Modeling Structural Conservation Practices

Cropland Component of the National Conservation Effects Assessment Project

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A DOCUMENTATION REPORT FOR MODELING STRUCTURAL CONSERVATION PRACTICES USING THE APEX SIMULATION MODEL FOR THE CEAP CROPLAND ASSESSMENT REPORT.

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Background

The purpose of the cropland component of the CEAP National Assessment is to estimate the environmental effects of conservation on cropland. Estimates are made via a sampling and modeling approach. Using a national sampling framework, current information on land management, including farming practices and conservation practices, are obtained from farm surveys. These data are combined with soil, climate, topography, and stream reach databases using a system of simulation models to estimate the physical effects of conservation practices. Edge-of-field effects are assessed by calculating differences in the nutrient, pesticide, and soil losses between a set of model runs simulating conservation currently in place (the baseline scenario) and a matching set of model runs representing a prior conditions (viz. prior to the implementation of conservation practices) in the "No Practice" scenario. The calculated outcomes are aggregated to the regional and national level using the statistical sampling weights derived from the National Resource Inventory (NRI). Reductions in pollution in the baseline (current condition) relative to the No Practice scenario represent the benefits and other effects of conservation.

The scope of this paper is to report on the assignment of structural practices to CEAP cropland points, conservation practice design considerations, and the simulation of those practices in the national assessment model. A comprehensive list of natural resource concerns related to soil, water, air, plants and animals has been identified by professional conservationists. This report, however, is designed to address only how conservation practices impact 1) nutrients and pesticides in water, 2) soil losses through major pathways and 3) changes in soil organic carbon; and how the APEX model is set up to represent these conservation practices.

Conservation Practice Modes of Action and Contaminant Loss Pathways

Conservation practices designed for cropland are implemented with the intend of accomplishing broad goals. The goals include, but are not limited to stable and productive soils, cleaner water, sustainable landscapes, enhanced crop production, or improved wildlife habitat. Farmers and ranchers may have multiple objectives and employ practices having secondary and tertiary benefits such as improving wildlife habitat, restoring native species, or accomplishing personal goals. However, the CEAP reports are designed to address only the effects practices have on the natural resource base.

On cropland, the practice function and mode of action usually relate to reducing the forces of wind and water. Wind erosion is reduced or even eliminated when the wind velocity at the soil surface is reduced below the terminal velocity necessary to initiate wind erosion. Maintaining crop residue on the soil surface is the most effective method of reducing wind speed at the soil surface. When residues are insufficient, clod forming tillage or soil roughening techniques are necessary to supplement crop residue requirements. Other wind erosion practices include windbreaks and shelterbelts which are structural practices installed to reduce wind erosion by establishing stable areas within the fields and effectively reducing wind velocities below terminal velocity for up to 10 times the height of the wind barrier.

Reducing the amount and velocity of runoff water reduces erosion and subsequently helps reduce the loss of water pollutants from the field or watershed. On cropland, the primary line of defense against runoff and erosion is, again, properly managing crop residue. To supplement the benefits of crop residue, structural practices such as terraces, diversions, waterways, grade stabilization structures, and vegetative buffers may be needed to reduce runoff and erosion. Structural practices that filter runoff are effective as a last line of defense against loss of pollutants from a field or watershed. Those practices include waterways, field borders, and various types of buffer strips.

In addition to modeling erosion and runoff, APEX models structural practices that effect loss pathways. Conservation practices and other best management practices reduce losses of nutrients, pesticides, and soil (hereafter called "contaminants") from farm fields by affecting one or more loss pathways. Contaminant source factors and the transport mechanism which moves the contaminant off-site form the loss pathway. Major pathways include particulate (or adsorbed) contaminants transported by surface water runoff, soluble contaminants transported with surface runoff, soluble contaminants transported with percolate, and particulate contaminants transported by the wind. Less recognized pathways include the movement to the atmosphere of the gaseous products from cycling processes such as volatilization, denitrification, respiration, and methanogenesis. Conservation practices may affect the contaminant source, the transport mechanism, or both. A practice acting on the contaminant source would affect one or more factors making the source less susceptible to the transporting action of wind or water. For instance, a nutrient management plan that reduces nutrient quantities on the soil surface (i.e. the contaminant source) reduces the quantity available for transport with surface runoff. Practices affecting the transport mechanism can also be effective. For example, reducing the quantity and/or velocity of surface runoff decreases the carrying capacity for moving contaminants off-site. Systems of practices affecting both the source and the transport are often the most effective.

Conservation practices serve other functions. The purpose of some may be to improve the efficiency of irrigation systems or improve water use efficiency. Other practices remove excess water to enhance crop growth, while others control water movement to prevent flooding. Sometimes drainage practices are used to improve productivity on saline or sodic soils. Practices may improve soil quality, enhance carbon sequestration and/or mitigate greenhouse gas emissions.

Structural vs. Cultural Practices

Cultural Practices

In the CEAP national assessment, conservation practices are classified into cultural practices or structural practices. The term “cultural methods or practices”, in agriculture, generally infers tillage and other cropland activities based on knowledge and experience of farmers. Cultural practices are, therefore, conservation practices a farmer or land manager implements, usually based on annual decisions, by changing the way cropland is managed to achieve production or conservation goals. Improving vegetative cover over the soil surface through practices such as cover crops, conservation crop rotations, and applying mulch are cultural practices. Reducing tillage intensity through practices such as conservation tillage is another. Managing nutrient applications through a nutrient management plan (NMP) and pest problems using integrated pest management are other cultural techniques. Cultural practices can be highly effective, yet, implementing cultural practices efficiently and effectively requires a high degree of experience and management experience.

Structural Practices

Structural practices are considered permanent practices that require more than annual management decisions. Usually these practices are considered permanent because implementation usually requires engineering designs, surveying, and usually contracting with a vendor. Plantings of perennial grasses, trees, or herbaceous cover to achieve the desired conservation effect are also included as structural practices. Practices like contour farming and strip cropping tend to “support” cultural management practices. Structural practices such as terraces and diversions work by intercepting and diverting surface runoff to stable outlets. Other structural practices including field borders, buffer strips, and riparian buffers, filter surface runoff and process contaminated water that infiltrates into the soil. See Appendix A Table A for definitions and functions of structural conservation practices.

Short Discription of APEX for Simulating Conservation Practices

The APEX model was created to evaluate various land management strategies considering sustainability, erosion (wind, sheet, and channel), economics, water supply and quality, soil quality, plant competition, weather and pests (Williams and Izaurralde, 2006). APEX has components for simulating hydrology, erosion-sedimentation, carbon and nutrient cycling, pesticide fate, crop growth, soil temperature, tillage, and plant environment control. Management capabilities include irrigation, drainage, furrow diking, buffer strips, terraces, waterways, fertilization, manure management, lagoons, reservoirs, crop rotation and selection, pesticide application, grazing, and tillage. Additional descriptions of the APEX model may be found elsewhere in this document as well as in Williams and Izaurralde, 2006 and Gassman et al., 2005. Further discussions in this section are limited to brief descriptions of the major APEX functions and input variables that are adjusted to represent the presence or absence of various conservation practices.

Processes especially important in simulating structural conservation practices include surface runoff, water erosion and sedimentation, wind erosion, and the routing of water, sediment, nutrients, and pesticides across complex landscapes and channel systems to the watershed outlet. In APEX, a watershed can be subdivided as much as necessary to assure that each subarea is relatively homogeneous in terms of soil, land use, and management. The routing mechanisms provide for evaluation of interactions between subareas involving surface runoff, return flow, sediment deposition and degradation, nutrient transport, and groundwater flow. Water quality in terms of nitrogen (ammonium, nitrate, and organic), phosphorus (soluble and adsorbed/mineral and organic), and pesticide concentrations may be estimated for each subarea and at the watershed outlet.

APEX provides the user considerable flexibility for simulating conservation practice effects. The model allows one to simulate effects using empirically based techniques, theoretical techniques, or a combination of both. Several common techniques used for the national assessment are briefly outlined in the following paragraphs.

Conservation Practice Effects (P factor)

Conservation practices including contours, strip cropping, contour buffer strips, and terraces can be simulated by adjusting the RUSLE conservation support practice factor (P factor), slope length, and the curve number. The P factor is an empirically derived factor that is multiplied into the RUSLE derived erosion estimate to account for effects from conservation support practices. The factor varies from 1.0 (to simulate straight row, up-downhill farming) to 0.15 to represent multiple practices on a gentle slope. Altering the P factor represents in-field effects resulting from changes in the erosivity of surface runoff and quantity of in-field soil deposition estimates using the USLE/MUSLE/RUSLE equations.

Curve Number

In the Curve Number method of runoff estimation, the combination of a hydrologic soil group and a land cover class (together known as a hydrologic soil-cover complex) indicate the potential for surface runoff. Higher curve numbers are assigned to complexes with a higher runoff potential. Changes in land use, conservation practices, or hydrologic conditions change the quantity of surface water runoff, thus affect the transport of waterborne soil, soil-bound nutrients, and soluble nutrients. This affect is simulated in APEX by changing the curve number. We parameterized the runoff potential of the land cover using a land use number (LUN). The LUN classifies an area by land use type (i.e. row crops, small grains, fallow, pasture, grass, trees, road), conservation practice (i.e. none, contour farming, strip cropping, terraces), and the indirect effects of cropland management decisions on surface hydrology (poor or good hydrologic condition). Table CP-1 shows the land cover classes, the assigned LUN, the soil hydrologic groups, and the resulting curve numbers used for the national assessment.

Channel Flow Technique

Channel flow techniques are employed for conservation practices designed to create a stable channel where the prior condition is an unstable or degrading channel or gully[1]. The basic concept is to parameterize the model so that very little channel degradation occurs when practices are in place and significant channel degradation occurs in the associated “No Practice” scenario. Two situations, 1) easily eroded channel material and 2) high velocity water flow through the channel, are assumed as the main drivers of channel degradation. Practice techniques target the two drivers. Unstable narrow channels consisting of easily eroded earth are converted into stable channels by changing the channel dimensions (depth, top width, and bottom width), Manning’s roughness coefficient, the K (soil erodibility) factor, and the C (plant cover) factor. Flow in steep, high-velocity channels can be slowed by reducing the channel gradient.

Riparian Simulation Technique

Riparian simulation techniques entail spreading and slowing water flow from an upland cropped area across buffer strips consisting of grasses, shrubs, and/or trees. Simulating riparian buffers makes use of the model feature which allows areas to be subdivided into fields, soil types, or landscape

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[1] The current state-of-the-art in modeling gully erosion processes is inadequate and representing gullies as unstable channels captures only part of the physical processes occurring.

positions. Flow is spread across the buffer strip using a special flood flow subroutine which is triggered by setting a filter flag, designating the fraction of flow spreading across the filter, and setting the floodplain dimensions. Figure 3 illustrates the field configuration and various subareas associated with a riparian buffer system.

Wind Erosion Estimates and Unsheltered Distance

Wind erosion is estimated in APEX using the Wind Erosion Continuous Simulation (WECS) model. WECS incorporates the daily distribution of wind speeds as the force driving wind erosion (Williams 1995). The wind erosion estimated in APEX represents the amount of eroded material leaving the field. In wind erosion science, a field is defined as the unsheltered distance along the prevailing wind erosion direction for the field or area being evaluated. WECS does not account for any material deposited in fence rows, barrow ditches or other barriers on the downwind side of the field. Estimated wind erosion can be adjusted based on soil properties, surface roughness, cover, and unsheltered distance across the field in the wind direction. For structural conservation practices, only the unsheltered distance factors (field length and field width) are adjusted when accounting for the wind erosion control practices.

