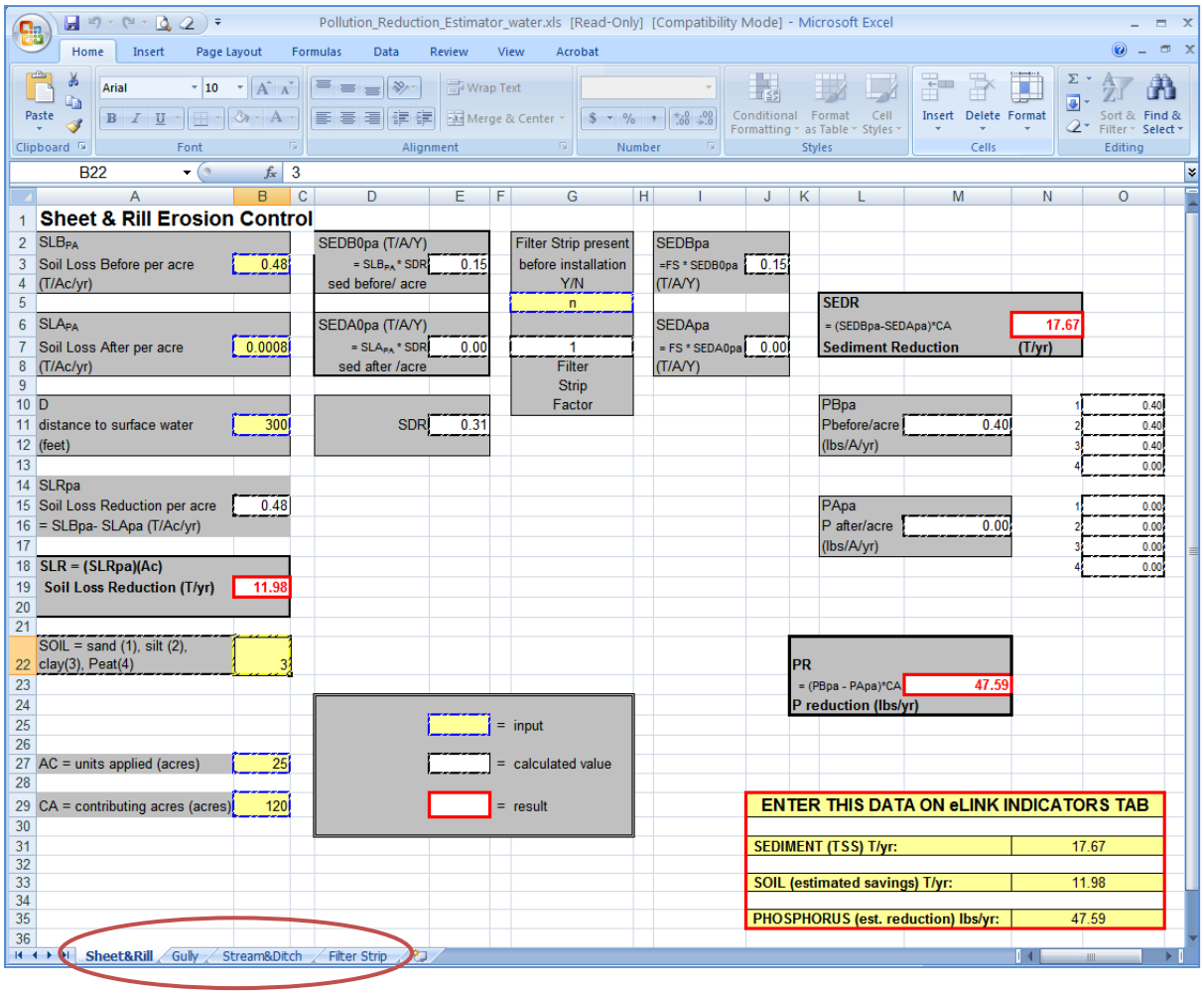
Pollution Reduction Estimator

Water Erosion - Microsoft Excel® Version

September 2010



Introduction

The Microsoft Excel® Spreadsheet ***Pollution Reduction Estimator - water erosion.xls*** is a version of the same pollution reduction estimator that was built-in to eLINK version 2. The inputs and results are the same. It requires Excel to Run.

There are 4 Water Erosion estimator types to choose from:

1. Sheet and rill erosion.
2. Gully stabilization.
3. Stream bank/ditch stabilization.
4. Filter strip projects.

The spreadsheet "workbook" contains 4 worksheets, one for each of the 4 estimator types. These are accessed via the worksheet tabs at the bottom of the spreadsheets (circled in red above).

Each of the worksheets has cells that require user input (shaded yellow and outlined in blue), cells with intermediate calculated values (outlined in black), and final results (outlined in red). The results are **Soil Loss Reduction** (tons/year), **Sediment Reduction** (tons/year) and **Phosphorus Reduction** (lbs/year).

Estimators for **Sheet and rill erosion** and for **Filter strip projects** require input from the **Revised Universal Soil Loss Equation 2 (RUSLE2).**

RUSLE2 includes several components. One is the **computer program** that solves the many **mathematical equations** used by RUSLE2. A very important part of the RUSLE2 computer program is its **interface** that connects the user to RUSLE2. Another major component of RUSLE2 is its **database,** which is a large collection of input data values. The user selects entries from the database to describe site-specific field conditions. The other major component of RUSLE2 is the **mathematical equations, scientific knowledge, and technical judgment** on which RUSLE2 is scientifically based. RUSLE2 is very easy to use. With the exception of topography, the RUSLE2 user describes the site-specific field conditions by selecting database entries from menus. When a menu selection is made, RUSLE2 "pulls" values stored in the RUSLE2 database and uses them as input values to compute erosion. The user enters site-specific values for slope length and steepness to represent topography

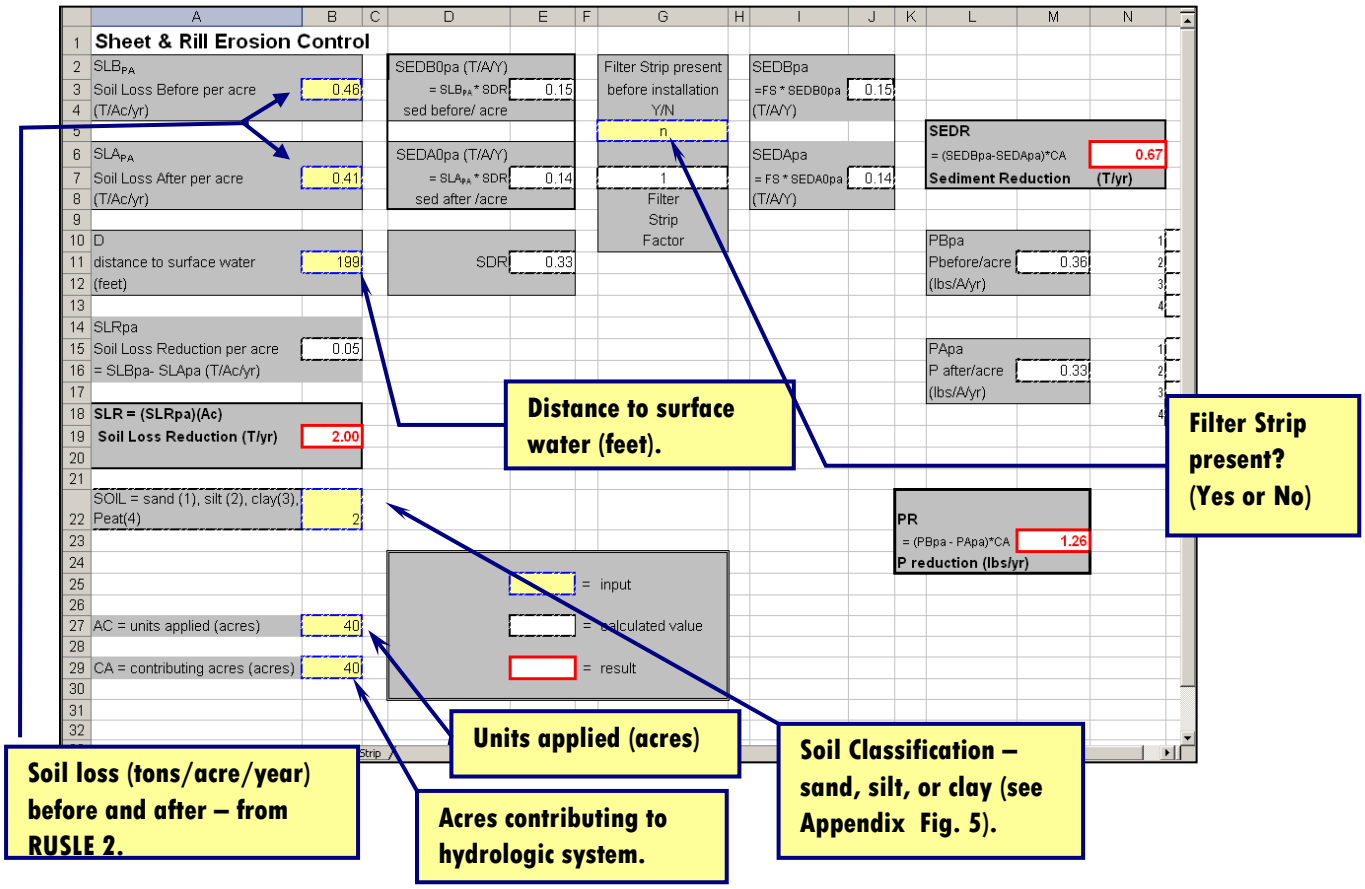
More information on RUSLE2:
www.ars.usda.gov/Research/docs.htm?docid=6010

See Appendix A for more detailed explanation of the calculations behind the different estimates.

