Knapp Creek

Watershed Based Plan

Submitted by the

West Virginia Conservation Agency

2012

Watershed Based Plan for Knapp Creek

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INTRODUCTION

The purpose of this watershed based plan is to define the problems, resources, costs and course of action necessary to restore the impaired streams of the Knapp Creek watershed to full compliance with water quality standards. Following this watershed based plan will implement the Total Daily Maximum Load (TMDL) set for these streams by the WV Department of Environmental Protection (DEP).

Knapp Creek, stream code WVKNG 53, is a tributary of the Greenbrier River and has been included in the Greenbrier River TMDL. Knapp Creek is a 26.3 mile stream located entirely within Pocahontas County, West Virginia. The watershed encompasses approximately 176 square miles. Its headwaters originate in the mountains that form the West Virginia/Virginia boundary north of the town of Frost. The other towns within the watershed are Minnehaha Springs, Huntersville and Marlinton at the confluence of Knapp Creek and the Greenbrier River.

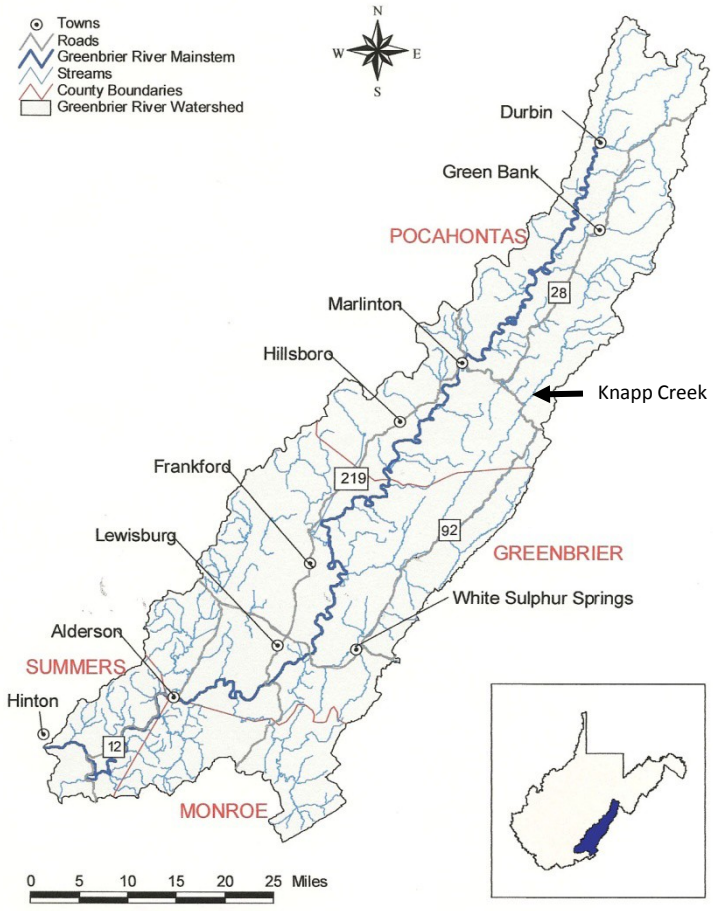


Figure1: Greenbrier River watershed

The upper Knapp Creek subwatersheds have been the focus of a long term restoration project implemented by the Natural Resources Conservation Service (NRCS) following a plan developed in 1999. The Upper Knapps Creek Watershed Restoration and Management Plan (Restoration Plan) focuses on stream bank stabilization needs within the upper watershed. The effort was started in response to flooding and severe stream bank erosion. The first project was completed in 2004 and two others were completed in 2011.

The upper Knapp Creek subwatersheds are also the primary area of fecal coliform contamination for Knapp Creek and therefore the focus of most of the practices called for in this plan. The characteristics of the watershed above the joining of Browns Creek and Knapp Creek are steep hillsides and drains flowing into a broad low gradient valley. The valley is considerably

narrower from Browns Creek to the mouth at Marlinton. The upper valley is ideal for agriculture, which is the predominant economic activity.

The basin morphology, geology and soil characteristics of the watershed make it vulnerable to high erosion rates. Geologically the watershed is divided between the Ridge and Valley Province and the Allegheny Plateau Province. The part of the watershed from Browns Creek upstream is in the Ridge and Valley Province. The eastern side of the watershed is characterized by steep tributaries that drain from narrow V shaped valleys, across alluvial fans onto the main valley floor. The bedrock is made up of siltstones, sandstones and shales. These impermeable layers cause a rapid runoff of water from rain and snowmelt. The western side of the watershed exhibits a more varied geology with shale, sandstone and some limestone. The presence of sinkholes is evidence of Karst geology in this part of the watershed.

According to the study conducted for the Restoration Plan, the soil types in the valley floor are a stony silt loams that are prone to high erosion rates. From 1948 to 1997 111.6 acres of farmland have been lost due to lateral erosion for an average of 8.57 acres lost annually. The study points out that during that time if 35 foot riparian wooded buffers had been employed for stream bank protection only 40.9 acres would have been taken out of production.

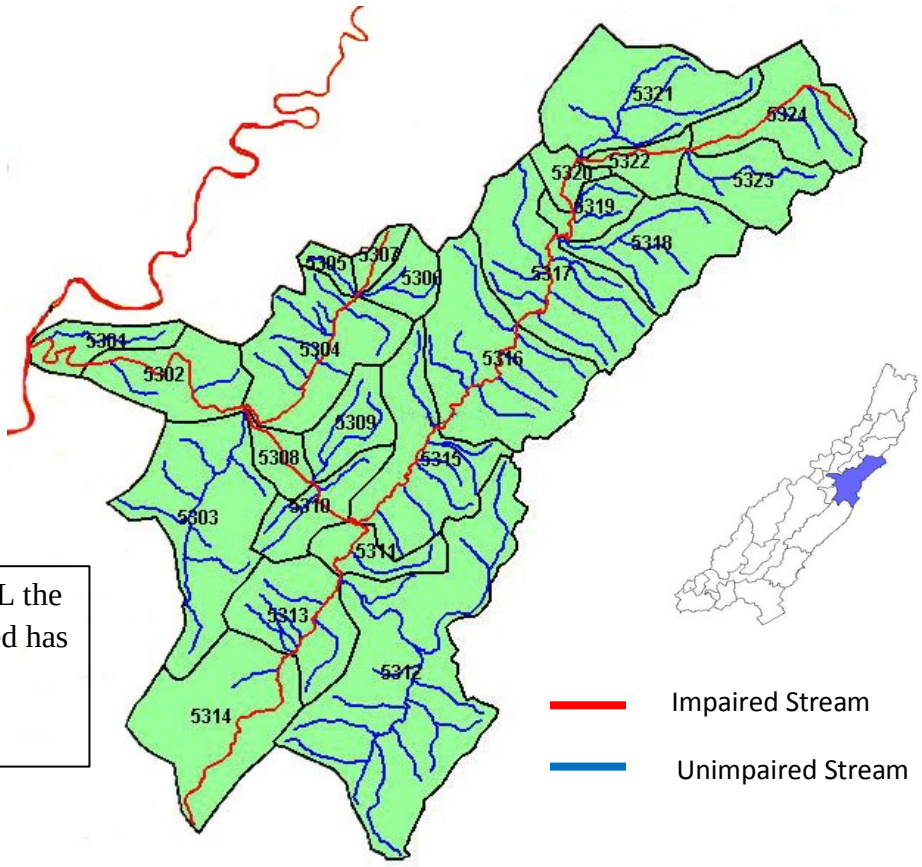


Figure 2: In the TMDL the Knapp Creek watershed has been divided into 24 subwatersheds

In 2008 a TMDL for the Greenbrier River was developed by DEP based on monitoring conducted in 2005. The monitoring showed high levels of fecal coliform bacteria throughout the watershed. The fecal coliform water quality standard was violated in three water bodies in the Knapp Creek watershed: Knapp Creek itself, Browns Creek and Douthat Creek. All three were placed on the 303(d) list of impaired streams in 2006.

Despite the impairments and sediment issues from eroding stream banks, Knapp Creek is a recreational fishery. Trout are stocked in the lower portions in the spring and fall of the year. The Greenbrier River itself is a highly valued recreational river supporting fishing, boating, kayaking and other water related recreation. In addition the 75 mile Greenbrier River Trail runs along-side the river from Cass to Caldwell, WV. In recent years the Greenbrier River has suffered severe algal blooms during low flow conditions due to high nutrient levels. The blooms usually start below the Hillsboro sewage treatment plant with intermittent outbreaks occurring the length of the river.

Figure 3: The old railroad trestle over Knapp Creek that is now a part of the Greenbrier River Trail. Photo by: Alvan Gale

CAUSES AND SOURCES

Section 303(d) of the federal Clean Water Act requires states to identify waterbodies that do not meet water quality standards and to develop appropriate TMDLs. A Total Maximum Daily Load (TMDL) establishes the maximum allowable pollutant loading for a waterbody to achieve compliance with established water quality standards. It also distributes the load among pollutant sources establishing load reduction goals from each source.

The TMDL for Greenbrier River watershed was approved by the U.S. Environmental Protection Agency (USEPA) in 2008. The TMDL model was based on extensive water quality monitoring from July 2004 through June 2005 by the DEP. The results of that monitoring were used to confirm the impairments to streams identified on previous 303(d) lists and to identify other impaired streams that were not previously listed.

Data obtained from pre-TMDL monitoring was compiled, and the impaired waters were modeled to determine baseline conditions and the gross pollutant reductions needed to achieve water quality standards. A TMDL is composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS) that accounts for uncertainty in the relationship between pollutant loads and the quality of the receiving stream. TMDLs can be expressed in terms of mass per time or other appropriate units. TMDLs are calculated by the following equation:

TMDL = sum of WLAs + sum of LAs + MOS

The determination of impaired waters involves comparing instream conditions to applicable water quality standards. West Virginia's water quality standards are codified at Title 47 of the *Code of State Rules* (CSR), Series 2, titled *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards*. Water quality standards consist of three components: designated uses; narrative and/or numeric water quality criteria necessary to support those uses; and an antidegradation policy.

In the Greenbrier River watershed, water contact recreation and public water supply are listed as the designated uses that have been impaired based on the water quality criteria for fecal coliform bacteria. The water quality standard for human health from 47 CSR, Series 2, *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards* is:

"**Human Health Criteria** Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN [most probable number] or MF [membrane filter counts/test]) shall not exceed 200/100 mL as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 mL in more than 10 percent of all samples taken during the month."

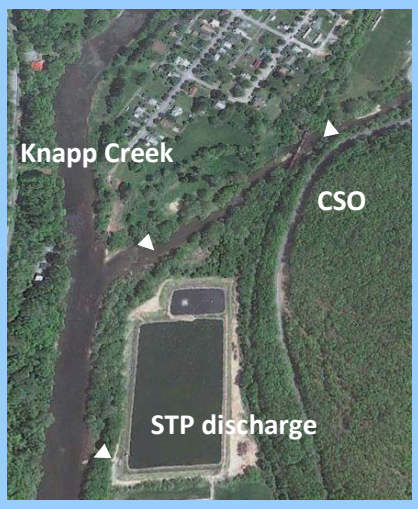
Knapp Creek, as a tributary to the Greenbrier River, shares the same impairments and sources. Three sources of fecal coliform pollution are listed for Knapp Creek: on-site wastewater treatment systems (septic systems), agriculture and the Marlinton sewage treatment plant.

