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Save Our Soils

Using a soil health system to turn dirt
into living soil



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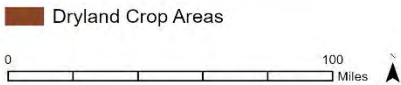
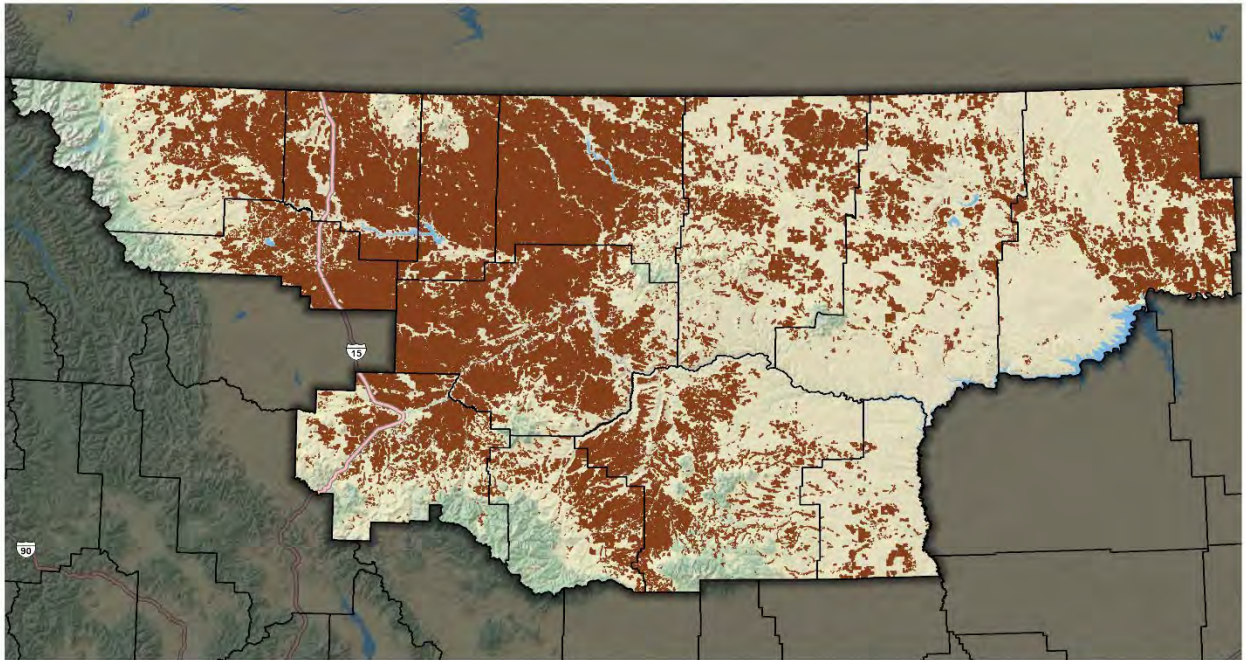
TIP SUMMARY

This Targeted Implementation Plan (TIP) will target dryland crop producers in the following counties in the Great Falls Area that are innovators in improving the health of their soils: Cascade, Chouteau, Pondera, Glacier, Toole, Hill, Phillips, Petroleum, Fergus, Judith Basin and Valley. This TIP will provide incentives for producers to implement conservation practices that implement the principles of soil health to improve primarily soil organism habitat loss and degradation. Soil organism habitat includes less disturbance, soil cover, a living root in the soil, diversity of plants. When soil organism habitat is in good condition, at a minimum, more water infiltrates, more nutrients are available to plants, and less soil erodes. This means that cropland will be more resilient to a changing climate, soils will regenerate, and producers will be more sustainable as inputs cost rise. Addition resource concerns that will be addressed include organic matter depletion and aggregate instability.

