2020

Phase III Conservation Measures Study: Tillage Survey Results

Prepared For:

CPNRD Central Platte Natural Resources District

Tri Basin Natural Resources District

Twin Platte Natural Resources District

Nebraska Department of Natural Resources

The Flatwater Group, Inc

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Phase III Conservation Measures Study - 2020 Tillage Survey Results

Twin Platte, Central Platte, and Tri-Basin NRD areas within the COHYST model domain

1. Introduction

1.1 Authorization

The Flatwater Group, Inc. (TFG) has prepared this report as authorized under Nebraska Department of Natural Resources (NeDNR) Contract 1153 between the Platte Basin Water Project Coalition (Basin Coalition) and TFG dated 11 December 2019.

1.2 Purpose and Scope

The Basin Coalition determined that in order to fulfill the requirements of *Nebraska Revised Statute §* 46-715 (5)(c) a study was necessary to assess the impacts of agricultural soil and water conservation measures on streamflow in the Platte River Basin (the Project). In Phase I of the Project, a general methodology to assess impacts that conservation measures have on streamflow of the Platte River and its tributaries was developed. In Phase II of the Project, a technical evaluation of conservation measure impacts to streamflow was conducted. Based on the results of those initial Phases, Phase III of the Project was developed to conduct a focused evaluation of tillage practices in the Platte River Basin portions of the Twin Platte, Central Platte, and Tri-Basin Natural Resource District (NRD) areas. This report summarizes the methods and results of the Phase III effort.

1.3 Acknowledgements

A number of individuals and organizations were essential in the successful completion of this project. The training and data collection support provided by personnel from the Nebraska State Office of the Natural Resources Conservation Service (NRCS) – specifically Brian Baskerville, Corey Brubaker, and Neil Dominy – in addition to previous survey route information provided by local county NRCS offices was greatly appreciated. Key to the success of this project were the efforts of the staffs of the Twin Platte NRD (TPNRD) (including their contractors), Central Platte NRD (CPNRD), and Tri-Basin NRD (TBNRD) – coordinated by Ann Dimmit (TPNRD), Brandi Flyr and Jesse Mintken (CPNRD), and John Thorburn and Nolan Little (TBNRD) – to collect the survey data in the field.

2. Study Area

The current study was focused in the Platte River Basin areas of the TPNRD, CPNRD, and TBNRD as shown on Figure 1.

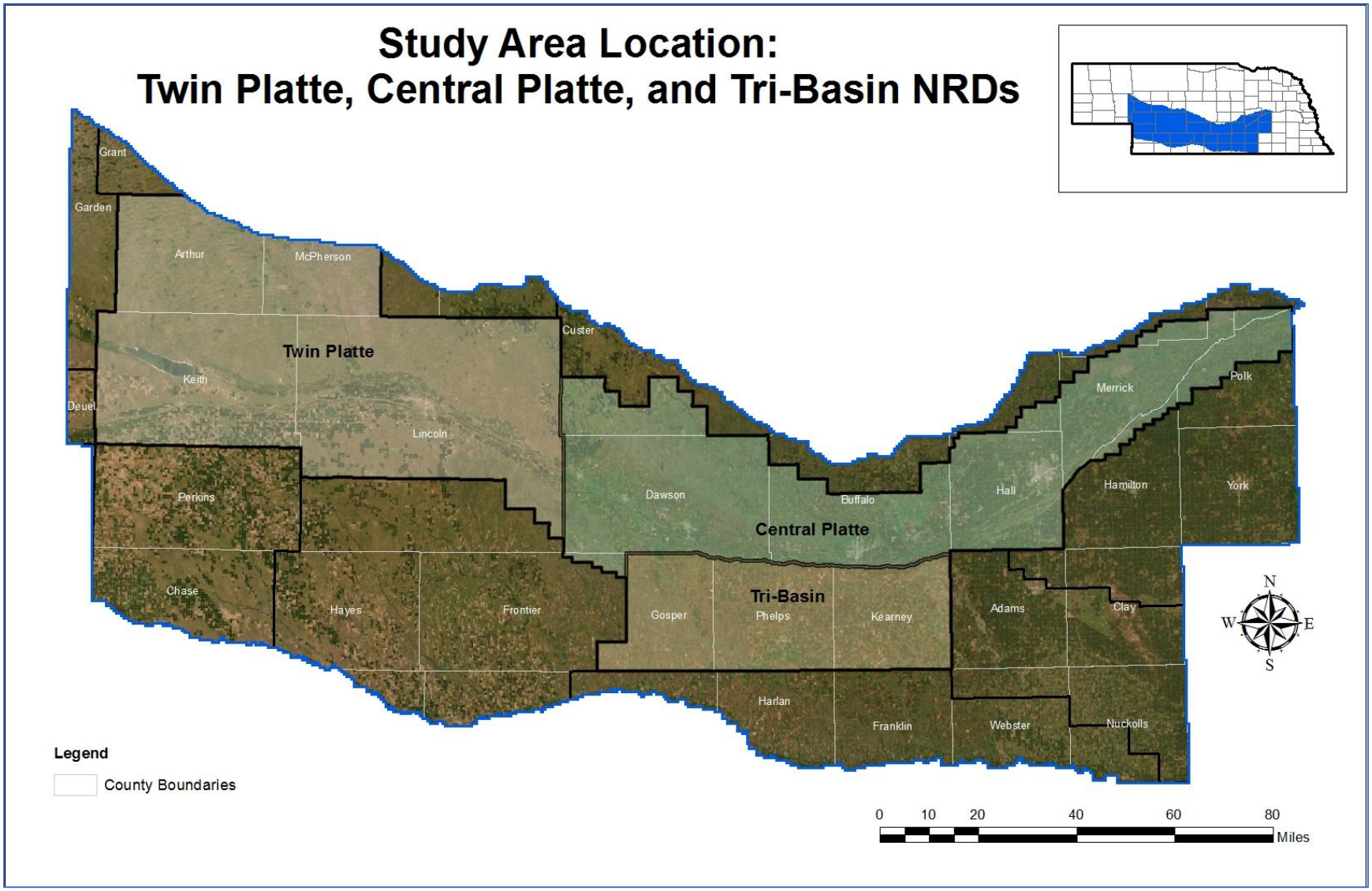

Figure 1: Study Area Location

3. Study Methodology

3.1 Protocols

The Phase III Tillage Survey was conducted in accordance with the 2002 Conservation Technology Information Center (CTIC) cropland roadside transect survey procedures (see Appendix A). The procedures outline the methods used to gather information on tillage and residue management systems via roadside transect surveys. Specifically, the surveys are designed to:

1. Provide information that can be used by individual soil and water conservation districts and others in establishing priorities for educational or other programs;
2. Evaluate progress achieved in reaching county or statewide conservation goals;
3. Provide accurate data on the adoption of conservation tillage systems by crop.

When conducted according to the adopted protocols, the process allows users to have a high degree of confidence in the survey results (per the 2002 procedures document, users can have a minimum of a 90% level of confidence in the accuracy of the results).

Tillage practice classifications used in the 2020 survey were defined by CTIC and are recognized as industry standard definitions. They are used nationwide and align with classifications used in previous tillage surveys conducted in the study area. The classifications used and their definitions are listed below:

No-Till – The soil is left undisturbed from harvest to planting. Planting or drilling is accomplished using disc openers, coulter(s), row cleaners, or in-row chisels. Weed control is accomplished with crop protection products. Crop residue coverage is over 50% following crop planting operations.

Strip-Till – The soil is left undistributed from harvest to planting except for strips up to 1/3 the row width. Planting or drilling is accomplished using disc openers, coulter(s), row cleaners, in-row chisels, or rototillers. Weed control is primarily accomplished with crop protection products. Crop residue coverage is over 30% following planting operations.

Ridge-Till – The soil is left undisturbed from harvest to planting except for the top 1-2 inches of the previous crop ridge removed. Planting is completed on the ridge with the use of sweeps, disk openers, coulters, or row cleaners with the residue being left on the surface between the ridges. Weed control is accomplished with crop protection products (frequently banded) and/or cultivation which rebuilds the crop ridge. Crop residue coverage is over 30% following planting operations.

Mulch-Till – Full width tillage that involves one or more tillage operations. The entire field is tilled prior to and/or during planting. Weed control is accomplished with crop protection products and/or row cultivation. Crop residue coverage is over 30% following planting operations.

Reduced-Till - Full width tillage that involves one or more tillage operations. The entire field is tilled prior to and/or during planting. Weed control is accomplished with crop protection products and/or row cultivation. Crop residue coverage ranges from 15% to 30% following planting operations.

Conventional-Till - Full width tillage that involves one or more tillage operations. The entire field is tilled prior to and/or during planting. Weed control is accomplished with crop protection products and/or row cultivation. Crop residue coverage is less than 15% following planting operations.

3.2 Process

A major goal of the 2020 survey was to maintain data collection methods consistent with previous survey efforts in order to build upon the database of previously collected information. This existing dataset was collected by local and state NRCS personnel in cooperation with CTIC. To maximize the efficiency of the 2020 survey, the current project team reached out to the NRCS for data collection and training assistance.