Table CP-1. Curve numbers and land use number settings for land cover classes and soil hydrologic groups.

Land Use Type	Conservation Practice	Hydrologic Condition	Land Use Number (LUN)	Hydrologic Group A Curve Number	Hydrologic Group B Curve Number	Hydrologic Group C Curve Number	Hydrologic Group D Curve Number
Row Crops	None	Poor	2	72	81	88	91
		Good	3	67	78	85	89
	Contour, Strip cropping or Terrace	Poor	4	70	79	84	88
		Good	5	65	75	82	86
	Two or more of Contour, Strip and Terrace	Poor	6	66	74	80	82
		Good	7	62	71	78	81
Small Grain	None	Poor	8	65	76	84	88
		Good	9	63	75	83	87
	Contour, Strip or Terrace	Poor	10	63	74	82	85
		Good	11	61	73	81	84
	Two or more of Contour, Strip and Terrace	Poor	12	61	72	79	82
		Good	13	59	70	78	81
Close- Seeded Legume	None	Poor	14	66	77	85	89
		Good	15	58	72	81	85
	Contour, Strip or Terrace	Poor	16	64	75	83	85
		Good	17	55	69	78	83
	Two or more of Contour, Strip and Terrace	Poor	18	63	73	80	83
		Good	19	51	67	76	80
Pasture or Range	None	Poor	20	68	79	86	89
		Fair	21	49	69	79	84
		Good	22	39	61	74	80
	Two or more of Contour, Strip and Terrace	Poor	23	47	67	81	88
		Fair	24	25	59	75	83
		Good	25	6	35	70	79
Woods	None	Poor	27	45	66	77	83
		Fair	28	36	60	73	79
		Good	29	25	55	70	77
Fallow	All	All	1	77	86	91	94
Brome Grass	All	All	21	49	69	79	84
Other	All	All	0	86	86	86	86

Table CP-2. Structural conservation practices reported by the NRCS field office, Farm Service Administration (CREP), and farmer included in the CEAP survey, 1997 NRI, and 2003 NRI with NASS Key and Functional Category.

APEX ID	Structural Practice Name	NRCS Code	NASS Key	CREP	CREP Name	Farmer Name	97NRI Name	03NRI Name	Functional Category
14	Contour Buffer Strips	332	332	CP15	Contour Grass Strips			contour buffer strips	Managed In-field Flow Interceptor
15	Contour Farming	330	330			Contours	contour farming	contour farming	Managed In-field Flow Interceptor
17	Strip cropping	585	585				stripcropping, contour	stripcropping, contour	Managed In-field Flow Interceptor
19	Cross Wind Ridges	589A	5891						Wind Erosion Control
20	Cross Wind Stripcropping	589B	5892				cross wind stripcropping	cross wind stripcropping	Wind Erosion Control
21	Cross Wind Trap Strips	589C	5893				cross wind trap strips	cross wind trap strips	Wind Erosion Control
26	Diversion	362	362	CP6	Diversions		Diversion	diversion	Engineered In-field Flow Interceptor
30	Field Border	386	386			FieldBorder	field border	field border	Complementary
31	Filter Strip	393	393	CP21	Filter Strips	FilterStrip	filter strip	filter strip	Riparian Buffer
42	Grade Stabilization Structure	410	410			GradeStabStruct			Complementary
43	Grassed Waterway	412	412	CP8	Grass Water Ways	Grasswa	grassed waterways or outlets	grassed waterways or outlets	Complementary
46	Hedgerow Planting	422	422			Hedgerow		hedgerow planting	Wind Erosion Control
47	Herbaceous Wind Barriers	603	603				herbaceous wind barriers	herbaceous wind barriers	Wind Erosion Control

APEX ID	Structural Practice Name	NRCS Code	NASS Key	CREP	CREP Name	Farmer Name	97NRI Name	03NRI Name	Functional Category
106	Riparian Forest Buffer	391	391	CP22	Riparian Buffers (trees)	RipForstBuf		riparian forest buffer	Riparian Buffer
107	Riparian Herbaceous Cover	390	390			RipHerbBuf			Riparian Buffer
118	Stripcropping, Field	586	586				stripcropping, field	stripcropping, field	
125	Terrace	600	600	CP7	Erosion Control Structures	Terr	Terrace	terrace	Engineered In-field Flow Interceptor
133	Vegetative Barrier	601	601						Engineered In-field Flow Interceptor
150	Windbreak/ Shelterbreak Establishment	380	380	CP5	Field Windbreaks		windbreak/ shelterbelt establishment	windbreak/ shelterbelt establishment	Wind Erosion Control
154	Grass Strip w/Terrace		600.1			GrassedTer			Engineered In-field Flow Interceptor

Conservation Practices on CEAP Cropland Points

The CEAP survey and the 2003 Natural Resource Inventory (NRI) were used to develop a pooled set of structural conservation practices occurring on cropland points. In the survey, sources reporting structural conservation practices on CEAP cropland points included the surveyed farmers, NRCS District offices, and the Farm Service Administration (FSA). The NRI provided an additional source of practice information on the points. When one or more sources reported a practice, we assumed that practice was in place and fully functioning. Any practice, however, was listed only once per point. The pooled set lists the suite of structural practices by combining the reporting practices from all sources for every CEAP cropland point following the below steps:

1. List all "structural" conservation practices reported in 2003, 2004, and 2005 CEAP surveys.
    - Practices reported by farmer in "crophistoryiii"
    - Practices reported by FSA in "consrvpracticesi_ccrp_crep"
    - Practices reported by NRCS in "consrvpracticesi_structural"
2. Resolve differences between practices recorded in survey and those inventoried in NRI.
3. Combine practices reported for each point from all survey sources into single set eliminating identical practices reported from multiple sources.

For many points, more than one structural practice was reported and it was important to capture the additive effects of multiple practices. Where practices might be used in combination along a uniform slope or single flow path, the combined practices were simulated to capture compound or additive effects. It was equally important not to understate practice effects by combining practices having duplicative functions. Where the suite of reported practices included practices with similar functions, we assumed those practices were targeting parts of the field where runoff flowed to different outlets. Since representative fields were simulated as having uniform slopes and with runoff following a single flow path to a single outlet, only one of the similar practices was simulated.

To capture combined effects and eliminate duplicate functions, practices were assigned into one of the following functional categories: managed in-field flow interceptor, engineered in-field flow interceptor, riparian buffer, and wind erosion control (table CP-2). A rule set was used to combine the suite of practices reported in each category and identify how the various combinations were simulated. Several practices (field borders, grass waterway, and grade stabilization structure) were not grouped into functional categories because their unique functions did not overlap with any other practices. Effects from these practices were always additive. For discussion, these practices are listed together in the complementary practice category. A simulation for an individual CEAP point could include any combination of a managed in-field flow interceptor, engineered in-field flow interceptor, riparian buffer, wind erosion control, field border, grade stabilization structure, and grass waterway.

For future modeling efforts, additional practices can be added into existing categories. For example, wetlands can be added to the riparian buffer functional category and sediment basins/detention ponds can be added to the complementary category. Additional functional categories can also be added. Likely categories include irrigation management and drainage management.

The following steps were used to prepare APEX inputs for conservation practices on cropland points:

1. Group practices by function and establish representative practices to simulate.
2. Develop rule set for simulating each representative practice (including "no practice") or practice set in APEX.
3. Document rule sets, parameter selection criteria, and structural practice simulation methods.
4. TAES & NRCS review rule sets and simulation methods.
5. Develop appropriate data tables for implementing rules.
6. Write program routines to implement conservation practice rules as APEX model inputs.

Simulating Structural Conservation Practice

Managed and engineered flow interceptor effects were simulated via changes in the conservation practice factor (P factor), slope, slope length, or curve number. Riparian areas were simulated as areas of grasses or trees separate from the cropland area which the water runoff from the cropland had to cross prior to reaching the "edge of field". Effects from wind erosion control were simulated by changing the unsheltered distance in the field length and width. Field border effects were simulated by reducing the P factor by 5 percent. Grade stabilization structures and grass waterways were simulated by channelizing water flow through part of the cropped field and comparing effects to those from an unstable channel. The assessment assumes all practices perform without failure throughout the simulation period.

A single subarea without a channel or ditch is the standard field configuration (designated as FID 1) used in the national assessment. The standard field represents a CEAP point for which

1) no structural practices were reported,

2) structural practices having only a single subarea (managed and engineered flow interceptors, wind erosion control practices, and field borders) were reported, or

3) the prior condition in the No Practice scenario for CEAP points having any structural conservation practices other than a grass waterway or grade stabilization structure.

The CEAP point is simulated as a 400 x 400 meter subarea (16 hectares or about 40 acres), representing a homogenous field with respect to soil, climate, and management (Figure 1 and table CP-3). Upland slope and slope length are assumed to be uniform and are set for each point to the values reported in the NRI. For calculating the time of concentration, a maximum channel length of 447 meters, representing the most distant point from the outlet, is calculated using the equation:

$$CHL = (L^2 + (0.5W)^2)^{1/2}$$

where CHL is the maximum channel length in meters, L is the subarea length (m), and W is the subarea width (m). Channel slope is estimated from the upland slope as reported in the NRI and the watershed area using the equation:

$$CHS = US * (1 + SAA)^{-.3}$$

where CHS is channel slope (m/m), US is the upland slope (m/m), and SAA is the subarea area (ha). Thus as the subarea increases, the overall channel slope decreases. For a 16 ha subarea, the channel slope is about 42.7 percent of the reported upland slope. Reach channel length equals the subarea channel length (0.447 Km).

Modifications of the standard field configuration were developed to simulate specific practices or suites of practices in the baseline scenario or conditions in the No Practice scenario. Whenever the baseline included any combination of grass filter strip, riparian buffer, grass waterway or grade stabilization structure, a modified field configuration was used in place the standard configuration for the baseline. Also, modified field configurations were required in the no practice scenario when a grass waterway or grade stabilization was reported. In total, fifteen field configurations, each identified by a unique field id (FID), were developed. Based on the suite of reported practices, every CEAP point was assigned two field configurations: one for the baseline and another for the no practices scenario. Practice combinations factoring into the assignment of field configurations are shown in table CP-4. Model input values for each field configuration were developed and imputed to CEAP points by linking each point with a baseline and no practice field configuration.

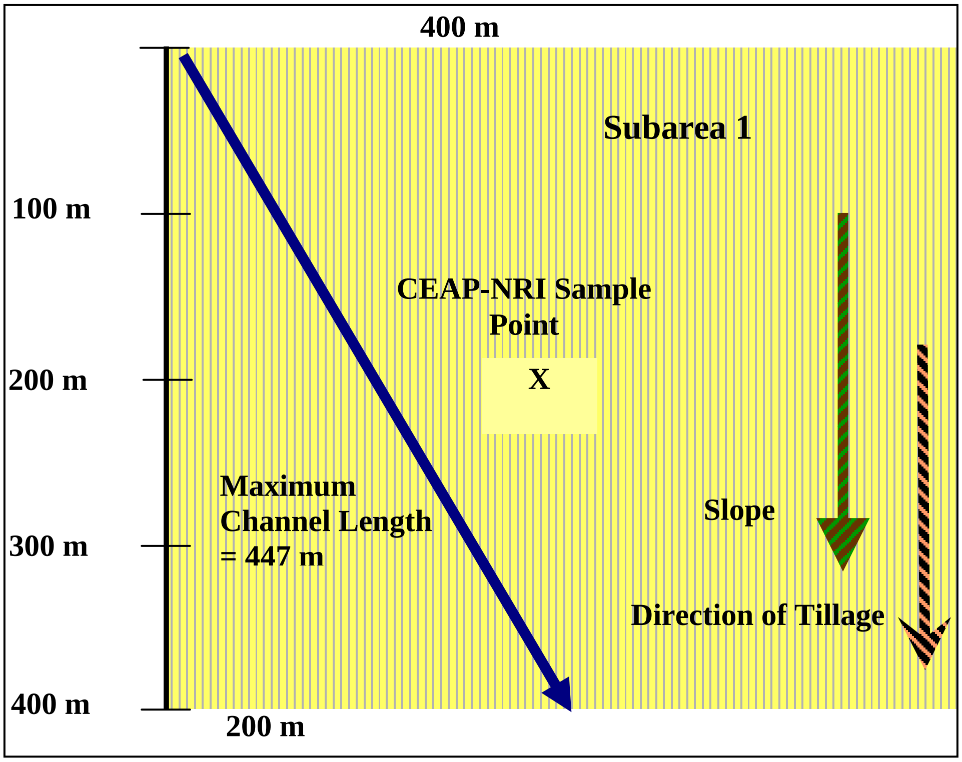

Figure 1. Standard field configuration (FID 1) for the national assessment. (Illustrated with tillage up and down the slope.)

