TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

ENERGY # 1 **Alaska 2015**

CROPLAND ENERGY ESTIMATION TOOL (CEET)
and
USER'S GUIDE

BACKGROUND

The Cropland Energy Estimation Tool (CEET) is a Microsoft Excel spreadsheet developed to track energy supplied to and captured by a given field. It assists both NRCS planners and Technical Service Providers (TSPs) by addressing energy as a resource concern for landscape or field operations through the planning process. CEET aligns with the criteria established for the Conservation Activity Plan (CAP) to reduce energy at the field.

As a planning tool, CEET compares energy use of the current operations in a given field to the potential operations of that field. CEET refers to these as "benchmark" and "planned" alternatives. The tool estimates energy use for up to five crop intervals on both irrigated and dryland crops. Energy is measured as it crosses the field boundary. CEET tracks energy in Million British Thermal Units per acre per year (MMBTU/acre/year), the primary reporting units used by NRCS. Additional reports, including greenhouse gas (GHG) emissions and energy use by NRCS practice standards, are available as needed by the planner or TSP.

The User's Guide provides an overview, detailed tool description, operation instructions, and procedures for meeting with landowners. Appendices provide definitions, equations, and examples. The user's guide assumes a basic understanding of the conservation planning process, agronomy, and irrigation.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

Alaska NRCS

CROPLAND ENERGY ESTIMATION TOOL

USER'S GUIDE

VERSION 1.0

NRCS Alaska
April, 2013

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CROPLAND ENERGY ESTIMATION TOOL (CEET)

USER'S GUIDE

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Introduction

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This User's Guide provides: an overview, detailed tool description, operation instructions, and procedures for meeting with landowners. Appendices provide definitions, equations, and examples. The manual assumes a basic understanding of the conservation planning process, agronomy, and irrigation. It provides references for gaining a better understanding of these topics, but does not provide detailed explanations. For example, CEET uses terminology and data from the Revised Universal Soil Loss Equation - Version 2 (RUSLE 2), a model used by NRCS in predicting annual soil loss. A detailed explanation of RUSLE 2 is available at http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm.

Overview

As stated previously, CEET tracks energy supplied to and captured by a given field crop. The energy supplied to the field consists of energy inputs supplied by the farmer and solar energy. CEET does not directly measure solar energy. It measures the amount of energy captured at the field through crop production.

Energy captured at the field is separated into the energy harvested or removed from the field, and the energy remaining in the field. Even though the remaining energy in the field is eventually lost, it is an important contributor to overall soil health. Figure 1 shows a simplified schematic of the process.

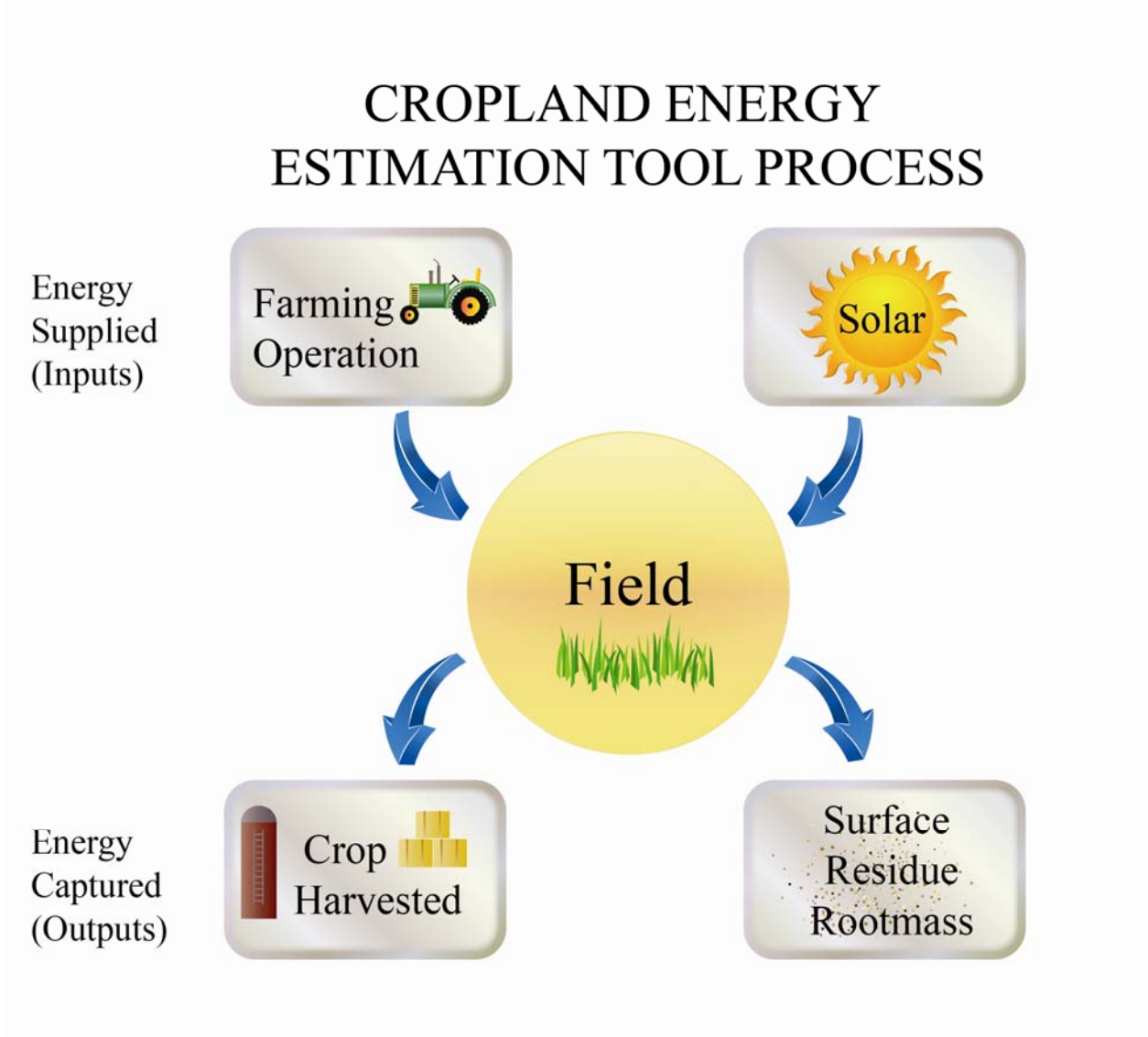


Figure 1: Cropland Energy Estimation Tool Process

For accounting purposes, CEET separates the energy captured into three categories: crop harvested, surface residue, and rootmass. Surface residue and rootmass make up the energy remaining in the field after harvest. These values are separated to allow for additional post harvest crop removal through baling and/or grazing. Once harvest and post harvest functions are complete, the remaining portion of the crop, defined as crop residue, decays and contributes to the overall soil health. Both surface residue and rootmass values are generated based on the crop type, yields, and the yield ratio taken from the RUSLE 2 database. Figure 2 shows a simplified schematic of the energy captured by the crop.

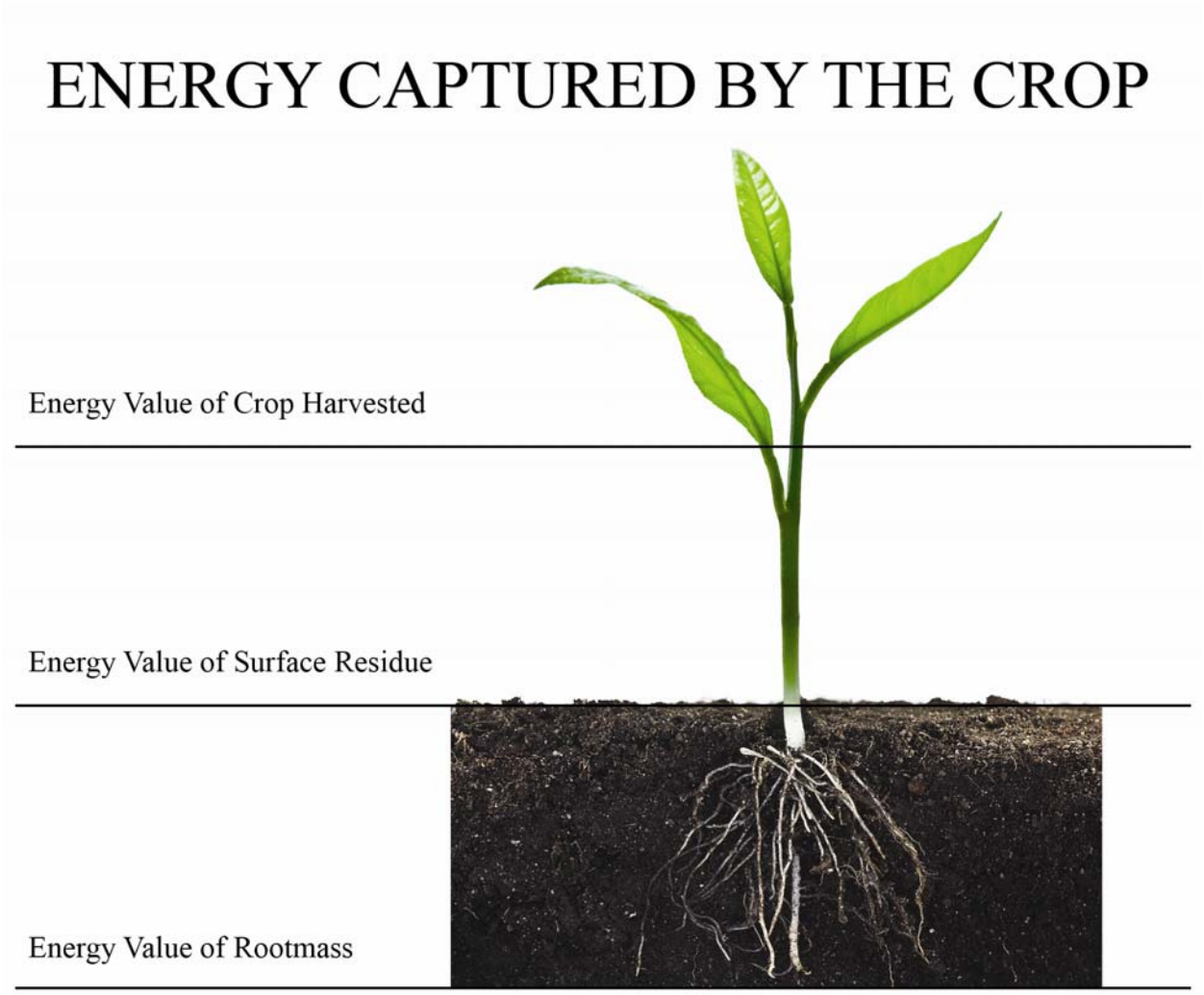


Figure 2: Energy Captured by the Crop

The defined field boundaries are physical borders of one or more fields having the same cropping pattern or rotation, and if irrigated, these fields are connected by the same irrigation system or pump. A field could range from one to thousands of acres.

CEET tracks energy supplied to and captured by the field at these physical boundaries. For example, energy use by farming equipment or aerial spraying is measured after arriving at the field. Crop yields are also measured as the harvested crop leaves the field. This allows consistent comparison of each field. Energy associated with transportation to the field boundary is not evaluated by the tool. Agrichemicals are the one exception to measuring energy at the field boundary. These energy estimates account for the energy required to manufacture the agrichemical. Figure 3 shows a graphical representation of the defined field boundary.

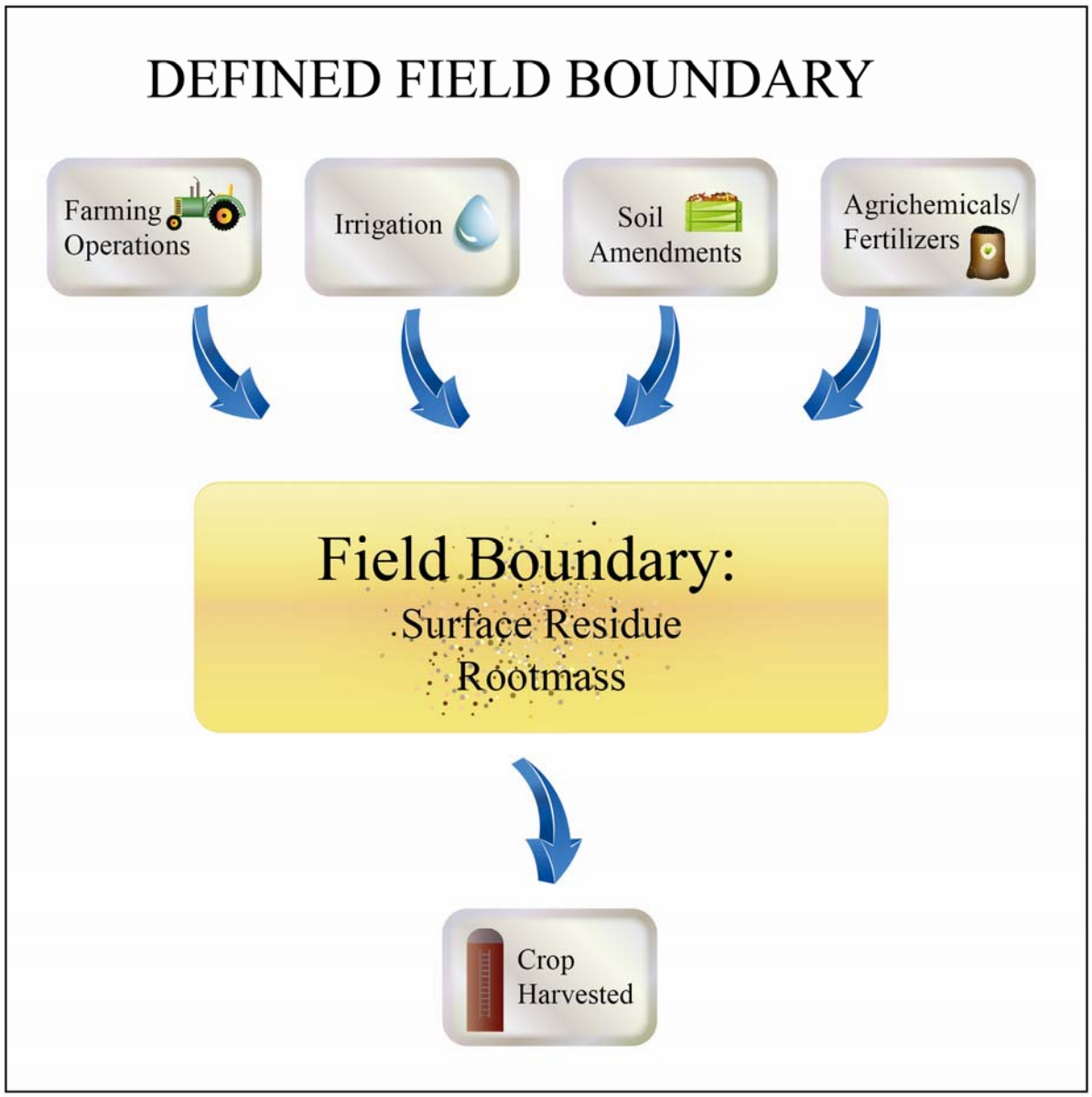


Figure 3: Defined Field Boundary

CEET tool consists of five worksheet tab categories. These include: homepage, input, supporting data, intermediate, and output reports. The worksheets are color coded by category beginning at the homepage with hyperlink buttons to navigate through the tool. For convenience, the homepage worksheet contains all hyperlinks to other worksheets developed in this tool. All worksheets are available for viewing, but initially the planner needs to become familiar with only the input and output worksheets.

All input required by the tool is located in the input worksheets. Manual input cells are shaded for ease and convenience. Other input cells are populated based on pull-down menus and tabular values located in the supporting data worksheets. Both manual input and tabular values are used in the intermediate worksheets to convert from landowner known units (i.e. gallons of diesel) to NRCS primary reporting units (MMBTU/acre/year). Figure 4 shows flow chart and the general logic followed by the tool.

Several optional input and output worksheets are available in this tool. These include greenhouse gas emissions and energy use separated by practice standards. These worksheets are accessed through the homepage worksheet tab. Figures 5 and 6 show the flow chart and general logic followed by the tool for greenhouse gas and practice standards worksheets.

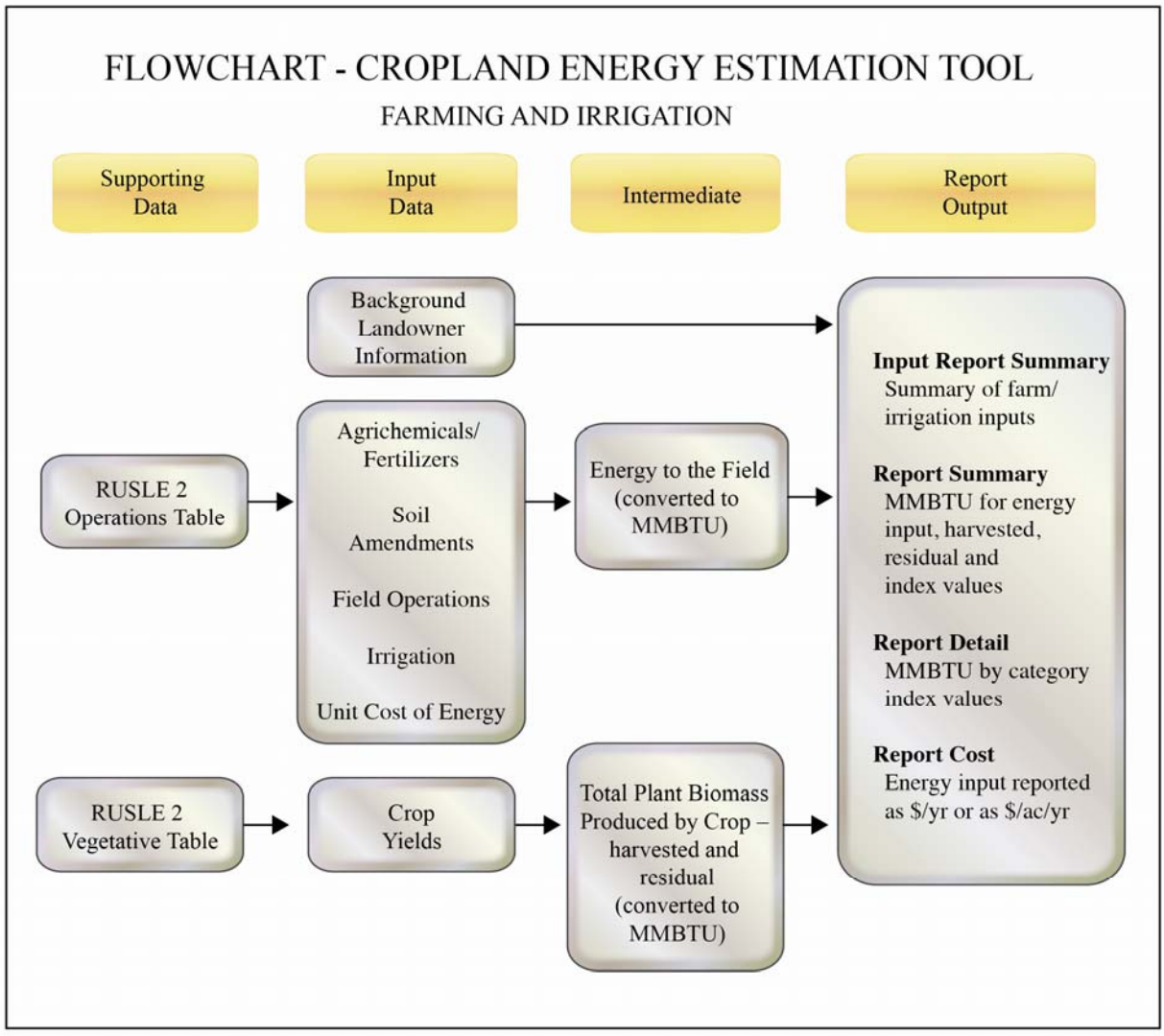


Figure 4: Farming and Irrigation Flow Chart

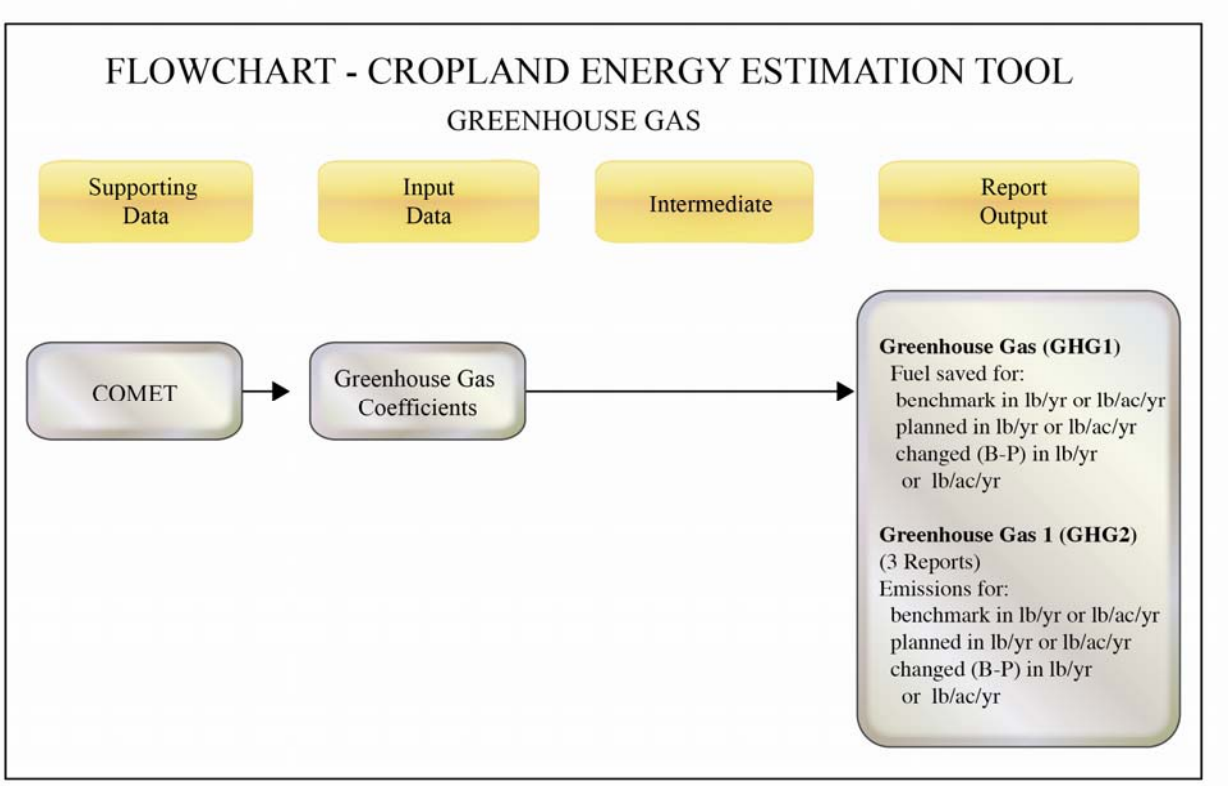


Figure 5: Greenhouse Gas Flow Chart

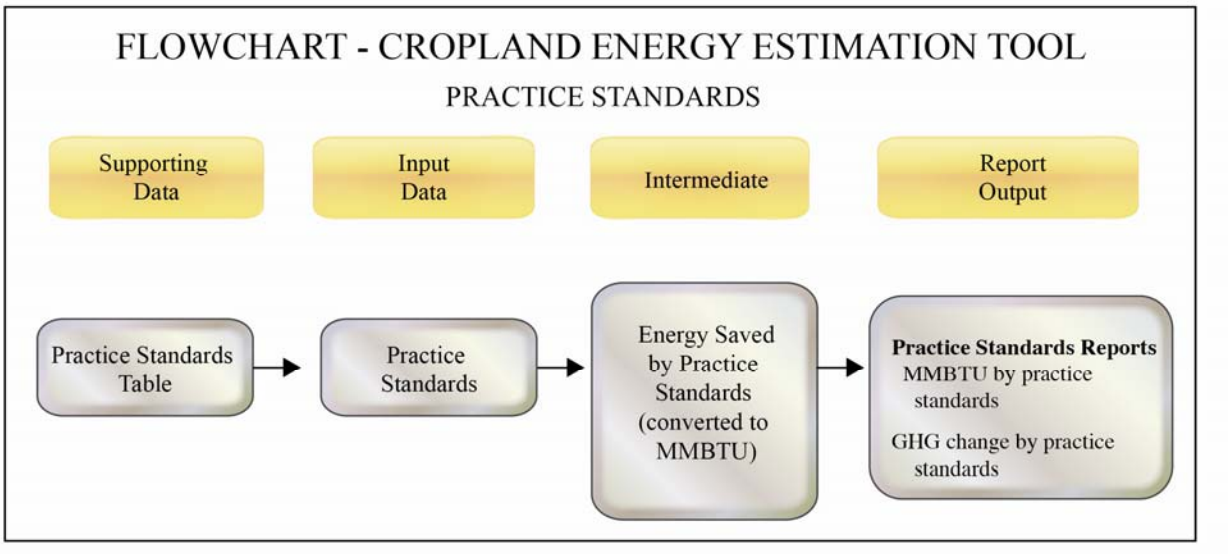


Figure 6: Practice Standards Flow Chart

Homepage

The homepage is the navigation vehicle for moving through the tool. It has hyperlinks to each worksheet used in the tool, which are macro driven and provide easy navigation through the tool. It is color coded by purpose, as shown in Table 1. The main input worksheet requires the bulk of the populating time and assistance from the landowner. The optional practice standards and greenhouse gas input worksheets provide a means of reporting the main input data by practice standards and greenhouse gas emissions.

Input

There are three input worksheets: the main, practice standards, and greenhouse gas emissions. All input worksheets contain necessary manual input variables required by the tool. The manual input values are shaded for ease and convenience. Other input cells are populated based on pull-down menus and tabular values located in the supporting data worksheets. Once the planner enters the manual inputs, CEET automatically fills in the remaining values.

The main input worksheet is separated into “benchmark” and “planned” alternatives for comparison of potential energy reduction measures. “Planned” alternatives involve modifying “benchmark” farming practices, operations, and/or management. The practice standard and greenhouse gas input worksheets calculate energy differences between the “benchmark” and “planned” alternatives. The input worksheets are separated by input categories as follows:

- background/landowner information
- crop planting and harvest dates
- crop yields
- soil amendments (organics)
- agrichemicals and fertilizers
- field operations
- pumping
- greenhouse gas emission coefficients
- practice standards

Supporting Data

CEET contains tables of NRCS RUSLE 2 energy data, practice standards, and greenhouse gas emission coefficients. RUSLE 2 tabular values were extracted in April 2013, from the vegetation and operation tables located in a RUSLE 2 database named NRCS_Moses_update_030104_to041113.gdb. Future updates to RUSLE 2 will not be reflected in this tool without extracting the data and repopulating the tables. The NRCS Practice Standard Table consists of the national list with the flexibility to allow users to develop a filtered list for convenience. The table of greenhouse gas emission coefficients was developed from NRCS COMET website at http://cometfarm.nrel.colostate.edu/QuickEnergy.

Intermediate

There are two intermediate worksheets. These worksheets contain intermediate values derived from the input worksheets. These values allow the user to view computations between the input worksheets and the output or report worksheets. Intermediate tables calculate: the plant biomass production, energy input, crop harvest output, irrigation pumping, other pumping for up to three different pumps, and practice standards implementation. The intermediate worksheets convert input values to MMBTU per acre per crop interval and average these results on an annual basis. These values are summarized in the report worksheets.

Output Reports

There are ten output reports located on seven worksheets:

- energy summary for alternative field rotations
- detailed energy summary for alternative field rotations
- cost analysis summary for alternative field rotations
- input summary worksheet
- field inputs used for computing greenhouse gas emissions
- benchmark greenhouse gas emissions from field inputs
- planned greenhouse gas emissions from field inputs
- greenhouse gas emission changes from field inputs
- energy summary by practice standard
- greenhouse gas change by practice standard

These reports are output summaries comparing energy use between a current “benchmark” with a future “planned” crop rotation. Some reports show the amount of energy reduced by applying various conservation measures. Other reports provide information on: the amount of energy saved based on applying practice standards, a cost savings for input energy, change in fuel use for different fuel types, changes in greenhouse gas input emissions, and an input data summary. Cost savings, reduced greenhouse gas emissions, and reduced fuel use are presented on a per acre and total field cost basis.

Detailed Tool Description

This section discusses the components of the tool. CEET is separated into sixteen worksheet tabs, as shown in Table 1. Each tab is color coded by purpose in the tool. CEET also contains descriptions of the variables associated with each tab. These descriptions are located in the individual cell comment boxes as well as in the appendices of this User's Guide.

Table 1: Worksheet Tabs Contained in CEET

Worksheet Tab Name	Description	Purpose
Home Page	Main navigation worksheet	Navigation
Input	Main Input Worksheet – Input field operations, irrigation, soil amendments, crop yields, agrichemicals, and fuel costs.	Input
Input_PS (Optional)	Practice Standard Input Worksheet – Input the percentage of energy saved by practice standard.	
Input_GHG (Optional)	Greenhouse Gas Input – Input greenhouse gas coefficients from COMET website. COMET provides GHG coefficients in pounds per unit of energy for different fuel types based on zip code. Most fuel types, except for electricity, are either static or seldom change. COMET should be periodically checked for updates.	
Intermediate_Calcs	Intermediate Calculations Worksheet – Converts input values from the main input worksheet to Million British Thermal Units (MMBTU) per acre per year. The irrigation input values are used to compute BTU per water gallon pumped before converting to MMBTU/acre/year.	Intermediate
Intermediate_PS (Optional)	Intermediate Practice Standard Worksheet – This worksheet multiplies MMBTU and practice standard percentages. These are reported by the following field input categories; harvest operations, field operations, irrigation delivery power, other delivery power, agrichemicals applied, soil amendments applied, crop harvest removed, post harvest grazing, post harvest residue removed, rootmass and remaining surface residue.	
Report_Sum	Summary Report titled - Energy summary for alternative field rotations – MMBTU reported by energy input, harvested crop and remaining residues. Index values are developed for comparison of other energy plans in the region.	Report Output
Report_Details	Detailed Report - Detailed energy summary for alternative field rotations – This summary reports MMBTU by various field input categories as stated above. Index values are developed for comparison with other energy plans in the region.	
Report_Cost	Cost Report – Cost analysis summary for alternative field rotations – This report shows a cost comparison of the energy input to the field for a benchmark versus planned scenario. It provides the cost savings per acre and per acre per year. Cost savings are separated into energy input categories (harvest operations, field operations, etc.). Several categories have the flexibility to change the type of energy used (diesel, electricity, etc.) for comparison.	

Worksheet Tab Name	Description	Purpose
Report_Input_ Summary	Input Summary Worksheet – This report provides a concise version of the main input worksheet. This can be used to gather data from the landowner or provide a report showing the input variables.	Report Output
Report_GHG1 (Optional)	Greenhouse Gas Report – Inputs for computing GHG emissions. This report shows the amount of energy used (gallons, kilowatt-hours, etc.) by the benchmark (B), planned (P), and changed (B–P) scenarios. These inputs are reported as a per year (Total Field Inputs) and a per acre per year (Per Acre Cost) basis.	
Report_GHG2 (Optional)	Greenhouse Gas Report - Greenhouse gas emissions from field inputs. This report shows the greenhouse gas emissions from field inputs for the benchmark (B), planned (P) and changed (B-P) on a per year (Total Field Inputs) and a per acre per year (Per Acre Cost) basis.	
Report_PS (Optional)	Practice Standard Report – Energy summary by practice standard – This report summarizes MMBTU calculated in the intermediate practice standard report as total energy input, energy harvested, and energy residual.	
Definitions	Definitions used by CEET	Supporting Data
Equations	Equations used by CEET	
Database_Tables	RUSE2 and Practice Standard data tables	

Main Input Worksheet

The planner populates the shaded cells in the main input worksheet. Those cells are conditionally formatted depending on the number of crop types selected. These are separated into benchmark and planned scenarios. Both scenarios are located adjacent to one another for convenience. The input worksheet is separated into an agronomy section and an irrigation section. Each section is discussed briefly below. A detailed description of each variable is provided in Appendix B, and individual cell comments are provided inside the tool.

The main input worksheet has the flexibility to handle most types of farming practices. It relies on RUSLE 2 for providing vegetative and farming operations. Fuel uses by farming equipment are averages based on research data collected for RUSLE 2. These averages can be modified if better values are known by adjusting the *Frequency* variable. If specific crops or equipment are not available in the RUSLE 2 data tables, select something similar in order to provide similar results. If unsure of agronomy input, look at appendices and/or contact an agronomist for assistance.

The irrigation component is also a simplified energy estimate. It calculates the energy required to pump irrigation water from the source and apply it to the field. This requires a basic knowledge of pumps and crop water requirements. As with any farm, conditions change from year to year as does the amount of energy input to the field. For example, irrigation may fluctuate depending on precipitation and other climatic factors. Precisely predicting energy use in a future year is not realistic and is not the intent of this tool. It estimates an energy use for a typical year. Again, if unsure of irrigation input, refer to appendices and/or contact an irrigation engineer for assistance.

Greenhouse Gas Input Worksheet

The greenhouse gas input worksheet estimates the amount of greenhouse gas emissions in pounds per unit of energy for different fuel types based on zip code. The COMET website provides the GHG emission coefficients for different fuel types. The fuel types consist of liquid, gas, and electricity. Other energy inputs have a place holder for assigning an emissions coefficient, but are defaulted as zero. Most fuel types, excluding electricity, are either static or seldom change. This worksheet should be checked periodically for updates.

Practice Standards Input Worksheet

The practice standards input worksheet accounts for energy saved by applying a practice standard to the existing "benchmark" field. The practice standards input worksheet provides pull-down menus attached to either a complete national practice standard list or a filtered list. The planner can toggle between the two lists. The filtered list allows the planner to select various practice standards that are related to energy as a resource concern. The filtered list can be modified as additional practice standards are needed or as practice standards are no longer used. To modify this list, click on the "Goto Practice Standard List" button and then check the boxes needed in the list. To return to the practice standard input worksheet, click on the "Goto Input_PS" button.

Once these lists and the main input worksheet are populated, the planner selects a practice standard that applies for this planned alternative from the pull-down menu. Then select the variable that changes due to the selected practice standard and the amount of change. The appendices provide examples of how to use the practice standards input worksheet and corresponding output reports. The output report shows the energy saved by practice standard.

Report Worksheets

The main report (labeled as Report_Sum) associated with this tool summarizes energy use for both the benchmark and planned scenarios based on NRCS primary reporting units of Million British Thermal Units per acre per year (MMBTU/acre/year). All other reports support or provide additional information based on the data collected for this report and additional input as required for the other reports. The reports are subdivided into three categories: farming and irrigation, practice standards, and greenhouse gas emissions. Practice standards and greenhouse gas emissions reports are optional and are used as needed by the planner.

The farming and irrigation category consists of four reports: summary report (Report_Sum), details report (Report_Details), cost report (Report_Cost), and input summary report (Report_Input_Summary). The details report contains a more detailed account of energy use than the summary report. The report cost (Report_Cost) provides the economics associated with the farmer inputs. It shows a landowner the potential financial savings that can be achieved through alternative energy measures. The input summary report summarizes all of the input provided for an alternative plan. This report provides a method of checking the input data, and a blank copy may be beneficial to collect the required data during the landowner meeting.

The greenhouse gas (GHG) emissions category consists of inputs for computing GHG emissions (Report_GHG1), "benchmark" GHG emissions (Report_GHG2 Benchmark), "planned" GHG emissions (Report_GHG2 Planned), and changes in GHG emissions between the "benchmark" and "planned" (Report_GHG2 Changes). As needed, these reports provide the amount of fuel used by the "benchmark", "planned" and change alternatives, as well as the amount of GHG emissions associated with the type of fuels used for each alternative.

The practice standards category consists of energy summary by practice standard (Report_PS Energy Summary) and greenhouse gas emissions by practice standard (Report_PS GHG Change). These reports may be beneficial for NRCS ranking criteria, but may not be necessary for every plan. These reports rely on data from both the main and greenhouse gas inputs. The energy summary by practice standards is the energy saved by applying a practice standard to the existing "benchmark" alternative.

Tool Operation

CEET is a Microsoft Excel spreadsheet tool that contains conditional formatting, lookup tables, and macros. The macros ensure that the look up values always match the set of input data selected from the pull-down menu. For example, the *Crop Name* and *Specific Crop Description* are a set of data used to select the *Biomass Yield Ratio* from the RUSLE 2 vegetative table. The tool relies on the *Specific Crop Description* value to look up the *Biomass Yield Ratio*. If the *Crop Name* is changed without changing the *Specific Crop Description* then the wrong *Biomass Yield Ratio* would be reported. To eliminate the potential wrong value, a macro automatically overwrites the *Specific Crop Description* to the default value of "Select Specific Crop Description." Macros also apply to the input data set of the *Operation – Operation Description* in reporting *Diesel Use*.

Conditional formatting shades potential input cells. This assists the planner in populating the correct cells in the spreadsheet. Copying and pasting input cells in the tool corrupts the conditional formatting because copying carries the formatting with the cell. The planner can still copy and paste input cells by using the "paste special" window and selecting values as shown below in Figure 7. Another method to copy from one cell to another is to highlight the contents from the Excel formula bar, right click copy (Ctrl C), and then paste into the appropriate cell as shown in Figure 8.

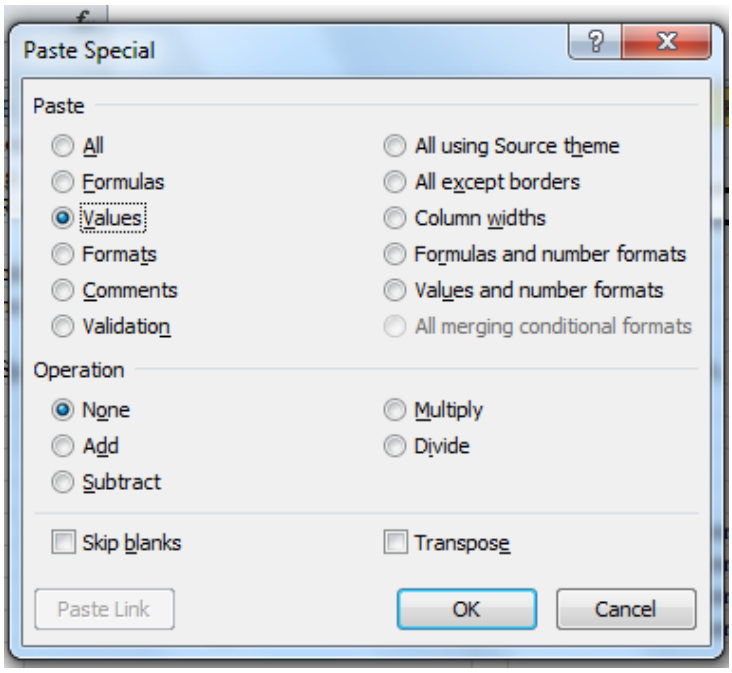


Figure 7 – Excel Paste Special Window

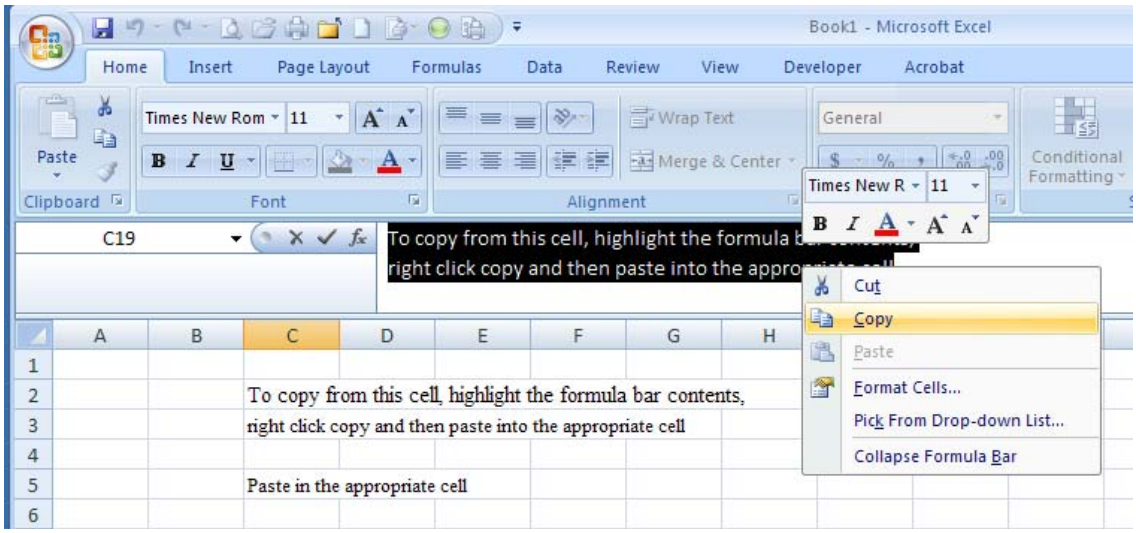


Figure 8 – Excel Copy/Paste Using Excel Formula Bar

Landowner Meeting

To reduce the meeting time with a landowner, the planner should fill in as much of the main input table as possible before the meeting begins. This requires additional work before the meeting. The following input summary worksheets may help frame questions for the landowner.

Home

NRCS - CROPLAND ENERGY TOOL

INPUT SUMMARY WORKSHEET

Date: 11/15/2012

Landowner: Field Area: Latitude:

Field Location: Field ID: Longitude:

BENCHMARK

Crop Yields

Crop Name	Year	Labor	Crop Harvest Moisture	Crop Yield	Yield Unit	Post Harvest	
						Forage Removed	Grazing AUD
	[yr]	[hr/ac]	[%]	[yld/ac]		[DM lb/ac]	

Soil Amendments Applied

Crop Name	Applied Stored Manure	Compost	Seed, transplnt, sprig, etc.	Animal Feed O. M.	Other Applied O. M.
	[DM lb/ac]				

Agrichemicals Applied

Crop Name	N Nitrogen [lbs/acre]	P Phosphorus [lbs/acre]	K Potassium [lbs/acre]	S Sulfur [lbs/acre]	H_{rb} Herbicide [oz/acre]	P_{st} Pesticide [oz/acre]

PLANNED

Crop Yields

Crop Name	Year	Labor	Crop Harvest Moisture	Crop Yield	Yield Unit	Post Harvest	
						Forage Removed	Grazing AUD
	[yr]	[hr/ac]	[%]	[yld/ac]		[DM lb/ac]	

Soil Amendments Applied

Crop Name	Applied Stored Manure	Compost	Seed, transplnt, sprig, etc.	Animal Feed O. M.	Other Applied O. M.
	[DM lb/ac]				

Agrichemicals Applied

Crop Name	N Nitrogen [lbs/acre]	P Phosphorus [lbs/acre]	K Potassium [lbs/acre]	S Sulfur [lbs/acre]	H_{rb} Herbicide [oz/acre]	P_{st} Pesticide [oz/acre]

Figure 9 Input Summary Worksheet Sheet 1 of 2

NRCS - CROPLAND ENERGY TOOL

INPUT SUMMARY WORKSHEET

Date: 11/15/2012

Landowner: Field Area: Latitude:

Field Location: Field ID: Longitude:

BENCHMARK

Diesel Use

Crop Name	Operation Description	No. Times	Diesel Use [gal/ac]
		Total:	0.00

Irrigation

Method	Op. Pressure [psi]	Pump plant Efficiency [%]	Operating Hours [hr]	Power Req [BTU/gal]	Ave. Amt Applied [in]	Ave. Amt Pumped [Mgal]
Irrigation Delivery	0	0%	0	0.0		
Other Delivery 1						
Other Delivery 2						
Other Delivery 3						

PLANNED

Diesel Use

Crop Name	Operation Description	No. Times	Diesel Use [gal/ac]
		Total:	0.00

Irrigation

Method	Op. Pressure [psi]	Pump plant Efficiency [%]	Operating Hours [hr]	Power Req [BTU/gal]	Ave. Amt Applied [in]	Ave. Amt Pumped [Mgal]
Irrigation Delivery						
Other Delivery 1						
Other Delivery 2						
Other Delivery 3						

Figure 10: Input Summary Worksheet Sheet 2 of 2

Appendix A - Homepage

NRCS - CROPLAND ENERGY TOOL

HOME PAGE

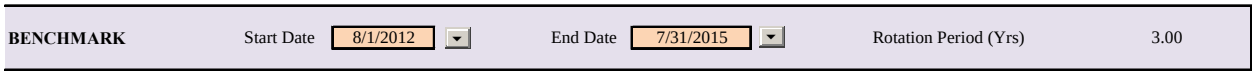
USDA NRCS Natural Resources Conservation Service

Input	**Farming and Irrigation**	
	Main Input Worksheet for Farming and Irrigation	Input
Reports	Energy Summary for Alternative Field Rotations	Report Sum
	Detail Energy Summary for Alternative Field Rotations	Report Details
	Cost Analysis Summary for Alternative Field Rotations	Report Cost
	Input Summary Worksheet	Report Input Summary
Input	**Greenhouse Gas Emissions** (Optional - Hidden Worksheet Tabs)	
	Greenhouse Gas Emission Coefficients	Input GHG
Report	Inputs for Computing Greenhouse Gas Emission Changes	Report GHG1
	Benchmark Greenhouse Gas Emissions From Field Inputs	Report GHG2 (Benchmark)
	Planned Greenhouse Gas Emissions From Field Inputs	Report GHG2 (Planned)
	Greenhouse Gas Emission Changes From Field Inputs	Report GHG2 (Changes)
Input	**Practice Standards** (Optional - Hidden Worksheet Tabs)	
	Practice Standard Input Percent Allocated	Input PS (Percent Allocated)
	Practice Standard Input Fuel Type Used	Input PS (Fuel Type Used)
Reports	Energy Summary by Practice Standard	Report PS (Energy Summary)
	Greenhouse Gas Change by Practice Standard	Report PS (GHG Change)
	Supporting Data	
	Definitions	Definitions
	Equations	Equations
	Database Tables	Database Tables
	Intermediate Sheets	
	Intermediate Calculations	Intermediate Calculations
	Intermediate Practice Standards	Intermediate Practice Standards

Appendix B - Input Worksheets and Defined Variables

Main Input Worksheet Tab

Variable	Description	Additional Comments
Harvest Date to Harvest Date		
Start Date	Enter the starting date of the crop.	Select the starting and ending dates from a drop down, pick date calendar menu. The selected dates are from harvest date to harvest date. For example, a field growing small grains, harvested on August 15, with no other crops grown that year will have a start date of August 16 and an end date of August 15. The starting and ending dates are used to determine the average annual MMBTU. Periods of record less than 1-year may overestimate actual energy results. For example, if a field uses 1MMBTU in a 6 month period, then the average annual energy use is computed as 2 MMBTU/year or 1MMBTU/0.5-year.
End Date	Enter the ending date of the crop.	



Variable	Description	Additional Comments
Landowner Information		
Landowner	Enter the landowner, organization or other descriptive information.	This is the landowner name or other descriptive information.
State	Select the state from pull down menu.	
County	Select the county from pull down menu.	
Date	Enter the date the plan was created.	
Latitude	Enter the latitude of the project.	Latitude and longitude values will be used in the future by GIS applications.
Longitude	Enter the longitude of the project.	

Landowner Information	
Landowner	Oliver Row
State	Washington
County	Whitman
Date	2/11/2013
Latitude, [decimal degrees]	46.88
Longitude, [decimal degrees]	117.21

Main Input Worksheet Tab

Variable	Description	Additional Comments
Background Information		
Field Acres	Enter the number of acres.	The field acres value is used to convert energy use per field (MMBTU/field) to energy use per acre (MMBTU/acre). Also, the irrigation component of this tool uses acres to convert the gross amount applied from a depth value to a volume of water applied to the field.
Field ID	Enter the field identification.	Field ID appears on the headings of most reports defining the individual field or group of fields.
Field Description	Enter the description.	This input value describes the benchmark field and the planned changes. As an example, the field description could be Wheat – Conventional Tillage to Direct Seed.

Background Information	Benchmark
Field Acres	150
Field ID	2
Field Description	Convent Tillage to Direct Seed

Crop Interval, Name and Harvest Dates

Crop Interval	Crop interval is the number of crop rotations being analyzed.	This is the number of crop intervals or rotations being analyzed. It ranges from 1 to 5 rotations. An interval starts the day after harvest and goes through the harvest of the crop.
Crop Name	Select the crop name from a pull-down menu.	This value is selected from crops listed in the RUSLE 2 vegetative table.
Specific Crop Description	Select the specific crop description from the pull-down menu.	This value is selected from the pull down menu tied to the RUSLE 2 vegetative table.
Year Crop Harvested	Enter the year the crop was harvested.	The year harvested is all that is required [YYYY]. This value is used in the intermediate calculations to sum multiple crops in the same year before averaging.
Biomass Yield Ratio	Biomass yield ratio is selected from a look-up table.	This value is selected from the RUSLE 2 vegetative table.
Labor	Enter the human labor in hours per acre	This is the number of hours per acre needed to produce the specified crop for the field. Hours should include farming (planting, tillage, spraying, harvesting, etc.) and irrigation.