1. Water Erosion - Sheet & Rill Erosion

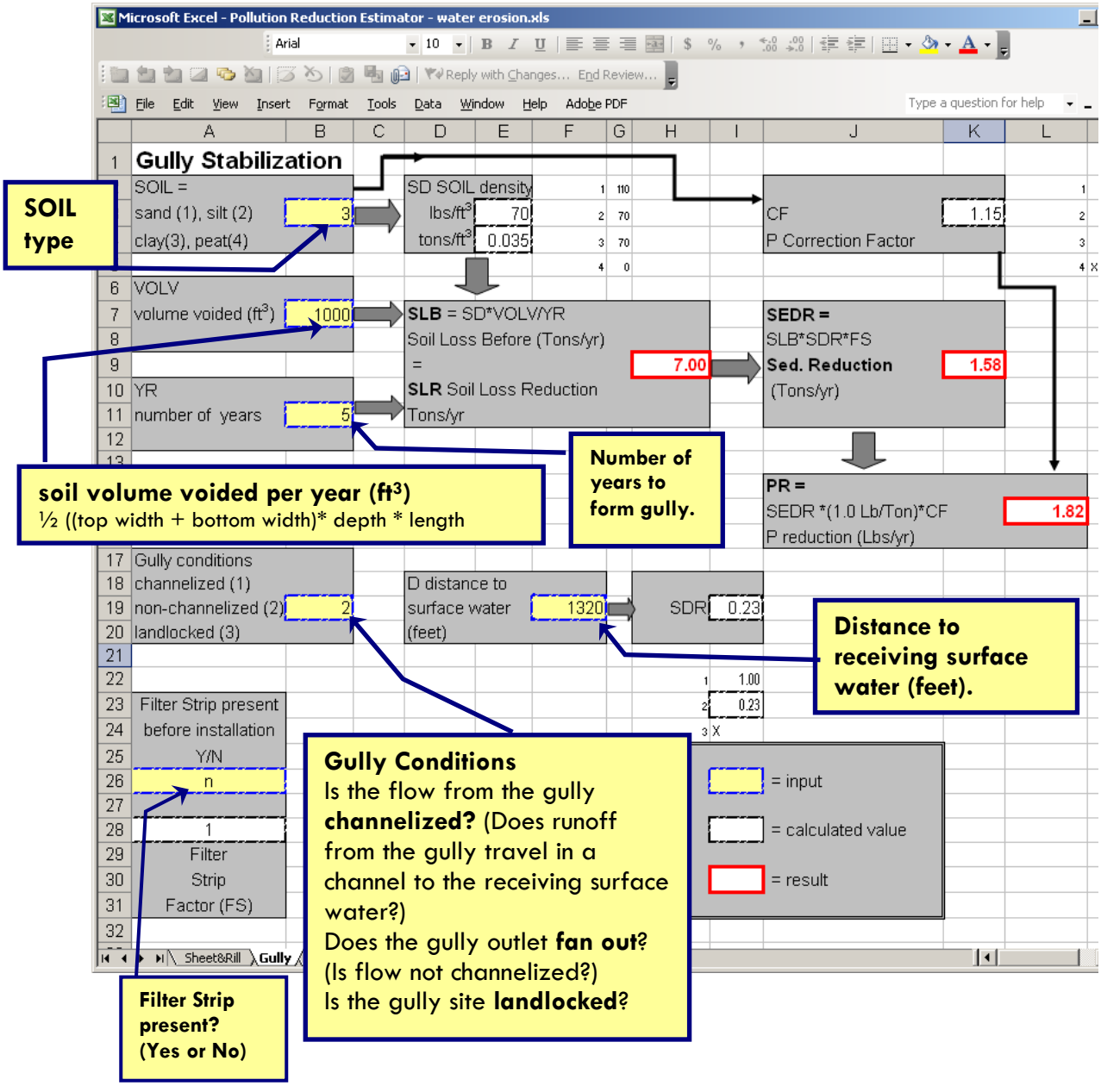
Required inputs for the sheet and rill erosion estimator are:

- Erosion before and after (tons/acre/year,) estimated using the **Revised Universal Soil Loss Equation 2 (RUSLE2).**
- The distance from the edge of field to the receiving water resource. This determines the sediment delivery ratio (SDR).
- Soil type (sand, silt, clay, peat).
- Units applied (acres).
- Area contributing to the hydrologic system (acres).
- Distance to surface water (feet).
- Presence of filter strip before project installation (yes or no).



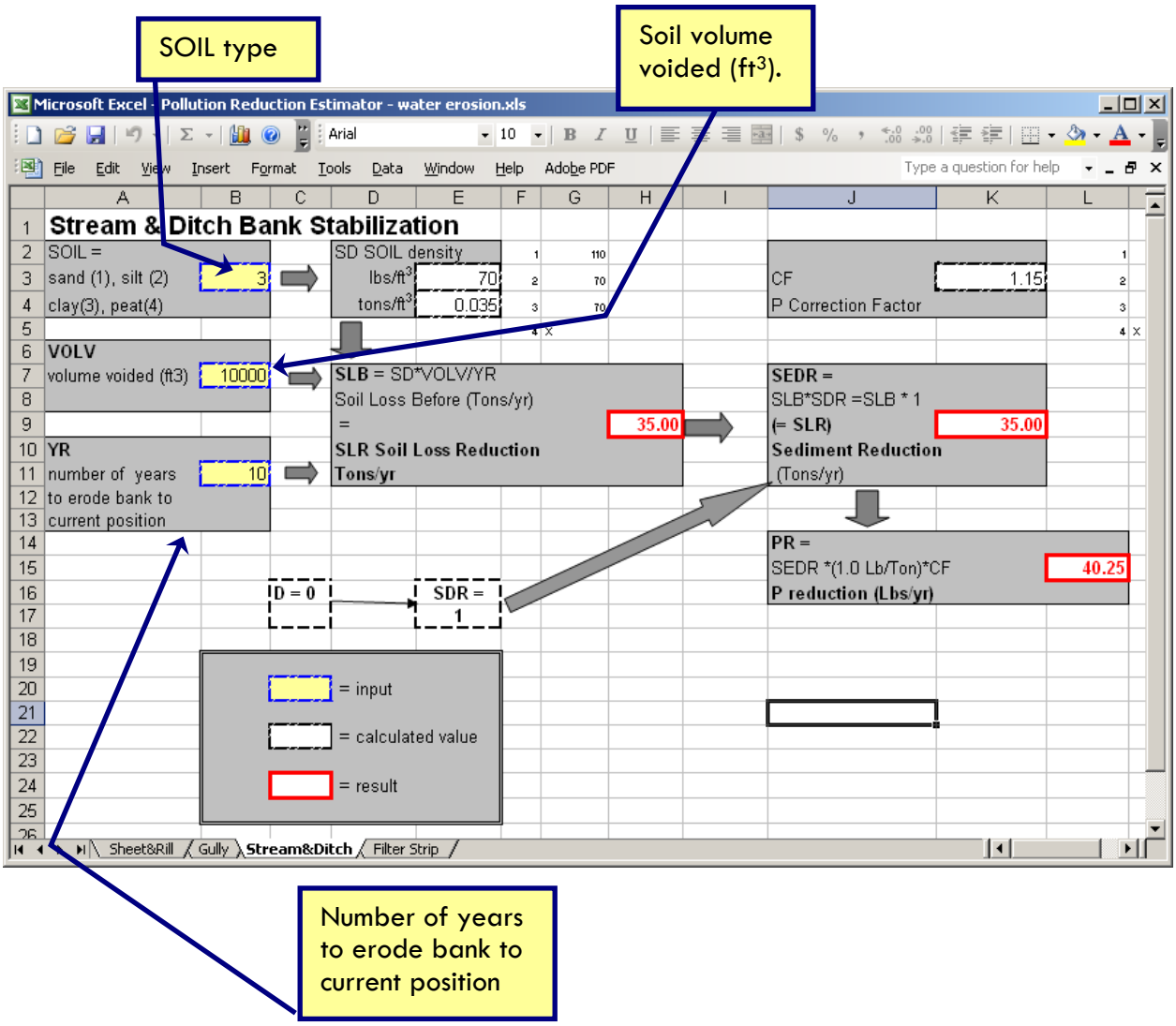
2. Water Erosion - Gully Stabilization

The estimates for reductions in soil loss, sediment, and attached phosphorus delivery for gully stabilization are based on estimation of **soil volume voided per year**. The estimate assumes that once the practice is in place, the stabilized condition controls gully erosion. Soil loss reduction from the practice is equal to soil erosion before the project was put in place. A **sediment delivery ratio (SDR)** is assigned based on characteristics of flow from the gully and is applied to estimate sediment reduction. Sediment-attached phosphorus reduction is estimated from the sediment reduction, default phosphorus content of 1.0 lb of phosphorus per 1 ton of soil, and a correction for soil texture.



3. Water Erosion - Stream and Ditch Bank Stabilization

The estimates for reductions in soil loss, sediment, and attached phosphorus delivery for bank stabilization are based on an estimate of volume voided per year. The estimate assumes that once the practice is in place, the stabilized condition controls bank erosion. Soil loss reduction from the practice is therefore equal to soil erosion before the project was put in place. The SDR = 1 since the practice is adjacent to the receiving surface water. Sediment-attached phosphorus reduction is estimated from the sediment reduction, a default phosphorus content of 1.0 lb of phosphorus per 1 ton of soil, and a correction for soil texture.

