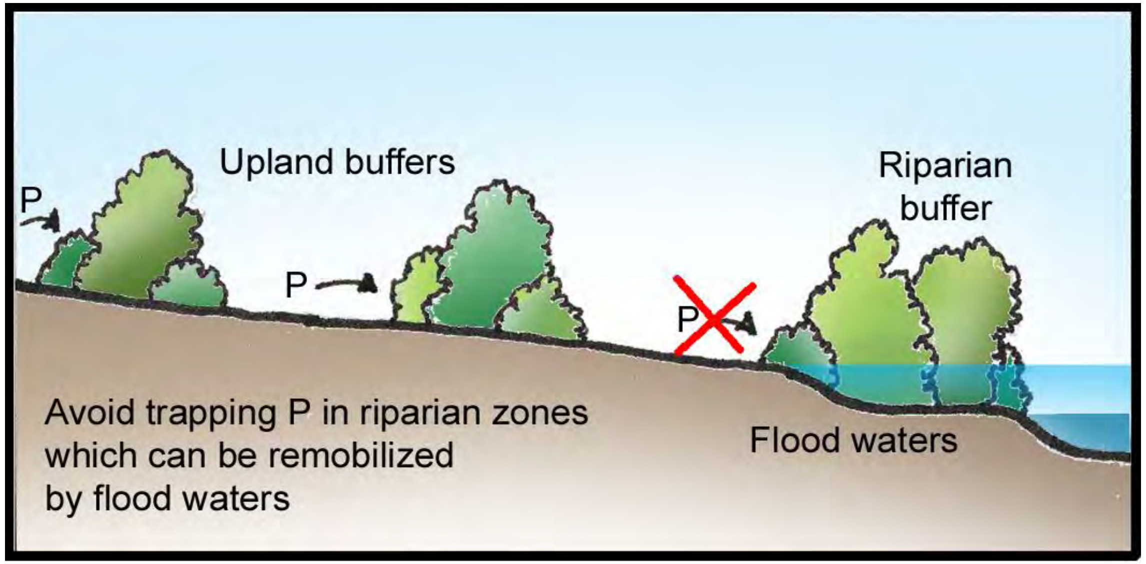
Variable	Factors Increasing Treatment Potential
Slope	Lower ground slope (0 to 3 percent)
Depth to Water Table	Shallower water table (0 to 3 ft below surface)
Hydric Soils	Present and occupying significant width (≥ 30 feet of buffer width)
Proximity to Source	Buffer closer to the source of pollution
Soil Drainage Class (natural)	Very poorly-, poorly-, and somewhat poorly-drained ratings
Organic Matter	Soils with higher concentrations of organic matter

Phosphorus

Up to 50% Total P

Up to 20% Dissolved P

Dosskey et al. 2001, Mankin et al. 2007



- Upland capture
- Biomass harvesting

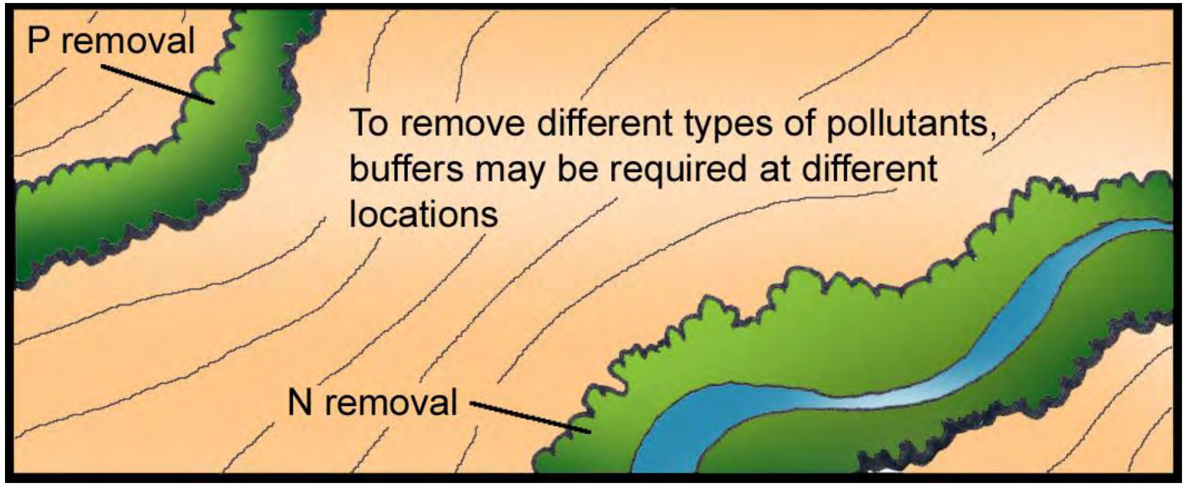



Photo: Minnesota Board of Water and Soil Resources

Pesticides

11% to 99% depending on chemical compounds
Dosskey et al. 2001,

- Soil adsorption index
- High infiltration
- Width

Koc Value Influence on Buffers for Pesticides		
Koc Value	Adsorption and Movement	Buffer Recommendation
< 500	Adsorbs weakly, movement with water	Maximize water infiltration and runoff contact time with soil and vegetation Generally requires wider buffers
> 500	Adsorbs strongly, movement with sediment	Maximize sediment trapping in buffer Narrower buffers may be sufficient