Local NRCS offices were contacted by the area NRDs to obtain previous survey route information for use in the 2020 effort. These routes were then extended/modified as necessary in order to satisfy the sampling threshold specified in the 2002 CTIC procedures document. The tillage observation points surveyed along the final route used for the project are shown on Figure 2.

State NRCS personnel were also contacted. Due to travel and meeting restrictions related to COVID-19, in person trainings/meetings were not possible prior to the start of the survey effort. Therefore an initial online training session was conducted by the NRCS on 9 April 2020 with a follow up online training held on 30 April 2020. The trainings were focused on reviewing the CTIC data collection protocols with several visual examples of tillage residue remaining after various tillage operations, discussions and examples of how to measure residue coverage in the field, and an overview of a mobile device application that was used to facilitate data entry into a cloud based data management platform.

Use of the cloud-based software package simplified the in-field record keeping process. Survey routes were loaded into the system via ESRI® ArcGIS shapefiles and pre-populated with sampling points spaced on either ½ mile or 1-mile distances apart depending on the county. These points were then downloaded onto global positioning system (GPS) enabled mobile devices running Trimble's® Terraflex™ software such that a surveyor could follow the established route map on the GPS device and populate a survey point as they were encountered on the route. It is important to note that the points were not geographically placed on the exact field surveyed; rather, the point was used to facilitate proper distancing between survey locations and to pre-populate point names to facilitate data management. At each point, survey crews attempted to select the most representative cropland area in the vicinity of the point to enter survey data about. Survey data was entered into forms programmed into Terraflex™ which were designed by the project team to allow for the entry of the following information about each point:

- County (auto-populated based on pre-processing of survey point GPS coordinates)
- Site Number (auto-populated based on route pre-processing)
- Land Use – Drop down menu with the following options:
    - Built Up / Farmstead
    - Pasture

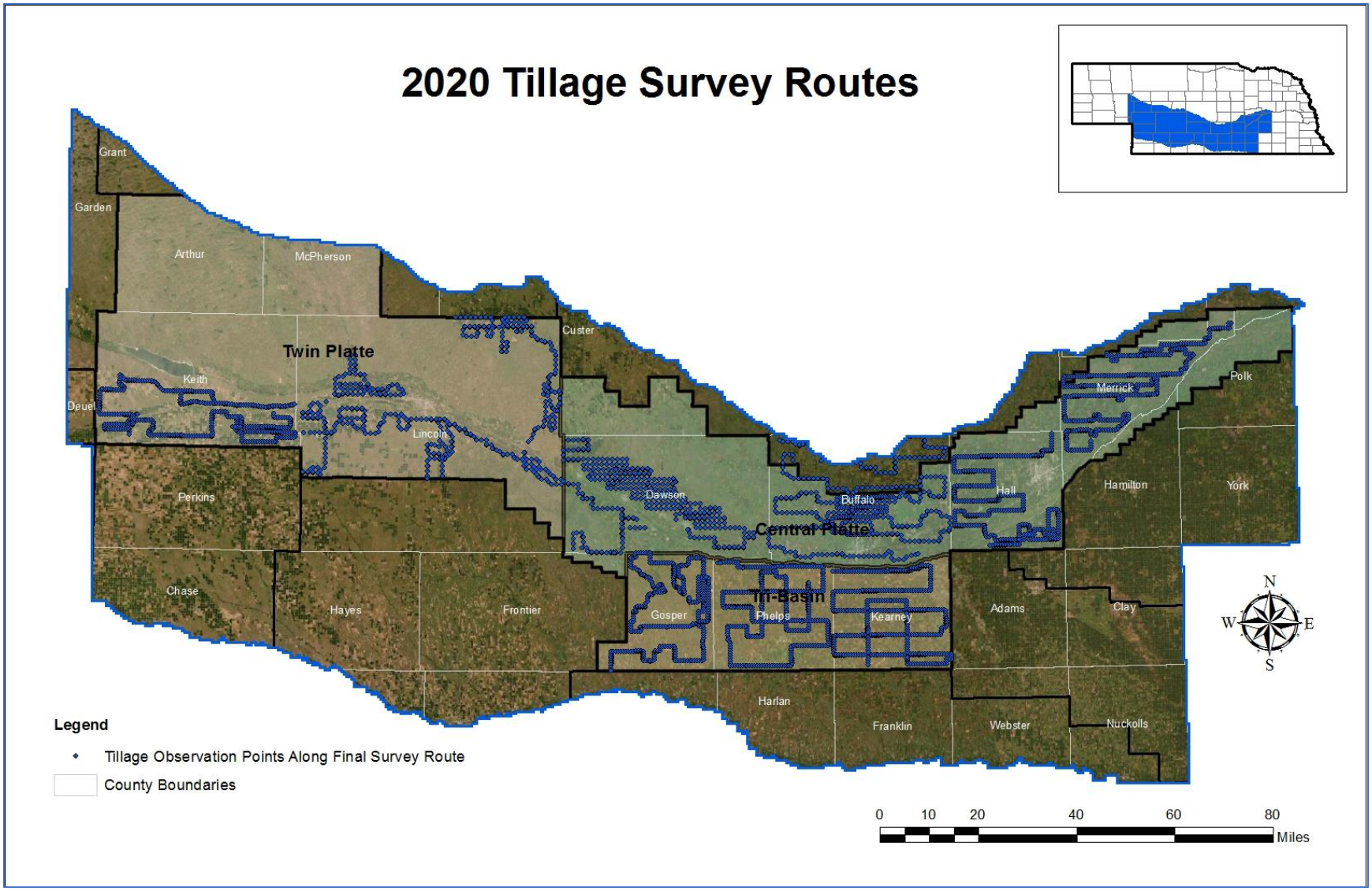

Figure 2: 2020 Tillage Survey Routes

    - Range
    - Windbreak / Forest
    - Crop
- Crop – Refers to the crop being planted, not the existing residue. Drop down menu activated if "Land Use = Crop" with the following:
    - Barley
    - Corn
    - Fallow
    - Oats
    - Other
    - Rye
    - Soybeans
    - Sugarbeets
    - Winter Wheat
- Tillage System Observed – Drop down menu activated if "Land Use = Crop" with the following:
    - No-Till
    - Strip-Till > 30%
    - Ridge-Till > 30%
    - Mulch-Till > 30%
    - Reduced-Till 15-30%
    - Conventional-Till <15%
    - Unknown/NA
- Cover Crops Present – Yes/No toggle
- Terraces Present – Yes/No toggle
- Notes – Optional field allowing for the entry of field observation notes

Figure 3 provides a snapshot of the data entry screens for the TerraFlex™ application. Survey information entered into the individual TerraFlex™ applications used by each surveyor was then uploaded to Trimble's® cloud-based data management software package InSphere™ which provided a web based platform for the centralized management of the project's data. Figure 4 provides a snapshot of the InSphere™ interface.

