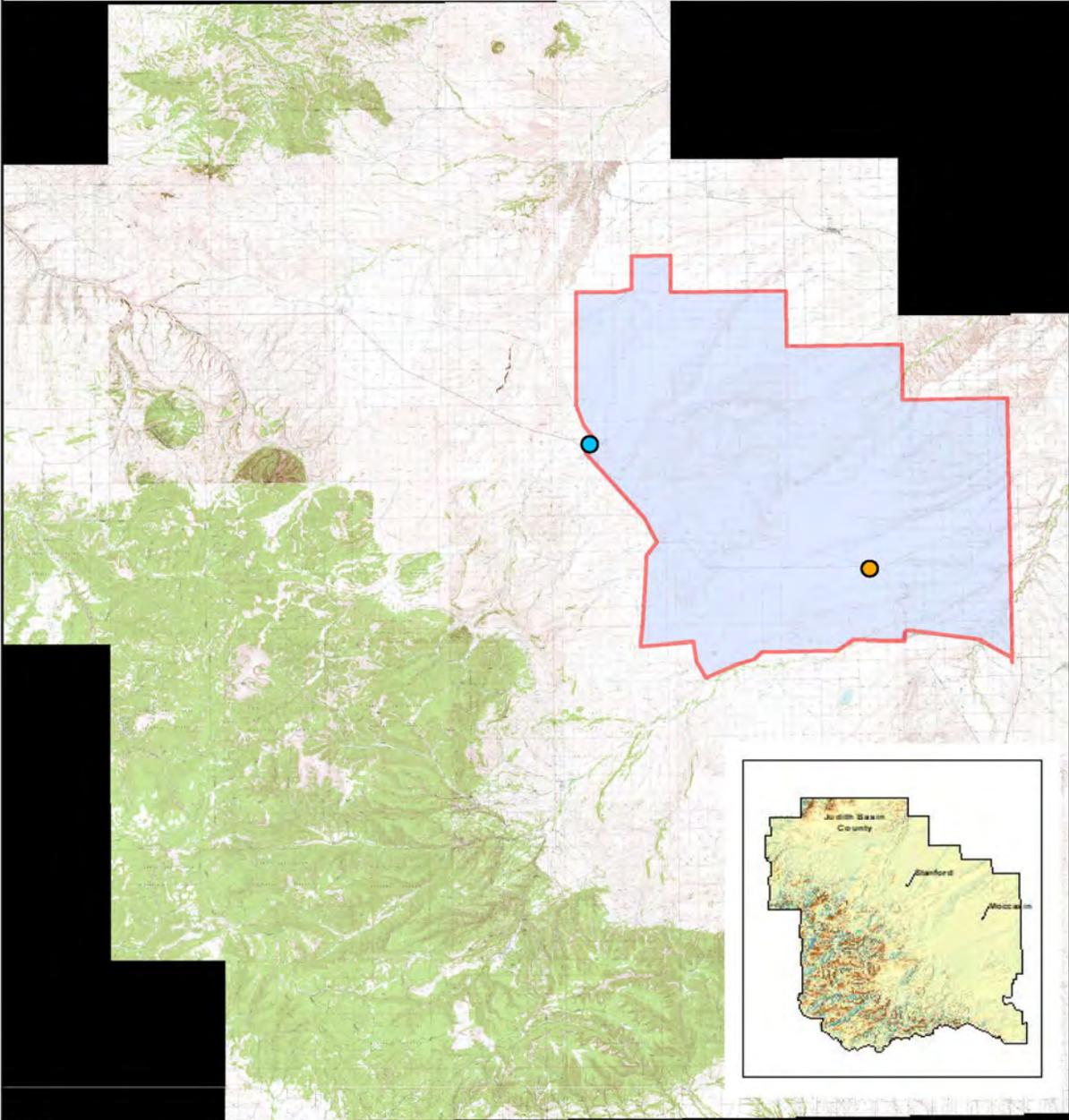


**Judith Basin Soil Health
Targeted Implementation Plan
Stanford USDA – NRCS Field Office**

**Submitted By:
Pam Linker
District Conservationist**



Judith Basin Soil Health TIP Location Map



Legend

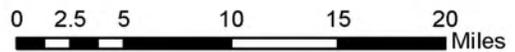
 JB_SoilHealth_TIP

Town Name

 Moccasin

 Stanford

Scale = 1:500,000



Goal Statement:

This Targeted Implementation Plan (TIP) will target crop producers in Judith Basin county that are innovators in improving the health of their soils: In 2021 the TIP will target the Moccasin area. (See map) The TIP will provide incentives for producers to implement conservation practices that address all 5 principles of soil health. Soil Health is a combination of many resource concerns. This TIP will focus on soil aggregate stability as the primary resource concern and improve wildlife cover as a secondary resource concern. The TIP will focus on producers that have attended workshops and have tried at least one or more of the soil health principles. Education and experience will increase the likelihood of success and adoption over their whole farm. This TIP will also focus on 600 acres of each producer's place. Focusing on a minimum of 600 acres of each producer's place accomplishes several factors: provides enough cost share incentive for producers to change their system, allows for several rotation options and is sufficient acres to monitor improvement in soil aggregate stability. Once a producer has committed to this system change, the equipment will be used on all their acres which in the case of the 2021 TIP would be approximately 35,000 acres.

Previous efforts by NRCS have generally focused on adoption of one or two soil health principles rather than the full system which is necessary to realize long-term improvements to aggregate stability. The problem with only implementing one or two of the soil health principles is that producers don't see the benefits to the soil or realize the benefits soil health has to their production system. If they don't see positive results, they tend to abandon everything and go back to what they know. This TIP will provide incentives to producers in Judith Basin county to implement practices that minimize disturbance, maximize diversity, keep the soil armored, and keep living roots in the soil. With the Judith Basin TIP most producers will also implement the 5th step of livestock integration. This TIP will showcase producers who are leading the charge in adopting soil health in this county and they will serve as a model for other producers beginning to adopt soil health principles in their operations

Overview/Background Information:

Although NRCS has been actively promoting soil health principles for several years, few producers have adopted cropping systems that incorporate all 5 principles. The soil health principles are decrease disturbance; have a living root in the soil; diversify crops; cover the soil; and incorporate livestock where possible. The 5th principle, incorporating livestock, is not as vital as the other 4 but has been proven to move the soil health needle faster. Late season cover crops also provide excellent nutrition for livestock and wildlife. NRCS has provided incentives for no till and cover crops for years, but we have never been able to offer program benefits to encourage producers to farm using a complete soil health system approach. Many producers in Montana have dabbled in soil health by trying one or two principles but these efforts have only provided mixed results. In some cases, the results have been negative and because of this people have abandoned the whole idea. It is only through adopting all four soil health principles and the 5th, where possible, that real results can be achieved. The overall purpose of this TIP is to target producers that are very interested in using and have received education regarding soil health methods of farming but have not yet applied all the principles on the land. The payment rates

offered through EQIP will provide incentive for the producers to take the risk of changing their operation to a soil health focus. This TIP will focus on 600 acres or more of each producer's place to implement all the soil health principles and importantly, while there is abundant support and enthusiasm to adopt better soil health practices. It is also important to do so now because we are witnessing large scale resource issues: wind and water erosion, soil compaction, crop pests, disease, soil acidity, and chemical resistance by weeds that all relate back to the health of the soil.

Judith Basin Local Work Group:

The Judith Basin Local Work Group (JBLWG) met in June of 2019 to gather and prioritize resource concerns within Judith Basin County. Addressing the problems identified by this group meets NRCS' Vision and Mission and the goals of the Judith Basin Soil Health TIP. A general concern identified during the process is that agriculture is struggling financially, and producers are often limited in what they can implement to improve resource concerns. Efforts to address resource concerns need to be economical for the community and producers.