Crop Interval, Name and Harvest Dates

Crop Interval	Crop Name	Specific Crop Description	Year Crop Harvested [YYYY]	Biomass Yield ratio [-]	Labor [hr/acre]
1	Wheat	Wheat, spring 7in rows	2013	1.30	1.0
2	Beans	Beans, garbonzo	2014	1.40	0.8
3	Wheat	Wheat, winter, CMZ 50 hi ppt, 7-10 in. spac. late plant	2015	1.31	1.3
4					
5					

Main Input Worksheet Tab

Variable	Description	Additional Comments
Crop Harvested and Yields		
Crop Harvest Type	Enter the crop harvest type from the pull down menu.	The crop harvest type selected from the pull down menu is either: (1) grazing, (2) forage, (3) commodity, or (4) multi-use. Grazing uses unit of Animal Unit Days instead of RUSLE2 units for the crop yield, since the crop is being grazed and not harvested. Forage (silage, hay etc.) and commodity (grains, fruits vegetables, etc.) use RUSLE 2 units. Multi-Use consists of harvesting a crop and then allowing the crop residue (stubble) to be bales (Post Harvest Forage) and/or grazed (Post Harvest Grazing).
Crop Harvest Moisture	Enter the moisture content of the crop when harvested.	This is the moisture content of the crop at the time of harvest. This is used to determine the amount of dry matter of the crop. The landowner should know this, but if unknown, typical values can be used. Consult an agronomist or other available references for typical values.
Crop Yield	Enter the yield of the crop in units specified by “Yield Units”.	The landowner should provide this value.
Yield Units	Yield units are automatically populated from a look-up table.	This value is selected from the RUSLE 2 vegetative table.
Rootmass	Rootmass is automatically populated from a lookup table.	This value is selected from the RUSLE 2 vegetative table.
Available Surface Residue	Available surface residue is automatically populated from a lookup table.	This value is selected from the RUSLE 2 vegetative table. This the available surface residue that can be grazed, baled or otherwise removed.
Post Harvest Forage Removed	Enter the post harvest forage removed.	The post harvest forage removed is the amount of forage removed after harvest. The Crop Harvest Type needs to be labeled as "Multiple Use" otherwise the input cell is not active.
Post Harvest Grazing	Enter the post harvest grazing as animal unit days (AUD.)	The amount of forage removed due to grazing after harvest based on animal unit days assuming 30 lbs of dry matter removed per AUD. The Crop Harvest Type needs to be labeled as "Multiple Use" otherwise the input cell is not active.
Remaining Surface Residue	Remaining surface residue is computed as Available Surface Residue – Post Harvest Forage – Post Harvest Grazing.	The amount of surface residue remaining after the harvest and post harvest removal is complete. It will check to ensure that there is sufficient residue remaining for the specified post harvest operations (Available Surface Residue – Post Harvest Forage – Post Harvest Grazing > 0).

Crop Harvested and Yields									
Crop Name	Crop Harvest Type	Crop Harvest Moisture [%]	Crop Yield [yield/acre]	Yield units	Rootmass [DM lbs/ac]	Available Surface Residue [DM lbs/ac]	Post Harvest Forage Removed [DM lbs/ac]	Post Harvest Grazing Animal Unit Days [AUD/acre]	Remaining Surface Residue [DM lbs/ac]
Wheat	Commodity	12	60.0	bu/acre	970	4,118			
Beans	Commodity	12	3000.0	lbs/acre	210	3,696			
Wheat	Commodity	15	75.0	bu/acre	1,445	5,020			

Main Input Worksheet Tab

Variable	Description	Additional Comments
Soil Amendments (Organics)		
Applied Stored Manure	Enter the amount of stored manure applied to the field.	This value is the amount of dry matter applied to the field. The user needs to know the volume and moisture content of the manure to estimate this value.
Compost	Enter the amount of compost applied to the field.	This value is the amount of dry matter applied to the field.
Seed, Transplants, Sprigs, etc.	Enter the amount of seeds, transplants, sprigs and/or any other matter required to establish the crop.	This value is the dry weight of seed, transplants, sprigs, etc. applied to establish the crop during each crop interval.
Animal Feed OM	Enter the amount of animal matter applied to the field.	This value is the dry matter weight of organic-based feed supplements imported to the field, such as hay.
Other Applied OM	Enter the amount of any other organic matter applied to the field.	This value is the dry matter weight of any other organic based materials such as mulching materials or wood chips imported to the field.

Soil Amendments					
Crop Name	Applied Stored Manure [DM lbs/ac]	Compost Organic Matter [DM lbs/ac]	Seed [DM lbs/ac]	Animal Feed Organ Mat [DM lbs/ac]	Other Applied Organ. Mat. [DM lbs/ac]
Wheat	0	0	50	0	0
Beans	0	0	100	0	0
Wheat	0	0	60	0	0

Agrichemicals (Fertilizers)

N	Enter the amount of nitrogen applied to the field in pounds per acre.	This value is the weight in pounds of nitrogen applied to the field. The tool assumes a value of 20,000 BTU/lb of nitrogen.
P	Enter the amount of phosphorus applied to the field in pounds per acre.	This value is the weight in pounds of phosphorus or P_2O_5 applied to the field in pounds per acre. The tool assumes a value of 7,000 BTU/lb of P_2O_5.
K	Enter the amount of potassium applied to the field in pounds per acre.	This value is the weight in pounds of potassium or K_2O applied to the field. The tool assumes a value of 5,500 BTU/lb of K_2O.
S	Enter the amount of sulfur applied to the field in pounds per acre.	This value is the weight in pounds of sulfur applied to the field. The tool assumes a value of 2,000 BTU/lb of sulfur.
Herbicide	Enter the amount of herbicide active ingredient (AI) applied to the field in ounces per acre.	This is the amount of active ingredient contained in all herbicides applied to the field. The chemical container provides the active ingredient for the herbicide.
Pesticide	Enter the amount of pesticide active ingredient (AI) applied to the field in ounces per acre.	This is the amount of active ingredient contained in all other chemicals applied that are not accounted for in the herbicide input value. The chemical container provides the active ingredient for the pesticide.

Agrichemicals/Fertilizers						
Crop Name	N Nitrogen Application [lbs/acre]	P_2O_5 Phosphorus Application [lbs/acre]	K_2O Potassium Application [lbs/acre]	S Sulfur Application [lbs/acre]	H_{rb} AI Herbicide Application [oz/acre]	P_{st} AI Pesticide Application [oz/acre]
Wheat	115	35	70	20	4	6
Beans	50	40	70	20	4	6
Wheat	100	40	85	20	4	6

Main Input Worksheet Tab

Variable	Description	Additional Comments
Field Operations Diesel Use		
Operation	Enter the type of operation from the pull down menu.	The operation variable filters the RUSLE 2 Operation Table values, based on five categories: application, tillage, planting, harvest and other.
Operation Description	Enter the operation description from the pull down menu.	This value is selected from the RUSLE 2 operations table.
Frequency	Enter the frequency or number of times this operation occurs per crop interval.	This value is used if the same operation occurs multiple times during the interval. If the value is left blank, the tool assumes the operation occurs one time during the interval. The user can also account for use of GPS technology to reduce the number of passes. For example, if planting with a 40' drill there is typically a 1' overlap but with GPS the overlap is no longer needed. This would reduce the number of passes by 1/40 or a 2.5%. A value of 0.975 could be used.
Diesel Use	Diesel use is automatically selected from a lookup table.	This value is automatically selected from the RUSLE 2 operations table.
Manual Input	Enter any operations not in RUSLE 2 operations table or any RUSLE 2 operations if additional lines are needed.	These two lines are provided to account for any additional operations not included in the RUSLE 2 drop down menu or if additional lines are needed. Combining multiple RUSLE 2 operations is also acceptable if more than 10 operations are required per crop interval. For example, if operations 11 and 12 are harvest (*Diesel Use* = 1.53 gal.ac) and bale (*Diesel Use* = 0.38 gal/ac) grain corn, these could be combined into one manual input row named harvest and bale grain corn with 1.91 gal/ac as the *Diesel Use* value.

Field Operations Diesel Use: Crop Interval 1 (Benchmark)				
Crop Name	Operation	Operation Description	Number of Times per Interval	Diesel Use [gal/ac]
Wheat	Tillage	Disk, tandem heavy primary op.	2	1.5
	Tillage	Chisel, sweep shovel 5 in. depth, coil tine har		1
	Tillage	Cultivator, field 6-12 in sweeps, coil tine har		0.96
	Planting	Drill or air seeder single disk openers, + fert. opnrs 7-10 in spac.		0.48
	Application	Sprayer, fungicide and insecticide tank mix		0.13
	Application	Sprayer, post emergence		0.13
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	

Main Input Worksheet Tab

Variable	Description	Additional Comments
System Design Input for Irrigation and Other Delivery Energy Needs		
Delivery Type	Select Yes/No for each Delivery Type.	This allows for multiple pumps to be used during the analysis. Irrigation Delivery is the main pump.
Operating Pressure	Enter the operating pressure of the pump.	This is the pressure required to lift the water from the source and apply it onto the field. For example if the pressure gage at the pump reads 50 psi and the water depth in the well is 23 feet (10 psi) below the pump. The operating pressure should be entered as 60 psi (50psi + 10psi).
Delivery or Pumping Plant Efficiency	Enter the delivery or pumping plant efficiency.	The pumping plant efficiency is the efficiency of the pump and motor. To get an accurate pump efficiency requires a pump test. Since this may not be available, the following resources may be helpful: obtain a pump curve; ask an irrigation engineer, specialists or manufacturer; or use the tables in NEH Part 652 Irrigation Guide – Chapter 12 and/or other irrigation resources.
Hours of Operation	Enter the hours per day the pump operates.	This is the number of hours the pump operates each day and is used to determine the horsepower of the pump.
Application Efficiency	Enter the application efficiency of the irrigation system.	This is the application efficiency of the system. It is the difference between the gross and net applied, or what is actually available to the crop. For example, a side roll may have an application efficiency of 70% or 7 out of 10 gallons pumped are available for the crop. The other 3 gallons were lost due to non-uniformity, deep percolation, evaporation, spray drift, or pipe leakage.
Energy Use Rate	The energy use rate is the computed value taken from the intermediate worksheet calculations.	The energy use rate is the amount of energy in BTU required to pump 1 gallon of water.
Irrigation Application	Enter the irrigation application rate for the field.	This is the rate at which the water is applied to the field. It can be in units of inches/day, cubic feet per second, or gallons per minute. The pump may have this value. It is used to determine horsepower of the pump.
Computed Delivery Power	The computed delivery power is the computed value taken from the intermediate calculations worksheet.	This value is the horsepower required for the system to operate. It is a function of the operating pressure, hours of operation, irrigation application, and field acres. It will not compute unless these are populated.
Actual Delivery Power	Enter the actual delivery power of the pump.	This value checks that the current pump is properly sized.

System Design Input for Irrigation and Other Delivery Energy Needs							Pump Check		
Delivery Type	Check to Activate	Operating Pressure [psi]	Delivery or Pump Plant Efficiency [%]	Hours of Operation per Day [hr]	Application Efficiency [%]	Energy Use Rate [BTU/gal]	Irrigation Application gpm	Computed Delivery Power [HP]	Actual Delivery Power [HP]
Irrigation Delivery	☑	50	65%	24	70%	1.9	850	38	
Other Delivery Energy 1	☑	35	75%	12	NA	1.2	NA	2	
Other Delivery Energy 2	☐								
Other Delivery Energy 3	☐								

Main Input Worksheet Tab

Variable	Description	Additional Comments
Water Use Applied for Irrigation and Other Delivery Energy Needs		
Pumping Description	Enter the operation description from the pull down menu.	For the main irrigation delivery system, select either gross or net applied. The gross amount applied is the amount pumped and the net is the amount available to the crop. This allows the user the flexibility to input either number. For the other pumping, select the type of pump as either booster, dairy, stock, windbreak or other. This is for documentation and as a check that all pumping has been discussed and input.
Unit Rate	Enter the units used to estimate the irrigation rate from the pull down menu.	For the main irrigation delivery system, the value is input as depth, or inches per season applied to the field. Field acres are used to convert the depth to a volume required to irrigate the crop. For the other delivery power, the selected units are a rate and are input as either cubic feet per second, gallons per field, or gallons per minute. Since this is a rate, it requires the number of days the system operates to compute a volume.
Amount Used by Crop	Enter the amount of water used by the crop.	This is the amount of water delivered to the crop. It can be input as either net or gross applied and has units of inches. The input value is then converted to a volume of water applied by multiplying the number of inches by the number of acres. For the other delivery power, the tool allows unit flexibility, so the planner should check that this value corresponds to the unit rate selected and the days of operation.
Days of Operation	Enter the days of the pump operates.	This is the number of days the pump is operated. This applies only to the other delivery power needs (other pumps).

Water Use Applied for Irrigation and Other Delivery Energy Needs							
Delivery Type	Pumping Description	Units	Amount Used by the Crop				
			Wheat	Beans	Wheat		
Irrigation Delivery	Gross Applied	in/season	40.0				
Other Delivery Energy 1	Booster	gpm	75				
	Days of Operation	days	90				
Other Delivery Energy 2							
Other Delivery Energy 3							

Input Greenhouse Gas Worksheet Tab

Variable	Description	Additional Comments
Greenhouse Gas Coefficient Using COMET		
Energy Input	Fuel type as provided by the COMET website.	These are separated into liquid, gas, electricity, and other energy inputs. The other energy inputs have a place holder for assigning an emission coefficient, but are defaulted as zero.
Units	Units are taken from fuel type and units costs table.	This table is found in the main input worksheet.
Energy	The energy in MMBTU is taken from the fuel type and units cost table.	This table is found in the main input worksheet.
GHG Emission Coefficients	Enter the emission coefficients from the COMET website. These values are in pounds per unit for CO_2, N_2O, CH_4, Total CO_2, SO_2 and NO_X.	COMET provides GHG coefficients in pounds per unit of energy for different fuel types based on zip code. Most fuel types, except for electricity, are either static or seldom change. COMET should be periodically checked for updates.
Zip Code	Enter the zip code of the field(s) where energy plan is being developed.	
Link to COMET website	Button linked to COMET.	

Greenhouse Gas Table	GHG Emission Coefficients (EC) in lbs. per unit of energy input							
Energy Input	Units	Energy [MMBTU]	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	Total CO_2 Equivalent [lb]	SO_2 [lb]	NO_x [lb]
Liquid								
Diesel	Gal	0.1390	22.3769	0.0005	0.003	22.586	0.0003	0.018
Gasoline (E10)	Gal	0.1200	19.6432	0.0006	0.003	19.888	0.0003	0.011
BioDiesel B2	Gal	0.1386	21.9139	0.0005	0.003	22.126	0.0001	0.010
BioDiesel B5	Gal	0.1380	21.2526	0.0005	0.003	21.461	0.0001	0.010
BioDiesel B10	Gal	0.1369	20.1282	0.0005	0.003	20.337	0.0001	0.010
BioDiesel B20	Gal	0.1349	17.9015	0.0005	0.003	18.110	0.0001	0.010
BioDiesel B100	Gal	0.1183	0.000	0.0005	0.003	0.209	0.0001	0.010
SVO	Gal	0.1231	0.000	0.0005	0.003	0.209	0.0001	0.010
Gas								
Propane	Gal	0.0916	12.6545	0.0004	0.002	12.821	0.0001	0.010
Natural Gas	CCF	0.1030	11.6977	0.0004	0.002	11.864	0.0001	0.010
CNG	CCF	0.1000	12.0372	0.00386	0.002	13.275	0.0001	0.010
Electricity								
Electricity	KWH	0.0034	0.2592	0.00000	0.00001	0.261	0.0001	0.0003
Other Energy Input								
Soil Admendments	Ton	11.25	0.000	0.0000	0.000	0.000	0.0000	0.000
Agrichemicals/Fert.	lb	Varies	0.000	0.0000	0.000	0.000	0.0000	0.000
Labor	Day	0.0119	0.000	0.0000	0.000	0.000	0.0000	0.000

Zip Code 99402

Input Practice Standards Worksheet Tab

Variable	Description	Additional Comments
Percent Allocated		
Select from	Select either All Practice Standards or Energy Only Practice Standards.	This is a toggle between a list containing all of the practice standards and a filtered list of practice standards associated with energy. The filtered list can be modified as needed by clicking on the "Goto Practice Standards List" button and checking the boxes next to the practice standard that are needed in the filtered list.
Practice Standards	Select from a practice standards used from the pull down menu for the planned scenario.	Select the practice standards that are being used with the planned scenario from the pull down menu.
Energy Input	Enter the percentage of energy saved for the following: harvest operation, field operation, irrigation delivery power, other delivery power, agrichemicals, and soil amendments.	This value is the percent of energy saved by the practice standard. A table shows the computed percentages based on the difference between the benchmark and planned input variables.
Energy Harvest	Enter the percentage of energy saved for the following: crop harvest removed, post harvest grazing yield, and post harvest crop residue removed.	This value is the percent of energy saved by the practice standard. A table shows the computed percentages based on the difference between the benchmark and planned input variables
Energy Residual	Enter the percentage of energy saved for the following; rootmass and surface residue.	This value is the percent of energy saved by the practice standard. A table shows the computed percentages based on the difference between the benchmark and planned input variables
Energy not accounted for in a practice standard	Computed value showing the remaining energy saved not associated with a practice standard.	
Energy change (Benchmark vs. Planned)	Computed value showing the difference between the benchmark versus planned scenarios.	The energy change is the difference between the benchmark and the planned (benchmark minus planned) scenarios for energy input to the field. For energy harvested and residual it is planned minus benchmark.
Fuel Type Used		
Practice Standards	Select from a practice standards used from the pull down menu for the planned scenario.	Select the practice standards that are being used with the planned scenario from the pull down menu.
Fuel Type Used	Select from the pull down menu for the type of fuel used (gas, diesel, biodiesel etc.)	All field operation are computed from RUSLE2 using the estimated diesel rate in gallon per acre. Selection a different fuel type is computed as the ratio of MMBTU of diesel versus the other fuel type.
Other Energy Input	Populated as Agrichemicals or Soil Amendments.	These values are automatically populated.

Percent Allocated

Practice Standards Select from ☐ All Practice Standards ☑ Energy Only Practice Standards	Energy Input to the Field							Energy Harvest			Energy Residual	
	Harvest Operations	Field Operations	Irrigation Delivery Power	Other Delivery Power	Agri-Chemical Applied	Soil Amend Applied	Labor	Crop Harvest Removed	Post Harvest		Root-mass	Surface Residue
									Grazing Yield	Crop Residue Removed		
329 Residue Management, No-Till/Strip Till/Direct Seed		100%	100%		100%		100%	100%				100%

Fuels Type Used

Practice Standards	Fuel Types Used				Other Energy Input		
	Harvest Operations	Field Operations	Irrigation Delivery Power	Other Delivery Power	Agri-Chemicals	Soil Amendments Applied	Labor
329 Residue Management, No-Till/Strip Till/Direct Seed		Diesel	Electricity		Agrichem		Labor

Appendix C - Report Worksheets and Defined Variables

Report: Energy Summary for Alternative Field Rotations Worksheet Tab

Variable	Description	Additional Comments
Summary Report		
Background – Landowner Input	Report headings are taken from the Main Input Worksheet and include: landowner, field location, field area, field ID, date, latitude, and longitude.	Report headings supply the information necessary for the plan description.
Alternatives	Report sub headings are taken from main input worksheets and include: crop rotation, length of rotation, and field description.	Report headings supply the information necessary for the plan description.
Energy Input	Computed summation of all energy inputs to the field on a per acre per year basis. These include: harvest operations, field operations, irrigation and delivery power, other delivery power, agrichemicals, and soil amendments.	This is the input energy required for the field to produce a crop. It basically accounts for fuel used, fertilizers, soil amendments, and pumping.
Energy Harvest	Computed summation of all energy harvested from field. These include: crop harvest removed, post harvest grazing, and post harvest crop residue removed.	This variable accounts for anything that is harvested or removed from the field. This includes grazing, and any post harvest removal of stubble through grazing and/or baling.
Energy Remaining	Computed summation of all energy remaining in the field. This would include stubble and rootmass.	This is the amount of plant matter remaining in the field including stubble and root mass. Removing residual matter could benefit one resource while negatively impacting another. For example, baling stubble is considered an energy benefit at the expense of soil health. Planning should consider all resources which are beyond this tool.
Total Energy Yield	Computed summation of all energy supplied to and generated by the field.	Energy input + energy harvest + energy residual
Energy Gain Index	Computed ratio of total biomass produced, divided by energy input.	Index ratio showing the energy gain per energy unit added to the field. (Energy harvest + energy residual)/energy input.
Output Index	Computed ratio of energy harvested divided by energy input.	Energy harvest / energy input.
Energy Harvest Index	Computed ratio of energy harvested divided by total biomass produced.	Energy harvest / (energy harvest + energy residual).

NRCS - CROPLAND ENERGY TOOL

ENERGY SUMMARY FOR ALTERNATIVE FIELD ROTATIONS

Landowner: Oliver Row
Field Location: Grant Co., WA
Field Area: 150 ac
Field ID: 2
Date: 2/11/2103
Latitude: 46.88
Longitude: 117.21

	ALTERNATIVES	
Alternative Description	BENCHMARK	PLANNED
Crop Rotation	Wheat-Beans-Wheat	Wheat-Beans-Wheat
Length of Rotation	3.00 yrs	3.00 yrs
Irrigation Method	Convential Tillage to Direct Seed	Convential Tillage to Direct Seed
Energy Input (added) to Field [MMBTU/Ac/Yr]	**3.7**	**3.4**
	Savings 7.4% 0.3 MMBTU/ac/yr	
Energy Harvest [MMBTU/Ac/Yr]	**24.1**	**25.0**
	Gain 3.7% 0.9 MMBTU/ac/yr	
Energy Remaining [MMBTU/Ac/Yr]	**38.6**	**39.8**
	Gain 3% 1.2 MMBTU/ac/yr	
Total Energy Yield [MMBTU/Ac/Yr]	**59.0**	**61.3**
	Gain 4% 2.3 MMBTU/ac/yr	
Energy Gain Index	**16.94**	**18.89**
Output Index	**0.38**	**0.39**
Energy Harvest Index	**6.51**	**7.29**

Report: Detailed Energy Summary for Alternative Field Rotations Worksheet Tab

Variable	Description	Additional Comments
Detailed Report		
Background – Landowner Input	Report headings are taken from the Main Input Worksheet and include: landowner, field location, field area, field ID, date, latitude, and longitude.	Report headings supply the information necessary for the plan description.
Alternatives	Report sub headings are taken from main input worksheet and include: crop rotation, length of rotation, and field description.	Report headings supply the information necessary for the plan description.
Energy Input	Computed summation of all energy inputs to the field on a per acre per year basis. These include: harvest operations, field operations, irrigation and delivery power, other delivery power, agrichemicals, and soil amendments.	This is the input energy required for the field to produce a crop. It basically accounts for fuel used, fertilizers, soil amendments, and pumping.
Energy Harvest	Computed summation of all energy harvested from field. These include: crop harvest removed, post harvest grazing, and post harvest crop residue removed.	This variable accounts for anything that is harvested or removed from the field. This includes grazing, and any post harvest removal of stubble through grazing and/or baling.
Energy Remaining	Computed summation of all energy remaining in the field. This would include stubble and rootmass.	This is the amount of plant matter remaining in the field including stubble and root mass. Removing residual matter could benefit one resource while negatively impacting another. For example baling stubble is considered an energy benefit at the expense of soil health. Planning should consider all resources which are beyond this tool.
Total Energy Yield	Computed summation of all energy supplied to and generated by the field.	Energy input + energy harvest + energy residual
Energy Gain Index	Computed ratio of total biomass produced divided by energy input.	Index ratio showing the energy gain per energy unit added to the field. (Energy harvest + energy residual)/ energy input.
Output Index	Computed ratio of energy harvested divided by energy input.	Energy harvest / energy input
Energy Harvest Index	Computed ratio of energy harvested divided by total biomass produced.	Energy harvest / (energy harvest + energy residual)

NRCS - CROPLAND ENERGY TOOL

ENERGY SUMMARY FOR ALTERNATIVE FIELD ROTATIONS

Landowner: Oliver Row | Field Area: 150 ac | Date: 2/11/2103
Field Location: Grant Co., WA | Field ID: 2 | Latitude: 46.88
Longitude: 117.21

	ALTERNATIVES	
Alternative Description	BENCHMARK	PLANNED
Crop Rotation	Wheat-Beans-Wheat	Wheat-Beans-Wheat
Length of Rotation	3.00 yrs	3.00 yrs
Irrigation Method	Convential Tillage to Direct Seed	Convential Tillage to Direct Seed
Energy Input (added) to Field [MMBTU/Ac/Yr]	**3.7**	**3.4**
	Savings 7.4% 0.3 MMBTU/ac/yr	
Energy Harvest [MMBTU/Ac/Yr]	**24.1**	**25.0**
	Gain 3.7% 0.9 MMBTU/ac/yr	
Energy Remaining [MMBTU/Ac/Yr]	**38.6**	**39.8**
	Gain 3% 1.2 MMBTU/ac/yr	
Total Energy Yield [MMBTU/Ac/Yr]	**59.0**	**61.3**
	Gain 4% 2.3 MMBTU/ac/yr	
Energy Gain Index	**16.94**	**18.89**
Output Index	**0.38**	**0.39**
Energy Harvest Index	**6.51**	**7.29**

Report: Cost Analysis Summary for Alternative Field Rotations Worksheet Tab

Variable	Description	Additional Comments
Report Costs		
Background – Landowner Input	Report headings are taken from the Main Input Worksheet and include: landowner, field location, field area, field ID, date, latitude, and longitude.	Report headings supply the information necessary for the plan description.
Fuel Types and Unit Cost	Fuel Type and Unit Costs can be manually input on main input worksheet.	This table provides the fuel types, unit of measurement, cost per unit, and the number of BTU per unit. A cost per MMBTU is also computed to compare different fuel type costs.
Per Acre Cost	Average annual input energy cost per acre for the field. These include farming and irrigation energy inputs.	This is the average input energy cost on a per acre per year basis. Different type of energy sources can be selected for the benchmark and planned scenarios. This provides a cost analysis of different fuels being used.
Total Field Costs	Average annual input energy costs for the field. These include farming and irrigation energy inputs.	This is the average input energy cost on a per year basis. Different type of energy sources can be selected for the benchmark and planned scenarios. This provides a cost analysis of different fuels being used.

NRCS - CROPLAND ENERGY TOOL

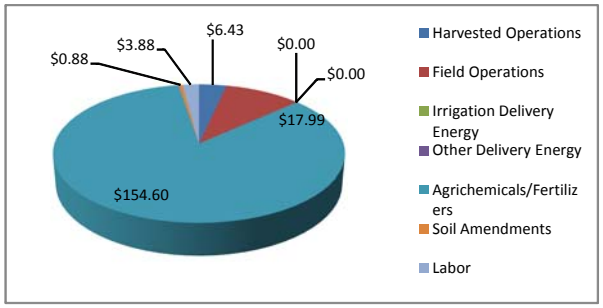
COST ANALYSIS SUMMARY FOR ALTERNATIVE FIELD ROTATIONS

Landowner: Oliver Row
Field Location: Grant Co., WA
Field Area: 150 ac
Field ID: 2
Date: 2/11/2103
Latitude: 46.88
Longitude: 117.21

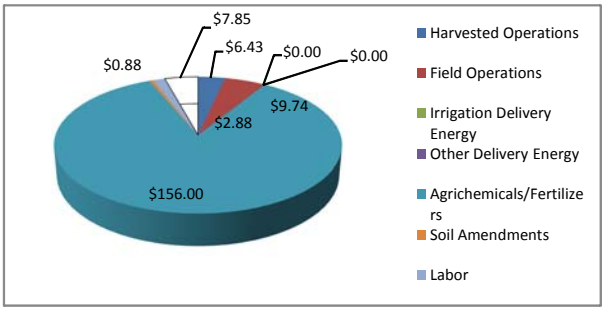
Energy Input - Fuel Types and Unit Costs

Fuel Type	Units	Unit Price	BTU/Unit	Unit Conversion to MMBTU	Cost per MMBTU
Diesel	Gal	$4.20	139,000	7.19	$30.22
Gasoline (E10)	Gal	$3.70	120,000	8.33	$30.83
BioDiesel B2	Gal	$4.00	138,600	7.22	$28.86
BioDiesel B5	Gal	$4.00	138,000	7.25	$28.99
BioDiesel B10	Gal	$4.00	136,900	7.30	$29.22
BioDiesel B20	Gal	$4.00	134,900	7.41	$29.65
BioDiesel B100	Gal	$4.00	118,300	8.45	$33.81
SVO	Gal	$4.00	123,140	8.12	$32.48
Heating Oil	Gal	$4.00	140,000	7.14	$28.56
Propane	Gal	$4.00	91,600	10.93	$43.72
Natural Gas	CCF	$0.86	103,000	10.00	$8.60
CNG	CCF	$4.00	100,000	10.99	$43.96
Ethanol	Gal	$3.00	84,400	11.85	$35.55
Electricity	KWH	$0.04	3,412	293.08	$11.72
Hydro Elec.	KWH	$0.00	3,412	293.08	$0.00
Solar	KWH	$0.00	3,412	293.08	$0.00
Wind	KWH	$0.00	3,412	293.08	$0.00
Soil Amend	ton	$25.00	11,250,000	0.09	$2.22
Labor	day	$30.00	11,900	84.03	$2,521.01
Nitrogen	lb	$0.70	20,000	50.00	$35.00
Phosphorus	lb	$0.65	7,000	142.85	$92.85
Potassium	lb	$0.55	5,500	181.82	$100.00
Sulfur	lb	$0.21	2,000	500.00	$105.00
Herbicide	oz	$0.35	6,250	160.00	$56.00
Pesticide	oz	$3.50	6,250	160.00	$560.00

BENCHMARK COSTS PER ACRE



PLANNED COSTS PER ACRE



Per Acre Costs

Energy Inputs (Added) to the Field	BENCHMARK Wheat-Beans-Wheat 3.00 yr				PLANNED Wheat-Beans-Wheat 3.00 yr				Difference
	Amount MMBTU/ac/yr	Energy Type	Amount Used [Unit/ac]	Cost [$/ac/yr]	Amount MMBTU/ac/yr	Energy Type	Amount Used [Unit/ac]	Cost [$/ac/yr]	Cost Change [$/ac/yr]
Harvested Operations	0.21	Diesel	1.53 Gal	$6.43	0.21	Diesel	1.53 Gal	$6.43	$0.00
Field Operations	0.60	Diesel	4.28 Gal	$17.99	0.32	Diesel	2.32 Gal	$9.74	$8.25
Irrigation Delivery Energy	0.00	Electricity	0 KWH	$0.00	0.00	Electricity	0 KWH	$0.00	$0.00
Other Delivery Energy	0.00	Electricity	0 KWH	$0.00	0.00	Electricity	0 KWH	$0.00	$0.00
Agrichemicals/Fertilizers	2.49	Agrichemicals	222.3 lb	$154.60	2.49	Agrichemicals	222.5 lb	$156.00	($1.40)
Soil Amendments	0.39	Soil Amend	0.04 ton	$0.88	0.39	Soil Amend	0.04 ton	$0.88	$0.00
Labor	0.00	Labor	0.13 day	$3.88	0.00	Labor	0.1 day	$2.88	$1.00
Total:	**3.69**			**$183.77**	**3.42**			**$175.92**	**$7.85**

Total Field Costs

Energy Inputs (Added) to the Field	BENCHMARK Wheat-Beans-Wheat 3.00 yr				PLANNED Wheat-Beans-Wheat 3.00 yr				Difference
	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Cost Change [$/yr]
Harvested Operations	31.90	Diesel	230 Gal	$963.90	31.90	Diesel	230 Gal	$963.90	$0.00
Field Operations	89.31	Diesel	643 Gal	$2,698.50	48.37	Diesel	348 Gal	$1,461.60	$1,236.90
Irrigation Delivery Energy	0.00	Electricity	0 KWH	$0.00	0.00	Electricity	0 KWH	$0.00	$0.00
Other Delivery Energy	0.00	Electricity	0 KWH	$0.00	0.00	Electricity	0 KWH	$0.00	$0.00
Agrichemicals/Fertilizers	373.71	Agrichemicals	33343.6 lb	$23,190	373.95	Agrichemicals	33381.1 lb	$23,400	($210)
Soil Amendments	59.06	Soil Amend	5.25 ton	$131	59.06	Soil Amend	5.25 ton	$131	$0
Labor	0.23	Labor	19 day	$581.48	0.17	Labor	14 day	$431.42	$150.06
Total:	**554.21**			**$27,565**	**513.45**			**$26,388**	**$1,177**

Report: Input Summary Worksheet

Variable	Description	Additional Comments
Input Summary from Main Input Worksheet		
Background – Landowner Input	Report headings are taken from the Main Input Worksheet and include: landowner, field location, field area, field ID, date, latitude, and longitude.	Report headings supply the information necessary for the plan description.
Benchmark versus Planned	Tabular values	This report provides the data recorded from the main input worksheet in a condensed format. This could also be used when meeting with the landowner to ensure all required data is collected and correct.

NRCS - CROPLAND ENERGY TOOL

INPUT SUMMARY WORKSHEET

Landowner: Oliver Row | Field Area: 150 ac | Date: 2/11/2103

Field Location: Grant Co., WA | Field ID: 2 | Latitude: 46.88 | Longitude: 117.21

BENCHMARK

Crop Yields

Crop Name	Year	Labor	Crop Harvest Moisture	Crop Yield	Yield Unit	Post Harvest	
						Forage Removed	Grazing AUD
	[yr]	[hr/ac]	[%]	[yld/ac]		[DM lb/ac]	
Wheat	2013	1.0	12	60.0	bu/acre		
Beans	2014	0.8	12	3000.0	lbs/acre		
Wheat	2015	1.3	15	75.0	bu/acre		

Soil Amendments

Crop Name	Applied Stored Manure	Compost	Seed, transplnt, sprig, etc.	Animal Feed O. M.	Other Applied O. M.
	[DM lb/ac]				
Wheat	0	0	50	0	0
Beans	0	0	100	0	0
Wheat	0	0	60	0	0

Agrichemicals/Fertilizers

Crop Name	N Nitrogen [lbs/acre]	P Phosphorus [lbs/acre]	K Potassium [lbs/acre]	S Sulfur [lbs/acre]	H_{rb} Herbicide [oz/acre]	P_{st} Pesticide [oz/acre]
Wheat	115	35	70	20	4	6
Beans	50	40	70	20	4	6
Wheat	100	40	85	20	4	6

PLANNED

Crop Yields

Crop Name	Year	Labor	Crop Harvest Moisture	Crop Yield	Yield Unit	Post Harvest	
						Forage Removed	Grazing AUD
	[yr]	[hr/ac]	[%]	[yld/ac]		[DM lb/ac]	
Wheat	2013	0.8	12	63.0	bu/acre		
Beans	2014	0.5	12	3050.0	lbs/acre		
Wheat	2015	1.0	15	78.0	bu/acre		

Soil Amendments

Crop Name	Applied Stored Manure	Compost	Seed, transplnt, sprig, etc.	Animal Feed O. M.	Other Applied O. M.
	[DM lb/ac]				
Wheat	0	0	50	0	0
Beans	0	0	100	0	0
Wheat	0	0	60	0	0

Agrichemicals/Fertilizers

Crop Name	N Nitrogen [lbs/acre]	P Phosphorus [lbs/acre]	K Potassium [lbs/acre]	S Sulfur [lbs/acre]	H_{rb} Herbicide [oz/acre]	P_{st} Pesticide [oz/acre]
Wheat	115	35	70	20	8	6
Beans	50	40	70	20	8	6
Wheat	100	40	85	20	8	6

NRCS - CROPLAND ENERGY TOOL

INPUT SUMMARY WORKSHEET

Landowner: Oliver Row | Field Area: 150 ac | Date: 2/11/2103
Field Location: Grant Co., WA | Field ID: 2 | Latitude: 46.88 | Longitude: 117.21

BENCHMARK

Diesel Use

Crop Name	Operation Description	No. Times	Diesel Use [gal/ac]
Wheat	Disk, tandem heavy primary op.	2	1.50
	Chisel, sweep shovel 5 in. depth, coil tine har	1	1.00
	Cultivator, field 6-12 in sweeps, coil tine har	1	0.96
	Drill or air seeder single disk openers, + fert. Opnrs 7-10 in spa	1	0.48
	Sprayer, fungicide and insecticide tank mix	1	0.13
	Sprayer, post emergence	1	0.13
	Harvest, killing crop 50pct standing stubble	1	1.53
Beans	Disk, tandem heavy primary op.	2	1.50
	Disk, tandem light finishing	1	0.40
	Cultivator, field 6-12 in sweeps, coil tine har	1	0.96
	Drill or air seeder single disk openers, + fert. Opnrs 7-10 in spa	1	0.48
	Sprayer, fungicide and insecticide tank mix	1	0.13
	Sprayer, post emergence	1	0.13
	Harvest, killing crop 50pct standing stubble	1	1.53
Wheat	Disk, tandem heavy primary op.	3	2.25
	Chisel, sweep shovel	1	1.10
	Cultivator, field 6-12 in sweeps, coil tine har	1	0.96
	Drill or air seeder single disk openers, + fert. Opnrs 7-10 in spa	1	0.48
		Total:	15.65

Irrigation

Method	Op. Pressure [psi]	Pump plant Efficiency [%]	Operating Hours [hr]	Power Req [BTU/gal]	Ave. Amt Applied [in]	Ave. Amt Pumped [Mgal]
Irrigation Delivery						
Other Delivery 1						
Other Delivery 2						
Other Delivery 3						

PLANNED

Diesel Use

Crop Name	Operation Description	No. Times	Diesel Use [gal/ac]
Wheat	Sprayer, kill crop	3	0.39
	Sprayer, fungicide and insecticide tank mix	1	0.13
	Fert applic. shank low disturbance, 12 in	1	0.90
	Drill, air seeder, 4 inch stealth openers on 12 in spac	1	0.43
	Harvest, killing crop 50pct standing stubble	1	1.53
Beans	Sprayer, kill crop	3	0.39
	Sprayer, fungicide and insecticide tank mix	1	0.13
	Fert applic. shank low disturbance, 12 in	1	0.90
	Drill, air seeder, 4 inch stealth openers on 12 in spac	1	0.43
	Harvest, killing crop 50pct standing stubble	1	1.53
Wheat	Sprayer, kill crop	2	0.26
	Fert applic. shank low disturbance, 15 in spacing	1	0.90
	Planter, in-row subsoiler low disturbace	1	2.10
	Harvest, killing crop 50pct standing stubble	1	1.53
		Total:	11.55

Irrigation

Method	Op. Pressure [psi]	Pump plant Efficiency [%]	Operating Hours [hr]	Power Req [BTU/gal]	Ave. Amt Applied [in]	Ave. Amt Pumped [Mgal]
Irrigation Delivery						
Other Delivery 1						
Other Delivery 2						
Other Delivery 3						

Report: Energy Summary by Practice Standard

Variable	Description	Additional Comments
Practice Standard Report for Energy Changes		
Background – Landowner Input	Report headings are taken from the Main Input Worksheet and include: landowner, field location, field area, field ID, date, latitude, and longitude.	Report headings supply the information necessary for the plan description.
Energy Change Distribution by Practice	Tabular values.	This table shows the energy gain/loss by practice standard. These are separated into energy input, energy harvested, and residual. The table also includes the energy that has not been account for in a practice standard.

NRCS - CROPLAND ENERGY TOOL

ENERGY SUMMARY BY PRACTICE STANDARD

Date: 2/11/2103

Landowner: Oliver Row | Field Area: 150 ac | Latitude: 46.88

Field Location: Grant Co., WA | Field ID: 2 | Longitude: 117.21

Energy Change Distribution by Practice

Benchmark Energy [MMBTU]	Energy Input to the Field			Energy Harvest			Energy Residual			Energy Gain (Loss)		
	3.70			24.08			38.60			58.98		
Practice Standard	Number	Percent		Number	Percent		Number	Percent		Number	Percent	
	[MMBTU]	Change	Total	[MMBTU]	Change	Total	[MMBTU]	Change	Total	[MMBTU]	Change	Total
329 Residue Management, No-Till/Strip Till/Direct Seed	(0.28)	100.0%	(7.4%)	0.89	100.0%	3.7%	1.17	100.0%	3.0%	2.34	100.0%	4.0%
Energy not accounted for in a practice standard	0.00	0.0%	0.0%	0.00	0.0%	0.0%	0.00	0.0%	0.0%	0.00	0.0%	0.0%
Energy Change [MMBTU]	(0.28)	100.0%	(7.4%)	0.89	100.0%	3.7%	1.17	100.0%	3.0%	2.34	100.0%	4.0%
Planned Energy [MMBTU]	3.43			24.97			39.77			61.32		

Report: Greenhouse Gas Change by Practice Standard

Variable	Description	Additional Comments
Practice Standards Report		
Background – Landowner Input	Report headings are taken from the Main Input Worksheet and include: landowner, field location, field area, field ID, date, latitude, and longitude.	Report headings supply the information necessary for the plan description.
Total Field Input/ Per Acre Input	Toggle between total field and per acre emissions.	This planner can select the total field greenhouse gas emissions or emissions on a per acre basis.
Reduced Greenhouse Gas Emissions	Tabular values.	This table shows the reduced greenhouse gas emissions based on energy saved by practice standard. This report is used as part of the planning process inside tool kit.

NRCS - CROPLAND ENERGY TOOL

GREENHOUSE GAS CHANGE BY PRACTICE STANDARD

Date: 2/11/2103

Landowner: Oliver Row | Field Area: 150 ac | Latitude: 46.88

Field Location: Grant Co., WA | Field ID: Washington | Longitude: 117.21

Total Field	Energy	Reduced Greenhouse Gas Emissions				
Practice Standard	Savings [MMBTU]	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	SO_2 [lb]	NO_x [lb]
329 Residue Management, No-Till/Strip Till/Direct Seed	41.29	6,590.0	0.143	0.818	0.084	5.301
Energy percentage not accounted for in a practice standard	0.00	0.0	0.000	0.000	0.000	0.000

Practice Standard (Summary)	Energy	Reduced Greenhouse Gas Emissions				
	Savings [MMBTU]	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	SO_2 [lb]	NO_x [lb]
Energy Practice Standards	41.29	6,590.0	0.143	0.818	0.084	5.301
Non-Energy Practice Standards	0.00	0.0	0.000	0.000	0.000	0.000
Energy percentage not accounted for in a practice standard	0.00	0.0	0.000	0.000	0.000	0.000
Total	41.29	6,590.0	0.143	0.818	0.084	5.301

Report: Inputs for Computing Greenhouse Gas Emissions

Variable	Description	Additional Comments
Practice Standards Report		
Background – Landowner Input	Report headings are taken from Main Input Worksheet and include: landowner, field location, field area, field ID, date, latitude, and longitude.	Report headings supply the information necessary information for plan description.
Total Field Input/ Per Acre Input	Toggle between total field and per acre emissions	The planner can select the total field inputs or per acre inputs to get amount of fuel used. The table shows benchmark, planned, and difference scenarios. Greenhouse gas emissions can also be computed from this table using COMET.

NRCS - CROPLAND ENERGY TOOL

INPUTS FOR COMPUTING GREENHOUSE GAS EMISSIONS

Landowner: Oliver Row
Field Location: Grant Co., WA
Field Area: 150 ac
Field ID: 2
Date: 2/11/2103
Latitude: 46.88
Longitude: 117.21

	Total Field Inputs		
Annual Energy Input (Fuel)	BENCHMARK	PLANNED	DIFFERENCE
Liquid			
Diesel	872 Gal	578 Gal	294 Gal
Gasoline (E10)	0 Gal	0 Gal	0 Gal
BioDiesel B2	0 Gal	0 Gal	0 Gal
BioDiesel B5	0 Gal	0 Gal	0 Gal
BioDiesel B10	0 Gal	0 Gal	0 Gal
BioDiesel B20	0 Gal	0 Gal	0 Gal
BioDiesel B100	0 Gal	0 Gal	0 Gal
SVO	0 Gal	0 Gal	0 Gal
Gas			
Propane	0 Gal	0 Gal	0 Gal
Natural Gas	0 CCF	0 CCF	0 CCF
CNG	0 CCF	0 CCF	0 CCF
Electricity			
Electricity	0 KWH	0 KWH	0 KWH
Other Energy Input			
Soil Amendments	5 ton	5 ton	0 ton
Agrichemicals/Fertilizers	33256 lb	33258 lb	(2) lb
Labor	19 day	14 day	5 day

Reports (3): Greenhouse Gas Emissions From Field Inputs for Benchmark (B), Planned (P), and Changed (B-P)

Variable	Description	Additional Comments
Greenhouse Gas Emissions		
Background – Landowner Input	Report headings are taken from the Main Input Worksheet and include: landowner, field location, field area, field ID, date, latitude, and longitude.	Report headings supply the information necessary for the plan description.
Total Field Input/ Per Acre Input	Toggle between total field and per acre emissions.	This planner can select the total field greenhouse gas emissions or emissions on a per acre basis.
Energy Input	Tabular values.	This table shows all of the COMET fuel type, units and greenhouse gas emissions.

NRCS - CROPLAND ENERGY TOOL

BENCHMARK GREENHOUSE GAS EMISSIONS FROM FIELD INPUTS

Landowner: Oliver Row
Field Location: Grant Co., WA
Field Area: 150 ac
Field ID: 2
Date: 2/11/2103
Latitude: 46.88
Longitude: 117.21

Total Field Inputs

Energy Input	Units	Value	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	Total CO_2 [lb]	SO_2 [lb]	NO_x [lb]
Liquid								
Diesel	Gal	872.0	19,512.7	0.42	2.42	19,694.6	0.25	15.70
Gasoline (E10)	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B2	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B5	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B10	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B20	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B100	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
SVO	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Gas								
Propane	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Natural Gas	CCF	0.0	0.0	0.00	0.00	0.0	0.00	0.00
CNG	CCF	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Electricity								
Electricity	KWH	0	0.0	0.00	0.00	0.0	0.00	0.00
Other Energy Input								
Soil Amendments	Ton	5	0.0	0.00	0.00	0.0	0.00	0.00
Agrichemicals/Fert.	lb	33,256	0.0	0.00	0.00	0.0	0.00	0.00
Labor	Day	19.00	0.0	0.00	0.00	0.0	0.00	0.00
TOTAL	**554 [MMBTU]**		**19,512.7**	**0.4**	**2.4**	**19,694.6**	**0.2**	**15.7**

NRCS - CROPLAND ENERGY TOOL

PLANNED GREENHOUSE GAS EMISSIONS FROM FIELD INPUTS

Landowner: Oliver Row | Field Area: 150 ac | Date: 2/11/2103
Field Location: Grant Co., WA | Field ID: 2 | Latitude: 46.88
Longitude: 117.21

Total Field Inputs

Energy Input	Units	Value	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	Total CO_2 [lb]	SO_2 [lb]	NO_x [lb]
Liquid								
Diesel	Gal	578.0	12,933.8	0.28	1.61	13,054.5	0.16	10.40
Gasoline (E10)	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B2	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B5	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B10	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B20	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B100	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
SVO	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Gas								
Propane	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Natural Gas	CCF	0.0	0.0	0.00	0.00	0.0	0.00	0.00
CNG	CCF	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Electricity								
Electricity	KWH	0	0.0	0.00	0.00	0.0	0.00	0.00
Other Energy Input								
Soil Amendments	Ton	5	0.0	0.00	0.00	0.0	0.00	0.00
Agrichemicals/Fert.	lb	33,258	0.0	0.00	0.00	0.0	0.00	0.00
Labor	Day	14.00	0.0	0.00	0.00	0.0	0.00	0.00
TOTAL	**513 [MMBTU]**		**12,933.8**	**0.28**	**1.61**	**13,054.5**	**0.16**	**10.40**

NRCS - CROPLAND ENERGY TOOL

GREENHOUSE GAS EMISSION CHANGES FROM FIELD INPUTS

Landowner: Oliver Row | Field Area: 150 ac | Date: 2/11/2103
Field Location: Grant Co., WA | Field ID: 2 | Latitude: 46.88
Longitude: 117.21

Total Field Inputs

Energy Input	Units	Value	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	Total CO_2 [lb]	SO_2 [lb]	NO_x [lb]
Liquid								
Diesel	Gal	294.0	6,578.8	0.14	0.82	6,640.2	0.08	5.29
Gasoline (E10)	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B2	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B5	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B10	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B20	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B100	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
SVO	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Gas								
Propane	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Natural Gas	CCF	0.0	0.0	0.00	0.00	0.0	0.00	0.00
CNG	CCF	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Electricity								
Electricity	KWH	0	0.0	0.00	0.00	0.0	0.00	0.00
Other Energy Input								
Soil Amendments	Ton	0	0.0	0.00	0.00	0.0	0.00	0.00
Agrichemicals/Fert.	lb	(2)	0.0	0.00	0.00	0.0	0.00	0.00
Labor	Day	5.00	0.0	0.00	0.00	0.0	0.00	0.00
TOTAL	**41 [MMBTU]**		**6,578.8**	**0.14**	**0.82**	**6,640.2**	**0.08**	**5.29**

Appendix D - Agronomy Examples

CEET evaluates energy associated with crop production, multiple crop rotations, farming operations, pesticides, herbicides, fertilizers, soil amendments, and labor. CEET is a flexible model allowing both simple and complex plans as required by the planning process. CEET generates output reports based on the input provided.

Below are two agronomic examples: a single crop for a single year period and a multiple crop rotation over a three year period. These examples may not represent practices common to all areas, but are provided to illustrate aspects of the tool.

Non-Irrigated Single Crop Example

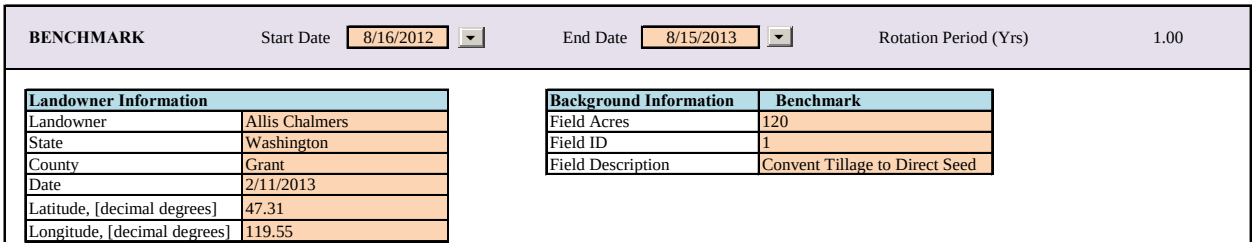
Farmer Allis has a 120 acre field of dry land spring wheat that produces 60 bushels to the acre. He harvests the spring wheat around August 15th. He is considering changing his method of operations from conventional tillage to direct seed. He wants to know how much energy he saves by changing operations.

For this field, changing from conventional tillage to direct seed should provide a slight increase in yield, decrease in labor, increase in pesticide application, and require different equipment use. NRCS Practice Standard 329 Direct Seed applies for this alternative. The following describes the procedure used in CEET.