Table CP-3. Model inputs for the standard configuration (FID 1).

I_APEX Table	Parameter	APEX Code	Unit	Subarea
				1
	Type Land Use			Crop
SA	Soil Type			NRI
SA	Filter Strip Flag	IFLS		0
SA	Drainage Area	WSA	Ha	16
SA	Op Schedule Number			1
SA	Avg. Upland Slope	STP	m/m	NRI
SA	Avg. Upland Slope Length	SPLG	m	NRI
SA	Manning's N for Upland.	UPN		
SA	Channel Length	CHL	Km	0.447
SA	Channel Slope	CHS	m/m	NRI * 0.427
SA	Channel Depth	CHD	m	
SA	Manning's N for Channel	CHN		
SA	Reach Channel Length	RCHL	Km	0
SA	Reach Channel Slope	RCHS	m/m	
SA	Routing Reach Channel Depth	RCHD	m	
SA	Reach Bottom Width	RCBW	m	
SA	Reach Top Width	RCTW	m	
SA	Reach Manning's N	RCHN		
SA	Reach USLE C Factor	RCHC		
SA	Reach USLE K Factor	RCHK		
SA	Reach Floodplain Width	RFPW	m	
SA	Reach Floodplain Length	RFPL	Km	
SA	Floodplain Flow Fraction	FFPQ		0
SA / FO	Land Use Number	LUN		XXXX
SA	Hydrologic Condition			XXXX
MAN	Conservation P Factor	PEC		XXXX

Table Notes:
I_APEX table definitions: SA = Subarea, FO = Field Operations, MAN = Management
"NRI" denotes value reported in the National Resource Inventory for the CEAP point.
"XXXX" denotes model inputs based on reported conservation practices.

Table CP-4. Field configuration assignment matrix.

Field Configuration ID (FID)		Grass Waterway (GWW)	Grade Stabilization Structure (GSS)	Buffer Type
Baseline	No Practice			
1	1	0	0	0
5	2	1	0	0
6	3	0	1	0
7	4	1	1	0
8	1	0	0	1
9	1	0	0	2
10	2	1	0	1
11	2	1	0	2
12	3	0	1	1
13	3	0	1	2
14	4	1	1	1
15	4	1	1	2

(0 denotes absence of practice; for GWW and GSS 1 denotes presence; for Buffer Type, 1 = grass filter strip and 2 = riparian buffer)

Managed In-field Flow Interceptors (Contour Farming, Strip Cropping, or Contour Buffer Strips)

Points having any combination of contour farming, strip cropping, or contour buffer strips are simulated as having "Managed Flow Interceptors". Contour farming occurs when tillage, planting, and other farming operations are performed on or near the contour of the field slope so that the tillage implements leave ridges which run perpendicular to the slope. The ridges limit surface runoff from moving directly down slope and slow the flow of runoff moving along the contour. The effect is a reduction in sheet and rill erosion, sediment transport, and movement of other water-borne contaminants. Strip cropping is growing row crops, forages, small grains, or fallow in a systematic arrangement of equal width strips across a field on the contour. For controlling water erosion, the strips are placed on the contour. Ideally the alternating strips are planted are planted to limit the periods which the entire field is without cover. Depending on the crops selected, alternating areas may act as a depositional zone where soil eroded from one area is trapped and deposited before it leaves the field. The effect of the practice is to reduce soil erosion from water, sediment transport, and movement of other water-borne contaminants. In addition, the alternating strips with a standing crop may act as a wind barrier, protecting bare soil from wind erosion. Contour buffer strips are narrow strips of permanent, herbaceous vegetative cover established across the slope on the contour and alternated down the slope with parallel, wider cropped strips farmed on the contour. Contour buffer strips slow runoff and trap sediment. They help reduce sheet and rill erosion, sediment transport, and soluble and particulate nutrients, pesticides, and other contaminants in runoff as they pass through the buffer strip. Sometimes contour buffer strips provide food and cover for wildlife.

Simulations did not include combinations of contour farming, strip cropping, and/or contour buffer strips. Instead, only the most intensive of the reported practices was simulated using the following precedence: contour buffer strips was ranked as the most intensive practice, which was followed by strip cropping and then contour farming. The specific practice simulated is identified by the "Managed Code" in table CP-5, column 1.

For the simulation, the standard field configuration (FID 1) is used. The conservation practice factor (P factor) is set to a value less than 1, found using rows in table CP-7 where the "Managed Code" in column 1 is a 1, 2, or 3 and the "Engineered Code" in column 2 is 0. The specific row is selected by matching the point's upland slope as reported in the NRI to the values in column 3. Where the NRI reports a slope length equal to or less than the maximum slope length value in table CP-7, column 4, the P factor in column 6 is used. Where the NRI slope length is greater than the maximum slope length value, the practice is assumed to be less than 100 percent effective and an over-limit P factor value is calculated by multiplying the listed P factor into a ratio expressed as [Maximum Slope Length]/[NRI Slope Length]. In any case, the maximum P factor value is 1. The curve number, initially set as a function of the cropping system, the hydrologic condition of the soil, and the soils hydrologic group is lowered relative to the No Practice setting (see table CP-1). These effects are parameterized in the model by increasing the LUN as shown in table CP-7, column 7 relative to the prior condition in the No Practice scenario.

According to literature sources including the Conservation Practice Physical Effects guide (CPPE), strip cropping can result in moderate to substantial reductions in wind erosion in vulnerable areas. Although there is some debate concerning the reductions, the unsheltered field length and field width are reduced as shown in table CP-11. Unsheltered length and width values are changed in all areas regardless of wind erosion concerns; however, the changes have little effect in non-vulnerable areas.

Table CP- 5. Simulation practice selection matrix for managed in-field flow interceptors.

Managed Code	Reported Practice			P id	Simulate As
	Contour Buffer Strips	Strip Cropping	Contour Farming		
1	0	0	1	1	Contour Farming
2	0	1	0	2	Strip Cropping
2	0	1	1	3	Strip Cropping
3	1	0	0	4	Contour Buffer Strips
3	1	0	1	5	Contour Buffer Strips
3	1	1	0	6	Contour Buffer Strips
3	1	1	1	7	Contour Buffer Strips

0 = practice is not reported in survey or NRI. 1 = practice is reported in either survey, NRI or both.

Engineered In-field Flow Interceptors (Terraces, Grass Terraces, Diversions, or Vegetative Barrier)

Points having any combination of terraces, grass terraces, diversions, or vegetative barriers are simulated as having "Engineered Flow Interceptors". Terraces are earth embankments or a combination ridge and channel, constructed on the contour across the field slope to reduce soil erosion or retain runoff for moisture conservation. The terrace can be covered by the crop or by grass. Typically terraces have drainage outlets which are not currently simulated, thus the simulation model may underestimate soluble N and P losses. A diversion is channel constructed across the slope generally with a supporting ridge on the lower side. The purpose is to reduce erosion and runoff by breaking up concentrations of water on long slopes, undulating land surfaces, and land that is too flat or irregular for terracing. Vegetated barriers are narrow, permanent strips of stiff stemmed, erect, tall, dense perennial vegetation established in parallel rows and perpendicular to the dominant slope of the field or across concentrated flow areas. The barriers provide water erosion control on cropland and offer an alternative to terraces where the soil might be degraded by terrace construction. The barriers reduce sheet, rill, and gully erosion, stabilize steep slopes, manage water flow and trap sediment.

Engineered flow interceptor effects were simulated via changes in the conservation practice factor (P factor), slope, slope length, or curve number (parameterized using the LUN) using the standard field configuration (FID 1). When one or more engineered flow interceptors are reported for a CEAP point table CP-6 identifies the specific practice (Terraces, Grass Terraces, Diversions, or Vegetative Barrier) to simulate. (The selected practice is identified by the "Engineered Code" in column 1.) The specific practice was selected using a rule-based decision system. Important rules included:

- If both terraces and grass terraces were reported then grass terraces were selected.
- If terraces, grass terraces, or vegetative barriers were reported, then reported diversions are not simulated.
- If terraces or grass terrace and vegetative barrier are reported, then a grass terrace is selected.

For terraces, grassed terraces, and vegetative barriers sediment detached from the cropping area is estimated using the appropriate P factors shown in table CP-7. The appropriate P factors are found where "Engineered Code" column has a value of 4, 5, or 7 and the "Managed Code" column is 0). The specific row in each grouping is selected to match the NRI reported slope for a CEAP point. Note that slope rule 2 is indicated for each practice. Rule 2 indicates that where the NRI reports terraces, the model input for slope length is set to the NRI reported value. In cases where the NRI did not report terraces, the model input for slope length is set to the shortest of 1) NRI reported slope length or 2) the maximum slope length (table CP-7, column 4) for the NRI reported slope. Reductions in surface runoff are simulated by reducing the curve number which is parameterized in the model by increasing the LUN by 2 for terraces and vegetative barriers, and by 4 for grassed terraces relative to the a priori condition in the No Practice scenario.   Diversions are simulated in APEX by multiplying the NRI reported slope length by a factor of 0.5. The P factor and curve number are unchanged from a priori conditions in the No Practice scenario.

Table CP-6. Simulation practice selection matrix for engineered in-field flow interceptors.

Engineered Code	Vegetative Barrier	Diversion	Grass Terrace	Terrace	Pid	Simulate As
4	0	0	0	1	1	Terrace
5	0	0	1	0	2	Grass Terrace
5	0	0	1	1	3	Grass Terrace
6	0	1	0	0	4	Diversion
4	0	1	0	1	5	Terrace
5	0	1	1	0	6	Grass Terrace
5	0	1	1	1	7	Grass Terrace
7	1	0	0	0	8	Vegetative Barrier
5	1	0	0	1	9	Grass Terrace
5	1	0	1	0	10	Grass Terrace
5	1	0	1	1	11	Grass Terrace
7	1	1	0	0	12	Vegetative Barrier
5	1	1	0	1	13	Grass Terrace
5	1	1	1	0	14	Grass Terrace
5	1	1	1	1	15	Grass Terrace

0 = practice is not reported in survey or NRI. 1 = practice is reported in survey or NRI

Simulating Combinations of Managed and Engineered Flow Interceptors

Functions of the practices in the managed and engineered flow interceptors have compound or additive effects when the two groups are combined. Model settings for the P factor, the LUN change, and the slope length rule are found for the various combinations by matching the managed code (table CP-5), the engineered code (table CP-6), and the NRI reported slope length to values in table CP-7 columns 1, 2, and 3. Where the NRI reported slope exceeds the Maximum Slope Length given in column 4, the P factor is handled as in other over limit cases, after first accounting for any slope changes associated with simulating the engineered flow interceptors.