The JBLWG prioritized resource concerns in the following order:

- 1) Watershed Issues
- 2) **Reduce erosion on cropland**, grazing land, and stream banks
- 3) Over grazing
 - a) Water developments and cross fencing
 - b) Grazing of cover crops**
 - c) Management of noxious weeds
- 4) **Lack of crop diversity**
 - a) Increase crop rotation diversity**
 - b) Soil health – cover crop**
 - c) Implement soil health principles**
 - d) Increase soil organic matter**
- 5) Weeds
- 6) Management of noxious weeds
- 7) **Salinity**
- 8) **Use of cover crops and/or permanent vegetation**
- 9) Labor
- 10) Average age of producers is 58 years old; families are smaller; seasonal help is hard to find
- 11) **Soil Acidification**
 - a) Soil health**
- 12) **Water Quality**
 - a) Address high nitrate levels**
 - 1. Soil Health, cover crops, nutrient management**

Judith Basin county has identified many resource concerns, but Soil Health issues are evident in many of the 8 priorities listed above. Soil Quality and soil erosion are directly related to aggregate stability. The Judith Basin Soil Health TIP will assist producers who have become pioneers in improving the health of their soil. The Moccasin terrace is perched on rock which makes this area a great location to demonstrate Soil Health principles. This area TIP will focus on producers who have attended workshops

and tried at least one soil health principle. The TIP will provide incentives to producers to implement practices that minimize disturbance, maximize diversity, keep the soil armored, and keep living roots in the soil.

Problem Statement:

The specific resource concern that will be addressed by this TIP is soil aggregate instability. Management-induced degradation of water stable soil aggregates results in destabilized soil carbon; surface crusting, reduced water infiltration, water holding capacity, and aeration, depressed resilience to extreme weather, increased ponding and flooding; increase soil erosion and plant stress, and reduced habitat and soil biological activity (National Resource Concern List and Planning Criteria). All over the Judith Basin of Central Montana we can see the issues listed above that can all relate back to aggregate stability. Currently the main crop rotation in Judith Basin county is small grain/chemical fallow. With the land being left idle every other year (fallow), there is very limited soil cover. Lack of cover increases soil erosion and reduces habitat and soil biological activity which decreases aggregate stability. Soil biology creates soil aggregates, but they need food and habitat to be able to complete this function. Without a diverse rotation that provides food for the biology, soil aggregation slows or ceases. Fallow acres have little to no soil cover and soil temperatures can increase so much that biology die. Along with the fallow, these producers use a hoe drill which creates soil disturbance which also affects soil biology habitat and soil aggregate stability. The combination of fallow and the use of a hoe drill has led to large scale wind and water erosion that is visible every year.

Due to decreased soil aggregate stability there are other secondary resource concerns that are also occurring in Judith Basin county. The crop/fallow rotation has decreased organic matter and has required an increase of fertilizer to realize the same production that they are accustomed to. As Nitrogen fertilizer use has increased, groundwater nitrates have also increased. (Judith River Watershed Nitrogen Project, Adam Sigler, Dissertation Defense, March 6, 2020) Due to large nitrogen fertilizer inputs and lack of organic matter, the soils in some regions of the area have turned acidic. In some cases, the soil is so acidic inputs of lime will be required to even produce a crop. Lime in the state of Montana is not very accessible and is expensive. During the fallow year excessive amounts of chemicals are being used to treat weeds. Recently, due to increasing amounts of chemical use we are seeing an influx of chemical resistant weeds. Landowners, not understanding soil aggregation, have opted for the quick fix and have returned to tillage during the fallow year on large blocks of land. If this continues, we will see wind and water erosion that could match that of the Dust Bowl. Not to mention huge issues with program compliance that would have a negative impact on field office workload. We are already witnessing whistleblower complaints and more field visits on FSA flights. Recently, several highways have been closed due to soil blowing. Also impacted using tillage and lack of soil cover are the wildlife species that depend on cover for protection. Because the current rotation lacks crop diversity, landowners in our area have a myriad of pest and disease issues. This has resulted in an increased amount of fungicide and pesticide use. These chemicals wipe out the biology in the soil and pollinators which drastically affects the building of the soil aggregates.