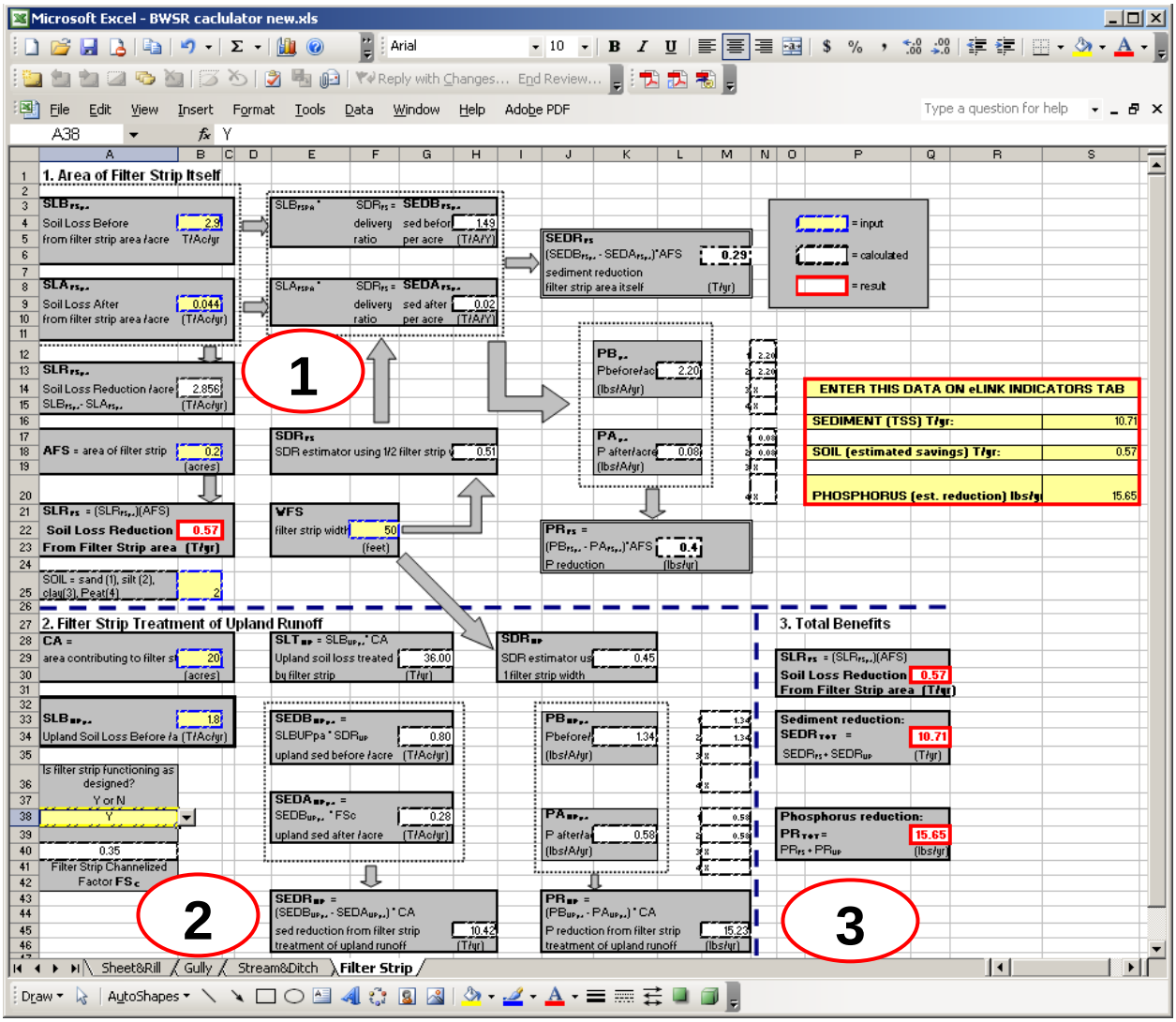


4. Water Erosion - Filter Strip Projects

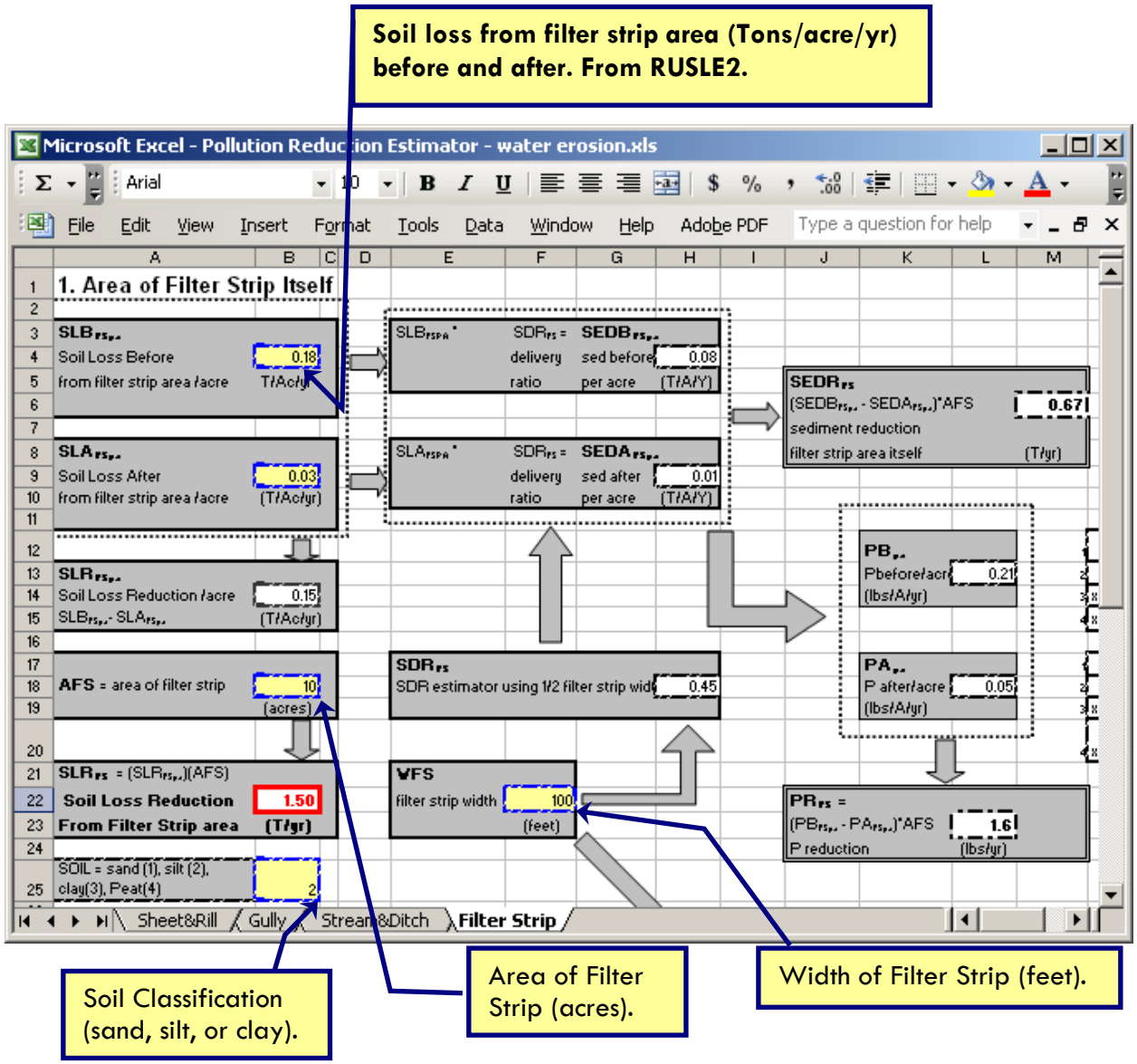
The pollution reduction estimates (soil loss reduction, sediment reduction, phosphorus reduction) from filter strip projects are made by:

1. Estimating pollutant reductions from the area of the filter strip itself resulting from conversion of the filter strip area to permanent vegetative cover;
2. Estimating pollutant reductions from the filter strip's treatment of runoff from the upland drainage area contributing to the filter strip; and
3. Summing the above to give the total pollution reduction estimate.

The worksheet for filter strip projects is divided into 3 areas – one for each of the steps.

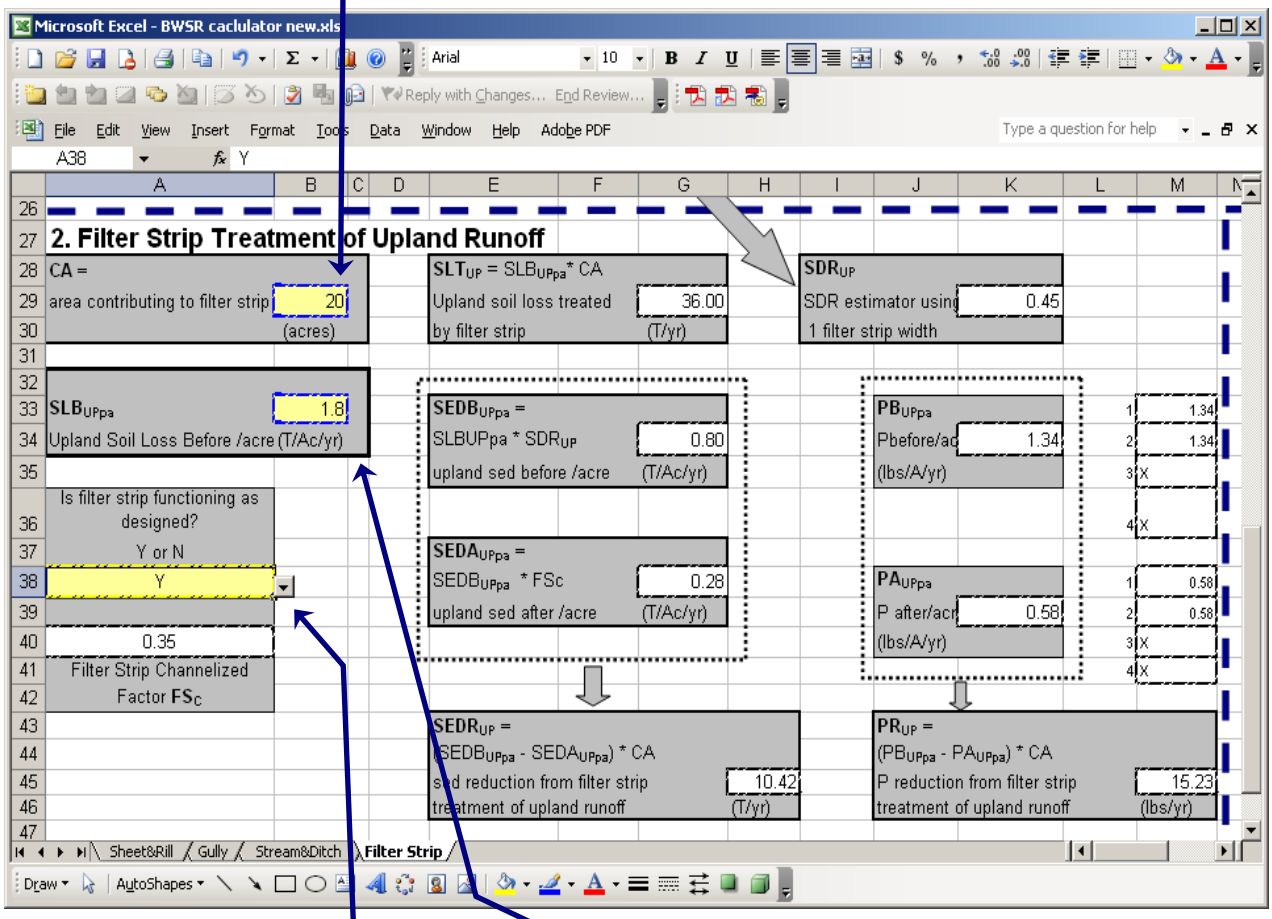


4.1 Area of Filter Strip



4.2 Filter Strip treatment of Upland Runoff

Area contributing to filter strip (area the filter strip is treating in acres).



