NONPOINT SOURCE 319(h) PROJECT PROGRESS REPORT FORM

Version 1.5

Federal Fiscal Year of project: 2005 **TODAY'S DATE:** 10/14/2005

Please select which reporting period.

MIDYEAR REPORT?: ☐ **ANNUAL REPORT?:** ☒ **QUARTERLY REPORT?:** ☐

PROJECT TITLE: Evaluating the performance of vegetated treat

REPORT DATES: FROM: 1 Dec 2004 **TO:** Sep 30, 2005

STATE NAME: South Dakota

ADDRESS: Agricultural and Biosystems Engineering

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OVERALL PROJECT ACCOMPLISHMENTS

Since the establishment of the project to evaluate vegetated treatment systems (VTS's), four stakeholders meetings have been held, in December 2004, January 2005, February 2005, and August 2005. Representatives of the following groups have attended one or more of the stakeholder meeting: SDSU, SD Farm Bureau, SD Cattlemen's Association, DENR, SD Dept of Ag, Moody County Conservation District, and NRCS. A consulting engineer with a private consulting firm in SD that does many animal waste system designs has also asked to be included in the stakeholders meetings.

The first graduate student has been hired.

A web site has been developed to foster communication among investigators, stakeholders, and the public.

The two pre-existing sites (Miner and McCook) were monitored during 2005. The three remaining sites are in various stages of design and construction and we expect that all will be operational early in 2006. Coliform sampling showed some reduction of coliforms across the

VTA for one event early in the growing season at the Miner site. Vegetation management treatments showed increased harvested dry matter from the VTA for multiple harvests (2 or 3) within the growing season.

An add-on project has already been discussed among various stakeholders and investigators. A grant proposal, sponsored by Cattlemen's Associations from SD, ND, NE, IA, MN, MO, and IL, was funded by the NRCS Conservation Innovation Grant program. We expect that two additional VTS sites will be established in SD. Additional funds, separate from this project, will be sought for monitoring those additional VTS sites.

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OBJECTIVES/TASKS ACCOMPLISHMENTS

OBJECTIVE 1: CHARACTERIZE AND ESTABLISH THE PILOT AFOS THAT WILL BE USED TO TEST THE EFFECTIVENESS OF VTAS AS AN ALTERNATIVE ANIMAL WASTE MANAGEMENT SYSTEM BMP.

TASK 1. CHARACTERIZE AND ESTABLISH FIVE VTA SITES.

The pre-existing sites in McCook and Miner Counties in SE SD were monitored during the summer of 2005.

The Roberts Co site (NE SD) has changed locations and cooperators because of change of plans by the original cooperator. The new location (and cooperator) is a suitable site. The site design has been completed by NRCS and construction will take place yet this fall, weather permitting.

The Meade Co (W SD) site is nearing the end of the construction phase. The contractor has completed activities and the site is operational in that it will contain runoff. Landforming in the VTA and some small diversion structures remain to be constructed by the owner. The site will contain runoff but will not be completed (vegetation, etc.) until early summer of 2006.

The fifth and final site has been identified and will be located in Haakon County. The design of the Haakon site (by SDSU) is nearing completion and it is expected that construction will take place yet in 2005 and through the winter, if possible. The Miner SCD has procured grant funds from the SD Conservation Commission to be used as cost-share for construction of the Haakon site.

Work planned for next six months: Final construction tasks at the Meade site will take place in early spring of 2006 then the site will be fully operational. Construction will commence at the Roberts site. The Haakon site design will be finalized and construction will commence, weather permitting.

This task is on schedule pending the completion of the remaining three sites.

OBJECTIVE 2: MEASURE THE SURFACE WATER QUALITY IMPACTS OF VTA'S AT THE SITES

TASK 2: CHARACTERIZE WATER, NUTRIENT, SALT, SEDIMENT, AND FECAL COLIFORM BACTERIA FLOWS AT EACH SITE.

Runoff samples have been collected at the two pre-existing sites, Miner and McCook. Nutrient analysis of the samples is continuing and will be summarized in the next report.

Coliform sampling and analysis at the Miner and McCook sites show varying effectiveness of the VTA's.

Samples were processed by adding different volumes ranging from one microliter up to 10 ml, depending on the appearance of the water sample. Samples that appeared very turbid/brown colored had less fluid volume processed than samples that appeared clearer/less turbid. Fluid samples were impinged onto the surface of filter membranes using a vacuum manifold. Three replicates of each dilution of water sample were prepared. Negative controls of sterile water were also processed. Filter membranes were aseptically placed onto the surface of small petri plates containing MFC agar (Difco). Plates were placed inside zip lock plastic bags and then set into a water bath set at 44.5^{o} C for 18-24 hours. After incubation, plates were examined for dark blue colonies (colonies of *E. coli*). Plates that had between 25 and 250 colonies were counted; those having fewer or more colonies were not statistically trustworthy. Averages of colony numbers on three replicate plates of a dilution were calculated.