Slope Rules

1. Slope length is input from the NRI without adjustment. For managed flow interceptors, if the NRI reported slope length exceeds the maximum slope length (table CP-7, column 4) for a given slope, calculate the over-limit P factor.
2. Where the NRI reports terraces, slope length is set to the NRI reported value. Where the NRI did not report terraces, slope length is set to the shortest of 1) NRI reported slope length or 2) the maximum slope length (table CP-7, column 4) for the NRI reported slope.
3. For diversions (Engineered Code 6) slope length is set to one-half the NRI reported slope length.

Over-limit P Factor Rule For Managed Flow Interceptors

Where the NRI reported slope length is greater than the maximum slope length value (Table CP-7, the practice is assumed to be less than 100 percent effective and an over-limit P factor value is calculated by multiplying the listed P factor into a ratio expressed as [Maximum Slope Length]/[NRI Slope Length]. In no case is the P factor set greater than one.

Table CP-7. Slope length rules P factor, and change in the LUN managed and engineered flow interceptors.

Managed Code	Engineered Code	NRI Reported Slope(%)	Maximum Slope Length (ft)	Slope Length Rule	P Factor	LUN Change
0	0	< 1	2500	1	1	0
0	0	1 to 2.99	2500	1	1	0
0	0	3 to 5.99	2500	1	1	0
0	0	6 to 8.99	2500	1	1	0
0	0	9 to 12.99	2500	1	1	0
0	0	13 to 16.99	2500	1	1	0
0	0	17 to 20.99	2500	1	1	0
0	0	21 to 25	2500	1	1	0
0	0	>25	2500	1	1	0
1	0	< 1	400	1	0.6	2
1	0	1 to 2.99	400	1	0.6	2
1	0	3 to 5.99	300	1	0.5	2
1	0	6 to 8.99	200	1	0.5	2
1	0	9 to 12.99	120	1	0.6	2
1	0	13 to 16.99	80	1	0.7	2
1	0	17 to 20.99	60	1	0.8	2
1	0	21 to 25	50	1	0.9	2
1	0	> 25	1000	1	1	2
2	0	< 1	800	1	0.6	4
2	0	1 to 2.99	800	1	0.6	4
2	0	3 to 5.99	600	1	0.5	4
2	0	6 to 8.99	400	1	0.5	4
2	0	9 to 12.99	240	1	0.6	4
2	0	13 to 16.99	160	1	0.7	4
2	0	17 to 20.99	120	1	0.8	4
2	0	21 to 25	100	1	0.9	4
2	0	>25	1000	1	1	4
3	0	< 1	800	1	0.3	4
3	0	1 to 2.99	800	1	0.3	4
3	0	3 to 5.99	600	1	0.25	4
3	0	6 to 8.99	400	1	0.25	4
3	0	9 to 12.99	240	1	0.3	4
3	0	13 to 16.99	160	1	0.35	4
3	0	17 to 20.99	120	1	0.4	4
3	0	21 to 25	100	1	0.45	4
3	0	>25	1000	1	1	4
0	4	< 1	143	2	0.45	4
0	4	1 to 2.99	143	2	0.45	4
0	4	3 to 5.99	102	2	0.45	4
0	4	6 to 8.99	90	2	0.55	4
0	4	9 to 12.99	90	2	0.55	4
0	4	13 to 16.99	90	2	0.65	4
0	4	17 to 20.99	90	2	0.65	4
0	4	21 to 25	90	2	0.75	4
0	4	>25	1000	2	1	4

Managed Code	Engineered Code	NRI Reported Slope(%)	Maximum Slope Length (ft)	Slope Length Rule	P Factor	LUN Change
1	4	< 1	143	2	0.45	4
1	4	1 to 2.99	143	2	0.45	4
1	4	3 to 5.99	102	2	0.45	4
1	4	6 to 8.99	90	2	0.55	4
1	4	9 to 12.99	90	2	0.55	4
1	4	13 to 16.99	90	2	0.65	4
1	4	17 to 20.99	90	2	0.65	4
1	4	21 to 25	90	2	0.75	4
1	4	>25	1000	2	1	4
2	4	< 1	143	2	0.3375	4
2	4	1 to 2.99	143	2	0.3375	4
2	4	3 to 5.99	102	2	0.3375	4
2	4	6 to 8.99	90	2	0.4125	4
2	4	9 to 12.99	90	2	0.4125	4
2	4	13 to 16.99	90	2	0.4875	4
2	4	17 to 20.99	90	2	0.4875	4
2	4	21 to 25	90	2	0.5625	4
2	4	>25	1000	2	1	4
3	4	< 1	143	2	0.225	4
3	4	1 to 2.99	143	2	0.225	4
3	4	3 to 5.99	102	2	0.225	4
3	4	6 to 8.99	90	2	0.275	4
3	4	9 to 12.99	90	2	0.275	4
3	4	13 to 16.99	90	2	0.325	4
3	4	17 to 20.99	90	2	0.325	4
3	4	21 to 25	90	2	0.375	4
3	4	>25	1000	2	1	4
0	5	< 1	143	2	0.3	4
0	5	1 to 2.99	143	2	0.3	4
0	5	3 to 5.99	102	2	0.25	4
0	5	6 to 8.99	90	2	0.25	4
0	5	9 to 12.99	90	2	0.3	4
0	5	13 to 16.99	90	2	0.35	4
0	5	17 to 20.99	90	2	0.4	4
0	5	21 to 25	90	2	0.45	4
0	5	>25	1000	2	1	4
1	5	< 1	143	2	0.3	4
1	5	1 to 2.99	143	2	0.3	4
1	5	3 to 5.99	102	2	0.25	4
1	5	6 to 8.99	90	2	0.25	4
1	5	9 to 12.99	90	2	0.3	4
1	5	13 to 16.99	90	2	0.35	4
1	5	17 to 20.99	90	2	0.4	4
1	5	21 to 25	90	2	0.45	4
1	5	>25	1000	2	1	4
2	5	< 1	143	2	0.225	4
2	5	1 to 2.99	143	2	0.225	4

Managed Code	Engineered Code	NRI Reported Slope(%)	Maximum Slope Length (ft)	Slope Length Rule	P Factor	LUN Change
2	5	3 to 5.99	102	2	0.1875	4
2	5	6 to 8.99	90	2	0.1875	4
2	5	9 to 12.99	90	2	0.225	4
2	5	13 to 16.99	90	2	0.2625	4
2	5	17 to 20.99	90	2	0.3	4
2	5	21 to 25	90	2	0.3375	4
2	5	>25	1000	2	1	4
3	5	< 1	143	2	0.15	4
3	5	1 to 2.99	143	2	0.15	4
3	5	3 to 5.99	102	2	0.125	4
3	5	6 to 8.99	90	2	0.125	4
3	5	9 to 12.99	90	2	0.15	4
3	5	13 to 16.99	90	2	0.175	4
3	5	17 to 20.99	90	2	0.2	4
3	5	21 to 25	90	2	0.225	4
3	5	>25	1000	2	0.75	4
0	6	< 1	2500	3	1	0
0	6	1 to 2.99	2500	3	1	0
0	6	3 to 5.99	2500	3	1	0
0	6	6 to 8.99	2500	3	1	0
0	6	9 to 12.99	2500	3	1	0
0	6	13 to 16.99	2500	3	1	0
0	6	17 to 20.99	2500	3	1	0
0	6	21 to 25	2500	3	1	0
0	6	> 25	2500	3	1	0
1	6	< 1	400	3	0.6	2
1	6	1 to 2.99	400	3	0.6	2
1	6	3 to 5.99	300	3	0.5	2
1	6	6 to 8.99	200	3	0.5	2
1	6	9 to 12.99	120	3	0.6	2
1	6	13 to 16.99	80	3	0.7	2
1	6	17 to 20.99	60	3	0.8	2
1	6	21 to 25	50	3	0.9	2
1	6	> 25	1000	3	1	2
2	6	< 1	800	3	0.6	4
2	6	1 to 2.99	800	3	0.6	4
2	6	3 to 5.99	600	3	0.5	4
2	6	6 to 8.99	400	3	0.5	4
2	6	9 to 12.99	240	3	0.6	4
2	6	13 to 16.99	160	3	0.7	4
2	6	17 to 20.99	120	3	0.8	4
2	6	21 to 25	100	3	0.9	4
2	6	>25	1000	3	1	4
3	6	< 1	800	3	0.3	4
3	6	1 to 2.99	800	3	0.3	4
3	6	3 to 5.99	600	3	0.25	4
3	6	6 to 8.99	400	3	0.25	4

Managed Code	Engineered Code	NRI Reported Slope(%)	Maximum Slope Length (ft)	Slope Length Rule	P Factor	LUN Change
3	6	9 to 12.99	240	3	0.3	4
3	6	13 to 16.99	160	3	0.35	4
3	6	17 to 20.99	120	3	0.4	4
3	6	21 to 25	100	3	0.45	4
3	6	>25	1000	3	1	4
0	7	< 1	143	2	0.45	2
0	7	1 to 2.99	143	2	0.45	2
0	7	3 to 5.99	102	2	0.45	2
0	7	6 to 8.99	90	2	0.55	2
0	7	9 to 12.99	90	2	0.55	2
0	7	13 to 16.99	90	2	0.65	2
0	7	17 to 20.99	90	2	0.65	2
0	7	21 to 25	90	2	0.75	2
0	7	>25	1000	2	1	2
1	7	< 1	143	2	0.45	4
1	7	1 to 2.99	143	2	0.45	4
1	7	3 to 5.99	102	2	0.45	4
1	7	6 to 8.99	90	2	0.55	4
1	7	9 to 12.99	90	2	0.55	4
1	7	13 to 16.99	90	2	0.65	4
1	7	17 to 20.99	90	2	0.65	4
1	7	21 to 25	90	2	0.75	4
1	7	>25	1000	2	1	4
2	7	< 1	143	2	0.3375	4
2	7	1 to 2.99	143	2	0.3375	4
2	7	3 to 5.99	102	2	0.3375	4
2	7	6 to 8.99	90	2	0.4125	4
2	7	9 to 12.99	90	2	0.4125	4
2	7	13 to 16.99	90	2	0.4875	4
2	7	17 to 20.99	90	2	0.4875	4
2	7	21 to 25	90	2	0.5625	4
2	7	>25	1000	2	1	4
3	7	< 1	143	2	0.225	4
3	7	1 to 2.99	143	2	0.225	4
3	7	3 to 5.99	102	2	0.225	4
3	7	6 to 8.99	90	2	0.275	4
3	7	9 to 12.99	90	2	0.275	4
3	7	13 to 16.99	90	2	0.325	4
3	7	17 to 20.99	90	2	0.325	4
3	7	21 to 25	90	2	0.375	4
3	7	>25	1000	2	1	4

Simulating Riparian Buffers

Riparian buffers reported include filter strips, riparian forest buffers, and riparian herbaceous buffers. A filter strip is a strip of grass or other permanent vegetation situated between cropland, grazing land, or disturbed land and environmentally sensitive areas. The filter strip slows and spreads surface runoff water, filters suspended soil particles, and increases infiltration of runoff and soluble pollutants and adsorption of pollutants on soil and plant surfaces. Filter strips: 1) reduce waterborne sediment, organic particulates, and sorbed contaminants; and 2) reduce dissolved contaminant loadings transported in runoff or surface irrigation tailwater entering environmentally sensitive zones. Filter strips can be designed to enhance wildlife habitat. Riparian areas are ecosystems that occur along watercourses or at the fringe of water bodies. A riparian forest buffer is an area of predominantly trees or shrubs located adjacent to and up-gradient from streams, lakes, ponds, and wetlands. It intercepts contaminants from surface runoff and shallow subsurface water flow, filtering nutrients and sediments. The buffer also can be designed to enhance wildlife habitat, impact water temperature, and aid in streambank stability. Riparian herbaceous cover consist of grasses, grass-like plants, and forbs located adjacent to and up-gradient from streams, lakes, ponds, and wetlands. It intercepts contaminants from surface runoff and shallow subsurface water flow, filtering nutrients and sediments. The buffer also can be designed to enhance wildlife habitat, impact water temperature, and aid in streambank stability.