Sewage Treatment

City of Marlinton Sewage Treatment Plant

In the TMDL a waste load allocation for the City of Marlinton Sewage Treatment Plant (STP) was placed in Knapp Creek. The TMDL identified Marlinton as a CSO community. The TMDL called for a fecal coliform reduction of 3.79 +13, a 100% reduction from the CSO. However some consideration is being given by DEP to a less than 100% elimination to the 200 counts/ 100 ml limit for the sewage treatment plant. The Town of Marlington has completed an Inflow and Infiltration (I/I) study. A Long Term CSO Control Plan was developed and is presently being updated to comply with permit requirements. The goal of the Plan is to reduce or eliminate the number and volume of CSO discharges.

Marlinton Sewage Treatment Plant discharge



The photo from Google Earth shows the spacing of the discharges in relation to the mouth of Knapp Creek.

The discharge point of the Marlinton POTW, Permit # WV 0024473001 CSO outlet 002, into Knapp Creek.

There is one sewage package plant in Browns Creek (SWS 5304) (Permit number WVG550415) which is in compliance with its discharge limits and has no required reductions from the plant Package plants are regulated under General Permit WV0103110 and are small, privately owned sewage treatment plants that have a design flow of less than 50,000 gallons per day.

On-site Wastewater Treatment

In the TMDL Knapp Creek was divided into 24 subwatersheds (Fig 2). All the subwatersheds are listed for 100% reductions in fecal coliform from failing septics systems except SWS 5314, the headwaters of Douthat Creek. SWS 5314 is shown to have no loading from failing septics because there are no residences in this subwatershed.

To calculate failing septic wastewater flows, the watersheds were divided into four septic failure zones during the source tracking process. Septic failure zones were delineated by geology, and defined by rates of septic system failure. Two types of failure were considered: complete failure and periodic failure. In the model a complete failure was defined as 50 gallons per house per day of untreated sewage escaping a septic system as overland flow to receiving waters. Periodic failure was defined as 25 gallons per house per day of untreated sewage escaping a septic system as overland flow to receiving waters. Table 1 from the TMDL shows the modeled percentage of homes with septic systems in each of the four septic zones experiencing septic system failure as determined by the source tracking process.

Figure 4: **Septic Failure Zones in Knapp Creek**

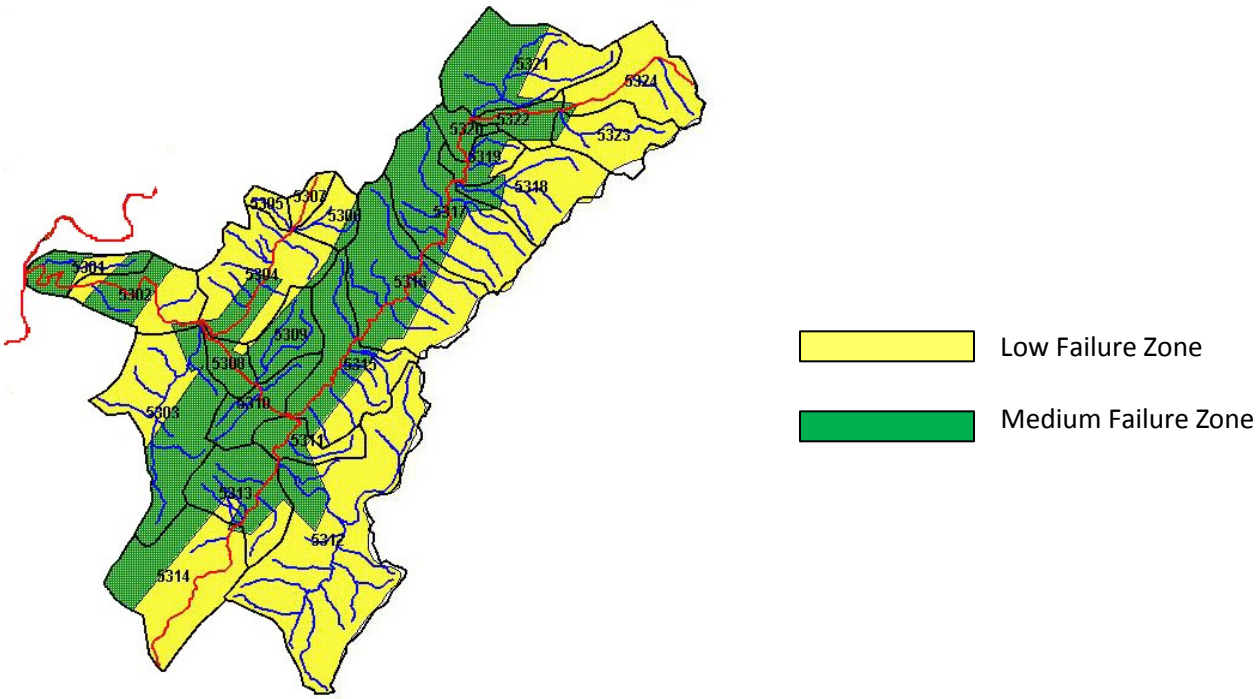


Table 1**: Percentage of septic system failure by septic failure zone**

Type	Zone			
	Very Low	Low	Medium	High
Periodic Failure	3%	7%	13%	19%
Complete Failure	5%	10%	24%	28%

As shown in Table 2 all the subwatersheds fall into the Low and Medium septic failure zones.

Table 2: **The Number of Homes in Knapp Creek by Septic System Failure Zone**

SUBID	Homes with septic systems by failure zone			
	Very Low	Low	Medium	High
5301	0.00	37.80	5.94	0.00
5302	0.00	5.40	3.24	0.00
5303	0.00	38.34	34.02	0.00
5304	0.00	50.22	38.88	0.00
5305	0.00	0.00	2.16	0.00
5306	0.00	14.04	8.64	0.00
5307	0.00	0.00	3.24	0.00
5308	0.00	49.68	0.00	0.00
5309	0.00	16.74	0.54	0.00
5310	0.00	16.20	0.00	0.00
5311	0.00	44.28	0.00	0.00
5312	0.00	12.42	24.30	0.00
5313	0.00	45.90	5.94	0.00
5314	0.00	0.00	0.00	0.00
5315	0.00	59.94	0.00	0.00
5316	0.00	52.38	0.00	0.00
5317	0.00	33.48	0.00	0.00
5318	0.00	3.24	0.00	0.00
5319	0.00	9.18	0.00	0.00
5320	0.00	19.44	0.00	0.00
5321	0.00	88.56	0.00	0.00
5322	0.00	50.22	0.00	0.00
5323	0.00	8.10	0.00	0.00
5324	0.00	4.32	33.48	0.00
Totals	0.00	659.88	160.38	0.00

The TMDL sets a target of zero load allocation for failing septic systems because West Virginia Bureau for Public Health (BPH) regulations prohibit the discharge of raw sewage into surface waters from all illicit discharges of human waste from failing septic systems and straight pipes. A base concentration of 10,000 counts per 100 mL was used as a beginning concentration for failing septics.

Table 3: **The Number of Homes with Periodic and Completely Failing Septic Systems**

			Home Septic System Failure Rate					
SUBID	Septic Failure Zone		Low Zone		Medium Zone		Total Failures/SWS	
	Low	Medium	Periodic	Complete	Periodic	Complete	Periodic	Complete
5301	37.80	5.94	2.65	3.78	0.77	1.43	3.42	5.21
5302	5.40	3.24	0.38	0.54	0.42	0.78	0.80	1.32
5303	38.34	34.02	2.68	3.83	4.42	8.16	7.11	12.00
5304	50.22	38.88	3.52	5.02	5.05	9.33	8.57	14.35
5305	0.00	2.16	0.00	0.00	0.28	0.52	0.28	0.52
5306	14.04	8.64	0.98	1.40	1.12	2.07	2.11	3.48
5307	0.00	3.24	0.00	0.00	0.42	0.78	0.42	0.78
5308	49.68	0.00	3.48	4.97	0.00	0.00	3.48	4.97
5309	16.74	0.54	1.17	1.67	0.07	0.13	1.24	1.80
5310	16.20	0.00	1.13	1.62	0.00	0.00	1.13	1.62
5311	44.28	0.00	3.10	4.43	0.00	0.00	3.10	4.43
5312	12.42	24.30	0.87	1.24	3.16	5.83	4.03	7.07
5313	45.90	5.94	3.21	4.59	0.77	1.43	3.99	6.02
5314	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5315	59.94	0.00	4.20	5.99	0.00	0.00	4.20	5.99
5316	52.38	0.00	3.67	5.24	0.00	0.00	3.67	5.24
5317	33.48	0.00	2.34	3.35	0.00	0.00	2.34	3.35
5318	3.24	0.00	0.23	0.32	0.00	0.00	0.23	0.32
5319	9.18	0.00	0.64	0.92	0.00	0.00	0.64	0.92
5320	19.44	0.00	1.36	1.94	0.00	0.00	1.36	1.94
5321	88.56	0.00	6.20	8.86	0.00	0.00	6.20	8.86
5322	50.22	0.00	3.52	5.02	0.00	0.00	3.52	5.02
5323	8.10	0.00	0.57	0.81	0.00	0.00	0.57	0.81
5324	4.32	33.48	0.30	0.43	4.35	8.04	4.65	8.47
Totals	659.88	160.38	46.19	65.99	20.85	38.49	67.04	104.48

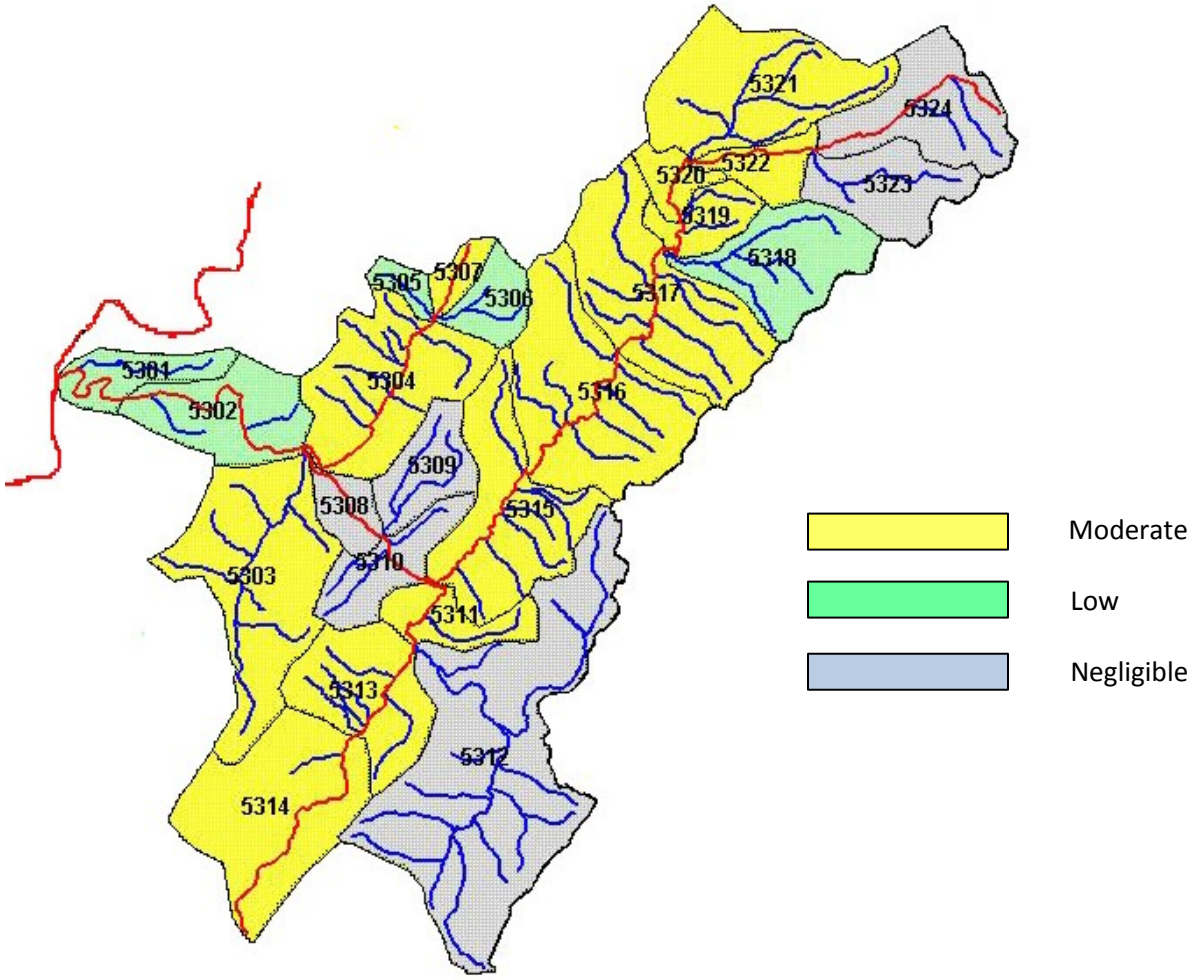
Table 3 above shows the number of homes in Knapp Creek with periodic and complete failures. For the entire watershed the modeled numbers are 67.04 homes with periodic failures and 104.48 homes with completely failing septic systems. For practical purposes these numbers will be rounded off to 68 periodic failures and 105 complete failures. Field inspections by the