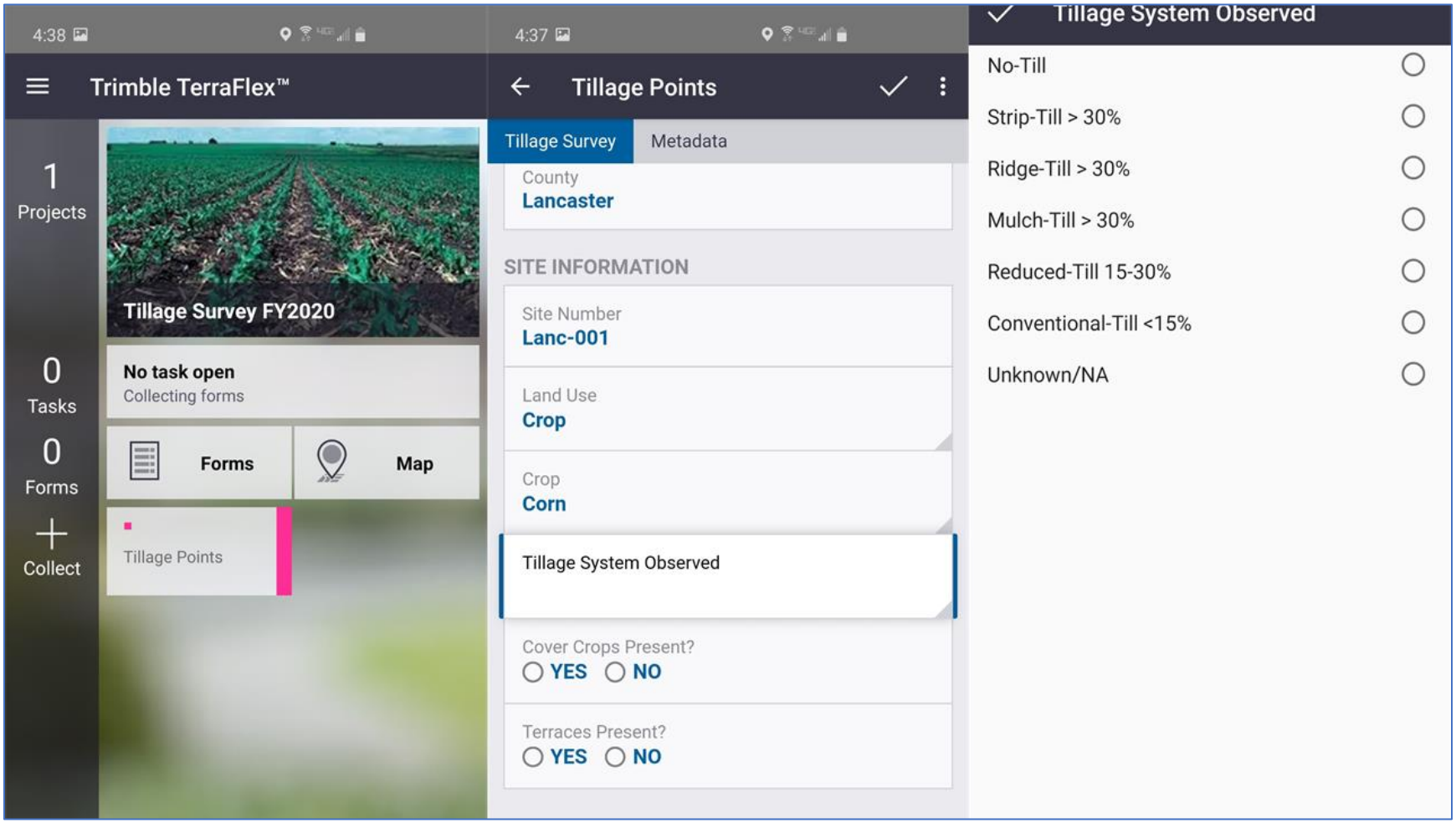

Figure 3: Terraflex™ Data Entry Application

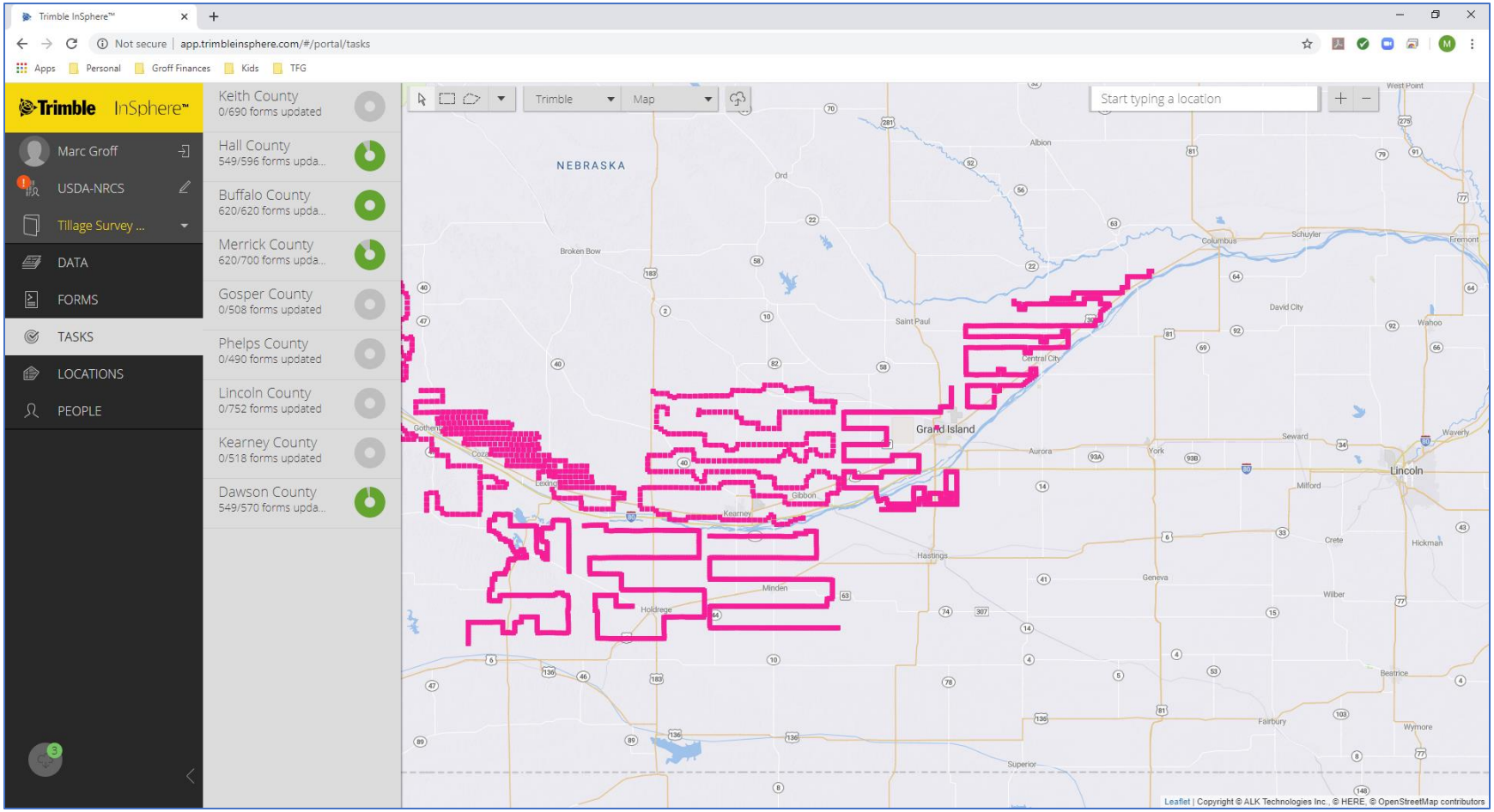

Figure 4: InSphere™ Data Management Web Platform

Following the establishment of the initial survey routes and project team trainings, NRD staff (and, in the case of the TPNRD, their contractors) began data collection efforts in late May and were finished by mid-June.

4. Study Results

The survey transects were designed to allow for evaluation of tillage systems being used on cropland. Figures 5-7 provide a view of the final routes in comparison to the density of irrigated, non-irrigated, and total cropland, respectively, from the 2013 land use dataset incorporated into the recently completed Robust Review project. The figures show the number of cultivated acres per 160-acre model cell for each class of cropland (i.e. the number of irrigated, non-irrigated, or total cultivated acres per model cell) overlayed with the 2020 tillage survey points.

Over 6,000 data points were collected during the project. Table 1 provides a summary by NRD and county showing how many of those points were from cropland areas versus other land use classifications. Per the 2002 CTIC procedures, a minimum of 460 cropland sites per county were desired. This goal was met for every county except for Gosper where as much data as was practical was collected due to the relatively low amount (when compared to the other counties in the survey) of cropland acreage in the county. The table also shows there were a few records removed due to QC issues. These issues were primarily related to records which had incomplete information populated into the database (e.g. null values entered for required fields).

Tables 2 – 10 provide county level summaries of the tillage type classifications by crop and also, for general reference, a crop acreage summary. Each table has an 'A', 'B', and 'C' component. The 'A' tables present the distribution of tillage type classifications for each of the cropland sites identified in Table 1. The 'B' tables summarize the percentage of each tillage type by crop calculated per the 2002 CTIC procedures. The 'C' tables summarize by crop the number of irrigated, non-irrigated, and total number of acres for the year 2013 included in the recently completed Robust Review.

In addition to the summarized results contained in this report, a geodatabase (FY2020_Tillage.gdb) containing GIS coverages of the survey routes and the data collected is available and has been enclosed with the final submittal. The terrace and cover crop survey information collected is included within this database for potential future use. Should this study be repeated in the future, notes regarding "lessons learned" during this effort have been compiled and are included in Appendix B.

