Dawson County Yellowstone River Irrigators Sediment Transport & Nutrient Loss Reduction Project

Glendive

Field Office

FY2024-2026

Selting/Peterson-Lohse

TIP SUMMARY

This Targeted Implementation Plan (TIP) addresses the primary resource concern of Sediment Transported to Surface Water and the secondary resource concern of Nutrients Transported to Surface Water by assisting producers in Dawson County, MT convert from flood irrigation to sprinkler irrigation. Implementation of IWM (Irrigation Water Management) and Nutrient Management practices will ensure the resource concerns are fully addressed. Contracts will be written from 2024 through 2026 with implementation of practices to be complete by 2030. Total requested funding is $1,479,710.

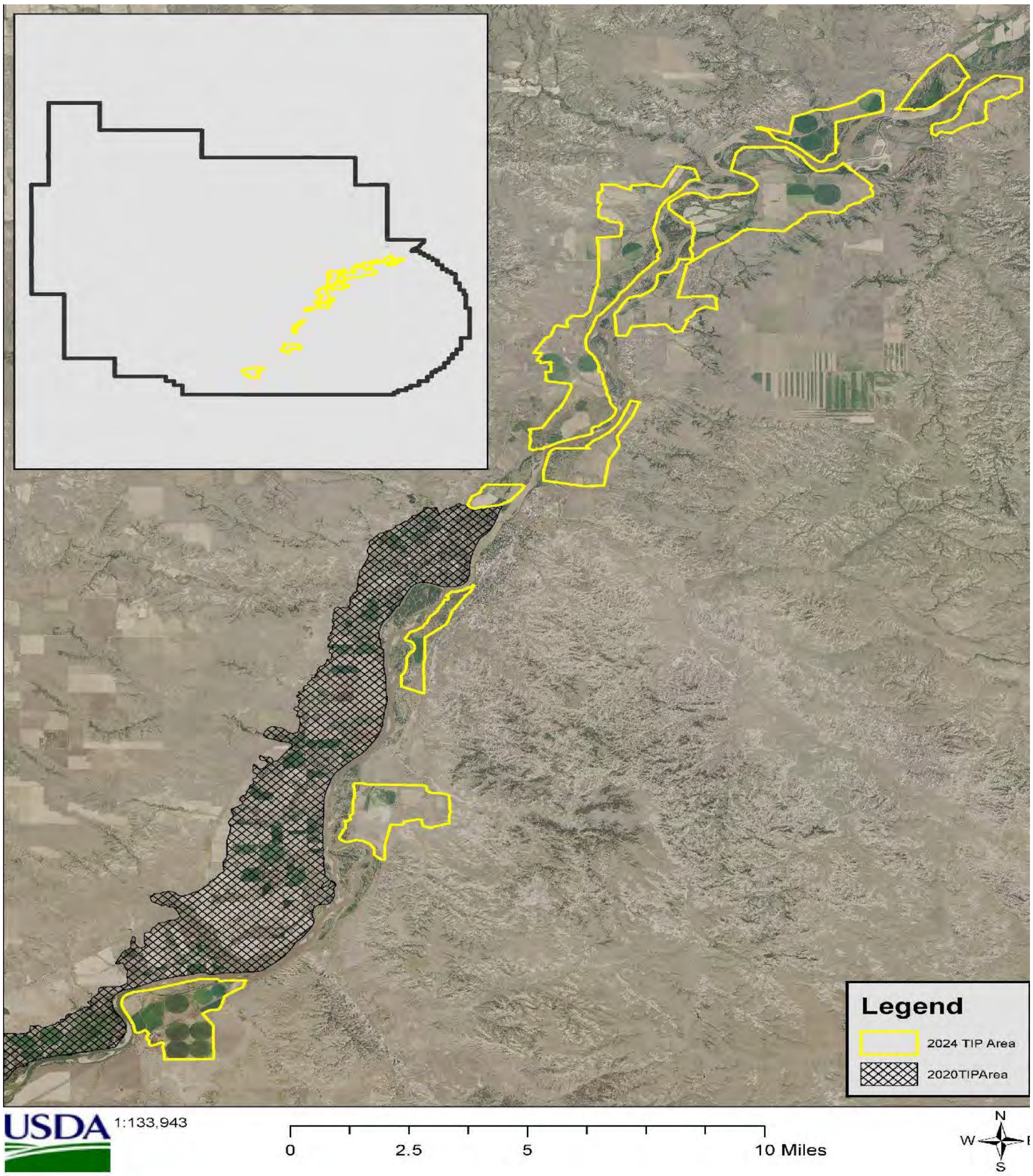
Figure 1. Pumping site on the Yellowstone River.

GEOGRAPHIC FOCUS:

The focus area encompasses approximately 14,000 acres are irrigated land. This TIP proposal will target approximately 1,000 acres of flood irrigated land operated by producers that have shown they are ready, willing, and able to convert from flood irrigation to sprinkler irrigation. The area was chosen based on producer interest at LWG meetings, field office visits, and resource concern questionnaires. Of special importance was a meeting with highly interested and committed producers on January 18, 2023 in the Glendive NRCS field office, who represent the agricultural producers in TIP area. These producers provided valuable information concerning the irrigation challenges and opportunities on their farms.

Specifically, the area encompasses irrigated land along both sides of the Yellowstone River in the northern ½ of the county and the east side of the river in the southern ½ of the county (see **Figure 2**). All producers in the TIP area pump directly out of the Yellowstone River in Dawson County. Land served by the Buffalo Rapids Irrigation District is covered under another TIP and is excluded from this TIP.

Figure 2. TIP Location Map



RESOURCE CONCERNS

Primary Resource Concern: Sediment Transported to Surface Water.

The primary resource concern is sediment transported to surface water. To adequately water the lower ends of flood irrigated fields, water must pass over the lower end of the field and exit the field without ponding. This creates field runoff which carries sediment with it (see Figure 3). According to the Surface Irrigation Soil Loss Model, producers using surface irrigation lose an average of 3.1 tons of soil per acre each year (Appendix B – Surface Irrigation Soil Loss Models). Additionally, there is the potential for bank erosion, which would contribute more sediment to surface waters where this field runoff drains back into the Yellowstone River.

Figure 3. Sugarbeet field showing furrow erosion from flood irrigation and low crop residue cover.

Secondary Resource Concern: Nutrients Transported to Surface Water.