Table 1. Counts of *E. coli* at the McCook and Miner sites during 2005. Designation TNTC means colonies were too numerous to count.

Sample site	**Sample date**	***E. coli* counts (cells/ml); pre VTA**	***E. coli* counts (cells/ml); post VTA**
McCook	June 14, 2005	1.99 X 10^4	1.41 X 10^4
Miner	June 14, 2005	1.35 X 10^5	2.11 X 10^2
Miner	July 26, 2005	TNTC	TNTC
Miner	September 8	TNTC	TNTC

Discussion: At the McCook site, there was a mix of woodland and grass. The collection site for fecal coliform analysis was primarily quackgrass (*Elytrigia repens*). It is suggested that the lack of difference between pre VTA and post VTA is due in part to the grass not having enough time and space to filter effectively. The source of the material in the water sample was from both the sediment basin and other areas. There are no other data points for the McCook site because there was no water sample at the collection sites at the later dates in July and September. In comparison, at the Miner site there was water sample to draw from at all sample dates, and the material in the water sample was primarily derived from the sediment basin. On June 14 there was a clear VTA filtration effect, with three orders of magnitude difference between pre VTA and post VTA samples. At the later sampling dates (July and September), fecal counts were very high and there did not appear to be a difference between pre VTA and post VTA sites. These two later sampling dates were after a drought period. In future studies correlations will be sought between rainfall events and fecal coliform numbers at the study sites. More frequent rain may

help move and dilute the fecal coliforms more effectively than periodic rainfall events after drought periods.

On September 2, 2005, near the Miner site, samples were obtained from the Vermillion River. The sampling sites were located at 40 meters east of the fence down the middle field from the river (upstream). The other sample was from 435 Avenue 235 Street, on the east side of the bridge in a stagnant water pool (downstream). Fecal coliform counts upstream were 1.49×10^2 cells/ml, compared to downstream counts of 1.07×10^3 cells/ml. Fecal numbers were higher in the stagnant, non moving pool than in the running water upstream.

Water mass flow rates are still being analyzed (the paper tapes require much labor to digitize) and will be correlated to coliform samples in the next report.

Work planned for next six months: Runoff sample analysis will continue and fall soil samples will be collected from the McCook and Miner Co sites. Mass flow rates will be analyzed and summarized. We expect that initial soil samples will be collected and runoff sample collection will commence at the Roberts, Meade, and Haakon Co sites.

OBJECTIVE 3: COMPARE THE PERFORMANCE AND FINANCIAL FEASIBILITY OF EACH VTA TO A WASTEWATER BASIN AT THE SAME SITE.

TASK 3: COMPARE PERFORMANCE OF VTA SYSTEMS TO SIMULATED PERFORMANCE OF BASINS AT ALL SITES.

Progress: The simulation models are installed at SDSU and input data are being entered.

Work planned for next six months: Model runs will be completed in multiple configurations to explore alternative scenarios and address optimization of VTS's. This work will form the basis of Sara's MS thesis. She will be spending a considerable amount of time with the models in the next 6 months.

This task is on schedule.

OBJECTIVE 4: DEVELOP RECOMMENDATIONS FOR MANAGING PERENNIAL GRASSES USED AS THE VEGETATION COMPONENT OF A VTA BASED AWMS.

TASK 4: COMPLETE ECONOMIC COMPARISONS OF SYSTEMS AT ALL SITES.

No progress to report.

Work planned for next six months: Activity addressing this task will commence in 2006, beginning with the identification of the economics graduate student.

This task is on schedule.

TASK 5: INFORMATION TRANSFER (I&E)

Press releases from SDSU announced the establishment of the project and outlined the objectives. Press releases were in both print and audio formats. Two examples of publication of the published press releases are in the Rapid City Journal (http://www.rapidcityjournal.com/articles/2005/10/06/news/agnews/ag05.txt) and the TriState Neighbor (http://www.tristateneighbor.com/articles/2005/10/06/tri_state_news/top_stories/news26.txt).

A web site dedicated to this project has been established. It is located at http://abe.sdstate.edu/vts. Initial project information is listed and results will be published there as they become available and as they are appropriate. Other information that will be contained at the web site includes announcement and minutes of meetings, contact information for the investigators, overviews of the locations, and links to related information.

Work planned for next six months: Further planning for print, audio, and video releases will take place with media personnel at SDSU. The web site will be updated as appropriate.

This task is on schedule.

TASK 6: EVALUATE THE EFFECTS OF VEGETATION HARVEST SYSTEMS ON THE ABILITY OF THE VTA TO MAINTAIN FILTERING CAPABILITES AND PRODUCE HIGH QUALITY FORAGE.

This task was appended to the project in August 2005.