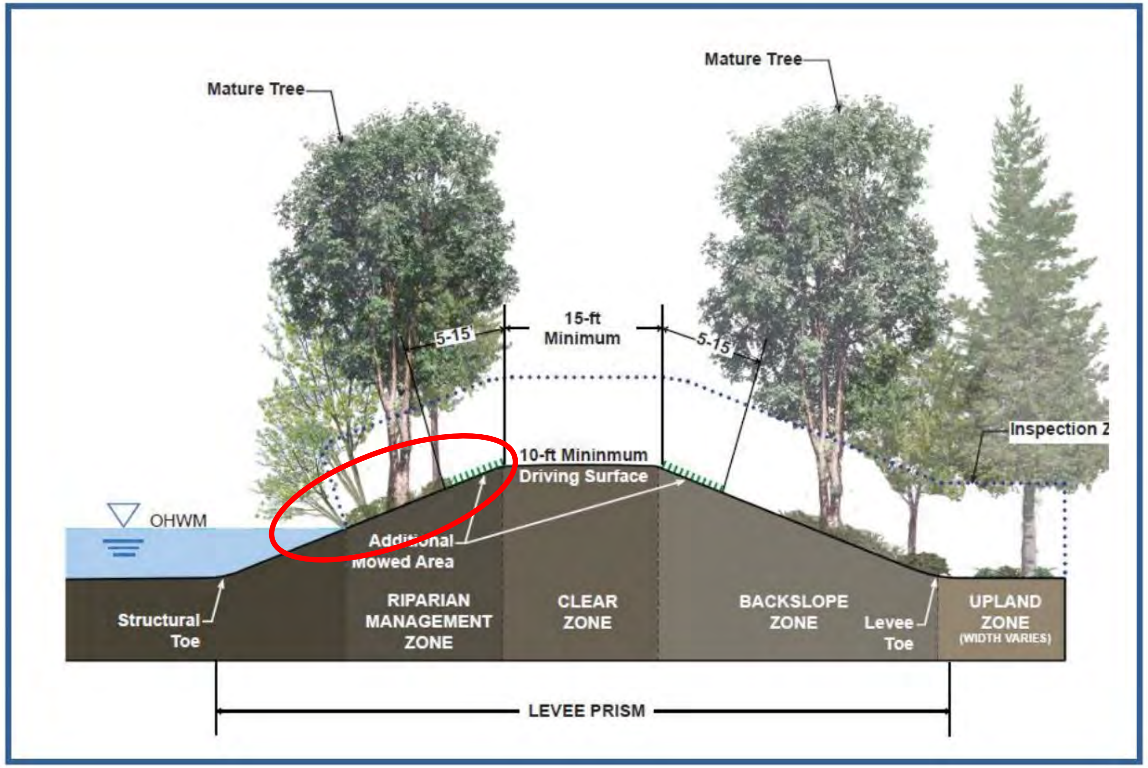
Pathogens

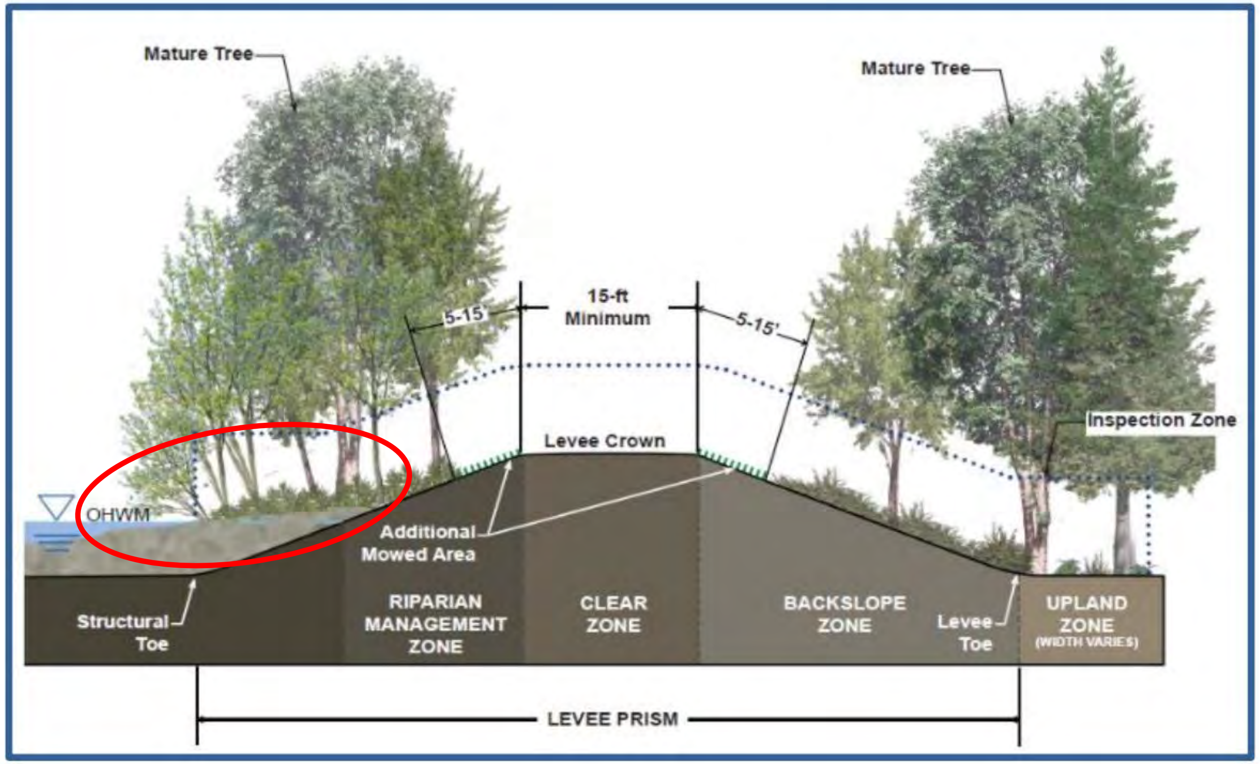
~40-70% removal
Dosskey et al. 2001,Pachepskyet al. 2006

- Zero discharge
- Other BMPs

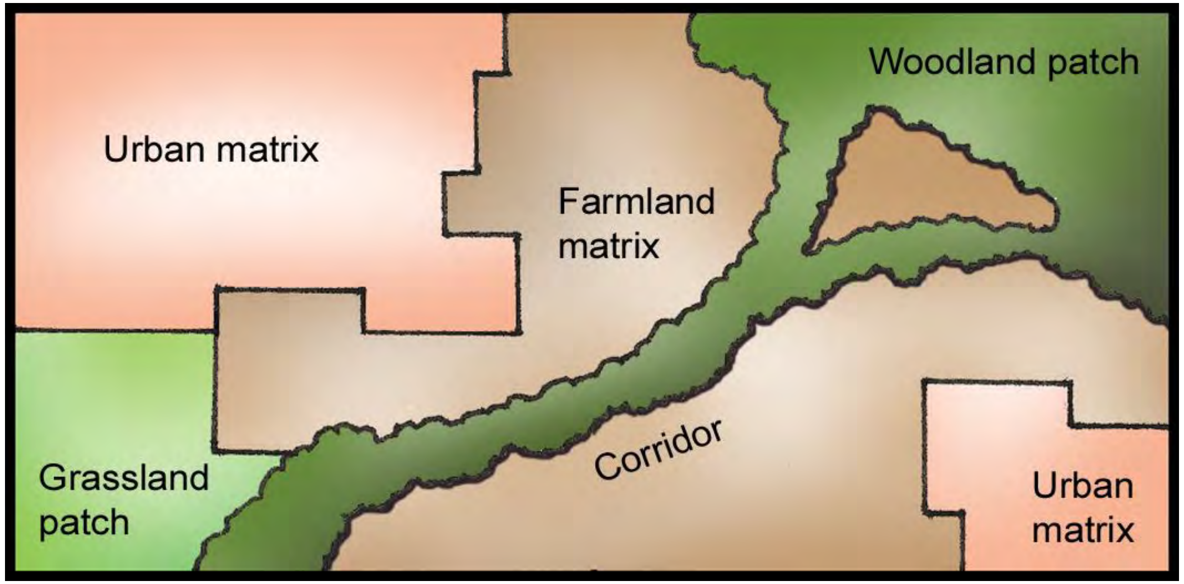
Key Considerations
Maintain or increase infiltration
Increase buffer widths for pesticides with low Koc values
Increase buffer widths in colder climates
Increase buffer widths for pesticides with high solubility
Select plants with high pesticide tolerance