Proper soil aggregation that forms the foundation for all ecological processes can only be realized on cropland when all soil health principles are adopted. When we improve the health of the soil, aggregate stability along with all the issues above improve over a period. This has been proven around

the country. Producers that try one or two soil health practices without fully implementing a soil health centric farming system are often disappointed with the results (reduced yields, no visible soil improvement). If NRCS does not encourage and offer financial incentive to producers to adopt a complete system, producers are less likely to adopt a complete soil health system because their neighbors are saying that it doesn't work. (See " The road less traveled: Assessing the impacts of farmer and stakeholder participation in groundwater nitrate pollution research", Nov/Dec 2018, Vol.73, No 6, Journal of soil and Water Conservation) With negative results producers are reverting to what they have always done. The reality is that dabbling in soil health does not provide positive results and the real problem is that many producers don't have a complete understanding of the system. Producers also struggle economically when adopting these changes and there is always risk involved with making large scale management changes. Focusing on 600 acres of a producer's farm with this TIP provides enough financial incentives for producers to make the change. We know this because the interest we have had in this TIP has far exceeded our expectations. Six hundred acres is also a large enough amount of acreage that allows us to really monitor the improvement of soil aggregate stability. With the monitoring protocol that has been designed for this TIP, producers will be able to see results that impact their economics and expand this type of management to the rest of the acres. A typical farm in the Judith Basin Area is 3500 acres. So, the impact we make on just 600 acres will be 4-fold. Once a producer has committed to this system change, the equipment will be used on all their acres which in the case of the 2021 TIP would be at least 35,000 acres.

Decreased soil aggregate stability is present nation-wide and certainly Central Montana and Judith Basin county are no exception. This TIP is difficult to define geographically because to a large degree the solution requires a paradigm shift in the way producers think about crop production and long-term sustainability of agricultural land. Consequently, the FOCUS of this TIP must be on the producers that are willing to adopt a complete soil health centric system of cropping because they understand the function of soil. The Great Falls area has hosted Soil Health Workshops for the past nine years and Judith Basin County has held plot tours at producers, and at the Central Ag Research Center. We participated in a Nitrate special Initiative to reduce the occurrence of nitrate in the ground and surface water in the NE quarter of the county, demonstrating Best Management practices with our projects, in partnership with the Central Ag Research Center and Montana State University. We have a growing contingency of producers throughout the Judith Basin area that attend soil Health workshops every year. The producers that we will focus on in this TIP have attended enough workshops and have a good basic soil health knowledge and many of them are ready, willing, and able to move to the next step by implementing the Full Soil Health Meal Deal. These innovative producers in the east and north part of Judith Basin will then serve to "inoculate" their neighbors and colleagues by demonstrating the advantages to farming with a soil-health oriented system. Judith Basin County will demonstrate the success of this TIP by having local field tours. These local field tours will start to occur in the third year of this TIP. The Central Montana Area will have enough monitoring data by year three to provide good education for other producers in the area.

Goals and Objectives: (Desired Future Conditions)

There are several goals that we would like to realize with the Judith Basin Soil Health TIP. The main measurable outcome we will monitor is the increase of soil cover. With all the practices we are installing we can expect a 10-20% increase in soil cover. Soil Cover will be measured with a 100 ft transect each spring. Soil Cover helps to create better habitat and soil biological habitat which is needed to increase aggregate stability. We also expect an increase in soil biology which will be measured with the Haney Soil Test. We also expect an increase in soil infiltration because of better aggregate stability which we will measure with infiltration rings in the spring. We also will increase wildlife cover with innovative harvesting techniques which will leave at least 12 inches of stubble height on grain stubble through the winter. Increased cover from stripper header stubble provides animal's with breeding, nesting, hiding loafing, sleeping, feeding and traveling cover. One or more types of cover such as grain stubble along with cover crop residue in the same area greatly enhance the survival and reproduction rate of animals. With the increase of the soil biology we would hope that producers could start to realize a decrease of inputs which would make them more sustainable in the future.

Another of the desired future conditions is that this Judith Basin County TIP would lead to local epicenters of interest based on the producers that are incorporating all principles of soil health that would spawn other county specific Soil Health based TIPS with focused goals and objectives. The Judith Basin Field Office will host local field tours to showcase the results we will measure.