This TIP will focus on dryland crop acres in the Great Falls Area. In addition to that focus, we will focus on 1,200 acres with each producer. The reason for focusing on the 1,200 acres is that this has been enough cost share to minimize the risk and enough for producers to adopt the soil health system. The TIP goals will be achieved by implementing the following practices: 328 Conservation Crop Rotation, 329 Residue and Tillage Management, 340 Cover Crop, 809 Conservation Harvest Management, and 216 Soil Health Testing. The practices in this TIP characterize this as a soil health system. The practices adopted alone do not improve soil organism habitat. Soil organism habitat improvements can only be seen when all the practices in this soil health system are adopted. This soil health system includes practices that are new and innovative so inherently focuses on early adopters which are scattered across the Great Falls Area. All the Long-Range plans for the counties in the Great Falls Area have a priority of soil erosion, soil health, or soil quality. This TIP has the potential to address all those concerns. The TIP will be offered from 2024-2026 and will be requesting \$14,303,580 from NRCS.

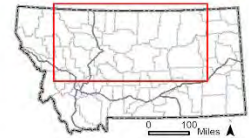
GEOGRAPHIC FOCUS

The geographic focus will be on dryland cropland acres within the Great Falls Area but will exclude Liberty County until the last year of the TIP. Currently, Liberty County has its own Soil Health TIP which is set to expire the last year of this TIP. This geographical focus area was chosen for several reasons. The first reason is the prevalence of bare soil that is causing widespread soil erosion in the Great Falls Area that has closed major highways and caused several accidents. NRCS employees in the Great Falls Area routinely see bare fields, barrow ditches filled with soil, and blowing soil. The second reason is that the level of interest is scattered all over the Great Falls Area. Great Falls field staff have been holding soil health workshops across the area for 12 years. We recently held several workshops to gauge interest and were overwhelmed and excited about the interest. Our hope is that we can grow interest in the soil health system to make large landscape changes to the soil. Refer to the map below.



This map uses the Montana State Plane projected coordinate system, North American Datum 1983. Additional data courtesy of the Montana State Library and ESRI.

Total Estimated Acres
of Dryland Crop Area: 7,956,700



Resource Concern

The **primary resource concern this TIP will address is Soil Organism Habitat Loss and Degradation.**

Bare soil, soil compaction, limited soil aggregation, and poor infiltration are all directly related to reduced and degraded soil organism habitat. Bare soil not only increases soil erosion (as seen in the picture) but also creates extreme soil temperature, increases evapotranspiration, and provides less food for the soil biology. Soil temperature on bare soil has been measured at 140 degrees.

When

temperatures reach 100 degrees, soil biology dies and 100% of soil moisture is lost. These high temperatures with bare soil make crops very susceptible to drought and producers less resilient to a changing climate.





Soil compaction, as shown in the picture to the left, can be found on almost all dryland cropland within the Great Falls Area. When soil is compacted it has poor aggregation and less pore space that provide air and water for the soil biology. Soil compaction also affects the ability of plant roots to grow and access water and nutrients. Soil compaction also reduces the ability of the soil to infiltrate water, making crops more susceptible to drought and extreme weather condition. Infiltration rates commonly measured in the Great Falls Area are greater than 30 minutes/inch of water applied which is indicative of compaction, reduced air spaces, and less biological habitat. In comparison to the infiltration rates above, producers that have improved their soils have increased infiltration to 19 seconds/inch of water applied. If we provide habitat for the soil biology, they decrease compaction by creating soil aggregates. With less disturbance and more living roots to feed the biology also decrease compaction. Deeper roots especially in cover crop mixes also break up compaction layers.