Water Quality - Summary



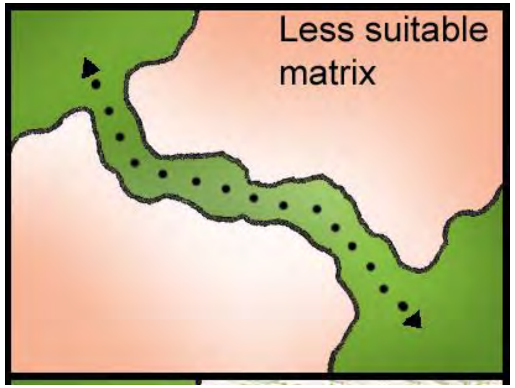


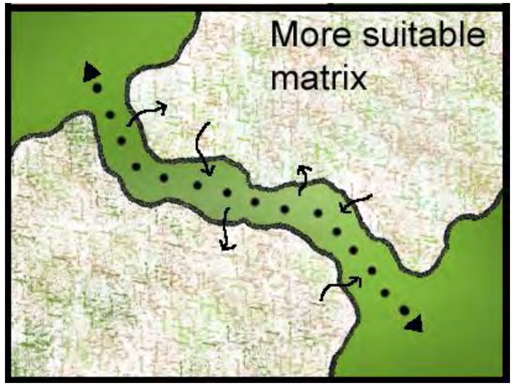
Habitat & Biodiversity

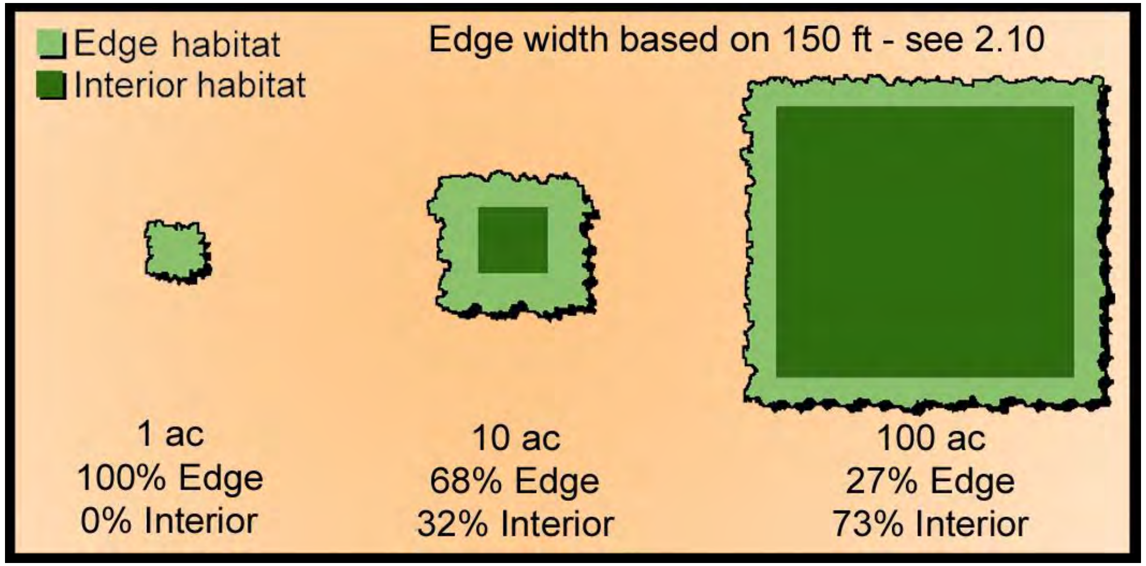


Example Ranges of Minimum Patch Area

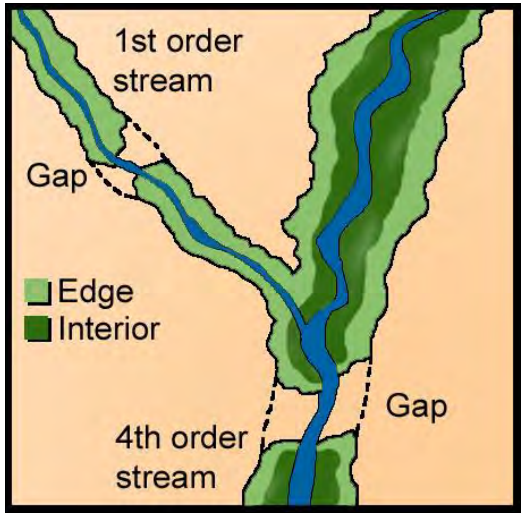
Taxa	Patch Area
Plants	5 to ≥ 250 ac
Invertebrates	50 sq ft to ≥ 2.5 ac
Reptiles and Amphibians	3 to ≥ 35 ac
Grassland Birds	12 to ≥ 135 ac
Waterfowl	≥ 12 ac
Forest Birds	5 to ≥ 95 ac
Small Mammals	2.5 to ≥ 25 ac
Large Mammals	40 ac to ≥ 2 sq mi
Large Predator Mammals	3.5 to ≥ 850 sq mi