Pocahontas County Health Department (PCHD) in cooperation with the WVCA and NRCS will determine the actual sites of failure to implement remedial practices.

Agriculture

Agricultural runoff potential was assessed by DEP during source tracking efforts. Pastures were categorized into four general types of runoff potential: high, moderate, low or negligible. In general, pastures with steeper slopes and livestock with stream access or close proximity to the stream channel received a high runoff potential assessment. Pastures in areas with gentle slopes, without livestock stream access, with greater distance to a stream, or where streams contained well-established riparian buffers received a negligible runoff potential. Fecal coliform build-up, wash-off and storage limit parameters in areas rated as high or moderate with respect to runoff potential were assigned higher values; pastures with negligible runoff potential were assigned values slightly above natural background conditions. Table 4 shows the 24 TMDL subwatersheds and their ranking for agricultural runoff potential.

Figure 5: **Knapp Creek Agriculture Runoff Potential Zones**



Pasture is the dominant agricultural land use along the valley floor for cattle, sheep and horses. A few farms also have row crops and there are some isolated patches of forest and shrub land. The negligible zones are located around the town of Huntersville and in headwater subwatersheds.

Table 4: **The Ranking of Subwatersheds by Agricultural Runoff Potential**

Ranking of Subwatersheds for Agricultural Runoff Potential

Moderate	Low	Negligible
5303	5301	5308
5304	5302	5309
5307	5305	5310
5311	5306	5312
5313	5318	5323
5314		5324
5315		
5316		
5317		
5319		
5320		
5321		
5322		

There were no subwatersheds ranked in the High runoff potential zone.

Grazing activities have impacted the stream bed and banks creating unstable conditions. In the past vegetative control practices such as spraying and mechanical removal of woody vegetation has eliminated this vegetation from the riparian zone. The result has been large scale stream bank erosion. This prompted the Upper Knapps Creek Watershed Restoration and Management Plan being implemented by the NRCS.

The lack of riparian vegetation also contributes to the runoff potential for sediment and fecal coliform from erosion of the surrounding land. Pasture and croplands usually exhibit the greater runoff potential because of the soil disturbance that occurs from livestock trampling and plowing. While grasslands, usually used for hay production, will exhibit a decreased runoff potential especially for sediment because of the lack of soil disturbance. However the practice of using manure from feeding areas to fertilize grasslands can contribute to fecal coliform levels from runoff especially if the riparian vegetative filter zoned has been removed.

Table 6 shows the subwatersheds ranked by the TMDL's baseline loading from pasture and croplands and color coded to the agricultural runoff potential zones. The table clearly shows that

the higher runoff potential (Moderate) has the highest fecal coliform counts. The one exception is the headwaters of Browns Creek (SWS 5307). The small amount of acreage involved accounts for is displacement in the table. Also evident is that the higher fecal counts come from the subwatersheds with a greater amount of acreage in pasture and cropland.

Table 5: **Fecal Counts by Agricultural Acreage**

SUBBASIN	STREAM NAME	Cropland (acre)	Grassland (acre)	Pasture (acre)	Pasture/Cropland Baseline Load (counts/yr)
5315	Knapp Creek	27.31	528.12	323.69	4.21E+13
5321	Sugar Camp Run	9.01	246.05	150.80	2.70E+13
5304	Browns Creek	13.74	295.54	181.14	2.32E+13
5303	Cummings Creek	0.00	242.16	148.42	1.84E+13
5316	Knapp Creek	26.21	389.53	238.74	1.57E+13
5322	Knapp Creek	6.94	123.21	75.52	1.07E+13
5313	Douthat Creek	0.00	131.60	80.66	9.98E+12
5317	Knapp Creek	31.92	228.14	139.83	9.75E+12
5311	Douthat Creek	0.00	103.93	63.70	7.88E+12
5320	Knapp Creek	4.43	149.32	91.52	6.19E+12
5319	Knapp Creek	11.28	68.52	41.99	3.29E+12
5314	Douthat Creek	0.00	24.79	15.19	1.88E+12
5301	Knapp Creek	2.51	129.19	14.35	8.90E+11
5306	Sampson Pike Hollow	0.00	80.63	8.96	8.06E+11
5302	Knapp Creek	0.00	111.83	12.43	7.20E+11
5307	Browns Creek	0.00	20.21	12.39	7.18E+11
5318	Moore Run	0.00	43.56	4.84	3.16E+11
5305	Moody Moore Hollow	0.00	19.60	2.18	1.26E+11
5308	Knapp Creek	0.00	100.66	0.00	0.00E+00
5309	Possum Hollow	0.00	172.18	0.00	0.00E+00
5310	Knapp Creek	0.00	71.94	0.00	0.00E+00
5312	Laurel Creek	0.00	136.16	0.00	0.00E+00
5323	Bird Run	0.00	6.18	0.00	0.00E+00
5324	Knapp Creek	0.00	16.68	0.00	0.00E+00
	Totals	133.35	3439.73	1606.35	

Other Sources

Urban Runoff: The potential for urban runoff contributions to fecal coliform pollution occurs mainly in the city of Marlinton (SWS 5301). Runoff from residential and urbanized areas during storm events can be a significant source, delivering bacteria from the waste of pets to the waterbody. SWS 5301 does exhibit the highest fecal coliform baseline load for residential sources in Knapp Creek, a 12.7E+10 counts/year and the highest impervious area, 31.75 acres. However the TMDL does not consider this high enough to require a reduction. Street drainage for Marlinton is routed through the sewage system which, as already discussed, is a part of the CSO.

Logging: Much of the Knapp Creek watershed lies within the Monongahela National Forest with some privately owned forested areas as well so that nearly 90% of the watershed is forested. Logging is one of the most vital economic activities in Pocahontas County, which includes all of Knapp Creek. Logging's primary impact on streams is the potential for increased sediment and rarely causes an increase in fecal coliform contamination. This land use has not been considered within the Greenbrier River TMDL.

Logging activities are regulated by the Logging Sediment Control Act enforced by the WV Division of Forestry (DOF). All logging operations must obtain a permit from DOF and comply with prescribed logging best management practices.

Stream bank erosion: Sediment from eroding stream banks contributes to the overall degradation of biological quality. Stream bank erosion was so severe, especially in the upper part of the watershed, that NRCS had the Upper Knapps Creek Watershed Restoration and Management Plan developed. The monitoring by DEP during the TMDL development process did not indicate biological impairment sufficient to warrant a sediment TMDL. However stream bank stabilization projects have been implemented for 8 years and are essential for the development of riparian buffer zones for reducing fecal coliform contamination from farms.

Figure 6: Just one example of eroding banks in Knapp Creek. Also as a part of the bank erosion process there are areas of excessive deposition and stream meandering visible as well.

Photo: Alvan Gale

LOAD REDUCTIONS REQUIRED

The load reductions being called for in this watershed based plan are based on the TMDL for the entire Greenbrier River watershed. The TMDL is a load allocation that expresses what is allowed to enter the stream. Load reduction (LR) targets are determined by subtracting the TMDL from baseline load (BL) levels:

LR= BL – TMDL

LR is the accumulated reductions from practices installed during the implementation process. As such, it becomes the primary criteria for tracking environmental results.

Table 6: **TMDL for the Knapp Creek Watershed**

Stream Name	Baseline LA (counts/day)	LA (counts/day)	Baseline WLA (counts/day)	WLA (counts/day)	MOS (counts/day)	TMDL (counts/day)	% Reduction
Knapp Creek	6.94E+11	5.53E+11	1.04E+11	2.88E+07	2.91E+10	5.82E+11	30.63
Browns Creek	8.57E+10	5.39E+10	2.88E+07	2.88E+07	2.84E+09	5.67E+10	37.15
Douthat Creek	1.09E+11	1.08E+11			5.66E+09	1.13E+11	1.01

The TMDL shows the waste load allocation from the Marlinton sewage treatment plant requiring a reduction of 1.0378E+11 and an additional margin of safety of 1.44E+6. As explained in Section A the town of Marlinton is in the process of updating the long range plan for eliminating the CSO discharge. Assuming that this plan will enable Marlinton to eliminate the CSO and come into compliance with the TMDL the WLA and the 1.44E+6 associated MOS will be removed from load reduction calculations. This would make the MOS 2.77E+10 counts/day and slightly decrease the TMDL for Knapp Creek to 5.81E+11 counts/day. The total reduction of fecal coliform required to restore Knapp Creek would be 1.13E+11 counts/day, assuming CSO elimination. Since BMP efficiencies are measured in the annual reductions they cause the TMDL target reductions will be measured in counts/year.

Table 7: **TMDL Reductions for Knapp Creek**

Stream Name	Baseline LA (counts/yr)	LA (counts/yr)	MOS (counts/yr)	TMDL (counts/yr)	% Reduction	LR (counts/yr)
Knapp Creek	2.53E+14	2.02E+14	1.01E+13	2.13E+14	20.26	4.07E+13
Browns Creek	3.13E+13	1.97E+13	1.04E+12	2.07E+13	37.16	1.06E+13
Douthat Creek	3.96E+13	3.92E+13	2.07E+12	4.13E+13	1.01	-1.67E+12

Douthat Creek presents a dilemma for the TMDL modeling process. As Table 7 shows the TMDL actually exceeds the baseline load and the LR is a negative number. DEP's explanation on this issue is that by the modeling process Douthat Creek is clean. The load reduction that would be required does not exceed the required MOS. However three out of the eleven samples taken during the TMDL monitoring exceeded water quality standards, one was a high 1600 counts/100 ml. Therefore by DEP's 303(d) listing methodology (10% of instantaneous samples exceed 400 counts/100 ml) Douthat Creek was impaired and required the stream to be listed and a TMDL to be developed. However, this does indicate that it shouldn't take much to fully restore Douthat Creek and remove it from the 303(d) list. The LR will be based on the formula LR=BL-LA with the MOS ignored.