Flood irrigation creates field runoff which can carry nutrients off the field. Nitrogen, a critical nutrient for plant growth, is easily transported by water and is often associated with the impairment of ground and surface water quality[3]. Current risk of nitrogen transport to surface water is high according to the Montana Nitrogen Risk Assessment tool (Appendix A). Phosphorus, like nitrogen, is a critical nutrient for crops. Phosphorus can be carried with the sediment into the surface waters during a runoff event[4] (Appendix A). Current risk of phosphorus transport to surface water is moderate according to the Montana Phosphorus Risk Assessment Tool.

Figure 4. Flood Irrigation Return flow into the Yellowstone River

Transportation of sediment in the Yellowstone River system was first analyzed in the late 1990s[1] and studies noted that sedimentation and irrigation induced erosion are primary natural resources concerns that need addressed. This was reinforced in the Yellowstone River Cumulative Effects study, which noted that ***reach D*** of the Yellowstone River[2], encompassing our proposed project, had a moderate to major altered sediment regime change due to irrigation for agriculture. Sediment that leaves fields and returns to the river has the potential to carry nutrients with it. Additionally, with the Yellowstone River shifting every year, some of the pump sites have had to be moved to a new location.

Resource concerns addressed by this TIP have strong ties back to the Dawson County Long Range Plan. On page 37 of the Dawson County Long Range Plan, water quantity and quality has been identified as one of the county's top resource concerns. In paragraph 2 under the Water Quality and Quantity section, it states that "the use of flood irrigation systems on cropland leads to sediment runoff, saline spots, and nutrient leaching as well as areas of inconsistent water application". The final paragraph states that the primary goals of the LWG are to convert the highest eroding earthen laterals to irrigation pipeline, convert flood irrigation systems to sprinklers, upgrade old conveyance systems, and to provide education about irrigation water management. On page 38, the Local Work Group has prioritized its top 9 resource "issues". The top 3 issues that the LWG chose as priorities are irrigation practices that directly impact the resource concerns addressed in this TIP.

Wind and Water Erosion Reduction Estimates – tons/acre/year (Appendix B & D)

	Current Condition	Planned Condition
Surface Loss Model	3.12	0.35
WEPS Model	20.3	1.6
Total Soil Loss	**23.4**	**2.0**

GOALS AND OBJECTIVES

The goal of this TIP is to reduce sediment and nutrient transport to the Yellowstone River. The primary goal is to stop 2,700 tons of sediment from entering the Yellowstone River per year. The secondary goal is to reduce risk ratings for offsite transportation of nitrogen and phosphorus. These goals will be accomplished if the TIP objective of installing more efficient irrigation systems on 1,000 irrigated acres along the Yellowstone River is accomplished. Inefficient irrigation causes runoff that transports large amounts of sediment into the Yellowstone River. The modernization of irrigation systems on the farm, together with the implementation of associated management practices, will provide the producers important tools to reduce sediment and nutrient transport to the Yellowstone River.

ALTERNATIVES

Alternative One (not selected) - Replace surface flood irrigation with sprinkler systems and flow meters to reduce sediment and nutrient transport to surface water. Conservation plans may include the following practices:

442 – Sprinkler System (Center Pivot)
430 – Irrigation Pipeline
533 – Pumping Plant
587 – Structure for Water Control

The primary and secondary resource concerns of the TIP may be addressed, but without associated management practices, may not be adequately addressed. Additionally, this alternative does not align with the LWG and TIP area participant goals. For these reasons, Alternative 1 was not selected.

Alternative Two (selected) - Encompasses the whole of Alternative One and will include implementation of Irrigation Water Management (449), Nutrient Management (590), and Residue and Tillage Management (329/345). These management practices apply strategies to improve sustainability and reduce production costs by using inputs (irrigation water and fertilizer) conservatively. Management practices will also better ensure that the resource concerns this TIP is targeting are adequately addressed.

442 – Sprinkler System (Center Pivot)
430 – Irrigation Pipeline
533 – Pumping Plant
587 – Structure for Water Control
449- Irrigation Water Management
590 – Nutrient Management
329 or 345 – Residue and Tillage Management

Alterative Three - No action (not selected). Under this alternative, current conditions and resource concerns persist. Without irrigation system improvements, erosion will carry sediment and nutrients from the crop fields to the Yellowstone River. Inefficient use of irrigation water application is likely to continue, and producers will often experience shortages of labor and time.

IMPLEMENTATION

Program applications will be accepted in years 2024 through 2026. Each contract will last no longer than 5 years, with infrastructure planned in the first two years.

TIP Funds					
Fiscal Year	**Number of Contracts**	**Acres Treated**	**Average Expected Cost Per Acre**	**Average Expected Cost per Contract**	**Total**
2024	4	400	$1479.71	$147,941	$591,884
2025	3	300	$1479.71	$147,941	$443,913
2026	3	300	$1479.71	$147,941	$443,913
TOTALS	**10**	1,000			$1,479,710

Technical assistance from NRCS will include cultural resources inventories, field visits, system design, plan development, construction checks, operation/maintenance plans, and assistance with irrigation water management.

Engineering capacity is limited in the Glendive Field Office with the current vacancy in the technician position. The Glendive Field Office will require significant assistance from the Miles City Area engineering staff for training, design review and design completion for the larger/more complex systems. The Glendive Work Unit will provide technical assistance as needed.