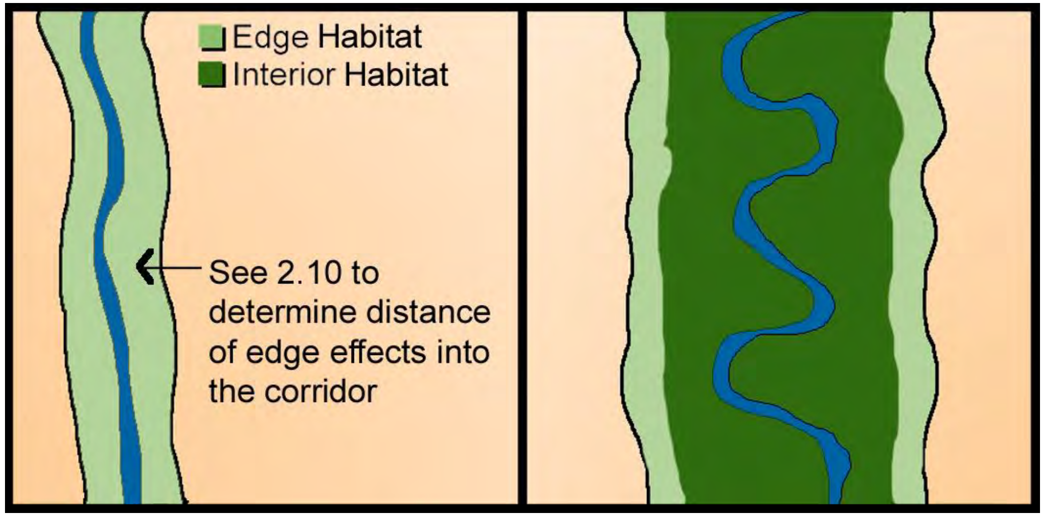


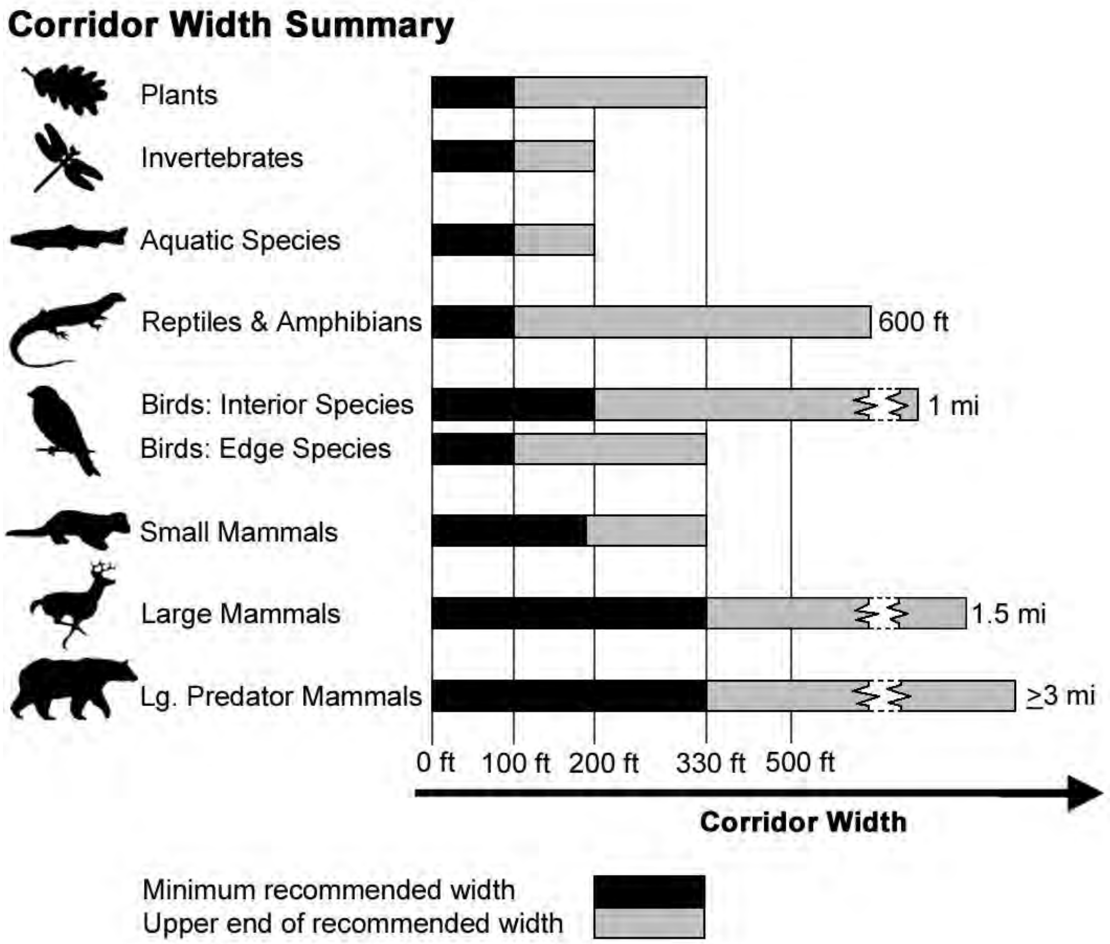


Habitat Corridors



- Higher order
- Target species
- Edge effects





Pollinator Benefits

1. Foraging resources
   - Timing and quality of pollen/nectar
   - Hi-density of resources
   - Microclimate modification
2. Habitat connectivity
   - Site and landscape connectivity
3. Pesticide exposure
   - Spray drift barrier
   - Runoff mitigation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Early Season Pollen & Nectar

Common Name	Scientific Name	March	April	May	June	July	August
Maples	*Acer* spp.						
Willows	*Salix* spp.						
Serviceberry	*Amelanchier* spp.						
Sassafras	*Sassafras albidum*						
Black cherry	*Prunus serotina*						
Blueberry	*Vaccinium* spp.						
Eastern redbud	*Cercis canadensis*						
Sumac	*Rhus* spp.						
Chokecherry	*Prunus* spp.						
Aronia	*Aronia melanocarpa*						
Cockspur hawthorn	*Crataegus crus-galli*						
Elderberry	*Sambucus* spp.						
Basswood	*Tilia americana*						
Wild rose	*Rosa setigera*						

Willows, maples, & *Prunus* spp. provided over 90% of the pollen collected in April by native bees. *Wood et al. 2018*

Mining bee (*Andrena* sp.) on willow (*Salix* sp.)
Blue Ridge Parkway, NC, Nancy Adamson

Quality Pollen & Nectar

Common Name	Scientific Name	Nectar	Pollen
Maples	*Acer* spp.	0.600	0.600
Serviceberry	*Amelanchier* spp.	0.500	0.400
Cherry	*Prunus* spp.	0.750	0.750
Oak	*Quercus* spp.	0.000	0.700
Brambles	*Rubus* spp.	0.700	0.600
Willow	*Salix* spp.	0.800	0.900
Elderberry	*Sambucus* spp.	0.300	0.600
Wild Indigo	*Baptisia* spp.	1.000	0.500
Goldenrod	*Solidago* spp.	0.900	0.800
Clover	*Trifolium* spp.	0.750	0.750

0=no pollen/nectar source
1=major pollen/nectar source

Adapted from Loose et al. 2005
*Based on honey bee data

- Pollen specialists (oligolectic) dependent on trees & shrubs (e.g., willows, dogwoods, heaths, New Jersey tea, native roses)

Dötterl and Vereecken 2010, Fowler 2016

- Plants with soft pithy centers provide nesting sites (e.g., elderberry, boxelder, brambles, dogwood, sumac)

Cane et al. 2007

Larval - Nectar Resources & Overwintering Sites

Common Name	Plant Genus	# of butterflies & moths supported
Oaks	*Quercus*	543
Cherry, plum	*Prunus*	456
Willow	*Salix*	455
Birch	*Betula*	411
Poplar	*Populus*	367
Crabapple	*Malus*	305
Maple	*Acer*	297
Blueberry	*Vaccinium*	294