On-site Wastewater Systems

Table 8: **Load Reductions for Failing Septics by SWS**

	Total Failures/SWS		
SUBID	Periodic	Complete	TMDL LR counts/yr
5301	3.42	5.21	1.20E+11
5302	0.80	1.32	2.97E+10
5303	7.11	12.00	2.69E+11
5304	8.57	14.35	3.22E+11
5305	0.28	0.52	1.14E+10
5306	2.11	3.48	7.83E+10
5307	0.42	0.78	1.71E+10
5308	3.48	4.97	1.16E+11
5309	1.24	1.80	4.19E+10
5310	1.13	1.62	3.78E+10
5311	3.10	4.43	1.03E+11
5312	4.03	7.07	1.57E+11
5313	3.99	6.02	1.38E+11
5315	4.20	5.99	1.40E+11
5316	3.67	5.24	1.22E+11
5317	2.34	3.35	7.81E+10
5318	0.23	0.32	7.56E+09
5319	0.64	0.92	2.14E+10
5320	1.36	1.94	4.54E+10
5321	6.20	8.86	2.07E+11
5322	3.52	5.02	1.17E+11
5323	0.57	0.81	1.89E+10
5324	4.65	8.47	1.87E+11

It should be noted that SWS 5314 is not listed for any reductions from failing septics and subwatersheds 5303,5305, 5306, 5309, 5312, 5318, 5321 and 5324 are not listed as impaired. However their combined contributions to Knapp Creek are significant enough that implementation of repairing failing septic systems should not be restricted in those subwatersheds. The load reductions from failing septics needed in the three 303(d) listed streams are:

Knapp Creek 1.8E+12 counts/year

Browns Creek 3.4E+11 counts/year

Douthat Creek 2.4E+11 counts/year

Agriculture

Agriculture is the primary economic activity in Knapp Creek and raising livestock is the main type of farming in the watershed. Therefore most of the load reductions from agriculture will be aimed at livestock pasturing. The TMDL only calls for load reductions in six subwatersheds (Table 10) one is Browns Creek and the other five are all part of the upper Knapp Creek watershed above the confluence with Douthat Creek. These subwatersheds will be the primary focus of agriculture BMP installations but tributary contributions will be given consideration. Farm boundaries sometimes do not follow subwatershed boundaries and in developing a comprehensive conservation plan, the farm is the unit for planning.

Table 9: **TMDL Load Reductions**

SWS	Stream Name	Stream Code	Pasture/Cropland Baseline Load (counts/yr)	Pasture/Cropland Allocated Load (counts/yr)	Load Reduction (counts/yr)	Pasture/Cropland Percent Reduction
5304	Browns Creek	WVKNG-53-D	2.32E+13	1.20E+13	1.12E+13	48.3
5315	Knapp Creek	WVKNG-53	4.21E+13	2.21E+13	2.00E+13	47.5
5316	Knapp Creek	WVKNG-53	1.57E+13	1.02E+13	5.50E+12	35.0
5319	Knapp Creek	WVKNG-53	3.29E+12	2.74E+12	5.50E+11	16.7
5320	Knapp Creek	WVKNG-53	6.19E+12	4.07E+12	2.12E+12	34.3
5321	Sugar Camp Run	WVKNG-53-Y	2.70E+13	1.74E+13	9.55E+12	35.4
		Totals	**1.18E+14**	**6.86E+13**	**4.89E+13**	41.6

Sugar Camp Run (5321) is not listed on the 303(d) list however it is a significant contributor to fecal coliform impairment to Knapp Creek. Figure 5 on page 9 shows that all of these subwatersheds fall into the highest agriculture runoff potential zone (Moderate) for the watershed. Two other subwatersheds also are included in that zone: Cummings Creek and Douthat Creek. Cummings Creek is not considered impaired and the TMDL does not call for

any load reductions from that stream. Douthat Creek's load reductions are small and will be accomplished by repairing septic systems.

To predict how practices installed in the future will affect the pollution in these streams the modeled fecal coliform count for the livestock, if the animal had direct access to the stream, must be known. These counts would be the maximum count per animal. Other factors considered in the TMDL model included rainfall, runoff potential, seasonal variance and bacterial die off when deposited on the land. Other variables that can affect load reduction calculations are: the amount of time livestock spends in or near a stream; the mobility of the livestock and the location of feeding and watering areas especially during the wet winter season. All factors taken together have resulted in the modeled TMDL baseline for the subwatersheds.

NRCS surveys for the six agricultural impacted subwatersheds shows that there are 1320 head of cattle, 580 yearlings, 30 sheep and 110 horses and mules. To be able to calculate the environmental effect of BMP installation a TMDL compatible loading per animal is needed along with the estimated efficiency of the BMP. To accomplish this, the different species of animals must be standardized into an Animal Unit (AU). The conversion is based upon the Maryland Department of Agriculture's Animal Unit Equivalencies. Some other assumptions need to be made to calculate load reductions:

1) The TMDL model is the basis for estimating fecal coliform survival and entry into the stream.
2) The AUs remain stable over time and are the same numbers and species that existed in the watershed at the time of source tracking for the TMDL.

Table 10: **Number of Animal Units in TMDL Target Subwatersheds**

Animal Type	AU Equivalency	# of Animals	Total AUs
Cattle	1	1320	1320
Yearlings	0.75	580	435
Horses/Mules	2	110	220
Sheep	0.1	30	3
Totals		2040	1978

Using these assumptions the total number of AUs in the six subwatersheds of concern is 1978. Considering the baseline load from the TMDL of 1.18E+14 as the starting point this would give a loading of 5.94E+10 counts/year per AU.

To sum up the TMDL target load reductions for agriculture the BMPs must achieve a load reduction of 4.89E+13 counts/year or a 41.6% reduction from agricultural sources.

Projects Completed Since TMDL Monitoring, 2005

Since the monitoring for the TMDL was conducted by DEP in 2005 the NRCS has continued with projects outlined in the Restoration Plan. Each stream bank stabilization project requires the protection of the riparian zone. This means that fencing, riparian zone plantings and other agricultural BMPs are employed. While the goal of the Restoration Plan may be to stabilize the creek banks and save farmers' land another effect of these projects is to reduce livestock access and resultant fecal coliform pollution.

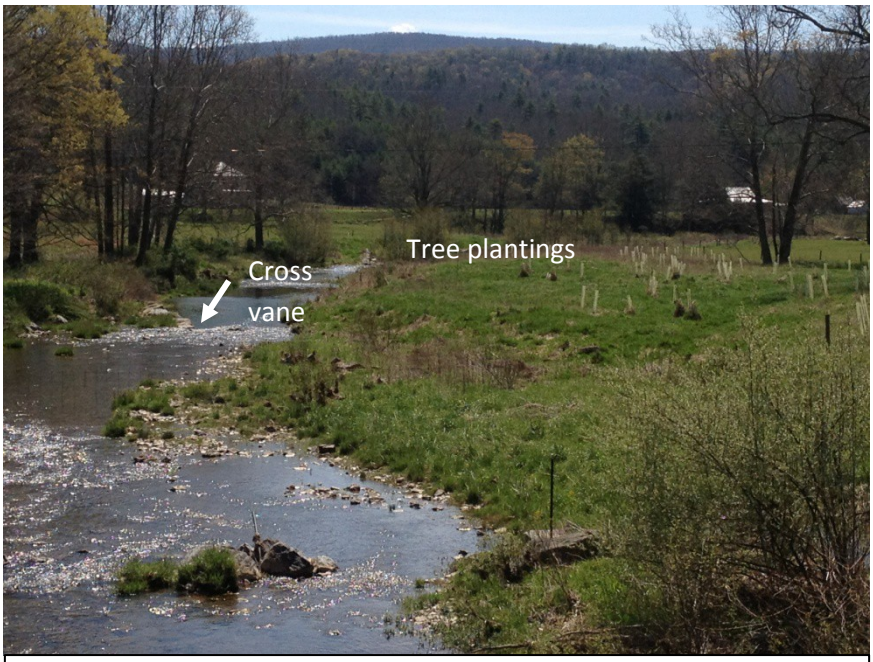


Figure 7: Knapp Creek: This photo shows a completed project. Existing trees on the left were kept intact. Cross vanes and other NSCD structures enables sediment transport and on the right fencing keeps livestock out and the visible tree guards protects tree plantings from deer. Photo: Alvan Gale

One project from the restoration plan was completed in 2004 (photo above) and will not be considered a post-TMDL load reduction. However, two projects, both in SWS 5315, were completed in 2011 and should be considered as BMPs installed after TMDL monitoring and counted for load reductions. The two projects together accounted for 3060 linear feet of stream bank stabilization with supportive BMPs that removed 115 cows and 60 yearlings from Knapp Creek. The corresponding load reduction for SWS 5315 is estimated as 7.6E+12. In addition 4000 feet of riparian protection fencing was installed in Guy Run in SWS 5316 removing 15 head of cattle from stream access. The estimated load reductions from these post-TMDL projects would be 8.32E+12.

MANAGEMENT MEASURES

The point sources of fecal coliform pollution in Knapp Creek are regulated by the DEP. The one source cited for exceeding its permitted discharge is in the process of updating its long term management plan. By law this source must be either eliminated or reduced to within the limits allotted to the Marlinton POTW. The majority of fecal coliform pollution is coming from nonpoint sources, primarily agriculture. The focus of this plan is to address these nonpoint sources.

All management measures to be installed to restore these streams must come about with the voluntary cooperation of the landowners. To do this the project managers will offer a variety of practices which can be specifically designed or combined to suit the circumstances for each farm or residence. The two primary causes of impairment according to the TMDL are inadequate on-site wastewater treatment (failing septic systems) and livestock pasture.

On-site wastewater treatment:

Two categories of failing septic systems have been identified: completely and periodically failing systems. Experience has shown that completely failing systems usually indicates a lack of any system or one that is so antiquated or poorly maintained it fails on a year round basis. Periodically failing systems are usually septic systems that are not being properly maintained so that the drain fields are not functioning as they should and fail during the wet season. To determine the specific needs a field survey must be conducted first to identify problem sites. This will require the participation of the Pocahontas County Health Department (PCHD. Once a problem site has been identified a specific project plan can be developed and must be approved by the PCHD.

Completely failing systems usually require the installation of a new or upgraded system. New or upgraded systems will be installed in compliance with Health Department regulations based on home size and soil porosity and must be approved by the PCHD Sanitarian. The average cost for such a project is about $7500 but can range widely due to specific circumstances. Similar efforts in other watersheds throughout the state have used a combination of Section 319 grants administered through DEP and low interest loans from the On-Site Loan Program (OSLP) to fund these system replacements.

Periodically failing systems are usually systems where pumping the system combined with proper maintenance will solve the problem. One potential solution that has been used successfully in some Potomac watersheds is to offer residents partial payment coupons for septic tank pumping in combination with an educational effort to inform homeowners how to maintain their system in the future. In most cases this has cost less than $500 per home. Due to the sparse population density in the watershed cluster systems would not be cost effective. However if the survey shows a grouping of failures in one location such a system could be an option.