Organic matter depletion and aggregate instability are two other resource concerns that will be addressed by this TIP. An undisturbed, native prairie soil in the Great Falls Area is generally comprised of about 5% organic matter. In comparison, the amount in most dryland cropland in the Great Falls Area is 1.5 – 2%. This calculates to 40% loss of food for the biology along with 40% less water holding capacity. Organic matter is food for soil biology and acts like a sponge for moisture. Stable soil aggregates are bound together to resist breaking apart when exposed to external forces. Soil aggregate stability is dependent on a glue that is produced by the soil biology called glomalin. When there is less biology, soil aggregates fall apart, they fill pore spaces and soil infiltration decreases drastically affecting the

ability of plants to grow. The causes of the above resource concern include the following:

1. A crop rotation that isn't diverse and includes crops that limit soil cover which leads to poor habitat for the biology;
2. Disturbance in the form of tillage or hoe drills actually breaks down organic matter, kills biology, destroys habitat, and breaks soil aggregates; and
3. Not planting a crop for one full growing season (a fallow season). Fallowing drastically reduces soil cover, organic matter, and food for the biology,

It is important to address this issue now because soil erosion is closing highways and causing a public safety hazard. Due to the education that NRCS has been providing we have significant interest in turning our soils around. There has been at least two years of drought that has exacerbated these conditions making agricultural operations and soils less resilient.

GOALS AND OBJECTIVES

There are several goals that we would like to achieve with the Great Falls Soil Health TIP.

- Improved soil organism habitat leading to increased aggregate stability and organic matter, which address the primary and secondary resource concerns.
 - Objective: Improved soil cover on all treated acres
 - Measurement: Maintain soil cover of 60% residue through the life of the rotation which will be measured with a 100 ft transect each spring by NRCS field offices.
 - Measurement: Soil organism quantity and diversity with the Haney Soil Test and the Phospholipid Fatty Acid (PLFA) test
 - Measurement: Annual aggregate stability testing
 - Objective: Improved water infiltration
 - Measurement: Infiltration rings will be used to compare infiltration rates at the beginning and end of each contract.
 - Objective: Decreased erosion
 - Measurement: This will not be officially quantified, but informally tracked through anecdotal information such as how many days roads in the area are closed for blowing soil.
- Producers see the value in the changes on the 1,200 acres
 - Objective: Producers transfer that management to the rest of their acreage.
 - Measurement: This will not be officially quantified, but informally tracked through producer visits at the end of their contract.
- This Area-wide TIP will lead to local epicenters of interest based on the producers that are incorporating all principles of soil health.
 - Objective: New county-specific soil health-based TIPs with focused goals and objectives.
 - Objective: The Great Falls Area has hosted local field tours and will continue to showcase the results we will measure to foster interest among producers other than the early adopters.
 - Measurement: Number of soil health TIPs developed in the future in the Great Falls Area. There are 13 counties in the Great Falls Area, so we would hope for at least one per county in the next 5 years.

The Montana Soil Health Card will also be used to determine benchmark conditions. With improved soil organism habitat, we would hope that producers will start to realize a decrease of inputs, increased infiltration, and decreased soil erosion which would make them more sustainable and resilient in the future.

PROPOSED ALTERNATIVE

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

1. Planting a cover crop as part of a rotation but not changing the rest of the rotation. This does not increase soil organism habitat over the long haul so aggregate stability does not change. Installing a cover crop for one year with no other soil health principles in Montana has shown little to no change in soil health.
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 and food of the biology which directly relates to the aggregate stability.

4. Implementing all the soil health principles in a systemic manner. Improving soil health is only accomplished by establishing the whole system that addresses all the soil health principles. The above alternatives that have been tried do not address all the soil health principles. Therefore, limited improvement in soil health has been seen. This TIP will require all the practices that function as a whole system to address all the soil health principles.

Alternatives 1-3 have been tried in several counties in the Great Falls Area for the last 5 years. Based on data from infiltration ring measurements and soil health tests, they have not achieved the goals we have listed above which include soil cover, soil organism habitat, increased water infiltration and decreased erosion.

CHOSEN ALTERNATIVE:

Due to limited success of singular practices not achieving the desired soil health outcomes, we are proposing alternative 4 - a systemic approach to fix a systemic problem. The following practices are all required in the chosen alternative.