Only one of the three riparian practices (filter strips, riparian forest buffer, and riparian herbaceous buffer) is simulated (table CP-8). Grass filter strips are simulated when a grass filter is reported and neither riparian buffer is reported. A riparian forest buffer is simulated when the either the forest buffer or riparian herbaceous buffer is reported. Grass filters are simulated as an integral component of either riparian buffer, thus no additional benefits accrue when a filter strip is reported with a riparian forest buffer or riparian herbaceous buffer.

Grass filter strips are simulated in APEX using multiple subareas as illustrated in figure 2. The upland subarea is a 15.6 hectare cropped field with management from the CEAP survey. The down slope subarea is a 0.4 hectare grass filter strip which is managed using basic field operations including planting, fertilization, mowing, and baling. Flow from the cropped subarea is routed through the grass filter strip such that the two subareas together form a simple watershed. To spread the flow, the filter strip is simulated as a floodplain so that surface runoff across the filter strip is parameterized as 95% overland flow and 5% channel flow. The filter strip has a maximum slope length of 10 meters. The slope is 25% of the value reported in the NRI. Managed and engineered flow interceptors can be simulated on the cropland subarea as described previously. Other model inputs for the two subareas are set as shown in the configuration description (table CP-9).

Since the two subareas comprising the filter strip simulation form a watershed, APEX model outputs at the watershed outlet must be taken from the Watershed Output or Monthly Swat Output tables in Access. Subarea outputs in the Average Output or Yearly Output tables cannot be averaged to calculate outputs at the watershed outlet. In-field outputs such as the change in soil carbon can be calculated.

CEAP points having a riparian forest buffer are simulated as a 14.4 hectare cropped area, 0.4 hectare grass filter strip, and a 1.2 hectare forest buffer (figure 3). The riparian zone consists of a 10 meter (33 feet) wide grass filter strip and a 30 meter (98 feet) riparian forest zone. Management for the cropland area is from the CEAP survey. Field Operations for the grass filter strip (subarea 2) are the same as reported in the previous section. Management for the forest zone includes planting pine and poplar trees as well as a perennial grass. No harvesting or other management occurs in the forest zone.

Flow from cropland is routed across the grass filter strip which is then routed through the riparian forest. Both grass and forest zones are simulated as floodplains. In the grass filter, 95% of surface runoff is simulated as overland flow. In the forest zone, 85% of surface runoff is simulated as overland flow. The remaining surface flow is assumed to move through small channels, which are parameterized in APEX as a single reach channel. Slope length for the cropland is based on the value in recorded in the NRI. The grass zone has a maximum slope length of 10 meters and the forest zone has a maximum slope length of 30 meters. The maximum slope for the grass zone is 25% of the slope reported in the NRI for the cropland area. Slope in the forest zone is 10% of the NRI value. Other model inputs describing the configuration of the subareas are shown in (table CP-10). Managed and engineered flow interceptors can be simulated on the cropland subarea as described previously.

Table CP- 8. Simulation practice selection matrix for the riparian practices.

Riparian Code	Reported Practice			P Code	Simulate As
	Riparian Herbaceous Buffer	Riparian Forest Buffer	Grass Filter Strip		
1	0	0	1	1	Grass Filter
2	0	1	0	2	Forest Buffer
3	0	1	1	2	Forest Buffer
4	1	0	0	2	Forest Buffer
5	1	0	1	2	Forest Buffer
6	1	1	0	2	Forest Buffer
7	1	1	1	2	Forest Buffer

0 = practice is not reported in survey or NRI. 1 = practice is reported in survey or NRI

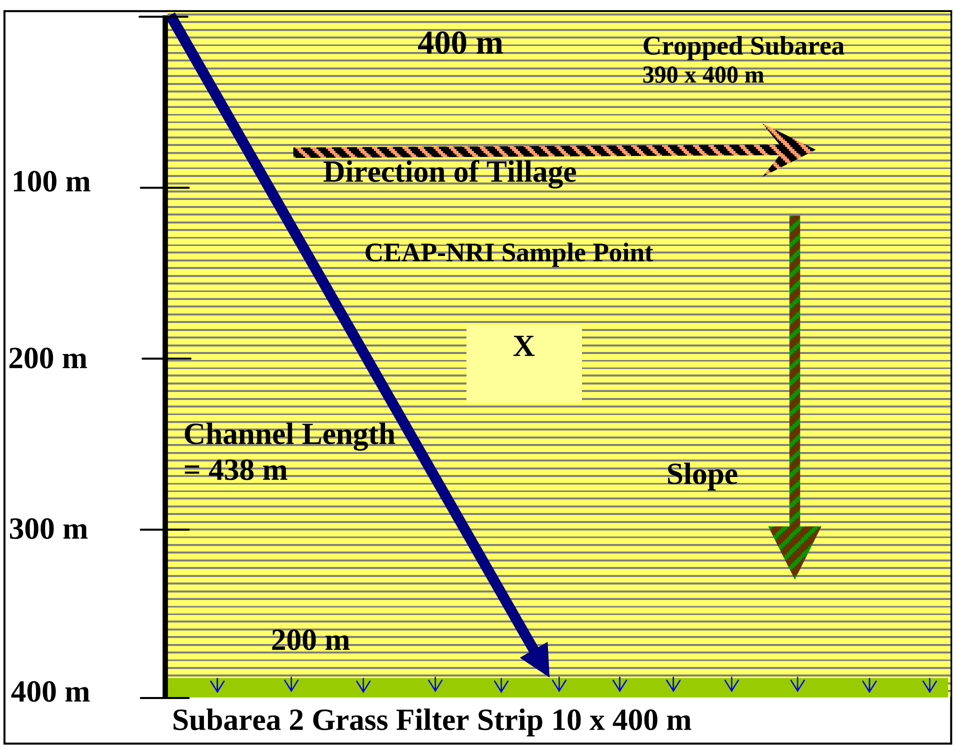

Figure 2. Field configuration used to represent a grass filter strip (FID 8). (Shown with tillage across the slope.)

Table CP-9. Model settings for a CEAP point having a grass filter strip (FID 8).

Table	Parameter	Code	Unit	Subarea	
				1	2
	Type Land Use			Crop	Grass Filter
SA	Soil Type			NRI	NRI
SA	Filter Strip Flag	IFLS		0	1
SA	Drainage Area	WSA	Ha	15.6	0.4
SA	Op Schedule Number			1	2
SA	Avg. Upland Slope	STP	m/m	NRI	NRI * 0.25
SA	Avg. Upland Slope Length	SPLG	m	NRI	10
SA	Manning's N for Upland.	UPN			0.1
SA	Channel Length	CHL	Km	0.44	0.02
SA	Channel Slope	CHS	m/m	NRI * 0.4304	NRI * 0.25
SA	Channel Depth	CHD	m		
SA	Manning's N for Channel	CHN			0.1
SA	Reach Channel Length	RCHL	Km	0.44	0.01
SA	Reach Channel Slope	RCHS	m/m	NRI * 0.4304	NRI * 0.25
SA	Routing Reach Channel Depth	RCHD	m		0.01
SA	Reach Bottom Width	RCBW	m		0.1
SA	Reach Top Width	RCTW	m		.2
SA	Reach Manning's N	RCHN			0.2
SA	Reach USLE C Factor	RCHC			0.001
SA	Reach USLE K Factor	RCHK			0.3
SA	Reach Floodplain Width	RFPW	m		400
SA	Reach Floodplain Length	RFPL	Km		0.01
SA	Floodplain Flow Fraction	FFPQ		0	0.95
SA / FO	Land Use Number	LUN		XXXX	22
SA	Hydrologic Condition			XXXX	Good
MAN	Conservation P Factor	PEC		XXXX	0.6

Table Notes:
I_APEX table definitions: SA = Subarea, FO = Field Operations, MAN = Management
"NRI" denotes value reported in the National Resource Inventory for the CEAP point.
"XXXX" denotes model inputs based on reported conservation practices.

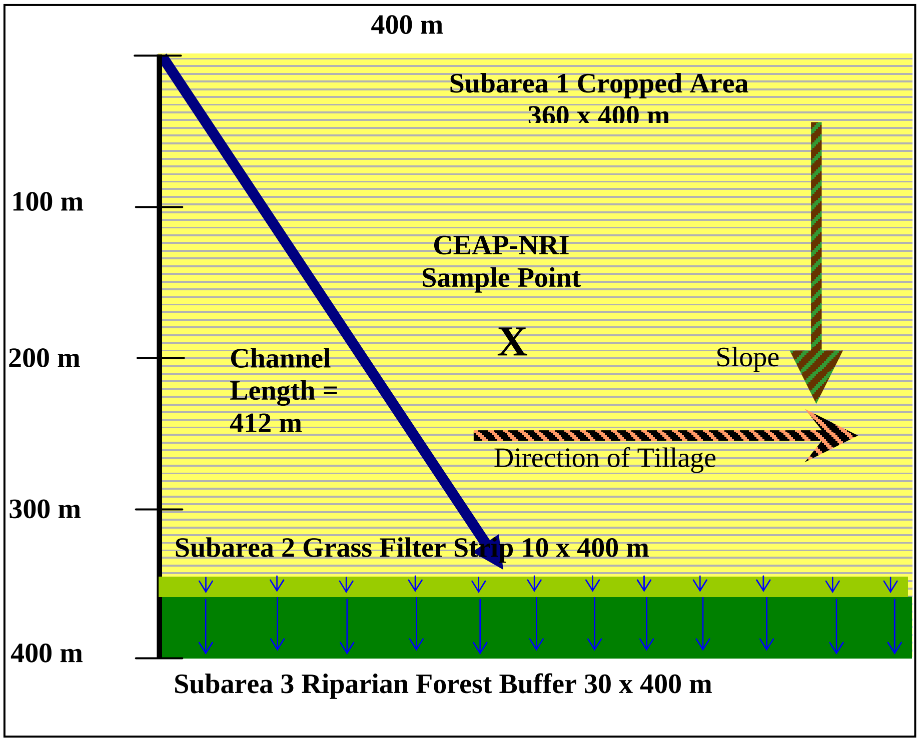

Figure 3. Field configuration (FID 9) used to represent a riparian buffer (shown w/ tillage across the slope).

Table CP-10. Model settings for a CEAP point having a riparian forest buffer (FID 9).