Livestock Pasture

To reduce fecal coliform pollution of these streams technicians with the WVCA and the NRCS will work closely with the farmers to develop conservation plans. The goal of these plans will be to install practices that will reduce the time livestock spend in or near a stream or ephemeral drainage. These practices will also have the intent of dispersing the livestock to avoid serious damage from trampling and manure build up. These management measures will be planned to assure they meet the overall load reduction required by the TMDL. These BMPs will be implemented through sound conservation planning and funded by various State programs, Federal Farm Bill Programs, Section 319 grants and landowner contributions. Where appropriate, these practices will be combined with the stream bank restoration work already in progress. The result will be a comprehensive conservation plan for each farm.

The following BMP's are practices recommended by NRCS that are necessary to achieve the goals of the TMDL target reductions.

Conservation Plans: A record of landowners' decisions combined with a combination of agronomic, management and engineered practices that protect and improve soil productivity and water quality; the plan must meet agency technical standards. These plans include technical advice prepared by a certified conservation planner. All practices included in the USDA Natural Resources Conservation Service Field Office Technical Guide are eligible to be included in a conservation plan.

Alternative watering sources, with fencing: To reduce occurrences of livestock coming into direct contact with a stream or other waterway, a narrow strip of land along the stream bank can be fenced off. Alternative watering sources, such as spring development and wells with pipelines and troughs, must then be provided for the livestock. This will prevent livestock form defecating in or close to the stream, and reduce stream bank erosion. NRCS conservation practices that can accomplish this are: 378 Pond, 382 Fence, 516 Pipeline, 533 Pumping Plant for Water Control, 574 Spring Development, 587 Structure for Water Control, 614 Watering Facility, 636Water Harvesting Catchment, 642 Well, 472 Access Control. These practices correspond to BMP efficiencies in Table 12 for: off-site watering systems and fencing.

Heavy Use Area Protection: Practices that restore or put into proper use, areas that are or have been used by large numbers of areas for feeding, walking, loafing. NRCS conservation practices that can accomplish this are: 313 Waste Storage Facility, 342 Critical Area Planting, 484 Mulching, 512 Pasture & Hayland Planting, 528 Prescribed Grazing, 560 Access Road, 561 Heavy Use Area Protection, 575 Animal Trails and Walkways, 561 Heavy Use Area Protection., as well as various erosion and sediment control measures according to the WV Erosion and Sediment Control Handbook. These practices correspond to BMP efficiencies in Table 12 for: Sediment Pond/Swale in combination with filter strip and fencing.

Nutrient Management Plans: Farm operators develop a comprehensive plan that describes the optimum use of nutrients to minimize nutrient loss while maintaining yield and appropriate ground cover. NRCS conservation practices that can accomplish this are: 100 CNMP Development, 313

Waste Storage Facility, 316 Animal Mortality Composter, 328 Conservation Crop Rotation, 329 Residue Management, 340 Cover Crop, 590 Nutrient Management, 634 Manure Transfer. These practices correspond to BMP efficiencies in Table 12 for: Waste Stabilization Lagoon and fencing.

Animal Waste Management Systems: livestock and Poultry operators design practices for proper storage, handling, and use of wastes generated from confined animal operations. This includes a means of collecting, scraping, or washing wastes and contaminated runoff from confinement areas into appropriate waste storage structures. For poultry operations, litter sheds are typically used. Livestock feedlots and dairies commonly utilize waste lagoons or move animal feeding areas away from the streamside. NRCS conservation practices that can accomplish this are: 313 Waste Storage Facility, 359 Waste Treatment Lagoon. These practices correspond to BMP efficiencies in Table 12 for: waste stabilization lagoon and fencing.

Nutrient Relocation: Farm operators who manage waste storage facilities will retain the right to retain all the manure necessary for their own fertilization purposes, but will be willing to give excess manure to other farmers to spread on hay, pasture, or cropland as an alternative source. NRCS conservation practices that can accomplish this are: 590 Nutrient Management, 634 Manure Transfer. These practices correspond to BMP efficiencies in Table 12 for: Waste Stabilization lagoon and fencing.

Natural Stream Channel Design (NSCD): NSCD is the focus of the Restoration Plan in the upper Knapp Creek watershed. It relies on a geomorphic approach using natural stability concepts. The objectives are to restore a stable, self maintaining channel form, reestablish interactions between stream and adjacent riparian areas and restore the natural functions of floodplains. Each problem area is assessed and the projects are designed to accomplish the objectives. Some of the techniques used in these projects include: root wad and boulder revetment, cross vanes, rock vanes, boulder structures such as J hooks and weirs and toe benches. Critical to the success of any NSCD is the establishment of a protected riparian area.

Figure 8: Knapp Creek: A cross vane redirects the current away from a vulnerable slip and creates a bench at the foot. Photo: Alvan Gale

Land Use Covenants: These covenants would control or restrict certain land use activities in highly sensitive areas.

Conservation Easements: These easements compensate landowners for voluntarily restricting their activities in sensitive areas.

Riparian Buffer practices: Areas of vegetation (herbaceous or woody) that are tolerant of intermittent flooding or saturated soils and that are established or managed in the transitional zone between terrestrial and aquatic habitats. NRCS conservation practices that can accomplish this are: 314 Brush Management, 390 Riparian Herbaceous Cover, 412 Waterways, 468 Lined Waterways, 490 Tree/Shrub Site Prep, 612 Tree/Shrub Establishment, 391 Riparian Forest Buffer. These practices correspond to BMP efficiencies in Table 12 for: Buffer and fencing.

Filter Strip: A strip or area of herbaceous vegetation situated between cropland, grazingland, or disturbed land (including forestland) and environmentally sensitive areas. NRCS conservation practices that can accomplish this are: 393 Filter Strip. These practices correspond to BMP efficiencies in Table 12 for: Filter Strip and fencing.

Erosion and sediment control: Practices that protect water resources from sediment pollution and increases in runoff associated with land development activities. By retaining soil on-site, sediment and attached nutrients are prevented from leaving disturbed areas and polluting streams. *Examples:* Silt fence, slope drain, permanent vegetation. NRCS conservation practices that can accomplish this are: 342 Critical Area Planting, 395 Stream Habitat Improvement and Management, 580 Streambank and Shoreline Protection, 362 Diversion, and 561 Heavy Use Area Protection. Other practices are available and located in the WV Erosion and Sediment Control Handbook. These practices correspond to BMP efficiencies in Table 12 for: sediment ponds/swale in combination with filter strip.

Table 11: **BMP Efficiencies**

BMP	Efficiency Rate
Filter Strip	70%
Single Stage Waste Stabilization Lagoon	85%
Sediment Pond/Swale in Combination with Filter Strip	85%
Fencing (complete removal of livestock from waterway)	90%
Buffer	80%
Off Watering System Without fencing	50%
Off Site Watering System With Flash Rotational Grazing In the Riparian Zone	90%

Riparian buffer strips and the supporting BMPs such as alternative watering systems and fencing are given a higher priority under the EQIP National Water Quality Initiative (page 23). Other BMPs may be employed, according to an approved NRCS list, but will be ranked lower in priority.

TECHNICAL AND FINANCIAL RESOURCES

Technical Resources:

West Virginia Conservation Agency (WVCA) – The WVCA will be the applicant for CWA Section 319 grants on this effort and will provide the technical assistance needed for implementation. The WVCA coordinates statewide conservation efforts to conserve natural resources, control floods, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, conserve wildlife and assist farmers with conservation practices. The WVCA Environmental Specialists (ES) will coordinate with other agencies and work directly with landowners to implement the practices called for in this watershed based plan. The WVCA ES will also conduct monitoring to determine the environmental results for the three impaired streams. They will also produce grant proposals and status reports.

The Natural Resources Conservation Service (NRCS) – The NRCS is the federal agency that works directly with farmers for designing and installing practices. In West Virginia they work closely with the WVCA for installing BMPs. The NRCS is the agency that has been implementing the Upper Knapps Creek Watershed Restoration and Management Plan and will continue that plan. The NRCS also implements the Wildlife Habitat Improvement Program (WHIP) and the Conservation Reserve Enhancement Program (CREP).

The West Virginia Department of Environmental Protection (DEP) – The DEP is the agency with primary responsibility for protecting the environment including stream water quality. The Nonpoint Source Program (NPS) within the DEP administers the Section 319 grants and the Basin Coordinators in the program work closely with project managers to accomplish the approved watershed based plans including assistance, if needed, with monitoring. The NPS also has experience and materials for outreach, education and volunteer monitoring. The Watershed Assessment Branch (WAB) includes the programs that develop the integrated watershed report with the 303(d) list of impaired streams, the TMDL and conduct water quality monitoring around the state. After completion of the installation of practices it will be WAB that makes the final determination if the TMDL has been fully implemented.

The Pocahontas County Health Department (PCHD) – The PCHD has the primary responsibility of inspecting and approving all on-site wastewater systems in Pocahontas County. The PCHD will have to conduct the initial survey to locate failing on-site systems. Through their contacts with homeowners the education of how to maintain an on-site system will be affected. The PCHD Sanitarian will have to select, inspect and approve all practices to be used in the treatment of failing septic systems.

The Pocahontas County Water Resources Task Force (WRTF) – The WRTF is a county based group who are developing a water management plan in cooperation with the DEP's Water

Use Program. While most of the emphasis for this group will be on surface and ground water quantity, issues of water quality and education will be addressed by the WRTF.

Financial Resources

Clean Water Act Section 319 Grants – 319 funds are provided to the state by the US Environmental Protection Agency (EPA). In West Virginia these funds are distributed by the DEP for agencies or organizations who are conducting projects related to nonpoint source pollution.

The WVCA – provides up to 15% cost share for agricultural practices associated with an approved Section 319 grant proposal.

Conservation Reserve Enhancement Program (CREP) – CREP is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. CREP addresses high-priority conservation issues in priority watersheds as designated by the NRCS State Conservationist.

Wildlife Habitat Incentive Program (WHIP) - WHIP is a voluntary program for landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land.

Environmental Quality Incentive Program (EQIP) – EQIP is a voluntary conservation program that provides assistance to farmers who face threats to soil, water, air, and related natural resources on their land. The NRCS through EQIP offers financial and technical assistance to eligible participants to install or implement structural and management practices to promote agricultural production and optimize environmental benefits to help farmers meet environmental requirements on eligible agricultural land. The USDA has selected Knapp Creek for receiving funding from the National Water Quality Initiative in 2012, an EQIP funded program.

> ***National Water Quality Initiative (NWQI) –*** The NWQI will assist farmers to address water resource concerns in high priority small watersheds that are impaired, threatened or critical to impaired waters. States will reserve 5% of EQIP funding for the NWQI. Knapp Creek is set to receive $300,000 in 2012. Watershed efforts will be evaluated on an annual basis for progress in using these funds. New funding may be continued in other years if progress is satisfactory.
>
> The emphasis of the BMPs to be installed is to avoid, control or trap pollutants from agriculture. The trapping of pollutants emphasis does include creating vegetated buffers as already has been done in Knapp Creek with a plan for many more. Any watershed in the NWQI program is expected to have a watershed based plan or an inventory and

assessment of the watershed. This watershed based plan in conjunction with the Restoration Plan will serve that purpose.

The WV Onsite State Revolving Fund Program (OSLP)- is administered through the DEP. This program can be used to provide loan funding for individual onsite systems as well as homeowner-owned components of decentralized systems

WV Infrastructure and Jobs Development Council (IJDC) - Most sources of public funding for wastewater infrastructure are administered by the IJDC.

Landowners – Farmers will provide 25% matching funds for practices developed on their property. Much of these funds will be in kind for labor, equipment use, and materials. Homeowners who participate in any septic project will provide 40% of the funding.