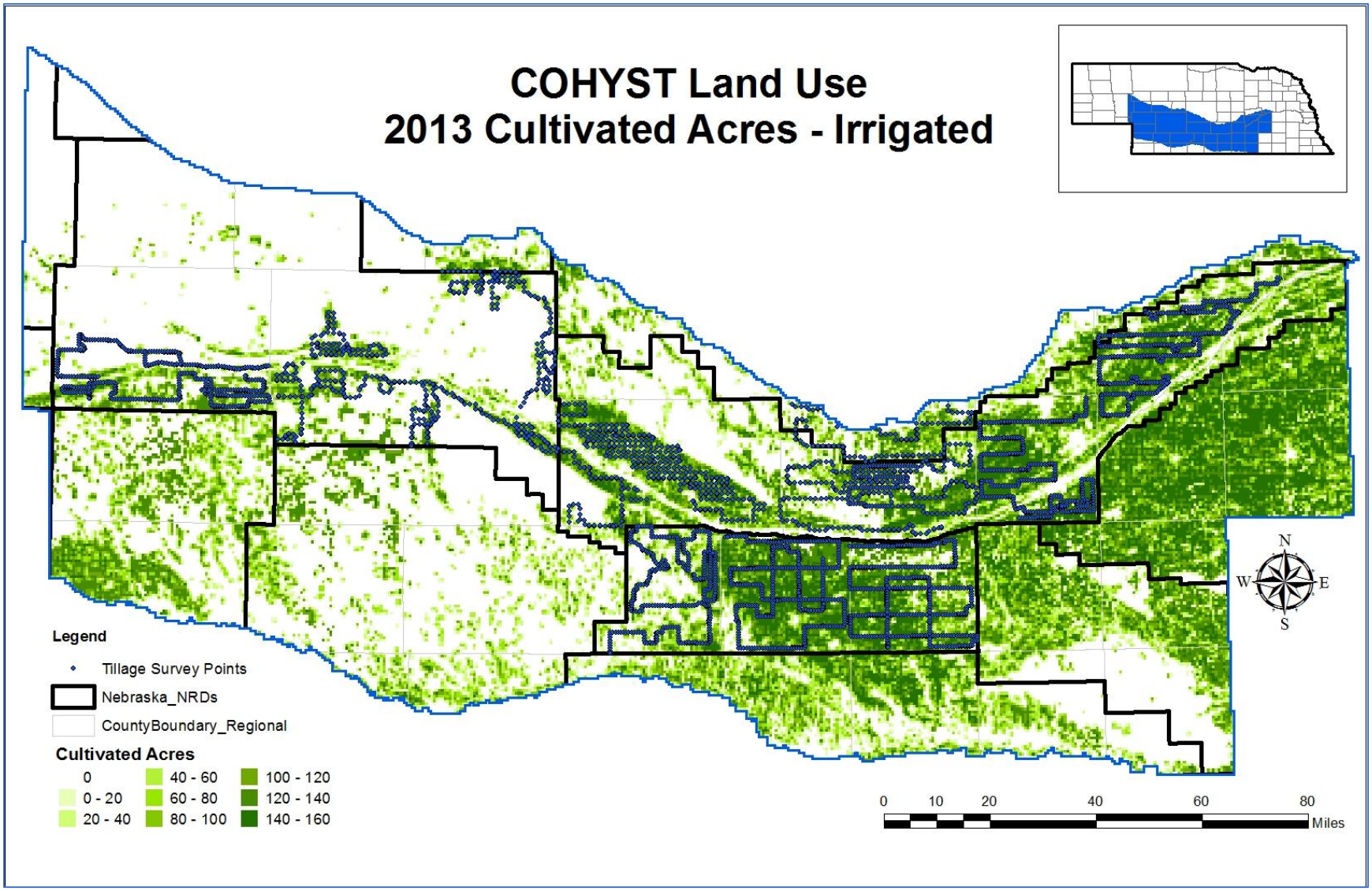

Figure 5: 2020 Tillage Survey Points with 2013 Irrigated Acreage

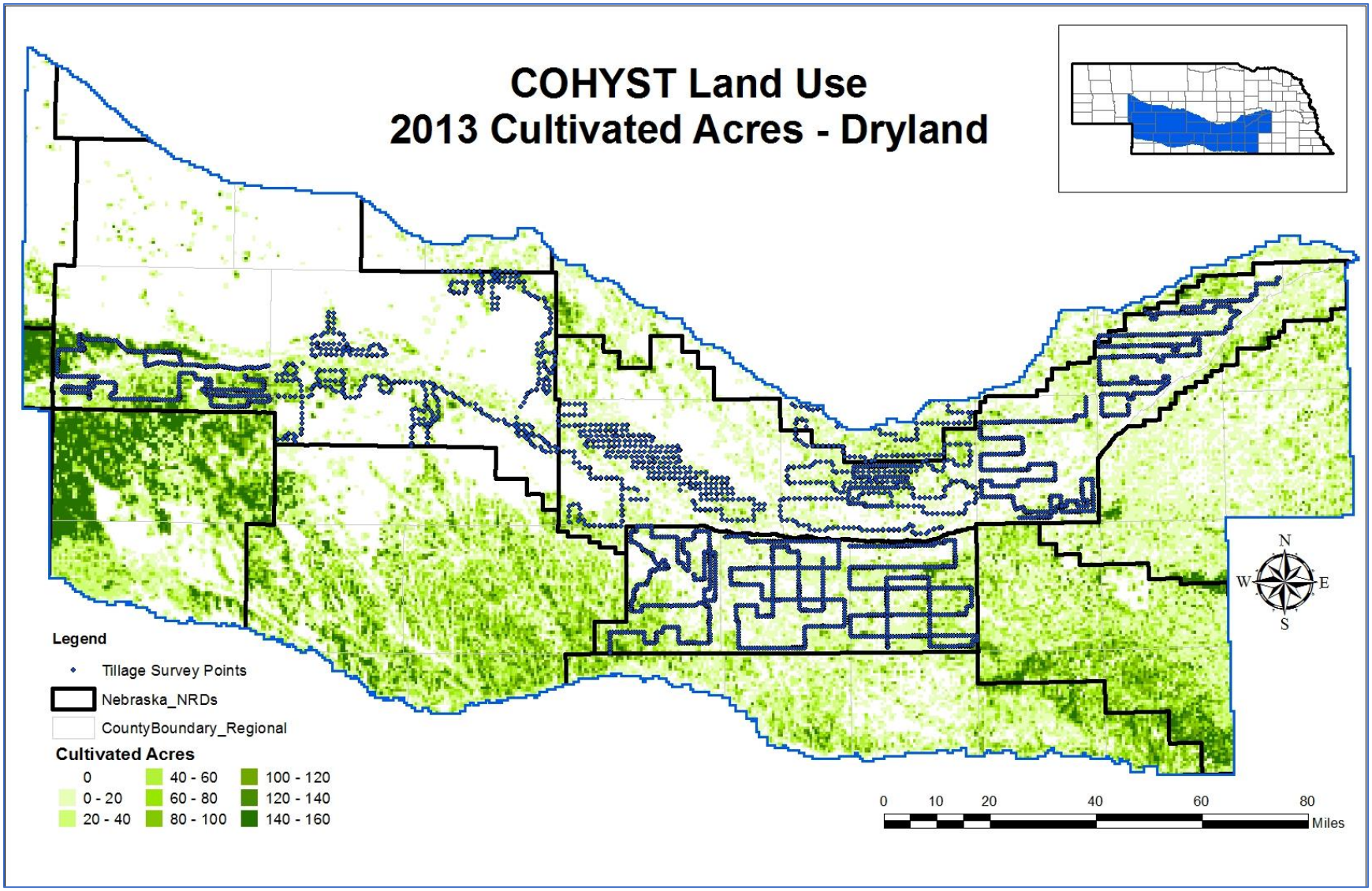

Figure 6: 2020 Tillage Survey Points with 2013 Non-Irrigated Acreage

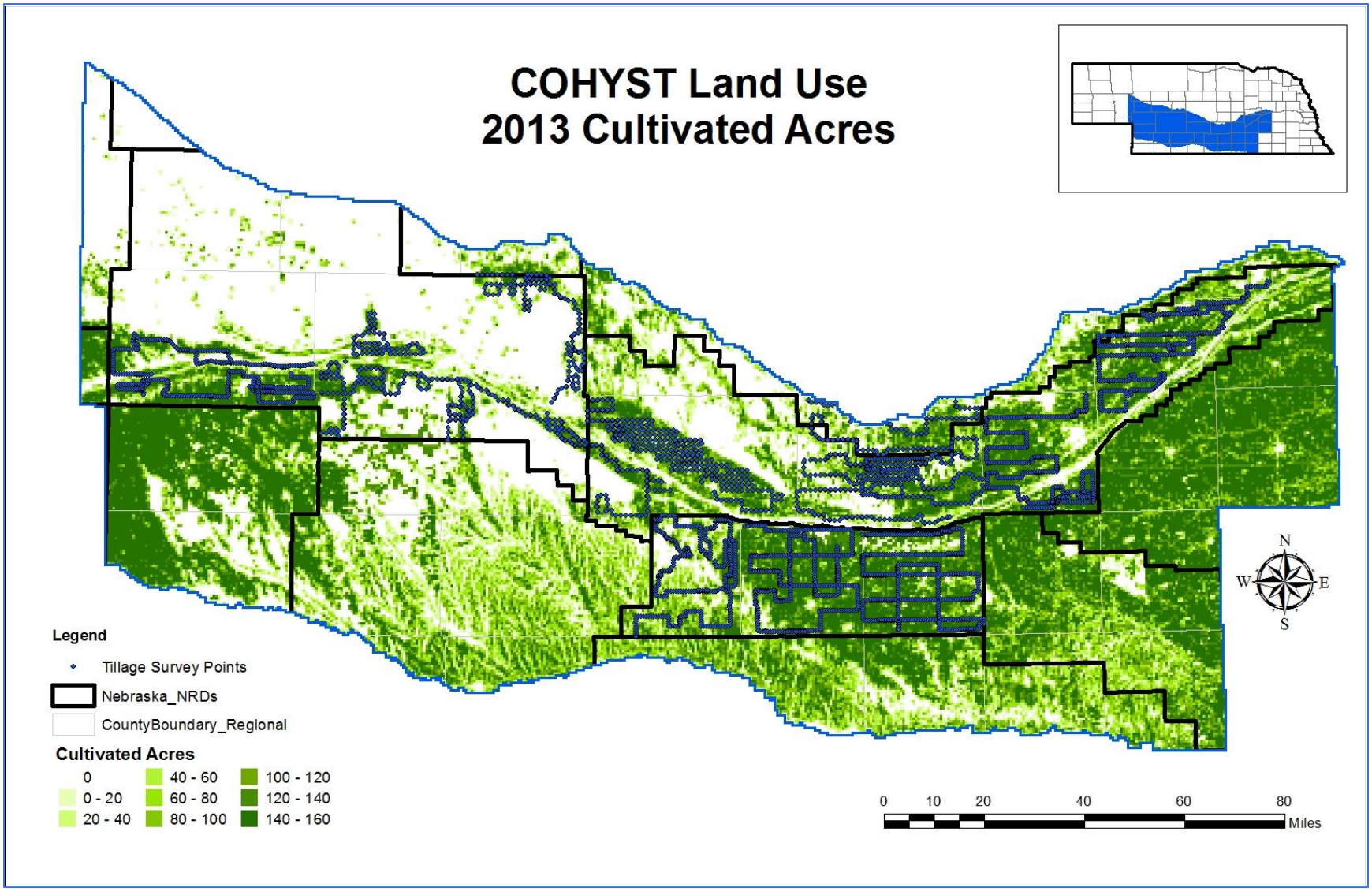

Figure 7: 2020 Tillage Survey Points with 2013 Total Cultivated Acreage

Table 1 - 2020 Conservation Study Field Work Summary

NRD	County	Total Number of Sites	Number of Cropland Sites	Number of Farmstead/Pasture/Range/ Windbreak Sites	Number of Sites Removed Due to QC Issues
Twin Platte NRD					
	Keith	690	538	149	3
	Lincoln	752	460	285	7
Tri-Basin NRD					
	Gosper	608	379	227	2
	Phelps	646	525	121	0
	Kearney	688	555	133	0
Central Platte NRD					
	Buffalo	806	551	246	9
	Merrick	700	524	164	12
	Dawson	573	464	96	13
	Hall	596	525	62	9
Totals		6,059	4,521	1,483	55

Table 2A - Cropland Site Count Matrix - Keith County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Barley	0	0	1	0	0	0	0	1
Corn	9	98	181	11	2	33	0	334
Fallow	7	0	34	0	0	0	5	46
Oats	2	0	1	0	0	0	0	3
Other	0	0	3	1	0	0	11	15
Rye	2	0	0	0	0	0	0	2
Soybeans	1	24	50	3	0	7	0	85
Sugarbeets	0	3	2	0	0	0	0	5
Wheat-Winter	31	1	1	14	0	0	0	47
Grand Total	52	126	273	29	2	40	16	538

Table 2B - Cropland Site Percentage Matrix - Keith County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Barley	0%	0%	100%	0%	0%	0%	0%	100%
Corn	3%	29%	54%	3%	1%	10%	0%	100%
Fallow	15%	0%	74%	0%	0%	0%	11%	100%
Oats	67%	0%	33%	0%	0%	0%	0%	100%
Other	0%	0%	20%	7%	0%	0%	73%	100%
Rye	100%	0%	0%	0%	0%	0%	0%	100%
Soybeans	1%	28%	59%	4%	0%	8%	0%	100%
Sugarbeets	0%	60%	40%	0%	0%	0%	0%	100%
Wheat-Winter	66%	2%	2%	30%	0%	0%	0%	100%
Grand Total	10%	23%	51%	5%	0%	7%	3%	100%

Table 2C - 2013 Robust Review Landuse Summary - Keith County

	Dryland		Irrigated		Total	
Crop	**Acres**	**% of Acres**	**Acres**	**% of Acres**	**Acres**	**% of Acres**
Alfalfa	2,905	1%	7,080	7%	9,985	1%
Corn	38,081	7%	85,376	79%	123,457	18%
Fallow	33,439	6%	0	0%	33,439	5%
Miscellaneous	23,829	4%	0	0%	23,829	4%
Pasture	417,929	74%	0	0%	417,929	62%
Sorghum	606	0%	126	0%	732	0%
Soybeans	82	0%	12,479	12%	12,561	2%
Winter Wheat	46,565	8%	3,023	3%	49,588	7%

Table 3A - Cropland Site Count Matrix - Lincoln County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Barley	0	0	1	0	0	0	0	1
Corn	8	68	125	22	10	61	1	295
Fallow	2	0	0	1	0	1	1	5
Oats	4	0	5	4	0	0	0	13
Other	13	0	0	0	0	0	27	40
Rye	9	0	0	1	0	0	0	10
Soybeans	1	20	50	8	5	9	0	93
Wheat-Winter	2	0	0	1	0	0	0	3
Grand Total	39	88	181	37	15	71	29	460

Table 3B - Cropland Site Percentage Matrix - Lincoln County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Barley	0%	0%	100%	0%	0%	0%	0%	100%