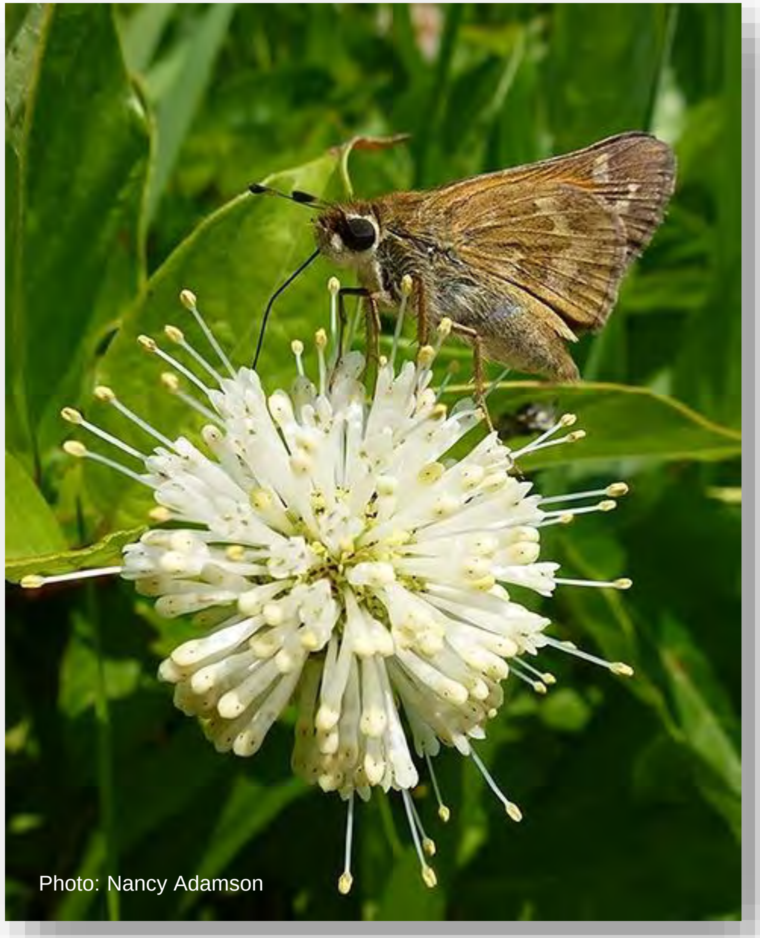


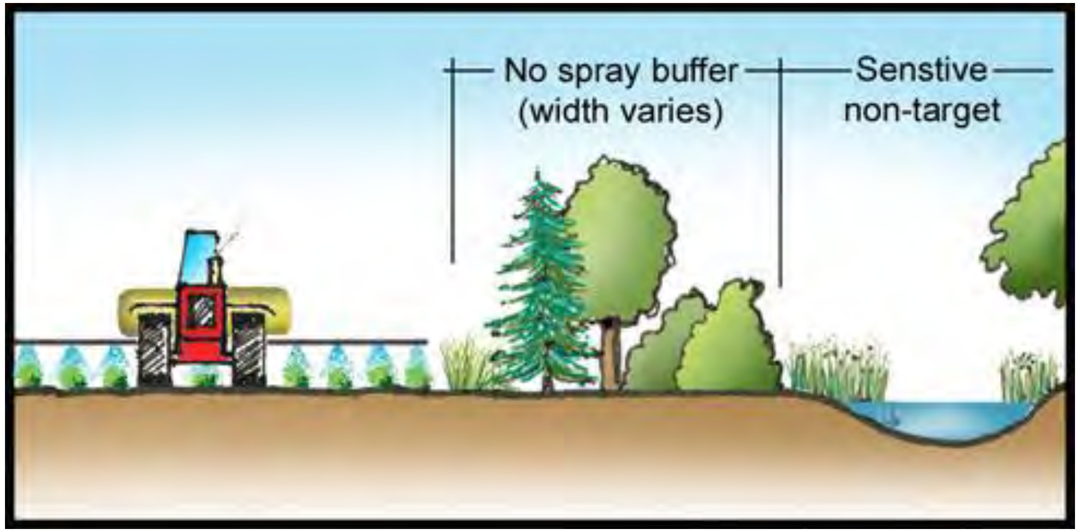
Photo: Nancy Adamson

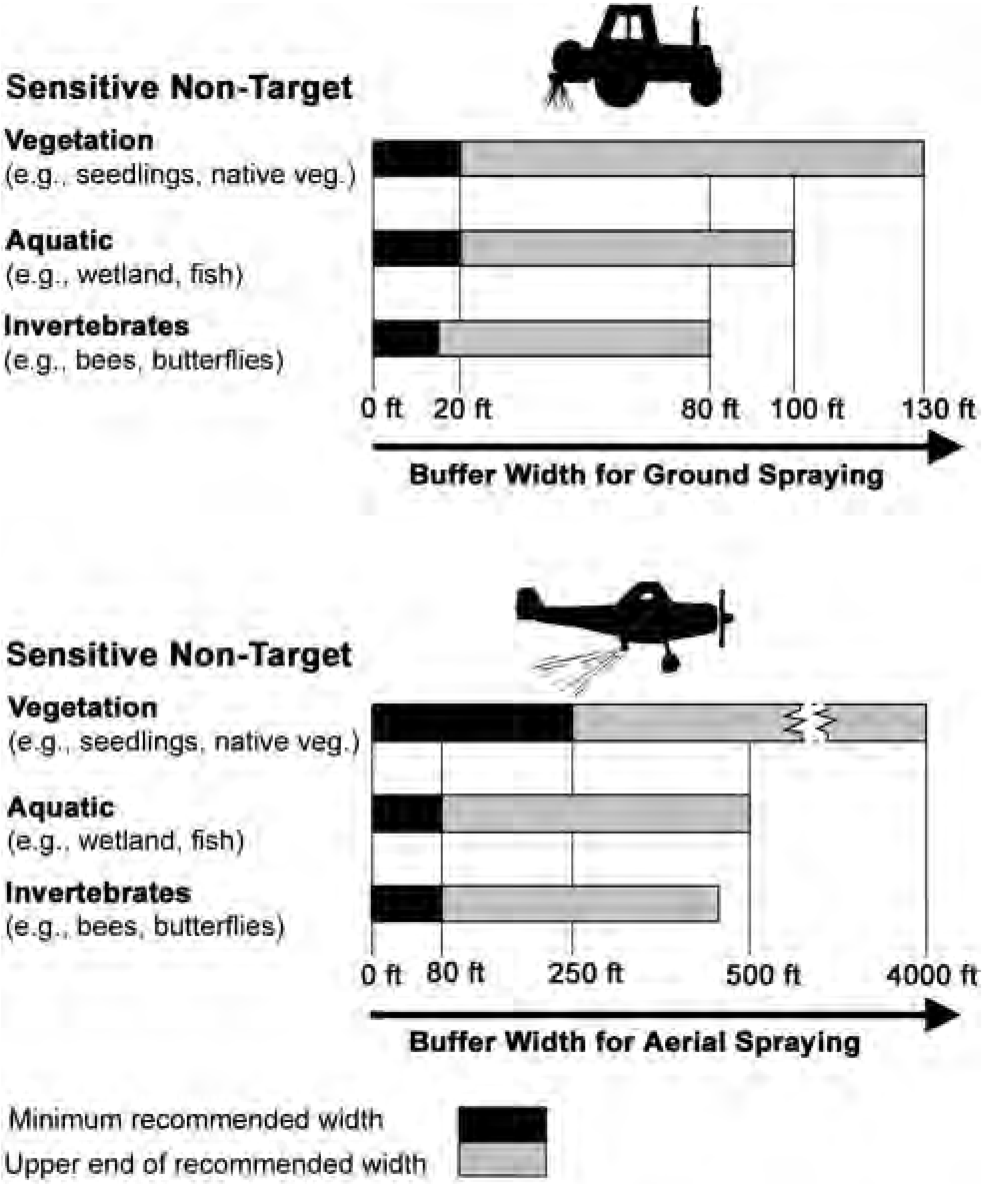
Photo: Xerces Society

- Woody species supported 10 times more moth and butterfly species than herbaceous plants. *Tallamy and Shropshire 2009*