The main input worksheet tab in CEET contains all of the input required for this example. Input cells are shaded to assist the planner. CEET is separated into the "benchmark" or existing condition and the "planned" or future condition of a given field. As shown in Figure D-1, enter the landowner and background information on the "benchmark" alternative. The "planned" side will auto-fill but can be overwritten if there are differences between the "benchmark" and "planned" alternatives.

Background and Landowner Information

Enter the *Start Date* and *End Date* for both the "benchmark" and 'planned" alternatives. The *Start Date* is the day after the previous crop is harvested and the *End Date* is the day of harvest. This computes the *Rotation Period* as shown in Figure D-1 and is used to average energy use on a per year basis (i.e. MMBTU/year). All states and counties are available through pull-down menus. The latitude and longitude cells are entered as decimal degrees and are included for future GIS applications.



BENCHMARK Start Date 8/16/2012 End Date 8/15/2013 Rotation Period (Yrs) 1.00

Landowner Information	
Landowner	Allis Chalmers
State	Washington
County	Grant
Date	2/11/2013
Latitude, [decimal degrees]	47.31
Longitude, [decimal degrees]	119.55

Background Information	Benchmark
Field Acres	120
Field ID	1
Field Description	Convent Tillage to Direct Seed

Figure D-1 Landowner and Background Input Information

Crop Interval, Name and Harvest Dates

For this example, select "Wheat" and "Wheat, spring 14in rows" from the pull-down menus for *Crop Name* and *Specific Crop Description*, respectively. The pull-down menus are attached to the RUSLE 2 vegetative tables. Enter the *Year Crop Harvested* as a 4 digit number, or 2013 for this example. This is the year when the crop is harvested and comes after the *Start Date* and before the *End Date* shown in Figure D-1. The *Biomass Yield Ratio* is selected from RUSLE 2 vegetative table.

Labor comprises the hours of work necessary to produce the crop on a per acre basis and is entered as 1.0 hr/acre for this example. The energy associated with labor is relatively insignificant when compared to other operations, but economically, may have a large impact on landowner decisions.

Crop Interval, Name and Harvest Dates					
Crop Interval	Crop Name	Specific Crop Description	Year Crop Harvested [YYYY]	Biomass Yield ratio [-]	Labor [hr/acre]
1	Wheat	Wheat, spring 14in rows	2013	1.30	1.0
2					
3					
4					
5					

Figure D-2 Crop Interval, Name and Harvest Dates

Crop Harvested and Yields

Once the crop is selected, CEET automatically shades the cell for input. For this example, only the rows associated with Crop Interval 1 are shaded. The Crop Harvested and Yields input values shown in Figure D-3 include: *Crop Harvest Type*, *Crop Harvest Moisture,* and *Crop Yield*. Enter "Commodity", 12, and 60, respectively. The *Crop Harvest Type* is selected from a pull-down menu with four choices: grazing, forage, commodity and multiple use. "Multiple Use" is selected from the pull-down menu when any post harvesting work is needed, for example baling the straw or grazing stubble.

For this example "Commodity" is selected because the field is not being baled or grazed. The moisture content is the percent of moisture in the harvested crop. The *Rootmass* and *Available Surface Residue* values are taken from RUSLE 2 vegetative table. The *Post Harvest Forage* and *Post Harvest Grazing* are available when *Crop Harvest Type* is selected as "Multiple Use". The *Remaining Surface Residue* is added to check that both post harvest input values do not exceed the *Available Surface Residue*.

Crop Harvested and Yields									
Crop Name	Crop Harvest Type	Crop Harvest Moisture [%]	Crop Yield [yield/acre]	Yield units	Rootmass [DM lbs/ac]	Available Surface Residue [DM lbs/ac]	Post Harvest Forage Removed [DM lbs/ac]	Post Harvest Grazing Animal Unit Days [AUD/acre]	Remaining Surface Residue [DM lbs/ac]
Wheat	Commodity	12	60.0	bu/acre	950	4,118			

Figure D-3 Crop Harvested and Yields

Soil Amendments

The soil amendment input values account for any manure, compost, seeding, animal feed, or other organic materials applied to the field. These values are entered as dry matter applied in pounds per acre. For this example, enter the dry seeding rate of 50 pounds per acre as shown in Figure D-4.

Soil Amendments					
Crop Name	Applied Stored Manure [DM lbs/ac]	Compost Organic Matter [DM lbs/ac]	Seed [DM lbs/ac]	Animal Feed Organ Mat [DM lbs/ac]	Other Applied Organ. Mat. [DM lbs/ac]
Wheat	0	0	50	0	0

Figure D-4 Soil Amendments

Agrichemicals/Fertilizers

CEET accounts for the energy associated with four types of fertilizers: nitrogen, phosphorus, potassium, and sulfur. Fertilizers are input as pounds applied of N, P_2O_5, K_2O and S per acre, respectively. CEET reports energy as BTU per pound of fertilizer and is the average energy required to produce the fertilizer.

The pesticides and herbicides are input as ounces of active ingredients. Active ingredients are the portion of the pesticide/herbicide that is used to kill, control, or repel pests or weeds. Active ingredients are not the entire amount in a chemical container, but are provided on the label. If this is unavailable, NRCS WinPST has percentages of active ingredients, and Pacific Northwest Weed Management Handbook, Pacific Northwest Plant Disease Management Handbook, or Pacific Northwest Insect Management Handbook are good references for these values. For this example, the field requires: 115 pounds of nitrogen, 40 pounds of phosphorus, 85 pounds of potassium, 20 pounds of sulfur, 4 ounces of herbicides, and 6 ounces of pesticides as shown in Figure D-5.

Agrichemicals/Fertilizers						
Crop Name	N Nitrogen Application [lbs/acre]	P_2O_5 Phosphorus Application [lbs/acre]	K_2O Potassium Application [lbs/acre]	S Sulfur Application [lbs/acre]	H_{rb} AI Herbicide Application [oz/acre]	P_{st} AI Pesticide Application [oz/acre]
Wheat	115	35	70	20	4	6

Figure D-5 Agrichemicals/Fertilizers

The energy value associated with the active ingredients varies significantly for different types of pesticides or herbicides. Tracking energy use associated with each active ingredient can become quite time consuming and is difficult to maintain an updated table in the tool. For these reasons, CEET applies an average energy value of 100,000 BTU per pound of active ingredient. For many alternatives, pesticides/herbicides are a small percentage of the overall energy use. Precise accounting of energy use for all pesticides/herbicides is not required unless an alternative merits this accounting. If the planner needs to conduct this type of accounting, CEET has the flexibility to adjust the average energy associated with pesticides/herbicides and fertilizers by adjusting the input values as shown at the bottom of the table in Figure D-6.

Energy Use for Fuel Types and Unit Costs					
Fuel Type	Units	Unit Price	BTU/Unit	Unit Conversion to MMBTU	Cost per MMBTU
Diesel	Gal	$4.20	139,000	7.19	$30.22
Gasoline (E10)	Gal	$3.70	120,000	8.33	$30.83
BioDiesel B2	Gal	$4.00	138,600	7.22	$28.86
BioDiesel B5	Gal	$4.00	138,000	7.25	$28.99
BioDiesel B10	Gal	$4.00	136,900	7.30	$29.22
BioDiesel B20	Gal	$4.00	134,900	7.41	$29.65
BioDiesel B100	Gal	$4.00	118,300	8.45	$33.81
SVO	Gal	$4.00	123,140	8.12	$32.48
Heating Oil	Gal	$4.00	140,000	7.14	$28.57
Propane	Gal	$4.00	91,600	10.92	$43.67
Natural Gas	CCF	$0.86	103,000	9.71	$8.35
CNG	CCF	$4.00	100,000	10.00	$40.00
Ethanol	Gal	$3.00	84,400	11.85	$35.55
Electricity	KWH	$0.04	3,412	293.1	$11.72
Hydro Elec.	KWH	$0.00	3,412	293.1	$0.00
Solar	KWH	$0.00	3,412	293.1	$0.00
Wind	KWH	$0.00	3,412	293.1	$0.00
Agrichemicals	lb	Varies	Varies	Varies	Varies
Soil Amend	ton	$25.00	11,250,000	0.089	$2.22
Labor	day	$30.00	11,900	84.03	$2,521.01
Nitrogen	lb	$0.70	20,000	50.00	$35.00
Phosphorus	lb	$0.65	7,000	142.86	$92.86
Potassium	lb	$0.55	5,500	181.82	$100.00
Sulfur	lb	$0.21	2,000	500.00	$105.00
Herbicide	oz	$0.35	6,250	160.00	$56.00
Pesticide	oz	$3.50	6,250	160.00	$560.00
Note: These values should be checked and updated periodically					

Figure D-6 Energy Use for Fuel Types and Unit Costs

Field Operations Diesel Use and Crop Interval

The *Operation* column is a pull-down menu that filters the RUSLE 2 operations table into 5 categories: harvest, tillage, application, planting, and other. The *Operation Description* contains the RUSLE 2 filtered list. The *Frequency* is the number of times an operation is completed per crop interval. The frequency value defaults as a value of "1" if left blank. *Frequency* can also account for any field efficiency not represented by RUSLE 2 diesel use values. A good example is GPS technology which could reduce the number of passes needed on the field, possibly reducing the amount of diesel use by 3% or "0.97" for the *Frequency* value.

For this example, enter the values as shown in Figure D-7 below. It is not necessary to input the field operations in any specific or chronological order. Operations occurring multiple times are accounted for by entering the number of times in the *Frequency* column. This eliminates the redundancy of selecting the same operation multiple times in the CEET tool. Crops having more than 10 different operations in an interval can combine operations and use the "Manual Input" lines, or the last two lines per interval, to input the combined operations and corresponding diesel use. The "Manual Input" lines are also available to account for field operations not included in RUSLE 2.

Field Operations Diesel Use: Crop Interval 1 (Benchmark)				
Crop Name	Operation	Operation Description	Number of Times per Interval	Diesel Use [gal/ac]
Wheat	Tillage	Disk, tandem heavy primary op., roller, smooth		0.88
	Tillage	Chisel, sweep shovel, coil tine har		1.3
	Tillage	Chisel, st. pt.		1
	Application	Fert applic. anhyd knife 12 in		0.9
	Planting	Drill or air seeder, hoe-chisel openers 12-15 in spac.		0.74
	Application	Sprayer, post emergence		0.13
	Application	Sprayer, fungicide		0.13
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	

Figure D-7 Field Operations Diesel Use

These are all of the input values required for the "benchmark" alternative. Inputting values for the "planned" alternative follows the same procedure. For this example, most of the input values are the same except *Labor*, *Crop Yield*, *Agrichemicals*, *Fertilizers*, and *Field Operations*. Figures D-8 through D-11 show these differences.

Crop Interval, Name and Harvest Dates					
Crop Interval	Crop Name	Specific Crop Description	Year Crop Harvested [YYYY]	Biomass Yield ratio [-]	Labor [hr/acre]
1	Wheat	Wheat, spring 14in rows	2013	1.30	0.8
2					
3					
4					
5					

Figure D-8 "Planned" Crop Interval, Name and Harvest Dates (compare to D-2)

Crop Harvested and Yields									
Crop Name	Crop Harvest Type	Crop Harvest Moisture [%]	Crop Yield [per acre]	Yield units	Rootmass [DM lbs/ac]	Available Surface Residue [DM lbs/ac]	Post Harvest Forage Removed [DM lbs/ac]	Post Harvest Grazing Animal Unit Days [AUD/acre]	Remaining Surface Residue [DM lbs/ac]
Wheat	Commodity	12	65.0	bu/acre	950	4,462			

Figure D-9 "Planned" Crop Harvested and Yields (compare to D-3)

Agrichemicals/Fertilizers						
Crop Name	N Nitrogen Application [lbs/acre]	P_2O_5 Phosphorus Application [lbs/acre]	K_2O Potassium Application [lbs/acre]	S Sulfur Application [lbs/acre]	H_{rb} AI Herbicide Application [oz/acre]	P_{st} AI Pesticide Application [oz/acre]
Wheat	125	45	90	20	12	6

Figure D-10 "Planned" Agrichemicals/Fertilizers (compared to D-5)

Field Operations Diesel Use: Crop Interal 1 (Planned)				
Crop Name	Operation	Operation Description	Frequency No. of Times per Interval	Diesel Use [gal/ac]
Wheat	Application	Sprayer, kill crop	3	0.39
	Application	Sprayer, fungicide and insecticide tank mix		0.13
	Application	Fert applic. shank low disturbance, 12 in		0.9
	Planting	Drill, air seeder, 4 inch stealth openers on 12 in spac		0.43
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	

Figure D-11 "Planned" Field Operations Diesel Use (compared to D-7)

Farmer Allis saved 3.2 gallons of diesel but used 20 more pounds of agrichemicals/fertilizers per acre. This shows an overall energy input savings of 0.14 MMBTU per acre. Farmer Allis also increased crop production by 5 bushels per acre or an overall energy harvested gain of 2.0 MMBTU per acre. He reduced his labor by 0.2 hours per acre. Figure D-12 shows the energy summary for this change in operations.

	ALTERNATIVES	
Alternative Description	BENCHMARK	PLANNED
Crop Rotation	Wheat	Wheat
Length of Rotation	1.00 yrs	1.00 yrs
Irrigation Method	Convent Tillage to Direct Seed	Convent Tillage to Direct Seed
Energy Input (added) to Field [MMBTU/Ac/Yr]	**4.35**	**4.21**
	Savings 3.1%	**0.1 MMBTU/ac/yr**
Energy Harvest [MMBTU/Ac/Yr]	**23.8**	**25.7**
	Gain 8.3%	**2 MMBTU/ac/yr**
Energy Remaining [MMBTU/Ac/Yr]	**38.0**	**40.6**
	Gain 6.8%	**2.6 MMBTU/ac/yr**
Total Energy Yield [MMBTU/Ac/Yr]	**57.4**	**62.1**
	Gain 8.2%	**4.7 MMBTU/ac/yr**

Figure D-12 Energy Summary Report for Example 1

Non-Irrigated Multiple Crop Example

Farmer Oliver has 150 acre dry land field in a 3 year rotation of spring wheat, garbanzo beans and winter wheat. He harvests his winter wheat around July 31st. He is considering changing his method of operations from conventional tillage to direct seed. He wants to know how much energy he saves by changing operations.

For this field, changing from conventional tillage to direct seed should provide a slight increase in yield, decrease in labor, increase in pesticide application, and require different equipment use for all crops. NRCS Practice Standard 329 Direct Seed applies for this alternative. The following describes the procedure used in CEET.

The main input worksheet tab in CEET contains all of the input required for this example. Input cells are shaded to assist the planner. CEET is separated into the "benchmark" or existing condition and the "planned" or future condition of a given field. As shown in Figure D-13, enter the landowner and background information on the "benchmark" alternative. The "planned" side will auto-fill but can be overwritten if there are differences between the "benchmark" and "planned" alternatives.

Background and Landowner Information

Enter the *Start Date* and *End Date* for both the "benchmark" and 'planned" alternatives. The *Start Date* is the day after the previous crop is harvested and the *End Date* is the day of harvest. This computes the *Rotation Period* as shown in Figure D-13 and is used to average energy use on a per year basis (i.e. MMBTU/year). All states and counties are available through pull-down menus. The latitude and longitude cells are entered as decimal degrees and are included for future GIS applications.

BENCHMARK Start Date 8/1/2012 End Date 7/31/2015 Rotation Period (Yrs) 3.00

Landowner Information	
Landowner	Oliver Row
State	Washington
County	Whitman
Date	2/11/2013
Latitude, [decimal degrees]	46.88
Longitude, [decimal degrees]	117.21

Background Information	Benchmark
Field Acres	150
Field ID	2
Field Description	Convent Tillage to Direct Seed

Figure D-13 Landowner and Background Input Information

Crop Interval, Name and Harvest Dates

For this example, select "Wheat" and "Wheat, spring 14in rows" from the pull-down menus for *Crop Name* and *Specific Crop Description,* respectively for crop interval 1. The pull-down menus are attached to the RUSLE 2 vegetative tables. Enter the *Year Crop Harvested* as a 4 digit number, or 2013 for crop interval 1. This is the year when the crop is harvested and comes after the *Start Date* and before the *End Date* shown in Figure D-13. The *Biomass Yield Ratio* is selected from RUSLE 2 vegetative table. Crop interval 2 and 3 are also selected and entered as describe above. These values are shown in Figure D-14 below.

Labor comprises the hours of work necessary to produce the crop on a per acre basis and is entered as 1.0 hr/acre for crop interval 1. The energy associated with labor is relatively insignificant when compared to other operations, but economically, may have a large impact on landowner decisions. Enter the labor values for crop interval 2 and 3 as shown in Figure D-14 below.

Crop Interval, Name and Harvest Dates					
Crop Interval	Crop Name	Specific Crop Description	Year Crop Harvested [YYYY]	Biomass Yield ratio [-]	Labor [hr/acre]
1	Wheat	Wheat, spring 7in rows	2013	1.30	1.0
2	Beans	Beans, garbonzo	2014	1.40	0.8
3	Wheat	Wheat, winter, CMZ 50 hi ppt, 7-10 in. spac. late plant	2015	1.31	1.3
4					
5					

Figure D-14 Crop Interval, Name and Harvest Dates

Crop Harvested and Yields

Once the crop is selected, CEET automatically shades the cell for input. For this example, the rows associated with Crop Intervals 1 through 3 are shaded. The Crop Harvested and Yields input values shown in Figure D-15 include: *Crop Harvest Type*, *Crop Harvest Moisture*, and *Crop Yield*. For Crop Interval 1, enter "Commodity", 12, and 60, respectively. The *Crop Harvest Type* is selected from a pull-down menu with four choices: grazing, forage, commodity and multiple use. "Multiple Use" is selected from the pull-down menu when any post harvesting work is needed, for example baling the straw or grazing stubble.

For this example, "Commodity" is selected for each interval because the field is not being baled or grazed. The moisture content is the percent of moisture in the harvested crop. The *Rootmass* and *Available Surface Residue* values are taken from RUSLE 2 vegetative table. The *Post Harvest Forage* and *Post Harvest Grazing* are available when *Crop Harvest Type* is selected as "Multiple Use." The *Remaining Surface Residue* is added to check that both post harvest input values do not exceed the *Available Surface Residue*. Figure D-15 below shows the input values for crop intervals 1, 2, and 3.

Crop Harvested and Yields									
Crop Name	Crop Harvest Type	Crop Harvest Moisture [%]	Crop Yield [yield/acre]	Yield units	Rootmass [DM lbs/ac]	Available Surface Residue [DM lbs/ac]	Post Harvest Forage Removed [DM lbs/ac]	Post Harvest Grazing Animal Unit Days [AUD/acre]	Remaining Surface Residue [DM lbs/ac]
Wheat	Commodity	12	60.0	bu/acre	970	4,118			
Beans	Commodity	12	3000.0	lbs/acre	210	3,696			
Wheat	Commodity	15	75.0	bu/acre	1,445	5,020			

Figure D-15 Crop Harvested and Yields

Soil Amendments

The soil amendment input values account for any manure, compost, seeding, animal feed, or other organic materials applied to the field. These values are entered as dry matter applied in pounds per acre. For this example, enter the dry seeding rate of 50, 100 and 60 pounds per acre for each crop interval as shown in Figure D-16.

Soil Amendments					
Crop Name	Applied Stored Manure [DM lbs/ac]	Compost Organic Matter [DM lbs/ac]	Seed [DM lbs/ac]	Animal Feed Organ Mat [DM lbs/ac]	Other Applied Organ. Mat. [DM lbs/ac]
Wheat	0	0	50	0	0
Beans	0	0	100	0	0
Wheat	0	0	60	0	0

Figure D-16 Soil Amendments

Agrichemicals/Fertilizers

CEET accounts for the energy associated with four types of fertilizers: nitrogen, phosphorus, potassium, and sulfur. Fertilizers are input as pounds applied of N, P_2O_5, K_2O and S per acre, respectively. CEET reports energy as BTU per pound of fertilizer and is the average energy required to produce the fertilizer.

The pesticides and herbicides are input as ounces of active ingredients. Active ingredients are the portion of the pesticide/herbicide that is used to kill, control, or repel pests or weeds. Active ingredients are not the entire amount in a chemical container, but are provided on the label. If this is unavailable, NRCS WinPST has percentages of active ingredients, and Pacific Northwest Weed Management Handbook, Pacific Northwest Plant Disease Management Handbook, or Pacific Northwest Insect Management Handbook are good references for these values. For this example, the input values are as shown in Figure D-17.

Agrichemicals/Fertilizers						
Crop Name	N Nitrogen Application [lbs/acre]	P_2O_5 Phosphorus Application [lbs/acre]	K_2O Potassium Application [lbs/acre]	S Sulfur Application [lbs/acre]	H_{rb} AI Herbicide Application [oz/acre]	P_{st} AI Pesticide Application [oz/acre]
Wheat	115	40	85	20	4	6
Beans	50	40	70	20	4	6
Wheat	100	40	85	20	4	6

Figure D-17 Agrichemicals/Fertilizers

The energy value associated with the active ingredients varies significantly for different types of pesticides or herbicides. Tracking energy use associated with each active ingredient can become quite time consuming and is difficult to maintain an updated table in the tool. For these reasons, CEET applies an average energy value of 100,000 BTU per pound of active ingredient. For many alternatives, pesticides/herbicides are a small percentage of the overall energy use. Precise accounting of energy use for all pesticides/herbicides is not required unless an alternative merits this accounting. If the planner needs to conduct this type of accounting, CEET has the flexibility to adjust the average energy associated with pesticides/herbicides and fertilizers by adjusting the input values as shown at the bottom of the table in Figure D-6.

Field Operations Diesel Use and Crop Interval

The *Operation* column is a pull-down menu that filters the RUSLE 2 operations table into 5 categories: harvest, tillage, application, planting, and other. The *Operation Description* contains the RUSLE 2 filtered list. The *Frequency* is the number of times an operation is completed per crop interval. The frequency value defaults as a value of "1" if left blank. *Frequency* can also account for any field efficiency not represented by RUSLE 2 diesel use values. A good example is GPS technology which could reduce the number of passes needed on the field, possibly reducing the amount of diesel use by 3% or "0.97" for the *Frequency* value.

For this example, enter the values as shown in Figure D-18 below. It is not necessary to input the field operations in any specific or chronological order. Operations occurring multiple times are accounted for by entering the number of times in the *Frequency* column. This eliminates the redundancy of selecting the same operation multiple times in the CEET tool. Crops having more than 10 different operations in an interval can combine operations and use the "Manual Input" lines, or the last two lines per interval, to input the combined operations and corresponding diesel use. The "Manual Input" lines are also available to account for field operations not included in RUSLE 2.

Field Operations Diesel Use: Crop Interval 1 (Benchmark)				
Crop Name	Operation	Operation Description	Number of Times per Interval	Diesel Use [gal/ac]
Wheat	Tillage	Disk, tandem heavy primary op.	2	1.5
	Tillage	Chisel, sweep shovel 5 in. depth, coil tine har		1
	Tillage	Cultivator, field 6-12 in sweeps, coil tine har		0.96
	Planting	Drill or air seeder single disk openers, + fert. opnrs 7-10 in spac.		0.48
	Application	Sprayer, fungicide and insecticide tank mix		0.13
	Application	Sprayer, post emergence		0.13
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
Field Operations Diesel Use: Crop Interval 2 (Benchmark)				
Beans	Tillage	Disk, tandem heavy primary op.	2	1.5
	Tillage	Disk, tandem light finishing		0.4
	Tillage	Cultivator, field 6-12 in sweeps, coil tine har		0.96
	Planting	Drill or air seeder single disk openers, + fert. opnrs 7-10 in spac.		0.48
	Application	Sprayer, fungicide and insecticide tank mix		0.13
	Application	Sprayer, post emergence		0.13
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
Field Operations Diesel Use: Crop Interval 3 (Benchmark)				
Wheat	Tillage	Disk, tandem heavy primary op.	3	2.25
	Tillage	Chisel, sweep shovel		1.1
	Tillage	Cultivator, field 6-12 in sweeps, coil tine har		0.96
	Planting	Drill or air seeder single disk openers, + fert. opnrs 7-10 in spac.		0.48
	Application	Sprayer, fungicide and insecticide tank mix		0.13
	Application	Sprayer, post emergence		0.13
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	

Figure D-18 Field Operations Diesel Use

These are all of the input values required for the "benchmark" alternative. Inputting values for the "planned" alternative follows the same procedure. For this example, most of the input values are the same except *Labor*, *Crop Yield*, *Agrichemicals*, and *Field Operations*. Figures D-19 through D-22 show the different input values.

Crop Interval, Name and Harvest Dates					
Crop Interval	Crop Name	Specific Crop Description	Year Crop Harvested [YYYY]	Biomass Yield ratio [-]	Labor [hr/acre]
1	Wheat	Wheat, spring 7in rows	2013	1.30	0.8
2	Beans	Beans, garbonzo	2014	1.40	0.5
3	Wheat	Wheat, winter, CMZ 50 hi ppt, 7-10 in. spac. late plant	2015	1.31	1.0
4					
5					

Figure D-19 "Planned" Crop Interval, Name and Harvest Dates (compare to D-14)

Crop Harvested and Yields									
Crop Name	Crop Harvest Type	Crop Harvest Moisture [%]	Crop Yield [per acre]	Yield units	Rootmass [DM lbs/ac]	Available Surface Residue [DM lbs/ac]	Post Harvest Forage Removed [DM lbs/ac]	Post Harvest Grazing Animal Unit Days [AUD/acre]	Remaining Surface Residue [DM lbs/ac]
Wheat	Commodity	12	63.0	bu/acre	970	4,324			
Beans	Commodity	12	3050.0	lbs/acre	210	3,758			
Wheat	Commodity	15	78.0	bu/acre	1,445	5,221			

Figure D-20 “Planned” Crop Harvested and Yields (compare to D-15)

Agrichemicals/Fertilizers						
Crop Name	N Nitrogen Application [lbs/acre]	P_2O_5 Phosphorus Application [lbs/acre]	K_2O Potassium Application [lbs/acre]	S Sulfur Application [lbs/acre]	H_{rb} AI Herbicide Application [oz/acre]	P_{st} AI Pesticide Application [oz/acre]
Wheat	115	35	70	20	8	6
Beans	50	40	70	20	8	6
Wheat	100	40	85	20	8	6

Figure D-21 “Planned” Agrichemicals/Fertilizers (compared to D-17)

Field Operations Diesel Use: Crop Interal 1 (Planned)				
Crop Name	Operation	Operation Description	Number of Times per Interval	Diesel Use [gal/ac]
Wheat	Application	Sprayer, kill crop	3	0.39
	Application	Sprayer, fungicide and insecticide tank mix		0.13
	Application	Fert applic. shank low disturbance, 12 in		0.9
	Planting	Drill, air seeder, 4 inch stealth openers on 12 in spac		0.43
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
Field Operations Diesel Use: Crop Interval 2 (Planned)				
Beans	Application	Sprayer, kill crop	3	0.39
	Application	Sprayer, fungicide and insecticide tank mix		0.13
	Planting	Fert applic. shank low disturbance, 12 in		0.9
	Planting	Drill, air seeder, 4 inch stealth openers on 12 in spac		0.43
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
Field Operations Diesel Use: Crop Interval 3 (Planned)				
Wheat	Application	Sprayer, kill crop	2	0.26
	Application	Fert applic. shank low disturbance, 15 in spacing		0.9
	Planting	Planter, in-row subsoiler low disturbace		2.1
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	

Figure D-22 “Planned” Field Operations Diesel Use (compared to D-18)

Farmer Oliver saved an average of 5.9 gallons of diesel per acre or 1.96 gallons of diesel per acre per year. He increased crop production for all three crops having an average annual energy harvested gain of 0.9 MMBTU per acre per year. He reduced his labor by 0.3 hours per acre. He used slightly more agrichemicals (0.025 MMTBU) per acre. Figure D-23 shows the energy summary for this change in operations.

	ALTERNATIVES	
Alternative Description	BENCHMARK	PLANNED
Crop Rotation	Wheat-Beans-Wheat	Wheat-Beans-Wheat
Length of Rotation	3.00 yrs	3.00 yrs
Irrigation Method	Convent Tillage to Direct Seed	Convent Tillage to Direct Seed
Energy Input (added) to Field [MMBTU/Ac/Yr]	**3.68**	**3.28**
	Savings 10.9%	**0.4 MMBTU/ac/yr**
Energy Harvest [MMBTU/Ac/Yr]	**24.1**	**25.0**
	Gain 3.7%	**0.9 MMBTU/ac/yr**
Energy Remaining [MMBTU/Ac/Yr]	**38.6**	**39.8**
	Gain 2.9%	**1.1 MMBTU/ac/yr**
Total Energy Yield [MMBTU/Ac/Yr]	**59.0**	**61.5**
	Gain 4.1%	**2.4 MMBTU/ac/yr**

Figure D-23 Energy Summary Report for Example 2

Appendix E - Irrigation Examples

This appendix provides two examples and several alternatives illustrating irrigation components of the tool. All background and farming inputs associated with these examples are the same for both the "benchmark" and "planned" alternatives. The "benchmark" background and farming inputs are provided below so the planner can follow and reproduce the output for these examples. Discussions of the background and farming inputs are not provided in this appendix, but are provided in Appendix F - Agronomy Examples.

In the first example, Farmer Hart has 100 acres of irrigated triticale and is considering several options for reducing energy. He wants to know how much energy he saves by changing various irrigation system components both individually and collectively. He is considering several alternatives including: renozzling the existing sprinklers, upgrading the pump and motor, reducing water use through irrigation scheduling, or combining the above three alternatives.

In the second example, Farmer Hart irrigates 120 acres of triticale with a center pivot and end gun. He wants to know how much energy he saves if he reduces water use through irrigation scheduling.

Example 1 - Irrigated Triticale for Silage, Pump Upgrade

Figures E-1 through E-6 show the background and farming data provided by Farmer Hart.

BENCHMARK Start Date 8/16/2012 End Date 8/15/2013 Rotation Period (Yrs) 1.00

Landowner Information	
Landowner	Hart Parr
State	Washington
County	Asotin
Date	2/11/2013
Latitude, [decimal degrees]	46.35
Longitude, [decimal degrees]	117.35

Background Information	Benchmark
Field Acres	100
Field ID	3
Field Description	Center Pivot

Figure E-1 Landowner and Background Input Information

Crop Interval, Name and Harvest Dates					
Crop Interval	Crop Name	Specific Crop Description	Year Crop Harvested [YYYY]	Biomass Yield ratio [-]	Labor [hr/acre]
1	Triticale	Triticale, silage	2013	0.30	0.5
2					
3					
4					
5					

Figure E-2 Crop Interval, Name and Harvest Dates

Crop Harvested and Yields									
Crop Name	Crop Harvest Type	Crop Harvest Moisture [%]	Crop Yield [yield/acre]	Yield units	Rootmass [DM lbs/ac]	Available Surface Residue [DM lbs/ac]	Post Harvest Forage Removed [DM lbs/ac]	Post Harvest Grazing Animal Unit Days [AUD/acre]	Remaining Surface Residue [DM lbs/ac]
Triticale	Commodity	70	18.0	tons/acre	1,100	3,240			

Figure E-3 Crop Harvested and Yields

Soil Amendments					
Crop Name	Applied Stored Manure [DM lbs/ac]	Compost Organic Matter [DM lbs/ac]	Seed [DM lbs/ac]	Animal Feed Organ Mat [DM lbs/ac]	Other Applied Organ. Mat. [DM lbs/ac]
Triticale	0	0	50	0	0

Figure E-4 Soil Amendments

Agrichemicals/Fertilizers						
Crop Name	N Nitrogen Application [lbs/acre]	P_2O_5 Phosphorus Application [lbs/acre]	K_2O Potassium Application [lbs/acre]	S Sulfur Application [lbs/acre]	H_{rb} AI Herbicide Application [oz/acre]	P_{st} AI Pesticide Application [oz/acre]
Triticale	130	40	85	20	4	6

Figure E-5 Agrichemicals/Fertilizers

Field Operations Diesel Use: Crop Interval 1 (Benchmark)				
Crop Name	Operation	Operation Description	Number of Times per Interval	Diesel Use [gal/ac]
Triticale	Tillage	Disk, tandem heavy primary op., roller, smooth		0.88
	Tillage	Chisel, sweep shovel, coil tine har		1.3
	Tillage	Chisel, st. pt.		1
	Application	Fert applic. anhyd knife 12 in		0.9
	Planting	Drill or air seeder, hoe-chisel openers 12-15 in spac.		0.74
	Application	Sprayer, post emergence		0.13
	Application	Sprayer, fungicide		0.13
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	

Figure E-6 Field Operations Diesel Use

Farmer Hart irrigates the field with a 50 horsepower motor and centrifugal pump located next to an irrigation pond. The on-farm irrigation system is a center pivot with overhead impact sprinklers. He says the pivot is nozzled to deliver 850 gallons per minute (gpm) to the field. He has not replaced his nozzles in over seven years in a moderately windy location. The pressure gage at the pump reads 65psi during operation. The efficiency stamped on the motor name plate is 90%. The pump curve shows an efficiency of 75%. Farmer Hart did not know how much water was applied to the field, but did know that the pump operated 89 days last season.

Based on the information provided, the two irrigation tables can be populated. Since there is only one pump, check the "Check to Activate" checkbox on the first line for *Delivery Type*. This shades the remaining applicable boxes for input. Farmer Hart provided *Operating Pressure* (65 psi), *Hours of*

Operation (24 hr), *Irrigation Application* (850 gpm), and *Actual Delivery Power* (50 HP). *Pumping Plant Efficiency* is the product of the pump and motor efficiencies (90% * 75%).

The *Application Efficiency* was not provided but can be estimated using the Washington Irrigation Guide or other irrigation guides. For this example, *Application Efficiency* is estimated as 70% for impact sprinklers. Farmer Hart provided enough information to compute the *Gross Applied*. In the second irrigation table, select *Gross Applied* from the pull-down menu and in the other shaded cell enter "40". The entered value is determined by multiplying the flow rate by the number of operating days and converting the volume of water to a depth of water over an area (100 acres). Equation E-1 below shows this conversion. Figures E-7 and E-8 show the input values provided for the irrigation system.

$$\frac{(850\text{gpm})(89\text{days})}{100\text{acre}}\frac{\frac{\text{acre}-\text{ft}}{\text{day}}}{228.28\text{gpm}}\frac{12\text{in}}{\text{ft}}=40\text{in} \qquad \text{Equation E-1}$$

System Design Input for Irrigation and Other Delivery Energy Needs							Pump Check		
Delivery Type	Check to Activate	Operating Pressure [psi]	Delivery or Pump Plant Efficiency [%]	Hours of Operation per Day [hr]	Application Efficiency [%]	Energy Use Rate [BTU/gal]	Irrigation Application gpm	Computed Delivery Power [HP]	Actual Delivery Power [HP]
Irrigation Delivery	☑	65	68%	24	70%	2.4	850	47	50
Other Delivery Energy 1	☐								
Other Delivery Energy 2	☐								
Other Delivery Energy 3	☐								

Figure E-7 "Benchmark" System Design Input

Water Use Applied for Irrigation and Other Delivery Energy Needs							
Delivery Type	Pumping Description	Units	Amount Used by the Crop				
			Triticale				
Irrigation Delivery	Gross Applied	in/season	40.0				
Other Delivery Energy 1							
Other Delivery Energy 2							
Other Delivery Energy 3							

Figure E-8 "Benchmark" Water Use Applied

Application Efficiency relates *Gross Applied* to *Net Applied*. The Washington Irrigation Guide also has *Net Applied* defined as consumptive use for different crops. Other states have published guides containing similar or related water use values for different crop types. If unsure, contact an irrigation engineer for assistance.

After entering the data, CEET calculates *Energy Use Rate* (2.4 BTU/gal) and *Computed Delivery Power* (47HP). *Energy Use Rate* is the amount of energy required to pump one gallon of water. The *Computed Delivery Power* checks that the pump is properly sized. Inputting a value for *Actual Delivery Power* (50HP) is optional and not required for tool operation, but is a convenient check of the existing pump. For this example, the pump is properly sized.

"Planned" Alternative 1 - Renozzling

For the first alternative, Farmer Hart plans on changing the existing impact sprinklers on top of the pivot to drop and spray nozzles. This reduces *Operating Pressure* to 55 psi and increases *Application Efficiency* to 85%. Figure E-8 shows the changes for the "planned" alternative.

Reducing *Operating Pressure* to 55 psi by installing drop spray nozzle sprinklers lowers *Computed Delivery Power* from 47 HP to 40 HP. The 50 HP motor could be reduced to a 40 HP motor. Figure E-9 shows this reduction and shades *Computed Delivery Power* to alert the planner to this potential system change.

System Design Input for Irrigation and Other Delivery Energy Needs							Pump Check		
Delivery Type	Check to Activate	Operating Pressure [psi]	Delivery or Pump Plant Efficiency [%]	Hours of Operation per Day [hr]	Application Efficiency [%]	Energy Use Rate [BTU/gal]	Irrigation Application gpm	Computed Delivery Power [HP]	Actual Delivery Power [HP]
Irrigation Delivery	☑	55	68%	24	85%	2.0	850	**40**	**50**
Other Delivery Energy 1	☐								
Other Delivery Energy 2	☐								
Other Delivery Energy 3	☐								
Actual delivery power exceeds computed delivery power by more than 10%									

Figure E-9 "Planned" Alternative 1 - System Design Input

Reducing *Energy Use Rate* from 2.4 BTU/gal to 2.0 BTU/gal saves 39.5 MMBTU per year or 11,600 kilowatt hours (KWH). In more practical terms, the energy reduction saves $695 based on a $0.06 per KWH. These savings are shown in Figure E-10.

Total Field Costs

Energy Inputs (Added) to the Field	BENCHMARK Triticale 1.00 yr				PLANNED Triticale 1.00 yr				Difference
	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Cost Change [$/yr]
Harvested Operations	21.27	Diesel	153 Gal	$642.60	21.27	Diesel	153 Gal	$642.60	$0.00
Field Operations	70.61	Diesel	508 Gal	$2,133.60	70.61	Diesel	508 Gal	$2,133.60	$0.00
Irrigation Delivery Energy	256.84	Electricity	75275 KWH	$4,516.51	217.33	Electricity	63694 KWH	$3,821.67	$694.85
Other Delivery Energy	0.00	Electricity	0 KWH	$0.00	0.00	Electricity	0 KWH	$0.00	$0.00
Agrichemicals/Fertilizers	345.00	Agrichemicals	27562.5 lb	$19,035	345.00	Agrichemicals	27562.5 lb	$19,035	$0
Soil Amendments	28.13	Soil Amend	2.5 ton	$63	28.13	Soil Amend	2.5 ton	$63	$0
Labor	0.07	Labor	6 day	$187.58	0.07	Labor	6 day	$187.58	$0.00
Total:	**721.92**			**$26,578**	**682.40**			**$25,883**	**$695**

Figure E-10 Cost Savings for "Planned" Alternative 1 - Renozzling Existing System

"Planned" Alternative 2 – Upgrading Pump and Motor

For the second alternative, Farmer Hart plans to upgrade the pump and motor. The US Department of Energy developed MotorMaster+, a database of motors and motor efficiencies. It shows that the highest efficiency premium motor for a 40 HP motor is 95%. For this pressure and flow rate we can find an 82% efficient pump, raising the overall pump efficiency to 78% (95% * 82%). Entering the new efficiency reduces the Energy Use Rate from 2.4 BTU/gal to 2.1 BTU/gallon as shown in Figure E-11.

System Design Input for Irrigation and Other Delivery Energy Needs							Pump Check		
Delivery Type	Check to Activate	Operating Pressure [psi]	Delivery or Pump Plant Efficiency [%]	Hours of Operation per Day [hr]	Application Efficiency [%]	Energy Use Rate [BTU/gal]	Irrigation Application gpm	Computed Delivery Power [HP]	Actual Delivery Power [HP]
Irrigation Delivery	☑	65	78%	24	70%	2.1	850	**41**	**50**
Other Delivery Energy 1	☐								
Other Delivery Energy 2	☐								
Other Delivery Energy 3	☐								
Actual delivery power exceeds computed delivery power by more than 10%									

Figure E-11 "Planned" Alternative 2 – Upgrade Pump and Motor

Reducing *Energy Use Rate* from 2.4 BTU/gal to 2.1 BTU/gal saves 32.9 MMBTU per year or 9,700 kilowatt hours (KWH). In more practical terms, the energy reduction saves $579 based on a $0.06 per KWH. These savings are shown in Figure E-12.

Total Field Costs

Energy Inputs (Added) to the Field	BENCHMARK Triticale 1.00 yr				PLANNED Triticale 1.00 yr				Difference
	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Cost Change [$/yr]
Harvested Operations	21.27	Diesel	153 Gal	$642.60	21.27	Diesel	153 Gal	$642.60	$0.00
Field Operations	70.61	Diesel	508 Gal	$2,133.60	70.61	Diesel	508 Gal	$2,133.60	$0.00
Irrigation Delivery Energy	256.84	Electricity	75275 KWH	$4,516.51	223.91	Electricity	65625 KWH	$3,937.47	$579.04
Other Delivery Energy	0.00	Electricity	0 KWH	$0.00	0.00	Electricity	0 KWH	$0.00	$0.00
Agrichemicals/Fertilizers	345.00	Agrichemicals	27562.5 lb	$19,035	345.00	Agrichemicals	27562.5 lb	$19,035	$0
Soil Amendments	28.13	Soil Amend	2.5 ton	$63	28.13	Soil Amend	2.5 ton	$63	$0
Labor	0.07	Labor	6 day	$187.58	0.07	Labor	6 day	$187.58	$0.00
Total:	**721.92**			**$26,578**	**688.99**			**$25,999**	**$579**

Figure E-12 Cost Savings for "Planned" Alternative 2 - Upgrade Pump and Motor

"Planned" Alternative 3 - Reducing Water Use

For the third alternative, Farmer Hart is considering reducing the water use by applying the correct amount required for the crop through irrigation scheduling. The Washington Irrigation Guide provides an average consumptive use of 24 inches for triticale. This requires changing *Gross Applied* to *Net Applied* from the pull-down menu and changing "40" to "24" in the other shaded cell as shown in Figure E-13 and E-14 below.

System Design Input for Irrigation and Other Delivery Energy Needs							Pump Check		
Delivery Type	Check to Activate	Operating Pressure [psi]	Delivery or Pump Plant Efficiency [%]	Hours of Operation per Day [hr]	Application Efficiency [%]	Energy Use Rate [BTU/gal]	Irrigation Application gpm	Computed Delivery Power [HP]	Actual Delivery Power [HP]
Irrigation Delivery	☑	65	68%	24	70%	2.4	850	47	50
Other Delivery Energy 1	☐								
Other Delivery Energy 2	☐								
Other Delivery Energy 3	☐								

Figure E-13 "Planned" Alternative 3 – System Design Input

Water Use Applied for Irrigation and Other Delivery Energy Needs							
Delivery Type	Pumping Descirption	Units	Amount Used by the Crop				
			Triticale				
Irrigation Delivery	Net Applied	in/season	24.0				
Other Delivery Energy 1							
Other Delivery Energy 2							
Other Delivery Energy 3							

Figure E-14 "Planned" Alternative 3 - Water Use Applied

For this alternative, *Energy Use Rate* did not change, but the volume of water applied decreased from 40-inches to 34.3-inches (24/0.70) or 15.5 million gallons pump as shown in Figure E-15. This water reduction saves 36.7 MMBTU per year or 10,700 kilowatt hours (KWH). In more practical terms, the energy reduction saves $645 based on a $0.06 per KWH. These savings are shown in Figure E-16.

Irrigation Delivery Power Worksheet for Energy Tool						
Operation ID : Hart Parr	Description:				Date: 2/11/2013	
Field Location : Asotin, WA	Center Pivot					
Field Acres : 100						
BENCHMARK						
Baseline crop names	Triticale					
Gross irrigation application [in/crop]	40.0					
Net application, [in/crop]	28					
Million gallons pumped per crop	108.6					
PLANNED						
Planned crop names	Triticale					
Gross irrigation application [in/crop]	34.3					
Net application, [in/crop]	24.0					
Million gallons pumped per crop	93.1					

Figure E-15 Water Savings for "Planned" Alternative 3 – Water Use Applied

Total Field Costs

Energy Inputs (Added) to the Field	BENCHMARK Triticale 1.00 yr				PLANNED Triticale 1.00 yr				Difference
	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Cost Change [$/yr]
Harvested Operations	21.27	Diesel	153 Gal	$642.60	21.27	Diesel	153 Gal	$642.60	$0.00
Field Operations	70.61	Diesel	508 Gal	$2,133.60	70.61	Diesel	508 Gal	$2,133.60	$0.00
Irrigation Delivery Energy	256.84	Electricity	75275 KWH	$4,516.51	220.15	Electricity	64522 KWH	$3,871.30	$645.22
Other Delivery Energy	0.00	Electricity	0 KWH	$0.00	0.00	Electricity	0 KWH	$0.00	$0.00
Agrichemicals/Fertilizers	345.00	Agrichemicals	27562.5 lb	$19,035	345.00	Agrichemicals	27562.5 lb	$19,035	$0
Soil Amendments	28.13	Soil Amend	2.5 ton	$63	28.13	Soil Amend	2.5 ton	$63	$0
Labor	0.07	Labor	6 day	$187.58	0.07	Labor	6 day	$187.58	$0.00
Total:	**721.92**			**$26,578**	**685.23**			**$25,933**	**$645**

Figure E-16 Cost Savings for "Planned" Alternative 3 – Water Use Applied

Planned Alternative 4 – All Alternatives Combined

Combining all three of the above alternatives as shown in Figures E-17 and E-18 reduces energy by 123.1 MMBTU per year or 36,100 kilowatt hours (KWH). In more practical terms, the energy reduction saves $2,164 based on a $0.06 per KWH. These savings are shown in Figure E-19.

System Design Input for Irrigation and Other Delivery Energy Needs							Pump Check		
Delivery Type	Check to Activate	Operating Pressure [psi]	Delivery or Pump Plant Efficiency [%]	Hours of Operation per Day [hr]	Application Efficiency [%]	Energy Use Rate [BTU/gal]	Irrigation Application gpm	Computed Delivery Power [HP]	Actual Delivery Power [HP]
Irrigation Delivery	☑	55	78%	24	85%	1.7	850	**35**	**50**
Other Delivery Energy 1	☐								
Other Delivery Energy 2	☐								
Other Delivery Energy 3	☐								
Actual delivery power exceeds computed delivery power by more than 10%									

Figure E-17 “Planned” Alternative 4 - System Design Input

Water Use Applied for Irrigation and Other Delivery Energy Needs							
Delivery Type	Pumping Descirption	Units	Amount Used by the Crop				
			Triticale				
Irrigation Delivery	Net Applied	in/season	24.0				
Other Delivery Energy 1							
Other Delivery Energy 2							
Other Delivery Energy 3							

Figure E-18 “Planned” Alternative 4 - Water Use Applied

Total Field Costs

Energy Inputs (Added) to the Field	BENCHMARK Triticale 1.00 yr				PLANNED Triticale 1.00 yr				Difference
	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Cost Change [$/yr]
Harvested Operations	21.27	Diesel	153 Gal	$642.60	21.27	Diesel	153 Gal	$642.60	$0.00
Field Operations	70.61	Diesel	508 Gal	$2,133.60	70.61	Diesel	508 Gal	$2,133.60	$0.00
Irrigation Delivery Energy	256.84	Electricity	75275 KWH	$4,516.51	133.74	Electricity	39197 KWH	$2,351.79	$2,164.72
Other Delivery Energy	0.00	Electricity	0 KWH	$0.00	0.00	Electricity	0 KWH	$0.00	$0.00
Agrichemicals/Fertilizers	345.00	Agrichemicals	27562.5 lb	$19,035	345.00	Agrichemicals	27562.5 lb	$19,035	$0
Soil Amendments	28.13	Soil Amend	2.5 ton	$63	28.13	Soil Amend	2.5 ton	$63	$0
Labor	0.07	Labor	6 day	$187.58	0.07	Labor	6 day	$187.58	$0.00
Total:	**721.92**			**$26,578**	**598.82**			**$24,413**	**$2,165**

Figure E-19 Cost Savings for “Planned” Alternative 4 – Combined Alternatives

Example 2 - Irrigated Triticale for Silage – End Gun

As stated previously, Farmer Hart irrigates 120 acres of triticale with a center pivot and end gun. He wants to know how much energy he saves if he reduces water use through irrigation scheduling.

Farmer Hart irrigates this field with a 100 horsepower motor and turbine pump. The irrigation system pumps water for an irrigation well having a water level 150 feet below the ground surface. The on-farm irrigation system is a center pivot with overhead impact sprinklers. He says the pivot is nozzled to deliver 900 gallons per minute (gpm) to the field. The pressure gage at the pump reads 65psi during operation. The efficiency stamped on the motor name plate is 90%. The pump curve shows an efficiency of 80%. Farmer Hart did not know how much water was applied to the field, but did know that the pump operated 85 days last season. He has an end gun sprinkler that delivers 75 gpm at boosts the existing pressure 35 psi and operates 12 hours a day.

Based on the information provided, the two irrigation tables can be populated. There are two types of pumps with this system, the turbine pump and the end gun. Check the "Check to Activate" checkbox on the first two lines for *Delivery Type*. This shades the remaining applicable boxes for input. Farmer Hart provided *Hours of Operation* (24 hr and 12 hr), *Irrigation Application* (950 gpm and 75gpm), and *Actual Delivery Power* (100 HP). *Actual Delivery Power* for the end gun was not provided nor required. *Pumping Plant Efficiency* is the product of the pump and motor efficiencies (90% * 80%).

The *Operating Pressure* is the pressure required to lift the water from the source and apply it onto the field. Based on his information we know the pressure at the pump (65 psi) and we know the depth to the water in the well (150 feet). We need to convert the water depth to a pressure and then add both the gage pressure and the pressure required to lift the water out of the well. The depth to pressure is a simple conversion; there is 2.31 feet of water per psi of pressure, or 65 psi for this example (150ft/2.31ft per psi). *Operating Pressure* is then computed as 130psi or (65psi + 65 psi).