Estimated Financial Needs

The estimated budget for this restoration effort includes both the Restoration Plan costs and fecal coliform treatment costs. The cost estimates are based on averages for West Virginia and can vary considerably. Personnel costs are not included, with the exception of conservation planning, because the project specialists will be funded from other sources. The estimated average cost for NSCD projects is $185 per linear foot, however NRCS is using in-house assessment and engineering to reduce costs to $80 per linear foot, the cost of construction.

Table 12: **Cost Estimates for BMPs**

BMP	Unit cost	Unit
Livestock fencing	$2	linear foot
Riparian buffer establishment	$1,000	acre
Armored stream crossing	$1,200	18” culvert, 20’ length
	$2,800	30” culvert, 30’ length
	$5,900	48” culvert, 40’ length
Alternative watering source	$3,000	unit
Conservation plans	$150	plan
Critical area planting	$720	acre
Armored, roofed feeding area	$75,000	unit
Stream channel stabilization	$80	linear foot
Septic system replacement	$7,500	unit
Septic system pumping	$500	unit action

The Restoration Plan called for twenty five projects along Knapp Creek. Three of these projects have already been completed encompassing a total of 2200 ft in SWS 5319 and 3260 ft in SWS 5315 for a cost of $436,800. The remaining projects’ location within the TMDL subwatersheds, the linear feet of bank stabilization and estimated costs are summarized in Table 14.

Table 13: **Restoration Plan Projects and Costs**

SWS ID	# of Projects	Linear feet	Estimated Cost
5315	6	12,370	$989,600
5316	7	16,075	$1,286,000
5317	5	9,850	$788,000
5319	3	5,860	$468,800
5320	1	3,790	$303,200
5322	3	4,450	$356,000
Total	**25**	**52,395**	**$ 4,191,600**

Before any stream bank stabilization project can proceed the landowner must agree to protecting the project by fencing out any livestock and allowing the area to become a riparian buffer strip. The total expected buffer in upper Knapp Creek will equate to 46.49 acres with an estimated cost of $46,490. There has been 4.39 acres of buffer established with tree plantings equating to $4,390.

Browns Creek SWS 5304 is the only other subwatershed with agriculture reductions in the TMDL. NSCD could be used in Browns Creek but it is not the primary BMP emphasis as it is in the upper Knapp Creek. Browns Creek is approximately 4.5 miles of flow through agricultural lands. The WVCA will take the lead on promoting and planning BMPs in Browns Creek. It is anticipated that it will take an estimated 25,000 feet of fencing and 12 alternative water sources in addition to all conservation and nutrient planning.

Combining the BMP needs of Browns Creek with the upper subwatersheds of Knapp Creek the estimated BMPs to be installed are:

1. 80,000 feet of fencing
2. 40 alternative watering structures
3. 20 armored stream crossings
4. 40 Conservation plans

The estimated budget for this watershed based plan includes all of these practices plus those included in the Restoration Plan and the anticipated costs to comply with the TMDL septic system repairs and replacements. Most personnel costs and other in-house costs are not included in the budget because the participating agencies are contributing these costs. In each case the personnel who will manage this plan are already employed with the agency.

The budget exhibited in Table 14 is an estimation of the cost of what is known and the expected BMPs to be implemented to restore Knapp Creek to water quality standards, with the exception of the costs the town of Marlinton will incur to eliminate the CSO as required by law. Since the

plan encompasses years of implementation, inflation will be a factor raising the cost or reducing the practices. In addition landowner acceptance, participation and cooperation are factors that can affect costs. Therefore it would be prudent to expect the total anticipated budget costs to be approximately $5.5 million.

Table 14: **Watershed Based Plan Budget**

Budget for Knapp Creek TMDL Implementation			
BMP	**Quantity**	**Cost/BMP**	**Total Cost**
Septic Replacement	105	$7,000	$735,000
Septic Repair	68	$500	$34,000
Fencing	80,000	$2	$160,000
Riparian buffers	43	$1,000	$43,000
NSCD	52,395	$80	$4,191,600
Alternative water	40	$3,000	$120,000
Armored crossings	20	$5,900	$118,000
conservation planning	40	$150	$6,000
Monitoring	5	$1,000	$5,000
Education	5	$100	$500
Total Budget			**$5,413,100**

INFORMATION AND EDUCATION

In any watershed restoration effort informing and educating the residents of the watershed and all other stakeholders is vital. In rural watersheds a small population the most important form of that communication is done face to face. The NRCS Conservationist and the WVCA Environmental Specialist has already started that process by contacting local farmers. It will be their responsibility to directly inform each farmer about the water quality issues as well as productivity issues. They will work closely with each farmer to design and customize each conservation plan to meet the TMDL while helping the farmer improve his operation.

For the onsite wastewater issue the WVCA and DEP will assist the PCHD in passing out information packets and brochures to the residents. Face to face contacts between the involved agencies and homeowners will be made to explain the problems and solutions.

The WVCA will also contact local organizations such as the 4-H to set up educational efforts. Field visits and farm tours especially after BMP installation will be conducted. Since Knapp

Creek is stocked with trout it offers an opportunity to inform fishermen of the projects and principles of stream restoration and protection with informational displays. Finally an attempt will be made to use the WV Save Our Streams volunteer monitoring program as both an educational tool and to promote citizen involvement in protecting their watershed.

The WRTF also has an educational component in its tasks. The WRTF educational efforts include water related classrooms for the local schools, sponsoring WVSOS events and general outreach to the public. The WRTF has also sponsored surveys regarding public interests and concerns in producing their county management plan. While the WRTF's focus is county wide the educational effort within Knapp Creek will benefit as well. The WVCA and the WRTF will coordinate their educational efforts so as to avoid repetition and share resources.

Figure 9: *The Huntersville Arch*, a small anticline (upfold) that was exposed by erosion from Knapp Creek (foreground) that cut through the anticline.

Photo: Alvan Gale

IMPLEMENTATION SCHEDULE

Table 15:

Projected Implementation Schedule

Date	*Activity*	*Stream*
June 2012	Begin sign-ups for the EQIP NWQI	Knapp
	Complete WBP and 1st 319 grant application	
July 2012	NRCS ranks NWQI applications	Knapp
	NRCS completes obligation of NWQI funds	Knapp
	Engineering of bank stabilization projects	Knapp
	Survey sites not eligible for NWQI for 319 proposals	Browns
May 2013	Receive funding approval for proposal and start BMP installation	
	Start on first septic surveys with PCHD	Douthat
	Finish baseline monitoring	All
	Begin educational effort	All
July 2013	Submit 2nd 319 project proposal	
	Complete 1st year's septic projects	Douthat
	Report on NWQI progress and request additional funding	Knapp
	Complete 2500 ft of bank stabilization and buffer	Knapp
Oct 2013	Start project WQ monitoring	All
	Acquire landowner permission for non-NWQI projects	Browns
	Begin conservation planning for non-NWQI projects	Browns
May 2014	Receive funding approval for 2nd proposal	
	Project WQ monitoring	All
	Complete 2nd year's septic projects	Douthat
June 2014	Submit 3rd 319 proposal	
	Install agriculture BMPs in Browns Creek – non-NWQI	Browns
	Complete 2500 ft of bank stabilization and buffer	Knapp
	Report on NWQI progress and request additional funding	
	Start additional septic projects	Browns, Knapp

Projected Implementation Schedule continued

Nov 2014	Acquire landowner permission for 3rd proposal	Browns, Knapp
	Finish installing 1st proposal BMPs	Browns
	Project WQ monitoring	All
	Assess effectiveness of installed BMPs	All
	Complete septic pumping & education program	All
	DEP conducts watershed monitoring and determines success	
May 2015	Receive funding for 3rd proposal and septic proposal	
	Begin installing BMPs from 3rd proposal	Browns
	Project WQ monitoring	All
June 2015	Report on NWQI progress and request additional	
	Complete at least 2500 ft of bank stabilization and	Knapp
Dec 2015	Finish 2nd proposal BMPs for agriculture	
	Install additional septic systems	Browns, Knapp
	Project WQ monitoring	
	Submit data for any restored subwatersheds to DEP	
2016	Complete BMP installation in non-NWQI tributaries	Browns, Knapp
	BMP effectiveness assessment	
	Complete at least 2500 ft of bank stabilization and	Knapp
	Install 2 additional septic systems	Browns, Knapp
2017	Complete agriculture BMPs in Browns Creek	Browns
	Continue assessment of success	
	Complete at least 2500 ft of bank stabilization and	Knapp
	Continue installing septic systems	Browns, Knapp
	Assess WBP progress	
	Marlinton CSO eliminated	Knapp
2018	Revise WBP if necessary	
	Complete at least 2500 ft of bank stabilization and	Knapp
2019	Submit data to DEP to remove streams from 303(d) list	
	Complete and maintain all BMPs	
2020	TMDL implemented	

MILESTONES

Table 16:

Anticipated Milestones

Date	*Implementation Milestone*	*Environmental Milestone*
June 2012	Apply for funding	
Dec 2012	Discussions with landowners and educational efforts are made. Additional NWQI projects completed	Anticipated load reduction of fecal coliform: 3.53E+12 cfu/yr
Dec 2014	1st set of BMPs installed affecting 20% of the livestock. 10 homes have had septic systems replaced, 68 pumped.	Additional anticipated load reduction of fecal coliform: 4.92E+13 cfu/yr
Dec 2015	2nd set of BMPs installed affecting a total of 50% of the livestock. All seasonally failing septic systems have been repaired and the septic educational program is complete. 10 new septic systems have been installed.	Additional anticipated load reduction of fecal coliform: 3.51E+13 cfu/yr
Dec 2016	All completed BMPs are evaluated for effectiveness and all adjustments or alterations of installed BMPs are identified. Non-NWQI BMPs are completed. Douthat Creek restored.	Additional anticipated load reduction of fecal coliform: 1.88E+13 cfu/yr. Total reductions: 1.03E+14 cfy/yr exceeds TMDL LR for non-point sources, 5.13E+13.
Dec 2017	Browns Creek restored. CSO eliminated. 100,000 feet of stream banks stabilized and protected with buffers, 70% of livestock affected.	An additional anticipated load reduction of fecal coliform: 1.04E+11(CSO) and 1.7E+13
Dec 2018	An additional 5,000 feet of stream bank is stabilized and buffered. WBP revised if necessary.	Additional anticipated load reduction of fecal coliform: 9.4E+12 cfu/yr
Dec 2019	All BMPs completed.	
Dec 2020	Knapp Creek removed from 303(d) list.	TMDL fully implemented.

ANTICIPATED LOAD REDUCTIONS BY STREAM

Table 17: A comparison of anticipated load reductions and TMDL reductions as presented in Table 7.

Date	Stream					
	Knapp		Browns		Douthat	
	TMDL LR	Anticipated Load Reduction	TMDL LR	Anticipated Load Reduction	TMDL LR	Anticipated Load Reduction
Dec. 2012	5.13E+13	3.53E+12	1.16E+13		3.99E+11	
Dec. 2014				1.73E+13		3.22E+13
Dec 2015		3.16E+13		3.46E+12		
Dec. 2016		1.88E+13				
Dec. 2017		1.70E+13				
Dec. 2018		9.40E+12				
Dec. 2019 Dec. 2020	Period of anticipated wrap up of any uncompleted projects and overall assessment					
Totals	5.13E+13	8.03E+13	1.16E+13	2.08E+13	3.99E+11	3.22E+13
Total TMDL Reductions	6.33E+13		Total Anticipated Reductions		1.33E+14	

- The TMDL LR values do not include the margin of safety as suggested by the DEP WAB to account for the modeling difficulty encountered with Douthat Creek as explained on page 14. The TMDL LR values are actually 5% higher than the actual TMDL LRs. This table only accounts for nonpoint sources and does not include the CSO reduction of 1.04E+11 in either the TMDL LR or anticipated load reductions.