Corn	3%	23%	42%	7%	3%	21%	0%	100%
Fallow	40%	0%	0%	20%	0%	20%	0%	100%
Oats	31%	0%	38%	31%	0%	0%	0%	100%
Other	33%	0%	0%	0%	0%	0%	63%	100%
Rye	90%	0%	0%	10%	0%	0%	0%	100%
Soybeans	1%	22%	54%	9%	5%	10%	0%	100%
Wheat-Winter	67%	0%	0%	33%	0%	0%	0%	100%
Grand Total	8%	19%	39%	8%	3%	15%	6%	100%

Table 3C - 2013 Robust Review Landuse Summary - Lincoln County

	Dryland		Irrigated		Total	
Crop	**Acres**	**% of Acres**	**Acres**	**% of Acres**	**Acres**	**% of Acres**
Alfalfa	21,507	2%	22,757	12%	44,264	4%
Corn	33,639	3%	127,471	70%	161,110	14%
Fallow	10,655	1%	0	0%	10,655	1%
Miscellaneous	96,479	10%	0	0%	96,479	8%
Pasture	829,338	82%	639	0%	829,977	70%
Sorghum	729	0%	329	0%	1,058	0%
Soybeans	2,201	0%	27,761	15%	29,962	3%
Winter Wheat	14,361	1%	3,494	2%	17,855	1%

Table 4A - Cropland Site Count Matrix - Gosper County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	9	9	9	9	9	9	0	242
Fallow	9	9	9	9	9	9	0	2
Other	9	9	9	9	9	9	0	16
Soybeans	9	9	9	9	9	9	0	101
Wheat-Spring	9	9	9	9	9	9	0	6
Wheat-Winter	9	9	9	9	9	9	0	12
Grand Total	9	9	9	9	9	9	0	379

Table 4B - Cropland Site Percentage Matrix - Gosper County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	4%	15%	34%	3%	9%	36%		100%
Fallow	0%	0%	100%	0%	0%	0%		100%
Other	6%	0%	88%	0%	0%	6%		100%
Soybeans	2%	7%	55%	1%	3%	32%		100%
Wheat-Spring	33%	17%	50%	0%	0%	0%		100%
Wheat-Winter	0%	0%	100%	0%	0%	0%		100%
Grand Total	4%	12%	45%	2%	6%	31%		100%

Table 4C - 2013 Robust Review Landuse Summary - Gosper County

	Dryland		Irrigated		Total	
Crop	**Acres**	**% of Acres**	**Acres**	**% of Acres**	**Acres**	**% of Acres**
Alfalfa	6,537	3%	3,010	3%	9,547	3%
Corn	13,277	7%	67,036	68%	80,313	27%
Fallow	1,918	1%	0	0%	1,918	1%
Miscellaneous	17,796	9%	0	0%	17,796	6%
Pasture	134,845	68%	233	0%	135,078	45%
Sorghum	1,766	1%	47	0%	1,813	1%
Soybeans	7,825	4%	26,450	27%	34,274	12%
Winter Wheat	14,985	8%	1,236	1%	16,221	5%

Table 5A - Cropland Site Count Matrix - Phelps County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	26	61	111	80	12	60	2	352
Other	1	1	19	0	1	2	2	26
Rye	0	0	1	0	0	0	0	1
Soybeans	3	14	66	32	4	19	0	138
Wheat-Spring	0	0	1	0	0	0	1	2
Wheat-Winter	0	0	3	1	0	0	2	6
Grand Total	30	76	201	113	17	81	7	525

Table 5B - Cropland Site Percentage Matrix - Phelps County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	7%	17%	32%	23%	3%	17%	1%	100%
Other	4%	4%	73%	0%	4%	8%	8%	100%
Rye	0%	0%	100%	0%	0%	0%	0%	100%
Soybeans	2%	10%	48%	23%	3%	14%	0%	100%
Wheat-Spring	0%	0%	50%	0%	0%	0%	50%	100%
Wheat-Winter	0%	0%	50%	17%	0%	0%	33%	100%
Grand Total	6%	14%	38%	22%	3%	15%	1%	100%