ESTIMATED COST PER CONTRACT

			Financial Assistance Payment Amounts			
General Practice Code	**Practice Component**	**Unit (ac/ft#)**	**Practice Amount**	**EQIP 2023 Rate**	**%**	**Estimated Assistance ($)**
533	Electric-Powered Pump, greater than 5 to 30 Horse Power	HP	50.00	$417.82	100%	$20,891.00
533	Variable Frequency Drive, less than 75 HP	HP	50.00	$108.09	100%	$5,404.50
587	Stationary Screen	Ft/Sec	2.00	$2,943.77	100%	$5,877.54
587	Miscellaneous Structure, Medium	Each	1.00	$12,659.22	100%	$12,659.22
430	Polyvinyl Chloride (PVC), Pipe, greater than or equal to 10 inch	Pound	8000.00	$2.37	100%	$18,960.00
587	Flow Meter with Mechanical Index – N Mtn	Inch	12.00	$123.34	100%	$1,480.08
442	Center Pivot, 801 to 1,200 feet					
		0		$0.00	100%	$0.00
449	Advanced IWM, Year 1	Each	1.00	$2,867.72	100%	$2,867.72
449	Advanced IWM, Years 2 and 3	Each	1.00	$560.52	100%	$560.52
449	Advanced IWM, Years 2 and 3	Each	1.00	$560.52	100%	$560.52
590	Basic NM (Non-Organic/Organic)	Acres	100.00	$6.92	100%	$692.00
590	Basic NM (Non-Organic/Organic)	Acres	100.00	$6.92	100%	$692.00
590	Basic NM (Non-Organic/Organic)	Acres	100.00	$6.92	100%	$692.00
345	Residue and Tillage Management, Reduced Till	Acres	100.00	$20.47	100%	$2,470.00
345	Residue and Tillage Management, Reduced Till	Acres	100.00	$20.47	100%	$2,470.00
345	Residue and Tillage Management, Reduced Till	Acres	100.00	$20.47	100%	$2,470.00
Total Financial Assistance:						$147,971.10

PARTNERSHIPS

Aside from the individual producers within the project boundary, the Dawson County Conservation District will be the primary partner on this project. The district will provide outreach services as well as assist producers with procurement of IWM equipment.

OUTCOMES

The outcomes of this TIP are measured primarily using the erosion prediction and nutrient risk assessment tools.

For sediment entering surface water, the Surface Irrigation Loss Tool is used to determine outcomes. The tool shows a reduction of 2.77 tons/ac/ yr in soil loss by converting from flood to sprinkler irrigation (Appendix B). Over the life of this TIP it is anticipated that 1000 acres will be treated. When the TIP is complete, 2,770 tons/yr of sediment will not enter the Yellowstone River. This is the equivalent of 277 end dump truckloads per year.

For nutrients entering surface water, risk assessment models are used to determine the outcomes of converting from flood irrigation to sprinkler irrigation. The nitrogen and phosphorus risk assessment tool shows that risk of nitrogen moving offsite changes from high to a medium rating (Appendix A). For phosphorus, the risk is moved from medium to low (Appendix A).

There are many additional outcomes typically seen after installation of sprinkler irrigation systems. The sprinkler irrigation practice is unique in that it acts as a gateway to many other conservation practices and their associated benefits. For example, most producers that install sprinkler irrigation systems change to less intense tillage systems since they no longer battle with crop residue that often causes furrow plugging when attempting to flood irrigate. They are also more likely to plant mid-summer cover crops due to the ease of watering them up. The WEPS before and after run summaries in Appendix D show an 18.7 T/Ac reduction in wind erosion with the adoption of residue management and cover crops. Nutrients and pesticides leaching out of the root zone are significantly reduced because of lower water application rates associated with sprinklers. Labor requirements decrease allowing more time for producers to do better irrigation water management. Finally, overall water use efficiency increases due to improvements in delivery (such as conversion from open ditch conveyance to buried pipe) and application methods.

RANKING QUESTIONS

The following questions will be used to rank all eligible applications for this TIP:

1) Will applicant convert from flood irrigation to sprinkler irrigation (442)?
   Yes
   No
2) Will the applicant implement IWM (Irrigation Water Management -449) and NM (Nutrient Management -590)?
   Both IWM and NM
   IWM only
   NM only
   None
3) Will the applicant implement Advanced Irrigation Water Management (449)?
   Yes
   No
4) What is the dominant soil K_w factor for the field(s) being treated?
   Equal to or greater than 0.37
   Less than 0.37 and greater than 0.20
   Less than or equal to 0.20
5) Will the applicant implement Residue and Tillage Management (329 or 345)?
   Yes
   No

References

1 November 1999 Improving Irrigation Efficiency and Water Quality – A Priority 2 Area Proposal,
2 June 1998 Yellowstone River Cumulative Effects Analysis, December 2015
3 NRCS Agronomy Tech Note MT-91
4 NRCS Agronomy Tech Note MT-77

Appendix A – N & P Risk Assessments

Nitrogen & Phosphorus Risk Assessment Tool Models

Montana Nitrogen Risk Assessment Tool

Completing Risk Ratings

Each site category's weighting factor in Table 3 is multiplied by the site risk rating (value) to get a weighted risk value. All categories are rated)according to individual category instructions), and the overall rating is the sum of all values. After individual sites/fields are rated, refer to the appropriate vulnerability rating in Table 5.

Table 3. MONTANA NITROGEN RISK ASSESSMENT TOOL

SITE CATEGORY	NONE (0)	LOW (1)	MEDIUM (2)	HIGH (4)	VERY HIGH (8)	RISK VALUE (0,1,2,4,8)	WEIGHT FACTOR	WEIGHTED RISK FACTOR
Water and Wind Erosion	N/A	<5 tons/ac/yr	5-10 tons/ac/yr	10-15 tons/acre/yr	>15 tons/acre/yr	4	x 1.0	4
Soil Series Risk Assessment	N/A	LOW	MEDIUM	HIGH	VERY HIGH	2	x 2.0	8
Precipitation Minus ET (October 1 – April 1)		LOW	MEDIUM	HIGH	VERY HIGH	1	x 2.0	8
Irrigation Method	N/A	Sprinkler system with soil moisture sensors or IWM	Sprinkler system without sensors or IWM	Other irrigation systems with sensors or IWM	Other irrigation systems without sensors or IWM	8	x 2.0	16
Nitrogen Soil Test N	-	<50 lbs/ac	51-75 lbs/ac	76-100 lbs/ac	>100 lbs/ac	1	x 0.5	.5
Nitrogen Application Method	None Applied	Applied according to current soil tests and MSU guidelines with soil applications based on growth stages	Applied according to current soil tests and MSU guidelines < 2 weeks of planting or surface applied during the growing season	Applied < 2 weeks of planting with no soil testing	Applied > 2 weeks of planting with no soil testing	8	x 0.5	4
Nitrogen Application Rate	None Applied	Total N application rate below agronomic rate	Total N application rate equal to agronomic rate	Total N application rate 1 – 50 lbs above agronomic rate	Total N application rate >50 lbs above agronomic rate	2	x 0.5	1
							Overall Risk Factor	31.5
							Overall Risk Rating	High

Interpreting Results of Site Vulnerability Ratings

After multiplying the weighting factor by the risk value for each category and totalling all values in Table 3, assign the overall site/field vulnerability to nitrogen loss from Table 4.