To increase aggregate stability the following conservation practices will be installed on 600 acres. Conservation Crop Rotation, Residue and Tillage Management – No till, Cover Crops, Upland Wildlife Management, and Nutrient Management. Producer will install a cropping rotation that will eliminate fallow and include at least 3 of the 4 crop types. Crop types include warm and cool season grasses, and warm and cool season broadleaves. As part of their rotation, they will be encouraged to incorporate a cover crop that will include a minimum of 8 species. The cover crop will be required to grow for the entire growing season. Grazing the cover crop will not be required but it will be encouraged. Some producers in the Judith Basin Area have no access to cattle or do not have fence in place, so we will not be requiring full implementation of the 5th principle, however the majority of producers are planning to implement the 5th principle. Producers will be required to seed crops every year with no-till drills that have a stir value rating less than 10. For the years that small grains are part of their rotation, we will use Upland Wildlife Management to provide incentive to leave stubble heights at harvest greater than 12 inches. In order to determine benchmark soil conditions prior to installation of the practices and to monitor progress throughout the contract we will install nutrient management. Nutrient management will include soil testing each year. These tests will include a standard soil test, Haney soil test, wet aggregate stability test, and phospholipid fatty acid test. These tests will be completed each spring.

The goals will be achievable in 5 years. The expected outcomes are as follows:

- Increase in 10-20% soil cover – measured with a 100 ft transect every spring
- Increase in soil biology – phospholipid fatty acid test
- Increase in biological diversity – phospholipid fatty acid test
- Increase in soil carbon – Haney Soil test
- Increase in wildlife cover – height measurement of grain stubble

Proposed Alternatives:

Conservation Practice Alternatives that have been tried in the Great Falls Area include the following:

- 1) Installing a cover crop as part of a rotation but not changing the rest of the rotation. This does not increase soil biological habitat over the long haul, so aggregate stability does not change.
- 2) Installing a diverse rotation but still using implements that disturb the soil. Disturbing the soil destroys habitat for the biology and aggregate stability.
- 3) Using a zero-till drill but not changing the cropping rotation. The cropping rotation is crucial for the habitat of the biology which directly relates to the aggregate stability.

All the alternatives have been tried in Judith Basin County and in the Great Falls Area for the last 5 years. These alternatives implemented individually have not achieved the goals we have listed above which include soil cover, soil biology, biological diversity, soil carbon, and increased wildlife. We have taken soil tests in several of these locations and have not achieved the goals we have desired due to implementation of individual practices rather than a collective system.

Conservation Practices Needed:

328 Conservation Crop Rotation: will be used to increase diversity in cash crops as well as eliminating fallow years to keep living roots in the soil to improve habitat for the biology. When the habitat for the biology increase soil aggregate stability increases. At least three of the four crop types will be required in the rotation. A diverse cover crop mix can be used to achieve the crop types.

329 Residue and Tillage Management: This practice will be to reduce disturbance to the soil. Less disturbance improves habitat for the soil biology which increases aggregate stability because the biology creates aggregates. Disturbance also directly breaks down soil aggregates. This practice will incentivize the use of equipment that has a STIR rating less than 10.

340 Cover Crop: This practice will be used as appropriate in some rotations to increase diversity and maintain living roots in the soil. It will be recommended that these cover crops are grazed by livestock, but it won't be required because not all producers have cattle. A minimum of an 8 species in the cover crop mix will be required. Cover Crop will be required to be a full season cover crop. Cover crops won't be sprayed out early in the growing season to maximize the potential to improve soil biology habitat.

645 Upland Wildlife Habitat Management: This practice will be applicable on small grains that are harvested using innovative techniques that leave 12 or more inches of stubble standing after harvest. Stubble will not be allowed to be grazed to maximize wildlife winter cover. Subsequent crops will be seeded directly into this standing stubble.

590 Nutrient Management: This practice will be used to test soils to determine bench-mark conditions and to measure soil outcomes throughout the life of the contract. Soil testing will include Haney test, Standard soil test, Aggregate stability, infiltration rings, and the Phospholipid fatty acid test.