The *Application Efficiency* was not provided but can be estimated using the Washington Irrigation Guide or other irrigation guides. For this example, *Application Efficiency* is estimated as 70% for impact sprinklers. Farmer Hart provided enough information to compute *Gross Applied*. In second irrigation table, select the *Gross Applied* from the pull-down menu and in the other shaded cell enter "40". The entered value is determined by multiplying the flow rate by the number of operating days and converting the volume of water to a depth of water over an area (120 acres). Equation E-2 below shows this conversion. For the end gun, select "Booster" from the pull-down menu, "gpm" from the next shaded pull-down menu and enter "75" as the flow rate in gpm. Enter "96" for *Days of Operation*. Figures E-20 and E-21 show the input values provided for the irrigation system.

$$\frac{(950\text{gpm})(96\text{days})}{120\text{acre}}\frac{\frac{\text{acre}-\text{ft}}{\text{day}}}{228.28\text{gpm}}\frac{12\text{in}}{\text{ft}} = 40\text{in} \qquad \text{Equation E-2}$$

System Design Input for Irrigation and Other Delivery Energy Needs							Pump Check		
Delivery Type	Check to Activate	Operating Pressure [psi]	Delivery or Pump Plant Efficiency [%]	Hours of Operation per Day [hr]	Application Efficiency [%]	Energy Use Rate [BTU/gal]	Irrigation Application gpm	Computed Delivery Power [HP]	Actual Delivery Power [HP]
Irrigation Delivery	☑	130	72%	24	70%	4.5	950	100	100
Other Delivery Energy 1	☑	35	75%	12	NA	1.2	NA	2	
Other Delivery Energy 2	☐								
Other Delivery Energy 3	☐								

Figure E-20 "Benchmark" System Design Input

Water Use Applied for Irrigation and Other Delivery Energy Needs							
Delivery Type	Pumping Description	Units	Amount Used by the Crop				
			Triticale				
Irrigation Delivery	Gross Applied	in/season	40.0				
Other Delivery Energy 1	Booster	gpm	75				
	Days of Operation	days	90				
Other Delivery Energy 2							
Other Delivery Energy 3							

Figure E-21 "Benchmark" Water Use Applied

"Planned" Alternative – Reducing Water Use

For the "planned" alternative, all values are the same except water use applied. The Washington Irrigation Guide provides an average consumptive use of 24 inches for triticale. This requires changing *Gross Applied* to *Net Applied* from the pull-down menu and changing "40" to "24" in the other shaded cell as shown in Figure E-22 below.

The number of days the end gun operates should decrease from 96 to 82. This is computed by solving Equation E-2 for an updated number of days and adjusting the depth of water applied from 40 to 34.3. Equation E-3 shows this computation.

$$\frac{(120\,\text{acre})(34.3\text{in})}{950\text{gpm}}\frac{228.28\text{gpm}}{\frac{\text{acre}-\text{ft}}{\text{day}}}\frac{1\text{ft}}{12\text{in}}=82\text{days} \qquad \text{Equation E-3}$$

Water Use Applied for Irrigation and Other Delivery Energy Needs							
Delivery Type	Pumping Descirption	Units	Amount Used by the Crop				
			Triticale				
Irrigation Delivery	Net Applied	in/season	24.0				
Other Delivery Energy 1	Booster	gpm	75				
	Days of Operation	days	82				
Other Delivery Energy 2							
Other Delivery Energy 3							

Figure E-22 "Planned" Water Use Applied

For this alternative, the *Energy Use Rate* did not change, but the volume of water applied decreased from 40-inches to 34.3-inches (24/0.70) or 18.6 million gallons for the turbine pump and 0.75 million gallons for the booster pump as shown in Figure E-23 and E-24. This water reduction saves 83.2 MMBTU per year or 24,400 kilowatt hours (KWH). In more practical terms, the energy reduction saves $1471 based on a $0.06 per KWH. These savings are shown in Figure E-25.

Irrigation Delivery Power Worksheet for Energy Tool						
Operation ID : Hart Parr	Description:				Date: 2/11/2013	
Field Location : Asotin, WA	Center Pivot					
Field Acres : 120						
BENCHMARK						
Baseline crop names	Triticale					
Gross irrigation application [in/crop]	40.0					
Net application, [in/crop]	28					
Million gallons pumped per crop	130.3					
PLANNED						
Planned crop names	Triticale					
Gross irrigation application [in/crop]	34.3					
Net application, [in/crop]	24.0					
Million gallons pumped per crop	111.7					

Figure E-23 Turbine Pump Water Savings for "Planned" Alternative – Water Use Applied

Other Delivery Power 1 Worksheet for Energy Tool						
Operation ID : Hart Parr	Description:				Date: 2/11/2013	
Field Location : Asotin, WA	Center Pivot					
Field Acres : 120						
BENCHMARK						
Baseline crop names	Triticale					
Other Pumping Type : Booster [gpm]	75					
Days of Operation, [days]	96					
Million gallons pumped per crop	5.18					
PLANNED						
Planned crop names	Triticale					
Other Pumping Type : Booster [gpm]	75					
Days of Operation, [days]	82					
Million gallons pumped per crop	4.43					

Figure E-24 Booster Pump Water Savings for "Planned" Alternative – Water Use Applied

Total Field Costs

Energy Inputs (Added) to the Field	BENCHMARK Triticale 1.00 yr				PLANNED Triticale 1.00 yr				Difference
	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Amount MMBTU/yr	Energy Type	Amount Used [Unit]	Cost [$/yr]	Cost Change [$/yr]
Harvested Operations	25.52	Diesel	184 Gal	$771.12	25.52	Diesel	184 Gal	$771.12	$0.00
Field Operations	84.73	Diesel	610 Gal	$2,560.32	84.73	Diesel	610 Gal	$2,560.32	$0.00
Irrigation Delivery Energy	582.17	Electricity	170624 KWH	$10,237.43	499.00	Electricity	146249 KWH	$8,774.94	$1,462.49
Other Delivery Energy	5.61	Electricity	1644 KWH	$98.66	5.11	Electricity	1498 KWH	$89.89	$8.77
Agrichemicals/Fertilizers	414.00	Agrichemicals	33075 lb	$22,842	414.00	Agrichemicals	33075 lb	$22,842	$0
Soil Amendments	33.75	Soil Amend	3 ton	$75	33.75	Soil Amend	3 ton	$75	$0
Labor	0.09	Labor	8 day	$225.09	0.09	Labor	8 day	$225.09	$0.00
Total:	**1145.87**			**$36,810**	**1062.21**			**$35,338**	**$1,471**

Figure E-25 Cost Savings for "Planned" Alternative – Water Use Applied

Appendix F - GHG & Practice Standards Examples

The Greenhouse Gas (GHG) and Practice Standards worksheets are optional and only require population if additional output reports are needed for planning or program purposes. Both Greenhouse Gas and Practice Standards worksheets rely on the input values contained in the main input worksheet.

Generally the output results are not needed by the farmer. In this case, Farmer Hart is interested in how much energy and reduced emissions his field would have if he followed "Planned" Alternative 4 shown in Appendix F. For convenience, previously developed input values are provided below: As needed, refer to Appendix F and G for additional discussion of these input values.

Figures F-1 through F-6 show the background and farming data provided by Farmer Hart. The background and farming data are the same for both the "Benchmark" and "Planned" alternative.

BENCHMARK Start Date 8/16/2012 End Date 8/15/2013 Rotation Period (Yrs) 1.00

Landowner Information	
Landowner	Hart Parr
State	Washington
County	Asotin
Date	2/11/2013
Latitude, [decimal degrees]	46.35
Longitude, [decimal degrees]	117.35

Background Information	Benchmark
Field Acres	100
Field ID	3
Field Description	Center Pivot

Figure F-1 Landowner and Background Input Information

Crop Interval, Name and Harvest Dates					
Crop Interval	Crop Name	Specific Crop Description	Year Crop Harvested [YYYY]	Biomass Yield ratio [-]	Labor [hr/acre]
1	Triticale	Triticale, silage	2013	0.30	0.5
2					
3					
4					
5					

Figure F-2 Crop Interval, Name and Harvest Dates

Crop Harvested and Yields									
Crop Name	Crop Harvest Type	Crop Harvest Moisture [%]	Crop Yield [yield/acre]	Yield units	Rootmass [DM lbs/ac]	Available Surface Residue [DM lbs/ac]	Post Harvest Forage Removed [DM lbs/ac]	Post Harvest Grazing Animal Unit Days [AUD/acre]	Remaining Surface Residue [DM lbs/ac]
Triticale	Commodity	70	18.0	tons/acre	1,100	3,240			

Figure F-3 Crop Harvested and Yields

Soil Amendments					
Crop Name	Applied Stored Manure [DM lbs/ac]	Compost Organic Matter [DM lbs/ac]	Seed [DM lbs/ac]	Animal Feed Organ Mat [DM lbs/ac]	Other Applied Organ. Mat. [DM lbs/ac]
Triticale	0	0	50	0	0

Figure F-4 Soil Amendments

Agrichemicals/Fertilizers						
Crop Name	N Nitrogen Application [lbs/acre]	P_2O_5 Phosphorus Application [lbs/acre]	K_2O Potassium Application [lbs/acre]	S Sulfur Application [lbs/acre]	H_{rb} AI Herbicide Application [oz/acre]	P_{st} AI Pesticide Application [oz/acre]
Triticale	130	40	85	20	4	6

Figure F-5 Agrichemicals/Fertilizers

Field Operations Diesel Use: Crop Interval 1 (Benchmark)				
Crop Name	Operation	Operation Description	Number of Times per Interval	Diesel Use [gal/ac]
Triticale	Tillage	Disk, tandem heavy primary op., roller, smooth		0.88
	Tillage	Chisel, sweep shovel, coil tine har		1.3
	Tillage	Chisel, st. pt.		1
	Application	Fert applic. anhyd knife 12 in		0.9
	Planting	Drill or air seeder, hoe-chisel openers 12-15 in spac.		0.74
	Application	Sprayer, post emergence		0.13
	Application	Sprayer, fungicide		0.13
	Harvest	Harvest, killing crop 50pct standing stubble		1.53
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	
	Manual Input	Manually Input Operation Description and Diesel Use (if needed)	NA	

Figure F-6 Field Operations Diesel Use

As previously discussed in Appendix F, "Planned" Alternative 4 considers upgrading the existing pump, renozzling sprinklers, and reducing water use through irrigation scheduling. Figures F-7 through F-10 show the "Benchmark" and "Planned" input values for this alternative.

System Design Input for Irrigation and Other Delivery Energy Needs							Pump Check		
Delivery Type	Check to Activate	Operating Pressure [psi]	Delivery or Pump Plant Efficiency [%]	Hours of Operation per Day [hr]	Application Efficiency [%]	Energy Use Rate [BTU/gal]	Irrigation Application gpm	Computed Delivery Power [HP]	Actual Delivery Power [HP]
Irrigation Delivery	☑	65	68%	24	70%	2.4	850	47	50
Other Delivery Energy 1	☐								
Other Delivery Energy 2	☐								
Other Delivery Energy 3	☐								

Figure F-7 "Benchmark" System Design Input

Water Use Applied for Irrigation and Other Delivery Energy Needs							
Delivery Type	Pumping Description	Units	Amount Used by the Crop				
			Triticale				
Irrigation Delivery	Gross Applied	in/season	40.0				
Other Delivery Energy 1							
Other Delivery Energy 2							
Other Delivery Energy 3							

Figure F-8 "Benchmark" Water Use Applied

System Design Input for Irrigation and Other Delivery Energy Needs							Pump Check		
Delivery Type	Check to Activate	Operating Pressure [psi]	Delivery or Pump Plant Efficiency [%]	Hours of Operation per Day [hr]	Application Efficiency [%]	Energy Use Rate [BTU/gal]	Irrigation Application gpm	Computed Delivery Power [HP]	Actual Delivery Power [HP]
Irrigation Delivery	☑	55	78%	24	85%	1.7	850	**35**	**50**
Other Delivery Energy 1	☐								
Other Delivery Energy 2	☐								
Other Delivery Energy 3	☐								
Actual delivery power exceeds computed delivery power by more than 10%									

Figure F-9 “Planned” System Design Input for Irrigation Example 1 (Alternative 4)

Water Use Applied for Irrigation and Other Delivery Energy Needs							
Delivery Type	Pumping Descirption	Units	Amount Used by the Crop				
			Triticale				
Irrigation Delivery	Net Applied	in/season	24.0				
Other Delivery Energy 1							
Other Delivery Energy 2							
Other Delivery Energy 3							

Figure F-10 “Planned” Water Use Applied for Irrigation Example 1 (Alternative 4)

Example 1: Greenhouse Gas Emissions by Field

Based on results after upgrading his pump, Farmer Hart will reduce his energy use by 123 MMBTUs per year. This is the total for the 100 acre field. On a per acre basis, Farmer Hart would reduce his energy use by 1.2 MMBTUs per acre per year or 361 KWH per acre per year.

To estimate the reduced GHG emissions, an emissions coefficient is needed. CEET contains a table of emission coefficients by fuel type. This table is located in the Input_GHG worksheet tab. The emission coefficients are generated based on coefficients provided by the COMET website. The website requires a zip code to determine emission coefficients for the area. The emission coefficients typically seldom change or are static for all fuel types except electricity. For this example, Farmer Hart has a zip code of 99402, and the following emission coefficients are provided as shown in Figure F-11 below.

Greenhouse Gas Table	GHG Emission Coefficients (EC) in lbs. per unit of energy input							
Energy Input	Units	Energy [MMBTU]	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	Total CO_2 Equivalent [lb]	SO_2 [lb]	NO_x [lb]
Liquid								
Diesel	Gal	0.1390	22.3769	0.0005	0.003	22.586	0.0003	0.018
Gasoline (E10)	Gal	0.1200	19.6432	0.0006	0.003	19.888	0.0003	0.011
BioDiesel B2	Gal	0.1386	21.9139	0.0005	0.003	22.126	0.0001	0.010
BioDiesel B5	Gal	0.1380	21.2526	0.0005	0.003	21.461	0.0001	0.010
BioDiesel B10	Gal	0.1369	20.1282	0.0005	0.003	20.337	0.0001	0.010
BioDiesel B20	Gal	0.1349	17.9015	0.0005	0.003	18.110	0.0001	0.010
BioDiesel B100	Gal	0.1183	0.000	0.0005	0.003	0.209	0.0001	0.010
SVO	Gal	0.1231	0.000	0.0005	0.003	0.209	0.0001	0.010
Gas								
Propane	Gal	0.0916	12.6545	0.0004	0.002	12.821	0.0001	0.010
Natural Gas	CCF	0.1030	11.6977	0.0004	0.002	11.864	0.0001	0.010
CNG	CCF	0.1000	12.0372	0.00386	0.002	13.275	0.0001	0.010
Electricity								
Electricity	KWH	0.0034	0.2592	0.00000	0.00001	0.261	0.0001	0.0003
Other Energy Input								
Soil Admendments	Ton	11.25	0.000	0.0000	0.000	0.000	0.0000	0.000
Agrichemicals/Fert.	lb	Varies	0.000	0.0000	0.000	0.000	0.0000	0.000
Labor	Day	0.0119	0.000	0.0000	0.000	0.000	0.0000	0.000

Zip Code 99402

Figure F-11 GHG Emissions Coefficients Table

Based on this input the results show that Farmer Hart reduced CO_2 emissions by 9,351 pounds per year. These results are provided in Figure F-12.

NRCS - CROPLAND ENERGY TOOL

GREENHOUSE GAS EMISSION CHANGES FROM FIELD INPUTS

Landowner: Hart Parr Field Area: 100 ac Date: 2/11/2013
Field Location: Asotin Co., WA Field ID: 3 Latitude: 46.35
Longitude: 117.35

Total Field Inputs

Energy Input	Units	Value	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	Total CO_2 [lb]	SO_2 [lb]	NO_x [lb]
Liquid								
Diesel	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Gasoline (E10)	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B2	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B5	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B10	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B20	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
BioDiesel B100	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
SVO	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Gas								
Propane	Gal	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Natural Gas	CCF	0.0	0.0	0.00	0.00	0.0	0.00	0.00
CNG	CCF	0.0	0.0	0.00	0.00	0.0	0.00	0.00
Electricity								
Electricity	KWH	36,078	9,351.1	0.16	0.36	9,407.1	4.50	10.97
Other Energy Input								
Soil Amendments	Ton	0	0.0	0.00	0.00	0.0	0.00	0.00
Agrichemicals/Fert.	lb	0	0.0	0.00	0.00	0.0	0.00	0.00
Labor	Day	0.00	0.0	0.00	0.00	0.0	0.00	0.00
TOTAL	**123 [MMBTU]**		**9,351.1**	**0.16**	**0.36**	**9,407.1**	**4.50**	**10.97**

Figure F-12 Reduced Greenhouse Gas Emissions for “Planned” Alternative 4 – Pump Upgrade

Example 2: Energy Reduced by Practice Standards

Typically, the energy initiative requires the planner to enter the energy saved by practice standard into Pro-tracts. Farmer Hart also wants to know how much energy he saves by applying each practice standard. CEET estimates energy savings by Practice Standard through the Input_PS worksheet tab. This worksheet contains a list of all Practice Standards and a filtered list of Practice Standards tied to the energy initiative. A toggle button allows the use of each list through a pull-down menu in the table.

For this example, three practice standards are applied: *Practice Standard 442 Irrigation System Sprinkler* (sprinkler renozzling), *Practice Standard 533 Pumping Plant* (pump upgrade), and *Practice Standard 449 Irrigation Water Management* (irrigation scheduling). The *Percent Allocated by Practice Standards* table is the input needed to estimate energy saved by practice standard. Figure F-13 shows this table. There are three shaded cells in this table located in the "Irrigation Delivery Power" category. The shaded cells are the only input cells available since "Irrigation Delivery Power" is the only category that has any energy change between the "Benchmark" and "Planned" alternative. The three cells are available for inputting a percentage of the total energy saved for the category. These input cells do not need to add up to 100%, since some of the energy savings may not be tied to a practice standard. For this example, all energy savings is tied a practice standard and so the cells should add up to 100%.

Practice Standards	Energy Input to the Field							Energy Harvest			Energy Remaining	
	Harvest Operations	Field Operations	Irrigation Delivery Energy	Other Delivery Energy	Agri-Chemical Fert.	Soil Amend	Labor	Crop Harvest Removed	Post Harvest		Root-mass	Surface Residue
Select from ☑ All Practice Standards ☐ Energy Only Practice Standards									Grazing Yield	Forage Removed		
442 Irrigation System, Sprinkler												
533 Pumping Plant												
449 Irrigation Water Management												
Energy percentage not accounted for in a practice standard			100%									

Energy Accounting	Benchmark - Planned							Planned - Benchmark				
	Energy Input to the Field							Energy Harvest			Energy Remaining	
Energy not accounted for in a practice standard [MMBTU]			(1.23)									
Energy Change (Benchmark vs. Planned) [MMBTU]			(1.23)									

Figure F-13 Percent Allocated by Practice Standard Table

Estimating the percentages for each Practice Standard can become quite complex since each variable is related to multiple other variables. For example, increasing the *Application Efficiency* from 70% to 85% reduces the amount of water pumped (*Gross Applied)* from 40-inches to 34-inches. The remaining water saved (*Gross Applied*) is credited to irrigation scheduling. Table 1 shows the "Benchmark", "Planned" and "Change" values for this alternative.

Table F-1 Summary of Adjusted Input Variables

Main Input Variables	"Benchmark"	"Planned"	"Change"	Practice Standard
Operating Pressure	65 psi	55 psi	10 psi	442 Irrigation System Sprinkler
Pump Plant Efficiency	68%	78%	10%	533 Pumping Plant
Application Efficiency	70%	85%	15%	533 Pumping Plant
Gross Applied	34 in	28.2 in	5.8 in	449 Irrigation Water Management

For the complex categories that have multiple input variables, CEET has a table that estimates percentages based on Practice Standards and input variables. The percentages are shaded in red as shown in Figure F-14 and include the input values for the *Percent Allocated by Practice Standard* table as shown in Figure F-15. For this example, *Practice Standard 442* saved 29% of the energy for the "Irrigation Delivery Power" category, *Practice Standard 533* saved 49%, and *Practice Standard 449* saved 22%.

Practice Standards	Main Input Worksheet		Individual Main Input Variables				Practice Standard Input Categories	
	Input Type	Input Variables (VAR)	Value	Allowable	Remaining	%	Input Category	%
442 Irrigation System, Sprinkler	Irrigation	Gross Applied	5.76	11.76 in	0.00	49%	Irrigation Delivery Power	29%
533 Pumping Plant	Irrigation	Pump Plant Efficiency	10	10 %	0.00	100%	Irrigation Delivery Power	18%
533 Pumping Plant	Irrigation	Gross Applied	6	11.76 in	0.00	51%	Irrigation Delivery Power	30%
449 Irrigation Water Management	Irrigation	Operation Pressure	10	10 psi	0.00	100%	Irrigation Delivery Power	22%

Figure F-14 Percentages of Energy Saved by Practice Standard by Input Variables.

Practice Standards	Energy Input to the Field							Energy Harvest			Energy Remaining	
Select from ☑ All Practice Standards ☐ Energy Only Practice Standards	Harvest Operations	Field Operations	Irrigation Delivery Energy	Other Delivery Energy	Agri-Chemical Fert.	Soil Amend	Labor	Crop Harvest Removed	Post Harvest Grazing Yield	Post Harvest Forage Removed	Root-mass	Surface Residue
442 Irrigation System, Sprinkler			29%									
533 Pumping Plant			49%									
449 Irrigation Water Management			22%									

Figure F-15 Entered Percentage for Percent Allocated by Practice Standard Table

The remaining input table requires selecting the fuel type used for each category and practice standard. For this example, the fuel type associated with upgrading the pump is electricity. This is selected from the pull-down menu as shown in Figure F-16. Once these are populated, the output results can be viewed. The results show the energy saved by Practice Standards and the reduced GHG emissions. For this example the energy saved for *Practice Standard 442*, *Practice Standard 533* and *Practice Standard 449* is 35.7, 60.3, and 27.1 MMBTUs per year, respectively and the CO_2 emissions were reduced by 2710, 4580, and 2060 pounds for each Practice Standard. These results are shown in Figure F-17.

Practice Standards	Fuel Types Used				Other Energy Input		
	Harvest Operations	Field Operations	Irrigation Delivery Energy	Other Delivery Energy	Agri-Chemicals Fert	Soil Amendments	Labor
442 Irrigation System, Sprinkler			Electricity				
533 Pumping Plant			Electricity				
449 Irrigation Water Management			Electricity				

Figure F-16 Practice Standard and Fuel Type Used

Total Field	Energy	Reduced Greenhouse Gas Emissions				
Practice Standard	Savings [MMBTU]	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	SO_2 [lb]	NO_x [lb]
442 Irrigation System, Sprinkler	35.70	2,711.9	0.045	0.104	1.305	3.183
533 Pumping Plant	60.32	4,582.1	0.076	0.175	2.205	5.378
449 Irrigation Water Management	27.08	2,057.3	0.034	0.079	0.990	2.415
Energy percentage not accounted for in a practice standard	0.00	0.0	0.000	0.000	0.000	0.000

Practice Standard (Summary)	Energy	Reduced Greenhouse Gas Emissions				
	Savings [MMBTU]	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	SO_2 [lb]	NO_x [lb]
Energy Practice Standards	87.40	6,639.4	0.110	0.254	3.194	7.792
Non-Energy Practice Standards	35.70	2,711.9	0.045	0.104	1.305	3.183
Energy percentage not accounted for in a practice standard	0.00	0.0	0.000	0.000	0.000	0.000
Total	123.10	9,351.2	0.155	0.357	4.499	10.975

Figure F-17 Reduced Greenhouse Gas Emissions by Practice Standard

Appendix G - Intermediate Worksheets

BENCHMARK

Field Biomass Production (Dry Matter lbs/ac)						
Crop Name	Triticale					Av. Annual
Total Biomass (Rootmass + Surface Biomass)	15,140	0	0	0	0	15,140
Rootmass in Field	1,100	0	0	0	0	1,100
Total surface biomass production	14,040	0	0	0	0	14,040
Harvested Crop Biomass	10,800	0	0	0	0	10,800
Post Harvest Grazing	0	0	0	0	0	0
Post Harvest Forage Removed	0	0	0	0	0	0
Available surface residue	3,240	0	0	0	0	3,240
Surface residue remaining	3,240	0	0	0	0	3,240

Crop	Crop Interval	CI 1	CI 2	CI 3	CI 4	CI 5	Av. Annual
	Crop Name	Triticale					
	Crop Year	2013	0	0	0	0	1.00
Energy Input (added) to field	Harvest operations	0.214	0.000	0.000	0.000	0.000	0.21
	Tillage operations	0.445	0.000	0.000	0.000	0.000	0.45
	Application operations	0.162	0.000	0.000	0.000	0.000	0.16
	Planting operations	0.104	0.000	0.000	0.000	0.000	0.10
	Other field operation	0.000	0.000	0.000	0.000	0.000	0.00
	Manual input operation	0.000	0.000	0.000	0.000	0.000	0.00
	Irrigation fuel energy inputs	4.85	0.00	0.00	0.00	0.00	4.85
	Other delivery power (irrigation)	0.05	0.00	0.00	0.00	0.00	0.05
	Other delivery power (farming)	0.00	0.00	0.00	0.00	0.00	0.00
	Labor	0.00	0.00	0.00	0.00	0.00	0.00
	Applied manure	0.00	0.00	0.00	0.00	0.00	0.00
	Grazing: Applied excreted manure	0.00	0.00	0.00	0.00	0.00	0.00
	Applied Compost Energy Input	0.00	0.00	0.00	0.00	0.00	0.00
	Seed	0.28	0.00	0.00	0.00	0.00	0.28
	Imported feed	0.00	0.00	0.00	0.00	0.00	0.00
	Other applied organic material	0.00	0.00	0.00	0.00	0.00	0.00
	Nitrogen	2.60	0.00	0.00	0.00	0.00	2.60
	Phosphorus	0.28	0.00	0.00	0.00	0.00	0.28
	Potassium	0.47	0.00	0.00	0.00	0.00	0.47
	Sulfur	0.04	0.00	0.00	0.00	0.00	0.04
	Herbicide	0.00	0.00	0.00	0.00	0.00	0.00
	Pesticide	0.00	0.00	0.00	0.00	0.00	0.00
Energy Output (removed) from field	Crop Harvest Removed	81.00	0.00	0.00	0.00	0.00	81.00
	Post Harvest Grazing Yield	0.00	0.00	0.00	0.00	0.00	0.00
	Post Harvest Removed	0.00	0.00	0.00	0.00	0.00	0.00

PLANNED

Field Biomass Production (Dry Matter lbs/ac)						
Crop Name	Triticale					Av. Annual
Total Biomass (Rootmass + Surface Biomass)	15,140	0	0	0	0	15,140
Rootmass in Field	1,100	0	0	0	0	1,100
Total surface biomass production	14,040	0	0	0	0	14,040
Harvested Crop Biomass	10,800	0	0	0	0	10,800
Post Harvest Grazing	0	0	0	0	0	0
Post Harvest Forage Removed	0	0	0	0	0	0
Available surface residue	3,240	0	0	0	0	3,240
Surface residue remaining	3,240	0	0	0	0	3,240

Crop	Crop Interval Crop Name Crop Year	CI 1 Triticale 2013	CI 2 0	CI 3 0	CI 4 0	CI 5 0	Av. Annual 1.00
Energy Input (added) to field	Harvest operations	0.214	0.000	0.000	0.000	0.000	0.21
	Tillage operations	0.692	0.000	0.000	0.000	0.000	0.69
	Application operations	0.162	0.000	0.000	0.000	0.000	0.16
	Planting operations	0.104	0.000	0.000	0.000	0.000	0.10
	Other field operation energy input	0.000	0.000	0.000	0.000	0.000	0.00
	Manual input operation	0.000	0.000	0.000	0.000	0.000	0.00
	Irrigation fuel energy inputs	4.16	0.00	0.00	0.00	0.00	4.16
	Other delivery power (irrigation)	0.05	0.00	0.00	0.00	0.00	0.05
	Other delivery power (farming)	0.00	0.00	0.00	0.00	0.00	0.00
	Labor	0.00	0.00	0.00	0.00	0.00	0.00
	Applied manure	0.00	0.00	0.00	0.00	0.00	0.00
	Grazing: Applied excreted manure	0.00	0.00	0.00	0.00	0.00	0.00
	Applied Compost Energy Input	0.00	0.00	0.00	0.00	0.00	0.00
	Seed	0.28	0.00	0.00	0.00	0.00	0.28
	Imported feed	0.00	0.00	0.00	0.00	0.00	0.00
	Other applied organic material	0.00	0.00	0.00	0.00	0.00	0.00
	Nitrogen	2.60	0.00	0.00	0.00	0.00	2.60
	Phosphorus	0.28	0.00	0.00	0.00	0.00	0.28
	Potassium	0.47	0.00	0.00	0.00	0.00	0.47
	Sulfur	0.04	0.00	0.00	0.00	0.00	0.04
	Herbicide	0.00	0.00	0.00	0.00	0.00	0.00
	Pesticide	0.00	0.00	0.00	0.00	0.00	0.00
Energy Output (removed) from field	Crop Harvest Removed	81.00	0.00	0.00	0.00	0.00	81.00
	Post Harvest Grazing Yield	0.00	0.00	0.00	0.00	0.00	0.00
	Post Harvest Removed	0.00	0.00	0.00	0.00	0.00	0.00

Irrigation Delivery Power Worksheet for Energy Tool					
Operation ID : Hart Parr	Description:			Date: 2/11/2103	
Field Location : Asotin, WA	Center Pivot				
Field Acres : 120					
BENCHMARK					
Baseline crop names	Triticale				
Gross irrigation application [in/crop]	40.0				
Net application, [in/crop]	28				
Million gallons pumped per crop	130.3				
PLANNED					
Planned crop names	Triticale				
Gross irrigation application [in/crop]	34.3				
Net application, [in/crop]	24.0				
Million gallons pumped per crop	111.7				
INPUT					
Highlighted Values from Input Tab	Units	Benchmark Amount	Planned Amount	Difference	
				Change	% change
Operating pressure	psi	130	130	0.0	0%
Delivery or Pumping plant efficiency	%	72%	72%	0.0	0%
Hours of Operation per day	hours	24.0	24.0	0.0	0%
Irrigation Application	inch/day	0.42	0.42	0.0	0%
Uniformity of Application	%	70%	70%	0.0	0%
CALCULATIONS					
Calculated Values	Units	Benchmark Amount	Planned Amount	Difference	
				Change	% change
Average Irrigation Days per Crop Interval	days	95.3	81.7	14	
Pumping Flowrate	cfs	2.1	2.1	0	
	gpm	950	950	0	
Pumping Power	HP	100.1	100.1	0	
	KW	75	75	0	
Energy Rate Use per unit	KWH/day	1791	1791	0	
	BTU/day	6,110,567	6,110,567	0	
	BTU/inch	14,555,153	14,555,153	0	
	BTU/gal	4.5	4.5	0.0	
Total Energy Use in Million BTUs	MMBTU	582.2	499.0	83	
Note: Values shaded yellow (Benchmark) and green (Planned) are input variables from the input tab. Values shaded red are used in energy calculations for reports tab.					

Other Delivery Power 1 Worksheet for Energy Tool					
Operation ID : Hart Parr	Description:			Date: 2/11/2103	
Field Location : Asotin, WA	Center Pivot				
Field Acres : 120					
BENCHMARK					
Baseline crop names	Triticale				
Other Pumping Type : Booster [gpm]	75				
Days of Operation, [days]	96				
Million gallons pumped per crop	5.18				
PLANNED					
Planned crop names	Triticale				
Other Pumping Type : Booster [gpm]	75				
Days of Operation, [days]	82				
Million gallons pumped per crop	4.43				
INPUT PUMP SYSTEM					
Highlighted Values from Input Tab	Units	Benchmark Amount	Planned Amount	Difference	
				Change	% change
Operating pressure	psi	35	35	0.0	0%
Delivery or Pumping plant efficiency	%	70%	70%	0.0	0%
Hours of Operation per day	hours	12.0	12.0	0.0	0%
CALCULATIONS					
Calculated Values	Units	Benchmark Amount	Planned Amount	Difference	
				Change	% change
Average Days of Operation	days	96.0	82.0	14	
Pumping Rate (maximum per rotation)	cfs	0.17	0.17	0	
	gpm	75	75	0	
Pumping Power	HP	2.2	2.2	0	
	KW	2	2	0	
Energy Rate Use per unit	KWH/day	20	20	0	
	BTU/day	133,583	133,583	0	
	BTU/gal	1.2	1.2	0	
Total Energy Use in Million BTUs	MMBTU	6.4	5.5	1	

Note: Values shaded yellow (Benchmark) and green (Planned) are input variables from the input tab.
Values shaded red are used in energy calculations for reports tab.

Other Delivery Power 2 Worksheet for Energy Tool					
Operation ID : Hart Parr	Description:			Date: 2/11/2103	
Field Location : Asotin, WA	Center Pivot				
Field Acres : 120					
BENCHMARK					
Baseline crop names					
Other Pumping Type : []					
Days of Operation, [days]					
Million gallons pumped per crop					
PLANNED					
Planned crop names					
Other Pumping Type : []					
Days of Operation, [days]					
Million gallons pumped per crop					
INPUT PUMP SYSTEM					
Highlighted Values from Input Tab	Units	Benchmark Amount	Planned Amount	Difference	
				Change	% change
Operating pressure	psi				
Delivery or Pumping plant efficiency	%				
Hours of Operation per day	hours				
CALCULATIONS					
Calculated Values	Units	Benchmark Amount	Planned Amount	Difference	
				Change	% change
Average Days of Operation	days				
Pumping Rate (maximum per rotation)	cfs				
	gpm				
Pumping Power	HP				
	KW				
Energy Rate Use per unit	KWH/day				
	BTU/day				
	BTU/gal				
Total Energy Use in Million BTUs	MMBTU				

Note: Values shaded yellow (Benchmark) and green (Planned) are input variables from the input tab.
Values shaded red are used in energy calculations for reports tab.

Other Delivery Power 3 Worksheet for Energy Tool					
Operation ID : Hart Parr	Description:			Date: 2/11/2103	
Field Location : Asotin, WA	Center Pivot				
Field Acres : 120					
BENCHMARK					
Baseline crop names					
Other Pumping Type : []					
Days of Operation, [days]					
Million gallons pumped per crop					
PLANNED					
Planned crop names					
Other Pumping Type : []					
Days of Operation, [days]					
Million gallons pumped per crop					
INPUT PUMP SYSTEM					
Highlighted Values from Input Tab	Units	Benchmark Amount	Planned Amount	Difference	
				Change	% change
Operating pressure	psi				
Delivery or Pumping plant efficiency	%				
Hours of Operation per day	hours				
CALCULATIONS					
Calculated Values	Units	Benchmark Amount	Planned Amount	Difference	
				Change	% change
Average Days of Operation	days				
Pumping Rate (maximum per rotation)	cfs				
	gpm				
Pumping Power	HP				
	KW				
Energy Rate Use per unit	KWH/day				
	BTU/day				
	BTU/gal				
Total Energy Use in Million BTUs	MMBTU				
Note: Values shaded yellow (Benchmark) and green (Planned) are input variables from the input tab. Values shaded red are used in energy calculations for reports tab.					

Appendix H - Definitions, Equations, and Supporting Data

Cropland Energy Estimation Tool (CEET) – Defined Variables			
Variable Label	**Variable**	**Units**	**Description**
Actual Delivery Power	P_{HPa}	[HP]	This is the actual delivery of the pump. This is used to check that the existing pump is adequate for the field based on the input values used to calculate the computed delivery power. Warning flags are generated at the bottom of the table if there is a 10% difference between the computed and actual delivery power values. If these are generated, check that all inputs are correct and all components accounted for (i.e. multiple pumps, booster pumps, elevations etc.). The actual delivery power is not used to compute the energy used for irrigating the field but is helpful to ensure that the input values are reasonable.
Amount Used by Crop	A_{ud}	[varies]	This is the amount of water delivered to the crop. It can be input as either net or gross applied and has units of inches. The input value is then converted to a volume of water applied by multiplying the number of inches by the number of acres. For the other delivery power, the tool allows unit flexibility, so the planner should check that this value corresponds to the unit rate selected and the days of operation.
Animal Feed Organic Material	A_{om}	[DM lbs/acre]	This input represents amount of organic-based feed supplements imported into the field, such as hay supplied by the landowner.
Animal Unit Days	AUD	[AUD]	An animal unit day is the number of days that a 1,000 pound animal grazes per day. (Assumed as 30 pounds of dry matter consumed per AUD)
Application Efficiency	E_{app}	[%]	For an irrigation system, this is the ratio between the water available to the crop (net applied) and the total amount pumped (gross applied). It accounts for losses due to non-uniformity, deep percolation, spray drift, evaporation, and pipe leakage. General efficiencies for irrigation systems can be found in an irrigation guide or textbook.
Applied Stored Manure	A_{sm}	[DM lbs/acre]	This input represents the pounds of dry matter applied per acre as stored manure during each crop interval as supplied by the landowner.
Available Surface Residue	R_{ar}	[DM lbs/acre]	The amount of available surface residue that can be grazed, baled or otherwise removed from the field after harvest.
Average Days of Operation	D_{avop}	[days]	This is the average number of days of irrigation the system must run per season to supply the necessary amount of irrigation water (Gross Application).
Biomass Yield Ratio	B_{yrat}	[-]	This value is taken from RUSLE2 vegetation table. It is the ratio of the crop harvest to the available surface residue as dry matter.
Compost Organic Material	C_{om}	[DM lbs/acre]	This input represent the pounds of dry matter applied per acre as composted material during each crop interval as supplied by the landowner.
Computed Delivery Power	P_{HPc}	[HP]	The computed delivery power supplied to the field via gravity or pumping for irrigation (see equation tab)
Crop Harvest Moisture	C_{harm}	[%]	This is the moisture content of the crop at the time of harvest. This is used to determine the amount of dry matter of the crop. The landowner should know this, but if

Cropland Energy Estimation Tool (CEET) – Defined Variables			
Variable Label	**Variable**	**Units**	**Description**
			unknown typical values can be used. An agronomist or other available reference can be used.
Crop Harvest Type	C_{harv}	[-]	The crop harvest type selected from the pull down menu is either: (1) grazing, (2) forage, (3) commodity, or (4) multi-use. Grazing uses unit of Animal Unit Days instead of RUSLE2 units for the crop, since the crop is being grazed and not harvested. Forage (silage, hay etc.) and commodity (grains, fruits vegetables, etc.) use RUSLE2 units. Multi-Use consists of harvesting a crop and then allowing the crop residue (stubble) to be baled (Post Harvest Forage) and/or grazed (Post Harvest Grazing).
Crop Interval	C_{int}	[-]	The number of crop intervals between 1 and 5 are being analyzed for this rotation. The crop interval starts immediately after the harvest or killing of the current crop, and goes through harvest/killing of the next crop.
Crop Name	C_{nam}	[-]	Select Crop name from pull down menu selected from crops listed in the RUSLE 2 vegetation table
Crop Yield	C_{yld}	[yield/acre]	The crop yield specified by the landowner.
Date	D	[-]	This is the date the plan was create so that the planner has record of work on the project.
Days of Operation	D_{op}	[days]	This input variable is used with other delivery power needs and is the number of days per season the delivery system is operated.
Delivery Type	D_{type}	[varies]	Select the number of different pumps being used by the field. The "Irrigation Delivery" pump is the primary pump used for irrigating the crop. For this pump, the irrigation application can be selected in units of gallons per minute, inches per day, or cubic feet per second. The type of "Other Delivery" pumps is selected as either: dairy wastes, wind break, stockwater, booster, or other. Application units for these pumps are selected below as either gallons per field, gallons per minute, or cubic feet per second. Application amounts for both "Irrigation Delivery" pump and "Other Delivery" pumps are entered in the table below.
Delivery/Pumping Plant Efficiency	P_{eff}	[%]	The pumping plant efficiency is the efficiency of the pump and motor. To get an accurate pump efficiency requires a pump test. Since this may not be available, the following resources may be helpful: obtain a pump curve; ask an irrigation engineer, specialists or manufacturer; and use the tables in NEH Part 652 Irrigation Guide – Chapter 12 and/or other irrigation resources.
Diesel Use	D_{use}	[gal/acre]	Diesel Use is the diesel equivalent use per acre as specified by operations table (harvest, application, tillage, planting, other). This value is taken from RUSLE 2 database. Manual input is specified by landowner if operations are not covered by RUSLE 2.
Dry Matter	DM	[lb]	The amount of dry matter contained in a crop, applied organics, or other organic matter after all moisture is removed.
End Date	E_{date}	[day]	The ending date is the day the existing crop was harvested.
Energy Gain Index	EGI	[-]	Index ratio showing energy gained per energy unit added

Cropland Energy Estimation Tool (CEET) – Defined Variables			
Variable Label	**Variable**	**Units**	**Description**
			to the field (Total Biomass Produced/Energy Input).
Energy Harvest Index	EHI	[-]	Index ratio showing energy harvested from the field versus energy input to the field. (Harvested/Energy Input).
Energy Use Rate	E_{ur}	[BTU/gal]	The energy use rate is the amount of energy in BTU required to pump 1 gallon of water (see equation tab).
Field Acres	F_{ac}	[acres]	The field acres value is used to convert energy use per field (MMBTU/field) to energy use per acre (MMBTU/acre).
Field Description	$F_{des}c$	[-]	This input value describes the benchmark field and the planned changes. As an example, the field description could be Wheat – Conventional Tillage to Direct Seed.
Field ID	F_{id}	[-]	Field ID appears on the headings of most reports defining the individual field or group of fields.
Frequency	F_{nti}	[-]	Input the number of times (if not equal to 1) an operation is completed during a crop interval. For example, swathing hay occurs several times per crop interval.
Gross Application	A_{gross}	[in]	Gross application is average water depth applied to the entire field. It is used to determine the total volume of water pumped (see equations P_{mgal}).
Herbicide	H_{rb}	[oz/acre]	Enter the amount of herbicide active ingredient (AI) applied to the field in ounces per acre. This is the amount of active ingredient contained in all herbicides applied to the field. The chemical container provides the active ingredient for the herbicide.
Harvested Crop Biomass	C_{hb}	[lbs]	This is the dry weight of the harvested portion of the crop biomass.
Hours of Operation per Day	H_{oper}	[hrs]	This is the number of hours the pump is operating each day. This is used to determine the horsepower of the pump.
Irrigation Application	I_{app}	[in/day],[gpm], or [cfs]	This is the rate at which the water is applied to the field. It can be in units of inches/day, cubic feet per second, or gallons per minute. This value may be found on the existing pump. Typical inches per day values are 0.2 to 0.6. It is used to determine horsepower of the pump
Landowner	L_{own}	[-]	This is the landowner name or other descriptive information.
Latitude	L_{Lat}	[decimal degrees]	Latitude coordinates of the proposed field. This will be used in the future by GIS applications.
Longitude	L_{Lon}	[decimal degrees]	Longitude coordinates of the proposed field. This will be used in the future by GIS applications.
Million British Thermal Units	M_{mbtu}	[MMBTU]	This unit of energy is the common unit of measurement for this tool and is for energy practice standards. All input energy values are converted to MMBTU.
Million Gallons Pumped	$P_{mgal\text{-}irr}$ $P_{mgal\text{-}other}$	[Mgal]	This is the unit of measurement used for computing total water pumped for the field for either irrigation delivery pump or other pump (see equations).
Moisture Content	M_c	[-]	The moisture content of a crop, applied organics, or soil organics.
Net Application	A_{net}	[in]	This is the average depth, after losses, of water applied to the field. It is the water available for the crop.
Nitrogen Application	N_{app}	[lb/acre]	This value is the amount of nitrogen (N) applied to the field. The tool assumes a value of 20,000 BTU/lb of

Cropland Energy Estimation Tool (CEET) – Defined Variables			
Variable Label	**Variable**	**Units**	**Description**
			nitrogen.
Operating Pressure	O_{pres}	[psi]	This is the pressure required to lift the water from the source and apply it onto the field. For example if the pressure gage at the pump reads 50 psi and the water depth in the well is 23 feet (10 psi) below the pump. The operating pressure should be entered as 60 psi (50psi + 10psi).
Operation Description	$O_{des}c$	[-]	Select the specific operation from pull down menu tied to RUSLE operations table
Operation	O_{per}	[-]	Enter the type of operation from the pull down menu. The operation variable filters the RUSLE 2 Operation Table values, based on five categories: application, tillage, planting, harvest and other.
Other Applied Organic Material	O_{om}	[DM lbs/acre]	This value is the dry matter weight of any other organic based materials such as mulching materials or wood chips imported to the field.
Output Index	OI	[-]	Index ratio showing energy harvested from the field versus total biomass produced at the field (Harvested/Total Biomass Produced).
Pesticide Application	P_{st}	[oz/acre]	Enter the amount of pesticide active ingredient (AI) applied to the field in ounces per acre. This is the amount of active ingredient contained in all other chemicals applied that are not accounted for in the herbicide input value. The chemical container provides the active ingredient for the pesticide.
Phosphorus Application	P_{app}	[lbs/acre]	The amount of phosphorus P_2O_5 applied to the field in pounds per acre The tool assumes7,000 BTU/lb of phosphorus.
Post Harvest Forage Removed	F_{phrem}	[DM lbs/acre]	The post harvest forage removed is the amount of forage removed after harvest. The Crop Harvest Type needs to be labeled as "multiple use" otherwise the input cell is not active.
Post Harvest Grazing Removed	G_{phrem}	[DM lbs/acre]	The amount of forage removed due to grazing after harvest, based on animal unit days, assuming 30 lbs of dry matter removed per AUD. The Crop Harvest Type needs to be labeled as "multiple use" otherwise the input cell is not active.
Potassium Application	K_{app}	[lbs/acre]	This value is the amount of potassium or K_2O applied to the field. The tool assumes a value of 5,500 BTU/lb of K_2O.
Pumping Description	P_{desc}	[-]	For the main irrigation delivery system, select either gross or net applied. The gross amount applied is the amount pumped and the net is the amount available to the crop. This allows the user the flexibility to input either number. For the other pumping, select the type of pump as either booster, dairy, stock, windbreak or other. This is for documentation and as a check that all pumping has been discussed and input.
Pumping Type	P_{typ}	[-]	Input the pumping type as either irrigation or other pumping. Other pumping type could include a booster pump, stock water, windbreak or dairy pump.