MONITORING

The responsibility for monitoring will fall primarily on the WVCA who will enlist the assistance of DEP and any other state or federal agency as well as volunteers. The parameters to be monitored will have to fulfill the requirements of this plan and the reporting requirements of Section 319 grants reports. The parameters will include: temperature, flow, fecal coliform, total nitrogen, total phosphorus and total suspended solids and any others that may be considered important. Monitoring stations will be located at the mouths of Douthat Creek, Browns Creek and Knapp Creek and on Knapp Creek above the confluence with Douthat Creek. If other stations need to be established to locate sources or for any other reason, such as determining project success, they will be located strategically to accomplish that goal.

The timing of sampling will be up to the local project managers but should include three samples within a year during different flow regimes for establishing the baseline. Afterward, two a year during different seasons and only after practices have been installed should provide adequate data for progress assessment. To determine if stream or stream segments have been returned to water quality standards WVCA will conduct fecal coliform sampling of at least ten samples in a one month period. The methods and location will correspond to DEP quality assurance standards and the data will be submitted to DEP.

Biological monitoring will be completed by the DEP WAB when a new assessment of this watershed is made in 2015. This date should be in time to measure some of the water quality improvements being made by implementing this plan. As stated in the Education section (page 26), the WVSOS program is an important educational tool for teaching citizens about the value of clean streams. It can also be a valuable monitoring tool. If suitable volunteer monitors are willing to sample these streams then WVCA and DEP will facilitate their efforts. By using the WVSOS protocols a good biological assessment of the streams' conditions can be made. Another assessment will be made by WAB in 2020 and should determine final success or a need for further action.

After the town of Marlinton corrects the CSO the DEP will monitor the mouth of Knapp Creek during the scheduled monitoring of the Greenbrier River watershed in 2020. DEP will determine if Knapp Creek should be removed from the 303(d) list.

In order to assure the data being collected is of good quality and usable for determining progress, a Quality Assurance Project Plan (QAPP) will be developed for this effort. The QAPP will be submitted to the DEP Nonpoint Source Program Coordinator for review and approval. The Coordinator will then be responsible for submitting the QAPP to EPA for review, comment and approval.

REFERENCES

Greenbrier River TMDL; 2008; WV Department of Environmental Protection and Tetra Tech

Upper Knapps Creek Watershed Restoration and Management Plan; 2001; Natural Resources Conservation Service and Clear Creek Consulting

Rosgen, D.L.; 1996; *Applied River Morphology*

Livestock Grazing Management and Watering Systems; Kevin S. Gould, MSU Extension Livestock Educator; *Reprinted from Cattle Call, 2008, Vol 13, Iss 2*

USDA, Natural Resources Conservation Service, MD Conservation Practice Standard, Prescribed Grazing Code 528

TMDL Modeling of Fecal coliform Bacteria with HSPF; Yagow, Dillaha, Mostaghimi, Brannon, Heatwole, Wolfe; Virginia Tech Univ.; Biosystems Engineering Department

Miertschin, James; 2006; *Project Area 2 River Basin Groups D and E Bacteria Impairments TMDL*; Texas Commission on Enviornmental Quality; James Miertschin & Assoc, Inc.

Animal Unit Equivalencies; Maryland Department of Agriculture; 1999 Regulatory Citation

APPENDIX:

Documents

Common Acronyms used in the WBP

NRCS Heavy Use Protection Standard

NRCS Filter Strip Standard

NRCS Herbaceous Cover Standard

NRCS Riparian Forest Buffer Standard

NRCS Fence Standard

Common Acronyms used in this Watershed Based Plan

TMDL	Total Maximum Daily Load
WLA	Waste load allocation
LA	Load allocation
LR	Load reduction
MOS	Margin of safety
BL	Baseline
SI	Stressor identification
USEPA or EPA	US Environmental Protection Agency
DEP	WV Department of Environmental Protection
WVCA	WV Conservation Agency
NRCS	Natural Resources Conservation Service
PCHD	Pocahontas County Health Department
BPH	Bureau of Public Health
WAB	Watershed Assessment Branch
OSLP	On-site Loan Program
BMP	Best management practice
WQ	Water quality
ES	Environmental Specialist
AU	Animal unit
WRTF	Pocahontas Water Resources Task Force

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

HEAVY USE AREA PROTECTION

(Acre)

CODE 561

DEFINITION

The stabilization of areas frequently and intensively used by people, animals or vehicles by establishing vegetative cover, by surfacing with suitable materials, and/or by installing needed structures.

PURPOSES

- Reduce soil erosion
- Improve water quantity and quality
- Improve air quality
- Improve aesthetics
- Improve livestock health

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to urban, agricultural, recreational or other frequently and intensively used areas requiring treatment to address one or more resource concerns.

CRITERIA

General Criteria Applicable to All Purposes

All planned work shall comply with Federal, state, and local laws and regulations ***governing structures and activities in or along streams, pollution abatement, health, and safety. The owner or operator shall secure all permits and approvals and is responsible for performing all planned work in accordance with such laws and regulations. NRCS employees shall not procure permits, rights, or approvals, nor shall they enforce laws and regulations. NRCS may provide the landowner or operator with technical information needed to obtain the required permits, rights or approvals to construct, operate, and maintain the practice.***

Additional permits may be required from the following agencies:

1. ***West Virginia Department of Health***
2. ***West Virginia Department of Agriculture***
3. ***West Virginia Department of Environmental Protection.***
4. ***Environmental Protection Agency***

Permits may be required from the following agencies when obstruction removal is performed within the boundaries of a stream or floodplain or if burning is required:

1. U.S. Army Corps of Engineers

2. WV Department of Natural Resources

3. WV Public Lands Corporation

4. US Fish and Wildlife Service

5. Local state and county ordinances.

Measures shall be taken to limit the generation of particulate matter.

Safety of the users shall be incorporated into the design of the heavy use area protection.

Design Load. The design load will be based on the type of traffic, (vehicular, animal, or human) anticipated on the heavy use area.

NRCS, NHCP
October 2003

NRCS, WV
June 2009

Conservation practice standards are reviewed periodically and updated as needed. To obtain the current version, contact your Natural Resources Conservation Service State Office, or download it from the electronic Field Office Technical Guide.
Note: Bold italics information added or changes made in the National Conservation Standard by WV.

The minimum design load for areas that support vehicular traffic will be a wheel load of 4000 lbs.

Foundation. All site foundations shall be evaluated for soil moisture, permeability, texture and bearing strength in combination with the design load and anticipated frequency of use.

A base course of gravel, crushed stone, other suitable material and/or geotextile shall be provided on all sites with a need for increased load bearing strength, drainage, separation of material and soil reinforcement. ***Unless otherwise specified, base course thickness shall be a minimum of six (6) inches of course aggregate, such as ASTM C33 or AASHTO M43: No. 57, No. 1 or No. 3 or similar material. The base course thickness shall be the greater of two (2) times the largest aggregate diameter or the minimum thickness. A properly designed geotextile shall be installed under the base material.***

Natural Resources Conservation Service (NRCS), National Engineering Handbook (NEH), Parts 642 and 643 (formerly, NEH, Section 20) and AASHTO M-288 (latest edition) provide guidance in quality specification and geotextile selection.

An impervious barrier shall be provided on sites with a porous foundation (high permeability rate), where there is a need to protect ground water from contamination.

Foundation preparation shall consist of removal and disposal of soil and other material that are not adequate to support the design loads.

Surface Treatment. The surface treatment shall meet the following criteria:

Bituminous Pavement. The thickness of the pavement course, the kind and size of aggregate, the type of proportioning of bituminous materials, and the mixing and placing of these materials shall be in accordance with ***West Virginia*** Department of Transportation***, Division of Highways Standard Specifications Roads and Bridges, Section 401 or 402*** criteria for the expected loading.

Choose a mix type appropriate for the surface application. The minimum thickness of asphalt wearing course shall be two inches for access areas.

When bituminous/asphalt pavement is used for animal feed pads it shall be protected by a coating of sand, sawdust or similar material.

Concrete. The quality and thickness of concrete and the spacing and size of reinforcing steel shall be appropriate for the expected loading.

Concrete thickness shall be a minimum of four (4) inches in accordance with the requirements in Conservation Practice (CP) Waste Storage Facility (313); Slabs on Grade section. Concrete surfaces shall be roughened for increased traction where used by livestock.

Other Cementatious Materials. Soil cement, roller compacted concrete, and coal combustion by-products (flue gas desulfurization sludge and fly ash) may be used as surface material if designed and installed to withstand the anticipated loads and surface abrasion.

Aggregate. A fine or coarse aggregate surface shall be a minimum ***two*** (2) inches thick. ***Aggregate such as ASTM C33 or AASHTO M43: No. 67 or No. 8, WV Crusher Run or similar material is appropriate for surface material.***

Other. Surfacing materials, such as cinders, tanbark, bark mulch, brick chips, shredded rubber and/or sawdust, shall have a minimum layer thickness of 2 inches.

Structures. All structures shall be designed according to appropriate NRCS standards and specifications or Engineering Handbook recommendations.

Fabricated and roofed structures shall be designed in accordance with CP Waste Storage Facility (313).

Sprays and Artificial Mulches. When utilizing sprays of asphalt, oil, plastic, manufactured mulches, and similar materials, the manufacturer's recommendations for application shall be incorporated into the design.

Drainage and Erosion Control. Provision shall be made for surface and subsurface drainage, as needed, and for disposal of runoff without causing erosion or water quality impairment. Provision shall be made to exclude unpolluted run-on water from the treatment area. All treatment areas shall be shaped to prevent ponding of water.

Vegetative Measures. Liming, fertilizing, soil preparation, seeding, mulching, sodding and vegetation management shall be according to the planned use and appropriate conservation practice standard in the local technical guide. If vegetation is not appropriate, other measures shall be used to accomplish the intended purpose. ***Grass covered areas are intended to provide permanent vegetated cover (not for prescribed grazing).***

Additional Criteria for *Heavy Use* Areas Utilized by Livestock.

The treated area shall extend an appropriate distance from facilities such as portable hay rings, water troughs, feeding troughs, mineral boxes and other facilities where livestock concentrations cause resource concerns.

Livestock Heavy Use Areas (LHUA) provide a protected surface from the animal's hoof action, reducing excessive erosion, sediment movement or nutrient transport to surface or subsurface water.

CNMP. LHUA's shall be planned in accordance with a Comprehensive Nutrient Management Plan (CNMP) and associated conservation practices. The CNMP documents the "conservation system" within the conservation plan that is unique to animal feeding operations and shall be developed before a LHUA structure is designed. This will include the producer's decisions concerning the management of the livestock, livestock manures and waste products, movement, loafing areas, etc.

Reference the conservation resources "Planning Guide for Livestock Heavy Use" for additional LHUA planning guidelines. NRCS conservation practice ***(CP)*** standards Critical Area Planting (342); Fencing (382); Prescribed Grazing (528); Filter Strip (393); ***Roofed Runoff (558); Animal Trails and Walkways (575); Manure Transfer (634); Waste Storage Facility (313); Vegetated Treatment Area (635); Watering Facilities (614); Windbreak /Shelterbelt Establishment (380);*** or Access Control (472) shall be used as companion practices, when needed, to meet the intended purpose of the heavy use area protection.