Spray Drift Control

- Fine or needle-like leaves.
- Use vegetation tolerant of the chemical
- 40-50% density to allow air passage. Several rows of vegetation are better than one dense row.
- Buffer at least two times taller than the crop





Aesthetics

- General preference for woody vegetation
- Mixed use of evergreen and deciduous plants
- Strong color contrast in vegetation
- High density and diversity
- Signs of human control of stream areas is desirable when shifting towards urban context
- Meandering vs channelized

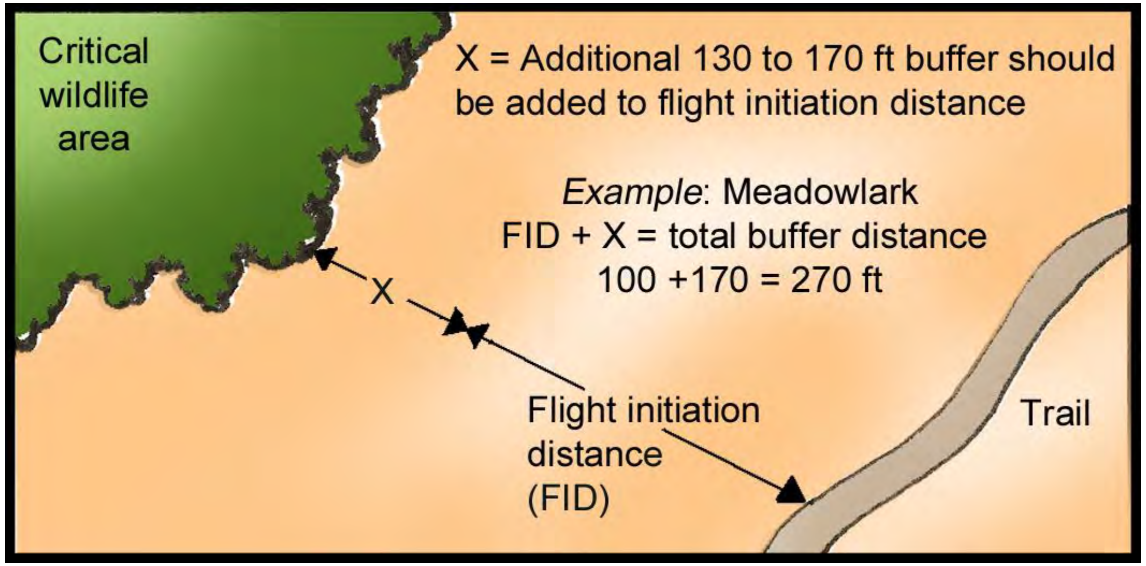
Hu et al. 2019.

No Buffer — Basic Buffer — Extensive Buffer

Sullivan et al. 2004 Kenwick et al. 2009.

Recreation

- Vegetation in support of aesthetics and wildlife
- Visual screening
- Safety and maintenance considerations

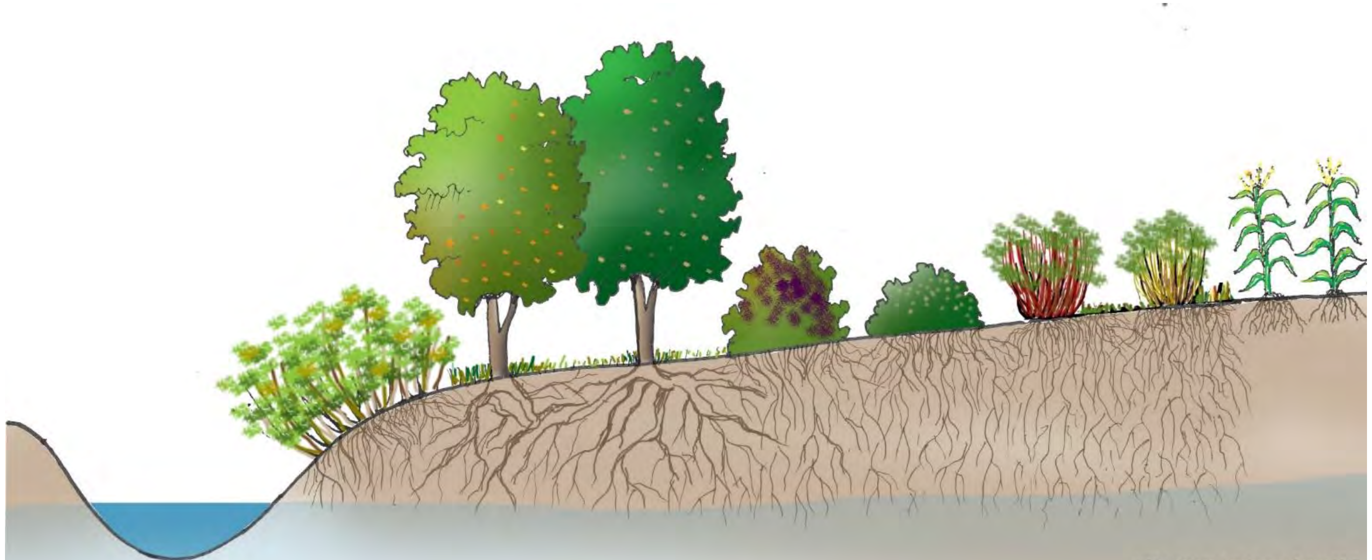


Salt Creek Levee Trail

Flight Initiation Distance		Flight Initiation Distance	
Species	**Flight Distance** (feet)	**Species**	**Flight Distance** (feet)
Mule Deer	490 to 820	Golden Plovers	660
Pronghorn	770	Great Blue Heron	660
Elk	280 to 660	Merlin	60 to 600
Bison	330	Prairie Falcon	60 to 600
Golden Eagle	345 to 1280	Great Egret	330
Rough-legged Hawk	175 to 2900	Meadowlark	100
Bald Eagle	165 to 2900	Robin	30

Production Buffers

- Program compatibility
- Invasive considerations
- Harvestability



USDA National Agroforestry Center 2017

Edibles and florals harvested from multifunctional riparian forest buffers*

Pawpaw

Market Opportunities

With a tropical flavor, custard texture and high nutrient content, America's forgotten fruit can be eaten fresh or made into desserts.