Table 5C - 2013 Robust Review Landuse Summary - Phelps County

	Dryland		Irrigated		Total	
Crop	**Acres**	**% of Acres**	**Acres**	**% of Acres**	**Acres**	**% of Acres**
Alfalfa	4,538	5%	3,204	1%	7,742	2%
Corn	9,990	11%	158,726	64%	168,716	49%
Fallow	295	0%	0	0%	295	0%
Miscellaneous	16,647	18%	0	0%	16,647	5%
Pasture	52,602	56%	292	0%	52,894	15%
Sorghum	799	1%	337	0%	1,135	0%
Soybeans	5,953	6%	85,970	34%	91,923	27%
Winter Wheat	2,693	3%	1,314	1%	4,007	1%

Table 6A - Cropland Site Count Matrix - Kearney County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	31	1	94	56	5	136	0	323
Fallow	1	0	0	0	0	0	0	1
Other	0	0	23	4	0	1	0	28
Soybeans	10	4	121	20	3	32	0	190
Wheat-Winter	0	0	13	0	0	0	0	13
Grand Total	42	5	251	80	8	169	0	555

Table 6B - Cropland Site Percentage Matrix - Kearney County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	10%	0%	29%	17%	2%	42%	0%	100%
Fallow	100%	0%	0%	0%	0%	0%	0%	100%
Other	0%	0%	82%	14%	0%	4%	0%	100%
Soybeans	5%	2%	64%	11%	2%	17%	0%	100%
Wheat-Winter	0%	0%	100%	0%	0%	0%	0%	100%
Grand Total	8%	1%	45%	14%	1%	30%	0%	100%

Table 6C - 2013 Robust Review Landuse Summary - Kearney County

	Dryland		Irrigated		Total	
Crop	**Acres**	**% of Acres**	**Acres**	**% of Acres**	**Acres**	**% of Acres**
Alfalfa	6,719	6%	9,635	4%	16,354	5%
Corn	20,391	19%	137,431	62%	157,822	48%
Fallow	1,550	1%	0	0%	1,550	0%
Miscellaneous	15,321	14%	0	0%	15,321	5%
Pasture	44,280	40%	231	0%	44,511	13%
Sorghum	107	0%	44	0%	151	0%
Soybeans	11,341	10%	73,058	33%	84,399	25%
Winter Wheat	10,023	9%	1,710	1%	11,733	4%

Table 7A - Cropland Site Count Matrix - Buffalo County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	78	34	56	54	33	147	2	404
Other	0	0	1	0	0	0	1	2
Rye	0	0	0	1	0	0	0	1
Sorghum	1	1	0	1	0	0	0	3
Soybeans	12	9	59	16	8	36	0	140
Wheat-Spring	1	0	0	0	0	0	0	1
Grand Total	92	44	116	72	41	183	3	551

Table 7B - Cropland Site Percentage Matrix - Buffalo County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	19%	8%	14%	13%	8%	36%	0%	100%
Other	0%	0%	50%	0%	0%	0%	50%	100%
Rye	0%	0%	0%	100%	0%	0%	0%	100%
Sorghum	33%	33%	0%	33%	0%	0%	0%	100%
Soybeans	9%	6%	42%	11%	6%	26%	0%	100%
Wheat-Spring	100%	0%	0%	0%	0%	0%	0%	100%
Grand Total	17%	8%	21%	13%	7%	33%	1%	100%

Table 7C - 2013 Robust Review Landuse Summary - Buffalo County

	Dryland		Irrigated		Total	
Crop	**Acres**	**% of Acres**	**Acres**	**% of Acres**	**Acres**	**% of Acres**
Alfalfa	13,811	6%	9,138	5%	22,950	6%
Corn	14,792	7%	120,225	69%	135,018	34%
Fallow	904	0%	0	0%	904	0%
Miscellaneous	39,291	17%	0	0%	39,291	10%
Pasture	142,942	63%	112	0%	143,054	36%
Sorghum	1,189	1%	378	0%	1,567	0%
Soybeans	8,464	4%	43,181	25%	51,646	13%
Winter Wheat	3,732	2%	1,039	1%	4,772	1%

Table 8A - Cropland Site Count Matrix - Merrick County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	63	16	48	15	56	153	0	351
Fallow	1	0	8	1	0	0	0	10
Other	1	0	0	0	0	4	1	6
Rye	3	0	1	0	0	1	0	5
Sorghum	1	0	0	0	0	0	0	1
Soybeans	12	8	24	16	31	57	1	149
Wheat-Winter	0	0	1	0	0	0	1	2
Grand Total	81	24	82	32	87	215	3	524

Table 8B - Cropland Site Percentage Matrix - Merrick County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	18%	5%	14%	4%	16%	44%	0%	100%
Fallow	10%	0%	80%	10%	0%	0%	0%	100%
Other	17%	0%	0%	0%	0%	67%	17%	100%
Rye	60%	0%	20%	0%	0%	20%	0%	100%
Sorghum	100%	0%	0%	0%	0%	0%	0%	100%
Soybeans	8%	5%	16%	11%	21%	38%	1%	100%
Wheat-Winter	0%	0%	50%	0%	0%	0%	50%	100%
Grand Total	15%	5%	16%	6%	17%	41%	1%	100%

Table 8C - 2013 Robust Review Landuse Summary - Merrick County

	Dryland		Irrigated		Total	
Crop	**Acres**	**% of Acres**	**Acres**	**% of Acres**	**Acres**	**% of Acres**
Alfalfa	2,725	2%	2,022	1%	4,747	2%
Corn	9,258	8%	121,216	67%	130,474	44%
Fallow	290	0%	0	0%	290	0%
Miscellaneous	27,192	23%	0	0%	27,192	9%
Pasture	71,558	61%	939	1%	72,498	24%
Sorghum	15	0%	72	0%	86	0%
Soybeans	4,480	4%	54,850	31%	59,330	20%
Winter Wheat	1,686	1%	658	0%	2,344	1%

Table 9A - Cropland Site Count Matrix - Dawson County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	59	13	25	46	28	185	1	357
Other	2	0	0	0	0	0	0	2
Sorghum	0	1	0	0	0	0	0	1
Soybeans	10	4	14	9	16	49	0	102
Wheat-Spring	1	0	0	1	0	0	0	2
Grand Total	72	18	39	56	44	234	1	464

Table 9B - Cropland Site Percentage Matrix - Dawson County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	17%	4%	7%	13%	8%	52%	0%	100%
Other	100%	0%	0%	0%	0%	0%	0%	100%
Sorghum	0%	100%	0%	0%	0%	0%	0%	100%
Soybeans	10%	4%	14%	9%	16%	48%	0%	100%
Wheat-Spring	50%	0%	0%	50%	0%	0%	0%	100%
Grand Total	16%	4%	8%	12%	9%	50%	0%	100%

Table 9C - 2013 Robust Review Landuse Summary - Dawson County

	Dryland		Irrigated		Total	
Crop	**Acres**	**% of Acres**	**Acres**	**% of Acres**	**Acres**	**% of Acres**
Alfalfa	15,359	4%	27,812	10%	43,171	7%
Corn	14,793	4%	188,817	69%	203,610	31%
Fallow	1,267	0%	0	0%	1,267	0%
Miscellaneous	40,897	11%	0	0%	40,897	6%
Pasture	289,226	77%	252	0%	289,477	45%
Sorghum	1,766	0%	219	0%	1,986	0%
Soybeans	4,166	1%	53,831	20%	57,997	9%
Winter Wheat	6,180	2%	2,616	1%	8,796	1%

Table 10A - Cropland Site Count Matrix - Hall County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	102	24	34	131	32	124	0	447
Fallow	0	0	1	0	0	0	0	1
Oats	0	0	0	1	0	0	0	1
Other	1	0	0	1	0	2	1	5
Soybeans	8	10	19	16	4	14	0	71
Grand Total	111	34	54	149	36	140	1	525

Table 10B - Cropland Site Percentage Matrix - Hall County

Crop	Conventional-Till <15%	Mulch-Till > 30%	No-Till	Reduced-Till 15-30%	Ridge-Till > 30%	Strip-Till > 30%	Unknown /NA	Grand Total
Corn	23%	5%	8%	29%	7%	28%	0%	100%
Fallow	0%	0%	100%	0%	0%	0%	0%	100%
Oats	0%	0%	0%	100%	0%	0%	0%	100%
Other	20%	0%	0%	20%	0%	40%	20%	100%
Soybeans	11%	14%	27%	23%	6%	20%	0%	100%
Grand Total	21%	6%	10%	28%	7%	27%	0%	100%

Table 10C - 2013 Robust Review Landuse Summary - Hall County

	Dryland		Irrigated		Total	
Crop	**Acres**	**% of Acres**	**Acres**	**% of Acres**	**Acres**	**% of Acres**
Alfalfa	5,128	4%	3,588	2%	8,716	2%
Corn	11,388	8%	174,977	82%	186,365	53%
Fallow	1,033	1%	0	0%	1,033	0%
Miscellaneous	33,678	25%	0	0%	33,678	10%
Pasture	77,208	57%	121	0%	77,329	22%
Sorghum	14	0%	0	0%	14	0%
Soybeans	3,454	3%	33,811	16%	37,265	11%
Winter Wheat	3,731	3%	1,630	1%	5,361	2%

Appendix A – 2002 CTIC Cropland Roadside Transect Survey Procedures

Revised & Simplified
Cropland Roadside Transect Survey

2002

Procedures for Using the
Cropland Roadside Transect Survey
for Obtaining Tillage/Crop Residue Data

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A special thanks to Purdue University, Cooperative Extension Service, Water Quality Section for developing the original transect instructions.