Table 4. SITE/FIELD VULNERABILITY TO NITROGEN LOSS

Total of Weighted Risk Values	Site Vulnerability	Site/Field Number(s)
<11	LOW	
11-21	MEDIUM	
22-43	HIGH	Current Condition
>43	VERY HIGH	

After Model:

Montana Nitrogen Risk Assessment Tool

Completing Risk Ratings

Each site category's weighting factor in Table 3 is multiplied by the site risk rating (value) to get a weighted risk value. All categories are rated)according to individual category instructions), and the overall rating is the sum of all values. After individual sites/fields are rated, refer to the appropriate vulnerability rating in Table 5.

Table 3. MONTANA NITROGEN RISK ASSESSMENT TOOL

SITE CATEGORY	NONE (0)	LOW (1)	MEDIUM (2)	HIGH (4)	VERY HIGH (8)	RISK VALUE (0,1,2,4,8)	WEIGHT FACTOR	WEIGHTED RISK FACTOR
Water and Wind Erosion	N/A	<5 tons/ac/yr	5-10 tons/ac/yr	10-15 tons/acre/yr	>15 tons/acre/yr	*1*	x 1.0	*1*
Soil Series Risk Assessment	N/A	LOW	MEDIUM	HIGH	VERY HIGH	*2*	x 2.0	*4*
Precipitation Minus ET (October 1 – April 1)		LOW	MEDIUM	HIGH	VERY HIGH	*1*	x 2.0	*2*
Irrigation Method	N/A	Sprinkler system with soil moisture sensors or IWM	Sprinkler system without sensors or IWM	Other irrigation systems with sensors or IWM	Other irrigation systems without sensors or IWM	*1*	x 2.0	*2*
Nitrogen Soil Test N	-	<50 lbs/ac	51-75 lbs/ac	76-100 lbs/ac	>100 lbs/ac	*1*	x 0.5	*.5*
Nitrogen Application Method	None Applied	Applied according to current soil tests and MSU guidelines with soil applications based on growth stages	Applied according to current soil tests and MSU guidelines < 2 weeks of planting or surface applied during the growing season	Applied < 2 weeks of planting with no soil testing	Applied > 2 weeks of planting with no soil testing	*2*	x 0.5	*1*
Nitrogen Application Rate	None Applied	Total N application rate below agronomic rate	Total N application rate equal to agronomic rate	Total N application rate 1 – 50 lbs above agronomic rate	Total N application rate >50 lbs above agronomic rate	*2*	x 0.5	*1*
							Overall Risk Factor	***11.5***
							Overall Risk Rating	***Medium***

Interpreting Results of Site Vulnerability Ratings

After multiplying the weighting factor by the risk value for each category and totalling all values in Table 3, assign the overall site/field vulnerability to nitrogen loss from Table 4.

Table 4. SITE/FIELD VULNERABILITY TO NITROGEN LOSS

Total of Weighted Risk Values	Site Vulnerability	Site/Field Number(s)
<11	LOW	
11-21	MEDIUM	***Planned Condition***
22-43	HIGH	
>43	VERY HIGH	

Nitrogen Risk Assessment Planned Condition

Before Model:

Montana Phosphorus Risk Assessment Tool

Completing Risk Ratings

Each site category's weighting factor in Table 4 is multiplied by the site risk rating (value) to get a weighted risk value. All categories are rated)according to individual category instructions), and the overall rating is the sum of all values. After individual sites/fields are rated, refer to the appropriate vulnerability rating in Table 5.

Table 4. MONTANA PHOSPHORUS RISK ASSESSMENT TOOL

SITE CATEGORY	NONE (0)	LOW (1)	MEDIUM (2)	HIGH (4)	VERY HIGH (8)	RISK VALUE (0,1,2,4,8)	WEIGHT FACTOR	WEIGHTED RISK FACTOR
Water and Wind Erosion	N/A	<5 tons/ac/yr	5-10 tons/ac/yr	10-15 tons/acre/yr	>15 tons/acre/yr	*1*	x 1.5	*1.5*
Furrow Irrigation Erosion	N/A	Tailwater recovery, QS >6 very erodible soils, or QS >10	QS >10 for erosion resistant sois	QS >10 for erodible soils	QS >6 for very erodible soils	*1*	x 1.5	*1.5*
Sprinkler Irrigation Erosion	All sites 0-3% slope, all sandy sites, or sites evaluation indicates little or no runoff, large spray on silts 3-8%	Medium spray on silty soils 3-15% slopes, large spray on silty soils 8-15% slope, low spray on silt soils 3-8%, large spray on clay soil 3-15% slope	Medium spray on clay soils 3-8% slopes, large spray on clay soils >15% slope, medium spray on silt soils >15% slope	Medium spray on clay soils >8% slopes, low spray on clay soils 3-8% slope, medium spray on silt soils >15% slope	Low spray on clay soils >8% slopes	*0*	x 0.5	*0*
Runoff Class	Neglible	Very low or low	Medium	High	Very high	*2*	x 0.5	*1*
Olsen Soil Test P	<10	10-20 ppm	20-40 ppm	41-80 ppm	>80 ppm	*0*	x 1.0	*0*
Phosophorus Application Method	None Applied	Injected deeper than 2 inches or subsurface applied	Incorporated <2 weeks or surface applied during the growing season	Incorporated >2 weeks ans <1 month or surface applied <1 month before crop emerges	Surface applied to pasture or applied >1 month efore crop emerges	*1*	x 1.0	*1*
Phosophorus Application Rate	None Applied	<30 lbs/ac P_2O_5	31-90 lbs/ac P_2O_5	91-150 lbs/ac P_2O_5	>150 lbs/ac P_2O_5	*2*	x 1.0	*2*
Distance to Concetrated Surface Water Flow	>1000 feet	200-1000 feet or functioning grass waterway in concentrated surface water	100-200 feet	<100 feet with a vegetated buffer at least 35 feet in width	<35 feet with no vegetated buffer	*4*	x 1.0	*4*
				Site/Field Phosphorus Risk Assessment Value				*11*
				Site/Field Phosphorus Risk Assessment Rating				*Medium*

Interpreting Results of Site Vulnerability Ratings

After multiplying the weighting factor by the risk value for each category and totalling all values in Table 3, assign the overall site/field vulnerability to nitrogen loss from Table 4.

