# Definition of a VFS (Vegetative Filter Strip) for CERSA's (Center of Excellence for Regulatory Science in Agriculture) 2018 Workshop on Innovation and Regulation in Agriculture, December 3-5, 2018

As a member of the Geographic Area (group 1) our group identified defining VFS as the most important first step in moving forward with this process so that items like literature reviews and filtering effectiveness could be better targeted and determined, respectively. Group Members were Giulio Ferruzzi, USDA-NRCS; Ross Breckels, PMRA; David Gustafson, CTIC; Nelson Thurman, US EPA. Proposed definitions for VFS's, advantages/disadvantages of those definitions and possible NRCS implications are:

## Option 1.

**Main Definition:** Adhere strictly to the predefined USDA-NRCS Conservation Practice Standard, Code 393 (Filter Strip), definition of ***A strip or area of herbaceous vegetation that removes contaminants from overland flow***. Along with the definition, adopt the general criteria in the NRCS CPS Code 393 that ensures efficacy of the implemented practice. The general criteria in NRCS CPS Code 393 is currently:

> General Criteria Applicable to All Purposes
> *Overland flow entering the filter strip will be uniform sheet flow.*
> *Concentrated flow will be dispersed before it enters the filter strip.*
> *The maximum gradient along the leading edge of filter strip will not exceed one-half of the up-and-down-hill slope percent, immediately upslope from the filter strip, up to a maximum of five percent.*
> *Filter strips will not be used as a travel lane for equipment or livestock.*

**Design Criteria:** Because this group is specifically interested in these vegetative practice's ability to mitigate pesticide losses from the application areas, the interests of this group corresponds to the first two purposes in NRCS CPS Code 393 and the third and final purpose for irrigated agriculture (mainly in the arid West). The full list of purposes in NRCS CPS Code 393 are:

> Purpose
>
> - *Reduce suspended solids and associated contaminants in runoff and excessive sediment in surface waters.*
> - *Reduce dissolved contaminant loadings in runoff.*
> - *Reduce suspended solids and associated contaminants in irrigation tailwater and excessive sediment in surface waters.*

The full list of additional criteria for NRCS CPS Code 393 are:

> Additional Criteria to Reduce Dissolved Contaminants, Suspended Solids and Associated Contaminants in Runoff and Excessive Sediment in Surface Waters.
> *The filter strip will be designed to have a 10-year life span, following the procedure in Agronomy Technical Note No. 2, "Using Revised Universal Soil Loss Equation, Version 2 (RUSLE2) for the Design and Predicted Effectiveness of Vegetative Filter Strips (FVS) for Sediment," based on the amount of sediment delivery to the upper edge of the filter strip and ratio of filter strip flow length to length of flow path from the contributing area. The minimum flow length through the filter strip will be 20 feet for suspended solids and associated contaminants in runoff and 30 feet for dissolved pesticides in runoff.*
>
> *The filter strip will be located immediately downslope from the source area of contaminants.*
>
> *The drainage area immediately above the filter strip will have a slope of one percent or greater.*

*Vegetation. The filter strip will be established to permanent herbaceous vegetation.*

*Species selected will be—*

- *Able to withstand partial burial from sediment deposition.*
- *Tolerant of herbicides used on the area that contributes runoff to the filter strip.*
- *Stiff stemmed and a high stem density near the ground surface.*
- *Suited to current site conditions and intended uses.*
- *Able to achieve adequate density and vigor within an appropriate period to stabilize the site sufficiently to permit suited uses with ordinary management activities.*

*Plant species, rates of seeding (lbs/ac), vegetative planting (plants/ac), minimum quality of planting stock (pure live seed [PLS] or stem caliper), and method of establishment shall be specified before application. Only viable, high quality seed or planting stock will be used.*

*Perform site preparation and seeding/planting at a time and in a manner that best ensures survival and growth of selected species. Successful establishment parameters, (e.g., minimum percent ground/ canopy cover, percent survival, stand density) will be specified before application.*

*Schedule planting dates during periods when soil moisture is adequate for germination and establishment. Seeding will be timed so that tillage for adjacent crop does not damage the seeded filter strip.*

*Where the purpose is to remove phosphorus, remove (or harvest) the filter strip aboveground biomass at least once each year.*

*The minimum seeding and stem density will be equivalent to the seeding rate for a high-quality grass hay seeding rate for the climate area or the density of vegetation selected in current water erosion technology to determine trapping efficiency, whichever is the higher seeding rate.*

Additional Criteria to Reduce Suspended Solids and Associated Contaminants in Irrigation Tailwater and Excessive Sediment in Surface Waters.