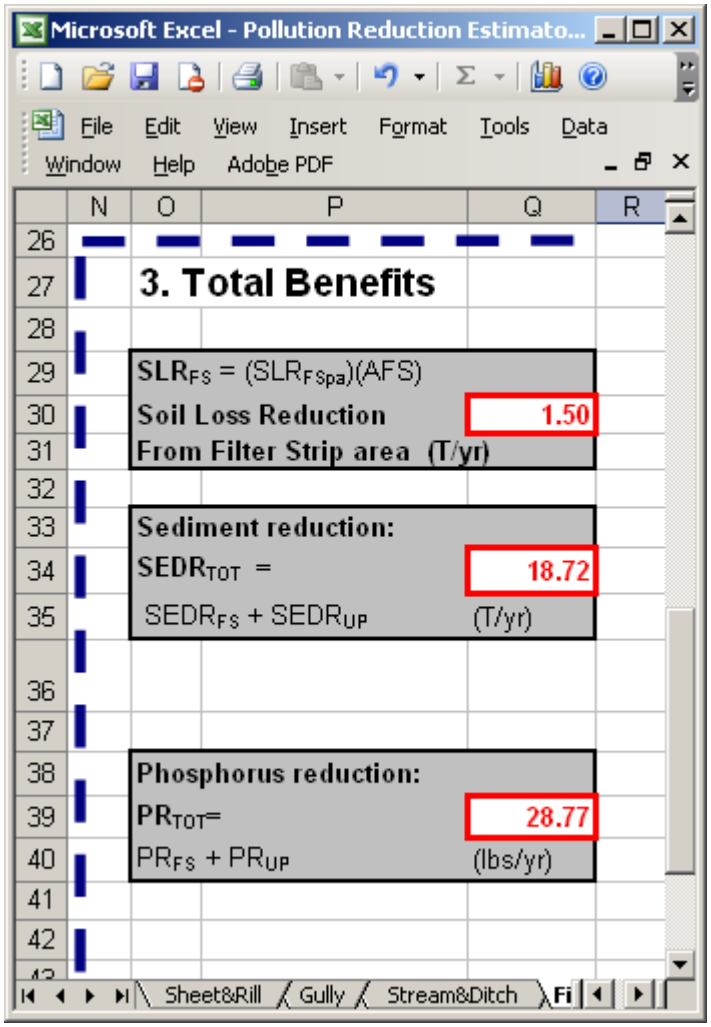
Does the filter strip function as designed?

Examples of non-functioning filter strip:

- Contributing Area (CA) is too large
- Flow is channelized through filter strip

Soil loss from upland (Tons/ac/yr) before. From RUSLE 2.

4.3 Result


Microsoft Excel - Pollution Reduction Estimato...
File Edit View Insert Format Tools Data
Window Help Adobe PDF
N O P Q R
3. Total Benefits
SLRFS = (SLRFSpa)(AFS)
Soil Loss Reduction
From Filter Strip area (T/yr)
1.50
Sediment reduction:
SEDRTOT =
SEDRFS + SEDRUP
(T/yr)
18.72
Phosphorus reduction:
PRTOT=
PRFS + PRUP
(lbs/yr)
28.77
Sheet&Rill Gully Stream&Ditch

Appendix A: Calculations Behind Pollution Reduction Estimates –Water Erosion

The Microsoft Excel Spreadsheet ***Pollution Reduction Estimator - water erosion.xls*** has the same water-erosion based pollution reduction estimators that were built-in to eLINK version 2. These include estimators for:

- Sheet and rill erosion
- Gully stabilization
- Stream bank/ditch stabilization
- Filter strip projects

The water erosion estimates are based on:

1. An estimate of soil erosion before and after installation of the practice;
2. An estimate of resulting reduction in sediment to the nearest surface water body; and
3. An estimate of resulting reduction in attached phosphorus

Soil erosion estimates use either: **(1)** the **Revised Universal Soil Loss Equation 2 (RUSLE2)** for sheet & rill erosion and filter strip projects, or **(2)** a volumetric calculation for gully/ stream bank/ ditch stabilization projects.

The estimates then calculate an estimated **Sediment Delivery Ratio (SDR)** based on the distance to the receiving water body, and is applies the SDR to the estimated soil loss reduction to produce an estimate of sediment reduction. Attached phosphorus reduction is derived from sediment delivery and a coefficient based on soil type.

Sheet & Rill Erosion Control

Erosion before and after, estimated using the Revised Universal Soil Loss Equation (RUSLE2) are required inputs. The distance from the edge of field to the receiving water resource determines the SDR. The SDR is applied to estimate sediment reduction. Sediment-attached phosphorus reduction is calculated using functions relating phosphorus content to sediment delivery.

Features:

- Use of an SDR estimator algorithm (Fig. 2) to estimate sediment delivery coefficient
- Sediment enrichment for sediment-borne phosphorus is factored in using functions estimating P content (pounds/acre/year) from sediment delivery (tons/acre/year) and soil type (Fig 3). The functions come from CREAMS (via AGNPS)[1] tables with the default value set a 1.0 lb of phosphorus per 1 Ton of soil.

Inputs:

RUSLE2 Before → **SLB_{pa}** soil loss before per acre (tons/acre/year)

RUSLE2 after → **SLA_{pa}** soil loss after per acre (tons/acre/year)

SOIL type (sand, silt, clay, peat)

AC = units applied (acres)

CA = contributing acres (contributing watershed)

D = distance to surface water

[1] **Kinsel, Walter G.(ed.),1980 CREAMS**: A Field Scale Model for Chemicals, Runoff, and Erosion From Agricultural Management Systems. U.S. Department of Agriculture, Conservation Report No. 26, 640 pp.
Young, R., C.A. Onstad, D.D. Bosch and W.P. Anderson.1987. AGNPS: Agricultural Non-Point Source Pollution Model: a watershed analysis tool. USDA-Agricultural Research Service. Conservation Research Report 35., U.S. Department of Agriculture, Washington, D.C.

Soil Loss Reduction Estimate

SLRpa = SLB_{pa} - SLA_{pa} Soil Loss Reduction per acre (tons/acre/year)

SLR = SLR_{pa}*AC Soil Loss Reduction (tons/year)

Sediment Reduction Estimate

$SEDB0_{pa}$ = SLB_{pa} * **SDR** **Preliminary** sediment **before** per acre (tons/acre/year)

$SEDA0_{pa}$ = SLA_{pa} * **SDR** **Preliminary** sediment **after** per acre (tons/acre/year)

Where **SDR** = sediment delivery ratio, calculated from the algorithm (Fig. 2).

Preexisting filter/buffer strip

Was a filter strip present before the installation of the project?

YES: **FS** = 0.35

NO: **FS** = 1

The filter strip factor (**FS**) modifies the preliminary sediment estimates to account for removal of sediment by the filter strip. It represents the fraction of sediment passing through the filter strip. If no filter strip was previously installed, the initial sediment reduction estimate is not modified (FS = 1). An estimate of the relative gross effectiveness of filter strips for sediment reduction is 65%. If the filter strip is judged to be functioning properly[2] then we use the estimate of 65% sediment removal (FS = 0.35).

$SEDB_{pa}$= FS * $SEDB0_{pa}$ sediment **before** per acre (tons/acre/year)

$SEDA_{pa}$= FS * $SEDA0_{pa}$ sediment **after** per acre (tons/acre/year)

SEDR = ($SEDB_{pa}$ - $SEDA_{pa}$)*CA Sediment Reduction (tons/year)

Phosphorus Reduction Estimate

PB_{pa} = **f**($SEDB_{pa}$, SOIL) phosphorus before per acre (pounds/acre/year)

PA_{pa} = **f**($SEDA_{pa}$, SOIL) phosphorus after per acre (pounds/acre/year)

Where **f** is the function estimating P content (pounds/acre/year) from sediment delivery (tons/acre/year) and soil type (Fig 3).

PR = (PB_{pa} - PA_{pa})*CA phosphorus reduction (pounds/year)

2

The filter strip credit should be given to a site that provides the following:

1) A healthy stand of grasses predominated by varieties of stem grasses versus blade grasses.
2) The stand of grass should be wide enough to impede the flow it receives (estimated ranges depend on the grass and the energy of the run-off. Widths can be as low as 10 feet for switch grass up to more common values of 66 feet).
3) Delivery of the run-off must remain in a thin overland flow pattern and not be channelized.
4) The delivery of the run-off from the credited area cannot be bypassed around or through the filter strip by a ditch, tile intake, side inlet or channel.