Table 5. SITE/FIELD VULNERABILITY TO PHOSPHORUS LOSS

Total of Weighted Risk Values	Site Vulnerability	Site/Field Number(s)
<11	LOW	
11-21	MODERATE or MEDIUM	*Current Condition*
22-43	HIGH	
>43	VERY HIGH	

After Model:

Montana Phosphorus Risk Assessment Tool

Completing Risk Ratings

Each site category's weighting factor in Table 4 is multiplied by the site risk rating (value) to get a weighted risk value. All categories are rated)according to individual category instructions), and the overall rating is the sum of all values. After individual sites/fields are rated, refer to the appropriate vulnerability rating in Table 5.

Table 4. MONTANA PHOSPHORUS RISK ASSESSMENT TOOL

SITE CATEGORY	NONE (0)	LOW (1)	MEDIUM (2)	HIGH (4)	VERY HIGH (8)	RISK VALUE (0,1,2,4,8)	WEIGHT FACTOR	WEIGHTED RISK FACTOR
Water and Wind Erosion	N/A	<5 tons/ac/yr	5-10 tons/ac/yr	10-15 tons/acre/yr	>15 tons/acre/yr	*1*	x 1.5	*1.5*
Furrow Irrigation Erosion	N/A	Tailwater recovery, QS >6 very erodible soils, or QS >10	QS >10 for erosion resistant sois	QS >10 for erodible soils	QS >6 for very erodible soils	*0*	x 1.5	*0*
Sprinkler Irrigation Erosion	All sites 0-3% slope, all sandy sites, or sites evaluation indicates little or no runoff, large spray on silts 3-8%	Medium spray on silty soils 3-15% slopes, large spray on silty soils 8-15% slope, low spray on silt soils 3-8%, large spray on clay soil 3-15% slope	Medium spray on clay soils 3-8% slopes, large spray on clay soils >15% slope, medium spray on silt soils >15% slope	Medium spray on clay soils >8% slopes, low spray on clay soils 3-8% slope, medium spray on silt soils >15% slope	Low spray on clay soils >8% slopes	*0*	x 0.5	*0*
Runoff Class	Neglible	Very low or low	Medium	High	Very high	*2*	x 0.5	*1*
Olsen Soil Test P	<10	10-20 ppm	20-40 ppm	41-80 ppm	>80 ppm	*0*	x 1.0	*0*
Phosophorus Application Method	None Applied	Injected deeper than 2 inches or subsurface applied	Incorporated <2 weeks or surface applied during the growing season	Incorporated >2 weeks ans <1 month or surface applied <1 month before crop emerges	Surface applied to pasture or applied >1 month efore crop emerges	*1*	x 1.0	*1*
Phosophorus Application Rate	None Applied	<30 lbs/ac P_2O_5	31-90 lbs/ac P_2O_5	91-150 lbs/ac P_2O_5	>150 lbs/ac P_2O_5	*2*	x 1.0	*2*
Distance to Concetrated Surface Water Flow	>1000 feet	200-1000 feet or functioning grass waterway in concentrated surface water	100-200 feet	<100 feet with a vegetated buffer at least 35 feet in width	<35 feet with no vegetated buffer	*4*	x 1.0	*4*
				Site/Field Phosphorus Risk Assessment Value				*9.5*
				Site/Field Phosphorus Risk Assessment Rating				*Low*

Interpreting Results of Site Vulnerability Ratings

After multiplying the weighting factor by the risk value for each category and totalling all values in Table 3, assign the overall site/field vulnerability to nitrogen loss from Table 4.

Table 5. SITE/FIELD VULNERABILITY TO PHOSPHORUS LOSS

Total of Weighted Risk Values	Site Vulnerability	Site/Field Number(s)
<11	LOW	*Planned Condition*
11-21	MODERATE or MEDIUM	
22-43	HIGH	
>43	VERY HIGH	

Appendix B – Surface Irrigation Loss Models

Surface Irrigation Soil Loss Model – Worksheet

Prepared for: 2024 Pivot TIP **Date** 2/10/2023
Prepared by Linda Peterson-Lohse **SCD** Dawson
Soil Map Unit Lt **Slope** 1-1.9% **K factor** 0.28

Present Condition: Flood irrigation – Before Conversion
Irrigation System Dirt Ditches with Feed **Length of run** 1320 feet **Convex End** Moderate

Crop Rotation	BSL	PC	CP	IP	SISL
Corn Silage	10.00	0.75	1	1	4.28
Hay Forage	3.7	0.85	1	1	1.79
Grain Corn	10	0.85	1	1	4.85
Small Grains	3.7	0.75	1	1	1.58
	0	1	1	1	0.00
	0	1	1	1	0.00
	0	1	1	1	0.00
	0	1	1	1	0.00
	0	1	1	1	0.00
	0	1	1	1	0.00
			Total (tons)		12.49
			Average (tons/year)		3.12