Cropland Energy Estimation Tool (CEET) – Defined Variables			
Variable Label	**Variable**	**Units**	**Description**
Remaining Surface Residue	R_{rr}	[DM lbs/acre]	The amount of surface residue remaining after the harvest and post harvest removal is complete. It is a check to ensure that there is sufficient residue remaining for the specified post harvest operations (Available Surface Residue – Post Harvest Forage – Post Harvest Grazing > 0).
Rootmass in field	R_f	[DM lbs/acre]	This value is taken from RUSLE2 vegetation table and is used track rootmass generated by the crop.
Rotation Period	R_{per}	[yrs]	The value is the number of years in the rotation of either the benchmark or planned scenario.
Seed, transplants, sprig, etc…	S_{etc}	[DM lbs/acre]	Input the amount of seed, transplants, sprigs etc applied to establish the crop during each crop interval as specified by the landowner.
Specific Crop Description	C_{des}	[-]	This value is selected from the pull down menu tied to the RUSLE2 vegetative table.
Start Date	S_{date}	[yrs]	The starting date is the day after the previous crop was harvested.
Sulfur	S_{app}	[lbs/acre]	This value is the amount of sulfur applied to the field. The tool assumes a value of 2,000 BTU/lb of sulfur.
Surface Biomass	S_b	[lbs]	This is the surface biomass of the plant and is derived using data from RUSLE2 vegetative table..
Total Plant Biomass	P_b	[lbs]	This is the total plant biomass and is derived using data from RUSLE2 vegetative table.
Total Weight	T_w	[lbs]	This is the measured total weight of the crop (see equations).
Weight of Water	W_w	[lbs]	This is the measured water weight of the crop
Year Crop Harvested	C_{yr}	[year]	The year harvested is all that is required [YYYY]. This value is used in the intermediate calculations to sum multiple crop rotations in the same year before averaging.
Yield Units	Y_u	[varies]	This value is taken from RUSLE2 vegetation table

Farming Equations:

Conversion crop yield harvested in pounds per acre to dry matter pounds per acre.

$$\frac{\text{DM lb}}{\text{acre}} = \frac{\text{Harvested lb}}{\text{acre}}\left(1 - \text{M}_\text{C}\ \%\right)\frac{\text{DM}}{\text{Harvested}}$$

Equations showing conversion of crops harvest by wet weight to dry matter.

$$\text{DM lb} = \text{T}_\text{w}\ \text{lb} - \text{W}_\text{w}\ \text{lb}$$

$$\text{DM}\ \% = \left(1 - \text{M}_\text{c}\ \%\right)$$

Conversion of dry matter pounds per acre to Million British Thermal units per acre (for yields, soil amendments, etc.).

$$\frac{\text{MMBTU}}{\text{acre}} = \frac{\text{DM lb}}{\text{acre}}\frac{\text{7,500 BTU}}{\text{DM lb}}\frac{\text{MMBTU}}{\text{1,000,000 BTU}}$$

Conversion of a gallon of diesel used per acre to Million British Thermal Units per acre.

$$\frac{\text{MMBTU}}{\text{acre}} = \frac{\text{gal Diesel}}{\text{acre}}\frac{\text{140,000 BTU}}{\text{gal Diesel}}\frac{\text{MMBTU}}{\text{1,000,000 BTU}}$$

Conversion of pounds of nitrogen applied per acre to Million British Thermal Units per acre.

$$\frac{\text{MMBTU}}{\text{acre}} = \frac{\text{N} - \text{lb}}{\text{acre}}\frac{\text{20,000 BTU}}{\text{lb}}\frac{\text{MMBTU}}{\text{1,000,000 BTU}}$$

Conversion of pounds of phosphorus applied per acre to Million British Thermal Units per acre.

$$\frac{\text{MMBTU}}{\text{acre}} = \frac{\text{P} - \text{lb}}{\text{acre}}\frac{\text{7,000 BTU}}{\text{lb}}\frac{\text{MMBTU}}{\text{1,000,000 BTU}}$$

Conversion of pounds of potassium applied per acre to Million British Thermal Units per acre.

$$\frac{\text{MMBTU}}{\text{acre}} = \frac{\text{K} - \text{lb}}{\text{acre}}\frac{\text{5,500 BTU}}{\text{lb}}\frac{\text{MMBTU}}{\text{1,000,000 BTU}}$$

Conversion of pounds of sulfur applied per acre to Million British Thermal Units per acre.

$$\frac{\text{MMBTU}}{\text{acre}} = \frac{\text{S} - \text{lb}}{\text{acre}}\frac{\text{2,000 BTU}}{\text{lb}}\frac{\text{MMBTU}}{\text{1,000,000 BTU}}$$

Conversion of ounces of herbicide applied per acre to Million British Thermal Units per acre.

$$\frac{\text{MMBTU}}{\text{acre}} = \frac{\text{H}_\text{rb} - \text{oz}}{\text{acre}}\frac{\text{lb}}{\text{16oz}}\frac{\text{100,000 BTU}}{\text{lb}}\frac{\text{MMBTU}}{\text{1,000,000 BTU}}$$

Conversion of ounces of pesticide applied per acre to Million British Thermal Units per acre.

$$\frac{\text{MMBTU}}{\text{acre}} = \frac{\text{P}_\text{st} - \text{oz}}{\text{acre}}\frac{\text{lb}}{\text{16oz}}\frac{\text{100,000 BTU}}{\text{lb}}\frac{\text{MMBTU}}{\text{1,000,000 BTU}}$$

Conversion of animal unit days grazed to dry matter pounds per acre

$$\frac{\text{DM lb}}{\text{acre}} = \frac{\text{AUD}}{\text{acre}} \frac{\text{30 DM - lb}}{\text{AUD}}$$

Conversion of grazing applied excreted manure as animal unit days to dry matter pounds per acre

$$\frac{\text{DM lb}}{\text{acre}} = \frac{\text{AUD}}{\text{acre}} \frac{\text{10 DM - lb}}{\text{AUD}}$$

Equation showing harvested crop biomass calculation

$$C_{hb} = C_{yld} Y_u \left(1 - M_c\right)$$

Equation showing available surface residue calculation

$$R_{ar} = C_{yld} Y_u \left(1 - M_c\right) B_{yrat}$$

Equation showing remaining surface residue calculation

$$R_{rr} = R_{ar} - F_{phrem} - 30 G_{phrem}$$

Equation showing plant surface biomass calculation

$$S_b = C_{hb} \left(B_{yrat} + 1\right)$$

Equation showing total plant biomass calculation

$$P_b = S_b + R_f$$

Irrigation equations

Equation showing net amount applied to the field calculation

$$A_{net} = E_{app} A_{gross}$$

Equation calculating horse power of the pump

$$P_{HPc} \frac{\text{HP}}{} = \frac{Q_{gpm} O_{pres} \left(2.31\right)}{P_{eff} \left(3960\right)}$$

Conversion of Horse Power at the irrigation pump to British Thermal Units per water gallon pumped

$$I_{eu} \frac{\text{BTU}}{\text{gal}} = \frac{P_{HPc}}{Q_{gpm}} \frac{\text{HP}}{\text{min}} \frac{\text{gal}}{\text{HP}} \frac{0.7457\text{KW}}{\text{KW}} \frac{\frac{\text{KJ}}{\text{s}}}{1.055\text{KJ}} \frac{\text{BTU}}{60\text{s}} \frac{\text{min}}{}$$

Equation calculating energy used in British Thermal Units to pump one gallon for irrigation pump

$$I_{eu} \frac{\text{BTU}}{\text{gal}} = \frac{O_{pres} H_{oper} \left(2.31\right)\left(0.7457\right)\left(60\right)\left(1000\right)}{P_{eff} \left(3960\right)\left(24\right)\left(1055\right)}$$

Equation calculating million gallons pumped for irrigation delivery pump

$$P_{mgal\text{-}irr}\frac{Mgal}{} = \frac{A_{net}F_{ac}(43560)(7.48)}{U_{app}(12)(1{,}000{,}000)}$$

Equation calculating energy used for irrigation pumping in Million British Thermal Units per acre

$$MMBTU = I_{eu}\frac{BTU}{gal}PI_{mgal}\frac{Mgal}{}\frac{1{,}000{,}000gal}{Mgal}\frac{MMBTU}{1{,}000{,}000BTU}$$

Other Pumping

Conversion of Horse Power at the other pump to British Thermal Units per water gallon pumped

$$O_{eu}\frac{BTU}{gal} = \frac{P_{HPc}}{Q_{gpm}}\frac{HP}{}\frac{gal}{min}\frac{0.7457KW}{HP}\frac{\frac{KJ}{s}}{KW}\frac{BTU}{1.055KJ}\frac{min}{60s}$$

Energy used in British Thermal Units to pump one gallon for other pump

$$O_{eu}\frac{BTU}{gal} = \frac{O_{pres}(2.31)(0.7457)(60)(1000)}{P_{eff}(3960)(1055)}$$

Equation calculating million gallons pumped for other pump

$$P_{mgal\text{-}other}\frac{Mgal}{} = \frac{Q_{gpm}D_{op}H_{oper}(60)}{1{,}000{,}000}$$

Equation calculating energy used for other pumping in million British Thermal Units per acre

$$MMBTU = O_{eu}\frac{BTU}{gal}P_{mgal\text{-}other}\frac{Mgal}{}\frac{1{,}000{,}000gal}{Mgal}\frac{MMBTU}{1{,}000{,}000BTU}$$

Report Equations

Equation calculating energy gain index

$$EGI = \frac{(Harvested + Residual)}{Inputs}$$

Equation calculating output index

$$OI = \frac{Harvested}{(Harvested + Residual)}$$

Equation calculating energy harvest index

$$EHI = (EGI)(OI) \text{ or } \frac{Harvested}{Input}$$

TABLE CREATED FROM RUSLE 2 VEGETATION DATABASE. DATA RETRIEVED APRIL, 2013

Count	* Crop Name	* Specific Crop Description	Crop Code	Relative Moisture Depletion Rate	*Yield in Measured Units	* Weight of One Unit [lb]	Assumed Yield # of Units	Above Ground Biomass at Max. Canopy [lb/ac]	* Biomass Yield Ratio	Max Root Biomass from Growth Curve Table
6	Alfalfa brome	Alfalfa brome, fall seed senes to yr2 regrowth	1	0.50	tons	2,000	1.5	3,000	1.00	2,500
7	Alfalfa brome	Alfalfa brome, fall seed senes to yr2 regrowtl	2	0.50	tons	2,000	1.5	3,000	1.00	2,500
8	Alfalfa brome	Alfalfa brome, spring seed	3	0.50	tons	2,000	1.5	3,000	1.00	1,500
9	Alfalfa brome	Alfalfa brome, spring seed regrowth after cut	4	0.50	tons	2,000	1.5	3,000	1.00	1,500
10	Alfalfa brome	Alfalfa brome, spring seed senes to y2 regrowth	5	0.50	tons	2,000	1.5	3,000	1.00	4,300
11	Alfalfa brome	Alfalfa brome, spring seed senes winter graze to y2 regro	6	0.50	tons	2,000	1.5	3,000	1.00	4,300
12	Alfalfa brome	Alfalfa brome, yr2 regrowth after cu	7	0.50	tons	2,000	1.5	3,000	1.00	4,300
13	Alfalfa brome	Alfalfa brome, yr2 senes to yr3 regrowtl	8	0.50	tons	2,000	2.25	4,500	1.00	4,900
14	Alfalfa brome	Alfalfa brome, yr2 senes winter graze to yr3 regrowtl	9	0.50	tons	2,000	2.25	4,500	1.00	4,900
15	Alfalfa brome	Alfalfa brome, yr3 regrowth after cu	10	0.50	tons	2,000	1.7	3,400	1.00	4,900
16	Alfalfa brome	Alfalfa brome, yr3 senes to yr4 regrowtl	11	0.50	tons	2,000	2.5	5,000	1.00	4,900
17	Alfalfa brome	Alfalfa brome, yr3 senes winter graze to yr4 regrowtl	12	0.50	tons	2,000	2.5	5,000	1.00	4,900
18	Alf-brome-oat	Alfalfa brome-oat silage, harv to yr2 1st cu	13	0.50	tons	2,000	1.5	3,000	1.00	4,300
19	Alf-brome-oat	Alfalfa brome-oat silage, spring seed	14	0.50	tons	2,000	12	7,200	0.30	1,500
20	Alf-brome-oat	Alfalfa brome-oat, seed	15	0.50	bu	32	60	3,840	2.00	1,700
21	Alf-brome-oat	Alfalfa brome-oat, harv to yr2 1st cu	16	0.50	tons	2,000	1.5	3,000	1.00	4,300
22	Alfalfa seed	Alfalfa seed nw, fall plant senes to yr2 clipbac	17	0.50	tons	2,000	0.5	1,000	1.00	2,000
23	Alfalfa seed	Alfalfa seed nw, spring plan	18	0.50	lbs	1	350	3,255	9.30	2,500
24	Alfalfa seed	Alfalfa seed nw, yr2 regrowth after clipbacl	19	0.50	lbs	1	350	3,238	9.25	2,500
25	Alfalfa seed	Alfalfa seed nw, yr2 senes to yr3 regrowtl	20	0.50	tons	2,000	0.5	1,000	1.00	2,500
26	Alfalfa seed	Alfalfa seed sw, fall plant senes to yr2 clipbacl	21	0.50	tons	2,000	1	2,000	1.00	2,500
27	Alfalfa seed	Alfalfa seed sw, yr2 regrowth after clipbacl	22	0.50	lbs	1	500	4,625	9.25	2,500
28	Alfalfa seed	Alfalfa seed sw, yr2 senes to yr3 regrowtl	23	0.50	tons	2,000	0.5	1,000	1.00	2,500
29	Alfalfa	Alfalfa, fall seed senes to yr2 regrowth	24	0.50	tons	2,000	1.5	3,000	1.00	2,500
30	Alfalfa	Alfalfa, NW fall seeding, senes to yr2 regrowtl	25	0.50	tons	2,000	2	4,000	1.00	2,500
31	Alfalfa	Alfalfa, NW spring seeding, senes to yr2 regrowtl	26	0.50	tons	2,000	2.5	5,000	1.00	2,500
32	Alfalfa	Alfalfa, NW yr2 regrowth after cutting	27	0.50	tons	2,000	1.5	3,000	1.00	2,500
33	Alfalfa	Alfalfa, NW yr2 senes to yr3 regrowtl	28	0.50	tons	2,000	2.5	5,000	1.00	3,000
34	Alfalfa	Alfalfa, NW yr3 regrowth after cutting	29	0.50	tons	2,000	1.7	3,400	1.00	3,000
35	Alfalfa	Alfalfa, NW yr3 senes to yr4 regrowtl	30	0.50	tons	2,000	2.5	5,000	1.00	3,500
36	Alfalfa	Alfalfa, South, fall seed senes to yr2 regrowtl	31	0.50	tons	2,000	1.5	3,000	1.00	2,500
37	Alfalfa	Alfalfa, South, spring seed senes to y2 regrowtl	32	0.50	tons	2,000	1.5	3,000	1.00	1,600
38	Alfalfa	Alfalfa, South, yr2 regrowth after cutting	33	0.50	tons	2,000	1.5	3,000	1.00	2,500
39	Alfalfa	Alfalfa, South, yr2 senes to yr3 regrowtl	34	0.50	tons	2,000	2.25	4,500	1.00	3,000
40	Alfalfa	Alfalfa, South, yr3 regrowth after cutting	35	0.50	tons	2,000	1.7	3,400	1.00	3,000
41	Alfalfa	Alfalfa, South, yr3 senes to yr4 regrowtl	36	0.50	tons	2,000	2.5	5,000	1.00	3,500
42	Alfalfa	Alfalfa, South, yr4 regrowth after cutting	37	0.50	tons	2,000	1.75	3,500	1.00	3,500
43	Alfalfa	Alfalfa, South, yr4 senes to yr5 regrowtl	38	0.50	tons	2,000	2	4,000	1.00	3,500
44	Alfalfa	Alfalfa, spring seed	39	0.50	tons	2,000	1.5	3,000	1.00	1,500
45	Alfalfa	Alfalfa, spring seed regrowth after cutting	40	0.50	tons	2,000	1.5	3,000	1.00	1,500
46	Alfalfa	Alfalfa, spring seed senes to y2 regrowtl	41	0.50	tons	2,000	1.5	3,000	1.00	2,500
47	Alfalfa	Alfalfa, spring seed senes winter graze to y2 regrowtl	42	0.50	tons	2,000	1.5	3,000	1.00	2,500
48	Alfalfa	Alfalfa, yr2 regrowth after cutting	43	0.50	tons	2,000	1.5	3,000	1.00	2,500
49	Alfalfa	Alfalfa, yr2 senes to yr3 regrowtl	44	0.50	tons	2,000	2.25	4,500	1.00	3,000
50	Alfalfa	Alfalfa, yr2 senes winter graze to yr3 regrowtl	45	0.50	tons	2,000	2.25	4,500	1.00	3,000
51	Alfalfa	Alfalfa, yr3 regrowth after cutting	46	0.50	tons	2,000	1.7	3,400	1.00	3,000
52	Alfalfa	Alfalfa, yr3 regrowth after seed harvest	47	0.50	tons	2,000	1.7	3,400	1.00	3,000
53	Alfalfa	Alfalfa, yr3 senes to yr4 regrowtl	48	0.50	tons	2,000	2.5	5,000	1.00	3,500
54	Alfalfa	Alfalfa, yr3 senes winter graze to yr4 regrowtl	49	0.50	tons	2,000	2.5	5,000	1.00	3,500
55	Alfalfa	Alfalfa, yr4 regrowth after cutting	50	0.50	tons	2,000	1.75	3,500	1.00	3,500
56	Alfalfa	Alfalfa, yr4 senes to yr5 regrowtl	51	0.50	tons	2,000	2	4,000	1.00	3,500
57	Alfalfa	Alfalfa, yr4 senes winter graze to yr5 regrowtl	52	0.50	tons	2,000	2	4,000	1.00	3,500
58	Alfalfa-oat	Alfalfa-oat(silage), spring seed	53	0.50	tons	2,000	8	5,000	0.31	1,400
59	Alfalfa-oat	Alfalfa-oat, grwth after oat harv to y2 regrtl	54	0.50	tons	2,000	1.5	3,000	1.00	2,500
60	Alfalfa-oat	Alfalfa-oat, nurse crop spring seec	55	0.50	bu	32	60	3,840	2.00	1,800
61	Alfalfa-oat	Alfalfa-oat, silage harv to yr2 1st cu	56	0.50	tons	2,000	1.5	3,000	1.00	2,500
62	Almond	Almond, Pistachio; bare ground	57	0.50	lbs	1	2000	2,000	1.00	300
63	Almond	Almond, Pistachio; fall sm grain cov cro	58	0.50	lbs	1	2000	2,000	1.00	1,100
64	Almond	Almond, Pistachio; permanent grass cov cro	59	0.50	lbs	1	2000	2,000	1.00	6,800
65	Almond	Almond, Pistachio; weeds annual cove	60	0.50	lbs	1	2000	2,000	1.00	1,270
66	Amaranth	Amaranth	61	0.50	lbs	1	1500	1,650	1.10	1,100
67	Artichoke	Artichoke, annua	62	0.50	boxes	22	450	1,800	0.18	600
68	Artichoke	Artichoke, perennial, establishec	63	0.50	boxes	22	450	1,800	0.18	600
69	Artichoke	Artichoke, perennial, transplants or sprig	64	0.50	boxes	22	450	1,800	0.18	600
70	Artichoke	Artichoke, perennia	65	0.50	boxes	22	450	1,800	0.18	600
71	Asparagus	Asparagus, yr1 and 2	66	0.50	lbs	1	500	500	1.00	200
72	Asparagus	Asparagus, yr1 cover crop	67	0.50	lbs	1	500	500	1.00	420
73	Asparagus	Asparagus, yr2 cover crop	68	0.50	lbs	1	1000	1,000	1.00	430
74	Asparagus	Asparagus, yr3+ HI PROD	69	0.50	lbs	1	3300	3,000	0.91	240
75	Asparagus	Asparagus, yr3+ cover crop	70	0.50	lbs	1	2000	2,000	1.00	520
76	Asparagus	Asparagus, yr3+	71	0.50	lbs	1	2000	2,000	1.00	200
77	Bahiagrass	Bahiagrass, y2+ senesc thru yr3 + greenup	72	0.50	lbs	1	4000	4,000	1.00	1,900
78	Bahiagrass	Bahiagrass, yr1 spring seeded	73	0.50	lbs	1	4000	4,000	1.00	1,400
79	Bahiagrass	Bahiagrass, yr2+ regrowth	74	0.50	lbs	1	4000	4,000	1.00	1,900
80	Barley	Barley, annual winter vineyard cover, CA, 3 mowing	75	0.75	lbs	1	3000	3,000	1.00	1,050
81	Barley	Barley, annual winter vineyard cover, CA	76	0.75	lbs	1	3000	3,000	1.00	1,050
82	Barley	Barley, annual winter, cover crop, CA	77	0.75	lbs	1	3000	3000	1	950
83	Barley	Barley, annual winter, grain, CA	78	0.75	lbs	1	2150	3010	1.4	893
84	Barley	Barley, regrowth after forage harves	79	0.5	tons	2000	0.4	800	1	1000
85	Barley	Barley, spring, CMZ 10, 10 in. spac	80	0.75	lbs	1	3000	3,090	1.03	780
86	Barley	Barley, spring, CMZ 47, 7 in. spac.	81	0.75	lbs	1	2500	2,800	1.12	676
87	Barley	Barley, spring, CMZ 50, 7 in. spac.	82	0.75	tons	2,000	2	4,400	1.10	1,100
88	Barley	Barley, spring, hay	83	0.75	bu	48	55	3,960	1.50	1,100
89	Barley	Barley, spring	84	1.00	lbs	1	2500	3,400	1.36	852
90	Barley	Barley, winter, CMZ 10, 10 in. spac	85	1.00	lbs	1	3000	3,800	1.27	1,111
91	Barley	Barley, winter, CMZ 47, 7 in. spac	86	0.50	tons	2,000	3	6,500	1.08	1,510
92	Barley	Barley, winter, hay	87	0.50	bu	48	90	6,480	1.50	1,510
93	Barley	Barley, winter	88	0.75	lbs	1	1400	1,400	1.00	260
94	Beans	Bean, field 30in rows	89	0.75	lbs	1	1400	1,400	1.00	290
95	Beans	Bean, field 7in rows	90	0.50	lbs	1	4000	2,400	0.60	130
96	Beans	Bean, green snap hand pick	91	0.50	lbs	1	8100	2,430	0.30	140
97	Beans	Bean, green snap mech harv HI PROD	92	0.50	lbs	1	5000	2,000	0.40	120
98	Beans	Bean, green snap mech harv	93	0.50	tons	2,000	1.2	1,000	0.42	850
99	Beans	Bean, lima processing	94	0.50	lbs	1	2400	1,000	0.42	850

100	Beans	Bean, lima	95	0.50	lbs	1	750	750	1.00	300
101	Beans	Bean, pinto	96	0.50	lbs	1	1200	1,680	1.40	210
102	Beans	Beans, garbonzo	97	0.50	lbs	1	29000	1,044	0.04	130
103	Beets	Beet, red garden var	98	0.50	lbs	1	430	1,720	4.00	320
104	Belladonna	Belladonna, yr1	99	0.50	lbs	1	1000	2,500	2.50	520
105	Belladonna	Belladonna, yr2	100	0.50	lbs	1	2000	2,000	1.00	1,300
106	Bermudagrass	Bermudagrass, 1st yr	101	0.50	lbs	1	2000	2,000	1.00	3,900
107	Bermudagrass	Bermudagrass, coastal regrowth yr2+	102	0.50	lbs	1	2000	2,000	1.00	3,900
108	Bermudagrass	Bermudagrass, coastal spring seeded 1st yeai	103	0.50	lbs	1	4000	4,000	1.00	3,900
109	Bermudagrass	Bermudagrass, coastal, y2+ senesc thru yr3 + greenup	104	0.50	lbs	1	1500	1,500	1.00	3,400
110	Bermudagrass	Bermudagrass, common regrowth yr2+	105	0.50	lbs	1	2000	2,000	1.00	3,400
111	Bermudagrass	Bermudagrass, common spring seeded 1st yeai	106	0.50	lbs	1	4000	4,000	1.00	3,400
112	Bermudagrass	Bermudagrass, common, y1 regrowth and senesc thru yr2	107	0.50	lbs	1	4000	4,000	1.00	3,400
113	Bermudagrass	Bermudagrass, common, y2+ senesc thru yr3 + greenup	108	0.50	lbs	1	4000	4,000	1.00	3,730
114	Blueberry	Blueberry, low bush, cov crop	109	0.50	lbs	1	4000	3,000	0.75	770
115	Blueberry	Blueberry, low bush	110	0.50	lbs	1	4000	3,200	0.80	700
116	Blueberry	Blueberry, med bush	111	0.50	lbs	1	4000	3,400	0.85	630
117	Blueberry	Blueberry, tall bush	112	0.50	lbs	1	6000	3,000	0.50	1,155
118	Blueberry	Blueberry, wild, low bush	113	0.50	tons	2,000	0.75	1,500	1.00	2,500
119	Bluestem	Bluestem, old world, established, regrowth after grazing	114	0.50	tons	2,000	1.25	2,500	1.00	2,500
120	Bluestem	Bluestem, old world, established, senesc thru spring regro	115	1.00	tons	2,000	1.6	2,400	0.75	1,680
121	Brassica	Brassica pasture, forage turnip	116	1.00	tons	2,000	1.6	2,400	0.75	1,680
122	Brassica	Brassica, winter cover crop, forage turnip	117	0.50	lbs	1	300	2,100	7.00	300
123	Brocolli	Brocolli and Cabbage seed	118	0.50	lbs	1	4100	1,800	0.44	200
124	Brocolli	Brocolli, fall	119	0.50	lbs	1	15000	2,880	0.19	250
125	Brocolli	Brocolli, HI PROD	120	0.50	lbs	1	4100	1,800	0.44	200
126	Brocolli	Brocolli, spring	121	0.75	lbs	1	3000	3,000	1.00	1,900
127	Brome	Brome, annual (Blando), winter vineyard cover, C/	122	0.50	lbs	1	3000	3,000	1.00	7,000
128	Bromegrass	Brome, California, established vineyard cover, C/	123	0.75	lbs	1	3000	3,000	1.00	3,000
129	Bromegrass	Brome, California, seeding period, vineyard cover, C/	124	0.50	tons	2,000	0.7	1,400	1.00	4,000
130	Bromegrass	Bromegrass, fall seed senes to yr2 regrowth	125	0.50	tons	2,000	2	4,000	1.00	4,500
131	Bromegrass	Bromegrass, hay, yr2 overwinter to yr3 regrowth after fal	126	0.50	tons	2,000	1.5	3,000	1.00	4,000
132	Bromegrass	Bromegrass, hay, yr2 regrowth after cu	127	0.50	tons	2,000	2	4,000	1.00	4,700
133	Bromegrass	Bromegrass, hay, yr2 senes to yr3 regrowth	128	0.50	tons	2,000	2	4,000	1.00	4,500
134	Bromegrass	Bromegrass, hay, yr3 plus, overwinter to yr4 plus, regrow	129	0.50	tons	2,000	1.5	3,000	1.00	4,500
135	Bromegrass	Bromegrass, hay, yr3 regrowth after cut	130	0.50	tons	2,000	2.25	4,500	1.00	4,500
136	Bromegrass	Bromegrass, hay, yr3 senes to yr4 regrowth	131	0.50	tons	2,000	1.5	3,000	1.00	4,000
137	Bromegrass	Bromegrass, spring seed 1st yr	132	0.50	bu	48	25	1,800	1.50	80
138	Buckwheat	Buckwheat	133	0.50	lbs	1	17600	4,930	0.28	280
139	Bulbs	Bulbs, lilly	134	0.50	lbs	1	52800	5,850	0.11	400
	Cabbage	Cabbage, for kraut	135	0.50	lbs	1	39000	4,260	0.11	410
	Cabbage	Cabbage, HI PROD	136	0.50	lbs	1	23000	2,550	0.11	348
	Cabbage	Cabbage	137							
143	Camelina	Camelina	138	0.50	lbs	1	1500	2,144	1.43	850
144	Canola	Canola, spring	139	1.00	lbs	1	1200	2,400	2.00	1,680
145	Canola	Canola, winter	140	1.00	lbs	1	1100	2,200	2.00	1,100
146	Cantaloupe	Cantaloupe, HI PROD	141	0.50	lbs	1	24800	2,160	0.09	240
147	Cantaloupe	Cantaloupe	142	0.50	lbs	1	14100	1,800	0.13	200
148	Carrot	Carrot and Onion seed	143	0.50	lbs	1	300	1,100	3.67	240
149	Carrot	Carrot, fresh market	144	0.50	lbs	1	28400	600	0.02	130
150	Carrot	Carrot, hybrid seed production	145	0.50	lbs	1	350	1,100	3.14	280
151	Carrot	Carrot, processing after small grain cove	146	0.50	tons	2,000	30	900	0.02	190
152	Carrot	Carrot, processing	147	0.50	tons	2,000	30	900	0.02	190
153	Cauliflower	Cauliflower, HI PROD	148	0.50	lbs	1	18300	20,300	1.11	270
154	Cauliflower	Cauliflower	149	0.50	lbs	1	10300	11,100	1.08	270
155	Celery	Celery, HI PROD	150	0.50	lbs	1	69000	71,100	1.03	3,180
156	Celery	Celery	151	0.50	lbs	1	48000	49,700	1.04	2,700
157	Chickpea	Chickpea	152	0.66	lbs	1	1680	3,696	2.20	290
158	Chicory	Chicory; seed Yr 1	153	0.50	lbs	1	1600	4,000	2.50	1,100
159	Chicory	Chicory; seed Yr 2	154	0.50	lbs	1	1600	4,000	2.50	1,100
160	Citrus	Citrus, bare ground	155	0.50	lbs	1	20000	200	0.01	400
161	Citrus	Citrus, cover in alley	156	0.50	lbs	1	20000	200	0.01	1,500
162	Citrus	Citrus, full cover	157	0.50	lbs	1	20000	200	0.01	3,500
163	Clover	Clover white seed; estb regrowth to seed harv	158	0.50	lbs	1	350	3,500	10.00	2,100
164	Clover	Clover white seed; fall plant sens. to 2yr. hay or graz	159	0.50	tons	2,000	1	2,000	1.00	2,100
165	Clover	Clover white seed; fall planted	160	0.50	lbs	1	350	525	1.50	1,600
166	Clover	Clover white seed; spring planted	161	0.50	lbs	1	500	750	1.50	2,100
167	Clover	Clover, annual	162	0.50	lbs	1	800	1,200	1.50	1,000
168	Clover	Clover, annual, early Aug seeded	163	0.50	tons	2,000	1.5	3,000	1.00	850
169	Clover	Clover, annual, fall cover crop, early Aug seeded	164	0.50	lbs	1	1500	1,500	1.00	850
170	Clover	Clover, annual, fall cover crop, mid Sept seeded	165	0.50	lbs	1	750	750	1.00	300
171	Clover	Clover, annual released growing cover after fall crop harv	166	0.5	tons	2000	1	2000	1	2100
172	Clover	Clover, annual, seed	167	0.50	lbs	1	800	1,200	1.50	1,000
173	Clover	Clover, annual, summer seeded	168	0.50	tons	2,000	1.5	3,000	1.00	850
174	Clover	Clover, red spring seed	169	0.50	tons	2,000	1.5	3,000	1.00	770
175	Clover	Clover, red , released growing cover after corn haves	170	0.50	tons	2,000	1.5	3,000	1.00	2,100
176	Clover	Clover, red late summer seed senes to yr2 regrowth	171	0.50	tons	2,000	1.5	3,000	1.00	2,100
177	Clover	Clover, red y1 regrowth after cut	172	0.50	tons	2,000	1.5	3,000	1.00	1,500
178	Clover	Clover, red y1 regrowth after small grain haves	173	0.50	tons	2,000	1.5	3,000	1.00	2,100
179	Clover	Clover, red y1 senesc to y2 regrow	174	0.50	tons	2,000	1.5	3,000	1.00	2,100
180	Clover	Clover, red y2 regrow after cu	175	0.50	tons	2,000	1.5	3,000	1.00	2,100
181	Clover	Clover, red, NW spr seed, harv seed	176	0.50	lbs	1	300	6,000	20.00	1,000
182	Clover	Clover, red, NW spr seed, senes to yr2 regrowth	177	0.50	tons	2,000	3	6,000	1.00	2,100
183	Clover	Clover, red, NW yr2 regrowth to seed harv	178	0.50	lbs	1	600	6,000	10.00	2,100
184	Clover	Clover, red, y2 senesc to yr3 regrowth	179	0.50	tons	2,000	1.5	3,000	1.00	2,300
185	Clover	Clover, red, y3 regrow after cu	180	0.50	tons	2,000	1.3	2,600	1.00	1,900
186	Clover	Clover, red, y3 senesc to spring greenup	181	0.50	tons	2,000	2	4,000	1.00	1,900
187	Clover	Clover, red-oat nurse crop spring seed	182	0.50	bu	32	60	3,840	2.00	800
188	Clover	Clover, red-timothy, fall seed senes to yr2 regrowt	183	0.50	tons	2,000	1.5	3,000	1.00	2,500
189	Clover	Clover, red-timothy, spring seed	184	0.50	tons	2,000	1.5	3,000	1.00	1,500
190	Clover	Clover, red-timothy, spring seed regrowth after cu	185	0.50	tons	2,000	1.5	3,000	1.00	1,500
191	Clover	Clover, red-timothy, spring seed senes to y2 regrowth	186	0.50	tons	2,000	1.5	3,000	1.00	2,500
192	Clover	Clover, red-timothy, y2 regrow after cu	187	0.50	tons	2,000	1.5	3,000	1.00	2,500
193	Clover	Clover, red-timothy, y2 senesc to yr3 regrowth	188	0.50	tons	2,000	1.5	3,000	1.00	2,900
194	Clover	Clover, red-timothy-oat nurse crop spring seed	189	0.50	bu	32	60	3,840	2.00	1,500
195	Clover	Clover, sweet, for seed or green manure	190	0.50	tons	2,000	1.5	3,000	1.00	2,700
196	Clover	Clover, sweet, spring seed	191	0.50	tons	2,000	1.5	3,000	1.00	1,000
197	Clover	Clover, sweet, spring seed regrowth after cutting	192	0.50	tons	2,000	1.5	3,000	1.00	1,100
198	Clover	Clover, sweet, spring seed senes to y2 regrowth	193	0.50	tons	2,000	1.5	3,000	1.00	2,500

199	Clover	Clover, sweet, yr2 regrowth after cutting	194	0.50	tons	2,000	1.5	3,000	1.00	2,500
200	Clover	Clover, sweet, yr2 senescence and death	195	0.50	tons	2,000	1.5	3,000	1.00	2,500
201	Collard	Collard greens, HI PROD	196	0.50	lbs	1	16000	1,800	0.11	210
202	Collard	Collard, greens	197	0.50	lbs	1	8900	1,000	0.11	190
203	Conifer	Conifer, establishec	198	0.50	cords	5,350	75	401,250	1.00	1,142
204	Corn	Corn, grain	199	0.50	bu	56	112	6,272	1.00	950
205	Corn	Corn, grain 18 in rows	200	0.50	bu	56	112	6,272	1.00	950
206	Corn	Corn, grain 18 in rows with interseeded cove	201	0.50	bu	56	112	6,272	1.00	950
207	Corn	Corn, grain with grass weeds	202	0.50	bu	56	112	6,680	1.07	1,012
208	Corn	Corn, grain with interseed oil seed radish cove	203	0.50	bu	56	112	6,272	1.00	1,300
209	Corn	Corn, grain with interseed Rye cove	204	0.50	bu	56	112	6,272	1.00	1,300
210	Corn	Corn, grain with interseed small grain cove	205	0.50	bu	56	112	6,272	1.00	1,300
211	Corn	Corn, grain with interseeded legume cove	206	0.50	bu	56	112	6,272	1.00	1,300
212	Corn	Corn, grain, 38 in rows	207	0.50	bu	56	112	6,272	1.00	900
213	Corn	Corn, grain, high yielc	208	0.50	bu	56	200	10,006	0.89	1,600
214	Corn	Corn, pop	209	0.50	lbs	1	3400	3,060	0.90	490
215	Corn	Corn, seed	210	0.50	bu	56	60	2,184	0.65	540
216	Corn	Corn, seed, with interseeded covei	211	0.50	bu	56	60	2,184	0.65	950
217	Corn	Corn, silage	212	0.50	tons	2,000	23	16,100	0.35	950
218	Corn	Corn, silage 18 in rows	213	0.50	tons	2,000	23	11,600	0.35	950
219	Corn	Corn, silage 18 in. rows with interseed Rye covei	214	0.50	tons	2,000	23	11,500	0.25	1,300
220	Corn	Corn, silage and grass covei	215	0.50	tons	2,000	23	15,000	0.33	1,300
221	Corn	Corn, silage and legume covei	216	0.50	tons	2,000	23	14,000	0.30	1,300
222	Corn	Corn, silage with grass weeds	217	0.50	tons	2,000	23	12,000	0.26	1,000
223	Corn	Corn, silage with interseed oil seed radish cove	218	0.5	tons	2000	23	16100	0.35	1300
224	Corn	Corn, silage with interseed Rye cover	219	0.50	tons	2,000	23	11,500	0.25	1,300
225	Corn	Corn, silage with interseed small grain cove	220	0.5	tons	2000	23	16100	0.35	1300
226	Corn	Corn, silage with interseeded legume cove	221	0.5	tons	2000	23	46000	1	1300
227	Corn	Corn, sweet	222	0.50	lbs	1	7300	3,400	0.47	820
228	Corn	Corn, sweet HI PROD	223	0.50	lbs	1	14560	4,080	0.28	970
229	Corn	Corn, with interseed Rye cover	224	0.50	bu	56	112	6,272	1.00	1,300
230	Corn	Corn, with Squash and Beans	225	0.50	bu	56	112	7,000	1.12	1,300
231	Corn	Corn, with Squash and Beans yield lbs	226	0.50	lbs	1	1000	1,000	1.00	229
232	Cotton	Cotton, CA Hi Prod	227	0.50	lbs	1	1200	5,000	4.17	400
233	Cotton	Cotton, delta	228	0.50	lbs	1	750	4,500	6.00	360
234	Cotton	Cotton, southern uplanc	229	0.50	lbs	1	750	3,375	4.50	360
235	Cotton	Cotton, stripper skip 1 row	230	0.50	lbs	1	420	1,260	3.00	210
236	Cotton	Cotton, stripper skip 2 rows	231	0.50	lbs	1	340	1,020	3.00	170
237	Cotton	Cotton, stripper	232	0.50	lbs	1	500	1,500	3.00	250
238	Cotton	Cotton, ultra narrow row	233	0.50	lbs	1	750	3,375	4.50	360
239	Cow pea	Cow pea	234	0.50	lbs	1	6550	3,406	0.52	210
240	Crambe	Crambe	235	0.75	lbs	1	2000	2,400	1.20	800
241	Cranberries	Cranberries, 3 year establishmen	236	0.50	lbs	1	16500	12,400	0.75	784
242	Cranberries	Cranberries, established stand	237	0.50	lbs	1	16500	12,400	0.75	784
243	Cucumber	Cucumber, HI PROD	238	0.50	lbs	1	28200	2,160	0.08	35
244	Cucumber	Cucumber	239	0.50	bu	50	600	1,800	0.06	30
245	Delayed germinatior	Delayed germinatior	240	0.50	lbs	1	1	1	1.00	0
246	Dichondra	Dichondra, establishmen	241	0.50	lbs	1	650	975	1.50	500
247	Dichondra	Dichondra, overwinter and spring regrowtl	242	0.50	lbs	1	650	975	1.50	500
248	Eggplant	Eggplant, HI PROD	243	0.50	lbs	1	22100	4,320	0.20	520
249	Eggplant	Eggplant	244	0.50	lbs	1	11670	2,270	0.19	440
250	Fescue	Fescue, annual (Zorro), winter vineyard cover, C/	245	0.75	lbs	1	3000	3,000	1.00	3,500
251	Fescue	Fescue, red, established vineyard cover, CA	246	0.50	lbs	1	2000	2,000	1.00	6,500
252	Fescue	Fescue, red, seeding period, vineyard cover, CA	247	0.75	lbs	1	3000	3,000	1.00	3,000
253	Filbert	Filbert, full covei	248	0.50	cwt	100	20	2,000	1.00	3,500
254	Filbert	Filbert, no covei	249	0.50	cwt	100	20	2,000	1.00	3,500
255	Flax	Flax (lbs)	250	0.50	lbs	1	840	1,201	1.43	500
256	Flax	Flax	251	0.50	bu	56	15	1,201	1.43	500
257	Flowers	Flowers, seed	252	0.50	lbs	1	200	1,320	6.60	270
258	Flowers	Flowers	253	0.50	lbs	1	1000	1,200	1.20	270
259	Garlic	Garlic seed production	254	0.50	lbs	1	17000	1,100	0.06	320
260	Ginseng	Ginseng, lath cover, 3 yr stanc	255	0.75	lbs	1	1300	4,030	3.10	3,000
261	Ginseng	Ginseng, lath cover, 4 yr stanc	256	0.75	lbs	1	1400	4,340	3.10	3,500
262	Ginseng	Ginseng, mesh cover, 3 yr stanc	257	0.75	lbs	1	1300	4,030	3.10	3,000
263	Ginseng	Ginseng, mesh cover, 4 yr stanc	258	0.75	lbs	1	1400	4,340	3.10	3,500
264	Gladiola	Gladiola	259	0.50	lbs	1	600	2,700	4.50	320
265	Grama	Grama, yr 1	260	0.50	lbs	1	300	300	1.00	390
266	Grama	Grama, yr 2	261	0.50	lbs	1	500	500	1.00	650
267	Grama	Grama, yr 3+	262	0.50	lbs	1	600	600	1.00	780
268	Grass seed	Grass seed, established, senescence	263	0.50	lbs	1	1200	5,400	4.50	5,000
269	Grass seed	Grass seed, fall seeding	264	0.50	lbs	1	500	2,250	4.50	5,000
270	Grass seed	Grass seed, interseeded growing crop	265	0.50	lbs	1	1200	5,400	4.50	5,000
271	Grass seed	Grass seed, per. ryegrass fall plant late	266	0.50	lbs	1	924	4,160	4.50	3,000
272	Grass seed	Grass seed, per. ryegrass late plant, established, senescend	267	0.5	lbs	1	1200	5400	4.5	5000
273	Grass seed	Grass seed, per. ryegrass yr2 regrowth, to yr3 seed harves	268	0.50	lbs	1	1200	5,400	4.50	5,000
274	Grass seed	Grass seed, spring seeded	269	0.50	lbs	1	1000	2,000	2.00	5,000
275	Grass seed	Grass seed, warm season, late summer seeding	270	0.50	lbs	1	350	840	2.40	3,000
276	Grass seed	Grass seed, warm season, spring seeding	271	0.50	lbs	1	400	960	2.40	3,000
277	Grass seed	Grass seed, warm season, y2 senesc to yr3 seed harvesi	272	0.50	lbs	1	500	4,000	8.00	6,000
278	Grass seed	Grass seed, warm season, yr3+ , senesc to next seed harve	273	0.50	lbs	1	500	4,000	8.00	9,000
279	Grass seed	Grass seed, y2 and later regrowth after clipping to seed ha	274	0.50	lbs	1	1200	5,400	4.50	5,000
280	Grass seed	Grass seed, y2 and later regrowth to seed harves	275	0.5	lbs	1	1200	5400	4.5	5000
281	Grass seed	Grass seed, yr2 senescence	276	0.50	lbs	1	1200	5,400	4.50	5,000
282	Grass	Grass, cool season pasture, regrowth after grazing	277	0.50	tons	2,000	1	2,000	1.00	7,000
283	Grass	Grass, cool season pasture, senesc to regrowtl	278	0.50	tons	2,000	2	4,000	1.00	7,000
284	Grass	Grass, cool season pasture, slow regrowth after grazing	279	0.50	tons	2,000	1	2,000	1.00	7,000
285	Grass	Grass, cool season, fall seed senes to yr2 regrowth SE	280	0.50	tons	2,000	1	2,000	1.00	4,800
286	Grass	Grass, cool season, fall seeded	281	0.50	tons	2,000	1	2,000	1.00	3,000
287	Grass	Grass, cool season, spring seeded	282	0.50	tons	2,000	1.5	3,000	1.00	3,000
288	Grass	Grass, cool season, y2+ senesc thru yr3 + greenup SE	283	0.50	tons	2,000	2	4,000	1.00	6,900
289	Grass	Grass, dense, senesc to 1st cut	284	0.50	tons	2,000	2	4,000	1.00	5,900
290	Grass	Grass, dense, regrowth after cut	285	0.50	tons	2,000	2	4,000	1.00	5,900
291	Grass	Grass, warm season pasture yr2, regrowth after grazing	286	0.50	lbs	1	1500	1,500	1.00	5,000
292	Grass	Grass, warm season pasture, spring seeded	287	0.50	lbs	1	1200	1,200	1.00	3,000
293	Grass	Grass, warm season pasture, y2 senesc to yr3 regrowtl	288	0.50	lbs	1	4000	4,000	1.00	6,000
294	Grass	Grass, warm season pasture, yr3+ , senesc to regrowth	289	0.50	lbs	1	4000	4,000	1.00	9,000
295	Grass	Grass, warm season pasture, yr3+, regrowth after grazing	290	0.50	lbs	1	1500	1,500	1.00	8,000
296	Grass	Grass, warm season pasture, yr3+, slow regrowth after gr	291	0.50	lbs	1	1500	1,500	1.00	8,000
297	Greens	Greens, baby leaf HI PROD	292	0.50	lbs	1	2000	2,207	1.10	250

298	Guar	Guar	293	0.50	lbs	1	1735	1,735	1.00	190
299	Hardwood	Hardwood, established stands	294	0.50	cords-lbs	1	100000	125,000	1.25	2,350
300	Hardwood	Hardwood, Five year old stanc	295	0.50	cords-lbs	1	5000	6,250	1.25	2,350
301	Hardwood	Hardwood, planted stands	296	0.50	cords-lbs	1	100000	125,000	1.25	2,350
302	Hops	Hops, 3 yr establishment perioc	297	0.50	bales	200	2	400	1.00	1,200
303	Hops	Hops, established	298	1.00	bales	200	13	4,000	1.54	1,600
304	Hops	Hops, establishment perioc	299	1.00	bales	200	4	4,000	5.00	1,600
305	Horseradish	Horseradish	300	0.50	lbs	1	18000	1,620	0.09	1,000
306	Kale	Kale, HI PROD	301	0.50	lbs	1	20600	2,260	0.11	190
307	Kale	Kale	302	0.50	lbs	1	11000	1,230	0.11	160
308	Kenaf	Kenaf	303	0.50	tons	2,000	6	12,000	1.00	630
309	Lavender	Lavender, established stanc	304	0.50	bundles	1	20000	18,000	1.80	1,900
310	Legume	Legume, released growing cover after corn harves	305	0.50	tons	2,000	1.5	3,000	1.00	2,100
311	Lentils	Lentils, fall	306	0.66	lbs	1	2500	4,217	1.69	350
312	Lentils	Lentils, grazed out	307	0.66	tons	2,000	1	1,500	0.75	310
313	Lentils	Lentils	308	0.66	lbs	1	1500	2,160	1.44	310
314	Lettuce	Lettuce, head HI PROD	309	0.50	lbs	1	35300	3,860	0.11	35
315	Lettuce	Lettuce, head	310	0.50	lbs	1	19200	2,080	0.11	30
316	Lettuce	Lettuce, leaf HI PROD	311	0.50	lbs	1	25200	2,781	0.11	100
317	Lettuce	Lettuce, leaf	312	0.50	lbs	1	16600	1,774	0.11	80
318	Lily	Lily, Cala yr1	313	0.50	lbs	1	30	300	10.00	320
319	Lily	Lily, Cala yr2	314	0.50	lbs	1	60	600	10.00	320
320	Lily	Lily, Cala yr3	315	0.50	lbs	1	80	800	10.00	900
321	Lily	Lily, Cala yr4+	316	0.50	lbs	1	110	1,100	10.00	1,070
322	Meadowfoam	Meadowfoam, seed	317	0.50	lbs	1	700	1,680	2.40	1,700
323	Millet	Millet, proso	318	0.50	bu	56	35	2,802	1.43	1,200
324	Mint	Mint, fall seec	319	0.50	lbs	1	1800	1,800	1.00	2,400
325	Mint	Mint, spring seed	320	0.50	lbs	1	1100	1,100	1.00	1,500
326	Mint	Mint, spring seed regrowth after cutting	321	0.50	lbs	1	1300	1,300	1.00	1,500
327	Mint	Mint, spring seed senes to y2 regrowth	322	0.50	lbs	1	1900	1,900	1.00	2,500
328	Mint	Mint, yr2 regrowth after cutting	323	0.50	lbs	1	1800	1,800	1.00	2,500
329	Mint	Mint, yr2 senes to yr3 regrowth	324	0.50	lbs	1	1900	1,900	1.00	3,000
330	Mint	Mint, yr3 regrowth after cutting	325	0.50	lbs	1	1800	1,800	1.00	3,000
331	Mint	Mint, yr3 senes to yr4 regrowth	326	0.50	lbs	1	1900	1,900	1.00	3,500
332	Mint	Mint, yr4 regrowth after cutting	327	0.50	lbs	1	1800	1,800	1.00	3,500
333	Mint	Mint, yr4 senes to yr5 regrowth	328	0.50	lbs	1	1800	1,800	1.00	3,500
334	Miscanthus	Miscanthus biomass prod yr1 overwinter, and yr2 regrow	329	0.5	tons	2000	6	12000	1	5000
335	Miscanthus	Miscanthus biomass prod, sprigged in spring	330	0.5	tons	2000	2	4000	1	1300
336	Miscanthus	Miscanthus, biomass prod. yr2 overwinter and yr3	331	0.5	tons	2000	12	24000	1	6000
337	Miscanthus	Miscanthus, sprigged with red clover nurse crop spring se	332	0.5	tons	2000	2	4000	1	800
338	Mungbean	Mungbean	333	0.50	lbs	1	6550	3,406	0.52	210
339	Muskmelon	Muskmelon	334	0.50	lbs	1	8000	1,800	0.23	200
340	Mustard	Mustard greens, fall	335	0.50	lbs	1	7400	844	0.11	320
341	Mustard	Mustard greens, HI PROD	336	0.50	lbs	1	16250	1,840	0.11	380
342	Mustard	Mustard greens, spring	337	0.50	lbs	1	7000	799	0.11	320
343	Mustard	Mustard seed, spring	338	1.00	lbs	1	1200	2,400	2.00	1,680
344	Oats	Oat forage, fall seed to 1st cut or graze, deep soutl	339	0.75	lbs	1	2800	2,800	1.00	950
345	Oats	Oat forage, regrowth, deep soutl	340	0.50	lbs	1	1500	1,500	1.00	950
346	Oats	Oats, fall cover crop, early Aug seeding	341	0.75	lbs	1	2000	2,000	1.00	800
347	Oats	Oats, fall cover crop, mid Sept seeding	342	0.75	lbs	1	1000	1,000	1.00	330
348	Oats	Oats, fall seeded cover	343	0.50	lbs	1	2000	900	0.45	400
349	Oats	Oats, fall seeded, hay	344	1.00	tons	2,000	2	4,500	1.13	970
350	Oats	Oats, hay regrowth after cut	345	0.50	tons	2,000	1.5	3,000	1.00	500
351	Oats	Oats, spring	346	0.75	bu	32	60	3,840	2.00	800
352	Oats	Oats, spring hay	347	0.50	tons	2,000	2.5	5,500	1.10	800
353	Oats	Oats, spring silage	348	0.50	tons	2,000	8	5,500	0.34	800
354	Oats	Oats, spring silage or hay	349	0.50	tons	2,000	4	2,750	0.34	800
355	Oats	Oats, spring silage-hay	350	0.50	tons	2,000	4	2,750	0.34	800
356	Oats	Oats, spring silage-hay 2	351	0.5	tons	2000	4	9600	1.2	400
357	Oats	Oats, winter cover crop S.E.	352	0.50	lbs	1	3840	3,840	1.00	1,070
358	Oats	Oats, winter S.E.	353	0.50	bu	32	60	3,840	2.00	1,070
359	Okra	Okra, HI PROD	354	0.50	lbs	1	8350	9,400	1.13	890
360	Okra	Okra	355	0.50	lbs	1	2650	7,345	2.77	750
361	Onion	Onion seed productior	356	0.50	lbs	1	300	1,100	3.67	280
362	Onion	Onion, after sm grair	357	0.50	cwt	100	310	1,240	0.04	240
363	Onion	Onion, bulb dry HI PROD	358	0.50	lbs	1	44000	1,490	0.03	290
364	Onion	Onion, bulb dry	359	0.50	cwt	100	310	1,240	0.04	240
365	Onion	Onion, dry bulb, Vidalia-type	360	0.50	cwt	100	435	1,935	0.04	370
366	Onion	Onion, green bunch	361	0.50	lbs	1	18200	1,100	0.06	240
367	Orchard	Orchard, bare ground	362	0.50	cwt	100	300	990	0.03	300
368	Orchard	Orchard, cover betw rows 50-50	363	0.50	cwt	100	300	990	0.03	3,400
369	Orchard	Orchard, cover betw rows 80-20	364	0.50	cwt	100	300	990	0.03	4,640
370	Orchard	Orchard, cover betw rows 90-10	365	0.50	cwt	100	300	990	0.03	5,880
371	Orchard	Orchard, cover betw rows	366	0.50	cwt	100	300	990	0.03	4,020
372	Orchard	Orchard, cover betw rows70-30	367	0.50	cwt	100	300	990	0.03	4,640
373	Orchard	Orchard, dwarf varieties	368	0.50	cwt	100	300	990	0.03	1,500
374	Orchard	Orchard, fall small grain cover crop	369	0.50	cwt	100	300	990	0.03	1,350
375	Orchard	Orchard, full cover	370	0.50	cwt	100	300	990	0.03	3,500
376	Orchard	Orchard, new yr1	371	0.50	lbs	1	1	100	100.00	300
377	Orchard	Orchard, new yr2	372	0.50	lbs	1	1	200	200.00	390
378	Orchard	Orchard, new yr3	373	0.50	lbs	1	1	300	300.00	480
379	Orchard	Orchard, new yr4	374	0.50	lbs	1	1	400	400.00	630
380	Orchard	Orchard, new yr5	375	0.50	lbs	1	1000	500	0.50	770
381	Orchard	Orchard, weeds annual cover	376	0.50	cwt	100	300	1,000	0.03	1,270
382	Orchardgrass	Orchardgrass, fall seed senes to yr2 regrowth	377	0.50	tons	2,000	1.5	3,000	1.00	4,800
383	Orchardgrass	Orchardgrass, seeding	378	0.50	tons	2,000	1.5	3,000	1.00	4,800
384	Orchardgrass	Orchardgrass, y2 regrowth after cut	379	0.50	tons	2,000	1.5	3,000	1.00	4,800
385	Orchardgrass	Orchardgrass, y2 senesc to 1st cut yr3	380	0.50	tons	2,000	2.25	4,500	1.00	5,900
386	Orchardgrass	Orchardgrass, y3 regrowth after cut	381	0.50	tons	2,000	1.7	3,400	1.00	5,900
387	Orchardgrass	Orchardgrass, y3 senesc to 1st cut yr4	382	0.50	tons	2,000	2.5	5,000	1.00	5,900
388	Palm	Palm, date, mature stand	383	1.00	tons	2,000	4.5	35,000	3.89	993
389	Palm	Palm, date, young stand-tree row	384	1.00	tons	2,000	2	17,100	4.28	993
390	Peanut	Peanut, runner, twin-row	385	0.75	lbs	1	3450	4,485	1.30	409
391	Peanut	Peanut, runner	386	0.75	lbs	1	3000	3,900	1.30	360
392	Peas	Peas, Austrian winter, northern climate	387	0.50	lbs	1	2000	2,140	1.07	700
393	Peas	Peas, Austrian winter	388	0.50	lbs	1	2500	2,500	1.00	1,400
394	Peas	Peas, field 7in rows	389	0.67	bu	60	30	1,728	0.96	290
395	Peas	Peas, green HI PROD	390	0.50	lbs	1	10000	930	0.09	180
396	Peas	Peas, green, drilled	391	0.50	lbs	1	3400	714	0.21	140