328 Conservation Crop Rotation: This practice will be used to increase diversity in cash crops as well as eliminate fallow years to keep living roots in the soil every year. This improvement in diversity increases the food source for the biology improving the overall habitat for the soil organisms. When the habitat increases soil aggregate stability and organic matter increases. At least three of the four crop types will be required in the rotation. A diverse cover crop mix with a minimum of 8 species can be used to achieve the crop type requirement.

329 Residue and Tillage Management: This practice uses zero-till seeding equipment to reduce soil disturbance. Less disturbance improves habitat for the soil organism which increases aggregate stability because the biology creates the aggregates. Disturbance also directly breaks down soil aggregates. This practice will incentivize the use of equipment that has a STIR rating less than 10 and is to be used every time a crop is planted.

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 8 species in the cover crop mix will be required. If selected, a full-season cover crop will be required; cover crops won't be sprayed out early in the growing season to maximize the potential to improve soil organism habitat.

809 Conservation Harvest Management: This practice will be applicable on small grains and oilseeds that are harvested using harvesting equipment that leaves all the residue standing. The harvesting equipment just strips the grain from the stem leaving all the residue standing. Stubble will not be allowed to be grazed until April 15th to maximize snow capture. Subsequent crops will be seeded directly into this standing stubble. Stubble heights with a draper header are usually 6 inches, we have measured stripper stubble consistently at 18-24 inches depending on drought.

217 Soil Testing: This test is a standard soil test that can assist producers with nutrient management.

216 Soil Health Testing: 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, aggregate stability, and the PLFA test. This practice scenario will include the Basic Soil Health Suite which is 5 soil health tests. This practice will also include two single indicator tests that are the Haney and the PLFA test.

Implementation

The timeframe for this TIP will include a three-year sign-up period from 2024-2026. Contract would be 5 years each.

Year 1 (2024) Financial Request

# of Producers	Acres affected	2024 request	2025 request	2026 request
20 each year	38,400 acres	\$4,767,860	\$4,767,860	\$4,767,860

Typical Contract Layout

Dirt to Soil	Producer: Jane				Example based on 640 acres	
<i>Estimate (based on FY2023 EQIP Cost Share Rates)</i>						
Practices cannot be cost shared more than 3 times per acre per contract						
Practice Code	Practice	Pay Rate	Extent	Unit	NOTES	
*329	Residue and Tillage Management	\$16.57	640	ac	*drill for seeding of all crops	
*328	Conservation Crop Rotation	\$10.51	640	ac	*crop rotation requiring 3 of 4	
*809	Conservation Harvest Management	\$59.67	640	ac	*use of stripper header required on small grains	
340	Cover Crop	\$76.67	640	ac	achieve warm season crop	
216	Soil Health Testing	\$153.46	2	each	contracted as single indicator	
216	Soil Health Testing	\$112.91	1	each	suite of the 5 soil health tests	
217	Standard Soil Test	\$637.35	1	each	Standard soil test	
Practice Code	Contract Year					
	Spring Wheat	Winter Wheat	Oilseed	Cover Crop	Pulse	
	1 (FY2024)	2 (FY2025)	3 (FY2026)	4 (FY2027)	5 (FY2028)	Total Payment/Practice
329	\$10,605	\$10,605	\$10,605	\$10,605	\$10,752	\$42,566
328	\$6,726	\$6,726	\$6,726	\$0	\$6,726	\$26,906
809	\$38,189	\$38,189	\$38,189	\$0	\$0	\$114,566
340	\$0	\$0	\$0	\$49,069	\$0	\$49,069
217	\$637	\$637	\$637	\$637	\$637	\$3,187
216	\$420	\$420	\$420	\$420	\$420	\$2,099
Annual Payment	\$56,577	\$56,577	\$56,577	\$60,731	\$18,536	\$238,393

The individual plan implementation will be managed by each field office with coordination and assistance from the State Soil Health Specialist. Specific outreach for this TIP has already been completed in Blaine, Chouteau, and Cascade counties. The level of interest in those locations assisted with the projections of financial assistance needed for the TIP. Continuing education and outreach are planned for the other counties in the Great Falls Area.