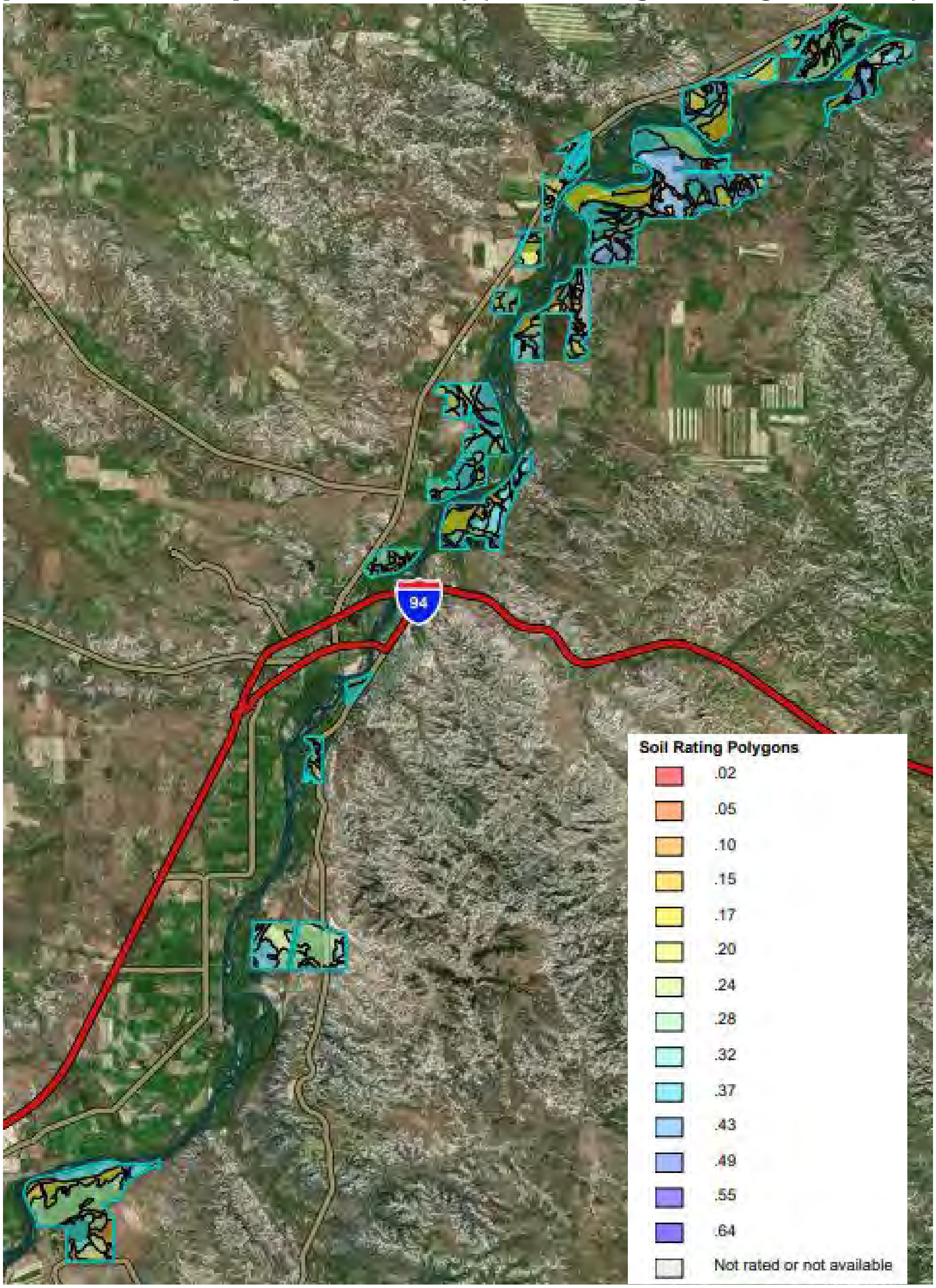
Alternative 2 Sprinkler irrigation –After Conversion
Irrigation System **Length of run** 1320 feet **Convex End** None

Crop Rotation	BSL	PC	CP	IP	SISL
Corn Silage	8.00	0.75	.02	0.7	0.48
Hay Forage	3.00	0.85	.02	0.7	0.20
Grain Corn	8.00	0.85	.02	0.7	0.54
Small Grains	3.00	0.75	.02	0.7	0.18
0	0	1	1	1	0.00
0	0	1	1	1	0.00
0	0	1	1	1	0.00
0	0	1	1	1	0.00
0	0	1	1	1	0.00
o	0	1	1	1	0.00
			Total (tons)		1.40
			Average (tons/year)		0.35

Figure 5: Surface Irrigation Soil Loss Model

***Note: The same rotation was used in both the present condition and Alternative 1. The model moved from gated pipe to a sprinkler, switched from conventional tillage to seasonal reduced tillage and added irrigation water management as a second conservation practice. Average (weighted to account for area) K factor of 0.28 used.*

Appendix C - K Factor Map from Web Soil Survey (0.28 is the weighted average for TIP area)



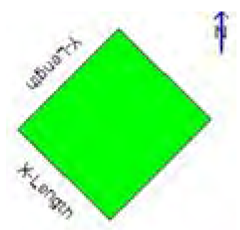
Appendix D – WEPS Model Flood Irrigation

Run Summary

Flood irrigation system – Dawson_calib

Run Date: Friday, February 10, 2023, 02:02 PM
Client Name: Flood irrigation system
Farm No: _ _ _ **Tract No**: _ _ _ **Field No:** _ _ _
Run Location: Runs
Management: Dawson Irrig. TIP before system_calib_calib.man
Soil: Wolf_Point_Lt_85_SICL.ifc

Location Site Information



X-Length: 2313.0 ft
Y-Length: 2580.1 ft
Area: 137.0 ft
Elevation: 2076.8 ft
Orientation: 45.0 ft

Mode: NRCS
Soil Loss Tolerance (T): 5.0 t/ac/yr
Site: UNITED STATES
MONTANA
DAWSON
Location: 47.26639 deg N, 104.89943 deg W
Cligen: GLENDIVW
Windgen: Interpolated (47.26639 deg N, 104.89943 deg W)

Erosion

Period	Crop/Residue	Gross Loss t/ac	Net Soil Loss from Field (t/ac) Total	Creep/Salt.	Suspen.	PM10
Rot. Year: 1	Corn, silage	23.7	23.7	9.1	14.5	0.42
Rot. Year: 2	Barley, spring, hay	25.3	25.3	9.7	15.7	0.46
Rot. Year: 3	Corn, grain	17.9	17.9	6.5	11.4	0.33
Rot. Year: 4	Wheat, spring 7in rows	14.4	14.4	5.6	8.8	0.25
Ave. Annual		20.3	20.3	7.7	12.6	0.37

Crop Interval Erosion

Date Range	Days	Crop	Gross Loss t/ac	Net Soil Loss from Field (t/ac) Total	Creep/Salt.	Suspen.	PM10
Aug 25, 04 - Sep 15, 01	386	Corn, silage	21.3	21.3	7.6	13.6	0.39
Sep 15, 01 - July 15, 02	303	Barley, spring, hay	22.0	22.0	8.5	13.5	0.40
July 15, 02 - Oct 03, 03	445	Corn, grain	28.9	28.9	11.3	17.7	0.52
Oct 03, 03 - Aug 25, 04	326	Wheat, spring 7in rows	9.1	9.1	3.6	5.5	0.16

Harvests

Date	Crop	Residue lb/ac	Harvest Yield	Yield % Moisture
Sep 15, 01	Corn, silage	332	22.5 ton/ac	65.0
July 15, 02	Barley, spring, hay	978	3.1 ton/ac	15.0
Oct 03, 03	Corn, grain	7,937	144.3 bu/ac	15.5