Procedures for Using the
Revised & Simplified
Cropland Roadside Transect Survey
for Obtaining 2002 Tillage/Crop Residue Data

Introduction

The cropland roadside transect survey method is designed to gather information on tillage and crop residue management systems. The 2002 crop-year driving transect will be targeted in counties with 100,000 or more planted cropland acres in following States: Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Texas, and Wisconsin. Other states and counties are encouraged to conduct a driving transect but the experience has been that counties with a grid road system, those with fields readily visible from the road, where crops are planted in a relatively short period of time, and where conservation tillage is being adopted are the most likely candidates for a transect. Cropland in these seventeen States represents about 238 million acres or about 80% of all cropland acres.

Crops, soils, and climate interaction dictate to some degree the adoption of high residue systems. Adoption of conservation tillage dramatically reduces nonpoint pollution, enhances soil quality, and enhances carbon accumulation in the soil. Some Midwest states have found the data so valuable that a transect survey has been completed on an annual basis by each county for a number of years. These counties can track changes in tillage practices due to changing weather conditions, as well as a means of documenting effective educational programs, equipment rental, and other affiliated activities.

The purpose of the survey is threefold: (1) to provide information that can be used by individual soil and water conservation districts and others in establishing priorities for educational or other programs, (2) to evaluate progress achieved in reaching county or statewide goals, and (3) to provide accurate data on the adoption of conservation tillage systems by crop for the biannual National Crop Residue Management Survey. This makes the transect survey an ideal tool for assessment as well as measuring progress for locally led conservation. The transect survey will enable counties to have a higher level of confidence in their data for use in county programs and in the report submitted to CTIC. State and national data will have a correspondingly higher confidence level.

Many users use the National Crop Residue Management Survey to assess changes in conservation tillage systems. Each county submitting data is a key part of the team and your effort is greatly appreciated.

Statistical reliability of the cropland roadside survey method

When conducted properly, this cropland transect survey procedure provides a high degree of confidence in the data summaries. Users can have 90% or more confidence in the accuracy of the results. This level of reliability translates into data summaries that can help guide the local or state decision-making process. Several states have used transect data to allocate cost-share funds, develop new resource management goals, and to provide information to the general public about the positive impact of progress on land use trends. In general, few data sources have such a high level of reliability combined with quick data collection!

Step 1 – Selecting the crops

The crop list for the 2000 CRM survey was expanded from 8 to 22 crops. The 2000 crop/tillage report for your county can be found at **www._____edu.** (This will be sent after the first of the year.)

Crops should be selected for each county from the following list:

corn	edible beans and peas	sunflowers
soybeans (FS)	barley	sugar beets
soybeans (double-cropped)	canola	sugarcane
cotton	forage crop (seeding year only	tobacco
spring wheat	peanuts	vegetables and other crops
winter wheat	potatoes	permanent pasture
oats	rice	fallow
grain sorghum	rye	

Important: Make sure that the correct crops are chosen. For example, do not place dry edible beans in the soybean category or rye in the winter wheat category.
A worksheet will be available from the CTIC Web site that should be customized to include only crops grown in your county.

Step 1 – Establishing and Marking the Route

The first step in conducting a tillage and crop residue management survey is to establish a driving route. Counties that conducted a transect in 2000 should use the same route if it worked well. A county highway map should be used to draw a route that passes through all areas that are heavily used for crop production. Avoid large urbanized areas, forested land, rangeland, and heavily traveled federal and state highways when possible. Orientation or direction of the route (east to west or north to south) is not significant; however, it should be at least 110 miles long. Routes for counties with more than 300,000 cropland acres should pass through townships at least twice, particularly in areas where the land is heavily used for crop production. This avoids large gaps between passes through a county even though the mileage traveled is considerably longer. Routes typically traverse east to west through a county five to eight times (see Figure 1).

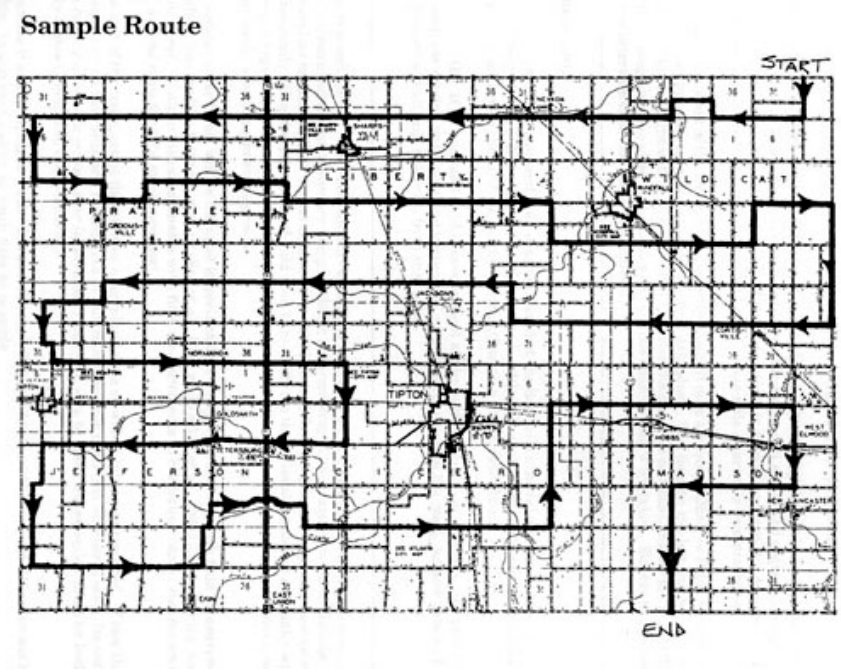

Figure 1. Sample county road transect route for Tipton County, Indiana. Note how the route bypasses towns (such as Tipton, Indiana located in the center of the county). This survey is applicable regardless of the layout of the county, i.e. counties need not be square to provide accurate results with this method.

Step 2 – Establishing the Survey Date and Team

Once the route is established and marked, schedule a date for conducting the survey. It should be after the majority of the main crops have been planted but before the crop canopy closes or the first row cultivation takes place. If a majority of the crops planted are spring-seeded, then the transect needs to be completed in late spring. If a majority of the crops in a county are fall-seeded, then the transect should be conducted in the fall after planting. If the percentage of fall-seeded crops is significant, but less than half, consider conducting the transect two times per year in order to capture the tillage systems being utilized for the spring and fall-seeded crops (or conduct the driving transect for the highest percentage [spring or fall] and estimate the tillage systems by crop for the other acreage). Conducting the survey at this time allows for easy "windshield observations" without stopping at each field.

Since the dates for conducting the county survey will depend upon local planting progress, flexibility in scheduling is recommended. For example, the northern half of a county may have had more rain than the southern half; therefore, a local team may survey the southern half of the county one week and finish the northern half two weeks later.

Next, assemble a survey team. It may consist of 2 to 4 individuals. Members may include the following: the NRCS district or soil conservationist, county Extension agriculture agent, the FSA county director, and a fourth person (perhaps a soil and water conservation district (SWCD) employee, supervisor, cooperator, or newspaper reporter) who can assist in making observations. At least one individual needs to be very familiar with tillage systems and estimating residue levels. When conducting the survey the following tasks need to be performed: driver, navigator who marks data collection points on the map, and data recorder, and occasionally someone will need to verify field observations (measuring residue, previous crop, etc.).

By getting a variety of people involved, the ability to assemble a full team for each day of surveying is greatly increased. Even if a SWCD supervisor or volunteer can only devote a half-day to collecting data, it would increase their understanding of the process while making a valuable contribution to the survey.

Step 3 – Collecting the Survey Data

The highway map will aid navigation across the county, especially if there are detours or road changes since the last transect.

The amount of transect data collected has been greatly simplified for the 2002 survey. Tillage practice by crop is the only information that will be collected. The simple data collection form, which can be customized for each county, will simply require a check mark for each field that is a data collection point.

For counties with 300,000 cropland acres or less, data should be collected at one-half mile intervals, as indicated by the vehicle odometer. For counties that have between 300,000 and 450,000 cropland acres, a one-mile interval is recommended. For counties with greater than 450,000 acres, a 1.5 to 2.0 mile interval is recommended. To obtain a statistically reliable data set, **approximately 460 cropland sites will need** to be observed along the route.

Beginning at the start of the route, travel exactly one-half mile and stop. Observe fields on both sides, and record the appropriate information on the first data sheet. Also mark the field location on the soil survey atlas sheet. Another option would be to use a GPS receiver to mark the field location. Repeat the procedure at half-mile intervals (or desired interval) until the route is completed.

Important:

(A) If a data point is a cropland field but is not planted to a crop (hayland, CRP, etc) in 2002, then note it as unknown for tillage type.