397	Peas	Peas, green, rows	392	0.50	lbs	1	2860	601	0.21	120
398	Peas	Peas, southern	393	0.50	lbs	1	6550	3,406	0.52	210
399	Peas	Peas, spring, grazed out	394	0.67	tons	2,000	1	1,700	0.85	290
400	Peas	Peas, spring, hay	395	0.66	tons	2,000	1	2,180	1.09	290
401	Peas	Peas, spring, NWRR	396	0.66	lbs	1	2000	2,180	1.09	290
402	Pecan	Pecan, Walnut; bare ground	397	0.50	lbs	1	2100	2,630	1.25	300
403	Pecan	Pecan, Walnut; fall sm. grain cover crop	398	0.50	lbs	1	2100	2,730	1.30	1,200
404	Pecan	Pecan, Walnut; perm. grass cover crop	399	0.50	lbs	1	2100	2,730	1.30	6,800
405	Pecan	Pecan, Walnut; weeds annual cover	400	0.50	lbs	1	2100	2,630	1.25	1,270
406	Peppers	Peppers, bell HI PROD	401	0.50	lbs	1	31800	3,816	0.12	470
407	Peppers	Peppers, bell	402	0.50	lbs	1	17500	3,570	0.20	400
408	Peppers	Peppers, chili HI PROD	403	0.50	lbs	1	22800	2,736	0.12	400
409	Peppers	Peppers, hot	404	0.50	lbs	1	7900	900	0.11	90
410	Pine bluegrass	Pine bluegrass, seeding period, vineyard cover, CA	405	0.50	lbs	1	1000	1,000	1.00	3,000
411	Pine bluegrass	Pine blugrass, established perennial vineyard cover, CA	406	0.50	lbs	1	2000	2,000	1.00	4,800
412	Pine	Pine, longleaf planted stands	407	0.50	cords	5,350	25	160,517	1.20	1,142
413	Pine	Pine, planted stands	408	0.50	cords	5,350	29	186,200	1.20	2,350
414	Potato	Potato, high yield	409	0.50	cwt	100	600	2,100	0.04	110
415	Potato	Potato, Irish	410	0.50	cwt	100	260	3,120	0.12	110
416	Potato	Potato, seed production	411	0.50	cwt	100	500	750	0.02	1,000
417	Potato	Potato, sweet	412	0.50	lbs	1	22000	2,500	0.11	250
418	Pumpkin	Pumpkin	413	0.50	lbs	1	31700	2,000	0.06	100
419	Radish	Radish, HI PROD	414	0.50	lbs	1	24000	900	0.04	65
420	Radish	Radish, oil seed, released growing cover after main crop h	415	0.50	lbs	1	3000	3,000	1.00	1,680
421	Radish	Radish, oilseed, cover crop, midsouth	416	1.00	lbs	1	3000	3,000	1.00	5,000
422	Radish	Radish, oilseed, cover crop	417	1.00	lbs	1	3000	3,000	1.00	3,000
423	Radish	Radish, oilseed, fall cover crop, early Aug seeding	418	1.00	lbs	1	3000	3,000	1.00	2,800
424	Radish	Radish, oilseed, fall cover crop, mid Sept seeding	419	1.00	lbs	1	1500	1,500	1.00	600
425	Radish	Radish, oilseed	420	1.00	lbs	1	1200	2,400	2.00	1,680
426	Radish	Radish	421	0.50	lbs	1	7420	816	0.11	50
427	Range	Range Desert grassland	422	1.00	lbs	1	600	600	1.00	648
428	Range	Range Northern desert shrub	423	1.00	lbs	1	200	200	1.00	1,300
429	Range	Range Northern mixed grass prairie seeding	424	1.00	lbs	1	600	600	1.00	600
430	Range	Range Northern mixed grass prairie	425	1.00	lbs	1	600	600	1.00	720
431	Range	Range Short grass prairie	426	1.00	lbs	1	750	750	1.00	450
432	Range	Range Southern desert shrub	427	1.00	lbs	1	200	200	1.00	1,136
433	Range	Range Southern mixed grass prairie seeding	428	1.00	lbs	1	150	150	1.00	176
434	Range	Range Southern mixed grass prairie	429	0.50	lbs	1	150	150	1.00	264
435	Range	Range Tall grass prairie	430	0.50	lbs	1	1000	1,000	1.00	180
436	Raspberry	Raspberry, black	431	0.50	lbs	1	4000	4,000	1.00	2,000
437	Raspberry	Raspberry, black, cov crop	432	0.50	lbs	1	4000	4,000	1.00	2,040
438	Raspberry	Raspberry, black, perm cov	433	0.50	lbs	1	4000	4,000	1.00	5,500
439	Rice	Rice, AR, flooded	434	0.50	bu	45	110	10,643	2.15	830
440	Rice	Rice, CA, flooded, semi-dwarf varieties	435	0.50	sacks	100	75	9,000	1.20	830
441	Rice	Rice, CA, flooded, tall varieties	436	0.50	sacks	100	55	12,650	2.30	830
442	Rice	Rice, CA, winter flooded , semi-dwarf varietie	437	0.50	sacks	100	75	9,000	1.20	830
443	Rice	Rice, CA, winter flooded, tall varietie	438	0.50	sacks	100	55	12,650	2.30	830
444	Rice	Rice, dwarf var. CA, flooded	439	0.50	sacks	100	90	8,100	0.90	988
445	Rice	Rice, dwarf var. CA, winter flooded	440	0.50	sacks	100	90	8,100	0.90	830
446	Rice	Rice, dwarf var. CA	441	0.50	sacks	100	90	8,100	0.90	988
447	Rice	Rice, ratoon crop, AR, flooded	442	0.50	bu	45	54	5,225	2.15	1,000
448	Rice	Rice, wild	443	0.50	lbs	1	1500	2,550	1.70	1,080
449	Rye	Rye and hairy vetch, released growing cover after fall cro	444	0.5	lbs	1	5000	5000	1	1320
450	Rye	Rye and Hairy vetch, winter cover	445	0.75	lbs	1	5000	5,000	1.00	2,000
451	Rye	Rye and Hairy vetch, winter cover, mid south	446	0.75	lbs	1	5000	5,000	1.00	2,100
452	Rye	Rye, cereal	447	0.75	bu	56	40	3,360	1.50	1,320
453	Rye	Rye, cereal forage, fall seed to 1st cut or graze, deep south	448	0.75	lbs	1	3000	3,000	1.00	1,000
454	Rye	Rye, cereal forage, regrowth, deep south	449	0.75	lbs	1	3000	3,000	1.00	1,200
455	Rye	Rye, cereal interseeded growing cover	450	0.75	lbs	1	3000	3,000	1.00	1,320
456	Rye	Rye, cereal silage	451	0.75	tons	2,000	15	9,000	0.30	1,100
457	Rye	Rye, cereal, mid south	452	0.75	bu	56	40	3,360	1.50	1,320
458	Rye	Rye, spring 7in rows	453	0.75	bu	60	30	2,340	1.30	970
459	Rye	Rye, winter cover	454	0.75	lbs	1	2240	2,240	1.00	1,320
460	Rye	Rye, winter cover crop, early Aug seeding	455	0.75	lbs	1	4500	4,500	1.00	1,700
461	Rye	Rye, winter cover crop, mid Oct seeding	456	0.75	lbs	1	1000	1,000	1.00	500
462	Rye	Rye, winter cover crop, mid Sept seeding	457	0.75	lbs	1	3300	3,300	1.00	1,600
463	Rye	Rye, winter cover S.E.	458	0.75	lbs	1	4200	4,200	1.00	1,000
464	Rye	Rye, winter cover, mid south	459	0.75	lbs	1	4000	4,000	1.00	1,320
465	Rye	Rye, winter grazed S.E.	460	0.75	lbs	1	2800	2,800	1.00	700
466	Rye	Rye, winter, grain S.E.	461	0.75	bu	56	40	4,211	1.88	1,000
467	Rye	Rye, winter, silage, SE	462	0.75	tons	2,000	15	9,000	0.30	1,000
468	Ryegrass	Ryegrass, ann, seed prod, regrowth	463	0.50	lbs	1	1200	5,960	4.97	1,600
469	Ryegrass	Ryegrass, ann, seed prod	464	0.50	lbs	1	1775	7,460	4.20	1,600
470	Ryegrass	Ryegrass, annual, fall cover crop, early Aug seeding	465	0.75	lbs	1	2000	2,000	1.00	800
471	Ryegrass	Ryegrass, annual, fall cover crop, mid Sept seeding	466	0.75	lbs	1	1000	1,000	1.00	330
472	Ryegrass	Ryegrass, annual, fall interseeded in established bermuda	467	0.50	lbs	1	7000	7,000	1.00	5,100
473	Ryegrass	Ryegrass, annual, fall seeding, deep south	468	0.50	lbs	1	3500	3,500	1.00	2,200
474	Ryegrass	Ryegrass, annual, regrowth after grazing or hay, deep sou	469	0.50	lbs	1	3500	3,500	1.00	2,200
475	Ryegrass	Ryegrass, annual, regrowth	470	0.50	tons	2,000	1.5	1,800	0.60	1,600
476	Ryegrass	Ryegrass, annual, seeding yr	471	0.50	tons	2,000	2	4,000	1.00	1,600
477	Ryegrass	Ryegrass, peren. interseeded growing cover	472	0.50	lbs	1	4000	4,000	1.00	1,600
478	Safflower	Safflower	473	0.50	lbs	1	1400	2,100	1.50	550
479	Sericean Lespedeza	Sericean Lespedeza, hay	474	0.50	tons	2,000	3	6,000	1.00	1,900
480	Sesame	Sesame, seed	475	0.50	lbs	1	2600	3,900	1.50	1,240
481	Sesame	Sesame	476	0.50	lbs	1	8940	8,940	1.00	1,240
482	Silvopasture	Silvopasture	477	0.50	cords	5,350	6	48,150	1.50	5,840
483	Small grain	Small grain cover, regrowth after mowing	478	0.50	lbs	1	800	800	1.00	1,000
484	Small grain	Small grain interseeded growing cover	479	0.50	lbs	1	3000	3,000	1.00	1,320
485	Small grain	Small grain, spring, hay	480	0.75	tons	2,000	2	4,400	1.10	1,100
486	Small grain	Small grain, winter, hay	481	0.50	tons	2,000	3	6,500	1.08	1,510
487	Sorghum	Sorghum, forage fall regrowth	482	1.00	tons	2,000	10	8,000	0.40	2,120
488	Sorghum	Sorghum, forage regrowth	483	1.00	tons	2,000	10	8,000	0.40	2,120
489	Sorghum	Sorghum, forage seeding to 1st cut	484	1.00	tons	2,000	10	8,000	0.40	2,120
490	Sorghum	Sorghum, forage, grazed	485	1.00	tons	2,000	20	40,000	1.00	1,060
491	Sorghum	Sorghum, grain	486	1.00	bu	56	60	3,360	1.00	980
492	Sorghum	Sorghum, grain 18 inch rows	487	1.00	bu	56	60	3,360	1.00	980
493	Sorghum	Sorghum, grain South 135day	488	1.00	bu	56	65	5,096	1.40	980
494	Sorghum	Sorghum, grain, hi biomass var	489	1.00	bu	56	70	3,920	1.00	980
495	Sorghum	Sorghum, grain, South, shrt seasn hi density	490	1.00	bu	56	60	4,765	1.42	1,313

496	Sorghum	Sorghum, silage	491	1.00	tons	2,000	20	8,000	0.20	1,060
497	Sorghum	Sorghum, sudangrass, 7in rows regrowth after cu	492	1.00	tons	2,000	15	8,000	0.27	2,120
498	Sorghum	Sorghum, sudangrass, 7in rows, seeding to 1st cu	493	1.00	tons	2,000	15	8,000	0.27	2,120
499	Soybean	Soybean, 15 in with interseeded clover or oil seed radish	494	0.50	bu	60	30	2,700	1.50	600
500	Soybean	Soybean, 15 in with interseeded rye cove	495	0.50	bu	60	30	2,700	1.50	600
501	Soybean	Soybean, 30 in with interseeded clover or oil seed radish	496	0.50	bu	60	30	2,700	1.50	600
502	Soybean	Soybean, 30 in with interseeded rye cove	497	0.50	bu	60	30	2,700	1.50	600
503	Soybean	Soybean, 7 in with interseeded cove	498	0.50	bu	60	30	2,700	1.50	600
504	Soybean	Soybean, group 0 and I, 30in rows	499	0.75	bu	60	20	1,200	1.00	280
505	Soybean	Soybean, group 0 and I, 7in rows	500	0.75	bu	60	20	1,200	1.00	280
506	Soybean	Soybean, group II, III and IV 30 in row	501	0.50	bu	60	30	2,700	1.50	320
507	Soybean	Soybean, group II, III and IV, 7in row	502	0.75	bu	60	20	1,800	1.50	280
508	Soybean	Soybean, groups V, VI, VII, and VIII 30 in row	503	0.75	bu	60	25	3,000	2.00	310
509	Soybean	Soybean, groups V, VI, VII, and VIII 7in row	504	0.75	bu	60	20	2,400	2.00	370
510	Soybean	Soybean, millet hay	505	0.50	tons	2,000	4	8,000	1.00	1,600
511	Soybean	Soybean, mw 15 - 20 in rows	506	0.50	bu	60	25	2,250	1.50	280
512	Soybean	Soybean, mw 30 in rows, relay croppec	507	0.50	bu	60	30	2,700	1.50	320
513	Soybean	Soybean, mw 30 in rows	508	0.50	bu	60	30	2,700	1.50	320
514	Soybean	Soybean, mw 7in rows	509	0.75	bu	60	20	1,800	1.50	280
515	Soybean	Soybean, southern 15-20 in rows	510	0.75	bu	60	20	2,400	2.00	330
516	Soybean	Soybean, southern 30 in rows	511	0.75	bu	60	25	3,000	2.00	310
517	Soybean	Soybean, southern 7in rows	512	0.75	bu	60	20	2,400	2.00	370
518	Spinach	Spinach, HI PROD	513	0.50	lbs	1	17500	1,992	0.11	50
519	Spinach	Spinach, regrowth after harv	514	0.50	lbs	1	8100	9,190	1.13	60
520	Spinach	Spinach	515	0.50	lbs	1	8100	919	0.11	40
521	Squash	Squash, HI PROD	516	0.50	lbs	1	21300	3,310	0.16	95
522	Squash	Squash	517	0.50	lbs	1	11600	2,749	0.24	80
523	Strawberry	Strawberry, annual,1st pick Ca and FL	518	0.50	lbs	1	20000	2,450	0.12	400
524	Strawberry	Strawberry, annual,2nd and later pick Ca and FI	519	0.50	lbs	1	20000	3,000	0.15	400
525	Strawberry	Strawberry, establishment yı	520	0.50	lbs	1	1	1,000	1000.00	400
526	Strawberry	Strawberry, high yield , yr2+	521	0.50	lbs	1	20000	3,000	0.15	400
527	Strawberry	Strawberry, high yield, yr1	522	0.50	lbs	1	16000	2,000	0.13	400
528	Strawberry	Strawberry, Southeast, high yield, yr1	523	0.5	lbs	1	18000	2225	0.124	400
529	Strawberry	Strawberry, yr2+	524	0.50	lbs	1	4700	2,021	0.43	400
530	Sugarbeet	Sugarbeet, seed	525	0.50	lbs	1	2600	6,240	2.40	1,000
531	Sugarbeet	Sugarbeet, sugar	526	0.50	tons	2,000	20	4,000	0.10	1,000
532	Sugarbush	Sugarbush, established stands	527	0.50	cords-lbs	1	100000	125,000	1.25	2,350
533	Sugarcane	Sugarcane establishment to 1st harves	528	0.50	tons	2,000	34	88,400	1.30	610
534	Sugarcane	Sugarcane, 1st ratoon	529	0.50	tons	2,000	34	87,088	1.28	610
535	Sugarcane	Sugarcane, 2nd ratoon	530	0.50	tons	2,000	34	87,088	1.28	610
536	Sugarcane	Sugarcane, 3rd ratoon	531	0.50	tons	2,000	34	87,088	1.28	610
537	Sugarcane	Sugarcane, 4th ratoon	532	0.50	tons	2,000	34	87,088	1.28	610
538	Sugarcane	Sugarcane, plus weeds, 1st ratoon	533	0.50	tons	2,000	34	88,400	1.30	785
539	Sugarcane	Sugarcane, plus weeds, 2nd ratoon	534	0.50	tons	2,000	34	88,400	1.30	1,050
540	Sugarcane	Sugarcane, plus weeds, 3rd ratoon	535	0.50	tons	2,000	34	88,400	1.30	1,050
541	Sugarcane	Sugarcane, plus weeds, 4th ratoon	536	0.50	tons	2,000	34	88,400	1.30	1,050
542	Sugarcane	Sugarcane, plus weeds, planting to 1st harvest	537	0.50	tons	2,000	34	85,000	1.25	1,120
543	Sunflower	Sunflower	538	1.00	lbs	1	1400	2,940	2.10	500
544	Switchgrass	Switchgrass bimass prod, spring seeded	539	0.50	tons	2,000	1	2,000	1.00	1,300
545	Switchgrass	Switchgrass biomass prod yr1 overwinter, and yr2 regrow	540	0.50	tons	2,000	2.5	5,000	1.00	5,000
546	Switchgrass	Switchgrass, biomass prod. yr2 overwinter and yr3	541	0.50	tons	2,000	5	10,000	1.00	6,000
547	Tall fescue	Tall Fescue pasture, senesc to regrowth	542	0.50	lbs	1	2000	2,000	1.00	7,000
548	Tall fescue	Tall fescue pasture, regrowth after grazing SE	543	0.50	lbs	1	1500	1,500	1.00	7,000
549	Tall fescue	Tall fescue pasture, regrowth after grazing	544	0.50	lbs	1	1500	1,500	1.00	7,000
550	Tall fescue	Tall fescue pasture, slow regrowth after grazing	545	0.50	lbs	1	2000	2,000	1.00	7,000
551	Tall fescue	Tall Fescue pasture, summer dormancy to fall regrowth S	546	0.50	lbs	1	1200	1,200	1.00	7,000
552	Tall fescue	Tall fescue y3+, regrowth after cu	547	0.50	lbs	1	3000	3,000	1.00	7,000
553	Tall Fescue	Tall Fescue, fall seed senes to yr2 regrowth	548	0.50	lbs	1	3000	3,000	1.00	4,000
554	Tall Fescue	Tall Fescue, fall seed senes to yr2 regrowth SE	549	0.50	lbs	1	3000	3,000	1.00	4,800
555	Tall fescue	Tall fescue, release growth after nurse crop harves	550	0.50	lbs	1	4000	4,000	1.00	4,800
556	Tall fescue	Tall fescue, spring seed 1st yea	551	0.50	lbs	1	4000	4,000	1.00	4,800
557	Tall fescue	Tall fescue, y2 regrowth after cut SE	552	0.50	lbs	1	3000	3,000	1.00	4,800
558	Tall fescue	Tall fescue, y2 regrowth after cu	553	0.50	lbs	1	3000	3,000	1.00	4,800
559	Tall fescue	Tall fescue, y2 senesc thru yr3 greenup	554	0.50	lbs	1	4000	4,000	1.00	7,000
560	Tall fescue	Tall fescue, y2+ senesc thru yr3 + greenup SE	555	0.50	lbs	1	4000	4,000	1.00	6,900
561	Tall fescue	Tall fescue, y3 regrowth after cut SE	556	0.50	lbs	1	3000	3,000	1.00	7,000
562	Tall fescue	Tall Fescue-Wheat, winter, grain S.E	557	0.50	bu	60	40	4,080	1.70	4,800
563	Teff	Teff; hay production, 2nd cutting	558	0.50	tons	2,000	2	4,000	1.00	2,100
564	Teff	Teff; hay production, planting to 1st cu	559	0.50	tons	2,000	3	6,000	1.00	1,000
565	Teff	Teff; seed production	560	0.50	lbs	1	850	5,100	6.00	2,100
566	Timothy	Timothy, fall seed senes to yr2 regrowth	561	0.50	tons	2,000	1.5	3,000	1.00	2,500
567	Timothy	Timothy, release growth after nurse crop harves	562	0.50	tons	2,000	2	4,000	1.00	2,300
568	Timothy	Timothy, spring seed senesc to yr2 regrowtl	563	0.50	tons	2,000	1.5	3,000	1.00	2,300
569	Timothy	Timothy, yr2 regrowth after cu	564	0.50	tons	2,000	1.5	3,000	1.00	2,300
570	Timothy	Timothy, yr2 senesc to yr3 1st cu	565	0.50	tons	2,000	2	4,000	1.00	2,900
571	Timothy	Timothy, yr3 regrowth after cut	566	0.50	tons	2,000	1.5	3,000	1.00	2,900
572	Timothy	Timothy, yr3 senesc to yr4 regrowtl	567	0.50	tons	2,000	2	4,000	1.00	2,900
573	Tobacco	Tobacco, burley	568	1.00	lbs	1	2500	3,250	1.30	1,250
574	Tobacco	Tobacco, dark	569	1.00	lbs	1	2500	3,250	1.30	1,250
575	Tobacco	Tobacco, flue cured	570	1.00	lbs	1	2100	2,730	1.30	1,250
576	Tomatilla	Tomatilla, staked	571	0.50	lbs	1	25000	4,300	0.17	220
577	Tomato	Tomato, fresh mkt staked	572	0.50	cwt	100	300	2,410	0.08	110
578	Tomato	Tomato, fresh mkt	573	0.50	cwt	100	300	2,410	0.08	110
579	Tomato	Tomato, processing	574	0.50	tons	2,000	25	2,300	0.05	110
580	Tree	Tree nurs, bare rt, fall pl, cov yr1	575	0.50	lbs	1	200	200	1.00	1,040
581	Tree	Tree nurs, bare rt, fall pl, cov yr2	576	0.50	lbs	1	1000	1,000	1.00	2,810
582	Tree	Tree nurs, bare rt, fall pl, cov yr3	577	0.50	lbs	1	2000	2,000	1.00	3,050
583	Tree	Tree nurs, bare rt, fall pl, yr1	578	0.50	lbs	1	200	200	1.00	1,050
584	Tree	Tree nurs, bare rt, fall pl, yr2	579	0.50	lbs	1	1000	1,000	1.00	1,790
585	Tree	Tree nurs, bare rt, fall pl, yr3	580	0.50	lbs	1	2000	2,000	1.00	2,420
586	Tree	Tree nurs, bare rt, fall pl, yr4	581	0.50	lbs	1	4000	4,000	1.00	2,740
587	Tree	Tree nurs, bare rt, spr pl, cov, yr1	582	0.50	lbs	1	1000	1,000	1.00	1,890
588	Tree	Tree nurs, bare rt, spr pl, cov, yr2	583	0.50	lbs	1	1000	1,000	1.00	2,250
589	Tree	Tree nurs, bare rt, spr pl, yr1	584	0.50	lbs	1	1000	1,000	1.00	1,690
590	Tree	Tree nurs, bare rt, spr pl, yr2	585	0.50	lbs	1	1000	1,000	1.00	2,200
591	Tree	Tree nurs, bare rt, spr pl, yr3	586	0.50	lbs	1	1000	1,000	1.00	2,690
592	Tree	Tree, nursery clean til	587	0.50	no.	40	500	19,750	0.99	1,500
593	Tree	Trees, Christmas grass strip, established stand, selective c	588	0.50	no.	40	500	19,750	0.99	5,100
594	Tree	Trees, Christmas grass strip	589	0.50	no.	40	500	19,750	0.99	5,500

595	Tree	Trees, Christmas yr1	590	0.50	lbs	1	20	20	1.00	100
596	Tree	Trees, Christmas yr2	591	0.50	lbs	1	20	20	1.00	200
597	Tree	Trees, Christmas yr3	592	0.50	lbs	1	50	50	1.00	200
598	Tree	Trees, Christmas yr4	593	0.50	lbs	1	200	200	1.00	100
599	Tree	Trees, Christmas yr5	594	0.50	lbs	1	500	500	1.00	100
600	Tree	Trees, Christmas yr6	595	0.50	lbs	1	500	500	1.00	100
601	Tree	Trees, Christmas yr7	596	0.50	lbs	1	500	500	1.00	100
602	Tree	Trees, Christmas yr8	597	0.50	lbs	1	20	20	1.00	150
603	Triticale	Triticale, hay	598	0.75	tons	2,000	3	6,000	1.00	1,100
604	Triticale	Triticale, silage	599	0.75	tons	2,000	15	9,000	0.30	1,100
605	Triticale	Triticale	600	0.50	bu	60	40	4,080	1.70	1,320
606	Turfgrass	Turfgrass established, Northern climate	601	0.50	tons	2,000	1	2,000	1.00	4,800
607	Turfgrass	Turfgrass established	602	0.50	tons	2,000	1	2,000	1.00	4,800
608	Turfgrass	Turfgrass, April seeding, thru yr 2, CMZ 04	603	0.50	tons	2,000	1.5	3,000	1.00	4,800
609	Turfgrass	Turfgrass, August seed, thru yr 2, CMZ 01	604	0.50	tons	2,000	1.5	3,000	1.00	4,800
610	Turfgrass	Turfgrass, August seed, thru yr 2, non irrigated, CMZ 01	605	0.50	tons	2,000	1.5	3,000	1.00	4,800
611	Turfgrass	Turfgrass, August seed, thru yr2, CMZ 04	606	0.50	tons	2,000	1.5	3,000	1.00	4,800
612	Turfgrass	Turfgrass, August seed, thru yr2, non irrigated, CMZ 04	607	0.50	tons	2,000	1.5	3,000	1.00	4,800
613	Turfgrass	Turfgrass, bermuda spring seed	608	0.50	tons	2,000	1.5	3,000	1.00	1,600
614	Turfgrass	Turfgrass, December dormant seed, thru yr 2, CMZ 01	609	0.50	tons	2,000	1.5	3,000	1.00	4,800
615	Turfgrass	Turfgrass, December dormant seed, thru yr 2, CMZ 04	610	0.50	tons	2,000	1.5	3,000	1.00	4,800
616	Turfgrass	Turfgrass, fall seed	611	0.50	tons	2,000	1.5	3,000	1.00	3,200
617	Turfgrass	Turfgrass, February dormant seed, thru yr 2, CMZ 01	612	0.50	tons	2,000	1.5	3,000	1.00	4,800
618	Turfgrass	Turfgrass, February dormant seed, thru yr 2, CMZ 04	613	0.50	tons	2,000	1.5	3,000	1.00	4,800
619	Turfgrass	Turfgrass, January dormant seed, thru yr 2, CMZ 01	614	0.50	tons	2,000	1.5	3,000	1.00	4,800
620	Turfgrass	Turfgrass, January dormant seed, thru yr 2, CMZ 04	615	0.50	tons	2,000	1.5	3,000	1.00	4,800
621	Turfgrass	Turfgrass, July seed, thru yr 2, CMZ 01	616	0.50	tons	2,000	1.5	3,000	1.00	4,800
622	Turfgrass	Turfgrass, July seed, thru yr 2, CMZ 04	617	0.50	tons	2,000	1.5	3,000	1.00	4,800
623	Turfgrass	Turfgrass, July seed, thru yr 2, Nonirrigated CMZ 01	618	0.50	tons	2,000	1.5	3,000	1.00	4,800
624	Turfgrass	Turfgrass, July seed, thru yr 2, Nonirrigated CMZ 04	619	0.50	tons	2,000	1.5	3,000	1.00	4,800
625	Turfgrass	Turfgrass, June seed, thru yr 2, CMZ 01	620	0.50	tons	2,000	1.5	3,000	1.00	4,800
626	Turfgrass	Turfgrass, June seed, thru yr 2, CMZ 04	621	0.50	tons	2,000	1.5	3,000	1.00	4,800
627	Turfgrass	Turfgrass, March dormant seed, thru yr 2, CMZ 01	622	0.50	tons	2,000	1.5	3,000	1.00	4,800
628	Turfgrass	Turfgrass, March dormant seed, thru yr 2, CMZ 04	623	0.50	tons	2,000	1.5	3,000	1.00	4,800
629	Turfgrass	Turfgrass, May seed, thru yr 2, CMZ 01	624	0.50	tons	2,000	1.5	3,000	1.00	4,800
630	Turfgrass	Turfgrass, May seeding, thru yr 2, CMZ 04	625	0.50	tons	2,000	1.5	3,000	1.00	4,800
631	Turfgrass	Turfgrass, November dormant seed, thru yr 2, CMZ 01	626	0.50	tons	2,000	1.5	3,000	1.00	4,800
632	Turfgrass	Turfgrass, November dormant seed, thru yr 2, CMZ 04	627	0.50	tons	2,000	1.5	3,000	1.00	4,800
633	Turfgrass	Turfgrass, September seed, thru yr 2, CMZ 01	628	0.50	tons	2,000	1.5	3,000	1.00	4,800
634	Turfgrass	Turfgrass, September seed, thru yr 2, CMZ 04	629	0.50	tons	2,000	1.5	3,000	1.00	4,800
635	Turfgrass	Turfgrass, spring seed	630	0.50	tons	2,000	1.5	3,000	1.00	3,200
636	Turnip	Turnip, fall	631	0.50	lbs	1	15500	1,400	0.09	25
637	Turnip	Turnip, spring	632	0.50	lbs	1	18000	1,620	0.09	25
638	Vetch	Vetch, hairy, deep south	633	0.50	lbs	1	4500	4,500	1.00	1,430
639	Vetch	Vetch, hairy, fall cover crop, early Aug seeding	634	0.50	lbs	1	5000	5,000	1.00	2,500
640	Vetch	Vetch, hairy, fall cover crop, mid Sept seeding	635	0.50	lbs	1	3000	3,000	1.00	1,500
641	Vetch	Vetch, hairy, Midwest	636	0.50	lbs	1	1200	1,200	1.00	501
642	Vetch	Vetch, hairy, northern climate, summer seeded	637	0.50	tons	2,000	2	4,000	1.00	2,100
643	Vetch	Vetch, hairy, released growing cover after early fall haves	638	0.50	tons	2,000	1.5	3,000	1.00	2,100
644	Vetch	Vetch, hairy	639	0.50	lbs	1	4200	4,200	1.00	1,430
645	Vineyard	Vineyard, clean till yr 1	640	0.50	lbs	1	65	65	1.00	520
646	Vineyard	Vineyard, clean till yr 2+	641	0.50	lbs	1	65	65	1.00	620
647	Vineyard	Vineyard, cover betw rows 9ft spac	642	0.50	lbs	1	12000	1,200	0.10	1,500
648	Vineyard	Vineyard, cover crop	643	0.50	cwt	100	300	900	0.03	4,500
649	Vineyard	Vineyard, cover in alley	644	0.50	cwt	100	300	900	0.03	1,500
650	Vineyard	Vineyard, established vine row, bare ground overwinte	645	0.50	tons	2,000	4	420	0.05	620
651	Vineyard	Vineyard, established vine row, grass or weed cover over	646	0.50	tons	2,000	4	1,500	0.19	2,000
652	Vineyard	Vineyard, establishment year to yr 4, vinerow, bare groun	647	0.50	tons	2,000	1	210	0.11	620
653	Vineyard	Vineyard, establishment year to yr 4, vinerow, grass or we	648	0.50	tons	2,000	1	210	0.11	620
654	Vineyard	Vineyard, full cover	649	0.50	cwt	100	300	900	0.03	2,000
655	Vineyard	Vineyard, vine row clean till yr 2-	650	0.50	lbs	1	65	650	10.00	620
656	Vineyard	Vineyard, yr1 cover	651	0.50	lbs	1	65	65	1.00	1,300
657	Vineyard	Vineyard, yr1	652	0.50	lbs	1	65	65	1.00	1,000
658	Watermelon	Watermelon, HI PROD	653	0.50	lbs	1	39700	1,620	0.04	24
659	Watermelon	Watermelon	654	0.50	lbs	1	17800	1,350	0.08	20
660	Weeds	Weeds, 12+ months	655	0.50	lbs	1	2500	2,500	1.00	1,000
661	Weeds	Weeds, exposed after harvest less than 3 mo growth	656	0.50	lbs	1	500	500	1.00	500
662	Weeds	Weeds, less than 3 mo growth	657	0.50	lbs	1	500	500	1.00	500
663	Weeds	Weeds, less than 6 mo growth	658	0.50	lbs	1	1500	1,500	1.00	1,100
664	Weeds	Weeds, less than 9 mo growth	659	0.50	lbs	1	3000	3,000	1.00	1,700
665	Weeds	Weeds, regrowth after mowing	660	0.50	lbs	1	500	500	1.00	500
666	Weeds	Weeds, winter, Central	661	0.50	lbs	1	1120	1,120	1.00	620
667	Weeds	Weeds, winter, Deep SO	662	0.50	lbs	1	1820	1,820	1.00	970
668	Weeds	Weeds, winter, Mid South	663	0.50	lbs	1	1400	1,400	1.00	750
669	Wheat	Wheat, regrowth after winter grazing	664	0.50	lbs	1	800	800	1.00	1,000
670	Wheat	Wheat, spring 14in rows	665	0.75	bu	60	35	2,730	1.30	950
671	Wheat	Wheat, spring 7in rows	666	0.75	bu	60	30	2,340	1.30	970
672	Wheat	Wheat, spring graze grain	667	0.75	bu	60	30	2,340	1.30	970
673	Wheat	Wheat, spring graze out	668	0.75	lbs	1	2300	2,300	1.00	720
674	Wheat	Wheat, spring, CMZ 10, 10 in. spac.	669	1.00	bu	60	40	3,500	1.46	844
675	Wheat	Wheat, spring, CMZ 47, 7 in. spac.	670	1.00	bu	60	60	4,600	1.28	1,051
676	Wheat	Wheat, spring, CMZ 50, 7-10 in. spac.	671	0.50	bu	60	50	4,100	1.37	908
677	Wheat	Wheat, spring, hay, 7in rows	672	0.75	tons	2,000	1	2,000	1.00	970
678	Wheat	Wheat, winter 10in 2-1 skip row	673	0.50	bu	60	40	4,080	1.70	1,200
679	Wheat	Wheat, winter 14in rows	674	0.75	bu	60	45	4,590	1.70	1,200
680	Wheat	Wheat, winter 7in rows irrigated	675	0.50	bu	60	80	6,288	1.31	2,210
681	Wheat	Wheat, winter 7in rows	676	0.50	bu	60	40	4,080	1.70	1,080
682	Wheat	Wheat, winter cover crop, mid Oct seeding	677	0.75	lbs	1	600	600	1.00	650
683	Wheat	Wheat, winter cover crop, mid Sept seeding	678	0.75	lbs	1	2240	2,240	1.00	1,320
684	Wheat	Wheat, winter cover	679	0.50	lbs	1	4000	4,000	1.00	400
685	Wheat	Wheat, winter graze out South	680	0.50	lbs	1	800	800	1.00	1,000
686	Wheat	Wheat, winter graze, grain	681	0.50	bu	60	30	3,060	1.70	850
687	Wheat	Wheat, winter grazed forage	682	0.75	lbs	1	2000	400	0.20	660
688	Wheat	Wheat, winter nurse crop with red clover	683	0.50	bu	60	40	4,080	1.70	1,400
689	Wheat	Wheat, winter silage S.E.	684	0.75	tons	2,000	11	6,800	0.31	1,070
690	Wheat	Wheat, winter silage	685	0.75	tons	2,000	11	6,800	0.31	1,000
691	Wheat	Wheat, winter south 7in rows	686	0.50	bu	60	30	3,060	1.70	837
692	Wheat	Wheat, winter, 10in rows and relay intercropped soybean	687	0.50	bu	60	40	4,080	1.70	1,160
693	Wheat	Wheat, winter, CMZ 10, 10 in. spac. delayed germ	688	1.00	bu	60	30	2,700	1.50	639

694	Wheat	Wheat, winter, CMZ 10, 10 in. spac. early plan	689	1.00	bu	60	40	3,600	1.50	715
695	Wheat	Wheat, winter, CMZ 10, 10 in. spac. late plan	690	1.00	bu	60	40	3,600	1.50	639
696	Wheat	Wheat, winter, CMZ 47, 7-10 in. spac. late plan	691	1.00	bu	60	80	6,300	1.31	1,336
697	Wheat	Wheat, winter, CMZ 47, 7-10 in.spac. early plan	692	1.00	bu	60	80	6,300	1.31	1,445
698	Wheat	Wheat, winter, CMZ 50 hi ppt, 14-16 in. spac. early plan	693	1.00	bu	60	80	6,300	1.31	1,671
699	Wheat	Wheat, winter, CMZ 50 hi ppt, 14-16 in. spac. late plant c	694	1.00	bu	60	80	6,300	1.31	1,445
700	Wheat	Wheat, winter, CMZ 50 hi ppt, 14-16 in. spac. late plan	695	1.00	bu	60	80	6,300	1.31	1,445
701	Wheat	Wheat, winter, CMZ 50 hi ppt, 7-10 in. spac. early plan	696	1.00	bu	60	80	6,300	1.31	1,545
702	Wheat	Wheat, winter, CMZ 50 hi ppt, 7-10 in. spac. late plan	697	1.00	bu	60	80	6,300	1.31	1,445
703	Wheat	Wheat, winter, CMZ 50 lo ppt, 16-18 in. spac. early plan	698	1.00	bu	60	60	5,000	1.39	1,115
704	Wheat	Wheat, winter, CMZ 50 lo ppt, 16-18 in.spac. late plan	699	1.00	bu	60	60	5,000	1.39	1,018
705	Wheat	Wheat, winter, cover S.E.	700	0.75	lbs	1	4080	4,080	1.00	1,070
706	Wheat	Wheat, winter, grain and timothy	701	0.50	bu	60	40	4,080	1.70	1,930
707	Wheat	Wheat, winter, grain S.E.	702	0.50	bu	60	40	4,080	1.70	1,070
708	Wheat	Wheat, winter, grain with timothy	703	0.50	bu	60	40	4,080	1.70	1,930
709	Wheat	Wheat, winter, grain, regrowth after winter grazing	704	0.50	bu	60	30	3,060	1.70	1,000
710	Wheat	Wheat, winter, hay or silage, CMZ 10, 10 in. spac	705	1.00	tons	2,000	6	3,600	0.30	665
711	Wheat	Wheat, winter, hay, 7in rows	706	0.50	tons	2,000	2	4,000	1.00	900
712	Wheat	Wheat, winter, mid-south	707	0.50	bu	60	40	3,810	1.59	1,100
713	Wheat	Wheat, winter, regrowth during continuous winter grazing	708	0.50	lbs	1	800	800	1.00	600
714	Wheat	Wheat, winter, silage, mid south, 7in rows	709	0.50	tons	2,000	7	4,500	0.32	837
715	Wheat	Wheat, winter, west coast	710	0.50	bu	60	60	5,184	1.44	1,500
716	Wheat	Wheat, winter, with winter peas, CMZ 50 hi ppt, 14-16 in	711	1.00	bu	60	80	6,300	1.31	1,445
717	Wheat	Wheat, winter, with winter peas, CMZ 50 hi ppt, 7-10 in.	712	1.00	bu	60	80	6,300	1.31	1,445
718	Wheat	Wheat, winter, with winter peas, CMZ 50 lo ppt, 16-18 in	713	1.00	bu	60	60	5,000	1.39	1,018
719	Yarrow	Yarrow	714	0.50	lbs	1	625	2,500	4.00	300
720	zdefault	zdefault, winter annual	715	1.00	bu	60	40	3,157	1.32	1,445
721	zdefault	zdefault	716	0.50	bu	56	200	200	0.02	200
722	Alaska Crops	Barley, hay senes., AK	717	0.50	tons	2,000	0.75	1,500	1.00	830
723	Alaska Crops	Barley, spring, AK	718	0.50	bu	48	30	2,160	1.50	830
724	Alaska Crops	Barley, spring, hay AK	719	0.50	tons	2,000	2	2,200	0.55	830
725	Alaska Crops	Broccoli, AK	720	0.50	lbs	1	9500	2,900	0.31	250
726	Alaska Crops	Bromegrass, seedng yr, AK	721	0.50	tons	2,000	1.5	3,000	1.00	1,700
727	Alaska Crops	Bromegrass, y2 regrowth after cut, AK	722	0.50	tons	2,000	1	2,000	1.00	1,700
728	Alaska Crops	Bromegrass, y2 senesc to yr3 regrowth, AK	723	0.50	tons	2,000	1	2,000	1.00	2,500
729	Alaska Crops	Bromegrass, y3 regrowth after cut, AK	724	0.50	tons	2,000	1	2,000	1.00	2,500
730	Alaska Crops	Bromegrass, yr3 senesc to yr4 regrow, AK	725	0.50	tons	2,000	1	2,000	1.00	2,500
731	Alaska Crops	Bromegrass, yr3 senesc to yr4 regrowth, AK	726	0.50	tons	2,000	1	2,000	1.00	2,500
732	Alaska Crops	Cabbage, AK	727	0.50	cwt	100	230	25,600	1.11	240
733	Alaska Crops	Canola, spring, AK	728	0.50	bu	50	25	3,000	2.40	800
734	Alaska Crops	Cauliflower, AK	729	0.50	lbs	1	10300	12,360	1.20	290
735	Alaska Crops	Grass, seed, short var, spring plant AK	730	0.50	lbs	1	1000	2,000	2.00	1,400
736	Alaska Crops	Grass, seed, short var, yr2 regrow AK	731	0.50	lbs	1	1000	3,000	3.00	1,400
737	Alaska Crops	Grass, seed, short var, yr2 senes AK	732	0.50	lbs	1	1000	4,000	4.00	3,000
738	Alaska Crops	Grass, seed, short var, yr3 regrow AK	733	0.50	lbs	1	1000	4,000	4.00	3,000
739	Alaska Crops	Grass, seed, short var, yr3 senes AK	734	0.50	lbs	1	1000	4,000	4.00	4,000
740	Alaska Crops	Grass, seed, short var, yr4 regrow AK	735	0.50	lbs	1	1000	4,000	4.00	4,000
741	Alaska Crops	Grass, seed, short var, yr4 senes AK	736	0.50	lbs	1	1000	4,000	4.00	4,000
742	Alaska Crops	Grass, seed, tall var, spring plant AK	737	0.50	lbs	1	1000	2,000	2.00	1,400
743	Alaska Crops	Grass, seed, tall var, yr2 regrow AK	738	0.50	lbs	1	1000	3,000	3.00	800
744	Alaska Crops	Grass, seed, tall var, yr2 senes AK	739	0.50	lbs	1	1000	4,000	4.00	3,000
745	Alaska Crops	Grass, seed, tall var, yr3 regrow AK	740	0.50	lbs	1	1000	4,000	4.00	3,000
746	Alaska Crops	Grass, seed, tall var, yr3 senes AK	741	0.50	lbs	1	1000	4,000	4.00	4,000
747	Alaska Crops	Grass, seed, tall var, yr4 regrow AK	742	0.50	lbs	1	1000	4,000	4.00	4,000
748	Alaska Crops	Grass, seed, tall var, yr4 senes AK	743	0.50	lbs	1	1000	4,000	4.00	4,000
749	Alaska Crops	Greens, AK	744	0.50	lbs	1	9765	1,450	0.15	160
750	Alaska Crops	Lettuce, AK	745	0.50	lbs	1	4400	5,400	1.23	80
751	Alaska Crops	Oats, hay senes., AK	746	0.50	tons	2,000	0.75	1,500	1.00	640
752	Alaska Crops	Oats, hay, AK	747	0.50	tons	2,000	2	4,480	1.12	640
753	Alaska Crops	Potato, Irish, AK	748	0.50	cwt	100	260	3,120	0.12	110
754	Alaska Crops	Radish, AK	749	0.50	lbs	1	6275	700	0.11	50
755	Alaska Crops	Squash, AK	750	0.50	cwt	100	180	2,700	0.15	80
756	Alaska Crops	Timothy, seeding yr., AK	751	0.50	tons	2,000	0.6	1,200	1.00	280
757	Alaska Crops	Timothy, y2 regro & senesc to yr3 cut, AK	752	0.50	tons	2,000	1	2,000	1.00	1,700
758	Alaska Crops	Timothy, y2 regro and senesc to yr3 cut, AK	753	0.50	tons	2,000	1	2,000	1.00	1,700
759	Alaska Crops	Timothy, y3 regro, senesc, to yr4 cut, AK	754	0.50	tons	2,000	1	2,000	1.00	1,700
760	Alaska Crops	Vegetables, mixed, AK	755	0.50	cwt	100	130	1,300	0.10	65
761	Alaska Crops	zdefault	756	0.50	bu	56	200	200	0.02	200
762	Forest Range	Established forest, conifer	757	0.50	lbs	1	100000	125,000	1.25	2,350
763	Forest Range	Established forest, Hardwood	758	0.50	cords-lbs	1	100000	125,000	1.25	2,350
764	Forest Range	Grass, cool season permanent not harvested 2yr establishr	759	0.50	tons	2,000	1.5	3,000	1.00	4,000
765	Forest Range	Grass, cool season permanent not harvested, mid soutl	760	0.50	tons	2,000	2.5	5,000	1.00	4,800
766	Forest Range	Grass, cool season permanent not harvested	761	0.50	tons	2,000	2.5	5,000	1.00	7,000
767	Forest Range	Grass, cool season, not harvested with killed strip	762	0.50	tons	2,000	3	6,000	1.00	3,600
768	Forest Range	Grass, warm season permanent, not harvested poor condit	763	0.50	tons	2,000	1.5	3,000	1.00	6,000
769	Forest Range	Grass, warm season permanent, not harvested, excellent c	764	0.50	tons	2,000	5	10,000	1.00	20,000
770	Forest Range	Grass, warm season permanent, not harvested, good cond	765	0.50	tons	2,000	3	6,000	1.00	12,000
771	Forest Range	Grass, warm season permanent, not harvested	766	0.50	tons	2,000	3	6,000	1.00	12,000
772	Forest Range	Grass, warm season, permanent, establishment period, po	767	0.50	tons	2,000	0.5	1,000	1.00	1,333
773	Forest Range	Grass, warm season, permanent, not harvested, 3yr establ	768	0.50	tons	2,000	3	6,000	1.00	8,000
774	Forest Range	Hardwood, established stands	769	0.50	cords-lbs	1	100000	125,000	1.25	2,350
775	Forest Range	Hardwood, Five year old stanc	770	0.50	cords-lbs	1	5000	6,250	1.25	2,350
776	Forest Range	Hardwood, planted stands	771	0.50	cords-lbs	1	100000	125,000	1.25	2,350
777	Forest Range	Heyman Burn site veg	772	0.50	bu	56	1000	1,000	0.02	200
778	Forest Range	Kentucky Bluegrass, not harvestec	773	0.50	tons	2,000	3	6,000	1.00	4,800
779	Forest Range	Pine, longleaf planted stands	774	0.50	cords	5,350	25	160,517	1.20	1,142
780	Forest Range	Pine, planted stands	775	0.50	cords	5,350	29	186,200	1.20	2,350
781	Forest Range	Range Desert grassland	776	1.00	lbs	1	600	600	1.00	648
782	Forest Range	Range Northern desert shrub	777	1.00	lbs	1	200	200	1.00	1,300
783	Forest Range	Range Northern mixed grass prairie seeding	778	1.00	lbs	1	600	600	1.00	600
784	Forest Range	Range Northern mixed grass prairie	779	1.00	lbs	1	600	600	1.00	720
785	Forest Range	Range Short grass prairie	780	1.00	lbs	1	750	750	1.00	450
786	Forest Range	Range Southern desert shrub	781	1.00	lbs	1	200	200	1.00	1,136
787	Forest Range	Range Southern mixed grass prairie seeding	782	1.00	lbs	1	150	150	1.00	176
788	Forest Range	Range Southern mixed grass prairie	783	0.50	lbs	1	150	150	1.00	264
789	Forest Range	Range Tall grass prairie	784	0.50	lbs	1	1000	1,000	1.00	180
790	Forest Range	Shrub Willow, planting to harvest in yr	785	0.5	dry tons	2000	4	8000	1	2700
791	Forest Range	Shrub Willow, regrowth after harves	786	0.5	dry tons	2000	8	16000	1	3000
792	Forest Range	Silvopasture	787	0.50	cords	5,350	6	48,150	1.50	5,840