Run Summary

Flood irrigation system – Dawson_calib

Harvests				
Date	Crop	Residue lb/ac	Harvest Yield	Yield % Moisture
Oct 03, 03	Corn, grain	1,897	1616.2 lb/ac	15.5
Aug 25, 04	Wheat, spring 7in rows	5,727	78.4 bu/ac	13.5

SCI Summary		
Soil Conditioning Index	-1.2	**SCI Subfactors**
Energy Calculator:	5.2 gal diesel/ac	**OM:** 0.55
Average Annual STIR:	102.8	**FO:** -0.02
Wind Erosion Loss:	20.3 t/ac	**ER:** -7.00
Water Erosion Loss:	0.0 t/ac	

Rotation Stir Energy					
Date	Operation	Fuel	Stir	Energy btu/ac	Cost USD/ac
Apr 6, 01	Disk, offset, heavy	Diesel	39.0	157,452	4.50
May 15, 01	Planter, double disk opnr	Diesel	2.4	76,930	2.20
Jun 01, 01	Furrow, shaper, torpedo	Diesel	2.2	61,215	1.75
Jun 01, 01	Irrigation, Start Monitor (Border, Furrow)	Diesel	0.0	0	0.00
Jun 30, 01	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Sep 01, 01	Irrigation, Stop Monitor	Diesel	0.0	0	0.00
Sep 15, 01	Harvest, silage	Diesel	0.1	166,283	4.75
Sep 20, 01	Disk, offset, heavy	Diesel	39.0	157,452	4.50
Sep 20, 01	Land Plane	Diesel	10.4	157,452	4.50
Apr 6, 02	Disk, offset, heavy	Diesel	39.0	157,452	4.50
Apr 6, 02	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Apr 20, 02	Drill or air seeder, hoe or chisel openers 6-12 in spac	Diesel	23.4	129,464	3.70
May 15, 02	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Jun 01, 02	Irrigation, Start Monitor (Border, Furrow)	Diesel	0.0	0	0.00
Jun 25, 02	Irrigation, Stop Monitor	Diesel	0.0	0	0.00
Jul 15, 02	Harvest, hay, no regrowth	Diesel	0.1	336,008	9.60
Aug 10, 02	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Sep 20, 02	Disk, offset, heavy	Diesel	39.0	157,452	4.50
Sep 20, 02	Land plane	Diesel	10.4	157,452	4.50
Apr 06, 03	Disk, offset, heavy	Diesel	39.0	157,452	4.50
May 15, 03	Planter, double disk opnr	Diesel	2.4	76,930	2.20
Jun 01, 03	Furrow shaper, torpedo	Diesel	2.2	61,215	1.75

Run Summary

Flood irrigation system – Dawson_calib

Rotation Stir Energy

Date	Operation	Fuel	Stir	Energy btu/ac	Cost USD/ac
Jun 01, 03	Irrigation, Start Monitor (Border, Furrow)	Diesel	0.0	0	0.00
Jun 30, 03	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Sep 15, 03	Irrigation, Stop Monitor	Diesel	0.0	0	0.00
Oct 03, 03	Harvest, corn grain and cobs	Diesel	0.1	267,758	7.65
Oct 05, 03	Disk, offset, heavy	Diesel	39.0	157,452	4.50
Oct 05, 03	Land Plane	Diesel	10.4	157,452	4.50
Apr 06, 04	Disk, offset, heavy	Diesel	39.0	157,452	4.50
Apr 06, 04	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Apr 20, 04	Drill or air seeder, hoe or chisel openers 6-12 in spac	Diesel	23.4	129,464	3.70
May 15, 04	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Jun 01, 04	Irrigation, Start Monitor (Border, Furrow)	Diesel	0.0	0	0.00
Aug 10, 04	Irrigation, Stop Monitor	Diesel	0.0	0	0.00
Aug 25, 04	Harvest, killing crop 10pct standing	Diesel	0.1	267,758	7.65
Sep 20, 04	Disk, offset, heavy	Diesel	39.0	157,452	4.50
Sep 20, 04	Land plane	Diesel	10.4	157,452	4.50
		Total/ac		3,621,698	103.51
		Total	411.3	496,166,005	14,180.35

Crop Interval Stir Energy

Date Range	Days	Crop	Stir	Energy Btu/ac	Cost USD/ac
Aug 25, 04 - Sep 15, 01	386	Corn, silage	93.3	799,533	22.85
Sep 15, 01 - July 15, 02	303	Barley, spring, hay	112.3	983,327	28.10
July 15, 02 - Oct 03, 03	445	Corn, grain	93.5	923,759	26.40
Oct 03, 03 - Aug 25, 04	326	Wheat, spring 7in rows	112.3	915,078	26.15

Notes

15/ 5 /1	Corn, silage	1.300
15/ 5/ 3	Corn, grain	1.300
20/ 4/ 4	Wheat, spring 7in rows	1.754

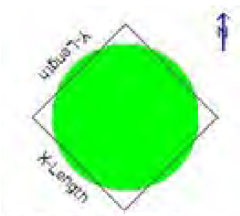
Run Summary

NRCS Natural Resources Conservation Service

Pivot irrigation system with cc – Dawson_calib

Run Date:	Friday, February 10, 2023, 02:23 PM				
Client Name:	Flood irrigation system				
Farm No:	_ _ _	**Tract No**:	_ _ _	**Field No:**	_ _ _
Run Location:	Runs				
Management:	Dawson Irrig. TIP after system- pivot, cover crop_calib.man				
Soil:	Wolf_Point_Lt_85_SICL.ifc				

Location Site Information



Field shape approximate

X-Length:	2442.9 ft	**Mode**:	NRCS
Y-Length:	2442.9 ft	**Soil Loss**	
Area:	1378.3 ft	**Tolerance (T):**	5.0 t/ac/yr
Elevation:	2076.8 ft	**Site:**	UNITED STATES
Orientation:	45.0 ft		MONTANA
			DAWSON
		Location:	47.26639 deg N, 104.89943 deg W
		Cligen:	GLENDIVW
		Windgen:	Interpolated (47.26639 deg N, 104.89943 deg W)