Fig. 1: Sheet & Rill Erosion Control

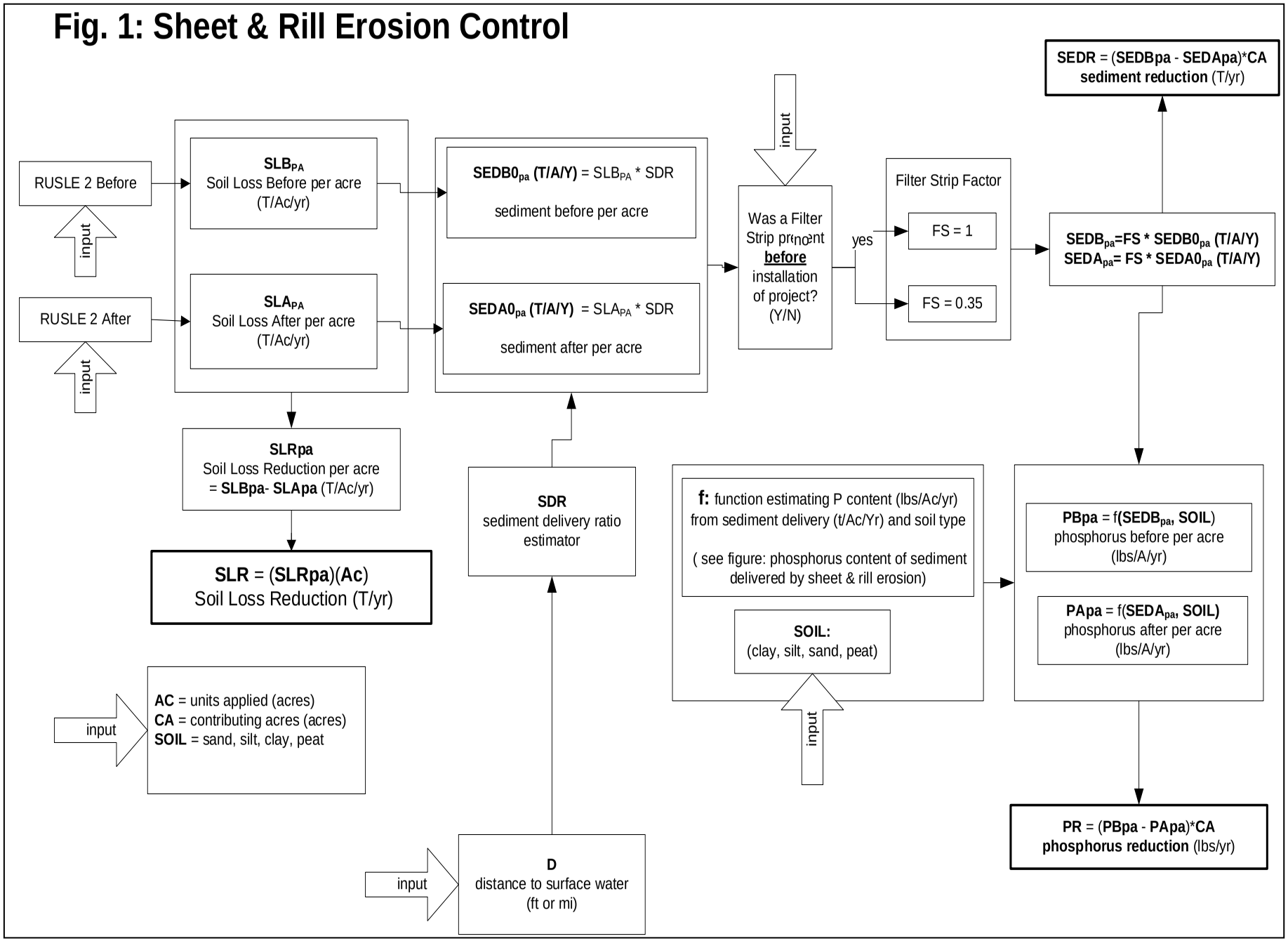
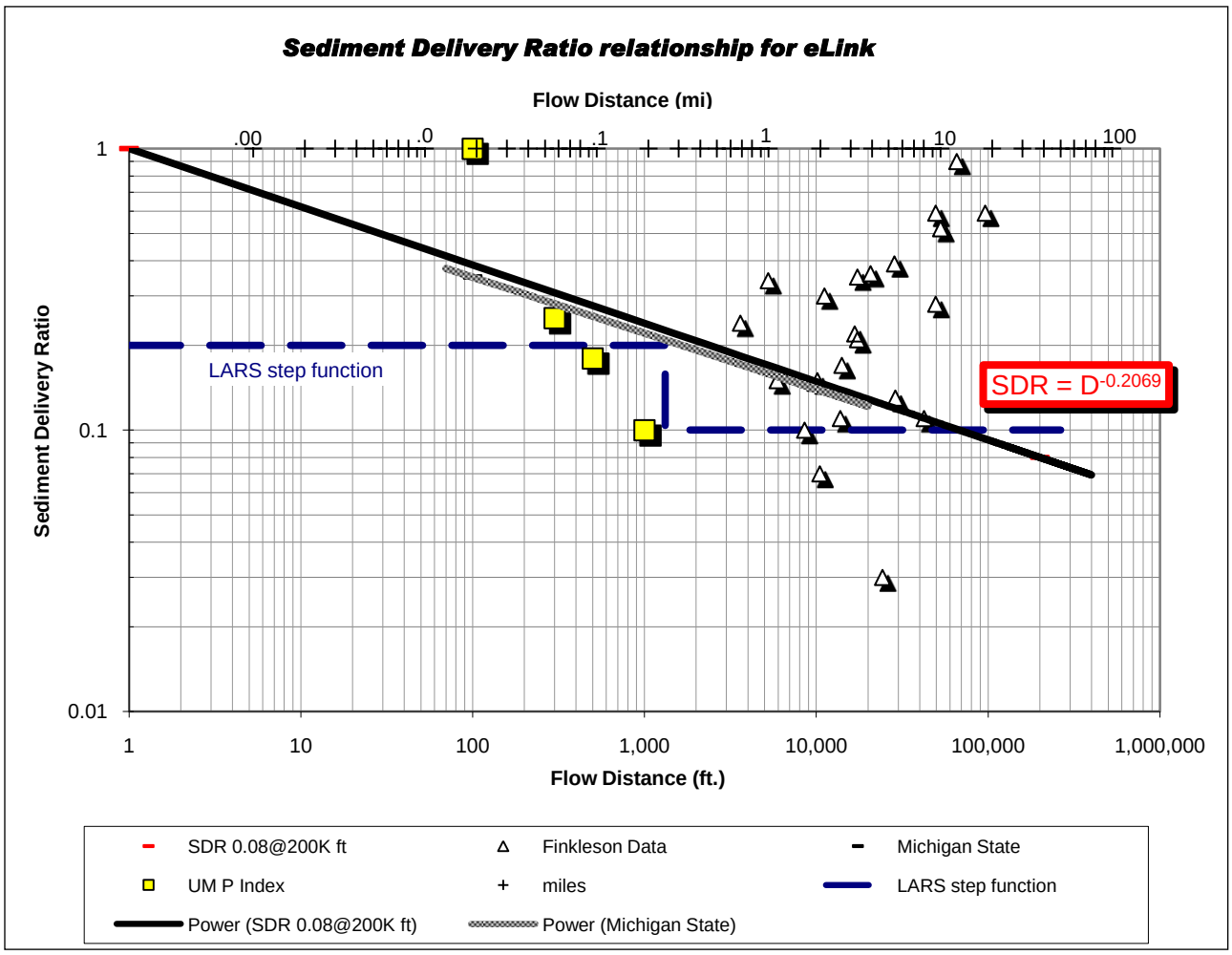


Fig. 2: Sediment Delivery Ratio Estimator for Sheet & Rill Erosion

The Sediment Delivery Ratio (SDR) estimator tool for sheet and rill erosion is based on an approximate relationship between SDR and distance from the edge-of-field to the receiving surface water. The relationship is defined by a power function passing through two points:

Distance (ft)	SDR
200,000	0.08
1	1

The same relationship has been proposed for use in the Phosphorus Index work currently underway. The graph shows the relationship in relation to the "step function" used in LARS.