*Filter strip vegetation will be a small grain or other suitable annual plant.*

*The seeding rate shall be sufficient to ensure that the plant spacing does not exceed 4 inches (about 16–18 plants per square foot).*

*Establish filter strips prior to the irrigation season so that the vegetation is mature enough to filter sediment from the first irrigation.*

**Advantages and disadvantages of this option:**

| Advantages | Disadvantages |
|---|---|
| Adoption of an existing definition. We do not have to agree on a new definition and educate everyone on what a VFS is or is not. | Being restricted to this definition will not allow the use of riparian forest buffers (because of the exclusion of woody vegetation in the definition of NRCS CPS Code 393) on the edges of waterways that seem to show significant mitigation benefits for some chemical movement to surface waters. Additionally, implementing a herbaceous VFS in place of, or as well as, a riparian buffer may lead to the removal of sections or entire existing riparian buffers, which could be detrimental to both aquatic and terrestrial biota. |
| Very narrow in scope and design so that data from the literature review should be less to review but should also provide for less scatter due to similar design features. This could also help define a narrower | Very narrow in scope and design so the data from the literature review will be greatly decreased and may not provide information from some parts of the country. This may make statistical analysis of the data |

| | |
|---|---|
| effectiveness range (e.g. 60%-90% effective rather than 20%-100% effective. | and extrapolations to certain parts of the country difficult or impossible with much confidence. |
| Others? | Others? |

**References:** USDA-NRCS CPS Code 393 in full:

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241319.pdf

## Option 2.

**Main Definition:** To meet the objectives of this groups' activities, the proposed definition for a VFS should be loosely based on USDA-NRCS CPS, Code 393 (Filter Strip), but made broader to include various types of vegetation to read: ***A strip of vegetation that removes contaminants from overland flow located at the lower edge(s) of a field***. Along with the definition, adopt a general set of criteria that can further describe the VFS design and requirements. The general criteria could come from an amalgamation of several, related NRCS CPSs such as Filter Strip (Code 393), Riparian Forest Buffer (Code 391), Field Border (Code 386), Riparian Herbaceous Cover (Code 390) and even potentially Vegetated Treatment Area (Code 635). The General Criteria applicable to all these practices to ensure adequate mitigation could be proposed as:

### General Criteria

- *Overland flow entering the VFS will be uniform sheet flow.*
- *Concentrated flow will be dispersed before it enters the VFS and sheet flow will be maintained within the VFS.*
- *The area immediately above the filter strip will have a slope of one percent or greater*
- *The maximum gradient along the leading edge of filter strip will not exceed one-half of the up-and-down-hill slope percent, immediately upslope from the filter strip, up to a maximum of five percent.*
- *The filter strip will be located immediately downslope from the source area of contaminants.*

**Design Criteria:** Because this group is specifically interested in the VFS's ability to mitigate pesticide losses from the application areas, the main focus of the criteria language from each practice will be for surface water quality protection. The full list of purposes in NRCS CPS Code 393 are:

### Additional Design Criteria.

*The minimum flow length through the filter strip will be 20 feet for suspended solids and associated contaminants in runoff and 30 feet for dissolved contaminants and pathogens in runoff.*

*Vegetation. The filter strip will be established to permanent vegetation with the exception of areas of the arid West where irrigation water is the main source of water. In those exceptional cases, USDA-NRCS CPS Code 393 criteria for irrigation tailwater is required.*

*Species selected will be—*

- *Able to withstand partial burial from sediment deposition.*
- *Tolerant of herbicides used on the area that contributes runoff to the filter strip.*
- *Suited to current site conditions and intended uses.*
- *Able to achieve adequate density and vigor within an appropriate period to stabilize the site sufficiently to permit suited uses with ordinary management activities.*