Other Funding Sources:

Other funding sources include Montana Fish, Wildlife, and Parks. Montana Fish, Wildlife, and Parks has a new pilot project called the Grain Stubble Management Project. This new pilot project is funded with Montana upland game bird hunting dollars. This project will provide \$6/acre per year to producer who leave at least 14-inch grain stubble. The guidelines include:

- Maximum of 320 acres per payment year
- Habitat must not be grazed until the following spring
- Cropland must be adjacent to nesting cover
- Verification taken after harvest
- Provide upland game bird hunting

Each producer will voluntarily contact FWP in Helena if they are interested in the pilot project. They will work with each producer for them to get in contact with the habitat specialist in their area. Annual payments will be made to producers in January. NRCS field staff and FWP biologist will work closely to assist each other with certification of the practice.

Implementation:

The timeframe for this tip will be three years for the mapped area with possibility of other tips when enough producers are ready in other parts of the county. The scope of acres impacted is estimated at acres.

Year 1 (2021) Financial Request:

Producers ready to implement	Producers that are integrating livestock	Cost with/out 328 waivers	Acres treated With TIP	Cost with 328 waivers
1	X	\$109,449.00	600	\$114,615.00
2	X	\$109,449.00	600	\$114,615.00
3	X	\$109,449.00	600	\$114,615.00
4		\$109,449.00	600	\$114,615.00
Total Financial Request: 4	3	\$437,796.00	2400	\$458,460.00

Year 2 (2022) Financial Request:

Producers ready to implement	Producers that are integrating livestock	Cost with/out 328 waivers	Acres treated With TIP	Cost with 328 waivers
1	X	\$109,449.00	600	\$114,615.00
2	X	\$109,449.00	600	\$114,615.00
3	X	\$109,449.00	600	\$114,615.00
Total Financial Request: 3	3	\$328,347.00	1800	\$343,845.00

Year 3 (2023) Financial Request:

Producers ready to implement	Producers that are integrating livestock	Cost with/out 328 waivers	Acres treated With TIP	Cost with 328 waivers
1	X	\$109,449.00	600	\$114,615.00
2	X	\$109,449.00	600	\$114,615.00
3		\$109,449.00	600	\$114,615.00
Total Financial Request: 3	3	328,347.00	1800	\$343,845.00

Example of Contract Layout for Judith Basin Soil Health TIP:

	Example Scenario:								
	Producer:		Producer #1						
	County:		Judith Basin						
	Acres enrolled:		600						
	Practice			Scenario	Pay Rate	Unit	Extent		
329	Residue and Tillage Management			1	\$17.00	ac	600		
328	Conservation Crop Rotation			1	\$8.61	ac	600		
645	Upland Wildlife Habitat Management			1	\$13.43	ac	600		
340	Cover Crop			11	\$53.41	ac	600		
590	Nutrient Management			1	\$6.08	ac	600		
	Contract Year								
		1	2	3	4	5	#	Total Payment	
329		\$10,200	\$10,200	\$10,200			3	\$30,600.00	
328		\$2583	\$2583	\$2583			3	\$7749.00	
645		\$4029		\$4029		\$4029	3	\$12087.00	
340		\$16023		\$16023		\$16023	3	\$48069.00	
590		\$3648	\$0	\$3648	\$0	\$3648		\$10944.00	
Annual		\$36,483	\$12,783	\$36,483		\$23,700			
Contract Total per Year Est (4)		\$145,932.00	\$51,132.00	\$145,932.00	0	\$94,800.00		\$109,449.00 Per individual	

- A waiver has been requested by the national office to extend 328 Crop Rotation to 5 years instead of 3.
- Yearly Financial Amount will depend on individual practices implemented with each Producer (See example Contract year for estimates)

The technical assistance and staff time needed from NRCS needed to complete this plan is based off the process we followed this year and is included below.

- (1) Meet with small producer groups in each field office: ½ day per field office
- (2) Inventory and Planning: 3 days per producer
- (3) Plan and contract development: 3 days per producer
- (4) Soil Testing, analyze soil test results, Clip for AUM's
- (5) Follow – up with producers: 2 days per producer per year.

The individual plan implementation will be managed by the Stanford field office with assistance from the Great Falls Area Resource Conservationists – Technology and the Agronomist. NRCS staff will convene each year or more to evaluate the progress of Soil Health Tips, evaluate ranking and screening questions, and evaluate the progress of soil and wildlife goals.