(B) If a cropland field (pasture, farmstead, subdivision, etc.) is not encountered at the stopping point on one side of the road, record data only for the side with cropland. The non-cropland point becomes not applicable (NA).

(C) Only record data for fields where the tillage type/residue level is obvious. For example, if one is conducting a transect in the spring, it is futile to walk into a winter wheat field to try and determine tillage/residue level. Simply mark that field as unknown for tillage/residue level.

(D) If no cropland field is encountered on either side of the road, continue driving until cropland is observed on at least one side of the road. Record data and then proceed.

As the transect survey continues, the survey team should stop and check field conditions on a regular basis to insure correct estimates are being made for different crop, tillage, and residue conditions. Once the team has calibrated their visual estimates to match actual field conditions, stops can then be made less frequently. Many fields will contain very little residue or high residue levels if the field was no-tilled. Usually only borderline residue levels require closer examination. However, the team should plan to re-calibrate their visual estimates especially when entering a region of the county with different soil surface conditions due to changes in moisture, organic matter levels, stoniness, or crops grown.

Crop residue cover levels will be the most important data category to confirm with field measurements. Therefore, use the line-transect method as described in the National Agronomy Manual for confirming percent residue cover. Confirm visual estimates with field measurements in borderline cases. *But remember, never use end rows for field measurements*!

At the end of the route, count the number of cropland sites where data were recorded. If less than 460, randomly extend the route and record data at half-mile intervals until this number is met. *Do not count fields twice if a transect crosses over its previous route*. Be sure to mark the extended route on the county highway map.

In counties that are highly urbanized, wooded, etc., collecting data on 460 cropland sites may not be feasible. In this case, collect as much data as practical.

Step 4 – Crop Acreage and Percentage Calculation

The number of check marks needs to be summed for each crop/tillage category and then summed for each crop. Dividing the sum in each category by the total for the crop will provide the percentage for each tillage system. (Yes, you will have to count and use your hand calculator.) For example, if there were 36 check marks for no-till corn, 22 for mulch-till corn, 28 for reduced-till corn, and 14 for conventional corn, the sum would be 100. So this county would have 36% no-till corn, 22% mulch-till corn, 28% reduced-till corn, and 14% conventional-till.

In addition to crop and tillage acres being reported, the total number of CRP acres should also be reported. **A new category for 2002 is the acres that were planted no-till into a cover crop.** This is to find out how the extent of cover crops usage.

The county crop acreage will need to be adjusted to reflect 2002 crop acres. Sources of information regarding the acres of crops planted for each county are Farm Service Agency (FSA) farmer certification (usually available in mid-August) and/or the State Agricultural Statistics Service. The State Agricultural Statistics Service in most States will release a crop report by crop reporting district on June 30th. This report will be very valuable in estimating the change in crop acreage from the previous year. The National Agricultural Statistics Service (NASS) State home page will also have the previous year's crop acreage by county (double-cropped acres are included in the acreage report). Discussion with government agency partners and local knowledge should not be discounted.

The 2000 Crop Residue Management Survey results for every county in the US will posted on the CTIC Web site (URL will be sent at a later date) using the expanded crop list of 22 crops. Counties will go to this Web site and update their 2002 crop acres. Users will have the option of updating either acres or percents for each crop/tillage category. The computer program will update acres if percents are entered or update percents if acres are entered. The program will not allow you to exit if percentages do not total 100% or if individual tillage/crop acres do not total the entered crop acres.

Tillage Definitions

Tillage Systems Definitions as featured in the *National Crop Residue Management Survey:*
The following set of definitions was established by CTIC and is recognized as a standard. They are used nationwide by many government agencies and private industry.

Conservation Tillage systems include no-till, ridge-till and mulch-till.
Any tillage and planting system that **covers 30 percent or more** of the soil surface with crop residue, after planting, to reduce soil erosion by water. Where soil erosion by wind is the primary concern, any system that maintains at least 1,000 pounds per acre of flat, small grain residue equivalent on the surface throughout the critical wind erosion period.

No-till/strip-till – The soil is left undisturbed from harvest to planting except for strips up to 1/3 of the row width (strips may involve only residue disturbance or may include soil disturbance). Planting or drilling is accomplished using disc openers, coulter(s), row cleaners, in-row chisels or rototillers. Weed control is accomplished primarily with crop protection products. Cultivation may be used for emergency weed control. Other common terms used to describe No-till include direct seeding, slot planting, zero-till, row-till, and slot-till.

No-till/strip-till

- Less than 1/3 of row disturbed
- Greater than 30% residue after planting
- Crop protection products used for weed control

Ridge-till – The soil is left undisturbed from harvest to planting except for strips up to 1/3 of the row width. Planting is completed on the ridge and usually involves the removal of the top of the ridge. Planting is completed with sweeps, disk openers, coulters, or row cleaners. Residue is left on the surface between ridges. Weed control is accomplished with crop protection products (frequently banded) and/or cultivation. Ridges are rebuilt during row cultivation.

Ridge-till

- Less than 1/3 of row disturbed
- Greater than 30% residue after planting
- Top 1-2" of ridge removed at planting
- Crop protection products are usually banded
- Row cultivation is used for weed control and to rebuild ridges

Mulch-till – Full-width tillage that involves one or more tillage trips, disturbs the entire soil surface and is done prior to and/or during planting. Tillage tools such as chisels, field cultivators, disks, sweeps or blades are used. Weed control is accomplished with crop protection products and/or cultivation.

Mulch-till

- Entire field is tilled
- Greater than 30% residue after planting
- Usually one to 3 tillage trips
- Chisel plow, disk, field cultivator, and combination tools are used

Other Tillage Types:

Reduced-till (15-30% residue) **–** Full-width tillage that involves one or more tillage trips, disturbs the entire soil surface and is performed prior to and/or during planting. There is 15-30 percent residue cover after planting or 500 to 1,000 pounds per acre of small grain residue equivalent throughout the critical wind erosion period. Weed control is accomplished with crop protection products and/or row cultivation.

Reduced-till

- Entire field is tilled
- 15 to 30% residue after planting
- Usually one to 3 tillage trips (maybe more)
- Chisel plow, disk, field cultivator, and combination tools are used

Conventional-till or intensive-till – Full-width tillage that involves one or more tillage trips and disturbs the entire soil surface and is performed prior to and/or during planting. There is less than 15 percent residue cover after planting, or less than 500 pounds per acre of small grain residue equivalent throughout the critical wind erosion period. Generally involves plowing or intensive (numerous) tillage trips. Weed control is accomplished with crop protection products and/or row cultivation.

Conventional-till

- Entire field is tilled
- Less than 15% residue after planting
- Usually two to as many as four or more tillage trips are used involving the moldboard plow, chisel plow, disk, field cultivator, or combination tools**.**

APPENDIX

Background on Surveys

Transects have been used by a number of states to quantify the amount of various tillage systems being used by crop. Although the exact method of data collection and procedure varies, all sought to improve the accuracy of the amount of conservation tillage by county.

Cropland surveys designed to estimate the amount of conservation tillage being used on the land are a relatively new concept. The Conservation Technology Information Center (CTIC) initiated the annual National Crop Residue Management Survey in 1982. The data gathered for this national survey usually involved a meeting of minds and data. NRCS field office personnel (usually district conservationists) in each county were annually urged to utilize area agricultural statistical data and meet with others who may have information to arrive at "best estimates" for the national survey. NRCS district conservationists are often assisted by soil and water conservation district personnel, county extension agents, agribusiness, local farm organizations, and other interested parties to complete a survey form that denotes these best estimates, which are generally based on personal knowledge.

Another survey conducted on a national basis is the 5-year NRCS National Resources Inventory (NRI). These data are collected on some 22 parameters, including physical characteristics of the land and the effects of agronomic practices on soil erosion. The NRI is a "point" survey method, where points correspond to random locations within a field. The first NRI in 1977 contained limited data on conservation tillage systems, as did subsequent surveys in 1982, 1987, 1992, and 1997.

Use of the NRI to estimate accurate acreage of conservation tillage or to document annual cropland trends in a state or county is greatly limited. The NRI has proven valuable in development of national resource policies.

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Appendix B – Lessons Learned During the 2020 Tillage Survey Effort

In the process of conducting the 2020 survey, notes about ways to improve future studies were developed. Following is a list of those notes.

1. Change color of site location on screen once data is complete and checked. It would make it much easier to see what is complete and what is NOT at a glance.
2. Add alfalfa as a crop. A 5-7 year crop in rotation that is mostly 100% ground cover (Good thing!)
3. Add (meadow) hayland as a crop. Permanent cover that is continually harvested, but has excellent ground cover.
4. Wait until June 1st to start survey (for many years) to ensure planting is completed and crops have emerged.
5. Survey valley sites first, since crops are usually more mature in the spring at lower elevations than at higher elevations.
6. Eliminate survey points along highways. Safety reasons are first priorities. Cropland fields may be farther away from roadway (especially if paralleling major railroad), making it more difficult and exposing vehicles for a longer time along highway Right Of Way.
7. Ensure samples are not taken on the same field after 90 degree turns on roads. (Especially when samples taken every 1/2 mile).
8. Make sure surveyors can agree on most entries.