Average Prices

Fresh fruit:	$2/lb wholesale
	$3+/lb retail
Frozen pulp	$6/lb retail
Jam	$6/oz jar retail

Persimmon

Market Opportunities

The "Fruit of the Gods," sweet persimmon can be sold fresh or made into pudding, jam, dried fruit and even beer.

Average Prices

Fresh fruit:	$2.75/lb retail
Frozen pulp:	$8+/lb retail
Dried fruit:	$11+/lb retail

Elderberry

Market Opportunities

Coined "Nature's Medicine Chest" for its immune boosting properties, elderberries can be made into syrup, cough drops, juice, wine, jam and food coloring.

Average Prices

Juice:	$15-$17/11oz jar
Syrup:	$18/4oz jar retail
Wine:	$10-$13/bottle retail
Cough drops:	$2.50/15 retail

Hazelnut

Market Opportunities

A great source of fiber and 'good' fats, hazelnuts can be sold in shell or shelled and made into flours, candies, butters and oils.

Average Prices

In shell:	$3/lb wholesale
Shelled:	$6/8oz retail
Oils:	$8/8oz jar retail

Woody Florals

Market Opportunities

Woody florals, such as pussy willow and red and yellow twig dogwood, can be coppiced every 2-3 years and sold to the floral industry or used in crafts.

Average Prices

Cuttings:	$0.37-0.45/stem retail
Wreaths:	$45+ ea retail

Black Walnut

Market Opportunities

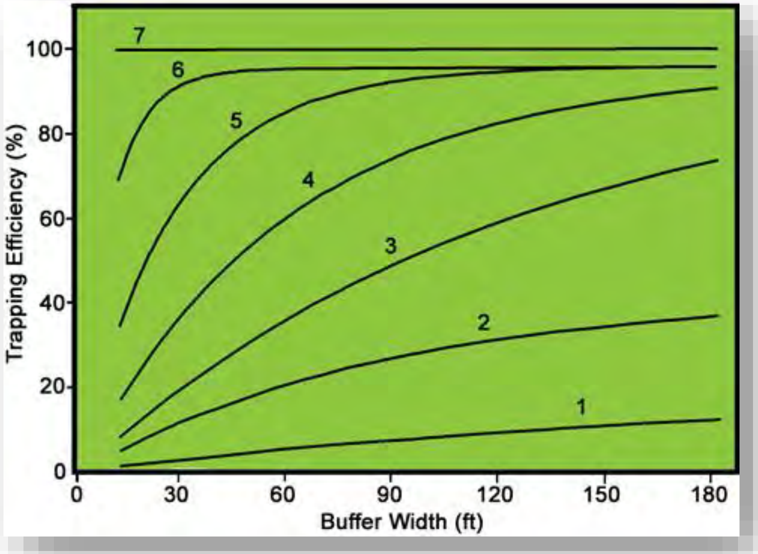
This multi-use tree produces valuable timber and heart-healthy nuts sold in shell or shelled.

Average Prices

In shell:	$9.25/lb retail
Shelled:	$12/lb retail

*Prices can vary considerably by season and local markets.

Function-based Tools and Resources



Buffer Width Tool

Subpart B Conservation Planning

Part 613 Conservation Corridor Plaanning at the Landscape Level—Managing for Wildlife Habitat

(Part 613 was originally distributed in August 1999 as Part 614.4 National Biology Handbook. It is revised and reformatted to fit within the format of this issue of the handbook.)

613.00 Introduction

(a) Background

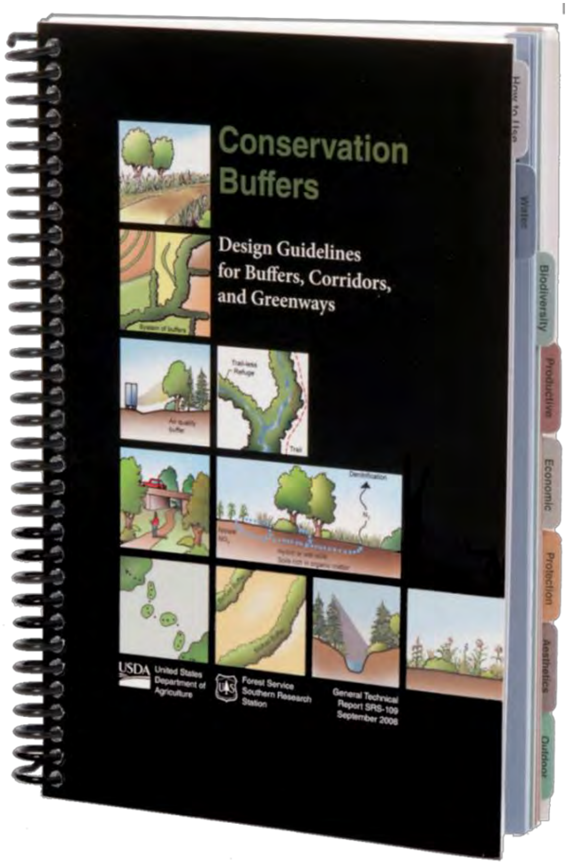
Conservation corridors are linear strips of vegetation that differ from the adjacent surroundings and function to conserve soil, water, plants, wildlife, or fish resources. Natural corridors of woody and herbaceous riparian vegetation occurring along the edges of streams, rivers, and lakes, are visually dominant in many landscapes. Windbreaks, field borders, roadsides, contour buffer strips, and grassed waterways are introduced (planted) corridors in agricultural landscapes (fig. 613–1). Corridors may also be created by disturbance; for example, a cleared powerline right-of-way. Both natural and planted corridors can be an ecological and aesthetic resource if properly managed and can yield significant benefits (value) to the landowner and society.

Corridors preserved or planted for soil and water conservation provide wildlife habitat for a variety of species. Riparian corridors are used by over 70 percent of all terrestrial wildlife species during some part of their life cycle, including many threatened and endangered (T&E) species. Corridors provide food and nesting, brooding, loafing, and protective cover for game and nongame wildlife. They also afford wildlife relatively safe access to adjacent resources and serve as travel ways for species dispersal and migration in our increasingly fragmented landscape.

