Appendix 3: Producer Economic Cost/ Willingness to Accept (WTA)

A producers' willingness to accept (WTA) is the minimum payment he or she would accept in exchange for taking a specific action, such as undertaking a given conservation treatment. WTA depends on a range of factors including (but not necessarily limited to) out-of-pocket costs (or savings), changes in production (positive or negative), changes in production risk, and the level of management skill required for successful implementation. For a given offer of payment in exchange for taking a specified action, a producer will accept the payment (apply for the programs in question) if the payment is equal to or larger than the producer's WTA.

In the text, we often refer to WTA as "economic cost" because WTA represents a producer's cost of applying conservation practices is a very broad sense of the term cost. Economic cost includes everything farmers must pay for (out-of-pocket expenses), but also includes things that are real but more difficult to estimate with precision. For example, producers may need to manage fertilizer applications more carefully to comply with terms of a nutrient management plan. This "hassle factor" is a real cost to the producer, but is hard to value in monetary terms.

In general, WTA is private information. Producers know what payment they would be willing to accept while policymakers and program managers do not. For model development, EQIP payments are used as a proxy for WTA. EQIP participants have shown that they are willing to accept the contract payment in exchange for adopting or installing practices specified in the contract. The EQIP payment is only a proxy because participants may also have been willing to accept lower payments. Moreover, producers who are not EQIP participants may or may not be willing to accept this same level of payment in exchange for taking similar actions. In the absence of other data, however, we assume that EQIP payments can serve as a reasonable proxy for WTA.

Information on the distribution of WTA across farms is given in table A3.1. For each land use and treatment combination, we provide a national average per acre WTA as well as the 5^{th}, 25^{th}, 50^{th}, 75^{th}, and 95^{th} percentiles. For example, WTA for water erosion control on nonirrigated cropland averaged $58 per acre, but 5 percent of acres that are eligible for this treatment can be treated for $16.28 or less, 25 percent of acres can be treated for $29.79 or less, and so on. Note that even though average per-acre WTA is higher for grazing land health ($81.56) than for water erosion on non-irrigated cropland ($58.04), a substantial share of grazing land could be treated for grazing land health at a relatively low cost: 25 percent of eligible acres have WTA estimates of $17.12 per acre or less while the same percentage of land eligible for water erosion control has WTA of $29.79 or less.

Data and Estimation

We estimate WTA as the average payment per treated acre for a suite of practices typically employed in addressing a specific physical effect in a given watershed (8-digit HUC). For example, conservation tillage, terraces, and contour farming, among other practices, are widely used to control the

Table A3.1

Distribution of willingness to accept payment (WTA) across modeled farms

Land use	Treatment	Percentiles					Average
		5	25	50	75	95	
		Dollars per acre					
Nonirrigated crop	Water erosion control	16.28	29.79	46.76	75.02	137.20	58.04
Nonirrigated crop	Wind erosion control	7.39	19.73	26.82	38.77	62.27	30.40
Nonirrigated crop	Nutrient management	3.28	9.11	12.90	16.18	26.98	13.62
Nonirrigated crop	Pest management	4.75	10.37	12.52	17.02	58.49	20.02
Nonirrigated crop	Habitat restore/enhance	4.20	12.73	16.22	27.47	55.73	22.93
Irrigated cropland	Water erosion control	7.48	23.29	35.81	55.32	107.63	44.17
Irrigated cropland	Wind erosion control	3.61	16.17	27.27	40.36	61.70	28.33
Irrigated cropland	Nutrient management	2.66	7.15	13.13	16.37	41.55	14.91
Irrigated cropland	Pesticide management	3.37	9.24	13.33	31.99	75.64	26.91
Irrigated cropland	Habitat restore/enhance	2.94	8.74	12.42	12.73	46.83	13.91
Grazing land	Grazing land health	5.82	17.12	49.12	105.45	281.75	81.56
Grazing land	Nutrient management and riparian erosion control	7.21	20.03	36.77	93.33	279.79	79.27
Grazing land	Habitat restore/enhance	2.81	7.11	19.59	40.56	80.65	29.08

Source: USDA, Economic Research Service.

physical effect sheet and rill erosion (details below). By focusing on specific areas, our WTA estimates reflect both the frequency with which specific practices are used and the out-of-pocket cost, etc., of applying those practices in that area. The 8-digit HUC was selected as the unit area because they are large enough to contain a substantial number of observations but small enough to capture both spatial diversity in the exact mix of practices used to treat a given physical effect and variation in the payment needed to leverage the application of these practices. In areas where data are sparse, some WTA estimates are calculated for larger watersheds.