I_APEX Table	Parameter	Code	Unit	Subarea		
				1	2	3
	Type Land Use			Crop	Grass	Forest
SA	Soil Type			NRI	NRI	NRI
SA	Filter Strip Flag	IFLS		0	1	1
SA	Drainage Area	WSA	Ha	14.4	0.4	1.2
SA	Op Schedule Number			1	2	3
SA	Avg. Upland Slope	STP	m/m	NRI	NRI * 0.25	NRI * 0.1
SA	Avg. Upland Slope Length	SPLG	m	NRI	10	30
SA	Manning's N for Upland.	UPN			0.1	0.2
SA	Channel Length	CHL	Km	0.41	.01	0.05
SA	Channel Slope	CHS	m/m	NRI * 0.44	NRI * 0.25	NRI * 0.1
SA	Channel Depth	CHD	m			
SA	Manning's N for Channel	CHN			0.1	0.2
SA	Reach Channel Length	RCHL	Km	0.41	0.01	0.03
SA	Reach Channel Slope	RCHS	m/m	NRI * 0.44	NRI * 0.25	NRI * 0.1
SA	Routing Reach Channel Depth	RCHD	m		0.01	0.1
SA	Reach Bottom Width	RCBW	m		0.1	2.5
SA	Reach Top Width	RCTW	m		.2	3
SA	Reach Manning's N	RCHN			0.2	0.1
SA	Reach USLE C Factor	RCHC			0.1	0.1
SA	Reach USLE K Factor	RCHK			0.3	0.3
SA	Reach Floodplain Width	RFPW	m		400	400
SA	Reach Floodplain Length	RFPL	Km		0.01	0.03
SA	Floodplain Flow Fraction	FFPQ			0.95	0.85
SA / FO	Land Use Number	LUN		XXXX	22	29
SA	Hydrologic Condition			XXXX	Good	Good
MAN	Conservation P Factor	PEC		XXXX	0.6	0.6

Table Notes:
I_APEX table definitions: SA = Subarea, FO = Field Operations, MAN = Management
"NRI" denotes value reported in the National Resource Inventory for the CEAP point.
"XXXX" denotes model inputs based on reported conservation practices.

Simulating Wind Erosion Control

One common technique to reduce wind erosion is to slow wind speed across the soil surface which in turn decreases the forces detaching soil particles from the surface as well as reducing the carrying capacity of the wind. Intercepting wind-borne soil particles is another means of reducing soil loss to wind erosion. Structural conservation practices include herbaceous wind barriers, windbreaks or shelterbelts, cross wind ridges, cross wind traps, hedgerows, and strip cropping. Herbaceous wind barriers are tall grass and other non-woody plants established in one- to two-row, narrow strips spaced across the field perpendicular to the normal wind direction. According to the CPPE, herbaceous wind barriers tend to have moderate to substantial decreases in wind erosion. A windbreak or shelterbelt is one or more rows of trees or shrubs that protects the soil from wind erosion, protects sensitive plants, manages snow, improves irrigation efficiency, protects livestock and structures, and creates or enhances wildlife habitat. Windbreaks and shelterbelts tend to result in substantial decreases in wind erosion. Cross wind ridges are formed by tillage, planting or other operations and aligned across the prevailing wind erosion direction to reduce soil erosion from wind. Moderate to substantial decreases in wind erosion result from cross wind ridges. Cross wind trap strips are areas of herbaceous vegetation that are resistant to wind erosion and grown as nearly as possible perpendicular to the prevailing wind direction in order to catch wind-borne sediment and other pollutants attached to the eroded material before it reaches water bodies or other sensitive areas. Cross wind trap strips can result in moderate to substantial decreases in wind erosion. A hedgerow is dense vegetation designed mainly to provide food, cover and corridors for terrestrial wildlife. Slight decreases in wind erosion are secondary benefits of hedgerows. When used as a wind erosion control practice, strip cropping can result in moderate reductions in wind erosion.

Structural wind erosion control practices were simulated by decreasing the unsheltered field length and unsheltered field width in APEX. Without practices, both distances are set as 400 meters (1312 feet). Unsheltered field length and field width when single or multiple practices are reported in table CP-11. An inherent assumption is that the practices are fully effective for the entire simulation. For example, trees in windbreaks are simulated as if they are at their full height throughout the simulation period. Another assumption is that the downwind field edge is a stable point. Therefore, APEX estimates the amount of windblown sediment leaving the field.

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Table CP-11. Unsheltered distance settings for wind erosion control practices.

Wind Erosion Control Code	Hedgerows	Cross Wind Practices	Windbreak / Shelterbelt	Herbaceous Wind Barrier	Unsheltered Field Length (Km)	Unsheltered Field Width (Km)	Unsheltered Distance With Strip Cropping
0	0	0	0	0	0.4	0.4	0.03
1	0	0	0	1	0.04	0.04	0.03
2	0	0	1	0	0.03	0.03	0.02
3	0	0	1	1	0.02	0.02	0.01
4	0	1	0	0	0.04	0.04	0.03
5	0	1	0	1	0.03	0.03	0.02
6	0	1	1	0	0.02	0.02	0.01
7	0	1	1	1	0.01	0.01	0.01
8	1	0	0	0	0.06	0.06	0.03
9	1	0	0	1	0.04	0.04	0.03
10	1	0	1	0	0.03	0.03	0.02
11	1	0	1	1	0.02	0.02	0.01
12	1	1	0	0	0.03	0.03	0.02
13	1	1	0	1	0.03	0.03	0.02
14	1	1	1	0	0.02	0.02	0.01
15	1	1	1	1	0.01	0.01	0.01

0 = practice is not reported in survey or NRI. 1 = practice is reported in survey or NRI

Simulating Complementary Practices

Structural practices, including field borders, grade stabilization structures, and grass waterways, are functionally versatile. These practices can be applied by themselves or in combination with many other practices. A field border is a band or strip of perennial vegetation established on the edge of a cropland field. It reduces sheet, rill, and gully erosion at the edge of fields; traps sediment, reduces particulate and soluble agro-chemicals, and other pollutants; provides turning areas for farm equipment; and provides habitat for wildlife. A grade stabilization structure prevents the formation or advance of gullies and controls head and erosion in cutting in natural or artificial channels by reducing the channel slope profile from a continuous steep gradient to a series of more gently sloping reaches. A grass waterway is a natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation for the purpose of conveying runoff from terraces, diversions, or other water concentrations without causing erosion or flooding.

Field borders are simulated using the standard field configuration. The P factor is set to 0.95 to account for the reduction in water erosion resulting from the stable turnaround space provided by the field border. Where other practices having P factor changes are present, the calculated P factor is multiplied by 0.95 to capture the field border effect.

Estimating the effects from grade stabilization structures and grass waterways requires a different simulation approach than for other practices. These two practices are unique in that a priori condition is not simply the absence of a practice. Rather, the No Practice scenario includes representative channel flow conditions the practices are designed to mitigate. Where a grade stabilization structure is reported, a steep gradient ditch/channel with high-velocity flow is the a priori condition. The grade stabilization structure is represented by reducing the channel gradient and increasing its surface roughness. For a grass waterway, the a priori condition includes an erodable earth ditch/channel. Practice effects are simulated by changing the channel cover factor, surface roughness, and dimensions. In cases where both practices are reported, the a priori condition is an erodable earth ditch/channel with a steep gradient and high velocity flow. The combined practices are represented by reducing the channel slope, increasing its surface roughness, changing the cover factor, and modifying the channel dimensions. Model inputs for the different reach types are given in table CP-12.

To simulate a channel flow, APEX requires two subareas, which are illustrated in figure 4. When the baseline conservation practices include a grade stabilization structure, grass waterway or the combination of both, the CEAP point is simulated as two 8 hectare subareas, each 200 x 400 meters. Both subareas are homogeneous with respect to soil, climate, and management. A 200 meter channel reach is parameterized in subarea 2. The cropping system management from the CEAP Survey is duplicated for each subarea. Two 8 hectare cropped subareas are similarly used to represent a priori conditions.

Combining Simulation Methods for Multiple Practices

Simulation methods were developed such that the suite of reported structural conservation practices on any CEAP point could be simulated as a:

> ***Managed Flow Interceptor + Engineered Flow Interceptor + Riparian Buffer + Wind Erosion Control + Field Border + Grade Stabilization Structure + Grass Waterway***

The suite of practices simulated for each CEAP point is identified with a conservation practice system id (CpSysId) as defined in table CP-13.

When the practice system includes any combination of a riparian buffer, grade stabilization structure, or grass waterway the field configuration requires multiple subareas. Table CP-8 identifies baseline field configuration as well as the configuration needed to represent a priori conditions. Model settings describing the configurations are given in table CP-14a and CP-14b. After the selecting the field configuration, other model inputs for representing the practices comprising the practice system are as previously described.

Table CP-12. Reach channel characteristics.

Reach Channel Description	Reach Channel Slope	Reach Channel Length (Km)	Reach Channel Depth (m)	Reach Channel Top Width (m)	Reach Channel Bottom Width (m)	Reach Channel Manning's N	Reach Channel USLE C	Reach Channel USLE K	Filter Flag	Filter Flow Fraction	Floodplain Length (Km)	Floodplain Width (m)
Steep Gradient Channel-Gully	NRI *0.775	0.2	0.75	0.75	0.75	0.05	1	0.3	0	0	0	0
Eroding Channel-Gully	NRI * 0.517	0.2	0.75	0.75	0.75	0.04	1	0.3	0	0	0	0
Eroding Channel-Gully w/ Steep Gradient	NRI *0.775	0.2	0.75	0.75	0.75	0.04	1	0.3	0	0	0	0
Grade Stabilization Structure (GSS)	NRI * 0.1	0.2	0.75	0.75	0.75	0.05	1	0.3	0	0	0	0
Grass Waterway (GWW)	NRI * 0.517	0.2	1	4.5	1.5	0.08	0.01	0.3	0	0	0	0
GSS + GWW	NRI * 0.1	0.2	1	4.5	1.5	0.08	0.01	0.3	0	0	0	0
Grass Filter	NRI * 0.25	0.01	0.01	0.2	0.1	0.2	0.001	0.3	1	0.95	0.01	399
Forest Buffer	NRI * 0.1	0.03	0.01	0.2	0.1	0.2	0.001	0.3	1	0.85	0.03	397

"NRI" is slope value reported in the National Resource Inventory for the CEAP point.

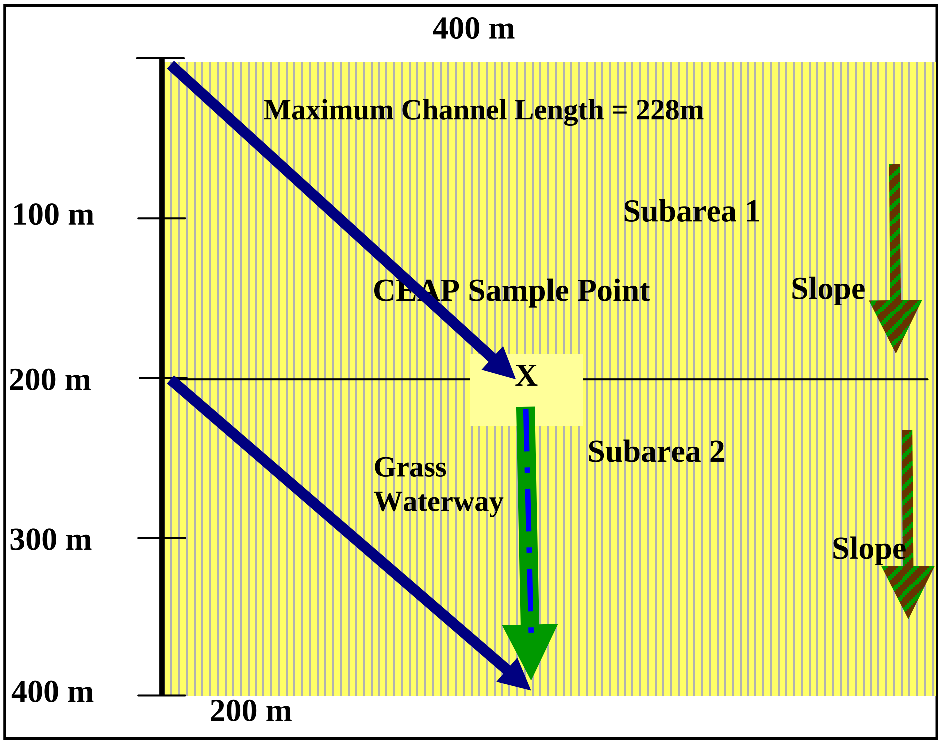

Figure 4. Field configuration illustrated for grass waterway (FID 5). Grade stabilization structure (FID 6) is configured similarly; however, model inputs are different. The point is simulated as two 8 hectare subareas, each 200 x 400 meters. Both subareas are homogeneous with respect to soil, climate, and management. A 200 meter channel is parameterized in subarea 2. The cropping system management from the CEAP Survey is duplicated for each subarea.