PARTNERS

The conservation districts in Chinook, Cascade, and Fort Benton have assisted the NRCS with outreach efforts that have already been completed to gauge interest. Each district has provided a lunch and advertising for each workshop. Other partners will include the conservation district in the following counties: Pondera, Glacier, Toole, Hill, Phillips, Petroleum, Fergus, Judith Basin and Valley. Another partner is the Montana Research Station in Moccasin. NRCS is entering into an agreement for a 5-year research project. The research project will be looking at comparisons of conventional rotations compared to the soil health system which includes all the 5 principles. This project will help promote soil health systems to a larger audience.

OUTCOMES

See the measurable outcomes listed in the Goals and Objectives section. In addition, the public will realize many benefits from the long-term landscape level adoption of soil health systems by Montana’s farmers and ranchers. Increased soil cover through residue and standing crop stubble, decreased soil disturbance through implement choices, improved crop diversity, increased living roots in the soil, and the incorporation of livestock where possible all potentially lead to:

- Reduced blowing soil and increased snow catch, which may mean safer roadways that aren’t closed due to blowing soil and less pressure on county road crews that are already strapped for money spend drastically less time on county roads next to stripper stubble.
- Improved wildlife habitat.
- Less evapotranspiration of water used to grow crops, less weed pressure, less plant pest and disease, better soil aggregation, and better infiltration. All leading to decreased use of chemicals and other commercial inputs that have their own environmental impacts. Agricultural producers would be more environmentally and economically sustainable, which supports rural economies. Food produced would be healthier and more nutritious

Combined, all these benefits amount to improved resiliency to changing weather and climate conditions while more carbon is stored in the soil. Based on COMET Planner modeling, potential carbon sequestration and greenhouse gas reductions from adopting the practices on the scale projected by this TIP amount to the following amounts annually.

NOTE: This assumes 60 producers total signing up, dispersed evenly across the 13 counties in the project area and implementing the typical contract shown on 640 acres.

COMET-PLANNER <http://comet-planner.com/>

EPA GREENHOUSE GAS CALCULATOR <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

Potential Carbon Sequestration and Greenhouse Gas Reductions and Comparable Equivalencies

County	Producers and Acres	Metric tons of CO2 Equivalent	Miles driven by an average gas-powered car	Gallons of gasoline consumed	Tree seedlings grown for 10 years
Glacier	4 producers 2,560 acres	866	2,149,590	97,466	14,319
Toole	4 producers 2,560 acres	1,145	2,842,125	128,840	18,933
Liberty	4 producers 2,560 acres	1,141	2,832,197	128,390	18,867
Hill	4 producers 2,560 acres	1,141	2,832,197	128,390	18,867
Blaine	4 producers 2,560 acres	1,224	3,038,220	137,729	20,239
Phillips	5 producers 3,200 acres	1,262	3,132,543	142,005	20,867
Valley	5 producers 3,200 acres	1,262	3,132,543	142,005	20,867
Petroleum	5 producers 3,200 acres	1,039	2,579,012	116,912	17,180

Fergus	5 producers 3,200 acres	1,039	2,579,012	116,912	17,180
Judith Basin	5 producers 3,200 acres	1,003	2,489,652	112,861	16,585
Cascade	5 producers 3,200 acres	1,176	2,919,074	132,328	19,445
Chouteau	5 producers 3,200 acres	1,262	3,132,543	142,005	20,239
Pondera	5 producers 3,200 acres	1,262	3,132,543	142,005	20,239
TOTAL for all three years	60 producers 38,400 acres	14,822	36,791,251	1,667,848	243,827

RANKING QUESTIONS (200 POINTS)

1. Does the application include a multi-species cover crop on 75% of the acres?
2. Does the applicant facilitate grazing on the multi-species cover crop?
3. Will the applicant be implementing inter-cropping as part of the conservation crop rotation on at least half of the proposed acreage?
4. Will changes to the residue management result in a planned STIR rating of < 10.