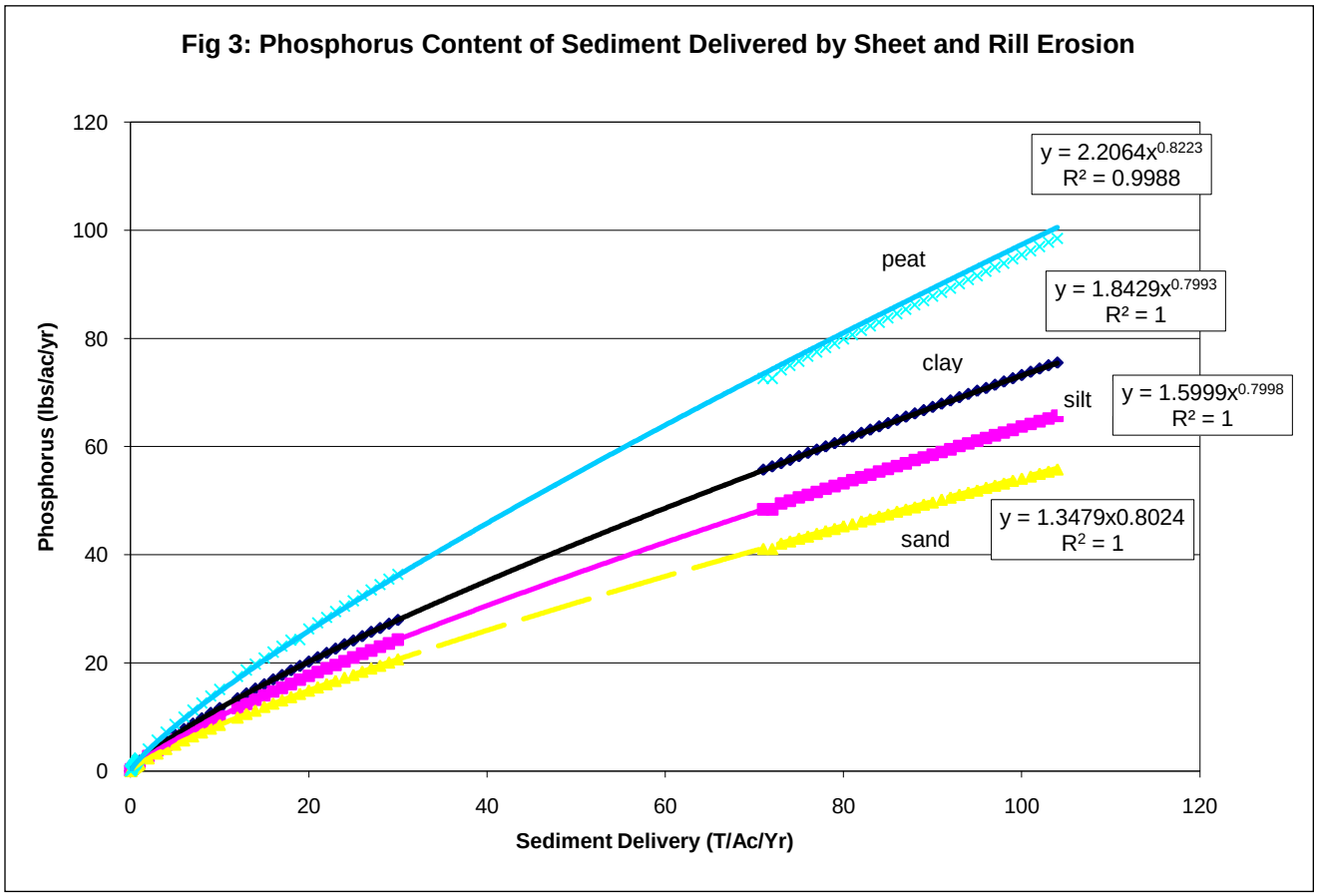


Fig 3:Phosphorus Content of Sediment Delivered by Sheet and Rill Erosion

Functions estimate phosphorus content (pounds/acre/year) from sediment delivery (tons/acre/year) and soil type. Source: CREAMS (via AGNPS)[3] tables with the default value set a 1.0 lb of phosphorus per 1 Ton of soil.

[3] **Kinsel, Walter G.(ed.),1980 CREAMS**: A Field Scale Model for Chemicals, Runoff, and Erosion From Agricultural Management Systems. U.S. Department of Agriculture, Conservation ReportNo. 26, 640 pp.
Young, R., C.A. Onstad, D.D. Bosch and W.P. Anderson.1987. AGNPS: Agricultural Non-Point Source Pollution Model: a watershed analysis tool. USDA-Agricultural Research Service. Conservation Research Report 35., U.S. Department of Agriculture, Washington, D.C.

2. Gully Stabilization

The estimates for reductions in soil loss, sediment, and attached phosphorus delivery for gully stabilization are based on calculation of soil volume voided per year. The estimate assumes that once the practice is in place, the stabilized condition controls gully erosion. Soil loss reduction from the practice is equal to soil erosion before the project was put in place. A sediment delivery ratio (SDR) is assigned based on characteristics of flow from the gully. The SDR is applied to estimate sediment reduction. Sediment-attached phosphorus reduction is estimated from the sediment reduction, default phosphorus content of 1.0 lb of phosphorus per 1 ton of soil, and a correction for soil texture.

Inputs:

VOLV volume voided (ft^3) ((top width + bottom width)/2)* depth * length

SOIL type (sand, silt, clay, peat)

YR number of years to form gully

Characteristics of flow from Gully

- Is the flow from the gully **channelized?** (Does runoff from the gully travel in a channel to the receiving surface water?)
- Does the gully outlet **fan out**? (Is flow **not channelized**?)
- Is the gully site **landlocked**?

D distance to receiving surface water

Soil Loss Reduction Estimate

SD soil density (tons/ft^3) - from table (Fig. 5)

SLB = SD*VOLV/YR Soil Loss Before (tons/year)

Assumed equal to:

SLR Soil Loss Reduction (tons/year)

Sediment Reduction Estimate

Assign SDR based on the characteristics of flow from the gully.

Channelized

D < 0.25 mi: SDR = 1.00

D > 0.25 mi: SDR = 0.5

Not channelized - gully fans out

Use SDR estimator (Fig. 2)

Landlocked

SDR = 0

Preexisting filter/buffer strip

Was a filter strip present before the installation of the project?

YES: **FS** = 0.35 NO: **FS** = 1

The filter strip factor (**FS**) modifies the preliminary sediment estimates to account for removal of sediment by the filter strip. It represents the fraction of sediment passing through the filter strip. If no filter strip was previously installed, the initial sediment reduction estimate is not modified (FS = 1). An estimate of the relative gross effectiveness of filter strips for sediment reduction is 65%. If the filter strip is functioning properly[4] then we use the estimate of 65% sediment removal (FS = 0.35).

SEDR = SLB*SDR*FS Sediment Reduction (tons/year)

Phosphorus Reduction Estimate

CF correction factor for soil texture (Fig. 5)

Clay - 1.15 Silt - 1.00 Sand - 0.85 Peat - 1.50

PR = SEDR *(1.0 pound/ton)*CF phosphorus reduction (pounds/year)

4

The filter strip credit should be given to a site that provides the following:

1) A healthy stand of grasses predominated by varieties of stem grasses versus blade grasses.
2) The stand of grass should be wide enough to impede the flow it receives (estimated ranges depend on the grass and the energy of the run-off. Widths can be as low as 10 feet for switch grass up to more common values of 66 feet).
3) Delivery of the run-off must remain in a thin overland flow pattern and not be channelized.
4) The delivery of the run-off from the credited area cannot be bypassed around or through the filter strip by a ditch, tile intake, side inlet or channel.

Fig 4: Gully Stabilization

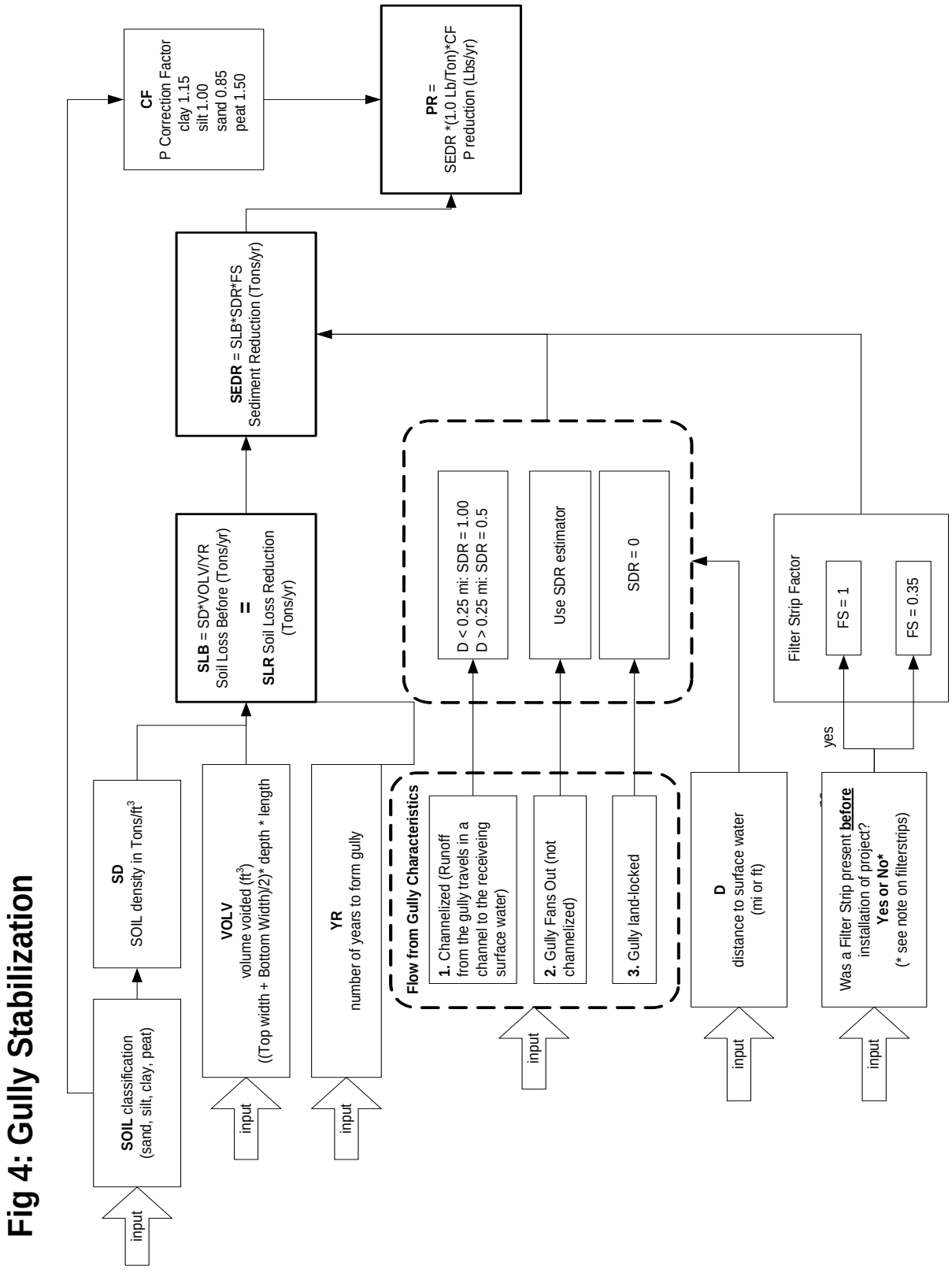
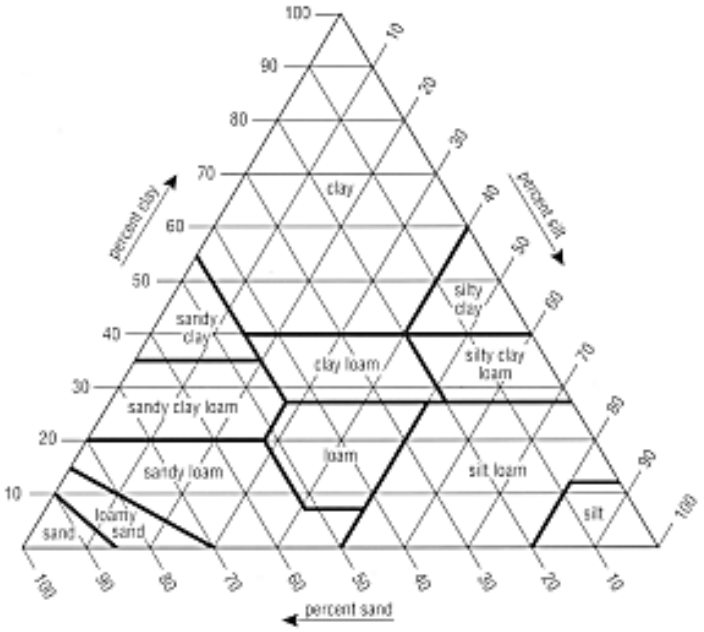