Table CP-13. Rules for combining functional practice categories into practice systems.

Cp Sys Id	Managed Code	Engineered Code	Riparian Code	Wind Code	Field Border (FB)	Grade Stabilization Structure (GSS)	Grass Waterway (GWW)	System Name
0	0	0	0	0	0	0	0	None
1	0	0	0	0	0	0	0	Simulated as None
10	1	0	0	0	0	0	0	Contour
11	2	0	0	0	0	0	0	Strip Cropping
12	3	0	0	0	0	0	0	Contour Grass Buffer Strips
13	0	4	0	0	0	0	0	Terraces
14	0	5	0	0	0	0	0	Grass Terraces
15	0	6	0	0	0	0	0	Diversion
16	0	7	0	0	0	0	0	Vegetated Barrier
17	0	0	1	0	0	0	0	Filter Strip
18	0	0	>1	0	0	0	0	Riparian Buffer
19	0	0	0	0	1	0	0	Field Border
20	0	0	0	0	0	1	0	Grade Stabilization Structure
21	0	0	0	0	0	0	1	Grass Waterway
22	0	0	0	>0	0	0	0	Wind
23	0	0	0	any	0	1	1	GWW + GSS
24	0	0	0	any	1	0	1	GWW + FB
25	0	0	0	any	1	1	0	GSS + FB
26	any	any	0	any	0	0	0	Any Managed or Engineered Flow Interceptor + Any Wind
27	any	any	0	any	0	0	1	Any Managed or Engineered Flow Interceptor + Any Wind + GWW
28	any	any	0	any	0	1	0	Any Managed or Engineered Flow Interceptor + Any Wind + GSS
29	any	any	0	any	0	1	1	Any Managed or Engineered Flow Interceptor + Any Wind + GWW + GSS
30	any	any	0	any	1	0	0	Any Managed or Engineered Flow Interceptor + Any Wind + FB
31	any	any	0	any	1	0	1	Any Managed or Engineered Flow Interceptor + Any Wind + FB + GWW
32	any	any	0	any	1	1	0	Any Managed or Engineered Flow Interceptor + Any Wind + FB + GSS

Cp Sys Id	Managed Code	Engineered Code	Riparian Code	Wind Code	Field Border (FB)	Grade Stabilization Structure (GSS)	Grass Waterway (GWW)	System Name
33	any	any	0	any	1	1	1	Any Managed or Engineered Flow Interceptor + Any Wind + FB + GSS + GWW
34	any	any	1	any	0	0	0	Any Managed or Engineered Flow Interceptor + Any Wind + Filter Strip
35	any	any	1	any	0	0	1	Any Managed or Engineered Flow Interceptor + Any Wind + GWW + Filter Strip
36	any	any	1	any	0	1	0	Any Managed or Engineered Flow Interceptor + Any Wind + GSS + Filter Strip
37	any	any	1	any	0	1	1	Any Managed or Engineered Flow Interceptor + Any Wind + GWW + GSS + Filter Strip
38	any	any	1	any	1	0	0	Any Managed or Engineered Flow Interceptor + Any Wind + FB + Filter Strip
39	any	any	1	any	1	0	1	Any Managed or Engineered Flow Interceptor + Any Wind + FB + GWW + Filter Strip
40	any	any	1	any	1	1	0	Any Managed or Engineered Flow Interceptor + Any Wind + FB + GSS + Filter Strip
41	any	any	1	any	1	1	1	Any Managed or Engineered Flow Interceptor + Any Wind + FB + GSS + GWW + Filter Strip
42	any	any	>1	any	0	0	0	Any Managed or Engineered Flow Interceptor + Any Wind + RB
43	any	any	>1	any	0	0	1	Any Managed or Engineered Flow Interceptor + Any Wind + GWW + RB
44	any	any	>1	any	0	1	0	Any Managed or Engineered Flow Interceptor + Any Wind + GSS + RB
45	any	any	>1	any	0	1	1	Any Managed or Engineered Flow Interceptor + Any Wind + GWW + GSS + RB
46	any	any	>1	any	1	0	0	Any Managed or Engineered Flow Interceptor + Any Wind + FB + RB
47	any	any	>1	any	1	0	1	Any Managed or Engineered Flow Interceptor + Any Wind + FB + GWW + RB
48	any	any	>1	any	1	1	0	Any Managed or Engineered Flow Interceptor + Any Wind + FB + GSS + RB
49	any	any	>1	any	1	1	1	Any Managed or Engineered Flow Interceptor + Any Wind + FB + GSS + GWW + RB

Table CP-14a. Model settings for field configurations 1 through 10.

FID	Field Configuration	Subarea Id	Op Schedule Number	Filter Strip Flag	Drainage Area	Channel Length	Channel Depth	Channel Slope	Manning's N for Channel	Upland Slope	Upland Slope Length	Manning's N for Upland	Filter Strip Flow Fraction	RR Channel Length of Routing Reach
1	Standard	1	1	0	16	0.45	0		0			0	0	0
2	A priori Grass Waterway (GWW)	1	1	0	8	0.29	0		0			0	0	0.29
		2	2	0	8	0.29	0		0			0	0	0.2
3	A priori Grade Stabilization Structure (GSS)	1	1	0	8	0.29	0		0			0	0	0.29
		2	2	0	8	0.29	0		0			0	0	0.2
4	A priori GSS + GWW	1	1	0	8	0.29	0		0			0	0	0.29
		2	2	0	8	0.29	0		0			0	0	0.2
5	GWW	1	1	0	8	0.29	0		0			0	0	0.29
		2	2	0	8	0.29	0		0			0	0	0.2
6	GSS	1	1	0	8	0.29	0		0			0	0	0.29
		2	2	0	8	0.29	0		0			0	0	0.2
7	GSS + GWW	1	1	0	8	0.29	0		0			0	0	0.29
		2	2	0	8	0.29	0		0			0	0	0.2
8	Grass Filter	1	1	0	15.6	0.44	0		0			0	0	0.44
		2	2	1	0.4	0.02	0		0.1		10	0.1	0.95	0.01
9	Riparian Buffer	1	1	0	14.4	0.41	0		0			0	0	0.41
		2	2	1	0.4	0.02	0		0.1		10	0.1	0.95	0.01
		3	3	1	1.2	0.05	0		0.2		30	0.2	0.85	0.03
10	GWW + Grass Filter	1	1	0	7.8	0.27	0		0			0	0	0.27
		2	2	0	7.8	0.27	0		0			0	0	0.2
		3	3	1	0.4	0.02	0		0.1		10	0.1	0.95	0.01

(Blank cells indicate NRI or calculated values.) (Table adapted from SubareasTemplate13Dec06.xls)

Table CP-14a. Model settings for field configurations 1 through 10 (cont.).

FID	Field Configuration	Subarea Id	RR Routing Reach Channel Depth	RR Bottom Width of Channel	RR Top Width of Channel	RR Slope	RR Manning's N for Channel	RR USLE C for Channel	RR USLE K for Channel	RR Floodplain Width	RR Floodplain Length	Land Use Number	P Factor
1	Standard	1	0	0	0	0	0	0	0	0	0	2	
2	A priori Grass Waterway (GWW)	1	0	0	0	0	0	0	0	0	0	2	
		2	0.75	0.75	0.75		0.04	1	0.3	0	0	2	
3	A priori Grade Stabilization Structure (GSS)	1	0	0	0	0	0	0	0	0	0	2	
		2	0.75	0.75	0.75		0.05	1	0.3	0	0	2	
4	A priori GSS + GWW	1	0	0	0	0	0	0	0	0	0	2	
		2	0.75	0.75	0.75		0.04	1	0.3	0	0	2	
5	GWW	1	0	0	0	0	0	0	0	0	0	2	
		2	1	1.5	4.5		0.08	0.01	0.3	0	0	2	
6	GSS	1	0	0	0	0	0	0	0	0	0	2	
		2	0.75	0.75	0.75		0.05	1	0.3	0	0	2	
7	GSS + GWW	1	0	0	0	0	0	0	0	0	0	2	
		2	1	1.5	4.5		0.08	0.01	0.3	0	0	2	
8	Grass Filter	1	0	0	0	0	0	0	0	0	0	11	
		2	0.01	0.1	0.2		0.2	0.001	0.3	399	0.01	26	0.6
9	Riparian Buffer	1	0	0	0	0	0	0	0	0	0	2	
		2	0.01	0.1	0.2		0.2	0.001	0.3	399	0.01	26	0.6
		3	0.01	0.1	0.2		0.2	0.001	0.3	397	0.03	29	0.6
10	GWW + Grass Filter	1	0	0	0	0	0	0	0	0	0	2	
		2	1	1.5	4.5		0.08	0.01	0.3	0	0	2	
		3	0.01	0.1	0.2		0.2	0.001	0.3	399	0.01	26	0.6

(Blank cells indicate NRI or calculated values.)

Table CP-14b. Model settings for field configurations 11 through 15.

FID	Field Configuration	Subarea Id	Op Schedule Number	Filter Strip Flag	Drainage Area	Channel Length	Channel Depth	Channel Slope	Manning's N for Channel	Upland Slope	Upland Slope Length	Manning's N for Upland	Filter Strip Flow Fraction	RR Channel Length of Routing Reach
11	GWW + Riparian Buffer	1	1	0	7.2	0.27	0		0			0	0	0.27
		2	2	0	7.2	0.27	0		0			0	0	0.2
		3	3	1	0.4	0.02	0		0.1		10	0.1	0.95	0.01
		4	4	1	1.2	0.05	0		0.2		30	0.2	0.85	0.03
12	GSS + Grass Filter	1	1	0	7.8	0.27	0		0			0	0	0.27
		2	2	0	7.8	0.27	0		0			0	0	0.2
		3	3	1	0.4	0.02	0		0.1		10	0.1	0.95	0.01
13	GSS + Riparian Buffer	1	1	0	7.2	0.27	0		0			0	0	0.27
		2	2	0	7.2	0.27	0		0			0	0	0.2
		3	3	1	0.4	0.02	0		0.1		10	0.1	0.95	0.01
		4	4	1	1.2	0.05	0		0.2		30	0.2	0.85	0.03
14	GSS + GWW + Grass Filter	1	1	0	7.8	0.27	0		0			0	0	0.27
		2	2	0	7.8	0.27	0		0			0	0	0.2
		3	3	1	0.4	0.02	0		0.1		10	0.1	0.95	0.01
15	GSS + GWW + Riparian Buffer	1	1	0	7.2	0.27	0		0			0	0	0.27
		2	2	0	7.2	0.27	0		0			0	0	0.2
		3	3	1	0.4	0.02	0		0.1		10	0.1	0.95	0.01
		4	4	1	1.2	0.05	0		0.2		30	0.2	0.85	0.03

(Blank cells indicate NRI or calculated values.)