In the relatively pure stand of smooth bromegrass (*Bromus inermis*) existing in a hydrologically active area within the VTA at the Miner site, four treatments have been established. The treatments are (1) control (not harvested for forage over the 3-year evaluation period, (2) one harvest (initial growth harvested at late anthesis/peak standing crop around July 1), (3) two harvests (first harvest of initial growth at late anthesis around July 1 and second harvest of regrowth around October 1), and (4) three harvests (first harvest of initial growth at late anthesis around July, second harvest of regrowth around August 1, and third harvest or regrowth around October 1). The experiment design is a latin square with four replications. Plot size is 3.05 by 3.05 meters.

Table 2. Total dry matter forage production from three harvest treatments for smooth bromegrass on a vegetated treatment area at the Miner site during 2005.

Harvest System (# of Harvests)	**Harvest Dates**	**Mg DM ha^{-1}**
1	July 1	6.21
2	July 1 and October 2	10.53
3	July 1, August 1, and October 2	9.91
LSD (0.05)		1.06

Table 3. Dry matter forage production of regrowth from the 2- and 3-harvest systems for smooth bromegrass on a vegetated treatment area at the Miner site during 2005.

Harvest System (# of Harvests)	Regrowth Period	Mg DM ha^{-1}
2	July 1 to October 2	3.08
3	July 1 to August 1	0.94
3	August 1 to October 2	1.60
LSD (0.05)		0.63

As would be expected in the first year of the application of harvest treatments, mean total dry matter forage produced from the 2- and 3-harvest treatments was significantly greater than forage production obtained from the single harvest in July. The 2- and 3-harvest systems produced about 65% more forage than the 1-harvest system in this the initial year of the study. However, there was no difference between 2- and 3-harvest treatments for total forage production (Table 2). The amount of forage production obtained from regrowth was related to the length of the regrowth period (Table 2). Stockpiling from July 1 until October 1 in the 2-harvest system resulted in regrowth comparable in amount to the total obtained from the two cycles of shorter regrowth duration in the 3-harvest system (Table 3).

Table 4. Morphological characteristics of tillers of regrowth from two harvest system treatments for smooth bromegrass on a vegetated treatment area at the Miner site during 2005.

Harvest System (# of Harvests)	Regrowth Period	Leaves $tiller^{-1}$	Shoot weight (mg)	Leaf fraction
2	July 1 to October 2	6.5	496	0.62
3	August 1 to October 2	4.2	230	0.78
Significance	**	**	**	**

** Difference between harvest system means significant at the 0.01 level.

Although there was no difference between the 2- and 3-harvest systems for forage production, large differences were found between these two treatments for tiller morphology (Table 4). Tillers from the August 1 to October 2 regrowth period were smaller and had fewer leaves but had a higher leaf fraction than tillers from the July 1 to October regrowth period. This suggests that regrowth from the 3-harvest system had higher forage quality than the regrowth forage from the 2-harvest system. Chemical analyses will be conducted this winter to determine forage quality and nutrient concentration characteristics of the regrowth from the 2- and 3-harvest systems.

Work planned for the next six months: Data analysis will continue. Nutrient content of the vegetation will be analyzed to calculate N and P removal from the VTA. Plots at the newly-built sites (Meade, Roberts, Haakon) will be established.

This task is on schedule.

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CONCLUSIONS

The project generally is on schedule. The dry winter and spring impeded runoff sample collection but summer and fall rains provided samples for analysis. Sampling and analysis from the two pre-constructed sites indicate that some nutrients are leaving the VTA so modifications are being made to those VTA's. Further sampling and analyses are needed to estimate mass flow rates and thus evaluate the effectiveness of the conceptual VTA. Harvest of smooth bromegrass at the Miner site showed increased dry matter for more than one harvest during the growing season. The stakeholder group has provided valuable input to the project in the meetings.

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Please select the pollutant, and then enter the numerical amount, units, and whether it is a TMDL related pollutant. Click in gray areas for dropdown list.
NOTE: If Nitrogen and/or Phosphorus are chosen, units must be lbs/yr. If Sedimentation is chosen, units must be in tons/yr.

Pollutant Type *	Pollutant Reduction Target	Current Year Pollutant Reduction	Cumulative Pollutant Reduction Achieved (Numerical)	Units	TMDL yes/no
POLLUTANTS:					
ADDITIONAL POLLUTANTS:					

Wetlands/Streambanks/Shorelines

Please select the appropriate item as it relates to the project or task. For this reporting period there should be an actual (when available) positive numerical value for each selection

- ☐ **Wetlands Restored**
- ☐ **Wetlands Created**
- ☐ **Streambank and Shoreline Protection**
- ☐ **Stream Channel Stabilization**

Description	Current Year	Cumulative Total	Units
Wetlands Restored			**Acres**
Wetlands Created			**Acres**
Streambank and Shoreline Protection			**Feet**
Stream Cannel Stabilization			**Feet**