Erosion

		Gross Loss	Net Soil Loss from Field (t/ac)			
Period	**Crop/Residue**	t/ac	**Total**	**Creep/Salt.**	**Suspen.**	**PM10**
Rot. Year: 1	Corn, silage	0.4	0.4	0.2	0.2	Trace
Rot. Year: 2	Barley, spring, hay	4.5	4.5	1.5	3.0	0.08
Rot. Year: 3	Corn, grain	1.5	1.5	0.6	0.9	0.03
Rot. Year: 4	Wheat, spring 7in rows	0.0	0.0	0.0	0.0	0.00
Ave. Annual		1.6	1.6	0.6	1.0	0.03

Crop Interval Erosion

			Gross Loss	Net Soil Loss from Field (t/ac)			
Date Range	**Days**	**Crop**	t/ac	**Total**	**Creep/Salt.**	**Suspen.**	**PM10**
Aug 25, 04 - Sep 15, 01	386	Corn, silage	0.0	0.0	0.0	0.0	0.00
Sep 15, 01 - July 15, 02	303	Barley, spring, hay	4.9	4.9	1.7	3.2	0.09
July 15, 02 - Sep 25, 02	72	Cover crop, warm season mix, summer see	0.0	0.0	0.0	0.0	0.00
Sep 25, 02 - Oct 03, 03	373	Corn, grain	1.5	1.5	0.6	0.9	0.03
Oct 03, 03 - Aug 25, 04	326	Wheat, spring 7in rows	9.1	9.1	3.6	5.5	0.16

Harvests

Date	**Crop**	**Residue** lb/ac	**Harvest Yield**	**Yield % Moisture**
Sep 15, 01	Corn, silage	353	22.6 ton/ac	65.0

Run Summary

Pivot irrigation system with cc – Dawson_calib

Harvests

Date	Crop	Residue lb/ac	Harvest Yield	Yield % Moisture
Jul 15, 02	Barley, spring, hay	1,072	3.3 ton/ac	15.0
Oct 03, 03	Corn, grain	8,306	151.5 bu/ac	15.5
Oct 03, 03	Corn, grain	1,986	1696.5 lb/ac	15.5
Aug 25, 04	Wheat, spring 7in rows	6,089	83.6 bu/ac	13.5

SCI Summary

Soil Conditioning Index	0.5	**SCI Subfactors**
Energy Calculator:	3.4 gal diesel/ac	**OM:** 0.72
Average Annual STIR:	58.3	**FO:** 0.42
Wind Erosion Loss:	1.6 t/ac	**ER:** 0.37
Water Erosion Loss:	0.0 t/ac	

Rotation Stir Energy

Date	Operation	Fuel	Stir	Energy btu/ac	Cost USD/ac
Apr 6, 01	Disk, offset, heavy	Diesel	39.0	157,452	4.50
May 15, 01	Planter, double disk opnr	Diesel	2.4	76,930	2.20
Jun 01, 01	Irrigation, Start Monitor (pivot, linear, wheelline)	Diesel	0.0	0	0.00
Jun 30, 01	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Sep 01, 01	Irrigation, Stop Monitor	Diesel	0.0	0	0.00
Sep 15, 01	Harvest, silage	Diesel	0.1	166,283	4.75
Apr 6, 02	Disk, offset, heavy	Diesel	39.0	157,452	4.50
Apr 20, 02	Drill or air seeder, hoe or chisel openers 6-12 in spac	Diesel	23.4	129,464	3.70
May 15, 02	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Jun 01, 02	Irrigation, Start Monitor (pivot, linear, wheelline)	Diesel	0.0	0	0.00
Jun 25, 02	Irrigation, Stop Monitor	Diesel	0.0	0	0.00
Jul 15, 02	Harvest, hay, no regrowth	Diesel	0.1	336,008	9.60
Jul 16, 02	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Jul 20, 02	Drill or air seeder, hoe or chisel openers 6-12 in spac	Diesel	23.40	129,464	3.70
Sep 25, 02	Killing frost	Diesel	0.0	0	0.00
Dec 20, 02	Graze, stubble or residue 50 pct	Diesel	0.5	0	0.00
Apr 06, 03	Disk, offset, heavy	Diesel	39.0	157,452	4.50
May 15, 03	Planter, double disk opnr	Diesel	2.4	76,930	2.20

Run Summary

Pivot irrigation system with cc – Dawson_calib

Rotation Stir Energy					
Date	**Operation**	**Fuel**	**Stir**	**Energy** btu/ac	**Cost** USD/ac
Jun 01, 03	Irrigation, Start Monitor (pivot, linear, wheeline)	Diesel	0.0	0	0.00
Jun 30, 03	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Sep 15, 03	Irrigation, Stop Monitor	Diesel	0.0	0	0.00
Oct 03, 03	Harvest, corn grain and cobs	Diesel	0.1	267,758	7.65
Apr 06, 04	Disk, offset, heavy	Diesel	39.0	157,452	4.50
Apr 06, 04	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Apr 20, 04	Drill or air seeder, hoe or chisel openers 6-12 in spac	Diesel	23.4	129,464	3.70
May 15, 04	Sprayer, post emergence	Diesel	0.1	22,750	0.65
Jun 01, 04	Irrigation, Start Monitor (pivot, linear, wheelline)	Diesel	0.0	0	0.00
Aug 10, 04	Irrigation, Stop Monitor	Diesel	0.0	0	0.00
Aug 25, 04	Harvest, killing crop 10pct standing	Diesel	0.1	267,758	7.65
		Total/ac		2,346,366	67.06
		Total	233.1	321,457,774	9,187.22

Crop Interval Stir Energy					
Date Range	**Days**	**Crop**	**Stir**	**Energy** Btu/ac	**Cost** USD/ac
Aug 25, 04 - Sep 15, 01	386	Corn, silage	41.7	423,414	12.10
Sep 15, 01 - July 15, 02	303	Barley, spring, hay	62.7	645,673	18.45
July 15, 02 - Sep 25, 03	72	Cover crop, warm season mix, summer see	23.5	152,214	4.35
Sep 25 - Oct 03, 03	373	Corn, grain	42.2	524,890	15.00
Oct 03, 03 - Aug 25, 04	326	Wheat, spring 7in rows	62.8	600,174	17.15

Notes

This WEPS Run generated one or more Warning messages. For detailed information about these Warnings, see this run's 'warnings.txt' output file.

15/ 5 /1	Corn, silage	1.300
15/ 5/ 3	Corn, grain	1.300
20/ 4/ 4	Wheat, spring 7in rows	1.754