A first step in calculating estimates of WTA is to identify practices that could be used to treat specific physical effects. Table 1 in the main text shows how treatments are linked to land use, physical effects, and resource concerns.

Cropland: Table A3.2 shows which practices are assigned to each treatments to estimate WTA. These groupings are drawn largely from Atwood, et al., 2003 and Atwood, et al., 2005. Grouping practices this way is not meant to infer that every farm would use every practice on every acre when addressing a specific physical effect. Rather, the WTA estimate for a given practice group in a given HUC reflects the frequency with which each practice within the group is used and local cost of applying these practices. For example, if conservation tillage is used frequently for soil erosion control in a given HUC while seasonal residue management is not used, the cost per acre will reflect the fact that conservation tillage is locally adapted while seasonal residue management is not.

The calculation of WTA must also consider whether individual practices can simultaneously treat more than one physical effect. Many soil erosion control practices can reduce both wind and water erosion. Because wind and water erosion occur under different conditions, the same practice can

be effective for both. Water erosion occurs during storm events when wind erosion is not a hazard, while wind erosion occurs when the soil surface is dry when water erosion is not a hazard. If both types of erosion control are needed, simply adding the estimated WTA for water and wind erosion control could lead to double-counting because some practices, included in estimates for both wind and water erosion control, would be applied only once. To account for this possibility, we define practices that are commonly used to address both wind and water erosion and the cost-savings if both are addressed on the same land.

Grazing land: A two-level screen is used to identify practices for grazing land treatments. First, we establish a set of practices that are commonly used on grazing land (table A3.3). Our list is drawn largely from Atwood et al., 2003 and Atwood et al., 2005 and augmented by information drawn from EQIP contract data (table A3.3). We assume that grazing land health is addressed by one of the practices on our list whenever it is associated with one of these NRCS classification codes[1]:

- Excessive erosion (PG1);
- Invasion of noxious weeds (PG2);
- Invasion of woody species (PG3);
- Other grazing land health issues (PG4);
- Loss of plant diversity – declining species (PP1);
- Plants not adapted to site (PP3);
- Insufficient water supply for livestock (WQ6).

For nutrient management and riparian erosion control, a similar set of practices is used (there is significant overlap), but practices are counted only when they appear with these NRCS classification codes:

- Animal waste, organics, and pathogens (WS2);
- Loss of riparian vegetation (WS6);
- Stream bank and shoreline erosion (WS8);
- Loss or degradation of riparian vegetation (PP2);
- Stream bank and shoreline erosion (PP4).

Because we cannot determine whether grazing land health concerns occur on the same acres as water quality concerns, we do not estimate payments to practices that address both. We do, however, exclude nutrient management practices where they are paired with livestock practices that involve waste handling structures and equipment typically found on large farms with confined animals. We exclude these contracts because they are more likely to reflect nutrient management costs on confined animal feeding operations (which is not our focus) than on grazing land (which is our focus).

Wildlife: We assume that wildlife habitat on working agricultural lands will be addressed primarily through use of Upland Wildlife Habitat Management

[1]NRCS refers to these as resource concerns. Because we have used the term "resource concern" to refer to the broader concerns of "water quality" or "air quality," we refer to these as NRCS classification codes to avoid confusion.

(NRCS practice code 645) and associated practices (listed in the national practice standard for Upland Wildlife Habitat Management, see table A3.4). When these associated practices occur in conjunction with any habitat-related NRCS classification code, they are used in the estimation of WTA for wildlife-related treatment. Some practices are assumed to be used only on grazing land acres (e.g., range planting), while we assume that others could be used on either cropland or grazing land (see table A3.4). Again, because we cannot determine whether wildlife concerns occur on the same acres as other physical effects, we do not estimate payments to practices that address wildlife in conjunction with other physical effects or resource concerns.

EQIP contract data for 2003-05 are used. All dollar amounts are adjusted to the beginning of fiscal year 2007 (October 1, 2006 through September 30, 2007) using the Gross Domestic Product (GDP) implicit price deflator. We also treat structural or vegetative practices differently from management practices due to differences in implementation. For structural and vegetative practices, EQIP payments are in the form of cost-sharing on actual (one-time) installation costs. For management practices, which must be re-applied each year, EQIP participants receive annual incentive payments for a 3-year period. These payments are designed to smooth the transition to the use of new management practices. Our estimate of WTA for specific practices is based on the cost-share payment to structural or vegetative practices, or the net present value of 3 years' worth of incentive payments on management practices. Discounting future costs at a rate of 7 percent, the net present value of the transition payment is equal to the annual payment times 2.62.