Fig 5 – Soil Properties

Soil Texture Triangle



Clays	Silts	Sands
Clay	Silt	Sand
Clay loam	Loam	Loamy sand
Silty clay	Silt loam	Sandy loam
	Silty Clay Loam	Sandy clay loam
		Sandy clay

Phosphorus Correction Factors for Soil Texture

Soil Texture	Correction Factor
Clay	1.15
Silt	1.00
Sand	0.85
Peat	1.50

Approximate Dry density Soil Weights

SOIL TEXTURAL CLASS	Dry Density Lbs/Ft^3	Soil texture used for calculations	Dry Density used for calculations Lbs/Ft^3
Sands, loamy sands	110	Sand	110
Sandy Loam	105		
Fine Sandy Loam	100		
Loams, sandy clay loams, sandy clay	90	Silt	85
Silt loam	85		
Silty clay loam, silty clay	80		
Clay loam	75	Clay	70
Clay	70		
Organic	22	Peat	22

3. Stream and Ditch Bank Stabilization

The estimates for reductions in soil loss, sediment, and attached phosphorus delivery for bank stabilization are based on an estimate of volume voided per year. The estimate assumes that once the practice is in place, the stabilized condition controls bank erosion. Soil loss reduction from the practice is therefore equal to soil erosion before the project was put in place. The SDR = 1 since the practice is adjacent to the receiving surface water. Sediment-attached phosphorus reduction is estimated from the sediment reduction, a default phosphorus content of 1.0 lb of phosphorus per 1 ton of soil, and a correction for soil texture.

Selection of the average lateral recession rate is critically important.

Inputs:

VOLV volume voided (ft^3)
SOIL type (sand, silt, clay, peat)
YR number of years to erode bank to current position

(**D = 0** distance to receiving surface water)
(**SDR = 1** all soil loss reduction is sediment reduction)

Soil Loss Reduction Estimate

SD soil density ($tons/ft^3$) - from table (Fig. 5)

SLB = SD*VOLV/YR Soil Loss Before (tons/year)
Assumed equal to:
SLR Soil Loss Reduction (tons/year)

Sediment Reduction Estimate

SEDR = SLB = SLR Sediment Reduction (tons/year)

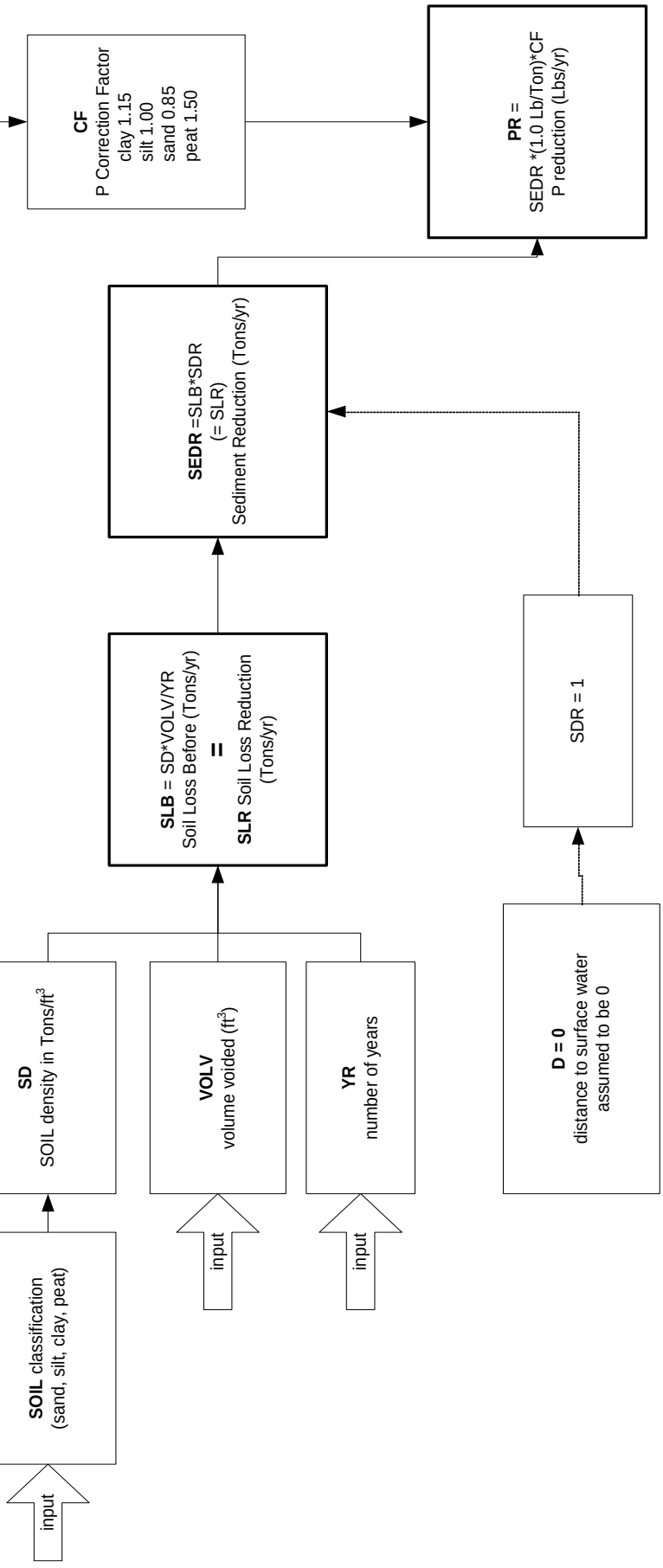
Phosphorus Reduction Estimate

CF correction factor for soil texture (Fig. 5)

Clay	1.15
Silt	1.00
Sand	0.85
Peat	1.50

PR = SEDR *(1.0 pound/ton)*CF phosphorus reduction (pounds/year)

Fig. 6 Stream & Ditch Bank Stabilization



4. Filter Strip Projects

The pollution reduction benefits (soil loss reduction, sediment reduction, phosphorus reduction) from filter strip projects are estimated by summing the benefits from:

1. Reductions from just the area of the filter strip, through the conversion of the filter strip area to permanent vegetative cover.
2. Reductions from the filter strip's treatment of runoff from the upland drainage area contributing to the filter strip.

Features:

1. Use the SDR estimator algorithm (Fig. 2) and the filter strip width; and
2. Correction of errors in the sediment and phosphorus reduction calculations for upland runoff.

4.1 Area of Filter Strip Itself

Inputs

RUSLE2 before → **SLB_{FSpa}** soil loss before (from filter strip area) per acre (tons/acre/year)

RUSLE2 after → **SLA_{FSpa}** soil loss after (from filter strip area) per acre (tons/acre/year)

(Revised Universal Soil Loss Equation analyses usually done locally)

A_{FS} = area of filter strip (acres)

W_{FS} = width of filter strip (ft.)

SOIL (sand, silt, clay, peat)

Soil Loss Reduction Estimate

SLR_{FSpa} = SLB_{FSpa} - SLA_{FSpa} Soil Loss Reduction (from filter strip area itself) per acre (tons/acre/year)

SLR_{FS} = SLR_{FSpa}* A_{FS} Soil Loss Reduction (from filter strip area itself) (tons/year)

Sediment Reduction Estimate

$SEDB_{Fspa}$ = SLB_{FSpa} * **SDR_{FS}** Sediment **before** (from filter strip area itself) per acre (tons/acre/year)

$SEDA_{Fspa}$ = SLA_{FSpa} * **SDR_{FS}** Sediment **after** (from filter strip area itself) per acre (tons/acre/year)

Where **SDR_{FS}** = sediment delivery ratio for filter strip area. Calculated using the **SDR estimator** algorithm (Fig. 2) with an input distance of **½ width of filter strip. This is a change from LARS.**

$SEDR_{FS}$ = ($SEDB_{FSpa}$ - $SEDA_{FSpa}$)* A_{FS} Sediment Reduction (tons/year)

Phosphorus Reduction Estimate

PB_{FSpa} = **f**($SEDB_{FSpa}$, SOIL) phosphorus **before** (from filter strip area itself) per acre (pounds/acre/year)

PA_{FSpa} = **f**($SEDA_{FSpa}$, SOIL) phosphorus **after** (from filter strip area itself) per acre (pounds/acre/year)

Where **f** is the function estimating P content (pounds/acre/year) from sediment delivery (tons/acre/year) and soil type (Fig. 3).

PR_{FS} = (PB_{FSpa} - PA_{FSpa})* A_{FS} phosphorus reduction from filter strip area (pounds/year)

4.2 Filter Strip treatment of upland area

Inputs

CA = acres contributing to filter strip

RUSLE2 before→ **SLB_{UPpa}** **upland** soil loss before per acre (tons/acre/year)

SOIL (sand, silt, clay, peat)

Sediment Reduction Estimate

SLT_{UP} = SLB_{UPpa} * CA **upland** soil loss treated (tons/year)

$SEDB_{UPpa}$ = SLB_{UPpa} * **SDR_{UP}** **upland** sediment before per acre (tons/acre/year)

Where **SDR_{UP} is** the sediment delivery ratio for filter strip area treatment of upland runoff. Calculated using the **SDR estimator** algorithm (Fig. 2) with an input distance of **1 width of filter strip. This is a change from LARS).**

Is the filter strip functioning as designed?