Progress Evaluation and Assessment:

The **Montana Soil Health Card** will be used to inventory benchmark conditions of the 600 acres. The Montana Soil Health Card is a tool used by NRCS employees to evaluate soil condition based on several different parameters scored in the field. Results are shared with producers to increase their knowledge of evaluation process. The main outcome of increasing soil cover will be measured with a 100 ft transect in the spring. We will be assessing infiltration benchmark and progress with infiltration rings. We will take the average of 5 infiltration rings. We will assist the producers with taking the Haney, Aggregate stability and Phospholipid Fatty Acid Test (PLFA) to monitor and evaluate the increase of soil biology every spring.

There are three parts to the **Haney Soil Test**. The first part of the Haney Soil Health Test is **Soil Respiration** test or CO₂ 24 hour burst test which is an indicator of soil microbial biomass with the higher the number being better. The more microbial life the more CO₂ produced. The second part is **Water Extract** where total organic carbon (TOC) and total nitrogen (TN) are measured. The third part is H3A Organic Acid Extract. The organic acid extract mimics plant root exudates. This extract is a good measure of nutrient supply. Nitrogen fertilizer recommendations are lower for the Haney test because we are able to measure mineralizable organic N and ammonium that we normally do not analyze in a standard soil test. The **Haney Test** lets us know how active our soil is and then help improve our Nitrogen fertilizer application.

Soil Aggregate Stability is a measure of the ability of soil aggregates to resist degradation when exposed to external forces such as water erosion, wind erosion, shrinking and swelling processes, and tillage. It is a measure of soil structure and can be impacted by soil management. The Soil Aggregate Stability test allows us to monitor changes in our soils as aggregate stability serves as an early indicator of recovery or degradation of the soils.

The **PLFA** test gives a representation of living soil microbial biomass and allows us to identify the presence or absence of various functional groups. PLFA is a snapshot of soil community structure and abundance at the time of sampling. Bacteria, fungi, protozoa, nematodes, earthworms, etc. are present in the soil. These organisms provide the breakdown of crop residues, store plant nutrients, create stable organic matter, and help build soil structure, leading to reduced compaction and erosion, increasing water holding capacity and allowing for deeper root structures. The relationship between different microorganisms and plants is dynamic! The ability of the soil microbial community to change provides producers with a tool to compare agricultural management techniques with respect to overall better microbial health and sustainable agriculture practices.

From a producer standpoint several long term Agronomic benefits to this program will be realized: Increased stubble height will maximize snow catch and lower evaporation rates, saving moisture for when the crop needs it; Use of zero-till with a disc drill equates to less weed pressure; reduction in pest pressures such as sawfly and helps maintain standing residue. Increase in crop diversity provides potential of less disease and weed pressure while decreasing herbicide resistance, and better resiliency to withstand drought. From an economic standpoint there are also benefits: increased combine capacity; fuel reduction at harvest; less yearly maintenance for combine as less material is going through machine; pesticide use decreases (herbicide, fungicide, seed treat); and an ability to spread workload (seeding and harvesting of crops) throughout the growing season. When the fifth element livestock are added to the program the benefit of healthier soils can occur much faster and a more cost-effective, high quality feed source becomes reality. Most importantly this regenerative approach should provide all of us with healthier soils, healthier food sources, better water quality and more wildlife to enjoy!

Ranking Questions:

1. Does the application include a multi-species cover crop?
 - a. >5 species
 - b. 2-4 species
 - c. 1 species
2. Will the applicants cropping rotation include four crop types not including the cover crop?
3. Will the applicant be implementing inter-cropping as part of their Conservation Crop rotation?
4. Will the applicant develop and seed a multi-species cover crop suitable for grazing?
5. Are the soil types in project area less than or equal to 25 cm to shallow gravel?
(Applicants will contract Nutrient Management to monitor effects of practices on shallow soil types)
*This question is drawn from the Judith Basin Nitrate Special Initiative Research (see links below)

<https://sites.google.com/site/ewinglab/research/soils-land-use-and-water-quality>

<https://waterquality.montana.edu/judith/index.html>