EQIP contract data indicates which practices have been used on a specific tract of land, how those practices were classified by NRCS, and the total number of acres treated (in all tracts associated with a given contract). Tract size is estimated as the total treated acres for the entire contract divided by the total number of tracts listed in the contract. Using this data, we calculate the average payment per acre for treating a specific physical effect as:

$$c_{kj}^{s} = \frac{\sum_{h \in k} \sum_{g} \sum_{t} x_{hgjt}^{s}}{\sum_{g} z_{g}}$$ for structural/vegetative practices and $$c_{kj}^{m} = \frac{\sum_{h \in k} \sum_{g} \sum_{t} d\, x_{hgjt}^{m}}{\sum_{g} z_{g}}$$

for management practices where

x_{hgjt}^{s} is expenditure for structural or vegetative practice *h* on tract g in use *j* at time *t* (already adjusted to 2007 dollars);

x_{hgjt}^{m} is expenditure for management practice *h* on tract g in use *j* at time *t* (already adjusted to 2007 dollars);

z_g is acreage in tract *g*;

d is a discount factor $d = r^{-1}(1-(1+r)^{-T}$ where r is the interest rate and T is the number of years the payment is made (d=2.62 for 7 percent discount rate over 3 years).

Note that location subscripts are suppressed to avoid clutter.

Formally, then, our estimate of WTA for treatment k on land in use j can be written as:

$$a_{kj}c_{kj} = a_{kj}(c_{kj}^{s} + c_{kj}^{m})$$

where a_{kj} is the number of treated acres. When practices overlap treatments (only between wind and water erosion) we define WTA as:

$$a_{kj}c_{kj} + a_{k'j}c_{k'j} - a_{kk'j}c_{kk'j}$$

$c_{kk'j}$ is the average EQIP expenditure, per treated acre, for practices in both group k and group k' on land use j;

$a_{kk'j}$ is the acreage that needs treatment practices in groups k and k' on land use j;

Again, note that estimates vary by HUC, but location subscripts are suppressed to avoid clutter.

Table A3.2

Practices for cropland

Code	Management	Practice name
Sheet and rill erosion only		
311	no	Alley cropping
330	yes	Contour farming
331	yes	Contour Orchard and other fruit area
386	no	Field border
410	no	Grade stabilization structure
585	yes	Contour strip-cropping
600	no	Terrace
638	no	Water and sediment control
716	yes	Anion polyacrylamide (PAM) erosion control.
741	no	Vegetative buffer strips
Wind erosion only		
380	no	Windbreak/shelterbelt establishment
392	no	Field windbreak
422A	no	Herbaceous wind barriers
422	no	Hedgerow planting
589A		yes Cross-wind ridges
589B	yes	Cross wind strip-cropping
589C	yes	Cross wind trap strips
609	yes	Surface roughening
612	no	Tree/shrub establishment
650	no	Windbreak/shelterbelt renovation
704	no	Agroforestry planting
Both sheet & rill and wind erosion		
328	yes	Conservation crop rotation
329A	yes	Residue management, no-till and strip till
329B	yes	Residue management, mulch till
329C	yes	Residue management, ridge till
340	yes	Cover crop
342	no	Critical area planting
344	yes	Residue management, seasonal
586	yes	Strip-cropping
758	yes	Strip–intercropping
Nutrient runoff/ leaching only		
590	yes	Nutrient management
Pesticide runoff/ leaching only		
595	yes	Pest management

Source: USDA Economic Research Service.

Table A3.3

Practices for grazing land

Code	Management	Practice name
Grazing land health only		
314	no	Brush management
338	yes	Prescribed burning
380	no	Windbreak/shelterbelt establishment
460	no	Land clearing
510	yes	Pasture and hayland management
512	no	Pasture and hay planting
528A	yes	Prescribed grazing
548	yes	Grazing land mechanical treatment
550	no	Range planting
612	no	Tree/shrub establishment
650	no	Windbreak/shelterbelt renovation
Water quality only		
590	yes	Nutrient management
Grazing land health and water quality		
382	no	Fence
472	no	Use exclusion
561	no	Heavy use area protection
574	no	Spring development
575	no	Animal trails and walkways
578	no	Stream crossing
614	no	Trough or tank
762	yes	Planned grazing system

Source: USDA Economic Research Service

Table A3.4

Practices for wildlife management

Code	Management	Practice name
Practices for use on grazing land		
338	yes	Prescribed burning
472	no	Use exclusion
512	no	Pasture and hay planting
528A	yes	Prescribed grazing
550	no	Range planting
612	no	Tree/shrub establishment
Practices for use on any land		
390	no	Riparian herbaceous cover
511	yes	Forage harvest management
643	no	Restoration of rare/declining habitat
645	yes	Upland wildlife management
647	no	Early successional habitat development
648	no	Wildlife watering facility

Source: USDA Economic Research Service.