**Advantages and disadvantages of this option:**

| Advantages | Disadvantages |
|---|---|
| A broader definition of a VFS would allow more types of vegetation to be considered effective at mitigating the loss than just the USDA-NRCS CPS Code 393. | Too broad of a definition may lead to varying designs and implementation of what is considered a VFS. |
| Broader in scope and design so that data from the literature review would be a larger set to review. This could provide a more comprehensive review of several different designs of VFSs. | The literature review could take longer in capturing all the different types of buffering vegetation designs. Trying to classify different designs into expected mitigation effectiveness could also be difficult or just more time consuming. |
| Others? | Others? |

**References:**


USDA-NRCS CPS Code 386: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241318.pdf

USDA-NRCS CPS Code 390: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026183.pdf

USDA-NRCS CPS Code 391: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026098.pdf

USDA-NRCS CPS Code 393: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241319.pdf

USDA-NRCS CPS Code 635:
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd340714&ext=pdf


## Option 3.

**Main Definition:** Maybe a compromise between the restrictive definition of Option 1 and Option 2 above to focus the most effective VFSs could read as Option 2 but with different design criteria. The basic definition would be like Option 2: ***A strip of vegetation that removes contaminants from overland flow located at the lower edge(s) of a field***. Along with the definition, adopt a general set of criteria that can further describe the VFS design and requirements. The general criteria could come from an amalgamation of the two most effective NRCS CPSs such as Filter Strip (Code 393) and Riparian Forest Buffer (Code 391). The General Criteria applicable to all these practices to ensure adequate mitigation could be proposed as:

### General Criteria

- *Overland flow entering the VFS will be uniform sheet flow.*
- *Concentrated flow will be dispersed before it enters the VFS and sheet flow will be maintained within the VFS.*
- *The area immediately above the filter strip will have a slope of one percent or greater*
- *The maximum gradient along the leading edge of filter strip will not exceed one-half of the up-and-down-hill slope percent, immediately upslope from the filter strip, up to a maximum of five percent.*
- *The filter strip will be located immediately downslope from the source area of contaminants.*

**Design Criteria:** Because this group is specifically interested in the VFS's ability to mitigate pesticide losses from the application areas, the main focus of the criteria language from each practice will be for surface water quality protection. The full list of purposes in NRCS CPS Code 393 are:

Additional Design Criteria.

*The minimum flow length through primarily herbaceous filter strip will be 20 feet for suspended solids and associated contaminants in runoff and 30 feet for dissolved contaminants and pathogens in runoff.*

*The minimum flow length through primarily woody riparian forest buffers will be 35 feet.*

*Vegetation. The filter strip will be established to permanent vegetation (herbaceous, woody or mixed) with the exception of areas of the arid West where irrigation water is the main source of water. In those exceptional cases, USDA-NRCS CPS Code 393 criteria for irrigation tailwater is required.*

*Species selected will be—*

- *Able to withstand partial burial from sediment deposition.*
- *Tolerant of herbicides used on the area that contributes runoff to the filter strip.*
- *Suited to current site conditions and intended uses.*
- *Able to achieve adequate density and vigor within an appropriate period to stabilize the site sufficiently to permit suited uses with ordinary management activities.*

**Advantages and disadvantages of this option:**

| Advantages | Disadvantages |
|---|---|
| Restricting the definition to include essentially the USDA-NRCS CPS 393 and 391 definitions, and associated criteria, which seem to be the most effective versions of VFS. | This may be too difficult to easily convey to the general public and clients that need to implement a VFS whether herbaceous or woody? |
| Very narrow in scope and design, but not as narrow as solely focusing on USDA-NRCS CPS 393 so that data from the literature review should be manageable to review but should also provide for good statistical analyses due to similar design features. | A compromise in the types of literature reviewed? |
| Others? | Others? |

**References:**

USDA-NRCS CPS Code 391: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026098.pdf

USDA-NRCS CPS Code 393: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241319.pdf