If YES: $FS_c = 0.35$

If NO: $FS_c = 1$

Examples of a non-functioning filter strip include:

- **channelized** flow through the filter strip
- the **contributing area (CA) too large** for adequate treatment by the filter strip?

This filter strip factor (FS_c) is used in the estimate the removal of sediment by the filter strip. It represents the fraction of sediment passing through the filter strip. If the flow is channelized through the filter strip, or if the contributing area to the filter strip is too large or would generate flows too large to be treated effectively by the filter strip, the sediment reduction is 0 ($FS_c = 1$).

An estimate of the relative gross effectiveness of filter strips for sediment reduction is 65% (Penn. State, 1992) If the filter strip is judged to be functioning properly[5] (if neither condition is met) then we use the estimate of 65% removal of sediment by the filter strip ($FS_c = 0.35$).

$SEDA_{UPpa}$ = $SEDB_{UPpa}$ * FS_c upland sediment **after** per acre (tons/acre/year)

$SEDR_{UP}$ = ($SEDB_{UPpa}$ - $SEDA_{UPpa}$) * CA Sediment reduction from filter strip treatment of upland runoff (tons/year)

Phosphorus Reduction Estimate

PB_{UPpa} = f ($SEDB_{UPpa}$, SOIL) upland phosphorus **before** per acre (pounds/acre/year)

PA_{UPpa} = f ($SEDA_{UPpa}$, SOIL) upland phosphorus **after** per acre (pounds/acre/year)

[5] The filter strip credit should be given to a site that provides the following:

1) A healthy stand of grasses predominated by varieties of stem grasses versus blade grasses.
2) The stand of grass should be wide enough to impede the flow it receives (estimated ranges depend on the grass and the energy of the run-off. Widths can be as low as 10 feet for switch grass up to more common values of 66 feet).
3) Delivery of the run-off must remain in a thin overland flow pattern and not be channelized.
4) The delivery of the run-off from the credited area cannot be bypassed around or through the filter strip by a ditch, tile intake, side inlet or channel.

Where **f** is the function estimating P content (pounds/acre/year) from sediment delivery (tons/acre/year) and soil type (Fig. 2).

$\mathbf{PR_{UP}} = (PB_{UPpa} - PA_{UPpa})^* CA$ Phosphorus reduction from upland runoff treatment (pounds/year)

4.3 TOTAL Filter Strip benefits

The total benefits are the sum of the benefits from the conversion of the filter strip area to permanent vegetative cover and from the filter strip's treatment of upland runoff:

Sediment Reduction Estimate

$\mathbf{SEDR_{TOT}} = SEDR_{FS} + SEDR_{UP}$

Phosphorus Reduction Estimate

$\mathbf{PR_{TOT}} = PR_{FS} + PR_{UP}$

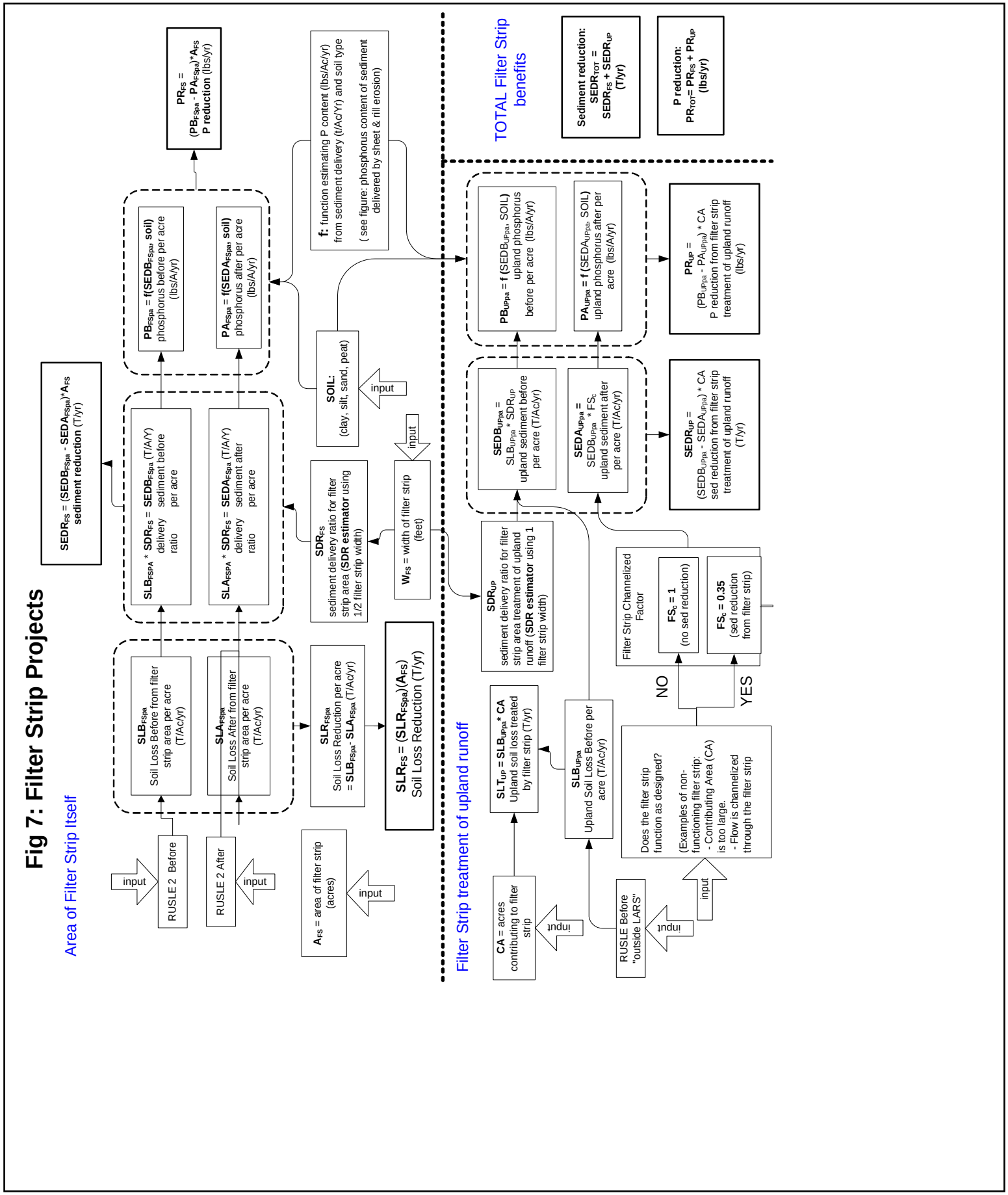


Fig 7: Filter Strip Projects
Area of Filter Strip Itself
Filter Strip treatment of upland runoff
TOTAL Filter Strip benefits
SEDR_FS = (SEDB_FSpa - SEDA_FSpa)*A_FS sediment reduction (T/yr)
PR_FS = (PB_FSpa - PA_FSpa)*A_FS P reduction (lbs/yr)
PB_FSpa = f(SEDB_FSpa, soil) phosphorus before per acre (lbs/A/yr)
PA_FSpa = f(SEDA_FSpa, soil) phosphorus after per acre (lbs/A/yr)
SLB_FSPA * SDR_FS = SEDB_FSpa (T/A/Y) delivery ratio sediment before per acre
SLA_FSPA * SDR_FS = SEDA_FSpa (T/A/Y) delivery ratio sediment after per acre
f: function estimating P content (lbs/Ac/yr) from sediment delivery (t/Ac/Yr) and soil type
(see figure: phosphorus content of sediment delivered by sheet & rill erosion)
SOIL: (clay, silt, sand, peat)
input
SDR_FS sediment delivery ratio for filter strip area (SDR estimator using 1/2 filter strip width)
W_FS = width of filter strip (feet)
SLB_FSpa Soil Loss Before from filter strip area per acre (T/Ac/yr)
SLA_FSpa Soil Loss After from filter strip area per acre (T/Ac/yr)
RUSLE 2 Before
RUSLE 2 After
SLR_FSpa Soil Loss Reduction per acre = SLB_FSpa - SLA_FSpa (T/Ac/yr)
A_FS = area of filter strip (acres)
SLR_FS = (SLR_FSpa)(A_FS) Soil Loss Reduction (T/yr)
SDR_UP sediment delivery ratio for filter strip area treatment of upland runoff (SDR estimator using 1 filter strip width)
SLT_UP = SLB_UPpa * CA Upland soil loss treated by filter strip (T/yr)
SLB_UPpa Upland Soil Loss Before per acre (T/Ac/yr)
CA = acres contributing to filter strip
RUSLE Before "outside LARS"
Does the filter strip function as designed?
(Examples of non-functioning filter strip:
- Contributing Area (CA) is too large.
- Flow is channelized through the filter strip
NO
YES
Filter Strip Channelized Factor
FS_c = 1 (no sed reduction)
FS_c = 0.35 (sed reduction from filter strip)
SEDB_UPpa = SLB_UPpa * SDR_UP upland sediment before per acre (T/Ac/yr)
SEDA_UPpa = SEDB_UPpa * FS_c upland sediment after per acre (T/Ac/yr)
SEDR_UP = (SEDB_UPpa - SEDA_UPpa) * CA sed reduction from filter strip treatment of upland runoff (T/yr)
PB_UPpa = f (SEDB_UPpa, SOIL) upland phosphorus before per acre (lbs/A/yr)
PA_UPpa = f (SEDA_UPpa, SOIL) upland phosphorus after per acre (lbs/A/yr)
PR_UP = (PB_UPpa - PA_UPpa) * CA P reduction from filter strip treatment of upland runoff (lbs/yr)
Sediment reduction: SEDR_TOT = SEDR_FS + SEDR_UP (T/yr)
P reduction: PR_TOT = PR_FS + PR_UP (lbs/yr)