793	Forest Range	zdefault	788	0.50	bu	56	200	200	0.02	200
794	Perm. Cover	Bahiagrass, not harvested	789	0.50	lbs	1	8000	8,000	1.00	1,920
795	Perm. Cover	Barley, annual winter cover, CA	790	0.75	lbs	1	3000	3,000	1.00	800
796	Perm. Cover	Bermudagrass, common, not harvested	791	0.50	lbs	1	6000	6,000	1.00	2,400
797	Perm. Cover	Brome, annual (Blando), winter cover, CA	792	0.75	lbs	1	3000	3,000	1.00	1,000
798	Perm. Cover	Brome, California, established cover, CA	793	0.50	lbs	1	3000	3,000	1.00	7,000
799	Perm. Cover	Brome, California, regrowth after cut, high cover, CA	794	0.50	tons	2,000	2	4,000	1.00	7,000
800	Perm. Cover	Brome, California, regrowth after cut, low cover, CA	795	0.50	tons	2,000	1.5	3,000	1.00	7,000
801	Perm. Cover	Brome, California, seeding period, CA	796	0.75	lbs	1	3000	3,000	1.00	2,500
802	Perm. Cover	Crownvetch, established, not harvested	797	0.50	tons	2,000	3	6,000	1.00	1,900
803	Perm. Cover	Fescue, annual (Zorro), winter cover, CA	798	0.75	lbs	1	3000	3,000	1.00	1,200
804	Perm. Cover	Fescue, red, established, CA	799	0.50	lbs	1	2000	2,000	1.00	6,500
805	Perm. Cover	Fescue, red, regrowth after cut, high cover, CA	800	0.50	tons	2,000	2	4,000	1.00	6,500
806	Perm. Cover	Fescue, red, regrowth after cut, low cover, CA	801	0.50	tons	2,000	1.5	3,000	1.00	6,500
807	Perm. Cover	Fescue, red, seeding period, CA	802	0.75	lbs	1	3000	3,000	1.00	2,500
808	Perm. Cover	Grass, Cool season permanent cover, August 1st seeding,	803	0.50	tons	2,000	1.5	3,000	1.00	4,800
809	Perm. Cover	Grass, Cool season permanent cover, March 1st seeding,	804	0.50	tons	2,000	1.5	3,000	1.00	4,800
810	Perm. Cover	Grass, Cool season permanent cover, March 1st seeding,	805	0.50	tons	2,000	1.5	3,000	1.00	4,800
811	Perm. Cover	Grass, Cool season permanent cover, May 1st seeding, th	806	0.50	tons	2,000	1.5	3,000	1.00	4,800
812	Perm. Cover	Grass, Cool season permanent cover, Mid Dec. dormant s	807	0.50	tons	2,000	1.5	3,000	1.00	4,800
813	Perm. Cover	Grass, Cool season permanent cover, October 1st seeding	808	0.50	tons	2,000	1.5	3,000	1.00	4,600
814	Perm. Cover	Grass, cool season permanent not harvested 2yr establish	809	0.50	tons	2,000	1.5	3,000	1.00	4,000
815	Perm. Cover	Grass, cool season permanent not harvested, mid soutl	810	0.50	tons	2,000	2.5	5,000	1.00	4,800
816	Perm. Cover	Grass, cool season permanent not harvested	811	0.50	tons	2,000	2.5	5,000	1.00	7,000
817	Perm. Cover	Grass, cool season, not harvested with killed strip	812	0.50	tons	2,000	3	6,000	1.00	3,600
818	Perm. Cover	Grass, warm season permanent, not harvested	813	0.50	tons	2,000	3	6,000	1.00	12,000
819	Perm. Cover	Grass, warm season permanent, not harvested fall mowed	814	0.5	tons	2000	3	6000	1	12000
820	Perm. Cover	Grass, warm season permanent, not harvested poor condit	815	0.50	tons	2,000	1.5	3,000	1.00	6,000
821	Perm. Cover	Grass, warm season permanent, not harvested, excellent c	816	0.50	tons	2,000	5	10,000	1.00	20,000
822	Perm. Cover	Grass, warm season permanent, not harvested, good cond	817	0.50	tons	2,000	3	6,000	1.00	12,000
823	Perm. Cover	Grass, warm season, permanent, establishment period, po	818	0.50	tons	2,000	0.5	1,000	1.00	1,333
824	Perm. Cover	Grass, warm season, permanent, not harvested, 3yr establ	819	0.50	tons	2,000	3	6,000	1.00	8,000
825	Perm. Cover	Kentucky Bluegrass, not harvested	820	0.50	tons	2,000	3	6,000	1.00	4,800
826	Perm. Cover	Pine bluegrass, California, regrowth after cut, high cover,	821	0.50	tons	2,000	2	4,000	1.00	4,800
827	Perm. Cover	Pine bluegrass, California, regrowth after cut, low cover,	822	0.50	tons	2,000	1.5	3,000	1.00	4,800
828	Perm. Cover	Pine bluegrass, seeding period, CA	823	0.50	lbs	1	1000	1,000	1.00	2,500
829	Perm. Cover	Pine blugrass, established perennial cover, CA	824	0.50	lbs	1	2000	2,000	1.00	4,800
830	Perm. Cover	Sericea Lespedeza, not harvested	825	0.50	tons	2,000	3	6,000	1.00	1,900
831	Perm. Cover	silt fence	826	0.50	lbs	1	50	50	1.00	100
832	Perm. Cover	straw bale barrier	827	0.50	lbs	1	50	50	1.00	100
833	Perm. Cover	Vegetation, grass and shrub mixed vegetation, established	828	0.50	lbs	1	3000	7,800	2.60	4,000
834	Perm. Cover	Vegetation, grass and shrub mixed vegetation, new planti	829	0.50	lbs	1	1500	3,900	2.60	3,600
835	Perm. Cover	Vegetation, grass, established CA climate	830	0.50	lbs	1	3000	3,000	1.00	6,000
836	Perm. Cover	Vegetation, grass, seeding and establishment CA climat	831	0.75	lbs	1	2000	2,000	1.00	3,667
837	Perm. Cover	Vegetation, shrub, established, CA climate	832	0.50	lbs	1	5000	33,000	6.60	13,204
838	Perm. Cover	Vegetation, shrub, planting and establishment period, CA	833	0.50	lbs	1	2000	13,200	6.60	13,204
839	Perm. Cover	Vegetation, woody, established, CA climate	834	0.50	lbs	1	5000	6,500	1.30	2,601
840	Perm. Cover	Vegetation, woody, planted or volunteer, CA climat	835	0.50	lbs	1	2000	2,600	1.30	2,600
841	Perm. Cover	Vegetative Barrier permanent, not harvested, excellent co	836	0.50	tons	2,000	13.5	27,000	1.00	12,000
842	Perm. Cover	Vegetative Barrier permanent, not harvested, fair conditio	837	0.50	tons	2,000	7	14,000	1.00	6,222
843	Perm. Cover	Vegetative Barrier permanent, not harvested, good condit	838	0.50	tons	2,000	10	20,000	1.00	8,889
844	Perm. Cover	Vegetative Barrier permanent, not harvested	839	0.50	tons	2,000	13.5	27,000	1.00	12,000
845	Perm. Cover	Vetiver grass barrier	840	0.50	lbs	1	27000	27,000	1.00	12,000
846	Perm. Cover	Weeping lovegrass, not harvested	841	0.50	tons	2,000	3	6,000	1.00	4,800
847	Tropical A-D	Agroforestry 30pct canopy	842	0.50	lbs	1	20000	20,000	1.00	1,007
848	Tropical A-D	Agroforestry 50pct canopy	843	0.50	lbs	1	20000	20,000	1.00	1,679
849	Tropical A-D	Agroforestry 90pct canopy	844	0.50	lbs	1	20000	20,000	1.00	3,021
850	Tropical A-D	Agroforestry tropical hardwoods	845	0.50	cords-lbs	1	100000	125,000	1.25	2,350
851	Tropical A-D	Agroforestry	846	0.50	lbs	1	20000	20,000	1.00	2,350
852	Tropical A-D	Asparagus, tropical, 2+ years	847	0.50	lbs	1	2000	2,000	1.00	200
853	Tropical A-D	Asparagus, tropical, first year	848	0.50	lbs	1	2000	2,000	1.00	200
854	Tropical A-D	Bahiagrass, mature	849	0.50	lbs	1	8000	8,000	1.00	1,300
855	Tropical A-D	Bahiagrass, new seeding, tropics	850	0.50	tons	2,000	2	4,000	1.00	1,300
856	Tropical A-D	Bahiagrass, seeding	851	0.50	tons	2,000	2	4,000	1.00	1,300
857	Tropical A-D	Banana, + grass yr1	852	0.50	lbs	1	19300	23,160	1.20	4,530
858	Tropical A-D	Banana, + grass yr2	853	0.50	lbs	1	27000	32,400	1.20	4,530
859	Tropical A-D	Banana, + grass yr3+	854	0.50	lbs	1	20000	24,000	1.20	4,530
860	Tropical A-D	Banana, yr1	855	0.50	lbs	1	19300	23,160	1.20	1,530
861	Tropical A-D	Banana, yr2	856	0.50	lbs	1	27000	32,400	1.20	3,070
862	Tropical A-D	Banana, yr3+	857	0.50	lbs	1	20000	24,000	1.20	3,070
863	Tropical A-D	Basil, tropics	858	0.50	lbs	1	600	3,000	5.00	1,240
864	Tropical A-D	Beans, fresh	859	0.50	lbs	1	5000	1,400	0.28	250
865	Tropical A-D	Beans, trellis	860	0.50	lbs	1	5000	2,900	0.58	530
866	Tropical A-D	Bermudagrass, common spring seeded 1st year	861	0.50	lbs	1	2000	2,000	1.00	3,400
867	Tropical A-D	Bittermelon, trellis	862	0.50	lbs	1	15000	2,500	0.17	200
868	Tropical A-D	Broccoli	863	0.50	lbs	1	4100	1,804	0.44	200
869	Tropical A-D	Buckwheat, cover crop tropics	864	0.50	tons	2,000	1.5	3,000	1.00	80
870	Tropical A-D	Cabbage, 6 ft rows	865	0.50	lbs	1	10500	19,950	1.90	250
871	Tropical A-D	Cabbage, Chinese 21 day	866	0.50	lbs	1	7500	9,530	1.27	150
872	Tropical A-D	Cabbage, Chinese 60 day	867	0.50	lbs	1	20000	25,400	1.27	220
873	Tropical A-D	Cabbage, head	868	0.50	lbs	1	27000	34,300	1.27	350
874	Tropical A-D	Cassava, + grass	869	0.50	lbs	1	26000	2,600	0.10	1,700
875	Tropical A-D	Cassava	870	0.50	lbs	1	26000	2,600	0.10	1,700
876	Tropical A-D	Cauliflower, 60 day	871	0.50	lbs	1	13000	13,000	1.00	350
877	Tropical A-D	Cauliflower, 75 day	872	0.50	lbs	1	15000	15,000	1.00	375
878	Tropical A-D	Clover, annual, established	873	0.50	tons	2,000	1.5	4,500	1.50	1,000
879	Tropical A-D	Clover, sweet, cover crop, tropics	874	0.50	tons	2,000	1.5	3,000	1.00	2,200
880	Tropical A-D	Clover, white, new seeding	875	0.50	tons	2,000	1.5	3,000	1.00	850
881	Tropical A-D	Coffee, + grass yr1	876	0.50	lbs	1	2000	2,000	1.00	1,940
882	Tropical A-D	Coffee, + grass yr2	877	0.50	lbs	1	2000	2,000	1.00	4,940
883	Tropical A-D	Coffee, + grass yr3+	878	0.50	lbs	1	2000	2,000	1.00	5,570
884	Tropical A-D	Coffee, yr1	879	0.50	lbs	1	2000	2,000	1.00	1,200
885	Tropical A-D	Coffee, yr2, no live surf. cove	880	0.50	lbs	1	2000	2,000	1.00	2,300
886	Tropical A-D	Coffee, yr2	881	0.50	lbs	1	2000	2,000	1.00	2,300
887	Tropical A-D	Coffee, yr3+, no live surf. cove	882	0.50	lbs	1	2000	2,000	1.00	3,200
888	Tropical A-D	Coffee, yr3+	883	0.50	lbs	1	2000	2,000	1.00	3,200
889	Tropical A-D	Coffee-plantain; yr 1	884	0.50	lbs	1	18150	18,150	1.00	4,400
890	Tropical A-D	Coffee-plantain; yr 2	885	0.50	lbs	1	18150	18,150	1.00	4,400
891	Tropical A-D	Cow pea, cover crop, tropics	886	0.50	tons	2,000	2	4,000	1.00	210

892	Tropical A-D	Cucumber, crawl seeded	887	0.50	lbs	1	15000	2,250	0.15	700
893	Tropical A-D	Cucumber, crawl transplant	888	0.50	lbs	1	15000	2,250	0.15	800
894	Tropical A-D	Cucumber, trellis seeded	889	0.50	lbs	1	20000	3,000	0.15	600
895	Tropical A-D	Cucumber, trellis transplan	890	0.50	lbs	1	20000	3,000	0.15	60
896	Tropical A-D	Dracena	891	0.50	lbs	1	4000	4,000	1.00	2,000
897	Tropical E-O	Eggplant, + grass	892	0.50	lbs	1	20000	5,400	0.27	1,390
898	Tropical E-O	Eggplant, trellis	893	0.50	lbs	1	10000	2,000	0.20	1,700
899	Tropical E-O	Eggplant	894	0.50	lbs	1	20000	3,600	0.18	390
900	Tropical E-O	Eucalyptus plantatior	895	0.50	cords	5,350	29	186,200	1.20	2,350
901	Tropical E-O	Forbs, tropical groundcover, new seeding, tropics	896	0.50	tons	2,000	1.5	3,000	1.00	850
902	Tropical E-O	Forbs, tropical groundcover	897	0.50	lbs	1	800	1,200	1.50	600
903	Tropical E-O	Ginger, hi density	898	0.50	lbs	1	46000	6,000	0.13	500
904	Tropical E-O	Grass and Shrub mixed tropical vegetation, establishe	899	0.50	lbs	1	30000	30,000	1.00	2,400
905	Tropical E-O	Grass and Shrub mixed tropical vegetation, new planting,	900	0.50	lbs	1	6000	6,000	1.00	2,400
906	Tropical E-O	Grass, warm season, permanent, not harvested, 3yr establ	901	0.50	tons	2,000	3	6,000	1.00	8,000
907	Tropical E-O	Lettuce, head 15 to 18 in rows	902	0.50	tons	2,000	9	18,800	1.04	40
908	Tropical E-O	Lettuce, romaine	903	0.50	lbs	1	12000	12,500	1.04	80
909	Tropical E-O	Macadamia nut, yr01	904	0.50	lbs	1	2000	2,000	1.00	50
910	Tropical E-O	Macadamia nut, yr02	905	0.50	lbs	1	2000	2,000	1.00	80
911	Tropical E-O	Macadamia nut, yr03	906	0.50	lbs	1	2000	2,000	1.00	1,150
912	Tropical E-O	Macadamia nut, yr04	907	0.50	lbs	1	2000	2,000	1.00	1,380
913	Tropical E-O	Macadamia nut, yr05	908	0.50	lbs	1	2000	2,000	1.00	1,800
914	Tropical E-O	Macadamia nut, yr06	909	0.50	lbs	1	2000	2,000	1.00	2,050
915	Tropical E-O	Macadamia nut, yr07	910	0.50	lbs	1	2000	2,000	1.00	2,300
916	Tropical E-O	Macadamia nut, yr08	911	0.50	lbs	1	2000	2,000	1.00	2,750
917	Tropical E-O	Macadamia nut, yr09	912	0.50	lbs	1	2000	2,000	1.00	3,200
918	Tropical E-O	Macadamia nut, yr10	913	0.50	lbs	1	2000	2,000	1.00	3,400
919	Tropical E-O	Macadamia nut	914	0.50	lbs	1	2000	2,000	1.00	3,400
920	Tropical E-O	Millet, cover crop, tropics	915	0.50	tons	2,000	2	4,000	1.00	1,200
921	Tropical E-O	Mungbean, cover crop, tropics	916	0.50	tons	2,000	1.5	3,000	1.00	210
922	Tropical E-O	Native grass, new seeding, tropics	917	0.50	tons	2,000	6	12,000	1.00	1,900
923	Tropical E-O	Oats, cover crop, tropics	918	0.50	tons	2,000	1.5	3,000	1.00	400
924	Tropical E-O	Onion, green seeded	919	0.50	lbs	1	9000	1,530	0.17	370
925	Tropical E-O	Onion, green transplant	920	0.50	lbs	1	9000	1,530	0.17	370
926	Tropical E-O	Orchard, tropical, bare ground	921	0.50	cwt	100	300	990	0.03	375
927	Tropical E-O	Orchard, tropical, cover betw rows	922	0.50	cwt	100	300	990	0.03	1,750
928	Tropical E-O	Orchard, tropical, full cove	923	0.50	cwt	100	300	990	0.03	3,960
929	Tropical E-O	Orchard, tropical, new	924	0.50	lbs	1	1	100	100.00	630
930	Tropical E-O	Ornamental ground cover, established, tropic	925	0.50	tons	2,000	3	6,000	1.00	1,430
931	Tropical E-O	Ornamental ground cover, new planting, tropic	926	0.50	tons	2,000	2.5	5,000	1.00	1,192
932	Tropical E-O	Ornamental ground cover, Oct planting, tropic	927	0.50	tons	2,000	2.5	5,000	1.00	1,192
933	Tropical P-S	Papaya, + weeds	928	0.50	lbs	1	26000	9,100	0.35	2,080
934	Tropical P-S	Papaya, yr1	929	0.50	lbs	1	26000	9,100	0.35	1,530
935	Tropical P-S	Papaya, yr2+	930	0.50	lbs	1	26000	9,100	0.35	1,530
936	Tropical P-S	Peppers, bell	931	0.50	lbs	1	14000	3,600	0.26	400
937	Tropical P-S	Pigeon peas, + weeds	932	0.50	lbs	1	1500	6,750	4.50	1,200
938	Tropical P-S	Pigeon peas, cover crop, tropics	933	0.50	tons	2,000	2.5	5,000	1.00	900
939	Tropical P-S	Pigeon peas, short season	934	0.50	lbs	1	3000	12,000	4.00	900
940	Tropical P-S	Pigeon peas	935	0.50	lbs	1	1500	6,000	4.00	700
941	Tropical P-S	Pineapple, yr 1	936	0.50	tons	2,000	16	10,000	0.31	3,670
942	Tropical P-S	Pineapple, yr 2	937	0.50	tons	2,000	16	10,000	0.31	3,390
943	Tropical P-S	Pineapple, yr 3+	938	0.50	tons	2,000	16	10,000	0.31	3,200
944	Tropical P-S	Plantain, + weeds yr1	939	0.50	lbs	1	19300	23,160	1.20	4,530
945	Tropical P-S	Plantain, + weeds yr2+	940	0.50	lbs	1	27000	32,400	1.20	4,530
946	Tropical P-S	Plantain, yr1	941	0.50	lbs	1	19300	23,160	1.20	1,530
947	Tropical P-S	Plantain, yr2	942	0.50	lbs	1	27000	32,400	1.20	3,070
948	Tropical P-S	Plantain, yr3+	943	0.50	lbs	1	20000	24,000	1.20	3,070
949	Tropical P-S	Potato, sweet + weeds	944	0.50	lbs	1	10000	3,250	0.33	600
950	Tropical P-S	Pumpkin, + weeds	945	0.50	cwt	100	320	1,600	0.05	280
951	Tropical P-S	Radish, daikon + weeds	946	0.50	lbs	1	11000	2,200	0.20	530
952	Tropical P-S	Radish, daikon	947	0.50	lbs	1	11000	1,710	0.16	130
953	Tropical P-S	Rye, cover crop, tropics	948	0.75	tons	2,000	1.5	3,000	1.00	970
954	Tropical P-S	Ryegrass, annual, cover crop, tropics	949	0.75	tons	2,000	1	2,000	1.00	970
955	Tropical P-S	Sakau	950	0.50	lbs	1	8000	2,400	0.30	1,500
956	Tropical P-S	Sorghum, cover crop, tropics	951	1.00	tons	2,000	3	6,000	1.00	1,060
957	Tropical P-S	Soybean, cover crop, tropics	952	0.75	tons	2,000	1.5	3,000	1.00	310
958	Tropical P-S	Squash, + weeds	953	0.50	lbs	1	10500	1,500	0.14	250
959	Tropical P-S	Star or Pangola grass hay, spring seeded	954	0.50	lbs	1	5760	5,760	1.00	3,840
960	Tropical P-S	Star or Pangola grass hay, yr2 regrowth after hay harv	955	0.50	lbs	1	4800	4,800	1.00	3,840
961	Tropical P-S	Star or Pangola grass hay, yr2, regrowth during dormancy	956	0.50	lbs	1	4800	4,800	1.00	6,700
962	Tropical P-S	Star or Pangola grass hay, yr3+regrowth after hay harv	957	0.50	lbs	1	4800	4,800	1.00	6,700
963	Tropical P-S	Star or Pangola grass hay, yr3, regrowth during dormancy	958	0.50	lbs	1	4800	4,800	1.00	9,600
964	Tropical P-S	Star or Pangola grass pasture sprig, spring seeded	959	0.50	lbs	1	3840	3,840	1.00	2,720
965	Tropical P-S	Star or Pangola grass pasture, spring seeded	960	0.50	lbs	1	3840	3,840	1.00	2,720
966	Tropical P-S	Star or Pangola grass pasture, yr1graze regrowth Dec. thr	961	0.50	lbs	1	1920	1,920	1.00	3,145
967	Tropical P-S	Star or Pangola grass pasture, yr1graze regrowth Feb. thr	962	0.50	lbs	1	1920	1,920	1.00	3,840
968	Tropical P-S	Star or Pangola grass pasture, yr2 graze regrowth Apr - N	963	0.50	lbs	1	3840	3,840	1.00	3,840
969	Tropical P-S	Star or Pangola grass pasture, yr2 graze regrowth Dec. th	964	0.50	lbs	1	2400	2,400	1.00	4,440
970	Tropical P-S	Star or Pangola grass pasture, yr2 graze regrowth Feb. th	965	0.50	lbs	1	2400	2,400	1.00	5,340
971	Tropical P-S	Star or Pangola grass pasture, yr3+ graze regrowth Apr -	966	0.50	lbs	1	3840	3,840	1.00	5,340
972	Tropical P-S	Star or Pangola grass pasture, yr3+ graze regrowth Dec. t	967	0.50	lbs	1	1920	1,920	1.00	6,200
973	Tropical P-S	Star or Pangola grass pasture, yr3+ graze regrowth Feb. t	968	0.50	lbs	1	1920	1,920	1.00	7,200
974	Tropical P-S	Star or Pangola grass, spring seeded, tropics	969	0.50	lbs	1	3840	3,840	1.00	2,720
975	Tropical P-S	Strawberry, tropical, annual, Hawai	970	0.50	lbs	1	20000	2,500	0.13	490
976	Tropical P-S	Sugarcane, 1st ratoon PR	971	0.50	tons	2,000	27	70,200	1.30	610
977	Tropical P-S	Sugarcane, yr1	972	0.50	tons sugar	2,000	10	112,000	5.60	650
978	Tropical P-S	Sugarcane, yr2	973	0.50	tons sugar	2,000	10	112,000	5.60	920
979	Tropical P-S	Sunn Hemp	974	0.50	tons	2,000	3	6,000	1.00	500
980	Tropical T-Z	Taro, Bunglong + weeds, regrowth	975	0.50	lbs	1	5500	1,100	0.20	1,960
981	Tropical T-Z	Taro, Bunglong + weeds, second regrowth	976	0.50	lbs	1	5500	1,100	0.20	1,580
982	Tropical T-Z	Taro, Bunglong + weeds	977	0.50	lbs	1	17000	3,400	0.20	2,020
983	Tropical T-Z	Taro, Bunglong tilled hi density	978	0.50	lbs	1	17000	3,400	0.20	500
984	Tropical T-Z	Taro, Bunglong tilled lo density 30pct canop	979	0.50	lbs	1	15000	3,000	0.20	103
985	Tropical T-Z	Taro, Bunglong tilled lo density 50pct canop	980	0.50	lbs	1	15000	3,000	0.20	172
986	Tropical T-Z	Taro, Bunglong tilled lo density 70pct canop	981	0.50	lbs	1	15000	3,000	0.20	241
987	Tropical T-Z	Taro, Bunglong tilled lo density	982	0.50	lbs	1	15000	3,000	0.20	310
988	Tropical T-Z	Taro, Bunglong weeds controlled	983	0.50	lbs	1	17000	3,400	0.20	1,020
989	Tropical T-Z	Tomato, fresh + weeds	984	0.50	lbs	1	20000	3,000	0.15	1,050
990	Tropical T-Z	Tropic lalo, Paspalum sp.	985	0.50	tons	2,000	4	8,000	1.00	1,300

991	Tropical T-Z	Tuberose	986	0.50	lbs	1	2000	2,000	1.00	2,250
992	Tropical T-Z	Turf grass, new seeding, tropics	987	0.50	lbs	1	2000	2,000	1.00	3,400
993	Tropical T-Z	Turf grass, new sod placement, tropics	988	0.50	lbs	1	2000	2,000	1.00	3,400
994	Tropical T-Z	Vetch, cover crop, tropics	989	0.50	tons	2,000	3	6,000	1.00	210
995	Tropical T-Z	Vetiver grass	990	0.50	lbs	1	27000	27,000	1.00	12,000
996	Tropical T-Z	Volunteer vegetation, grass	991	0.50	lbs	1	20000	20,000	1.00	3,770
997	Tropical T-Z	Volunteer vegetation, mixed shrub	992	0.50	lbs	1	30000	30,000	1.00	2,450
998	Tropical T-Z	Volunteer vegetation, woody	993	0.50	lbs	1	40000	40,000	1.00	1,885
999	Tropical T-Z	Watermelon, + weeds	994	0.50	lbs	1	18000	1,800	0.10	750
1000	Tropical T-Z	Watermelon	995	0.50	lbs	1	20000	1,800	0.09	195
1001	Tropical T-Z	Weeds, released from crop understory, tropics	996	0.50	lbs	1	4000	4,000	1.00	1,700
1002	Tropical T-Z	Weedy vegetation, mature, high productivity, tropic	997	0.50	lbs	1	8000	8,000	1.00	2,000
1003	Tropical T-Z	Wheat, cover crop, tropics	998	0.75	tons	2,000	1.5	3,000	1.00	970
1004	Tropical T-Z	Yams	999	0.50	cwt	100	200	5,000	0.25	1,542
1005	Fallow	Fallow	1000	0.5	lbs	0	0	0	0	0

Not part of RUSLE 2

RUSLE 2 Operations Table

TABLE CREATED FROM RUSLE 2 OPERATIONS DATABASE. DATA RETRIEVED APRIL, 2013

Count		Description	Diesel Use gal/area	Description
1		Add mulch	0.00	Use to apply mulch cover. Internally defaults to straw mulch at 2000 pounds per acre. Adjust i
2		Add PAM	0.00	WI-Construction; add polyacrylimid
3		Aerator, field surface, ground driver	0.45	AerWay tool . 5 degree gang angle setting. Ground driven 8" knife-tines mounted on a rotatin
4		Aerator, field surface, ground driven 0 degree offse	0.35	AerWay tool . Ground driven 8" knife-tines mounted on a rotating shaft pulled across the soil,
5		Aerator, field surface, ground driven 10 degree offse	0.55	AerWay tool . Ground driven 8" knife-tines mounted on a rotating shaft pulled across the soil,
6		Aerator, field surface, ground driven 5 degree offse	0.45	AerWay tool . 5 degree gang angle setting. Ground driven 8" knife-tines mounted on a rotatin
7		Aerator, single drum, lugs, angle (	0.35	Drum aerator typified by the Lawson Single Drum Pasture Aerator . Ground driven roller drun
8		Aerator, tandem drum, lugs, angle 10	0.65	Tandem Drum aerator typified by the Lawson Tandem Pasture Aerator . Tandem ground driver
9		Aerator, tandem drum, lugs, angle 5	0.55	Tandem Drum aerator typified by the Lawson Tandem Pasture Aerator . Tandem ground driver
10		Aerial interseeding	0.00	Aerial interseeding. Although used for interseeding cover crops, etc. by aircraft into live growi
11		Aerial seeding	0.00	Aerial seeding. Begins growth with no soil disturbance. Used for seeding cover crops, etc. by a
12		Bale combine windrows	0.38	Bale straw or residue windrows directly behind the combine. Revised flattening fractions. Affec
13		Bale Corn husk, cob and chaff windrows	0.38	Bale corn husks, cobs and chaff windrows behind combine. The combine chaff speader is remo
14		Bale Corn stalk strips	0.38	Bale cornstalks in strips where only part of the residue is harvested. 021109 DT
15		Bale corn stover	0.38	Bale corn stover. Revised flattening fractions. Affects only current residue 012210 DT
16		Bale straw or residue	0.38	Bale straw or residue. Revised flattening fractions. Affects all residue 022509 DT
17		Bed shaper	0.38	Bed shaping operation on existing beds. May include drip tape installation. 10/28/01 DT
18		Bed shaper high disturbance	0.45	Bed shaping operation on existing beds with high disturbance. (Similar to Sundance wide bed c
19		Bed shaper, 12 in	0.45	Bed shaping operation on existing 12" high beds. May include drip tape installation. 11/18/01
20		Bed shaper, 12 in, low flattening	0.45	Bed shaping operation on existing 12" high beds in standing row crop residue. Since no crop w
21		Bed shaper, low flattening, high disturbance	0.45	Bed shaping operation on existing 10" high beds in standing row crop residue. Since no crop is
22		Bedder, hipper, disk hiller	0.45	10/26/01 DTL
23		Bedder, hipper, hiller 12 in high	0.50	Bedder/hipper/ridger with high 12" ridges. 11/08/01 DTI
24		Bedder, hipper, hiller 15 in high	0.60	Bedder/hipper/ridger with high 15 inch ridges.02-28-02 DTI
25		Bedder, hipper, hiller 18 in high	0.75	Bedder/hipper/ridger with high 18 inch ridges. 2-28-02 DTI
26		Begin growth	0.00	060701 DTL
27		Begin new growth	0.00	Use to initiate growth of a new crop or weed record in cases where a planter, drill or seeding op
28		Begin weed growth	0.00	Weed growth initiated after harvest. 10/28/01 DTI
29		BFM applicaton	0.00	Bonded Fiber Matrix mulch (BFM) application covering 100% of the surface. Applied after see
30		Bulldozer, clearing-cutting	0.50	Clearing and or cutting with a bulldozer 101009 DTI
31		Bulldozer, clearing-cutting high	0.50	Bulldozer, clearing/cutting light. Grader or dozer blade for cutting and clearing vegetation. Cle
32		Bulldozer, filling-leveling	0.60	Grader or dozer blade for filling and leveling material.
33		Burn residue	0.00	6/7/01 DTL
34		Burn residue, high intensity	0.00	Burn residue 92.5% of flat biomass and 100% of standing residue affected 11/08/01 DTI
35		Burn residue, low intensity	0.00	Burn residue 50% of flat biomass and 80% of standing residue affected 11/08/01 DTI
36		Burn residue, mod. high intensity	0.00	Burn residue 100% standing stubble and 85% flat. 020904 DTI
37		Burn residue, moderate intensity	0.00	Burn residue 100% standing stubble and 75% flat. 020904 DTI
38		Burn sugarcane	0.00	Burn standing sugarcane prior to harvest. 111605 DTI
39		Burrowing, heavy, Prairie dog	0.00	Prairie dog burrowing high infestation. 062205 DTI
40		Burrowing, light, Prairie dog	0.00	Prairie dog burrowing light infestation. 062205 DTI
41		Burrowing, moderate, Prairie dog	0.00	Prairie dog burrowing moderate infestation. 062205 DTI
42		Chisel plow, coulter, st. pts	1.20	Chisel plow with coulters and straight points 062806 DTL REV 110207 DTI
43		Chisel plow, coulter, st. pts., cover disks	1.40	Coulter chisel plow with straight points and covering disks. 061206 DTL REV 110207 DT
44		Chisel plow, coulter, st. pts., cover disks, rlng baske	1.80	Coulter caddy chisel plow with straight points or winged straight points, 2 ranks of leveling disl
45		Chisel plow, coulter, sweeps	1.30	Coulter chisel plow with sweeps. 061206 DTL REV 110207 DTI
46		Chisel plow, coulter, twst. pts	1.30	Coulter chisel plow with twisted points. 061206 DTL REV 110207 DTI
47		Chisel plow, coulter, twst. pts., cover disks	1.50	Coulter chisel plow with twisted points and covering disks. 061206 DTL rev 110207 DT
48		Chisel plow, disk, st. pts.	1.50	Disk chisel plow with straight points. 061206 DTL REV 110207 DTI
49		Chisel plow, disk, st. pts., cover disks	1.50	Disk chisel plow with straight points and covering disks. 061206 DTL REV 110207 DTL revise
50		Chisel plow, disk, twst. pts.	1.75	Disk chisel plow with twisted points. 061206 DTL rev 110207 DTI
51		Chisel plow, disk, twst. pts., cover disks	1.87	Disk chisel plow with twisted points and covering disks. 061206 DTL REV 110207 DTL revise
52		Chisel, 12-16 in. low crown sweep 3 to 4 in. depth	0.74	Chisel plow with 12 to 16 inch low crown sweeps operating at 3 to 4 inch depth 022806 DT
53		Chisel, st. pt.	1.00	060701 DTL
54		Chisel, st. pt. 12 in deep	1.10	Chisel plow with straight points at 12 inch operating depth 02-28-02 DTL REV 110207 DTI
55		Chisel, st. pt. 15 in deep	1.30	Chisel plow with straight points at 15 inch operating depth 02-28-02 DTL rev 110207 DT
56		Chisel, st. pt. 5 in deep	0.74	Chisel plow with straight points operated at 5 inch depth. 012605 DTI
57		Chisel, st. pt. 5 in deep, coil tine ha	0.96	Chisel plow with straight points operated at 5 inch depth. 012605 DTL with a coiled tine harro
58		Chisel, st. pt., coil tine ha	1.20	Chisel st pt 060701 DTL with a coiled tine harrow dragged behind 09-13-11 GG
59		Chisel, sweep shovel	1.10	060701 DTL REV 10/4/01 DTL
60		Chisel, sweep shovel 5 in. depth	0.80	Chisel plow with sweeps operating at 5 inch depth 012605 DTI
61		Chisel, sweep shovel 5 in. depth, coil tine ha	1.00	Chisel plow with sweeps operating at 5 inch depth 012605 DTL with a coiled tine harrow dragg
62		Chisel, sweep shovel, coil tine ha	1.30	Chisel, sweep shovel 060701 DTL REV 10/4/01 DTL with a coiled tine harrow dragged behind
63		Chisel, twisted shovel	1.10	060701 DTL
64		Chisel, twisted shovel, coil tine ha	1.30	Chisel, twisted shovel 060701 DTL with a coiled tine harrow dragged behind 09-13-11 GG
65		Chisel, winged with furrow diker	1.00	Chisel plow shanks on 30 inch spacing with winged straight points and a furrow diker. 071211
66		Chop veg. with machete	0.00	Selective cutting of weeds with a machete between rows of crop plants. 11-30-01 DTL Revise
67		Continuous disturbance and smoothing	2.10	Not a real operation. For use in continous disturbance for Potential erodibility estimation purpo
68		Coulter caddy, dbl gang with fluted coulter	0.35	Coulter Caddy fluted coulters with two offset gangs on 10 inch spacing with effective spacing o
69		Coulter caddy, with fluted coulters	0.35	Coulter Caddy fluted coulters on 7 to 10 inch spacing. 040405 DTL rev 103107DTI
70		Coulter caddy, with smooth coulters	0.35	Coulter Caddy smooth coulters on 7 to 10 inch spacing. 101706 DTI
71		Coulter tiller and spike harrow	0.85	Like tubo-till machine with two gangs of fluted Coulters and a spike harrow. 103107 DT
72		Coulter tiller, 10 degree angle, coiled tine harrow, rolling	0.85	Like Salford RTS machine with multiple ranks of staggered fluted coulters preloaded on a 10
73		Cover crop underseeder	0.35	A tool bar with Drill or Air seeder units with two single disk no-till openers spaced about 10 inc
74		Cultipacker, roller	0.62	Based on core Cultipacker Roller finishing tool. Consists of an inline gang of ridged rollers foll
75		Cultivate, manually	0.00	gaw 01-22-02 Manually till small fields with hoe or similar hand tool. Use this operation before
76		Cultivate, manually, low intensity	0.00	6/20/06 MPR Manually till small fields with hoe or similary hand tool at lower intensity (50% c

77		Cultivate, manually, moderate intensit	0.00	6/20/06 MPR Manually till small fields with hoe or similary hand tool at less intensity (75% dis
78		Cultivate, rows manually	0.00	Manually cultivate between crop rows in small fields with hoe or similar hand tool. 102109 DT
79		Cultivator, between beds, add residue	0.43	Cultivator used on beds covered with plastic mulch. This operation cultivates between the beds
80		Cultivator, field 6-12 in shovels C	0.74	060701 DTL
81		Cultivator, field 6-12 in sweeps	0.74	060701 DTL
82		Cultivator, field 6-12 in sweeps, coil tine ha	0.96	Field cultivator w/ 6-12 inch sweeps 060701 DTL with a coil tine harrow dragged behind 09-13
83		Cultivator, field with spike point	0.74	Field cultivator w/ spike points 01-03-02 DTI
84		Cultivator, field with spike points, coil tine ha	0.96	Field cultivator w/ spike points 01-03-02 DTL with a coiled tine harrow dragged behind 09-13-
85		Cultivator, flame	1.00	Flame cultivator on growing crop. Crop is not killed. In the management screen the user must
86		Cultivator, hipper, disk hiller on bed	0.43	Cultivator used on beds covered with plastic mulch. Adds other cover. User must specify type
87		Cultivator, off bar with disk hillers on bed	0.43	Off bar cultivator w/ opposing gangs of disk hillers. 12-18-01 DTI
88		Cultivator, rotary	0.54	Rotary row crop cultivator operated on preformed beds or flat planted with spider gangs typifie
89		Cultivator, rotary on beds	0.54	Rotary row crop cultivator operated on preformed beds with spider gangs typified by the Lilliste
90		Cultivator, rotary on beds, Bedder, hipper, disk hille	0.84	Rotary row crop cultivator operated on preformed beds with spider gangs typified by the Lilliste
91		Cultivator, row - 1st pass ridge til	0.62	060701 DTL
92		Cultivator, row - 2nd pass ridge till	0.74	Ridgetill cultivator second pass with ridging wings down. 051107 DTI
93		Cultivator, row 1 in ridge	0.62	Row crop cultivator w/ sweeps leaving a 1" ridge 05-14-02 DTI
94		Cultivator, row 3 in ridge	0.62	Row crop cultivator w/ sweeps leaving a 3" ridge 05-14-02 DTI
95		Cultivator, row between beds	0.62	Cultivator w/ opposing gangs of disk hillers. Used to cultivate between Sugarcane beds. 02010
96		Cultivator, row, high residue	0.43	High residue cultivator w/ single 24" sweep per row. 12-18-01 DTI
97		Detasseler, seed corn	0.13	Rotary or flail detasseling machine used to remove seed corn tassels. When using this operation
98		Disk, inter row strips	0.45	6/8/01 DTL; Revision 9/1/05 of Disk, tandem light finishing to represent a disk in orchards, nur
99		Disk, offset, heavy	0.90	6/8/01 DTL
100		Disk, offset, heavy 12 in deptl	1.10	Heavy or Offset disk at 12inch depth 101706 DTI
101		Disk, offset, heavy 15 in deptl	1.30	Heavy or Offset disk at 15inch depth 082907DTI
102		Disk, offset, heavy, roller, corr packe	1.15	Heavy or Offset disk at 6-8 inch depth with corrugated roller packer. Based on; Disk, offset, he
103		Disk, offset, heavy, roller, smootl	1.00	Disk, offset, heavy 6/8/01 DTL and smooth roller 09-16-11 GGI
104		Disk, oxen, strip 30 pct disturb	0.00	Disk pulled by oxen.30% disturbed in strips Puerto Rico. 082704 DTI
105		Disk, oxen, strip 60 pct disturb	0.00	Disk pulled by oxen.60% disturbed in strips Puerto Rico. 082704 DTI
106		Disk, single gang	0.38	Single disk gang 101706 DTL
107		Disk, tandem heavy primary op	0.75	6/8/01 DTL
108		Disk, tandem heavy primary op., roller, smootl	0.88	Disk, tandem heavy primary op. 6/8/01 DTL and smooth roller 09-16-11 GGI
109		Disk, tandem light finishing	0.40	6/8/01 DTL
110		Disk, tandem secondary op	0.48	6/7/01 DTL
111		Do all	1.50	Do all Seedbed finisher consisting of a single disk gang, field cultivator, coiled tine harrow and
112		Do all, on beds	1.33	Do all on beds. Same as Bed shaper high disturbance. Beds are lightly tilled with a disk hiller
113		Dozer track walking	0.60	Represents ridges left by running bulldozer up and down a slope to create cleat marks laterally a
114		Drill or air seeder single disk openers 7-10 in spac	0.35	Drill or Air seeder with single disk no-till openers JD 750 or similar openers. (No-till air drill)
115		Drill or air seeder single disk openers, + fert. opnrs 7-10 i	0.48	Drill or Air seeder with single disk no-till openers JD 750 or similar openers plus fert. openers.
116		Drill or air seeder tee slot openers 7-10 in spac	0.40	Drill or Air seeder with tee slot or cross slot or similar openers.102403DTI
117		Drill or air seeder, combo field cult, dd opener	1.30	Combination Seedbed finisher and double disk opener drill consisting of a field cultivator, a rol
118		Drill or air seeder, combo single disk-hoe openers, 10 in s	0.74	Drill or Airseeder, single disk openers with fertilizer in the row using a combo single disk/hoe
119		Drill or air seeder, hoe opener in hvy residu	0.74	Airseeder, hoe opener on 10 to 15 "row spacing and 3"wide presswheels operated in sod or mor
120		Drill or air seeder, hoe opener in hvy residue with fert ope	1.34	Airseeder, hoe opener on 10 to 15 "row spacing and 3"wide presswheels operated in sod or mor
121		Drill or air seeder, hoe-chisel openers 12-15 in spac	0.74	Drill or Airseeder, hoe or chisel openers 12-15 inch spacing and 3"wide presswheels. 060403 I
122		Drill or air seeder, hoe-chisel openers 12-15 in spac. with	1.30	Drill or Airseeder, hoe or chisel openers 12-15 inch spacing and 3"wide presswheels. 060403 I
123		Drill or air seeder, hoe-chisel openers 6-12 in spac	0.74	Drill or Airseeder, hoe or chisel openers and 3"wide presswheels. 10/11/01 DTI
124		Drill or air seeder, hoe-chisel openers 6-12 in spac. with;	1.34	Drill or Airseeder, hoe or chisel openers and 3"wide presswheels. 10/11/01 DTL with fertilizer
125		Drill or air seeder, paired, opposing single disk openers 6	0.74	Drill or Air seeder with twin single disk no-till openers angled to pull soil toward each other. S
126		Drill or airseeder, dble disk opnr with fluted coult 5x10 pa	0.74	Drill or airseeder with double disk openers and fluted coulters on 5x10 inch paired row spacing.
127		Drill or airseeder, double disk	0.36	Drill or air seeder with double disk openers on 7 to 10 inch spacings. Rev102403 DTI
128		Drill or airseeder, double disk opener, with fert openers	0.43	Drill or airseeder with double disk openers with fertilizer knives or openers on 7 -12 inch spacin
129		Drill or airseeder, double disk, with fluted coulter	0.43	Drill or airseeder with double disk openers and fluted coulters on 7 to 10 inch spacing. REVISI
130		Drill or airseeder, offset double disk opener	0.32	No-till drill or airseeder with narrow offset double disk openers 01-10-02 DTI
131		Drill, air seeder, 4 inch stealth openers on 12 in spa	0.43	Airseeder with Anderson openers or similar openers seeding 3-4" bands of seed on 12" row sp
132		Drill, air seeder, 6 inch stealth openers on 12 in spa	0.43	Airseeder with 6 inch stealth openers or similar openers seeding 3-4" bands of seed on 12" row
133		Drill, air seeder, sweep or band opene	0.43	Airseeder with Anderson openers or similar openers seeding 3-4" bands of seed on 12" row sp
134		Drill, deep furrow 12 to 18 in spacing	0.60	Deep furrow drills on 12 to 18 inch spacing 04-18-02 DTI
135		Drill, deep furrow 7 to 10 in spacing	0.74	Deep furrow drills on 7 to 10 inch spacing 031405 DTI
136		Drill, double disk, 7-8 in packer C	0.36	Drill or air seeder with double disk openers on 7 to 10 inch spacings. 06070
137		Drill, double disk, orchard vineyard cove	0.36	Drill used for orchard and vineyard managements that include vine and cover crop growth in the
138		Drill, heavy, direct seed, dbl disk opnr	1.10	Very Heavy direct seeding drill used for one pass seeding. Surface disturbance is 85% and gre
139		Drill, heavy, direct seed, dbl disk opnr with row cleaner	1.30	Very Heavy direct seeding drill used for one pass seeding. Also equipped with disk or residue n
140		Drill, range	0.48	Drill for seeding on rangeland. from RUSLE1.06. 062403 gaw
141		Drill, semi-deep furrow 12 to 18 in spacing	0.55	6/7/01 DTL
142		Drip tape extractor	0.38	Drip Tape extractor (similar to Sundance Tape extractor) rev 112707 DTI
143		Drip tape injection shank	0.80	Drip tape injection shank. 112707 DTL
144		Drip tape injection shank on bed	0.80	Drip tape injection shank on lister beds. 112707 DTI
145		Drip tape injector bed shape	0.45	Drip Tape injector bed shaper (similar to Sundance Tape Injector) 112707 DTI
146		Erosion blanket applicato	0.00	Straw or curlex erosion control blanket application covering 100% of the surface. Applied after
147		Fert applic. anhyd knife 12 in	0.90	6/7/01 DTL
148		Fert applic. anhyd knife 12 in, coil tine ha	1.10	Fert applic. anhyd knife 12 in, 6/7/01, with coiled tine harrow. 09/16/11 GG
149		Fert applic. broadcast by hanc	0.00	Broadcast fertilizer by hand 033111 DTL
150		Fert applic. coulter, high press. inject 12 in	0.16	6/7/01 DTL 12 inch spacing
151		Fert applic. deep plcmt hvy shnk	0.90	6/7/01 DTL
152		Fert applic. shank low disturbance, 12 in	0.90	Minimum disturbance fertilizer injector shank.012904 DTI
153		Fert applic. shank low disturbance, 12 in, coil tine ha	1.10	Minimum disturbance fertilizer injector shank.012904 DTL with coiled tine harrow. 091611 g
154		Fert applic. shank low disturbance, 15 in spacing	0.90	Minimum disturbance fertilizer injector shank.on 15 inch spacing. Each injector typically has
155		Fert applic. side-dress, liquic	0.13	Spray or dribble side-dress application of fertilizer into row crop. Crop is not affected. Create
156		Fert applic. surface broadcast	0.16	Broadcast fertilizer spreader. Wheel traffic only. rev 082107 DTI
157		Fert applic., aerial	0.16	Aerial broadcast fertilizer. Although used for aerial application of Fertilizer into flooded rice fi
158		Fert. applic. anhyd knife 15 in spacing	0.90	Anhydrous knife applicator on 15inch spacing. About 6 inch wide disturbed area per shank. 12
159		Fert. applic. anhyd knife 15 in spacing high disturbanc	0.90	Double shot liquid fertilizer knife applicator on 15inch spacing. 90 to 100 percent disturbance
160		Fert. applic. anhyd knife 15 in spacing high disturbance, c	1.10	Fert. applic. anhyd knife 15 in spacing high disturbance 112307 DTL with coil tined harrow. r
161		Fert. applic. anhyd knife 15 in spacing, coil tine ha	1.10	Anhydrous knife applicator on 15inch spacing. About 6 inch wide disturbed area per shank. 12
162		Fert. applic. anhyd knife 30 in	0.80	6/7/01 DTL
163		Fert. applic. anhyd knife 30 in, bedde	0.80	04/01/10 DTL
164		Fert. applic. anhyd, liq, dry, minimal dist. precision placm	0.80	
165		Fert. applic. anhyd, low dist. single disk opener, 30 in	0.80	
166		Fert. applic. double shot knife 15 in spacing high disturba	0.90	Double shot liquid fertilizer knife applicator on 15inch spacing. 90 to 100 percent disturbance
167		Fert. applic. shallow anhyd knife 38 in	0.80	Anhydrous knife or applicator on 38 inch spacing used to apply side-dress fertilizer at a shallow
168		Fert. applic. single disk opener, low disturbance, 30 inch s	0.80	
169		Fert. applic. sugarcane	0.70	Fertilizer applicator, sugarcane. This applicator is similar to an anhydrous applicator except pai
170		Fert. applic., strip-till 30 in	0.90	Used to mark rows or apply fertilizer for strip till systems. 12-07-01 DTI
171		Furrow diker	0.35	Furrow Diker creates dams in furrows between lister ridges or beds. 11/08/01 DTI
172		Furrow shaper, torpedo	0.35	Furrow shaping operation on existing beds. Torpedo shaped device used to shape the furrows f
173		Germination of dormant seeding	0.00	Germination of dormant seeding. Enter this operation on the date of spring germination of early
174		Graze, continuous	0.00	Continuous Grazing system. Long duration grazing periods 12-20-01 DTI
175		Graze, continuous overgrazing	0.00	Continuous Grazing system. Represents overgrazing. Long duration grazing periods Rev 0709