Table CP-14b. Model settings for field configurations 11 through 15 (cont.).

FID	Field Configuration	Subarea Id	RR Routing Reach Channel Depth	RR Bottom Width of Channel	RR Top Width of Channel	RR Slope	RR Manning's N for Channel	RR USLE C for Channel	RR USLE K for Channel	RR Floodplain Width	RR Floodplain Length	Land Use Number	P Factor
11	GWW + Riparian Buffer	1	0	0	0	0	0	0	0	0	0	2	
		2	1	1.5	4.5		0.08	0.01	0.3	0	0	2	
		3	0.01	0.1	0.2		0.2	0.001	0.3	399	0.01	26	0.6
		4	0.01	0.1	0.2		0.2	0.001	0.3	397	0.03	29	0.6
12	GSS + Grass Filter	1	0	0	0	0	0	0	0	0	0	2	
		2	0.75	0.75	0.75		0.05	1	0.3	0	0	2	
		3	0.01	0.1	0.2		0.2	0.001	0.3	399	0.01	26	0.6
13	GSS + Riparian Buffer	1	0	0	0	0	0	0	0	0	0	2	
		2	0.75	0.75	0.75		0.05	1	0.3	0	0	2	
		3	0.01	0.1	0.2		0.2	0.001	0.3	399	0.01	26	0.6
		4	0.1	0.1	0.2		0.2	0.001	0.3	397	0.03	29	0.6
14	GSS + GWW + Grass Filter	1	0	0	0	0	0	0	0	0	0	2	
		2	1	1.5	4.5		0.08	0.01	0.3	0	0	2	
		3	0.01	0.1	0.2		0.2	0.001	0.3	399	0.01	26	0.6
15	GSS + GWW + Riparian Buffer	1	0	0	0	0	0	0	0	0	0	2	
		2	1	1.5	4.5		0.08	0.01	0.3	0	0	2	
		3	0.01	0.1	0.2		0.2	0.001	0.3	399	0.01	26	0.6
		4	0.1	0.1	0.2		0.2	0.001	0.3	397	0.03	29	0.6

(Blank cells indicate NRI or calculated values.)

Appendix A

Table A. Conservation Practice Definitions and Functions

Name	CP#	Definition	Cropland Related Function
Alley Cropping	311	Trees or shrubs planted in a set or series of single or multiple rows with agronomic, horticultural crops or forages produced in the alleys between the rows of woody plants.	Produce tree and/or shrub products along with crops or forages. Improve crop or forage quality and quantity by enhancing microclimatic conditions. Reduce surface water runoff and erosion. Improve utilization and recycling of soil nutrients. Reduce subsu
Contour Farming	330	Tillage, planting, and other farming operations performed on or near the contour of the field slope.	To reduce sheet and rill erosion. To reduce transport of sediment and other water-borne contaminants.
Contour Orchard And Other Fruit Areas	331	Planting orchards, vineyards, or small fruits so that all cultural operations are done on the contour.	Reduce soil erosion and water loss.
Contour Buffer Strips	332	Narrow strips of permanent, herbaceous vegetative cover established across the slope and alternated down the slope with parallel, wider cropped strips.	Reduce sheet and rill erosion, reduce sediment transport, enhance wildlife habitat
Critical Area Planting	342	Establishing permanent vegetation on sites that have or are expected to have high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices.	Stabilize areas with existing or expected high rates of soil erosion by water or wind. Restore degraded sites that cannot be stabilized through normal methods.
Diversion Dam	348	A structure built to divert all or part of the water from a waterway or a stream.	To divert all or part of the water from a waterway so that it can be controlled and used beneficially, or to divert periodic damaging flows from one watercourse to another watercourse thereby reducing the damage potential of the flows.
Sediment Basin	350	A basin constructed to collect and store debris or sediment.	To preserve the capacity of reservoirs, ditches, canals, diversion, waterways, and streams; to prevent undesirable deposition on bottom lands and developed areas; to trap sediment originating from construction sites; and to reduce or abate pollution by pr
Diversion	362	A channel constructed across the slope generally with a supporting ridge on the lower side.	Break up concentrations of water on long slopes, undulating land surfaces, and land that is too flat or irregular for terracing. Divert water away from farmsteads, agricultural waste systems, and other improvements. Reduce erosion and runoff.
Windbreak/Shelterbelt Establishment	380	Linear plantings of single or multiple rows of trees or shrubs or sets of linear plantings.	Reduce soil erosion from wind. protect plants from wind related damage
Field Border	386	A strip of permanent vegetation established at the edge or around the perimeter of a field.	Reduce erosion from wind and water

Table A. Conservation Practice Definitions and Functions

Name	CP#	Definition	Cropland Related Function
Irrigation Field Ditch	388	A permanent irrigation ditch constructed in or with earth materials, to convey water from the source of supply to a field or fields in an irrigation system.	This practice may be applied as part of an irrigation water management system to efficiently convey and distribute irrigation waters.
Riparian Herbaceous Cover	390	Riparian areas are ecosystems that occur along water courses or at the fringe of water bodies. Riparian herbaceous cover consist of grasses, grasslike plants, and forbs.	Improve habitat, filter runoff, channel stabilization.
Riparian Forest Buffer	391	An area of predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.	Habitat improvement and filtering nutrients and sediments
Filter Strip	393	Strip or area of herbaceous vegetation situated between cropland, grazing land, or disturbed land and environmentally sensitive areas.	To reduce: 1) waterborne sediment, organic particulates, and sorbed contaminants and 2) dissolved contaminant loadings transported in runoff or surface irrigation tailwater entering environmentally sensitive zones. Enhance habitat.
Grade Stabilization Structure	410	A structure used to control the grade and head cutting in natural or artificial channels.	To stabilize the grade and control erosion in natural or artificial channels, to prevent the formation or advance of gullies, and to enhance environmental quality and reduce pollution hazards.
Grass Waterway	412	A natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation.	Convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding.
Hedgerow Planting	422	Establishment of dense vegetation in a linear design to achieve a natural resource conservation purpose.	Food, cover and corridors for terrestrial wildlife.
Hillside Ditch	423	A channel that has a supporting ridge on the lower side constructed across the slope at defined vertical interval and gradient, with or without a vegetative barrier.	To safely control the flow of water by diverting runoff into a protected outlet.
Irrigation System, Microirrigation	441	An irrigation system for distribution of water directly to the plant root zone by means of surface or subsurface applicators.	To efficiently and uniformly apply irrigation water and maintain soil moisture for optimum plant growth. Apply chemicals and/or nutrients as part of an irrigation system.
Irrigation System, Sprinkler	442	A planned irrigation system in which all necessary facilities are installed for efficiently applying water by means of perforated pipes or nozzles operated under pressure.	To efficiently and uniformly apply irrigation water to maintain adequate soil moisture for optimum plant growth without causing excessive water loss, erosion, or reduced water quality.

Table A. Conservation Practice Definitions and Functions

Name	CP#	Definition	Cropland Related Function
Irrigation System, Surface And Subsurface	443	A system in which all necessary water-control structures have been installed for the efficient distribution of water by surface means, such as furrows, borders, contour levees, or contour ditches, or by subsurface means.	Efficiently convey and distribute irrigation water to the point of application without causing excessive water loss, erosion, or reduced water quality. Apply chemicals and/or nutrients as part of an irrigation system.
Irrigation System, Tailwater Recovery	447	A planned irrigation system in which all facilities utilized for the collection, storage, and transportation of irrigation tailwater for reuse have been installed.	Conserve irrigation water supplies. Improve offsite water quality.
Precision Land Forming	462	Reshaping the surface of land to planned grades.	To improve surface drainage and control erosion.
Irrigation Land Leveling	464	Reshaping the surface of land to be irrigated to planned grades.	To permit uniform and efficient application of irrigation water to the leveled land.
Land Smoothing	466	Removing irregularities on the land surface.	To improve surface drainage, provide for more uniform cultivation, and improve equipment operation and efficiency.
Lined Waterway Or Outlet	468	A waterway or outlet having an erosion-resistant lining of concrete, stone, synthetic turf reinforcement fabrics, or other permanent material.	Provide for safe conveyance of runoff from conservation structures or other water concentrations without causing erosion or flooding
Drainage Water Management	554	Control of water surface elevations and discharge from surface and subsurface drainage systems.	Improve water quality. Improve the soil environment for vegetative growth. Reduce the rate of oxidation of organic soils. Prevent wind erosion. Enable seasonal shallow flooding.
Strip Cropping	585	Growing row crops, forages, small grains, or fallow in a systematic arrangement of equal width strips across a field.	Reduce soil erosion from water or wind. Protect crops from wind damage,
Structure For Water Control	587	A structure in an irrigation, drainage, or other water management systems that conveys water, controls the direction or rate of flow, or maintains a desired water surface elevation.	To control the stage, discharge, distribution, delivery, or direction of flow of water in open channels or water use areas. Also used for water quality control, such as sediment reduction or temperature regulation. Also used to protect fish and wildlife
Terraces	600	An earth embankment, or a combination ridge and channel, constructed across the field slope.	Reduce soil erosion and/or retain runoff for moisture conservation
Vegetative Barriers	601	Permanent strips of stiff, dense vegetation along the general contour of slopes or across concentrated flow areas.	Reduce sheet, rill, and gully erosion. Stabilize steep slopes. Manage water flow. Trap Sediment
Herbaceous Wind Barriers	603	Herbaceous vegetation established in rows or narrow strips in the field across the prevailing wind direction.	Reduce soil erosion from wind. protect plants from wind related damage.

Table A. Conservation Practice Definitions and Functions

Name	CP#	Definition	Cropland Related Function
Subsurface Drainage	606	A conduit, such as corrugated plastic tubing, tile, or pipe, installed beneath the ground surface to collect and/or convey drainage water.	Regulate water table and ground water flows. Removing surface runoff. Intercept and prevent water movement into a wet area. Leaching of saline and sodic soils. Regulating subirrigated areas or waste disposal areas.
Surface Drainage, Field Ditch	607	A graded ditch for collecting excess water in a field.	Collect or intercept excess surface water or subsurface water and carry it to an outlet.
Toxic Salt Reduction	610	Reducing or redistributing the harmful concentrations of salt and/or sodium in a soil .	To permit desirable plants to grow.
Underground Outlet	620	A conduit installed beneath the surface of the ground to collect surface water and convey it to a suitable outlet.	Dispose of excess water from terraces, diversions, subsurface drains, surface drains, trickle tubes or principal spillways from dams , or other concentrations without causing damage by erosion or flooding.
Water And Sediment Control Basin	638	An earth embankment or a combination ridge and channel generally constructed across the slope and minor watercourses to form a sediment trap and water detention basin.	Improve farmability of sloping land. Reduce watercourse and gully erosion. Trap sediment. · Reduce and manage onsite and downstream runoff. Improve downstream water quality.
Windbreak/Shelterbelt Renovation	650	Replacing, releasing, and/or removing selected trees and shrubs or rows within an existing windbreak or shelterbelt, adding rows to the windbreak or shelterbelt or removing selected tree and shrub branches.	Restoring or enhancing the original planned function of existing windbreaks or shelterbelts performance of a partially functioning or non-functioning windbreak or shelterbelt:
Cross Wind Ridges	589A	Ridges formed by tillage, planting or other operations and aligned across the prevailing wind erosion direction.	Reduce soil erosion from wind.
Cross Wind Trap Strips	589C	Herbaceous cover resistant to wind erosion established in one or more strips across the prevailing wind erosion direction.	Reduce soil erosion from wind. Protect plants from wind related damage. Induce deposition of windborne contaminants. Habitat improvement.

References

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