Figure 613–1 Conservation corridors plants on this farm include field borders,vegetated terraces, grassed waterways, windbreaks, and forested riparian buffers, which are carefully linked to make this farm a haven for wildlife (photo courtesy Lynn Betts, USDA NRCS)

(190-VI-NBH, November 2004) 613–1

Link



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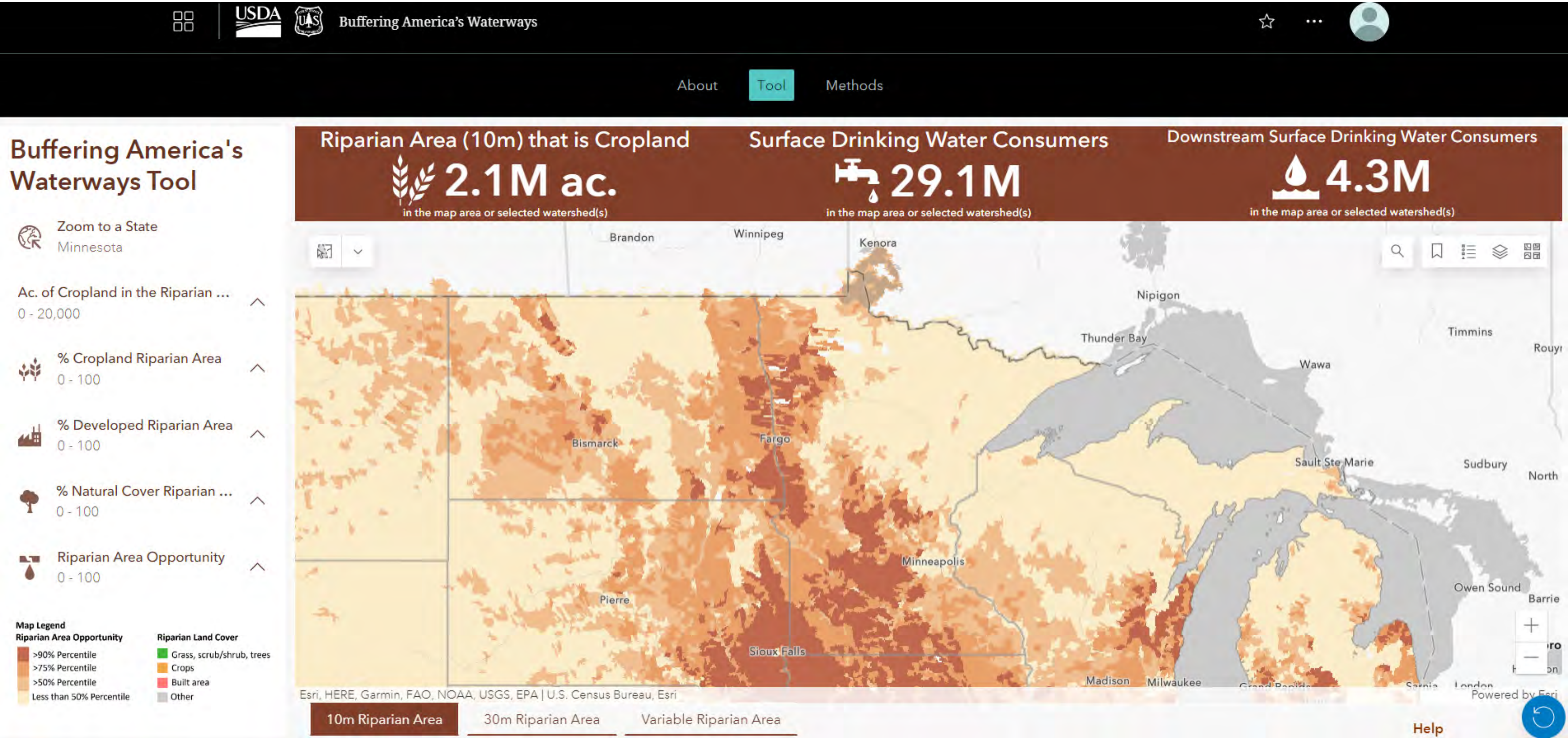
Buffering America's Waterways
About
Tool
Methods
Buffering America's Waterways Tool
Zoom to a State
Minnesota
Ac. of Cropland in the Riparian ...
0 - 20,000
% Cropland Riparian Area
0 - 100
% Developed Riparian Area
0 - 100
% Natural Cover Riparian ...
0 - 100
Riparian Area Opportunity
0 - 100
Map Legend
Riparian Area Opportunity
>90% Percentile
>75% Percentile
>50% Percentile
Less than 50% Percentile
Riparian Land Cover
Grass, scrub/shrub, trees
Crops
Built area
Other
Riparian Area (10m) that is Cropland
2.1M ac.
in the map area or selected watershed(s)
Surface Drinking Water Consumers
29.1M
in the map area or selected watershed(s)
Downstream Surface Drinking Water Consumers
4.3M
in the map area or selected watershed(s)
Brandon
Winnipeg
Kenora
Nipigon
Thunder Bay
Timmins
Wawa
Bismarck
Fargo
Sault Ste Marie
Sudbury
North
Minneapolis
Pierre
Owen Sound
Barrie
Sioux Falls
Madison
Milwaukee
Esri, HERE, Garmin, FAO, NOAA, USGS, EPA | U.S. Census Bureau, Esri
Powered by Esri
10m Riparian Area
30m Riparian Area
Variable Riparian Area
Help

http://comet-planner.com/

Conservation Practice Standard (CPS):

- ○ Alley Cropping (CPS 311)
- ○ Hedgerow Planting (CPS 422)
- ○ Multi-story Cropping (CPS 379)
- ● Riparian Forest Buffer (CPS 391)
- ○ Tree/Shrub Establishment (CPS 612)
- ○ Windbreak/Shelterbelt Establishment (CPS 380)
- ○ Windbreak/Shelterbelt Renovation (CPS 650)

Approximate Carbon Sequestration and Greenhouse Gas Emission Reductions*

(tonnes CO_2 equivalent per year)

NRCS Conservation Practices	Acreage	Carbon Dioxide	Nitrous Oxide	Methane	Total CO_2 Equivalent
Replace a Strip of Cropland Near Watercourses or Water Bodies with Woody Plants	10 ac	54	2	N.E.**	56
Totals	10	54	2	0	56

*Negative values indicate a loss of carbon or increased emissions of greenhouse gases
**Values were not estimated due to limited data on reductions of greenhouse gas emissions from this practice

Download COMET-Planner Results

Info

NRCS Conservation Practices	Soil Carbon	Biomass Carbon	Fossil CO2	Biomass Burning CO2	Biomass Burning N2O	Biomass Burning CH4	Liming	Direct Soil N2O	Indirect Soil N2O	Soil CH4	Total CO_2 Equivalent	Minimum Total Emission Reductions*	Maximum Total Emission Reductions*
Replace a Strip of Cropland Near Watercourses or Water Bodies with Woody Plants	0.47	4.93	0.00	0.00	0.00	0.00	0.00	0.16	0.02	0.00	5.59	N.E.**	N.E.**

*Minimum and maximum emission reductions represent the minimum and maximum total emissions over a range of soil, climate and management conditions within multi-county regions. Min/Max emissions are not estimated for all practices, due to limitations in quantification methods
**Values were not estimated due to limited data on reductions of greenhouse gas emissions from this practice

- Carbon Sequestration, Greenhouse Gas Reduction
- Carbon Loss, Greenhouse Gas Increase

Cancel

References

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