176		Graze, continuous, heavy hoof traffi	0.00	Graze continuous heavy hoof traffic. Represents dairy night pastures or holding lots with daily
177		Graze, continuous, light hoof traffi	0.00	Continuous Grazing system. Long duration grazing periods 12-20-01 DTI
178		Graze, continuous, moderate hoof traffi	0.00	Continuous Grazing system. Long duration grazing periods 12-20-01 DTI
179		Graze, intensive rotational	0.00	Intensive Rotatioal Grazing system with 85% of growth removed with each grazing cycle.12-20
180		Graze, rotational	0.00	Rotational Grazing system with 50% of growth removed with each grazing cycle.12-20-01 DT
181		Graze, stubble or residue	0.00	Grazing of crop residue such as corn stalks or cotton. 10/26/01 DTI
182		Graze, stubble or residue 25 pct	0.00	Moderate grazing of crop residue such as corn stalks or cotton. 112003 DTI
183		Graze, stubble or residue 50 pct	0.00	Heavy grazing of crop residue such as corn stalks or cotton. 112003 DTI
184		Graze, stubble or residue 75 pct	0.00	Very heavy grazing of crop residue such as corn stalks or cotton. 112003 DTI
185		Grazing set season, time on, time off, rat	0.00	
186		Grazing, continuous, high traffic, set season, rat	0.00	
187		Grazing, continuous, set season, rate	0.00	
188		Grazing, continuous, severe hoof traffic, set season, rat	0.00	
189		Grazing, continuous, time on, time off, rat	0.00	
190		Grazing, frost kill	0.00	
191		Grazing, set end ht, and rate	0.00	
192		Grazing, set end ht, and time or	0.00	
193		Grazing, set harvest portion and time or	0.00	
194		Grazing, set harvest portion, and removal rat	0.00	
195		Grazing, set season, harvest portion, removal rate and sta	0.00	
196		Grazing, set season, start ht, end ht, rat	0.00	
197		Grazing, set season, start ht, end ht, rate, then mowe	0.73	
198		Grazing, set season, start ht, end ht, time or	0.00	
199		Grazing, set season, start ht, end ht, time on, then mowe	0.73	
200		Grazing,set season, harvest portion, start mass, and time o	0.00	
201		Harrow, coiled tine	0.44	6/7/01 DTL
202		Harrow, coiled tine weeder	0.44	Coiled Tine harrow used as a tine weeder in young growing crops. 021109 DTI
203		Harrow, disk chain	0.40	
204		Harrow, heavy	0.44	Heavy Harrow. adapted from spring tooth harrow. 10/11/01 DTI
205		Harrow, heavy on heavy resdu	0.35	This record represents none to very slight ground disturbance. Heavy harrow used to flatten star
206		Harrow, rolling	0.57	Rolling Harrow similar to Unverferth single basket reel. Built from a combination of coil tine h
207		Harrow, rotary	0.44	Rotary harrow (Phoenix or Phillips) with clusters of spike tines mounted on a rotating cable pu
208		Harrow, rotary paddle wheel and spike gang	0.73	Rotary Harrow with ground driven with single rotor gang and rotary spike tine gang covering th
209		Harrow, rotary, light, fluff fragile residu	0.44	Rotary Harrow on fragile residue such as soybean or vegetable crop residues. Used preplant in
210		Harrow, rotary, light, fluff residu	0.44	Rotary harrow used preplant in No-till to "fluff" residue. Rotary harrow set to low angle of agg
211		Harrow, spike tooth	0.34	6/7/01 DTL
212		Harrow, spike tooth, cover seed	0.34	Revised to represent harrowing to smooth and cover after seeding or planting crops such as, pea
213		Harrow, tine, on beds	0.22	Drag with light harrow or chain link fence panel on existing beds. 11/17/01 DTI
214		Harvest, banana	0.35	Harvest banana cut stem and leave all residue on the surface. The begin growth process calls in
215		Harvest, banana remove stem	3.60	Harvest banana, cut down stem and remove stem from the field. 90% of the standing residue is
216		Harvest, broccoli and cauliflowe	1.35	6/7/01 DTL
217		Harvest, cabbage and head lettuce	1.35	REV 092304 DTL
218		Harvest, cabbage and head lettuce, hanc	0.35	Hand harvest of cabbage or head lettuce REV 092304 DTI
219		Harvest, combine windrows	0.35	Represents peanut or dry bean harvester with a pickup reel that pulls the previously undercut cr
220		Harvest, corn cobbage or earlage	1.53	Represents a combine or picker designed to harvest high moisture grain and the cobs. Ears and
221		Harvest, corn grain and 60pct of residue mas	1.91	Represents biomass harvest equipment on a combine . Shelled corn is harvested normally but i
222		Harvest, corn grain and cobs	1.53	Represents a combine or picker designed to harvest the grain and the cobs. Ears and husks are s
223		Harvest, corn grain and part of stover, 14 inch stubbl	1.53	Represents biomass harvest equipment on a combine. Shelled corn is harvested normally but in
224		Harvest, corn silage with cover crop	0.95	Harvest corn silage with cover crop. This operation is used when harvesting silage that has a gr
225		Harvest, cotton	1.53	Represents cotton harvest equipment not followed immediately by a shredder. A shredder opera
226		Harvest, cotton and shred	2.35	6/7/01 DTL Use when cotton is shredded. If cotton harvest is not followed immediately by a sl
227		Harvest, cranberries	0.35	Harvest cranberries. Rev101205DTL
228		Harvest, cut flowers	1.35	11/27/01 DTL
229		Harvest, dig root crops 12 in depth res. buried	2.10	Harvest, root crops like potatoes or carrots. 12 inch depth Surface is rough with 4" ridges and n
230		Harvest, dig root crops 12 in depth res. on surf	1.87	Harvest, root crops like potatoes or sugar beets. 12 inch depth Surface is rough with 4" ridges
231		Harvest, dig root crops res. buried	1.87	Harvest, root crops like potatoes or sugar beets. Surface is rough with 4" ridges and much of th
232		Harvest, dig root crops res. buried 10in ridge	2.10	Harvest, root crops like potatoes or sugar beets. Surface is rough with 10" ridges and much of t
233		Harvest, dig root crops res. on surf	1.87	Harvest, root crops like potatoes or sugar beets. Surface is rough with 4" ridges and much of th
234		Harvest, forage sorghum	0.95	Harvest forage sorghum 11/18/01 DTL
235		Harvest, fruit crops	0.35	Hand pick fruit crops with no disturbance of soil or reduction in canopy. Pineapple, citrus, appl
236		Harvest, grain, grow cover	1.53	Harvest grain with interseeded cover crop. Kills current crop and calls in new growth. User mu
237		Harvest, grass or legume seed, burn forage	3.60	Harvest grass seed and remove the vegetative material with high intensity burning. Vegetation
238		Harvest, grass or legume seed, leave forage	1.53	Harvest grass or legume seed at 12 to 15 inch cutter bar height with a swather, running this mat
239		Harvest, grass or legume seed, remove forage	3.60	Harvest grass seed and remove the vegetative material as hay. Vegetation is cut at 4 to 6 inches
240		Harvest, grass seed, remove forage	3.60	Harvest grass seed and remove the vegetative material as hay or burning. Vegetation is cut at 4
241		Harvest, hand pick	0.00	Hand pick lettuce or similar crops or to represent one final picking of fruit or berry crops. Do n
242		Harvest, hand pick	0.00	Hand pick strawberries or similar crops. 03-12-02 DTI
243		Harvest, hand pick multiple time	0.35	
244		Harvest, hand pick vegetables	0.35	Hand pick tomato, artichoke, peppers, strawberries or similar crops with multiple harvests from
245		Harvest, hand pull	0.35	Hand harvest bulb crops like onions or garlic leaving 4" diameter holes that are 3 to 5" deep.
246		Harvest, hay set date	3.60	
247		Harvest, hay set season, start and end h	3.60	
248		Harvest, hay, grass	1.92	Harvest pure grass hay with 15% of biomass remaining. Use Harvest, legume hay for legume
249		Harvest, hay, legume	1.92	Harvest legume hay crops such as Alfalfa and Red clover and grass-legume mixed hay such as
250		Harvest, hay, no regrowth	1.92	Hay harvest with no regrowth. Use to harvest crops like oat hay or other annuals which are kille
251		Harvest, hops	0.95	Harvest hops from wires with 4 foot vine remaining 053007 TMG and DTI
252		Harvest, kenaf	1.53	Sugarcane harvest, new style equipment 8/23/01 Aycock and Lightl
253		Harvest, killing crop 10pct standing stubbl	1.53	Represents modern harvest equipment like a combine with a corn head or grain header. Very lo
254		Harvest, killing crop 20pct standing stubbl	1.53	Represents modern harvest equipment like a combine with a corn head or grain header. Very lo
255		Harvest, killing crop 20pct standing stubble, release cove	1.53	Harvest grain with interseeded cover crop. 20% standing stubble. Kills current crop and calls i
256		Harvest, killing crop 30pct standing stubbl	1.53	Represents modern harvest equipment like a combine with a corn head or grain header. Low stu
257		Harvest, killing crop 50pct standing stubbl	1.53	Represents modern harvest equipment like a combine with a corn head or grain header. Use as t
258		Harvest, killing crop 50pct standing stubble, release cove	1.53	Harvest grain with interseeded cover crop. 50% standing stubble. Kills current crop and calls i
259		Harvest, killing crop 60pct standing stubbl	1.53	Represents modern harvest equipment like a combine with a corn head or grain header. Modera
260		Harvest, killing crop 70pct standing stubbl	1.53	Represents modern harvest equipment like a combine with a corn head or grain header. High stu
261		Harvest, knife, windrow, combin	3.40	2/95 DDB MN & ND Knife or undercut field beans. Bean stems and some roots placed in a w
262		Harvest, lavender bundles	0.35	Harvest lavender bundles by hand with 24 inch stubble height 051705 DTI
263		Harvest, leafy veg	0.35	Harvest greens with no regrowth. Use to harvest crops like Spinach, kale, chard, beet greens
264		Harvest, leafy veg. mechanica	0.35	Harvest leafy vegetables with regrowth. Use to make multiple harvests of crops like Spinach, ka
265		Harvest, legume seed, remove forage	3.60	Harvest legume seed such as Alfalfa and Red clover and remove the vegetative material as hay
266		Harvest, onions	0.46	Harvest onions, after bulbs have been lifted out of the ground with a rod weeder to dry. Increas
267		Harvest, orchard and nut crops	0.35	Hand or mechanical harvest of orchard fruit or nut crops where little if any ground disturbance
268		Harvest, peanut digger	1.87	Smooth soil surface (roughness) left after harvest like a peanut digger. Vee blades undercut the
269		Harvest, plantains,stalks lef	1.87	Harvest plantains or bananas, stalks left 092104 DTI
270		Harvest, plantains,stalks remove	3.60	Harvest plantains or bananas, stalks removed 092104 DTI
271		Harvest, residue, forage chopper, complet	0.73	Flail chopper harvester used to harvest residue. High removal 022509 DTI
272		Harvest, residue, forage chopper, incomplet	0.73	Flail chopper harvester used to harvest residue. Incomplete removal 022509 DTI
273		Harvest, residue, forage chopper, intermediat	0.73	Flail chopper harvester used to harvest residue. Intermediate removal 052308 DTI
274		Harvest, rootcrops, manually	0.35	Hand digging of rootcrops such as potatoes. Rev042808 DTL rev energy use 12132011 lo

275		Harvest, rootcrops, manually, 25pct of field disturbed	0.00	6/20/06 MPR Manually harvest root crops, 25% of field disturbed by harvest operation. Residue
276		Harvest, rootcrops, manually, 33pct of field disturbed	0.00	6/20/06 MPR Manually harvest root crops, 33% of field disturbed by harvest operation. Residue
277		Harvest, rootcrops, manually, 50pct of field disturbed	0.00	6/20/06 MPR Manually harvest root crops, 50% of field disturbed by harvest operation. Residue
278		Harvest, rootcrops, manually, one third	0.00	121605 DTL Hand digging of rootcrops such as potatoes
279		Harvest, seed heads by hand	0.00	Hand harvest seed heads from onions, garlic and similar crops. 11/01/10 GGF. Developed fro
280		Harvest, silage	0.95	6/7/01 DTL
281		Harvest, silage 3ft stubble	0.95	Silage harvest with 36 inch stubble height 030904 DTI
282		Harvest, small grain haylage 5 in h	3.60	Harvest small grain as high moisture haylage with 5 inch stubble or about 13% of biomass rem
283		Harvest, small grain silage with cover cro	0.95	05/14/03 DTL
284		Harvest, small grain, release understory	1.53	Represents a combine with a grain header used to harvest small grain with a live understory cro
285		Harvest, snapper header	1.53	Represents a combine or picker with a snapper header. Ears and husks are snapped from stalks
286		Harvest, sprig rototiller digger	2.10	Rototiller mint digger 110210 GGF and DTL
287		Harvest, stalk chopping corn header	1.60	Represents a combine with a corn head with rotating knife blades mounted below knife type sta
288		Harvest, stripper header	1.53	Represents a combine with a small grain stripper header. Strips only the head leaving 90% of s
289		Harvest, sugarcane, after burning	3.60	Sugarcane harvest, new style equipment after standing sugar cane is burned. This operation mu
290		Harvest, sugarcane, after burning, no regrowth	3.60	Sugarcane harvest, new style equipment after standing sugar cane is burned. This operation mu
291		Harvest, sugarcane, modern	3.60	Sugarcane harvest, new style equipment 8/23/01 Aycock and Lightl
292		Harvest, sugarcane, old type	3.60	Sugarcane harvest, old method with high harvest losses 8/23/01 Aycock and Lightl
293		Harvest, sugarcane, root rake	1.87	Harvest sugarcane, with Root Rake Depth represents depth of incorporated residue. 111605 DT
294		Harvest, timber remove tops	3.60	Clear cut trees and use chipper. Most of the material is removed. 062603 DTl
295		Harvest, tobacco, burley	0.35	Harvest of burley tobacco where entire plant is cut and removed leaving only short stubble. 021
296		Harvest, tobacco, burley, mechanical harveste	1.40	Harvest of burley tobacco where entire plant is cut and removed leaving only short stubble usin
297		Harvest, tobacco, flue cured	0.35	Harvest of flue cured tobacco where lower mature leaves are systematically picked and removed
298		Harvest, tobacco, flue cured, 1 pass mechanica	1.50	Mechanical harvest of flue cured tobacco where all leaves are stripped in one pass leaving only
299		Harvest, tobacco, flue cured, selective mechanical harves	1.40	Mechanical harvest of flue cured tobacco where only the more mature lower leaves are stripped
300		Harvest, tree buck	3.60	Tree harvest "buck" 3 to 4 lumber length logs harvested per tree. All limbs and tops left. 07-20
301		Harvest, tree length logs	3.60	Tree length logs harvested. Limbs and tops under 4"diameter are left on ground in the woods
302		Harvest, tree pulpwood cut	3.60	Tree harvest pulpwood cut. All limbs and tops left. 07-20-03 DTI
303		Harvest, tree, Christmas grow cover	0.35	Harvest Christmas trees with permanent grass cover. This operation is used when harvesting Cl
304		Harvest, trees, chipper	3.60	Clear cut trees and use chipper. The entire tree is chipped and harvested. 071703 DTl
305		Harvest, vine crops	0.35	Hand pick melons, cucumbers, pumpkins or similar crops such as strawberries. revised energy
306		Harvest, vine crops, mechanica	0.35	Represents harvest equipment like a tomato harvester that pulls the vine and runs the entire plan
307		Harvest, windrows	1.53	Represents harvest equipment like a dry bean harvester that pulls a windrow of previously cut b
308		Harvest, woody biomass	0.95	
309		Hilling, manual hoe	0.00	Manually hip or hill rootcrops in small fields using hoe or similar tool that disturbs soil in the f
310		Hydro-seeder	0.35	Hydro-seeder with mulch. Begins growth. Applies other residue cover to the surface, none is in
311		Install Compost Sock	0.00	Install Compost Sock 101009 DTL
312		Install Silt Fence	0.00	Manual installation of silt fence 101009 DTL rev06/25/10 DTl
313		Install Straw Bale	0.00	Install a straw bale barrier in accordance with DNR technical standard. 101009 DTl
314		Kill crop	0.00	Kills growing crop and puts 50 to 70 % of the live biomass (leaves) into the flat residue pool. I
315		Knife, windrow dry beans	1.87	2/95 DDB MN & ND Knife or undercut field beans. Bean stems and some roots placed in a w
316		Land plane	0.90	Land plane or land leveler. Rev 032006 DTl
317		Land plane; orchard and vine crop	0.90	Land plane or land leveler in alley ways or rows of tree fruits, nuts, vineyards, etc. Leveling ma
318		Laser Land leveler	0.90	Laser land leveler . 032006 DTL
319		Lister, 30 in	0.90	110207 DTL
320		Lister, 30 in with fert applic	1.50	30 in lister 122106 DTL with Minimum disturbance fertilizer injector shank on 15 inch spacing
321		Lister, 40 in	0.90	6/8/01 DTL
322		Lister, 40 in with fert applic	1.50	Combination of Lister 6/8/01 DTL with Minimum disturbance fertilizer injector shank.on 15 inc
323		Log skidder	0.35	Log skidder 062703 DTL
324		Manure injector, liquid high disturb.30 incl	1.56	Multiply the oven dry weight times an effectiveness factor of 0.5 to calculate the rate of applica
325		Manure injector, liquid low disturb.15 incl	1.56	Multiply the oven dry weight times an effectiveness factor of 0.5 to calculate the rate of applica
326		Manure injector, liquid low disturb.30 incl	1.56	Multiply the oven dry weight times an effectiveness factor of 0.5 to calculate the rate of applica
327		Manure injector, low disturb.15 incl	1.56	
328		Manure injector, low disturb.30 incl	1.56	
329		Manure spreader, liquid	1.23	Multiply the oven dry weight times an effectiveness factor of 0.5 to calculate the rate of applica
330		Manure spreader, slurry	1.23	Multiply the oven dry weight times an effectiveness factor of 0.5 to calculate the rate of applica
331		Manure spreader, solid and semi-solic	1.23	When spreading semisolid manure, multiply the oven dry weight times an effectiveness factor o
332		Manure, liquid irrigatior	0.35	Multiply the oven dry weight times an effectiveness factor of 0.5 to calculate the rate of applica
333		Middle buster, digger	0.90	Middle buster. Includes use as a potato digger. Runs below and down the middle of potato bed
334		Mow pasture	3.60	
335		Mower, swather, on stubble	0.35	Mow and windrow small grain or other crop stubble. Flattens standing material. Material mus
336		Mower, swather, on stubble 4ir	0.35	Mow and windrow small grain or other crop stubble. Approximately 4 inch stubble left. Flatte
337		Mower, swather, windrower	0.35	Mow and windrow crop. Flattens standing material and calls in new growth file. Material mus
338		Mulch crimper	0.35	Mulch crimper A gang of ground driven straight, notched or smooth coulters on a rotating shaf
339		Mulch treader	0.35	Mulch Treader flattens and achors straw and stubble by placing some soil on loose residue. Als
340		No operation	0.00	6/8/01 DTL
341		Para-plow or para-till	1.56	Paratill or Paraplow consisting of bent leg shanks that disturb less than 30% of the surface but t
342		Pasture renovator	0.48	Pasture renovator. A gang of ground driven straight, notched or smooth coulters on a rotating s
343		Paving	3.60	Paving with Concrete or Asphalt 071404DTL
344		Permeable weed barrier applicator	0.39	Permeable weed barrier covering 40% of the surface having 50% permeability. 12-19-01 DTL r
345		Planter, double disk opener on 12 inch high bed	0.44	Double disk opener planter on existing 12 inch high beds or ridges leaving a 10 inch ridge after
346		Planter, double disk opener on 15 inch high bed	0.44	Double disk opener planter on existing 15 inch high beds or ridges leaving a 14 inch ridge after
347		Planter, double disk opener on 18 inch high bed	0.44	Double disk opener planter on existing 18 inch high beds or ridges leaving a 16 inch ridge after
348		Planter, double disk opener on 8 inch high bed	0.44	Double disk opener planter on existing 8 inch high beds or ridges leaving a 6 inch ridge after pl
349		Planter, double disk opnr	0.44	6/7/01 DTL
350		Planter, double disk opnr with fluted coulter	0.54	REVISED102403 DTL
351		Planter, double disk opnr with fluted coulter with starter f	0.65	REVISED102403 DTL revised planter, double disk opnr w/fluted coulter to add starter fertilize
352		Planter, double disk opnr with fluted coulter, 15 inch row	0.74	No-till planter with double disk openers and fluted coulters on 15 inch row spacing. Typical of
353		Planter, double disk opnr with starter fertilize	0.53	6/7/01 DTL revised planter, double disk opnr to add starter fertilizer operation. rev 8/30/11 LO
354		Planter, double disk opnr, 15 inch row spacing	0.64	Planter with double disk openers on 15 inch row spacing. Typical of planters with splitter units
355		Planter, double disk opnr, 18 in row	0.64	10/18/01 DTL
356		Planter, double disk opnr, 40 in row	0.44	Row crop planter on 40 inch row spacing not on ridges or beds. 040808 DTl
357		Planter, furrow opener in 4 inch deep furrow	0.44	Furrow opener planter leaving 4 inch furrows or ridges after planting. 040708 DTl
358		Planter, furrow opener in 6 inch deep furrow	0.60	Furrow opener planter leaving 6 inch furrows or ridges after planting. Seed planted in the furro
359		Planter, furrow opener in 8 inch deep furrow	0.80	Furrow opener planter leaving 6 inch furrows or ridges after planting. Seed planted in the furro
360		Planter, in-row subsoiler	2.10	Planter, in-row chisel or subsoiler consisting of double disk opener planter units running behind
361		Planter, in-row subsoiler low disturbac	2.10	Planter, in-row chisel or subsoiler consisting of double disk opener planter units running behind
362		Planter, in-row subsoiler with residue mgr	2.10	Planter, in-row chisel or subsoiler consisting of double disk opener planter units running behind
363		Planter, narrow slot with smooth or rippled coulter	0.39	Narrow no-till planter on 30 inch row spacing. Minimal disturbance and burial. 052302 DT
364		Planter, potato, 6 in beds	0.75	Potato planter on existing 6 inch high beds or ridges leaving a 6 inch ridge after planting. 11/1
365		Planter, RELAY INTERCROP, double disk opnr with flu	0.44	
366		Planter, RELAY INTERCROP, double disk opnr with flu	0.44	Planter with double disk openers and fluted coulters used in No-till relay intercropped soybeans
367		Planter, ridge till	0.62	6/7/01 DTL
368		Planter, runner opener	0.44	Runner shoe planter with metal presswheels. Based on core Conventional Row Planter with run
369		Planter, small veg seed	0.36	Small seed planter like used in planting small seeded vegetables in 25 to 30" rows. Shallow dep
370		Planter, small veg seed on 8 inch high bed	0.36	Small seed planter like used in planting small seeded vegetables in 25 to 30" rows on 8 inch hig
371		Planter, sprig conventiona	0.40	Planter used to plant sprigs. Similar to a light finishing disk Rev043008 DT
372		Planter, sprig, no-til	0.39	Grass clippings or sprigs are planted with little soil disturbance. Use for No-till or manual sprig
373		Planter, sprigs on beds	0.45	Sprig planter on beds 110210 GGF and DTL

374		Planter, strip till	0.62	6/7/01 DTL
375		Planter, strip till, 22 inch	0.62	6/7/01 DTL
376		Planter, strip till, shallow subsoile	2.40	In-row chisel or subsoiler shanks that disturb less than 40% of the surface but lift and fracture th
377		Planter, strip till, subsoiler	2.40	In-row chisel or subsoiler shanks that disturb less than 40% of the surface but lift and fracture th
378		Planter, sugarcane	0.44	Rev 043008 DTL
379		Planter, transplanter, vegetable	0.80	Vegetable transplanter.10/18/10 DTL
380		Planter, transplanter, vegetable on 8 inch high bed	0.80	Vegetable transplanter on 8 inch beds or ridges.11/15/02 DTI
381		Planter, transplanter, vegetable, no-till	0.90	10/18/01 DTL
382		Planter, tree, mechanical transplanter	2.10	Tree Planter, similar to an in-row chisel or subsoiler opener running behind a large coulter, foll
383		Planting, broadcast interseeder	0.13	
384		Planting, broadcast seeder	0.13	Broadcast seeding. Begins growth . 11/30/01 DTL
385		Planting, hand 10 percent dist	0.00	Hand planting with 10% disturbance 12-12-01 DTL
386		Planting, hand 5 percent dist	0.00	#N/A
387		Planting, manual	0.00	'Drip Tape extractor (similar to Sundance Tape extractor) 040805 DTL
388		Planting, manual on 8 inch high bed	0.00	'Rotary or flail detasseling machine used to remove seed corn tassels. When using this operation in a managem
389		Planting, no-til manually	0.00	'Continuous Grazing system. Long duration grazing periods 12-20-01 DTL
390		Plastic hoop tunnel installation 100 percent cove	0.27	'Continuous Grazing system. Represents overgrazing. Long duration grazing periods Rev 070904 DTI
391		Plastic hoop tunnel installation 50 percent cove	0.27	'Graze continuous heavy hoof traffic. Represents dairy night pastures or holding lots with daily heavy hoof tra
392		Plastic hoop tunnel installation 75 percent cove	0.27	'Intensive Rotatioal Grazing system with 85&per; of growth removed with each grazing cycle.12-20-01 DT
393		Plastic hoop tunnel installation on beds 50 percent cove	0.27	'Rotational Grazing system with 50&per; of growth removed with each grazing cycle.12-20-01 DT
394		Plastic hoop tunnel installation on beds 75 percent cove	0.27	'Grazing of crop residue such as corn stalks or cotton. 10/26/01 DTL
395		Plastic hoop tunnel removal on bed	0.39	'Moderate grazing of crop residue such as corn stalks or cotton. 112003 DTI
396		Plastic hoop tunnel, remova	0.39	'Heavy grazing of crop residue such as corn stalks or cotton. 112003 DTI
397		Plastic mulch applic. 40 inch beds 100 percent cove	0.27	'Very heavy grazing of crop residue such as corn stalks or cotton. 112003 DTI
398		Plastic mulch applic. 40 inch beds 75 percent cove	0.27	'Log skidder 062703 DTL'
399		Plastic mulch applic. 48 inch beds 100 percent cove	0.27	'Mulch crimper A gang of ground driven straight, notched or smooth coulters on arotating shaft that is used to
400		Plastic mulch applic. 48 inch beds 80 percent cove	0.27	'Mulch Treader flattens and achors straw and stubble by placing some soil on loose residue. Also called skew t
401		Plastic mulch applic. 54 inch beds 100 percent cove	0.27	'6/8/01 DTL'
402		Plastic mulch applic. 54 inch beds 80 percent cove	0.27	'Paving with Concrete or Asphalt 071404DTL
403		Plastic mulch applic. 64 inch beds 100 percent cove	0.27	'6/23/93 sntc Drain Flooded Rice field prior to harvest. Arkansas, EI Zone 106. Revised for RUSLE2 01-23-02
404		Plastic mulch applic. 64 inch beds 85 percent cove	0.27	'6/23/93 sntc Flood Rice Field when plant height is 6-8". Arkansas, EI Zone 106. Revised for RUSLE2 (
405		Plastic mulch applicator 100 percent cove	0.27	'060701 DTL'
406		Plastic mulch applicator 40 percent cove	0.27	'Use to initiate growth of a new crop or weed record in cases where a planter, drill or seeding operation is not u
407		Plastic mulch applicator 50 percent cove	0.27	'Weed growth initiated after harvest. 10/28/01 DTL
408		Plastic mulch applicator 75 percent cove	0.27	0
409		Plastic mulch, 05 percent removal	0.39	'6/8/01 DTL'
410		Plastic mulch, 10 percent removal	0.39	'Beds are lightly tilled and tops flatted in preparation for planting. 6/8/01 DT
411		Plastic mulch, 25 percent removal	0.39	'Germination of dormant seeding. Enter this operation on the date of spring germination of early winter or late
412		Plastic mulch, 50 percent removal	0.39	'6/8/01 DTL'
413		Plastic mulch, remove	0.39	'Middle buster. Includes use as a potato digger. Runs below and down the middle of potato beds to lift and ex
414		Plastic weed barrier 40 inch beds 100 percent cove	0.27	'6/8/01 DTL'
415		Plastic weed barrier 40 inch beds 50 percent cover	0.27	'Sandfighter Makes roughened surface with spade points mounted on spiderwheels mounted on a shaft. Simil
416		Plastic weed barrier 40 inch beds 75 percent cover	0.27	
417		Plastic weed barrier applicator 100 percent cove	0.27	
418		Plastic weed barrier applicator 50 percent cove	0.27	
419		Plastic weed barrier applicator 75 percent cove	0.27	
420		Plow, deep, large, moldboard	3.60	
421		Plow, disk	1.30	
422		Plow, moldboard	1.87	
423		Plow, moldboard 10 inch depth	2.10	
424		Plow, moldboard 6-7 inch depth	1.87	
425		Plow, moldboard, conservation	1.87	
426		Plow, moldboard, up hill	1.87	
427		Plow, oxen 12 in ridge	0.00	
428		Plow, oxen 18 in ridge	0.00	
429		Plow, oxen on 6 in ridge	0.00	
430		Plow, oxen, strip 30 pct disturb	0.00	
431		Plow, oxen, strip 60 pct disturb	0.00	
432		Plow, reversable	1.87	
433		Power mulcher bed conditioner	2.10	
434		Pruning	0.00	
435		Rake or windrower	0.25	
436		Reel disk vertical tille	0.85	
437		Regrow	0.00	
438		Remove Compost Sock	0.00	
439		Remove Silt Fence	0.00	
440		Remove Straw Bale	0.00	
441		Residue conditioner, coil tine har, rlng bsk	0.75	
442		Residue removal by wind	0.00	
443		Residue, row cleaner	0.32	
444		Rice residue stomper	2.10	
445		Ripper, intra row	2.10	
446		Ripper, intra row and furrow diker	2.50	
447		Road grader	0.60	
448		Rodweeder	0.46	
449		Rodweeder, harrow, spike tooth	0.63	
450		Roller harrow	0.60	
451		Roller, corrugated packer	0.25	
452		Roller, corrugated packer 6 by 16	0.25	
453		Roller, crimp, covercrop	0.25	
454		Roller, on beds	0.25	
455		Roller, residue	0.25	
456		Roller, residue incorporator	0.48	
457		Roller, row shaper	0.48	
458		Roller, smooth	0.25	
459		Rolling basket incorporator	0.25	
460		Root rake	1.87	
461		Rotary hoe	0.25	
462		Rotary hoe, on heavy soi	0.25	
463		Rotary hoe, residue	0.25	
464		Rototiller, field	2.10	
465		Rototiller, field, add residue	2.10	
466		Rototiller, on beds	2.10	
467		Rototiller, row cult add residue	2.10	
468		Rototiller, row cultivator	2.10	
469		Sand fighter	0.44	
470		Scalper, tree	0.90	
471		Scarifier	0.90	
472		Scraper-pan-grader, clearing-cutting	0.60	

473		Seedbed conditioner, coil tine har, rlng bsk	0.75	
474		Seedbed conditioner, coulter caddy, coil tine ha	0.55	
475		Seedbed conditioner, coulter caddy, coil tine har, rlng bsk	0.75	
476		Seedbed conditioner, coulter caddy, field cult, spike harro	0.55	
477		Seedbed conditioner, coulter caddy, rtry ha	0.65	
478		Seedbed conditioner, coulter caddy, rtry har, rlng bsk	0.85	
479		Seedbed conditioner, coulter caddy, spk ha	0.55	
480		Seedbed conditioner, coulter caddy, spk har, rlng bsk	0.75	
481		Seedbed finisher	0.90	
482		Seedbed finisher	0.90	
483		Seedbed finisher, fld cult, chop, spk har, rlng bsk	1.30	
484		Seedbed finisher, fld cult, coil tine har, rollng bsk	1.10	
485		Seedbed finisher, fld cult, mlch trdi	1.10	
486		Seedbed finisher, fld cult, rtry hai	1.10	
487		Seedbed finisher, sngl disk, fld cult, coil tine har, rollng b	1.50	
488		Seedbed finisher, sngl disk, rotry ha	0.90	
489		Seedbed finisher, sngl dsk, fld cult, coil tine ha	1.30	
490		Seeder, corrugated packer	0.25	
491		Seeder, dormant, corrugated packer	0.25	
492		Seeder, high density vegetable	0.44	
493		Shred residue, 6 inch stubble	0.73	
494		Shred standing residue in live cover crop	0.35	
495		Shredder, flail or rotary	0.73	
496		Shredder, flail or rotary, add other cover	0.73	
497		Shredder, flail or rotary, filberts and pecan	0.73	
498		Shredder, rotary mower	0.73	
499		Shredder, rotary, regrow veg	0.73	
500		Shredder, rotary, remove residue	0.73	
501		Slip plow 48 to 60 in. deep	2.50	
502		Sod cutter	0.90	
503		Sod installation	0.00	
504		Spader	1.50	
505		Spader, shallow depth	1.50	
506		Spray, glysophate on resistant growing crop	0.13	
507		Sprayer, backpack, kill vegetation	0.00	
508		Sprayer, backpack, post emergence	0.00	
509		Sprayer, defoliant	0.13	
510		Sprayer, fungicide	0.13	
511		Sprayer, fungicide and insecticide tank mi:	0.13	
512		Sprayer, growth regulator	0.13	
513		Sprayer, insecticide post emergence	0.13	
514		Sprayer, kill cover in growing crop	0.13	
515		Sprayer, kill cover in growing vegetable	0.13	
516		Sprayer, kill crop	0.13	043008 DTL Sprayer, kill crop. Use this operation to kill growing weeds or a growing cover crop or forage cr
517		Sprayer, kill strips	0.13	
519		Sprayer, post emergence	0.13	
520		Sprayer, post emergence and fert. tank mix	0.13	
521		Sprayer, pre-emergence	0.13	
522		Stalk chopper, rolling	0.73	
523		Stalk chopper, rolling, light disturbance	0.73	
524		Stalk chopper, rolling, on ridgetill ridge	0.73	
525		Stalk chopper, rolling, strip	0.73	
526		Stalk chopper, rotary	0.73	
527		Stalk chopper, strip rotary	0.73	
528		Stalk puller	0.32	
529		Stalk puller high disturbance	0.32	
530		Stalk slicer	0.45	
531		Stop Grazing	0.00	
532		Strip till bed conditioner	0.32	
533		Striptiller with middlebuster on bed	0.45	
534		Subsoil disk ripper	2.50	
535		Subsoil disk ripper, coulter smooth, rlng bsk	2.70	
536		Subsoil disk ripper, roller smooth	2.80	
537		Subsoiler	2.10	
538		Subsoiler bedder (ripper-hipper)	2.10	
539		Subsoiler leveler	2.25	
540		Subsoiler ripper, 24 to 40 in. deep	2.50	
541		Subsoiler, 12 foot spacing	1.87	
542		Subsoiler, in row	2.10	
543		Subsoiler, in row strip conditioner	2.60	
544		Subsoiler, in row strip conditioner, 40 in row	2.60	
545		Subsoiler, inline heavy shanks with coulter cadd	2.80	
546		Subsoiler, inline with coulter caddy	2.30	
547		Subsoiler, rlng stlk chpr, roller, mulch treade	2.80	
548		Subsoiler, wide spacing	2.10	
549		Subsoiler; Stalk chopper, rolling	2.45	
550		Sweep plow 20-40 in wide	0.74	
551		Sweep plow wider than 40 in with mulch treader	0.90	
552		Sweep plow, under bed	0.74	
553		Sweep plow, wider than 40 in	0.80	
554		Sweep, single under row	0.74	
555		Sweep, single under row, regrow perennia	0.64	
556		Tree spade, holes left	2.50	
557		Tree spade, holes plugged	2.50	
558		Water mulch; off	0.00	
559		Water mulch; on	0.00	
560		Weed control, hoeing in row	0.00	
561		Weed control, manual hoe	0.00	
562		Weed control, string trimmer	0.25	
563		Weeder, finger weeder	0.35	
564		Winter kill annual crop	0.00	
565		zdefault	0.00	
566		ztemp	0.25	'Tree scalper. 072102 DTL'

Filtered Table

	Combined Name/Code	Practice Name	Practice Code	Unit Type
☐	431 Above Ground I	Above Ground Multi-Outlet Pipelin	431	Ft.
☐	560 Access Road	Access Road	560	Ft.
☐	309 Agrichemical H	Agrichemical Handling Facility	309	No.
☐	371 Air Filtration an	Air Filtration and Scrubbing	371	No.
☐	311 Alley Cropping	Alley Cropping	311	Ac.
☐	591 Amendments fo	Amendments for the Treatment of Agricultural Waste	591	No.
☐	366 Anaerobic Dige	Anaerobic Digester, Controlled Temperature	366	No.
☐	316 Animal Mortalit	Animal Mortality Facility	316	No.
☐	575 Animal Trails ar	Animal Trails and Walkways	575	Ac.
☐	450 Anionic Polyacr	Anionic Polyacrylamide	450	PAM
☐	397 Aquaculture Po	Aquaculture Ponds	397	Ac.
☐	370 Atmospheric Re	Atmospheric Resource Quality Management	370	Ac.
☐	310 Bedding	Bedding	310	Ac.
☐	314 Brush Managem	Brush Management	314	Ac.
☐	322 Channel Bank V	Channel Bank Vegetation	322	Ac.
☐	584 Channel Stabiliz	Channel Stabilization	584	Ft.
☐	326 Clearing & Snag	Clearing & Snagging	326	Ft.
☐	360 Closure of Wast	Closure of Waste Impoundments	360	No.
☑ 1	372 Combustion Sys	Combustion System Improvemen	372	No.
☐	317 Composting Fac	Composting Facility	317	No.
☐	327 Conservation C	Conservation Cover	327	Ac.
☑ 2	328 Conservation Cr	Conservation Crop Rotation	328	Ac.
☐	656 Constructed We	Constructed Wetland	656	Ac.
☐	332 Contour Buffer	Contour Buffer Strips	332	Ac.
☐	330 Contour Farmin	Contour Farming	330	Ac.
☐	331 Contour Orchar	Contour Orchard and Other Fruit Area	331	Ac.
☑ 3	340 Cover Crop	Cover Crop	340	Ac.
☐	342 Critical Area Pl	Critical Area Planting	342	Ac.
☐	588 Cross Wind Rid	Cross Wind Ridges	588	Ac.
☐	589 Cross Wind Tra	Cross Wind Trap Strips/Ridges	589	Ac.
☐	402 Dam	Dam	402	No.
☐	348 Dam, Diversion	Dam, Diversion	348	No.
☐	324 Deep Tillage	Deep Tillage	324	Ac.
☐	356 Dike	Dike	356	Ft.
☐	362 Diversion	Diversion	362	Ft.
☐	554 Drainage Water	Drainage Water Management	554	Ac.
☐	432 Dry Hydrant	Dry Hydrant	432	No.
☐	375 Dust Control fro	Dust Control from Animal Activity on Open Lot Surface	375	Ac.
☐	373 Dust Control on	Dust Control on Unpaved Road and Surface	373	Sq. Ft.
☐	647 Early Successio	Early Successional Habitat Development/Management	647	Ac.
☑ 4	374 Farmstead Ener	Farmstead Energy Improvemen	374	
☐	382 Fence	Fence	382	Ft.
☐	386 Field Border	Field Border	386	Ft.
☐	393 Filter Strip	Filter Strip	393	Ac.
☐	394 Firebreak	Firebreak	394	Ft.
☐	396 Fish Passage	Fish Passage	396	No.
☐	398 Fish Raceway o	Fish Raceway or Tank	398	Ft.
☐	399 Fishpond Manag	Fishpond Management	399	No.
☐	511 Forage Harvest	Forage Harvest Management	511	Ac.
☐	490 Forest Site Prep	Forest Site Preparation	490	Ac.
☐	384 Forest Slash Tre	Forest Slash Treatment	384	Ac.
☐	666 Forest Stand Im	Forest Stand Improvement	666	Ac.
☐	655 Forest Trails &	Forest Trails & Landings	655	Ac.
☐	383 Fuel Break	Fuel Break	383	Ac.
☐	410 Grade Stabilizat	Grade Stabilization Structure	410	No.
☐	412 Grassed Waterw	Grassed Waterway	412	Ac.
☐	548 Grazing Land M	Grazing Land Mechanical Treatment	548	Ac.
☐	561 Heavy Use Area	Heavy Use Area Protection	561	Ac.
☐	422 Hedgerow Plant	Hedgerow Planting	422	Ft.
☐	603 Herbaceous Wi	Herbaceous Wind Barriers	603	Ft.
☐	423 Hillside Ditch	Hillside Ditch	423	Ft.
☐	320 Irrigation Canal	Irrigation Canal or Lateral	320	Ft.
☐	388 Irrigation Field	Irrigation Field Ditch	388	Ft.
☐	464 Irrigation Land	Irrigation Land Leveling	464	Ac.
☐	552 Irrigation Regul	Irrigation Regulating Reservoir	552	No.
☑ 5	436 Irrigation Storag	Irrigation Storage Reservoir	436	No. & Ac. Ft
☐	202 Irrigation Syste	Irrigation System, Low Energy Precision Application	202	No.
☐	441 Irrigation Syste	Irrigation System, Microirrigation	441	No.
☐	442 Irrigation Syste	Irrigation System, Sprinkler	442	No.
☐	443 Irrigation Syste	Irrigation System, Surface and Subsurface	443	No.
☐	447 Irrigation Syste	Irrigation System, Tailwater Recovery	447	No.
☐	428 Irrigation Wate	Irrigation Water Conveyance, Ditch and Canal Lining	428	Ft.
☐	430 Irrigation Wate	Irrigation Water Conveyance, Pipeline	430	Ft.
☑ 6	449 Irrigation Wate	Irrigation Water Management	449	Ac.
☐	460 Land Clearing	Land Clearing	460	Ac.
☐	543 Land Reclamati	Land Reclamation, Abandoned Mined Land	543	Ac.
☐	453 Land Reclamati	Land Reclamation, Landslide Treatment	453	No.
☐	455 Land Reclamati	Land Reclamation, Toxic Discharge Control	455	No.
☐	466 Land Smoothing	Land Smoothing	466	Ac.
☐	468 Lined Waterway	Lined Waterway or Outlet	468	Ft.
☐	634 Manure Transfe	Manure Transfer	634	No.
☐	457 Mine Shaft and	Mine Shaft and Adit Closing	457	No.
☐	482 Mole Drain	Mole Drain	482	Ft.
☐	353 Monitoring Wel	Monitoring Well	353	No.
☐	484 Mulching	Mulching	484	Ac.
☐	379 Multi-Story Cro	Multi-Story Cropping	379	Ac.
☐	590 Nutrient Manag	Nutrient Management	590	Ac.
☐	500 Obstruction Rer	Obstruction Removal	500	Ac.
☐	374 On-Farm Equip	On-Farm Equipment Efficiency Improvement	374	No.
☐	582 Open Channel	Open Channel	582	Ft.
☐	512 Pasture & Hayla	Pasture & Hayland Planting	512	Ac.
☐	595 Pest Manageme	Pest Management	595	Ac.
☐	516 Pipeline	Pipeline	516	Ft.
☐	378 Pond	Pond	378	No.
☐	521 Pond Sealing or	Pond Sealing or Lining	521	No.
☐	462 Precision Land I	Precision Land Forming	462	Ac.

Combined Name/Code	
372 Combustion Syst	
328 Conservation Cro	
340 Cover Crop	
374 Farmstead Energy	
436 Irrigation Storage	
449 Irrigation Water M	
533 Pumping Plant	
345 Residue and Tilla	
329 Residue Manager	
346 Residue Manager	
380 Windbreak/Shelte	

☐	528 Prescribed Graz	Prescribed Grazing	528	Ac.
☑ 7	533 Pumping Plant	Pumping Plant	533	No.
☐	550 Range Planting	Range Planting	550	Ac.
☐	562 Recreation Area	Recreation Area Improvement	562	Ac.
☐	566 Recreation Land	Recreation Land Grading & Shaping	566	Ac.
☐	568 Recreation Trail	Recreation Trail & Walkway	568	Ft.
☑ 8	345 Residue and Till	Residue and Tillage Management, Mulch Till	345	Ac.
☑ 9	329 Residue Manage	Residue Management, No-Till/Strip Till/Direct Seed	329	Ac.
☑ 0	346 Residue Manage	Residue Management, Ridge Till	346	Ac.
☐	344 Residue Manage	Residue Management, Seasonal	344	Ac.
☐	643 Restoration and	Restoration and Management of Declining Habitats	643	Ac.
☐	391 Riparian Forest	Riparian Forest Buffer	391	Ac.
☐	390 Riparian Herbac	Riparian Herbaceous Cover	390	Ac.
☐	654 Road/Trail/Land	Road/Trail/Landing Closure and Treatmen	654	Ft.
☐	555 Rock Barrier	Rock Barrier	555	Ft.
☐	558 Roof Runoff Str	Roof Runoff Structure	558	No.
☐	557 Row Arrangeme	Row Arrangement	557	Ac.
☐	570 Runoff Manage	Runoff Management System	570	No.
☐	610 Salinity and Soc	Salinity and Sodic Soil Management	610	Ac.
☐	798 Seasonal High T	Seasonal High Tunnel System for Crops	798	Sq. Ft.
☐	350 Sediment Basin	Sediment Basin	350	No.
☐	646 Shallow Water I	Shallow Water Management for Wildlife	646	Ac.
☐	381 Silvopasture Est	Silvopasture Establishment	381	Ac.
☐	527 Sinkhole and Si	Sinkhole and Sinkhole Area Treatmen	527	No.
☐	632 Solid/Liquid Wa	Solid/Liquid Waste Separation Facility	632	No.
☐	572 Spoil Spreading	Spoil Spreading	572	Ft.
☐	574 Spring Develop	Spring Development	574	No.
☐	578 Stream Crossing	Stream Crossing	578	No.
☐	395 Stream Habitat I	Stream Habitat Improvement and Management	395	Ac.
☐	580 Streambank & S	Streambank & Shoreline Protection	580	Ft.
☐	585 Stripcropping	Stripcropping	585	Ac.
☐	587 Structure for Wa	Structure for Water Control	587	No.
☐	606 Subsurface Drai	Subsurface Drain	606	Ft.
☐	607 Surface Drainag	Surface Drainage, Field Ditch	607	Ft.
☐	608 Surface Drainag	Surface Drainage, Main or Lateral	608	Ft.
☐	609 Surface Roughe	Surface Roughening	609	Ac.
☐	600 Terrace	Terrace	600	Ft.
☐	612 Tree/Shrub Esta	Tree/Shrub Establishment	612	Ac.
☐	660 Tree/Shrub Prun	Tree/Shrub Pruning	660	Ac.
☐	620 Underground Ou	Underground Outlet	620	Ft.
☐	645 Upland Wildlife	Upland Wildlife Habitat Management	645	Ac.
☐	472 Use Exclusion	Use Exclusion	472	Ac.
☐	601 Vegetative Barr	Vegetative Barrier	601	Ft.
☐	630 Vertical Drain	Vertical Drain	630	No.
☐	367 Waste Facility C	Waste Facility Cover	367	No.
☐	313 Waste Storage F	Waste Storage Facility	313	No.
☐	629 Waste Treatmen	Waste Treatment	629	No.
☐	359 Waste Treatmen	Waste Treatment Lagoon	359	No.
☐	633 Waste Utilizatio	Waste Utilization	633	Ac.
☐	635 Wastewater Tre	Wastewater Treatment Strip	635	Ac.
☐	638 Water & Sedime	Water & Sediment Control Basin	638	No.
☐	636 Water Harvestin	Water Harvesting Catchment	636	No.
☐	642 Water Well	Water Well	642	No.
☐	614 Watering Facilit	Watering Facility	614	No.
☐	640 Waterspreading	Waterspreading	640	Ac.
☐	351 Well Decommis	Well Decommissioning	351	No.
☐	355 Well Water Tes	Well Water Testing	355	No.
☐	658 Wetland Creatio	Wetland Creation	658	Ac.
☐	659 Wetland Enhanc	Wetland Enhancement	659	Ac.
☐	657 Wetland Restor	Wetland Restoration	657	Ac.
☐	644 Wetland Wildlif	Wetland Wildlife Habitat Management	644	Ac.
☑ 1	380 Windbreak/Shel	Windbreak/Shelterbreak Establishment	380	Ft.
☐	650 Windbreak/Shel	Windbreak/Shelterbreak Renovation	650	Ft.

		MMBTU per unit	CO_2 [lb]	N_2O [lb]	CH_4 [lb]	SO_2 [lb]	NO_x [lb]	Total [lb]
	Diesel	0.139	22.3769	0.00048505	0.0027783	0.000285	0.018	22.58559
	Gasoline (E10)	0.12	19.6432	0.000573202	0.00317466	0.000285	0.0110231	19.88756
	BioDiesel B2	0.1386	21.9139	0.000485011	0.00277783	0.0001	0.01	22.12559
	BioDiesel B5	0.138	21.2526	0.000485011	0.00277783	0.0001	0.01	21.46129
	BioDiesel B10	0.1369	20.1282	0.000485011	0.00277783	0.0001	0.01	20.33689
	BioDiesel B20	0.1349	17.9015	0.000485011	0.00277783	0.0001	0.01	18.11019
	BioDiesel B100	0.1183	0	0.000485011	0.00277783	0.0001	0.01	0.20869
	SVO	0.12314	0	0.000485011	0.00277783	0.0001	0.01	0.20869
	Propane	0.0916	12.6545	0.0004	0.002	0.0001	0.01	12.8205
	Natural Gas	0.103	11.6977	0.0004	0.002	0.0001	0.01	11.8637
	CNG	0.1	12.0372	0.00385809	0.002	0.0001	0.01	13.275208
	Electricity	0.003412	0.25919	0.0000043	0.0000099	0.0001247	0.0003042	0.2607423
	Agrichem	0.0200	0.000	0.000	0.000	0.000	0.000	0.000
	Soil Amendments	11.25	0.000	0.000	0.000	0.000	0.000	0.000
	Labor	0.0119	0.000	0.000	0.000	0.000	0.000	0.000