Provisions shall be made to collect, store, utilize and/or treat manure accumulations and contaminated runoff in accordance with appropriate conservation practice standards ***and regulations.***

Livestock Heavy Use Areas (LHUA). Feed Pads or Lots designed for cattle, sheep, horses etc. may or may not be roofed. They are designed for 100 % confinement or where livestock have pasture access (not confined) in association with CP Prescribed Grazing (528).

LHUA Equine All-Weather Lots (not roofed, not grazed exercise or holding area), shall be gravel surfaced lots designed in conjunction with prescribed grazing pastures. Lots shall be used when the prescribed pastures are not available for use. Lots are especially useful in times of pasture establishment, maturing vegetation or during very wet or drought conditions.

Location. The location of LHUA shall:

- ***Be above the 25 year-24-hour floodplain delineation.***
- ***Divert all surface water away from the feed pad, lot and/or vegetated treatment area.***
- ***Be located as far as possible from springs and wells and no closer than 100 feet to neighboring wells or potable water sources.***
- ***Not be placed closer than ten (10) feet from the top or toe of a defined bank.***
- ***Be buffered by terrain or a windbreak/ shelterbelt when a separation distance (visual or odorous) is a concern.***

Roofs. A roof may be installed for the purpose of diverting rainfall away from a feed pad, when other practices are not practical or cost effective. The roof and supporting structure shall be designed and

installed in accordance to CP Waste Storage Facility (313).

Curbing. Curbing shall be installed in areas necessary to:

- ***Contain manure or prevent clean water from entering an area. Curbs shall be a minimum of twelve (12) inches high except where equipment needs to cross.***
- ***Divert waste to a Manure Transfer System or Waste Storage Facility.***
- ***Contain solids while allowing liquids to discharge to a Vegetated Treatment Area (VTA) thru a slotted or open curb (normally 4" wide and spaced every 10 feet).***

Size. The LHUA's square footage shall be sized according to the number and size of livestock and the area necessary for feed rings, watering facilities, equipment and necessary feed bunker length as needed (Reference Table 1).

LHUA's

All Livestock Heavy Use Areas

- ***Are designed for livestock use during the winter months and/or mud season.***
- ***Temporarily contain waste.***
- ***Have a protected transition area (concrete, gravel, etc.) such as from the access lane to the pad access/egress gate.***
- ***Store dry and liquid manure and accumulated waste in accordance with CP Waste Storage Facility (313), unless otherwise noted.***
- ***Where livestock are not confined and have unlimited access to feed pads, planning considerations shall be given to reduce or eliminate waste accumulation near and around the LHUA.***

In addition to the above bullets;

Roofed Feed Pads:

- ***Shall be surfaced with concrete unless other materials such as asphalt, gravel or wood chips are approved by SCE.***
- ***Shall provide watering facilities to confined livestock on the pad.***

Uncovered (no roof) Feed Pads Serving Ten (10) Animal Units or Less:

- ***Shall be surfaced with concrete unless other materials such as asphalt, gravel or wood chips are approved by SCE.***
- ***Shall have a minimum 2% grade.***
- ***May be designed so liquid waste and runoff can be treated in accordance with CP Vegetated Treatment Area (635).***
- ***Shall remove solid waste weekly and store solids according to CP Waste Storage Facility (313).***

Equine Exercise Lots Serving Ten (10) Units or Less:

- ***Shall not be used as an arena or riding area.***
- ***Shall be surfaced with gravel when used as an exercise lot.***
- ***Shall have a minimum 2% grade to a maximum 6% grade.***
- ***May be designed so runoff can be treated in accordance with CP Vegetated Treatment Area (635).***
- ***Shall remove solid waste daily and store solids according to CP WSF (313).***

Other Uncovered (no roof) Feed Pads or Lots shall:

- ***Shall have a minimum 2% grade.***
- ***Collect and store all runoff and liquid, solid, and waste in accordance with CP Waste Storage Facility (313) and CP Manure Transfer (634).***

Additional Criteria for Areas Utilized for Recreation. The treated area shall be conducive to the overall recreation area and aesthetically blend with the general landscape and surroundings.

Plants, landscaping timbers, traffic control measures, wooden walkways, etc. shall be evaluated for effectiveness, aesthetics and

accessibility as covered by the Americans with Disabilities Act.

CONSIDERATIONS

When stabilizing heavily used areas consider adjoining land uses and the proximity to residences, utilities, cultural resource areas, wetlands or other environmentally sensitive areas, and areas of special scenic value.

For heavy use areas conducive to protection by vegetation, consideration must be given to the effect(s) of treading and/or miring. The vegetative species selected should tolerate and persist under heavy use conditions. If practicable, consider increasing the size of the area and/or establishing a rest/non-use period to allow plant recovery and increase vigor.

Heavy use area protection effects on the water budget, especially on volumes and rates of runoff, infiltration, and transpiration due to the installation of less pervious surfaces should be considered in the selection of surfacing materials.

The transport of sediments, nutrients, bacteria, organic matter from animal manures, oils and chemicals associated with vehicular traffic, and soluble and sediment-attached substances carried by runoff should be considered in selection of companion conservation practices.

If the purpose of the heavy use area protection is improvement of water quality, the heavy use area should be (re)located as far away from the waterbody or watercourse as possible. Any work in and/or discharges near streams, wetlands or waterbodies may require a permit from the US Army Corps of Engineers, state water quality (permitting) authority, or local authority.

The size of heavy use areas utilized by livestock is dependent on the landowner's operation including type and number of animal, confinement periods, and/or the intended use. The size of treatment areas can range from 30 square feet per animal in partial-confinement to 400 square feet per animal in total confinement to 4000 or more square feet for animal exercise areas. Heavy use protection areas should be kept as small as practicable.

For areas with aggregate surfaces that will be frequently scraped, consideration should be given to the use of concrete or cementatious materials to lessen the recurring cost of aggregate replacement.

Encourage the use of multiple feed pads to reduce excessive use of adjoining pastures and improve pasture rotation. If the herd is maintained in groups on separate parts of the farm, then more than one LHUA may be planned.

Fencing may be needed to confine livestock, control access to the stabilized pad, separate animals from vegetated treatment area, or where vegetation requires protection.

*TABLE 1 – RECOMMENDED SPACE REQUIREMENTS FOR LIVESTOCK HEAVY USE AREAS **

TABLE 1-A SPACE REQUIREMENTS FOR BEEF CATTLE 100% CONFINED (24 HR/DAY)
SQUARE FEET (SF) PER HEAD

TYPE OF AREA	CALVES 400 – 800 LBS.	BRED HEIFERS, STEERS OR COWS 800 – 1200 LBS.	COWS 1,300 LBS.
Roofed Concrete Feed Pad (SF/Head)	25	35	50
Paved Lot ; open- no roof (SF/Head)	50	60	75
Not Paved Lot; open-no roof with mound (SF/Head)	300-600	400-800	500-800
Trough Width (Linear feet/cow)	1.7	2.0	2.5

Trough Area Length (length of animal or 4.0')
Center Feed Width (hay or bunkers) : 5 – 8 LF (when accessed from both sides)

TABLE 1-B SPACE REQUIREMENTS FOR BEEF CATTLE NOT 100% CONFINED
ROOFED OR NOT ROOFED
SQUARE FEET (SF) PER HEAD

TYPE OF AREA	CALVES 400 – 800 LBS.	BRED HEIFERS, STEERS OR COWS 800 – 1200 LBS.	COWS, BULLS 1300 LBS. AND OVER	COW/CALF
Concrete Feed Pad (with pasture access)	20	25	30 Cows 40 Bulls	45
Trough Width (LF/animal)	1.7	2.0	2.5	2.5

Trough Area Length (length of animal or 4.0')
Center Feed Width (hay or bunkers) : 5 – 8 LF (when accessed from both sides)

TABLE 1-C SPACE REQUIREMENT FOR EQUINE LOT/EXERCISE
(MAX. 10 AU) -NOT ROOFED 100% CONFINED WITH ACCESS TO SHELTER
SQUARE FEET (SF) PER HEAD

Type of Area	Horses	Watering Facility
Lot Surfaced with Gravel (2 -6% slope)	400 SF /horse; (min. width 12 feet/horse)	Do not add to total design area.
Exercise Lot (2 -6% slope) Not Surfaced; i.e. sandy soil (well drained) or natural rocky surface	500 minimum SF 1000 SF/Horse High Density 2500 SF/Horse Low Density	Do not add to total design area.
Dry Lot Pen-No Exercise Surfaced with Gravel (min. width 12')	192 SF /horse and used by one horse.	4 ft. x 6 ft. concrete apron for automatic waterer.

Feed Area Length (length of animal or 6.0')
Feed Area Width =6.0' (min.)
Center Feed Width (hay or bunker) : 5 – 8 LF (when accessed from both sides)

TABLE 1-D RECOMMENDED SPACE REQUIREMENTS FOR SHEEP (CONFINED OR NOT CONFINED)
SQUARE FEET (SF) PER HEAD

Type of Area	Feeder 30 – 110 lbs.	Ewes with Lambs	Dry Ewes 150-200 lbs.	Rams 180-300 lbs.
Roofed Feed Pad	10	15	16	30
Open Lot ; Surfaced, with access to shelter	10	20	16	30
Open Lot -Not Surfaced	25	40	35	35
Trough Width: LF per animal	1.0	1.5	1.5	1.0
Feed Area Length (length of animal or 4.0')				

TABLE 1-E OTHER RECOMMENDED SPACE REQUIREMENTS

Feed Width	Hay Ring – Dia. = 7' 10"	Automatic Watering Facility	Center Aisle Width for Tractor or Feed Wagon
Center Feed Width 5 – 8 Linear Feet (when accessed from both sides)	50 square feet	4 ft. x 6 ft. concrete apron for each automatic waterer	10 – 12 LF (not applicable to equine lot/exercise areas)
Feed Area Length (length of animal or 4.0')	10 cows or 5 horses per ring	Maximum 20 beef cows, 16 bulls, 40 ewes, 10 rams, 10 horses/bowl or according to manufacturer.	

Livestock Heavy Use Area feed pads or lots shall be sized according to the following:

1. Select Table based on type of animal, confinement and if the area is roofed or not roofed.
2. Use the information from Table(s) selected in Item 1 to determine the required square footage (SF) per animal based on type of operation.
3. Use the information from Table(s) selected in Item 1 to determine the required minimum trough length or width for the number of animals (if appropriate).
4. Determine additional square footage necessary for hay rings, watering facilities, feed bunks, equipment access, etc. from Table 1E.

* ***References: MWPS- 6, MWPS-18, NDSU NM-1155, PSU –G-5 Sheep Design Criteria, Oregon State Univ.-Extension EC 1610-2007, All-Weather Horse Paddocks Ohio DNR,***

REFERENCES

National Pollutant Discharge Elimination System (NPDES)

National Clean Water Act (CWA) Section 502(14]

U.S. Environmental Protection Agency (EPA)

West Virginia Department of Agriculture

WV Dept. of Environmental Protection

WV Department of Health and Human Resources; 64CSR46, TITLE 64, Interpretive Rule Department of Health, Series 46

WV DEP or EPA website on CAFO's;

http://cfpub.epa.gov/npdes/home.cfm?program_id=7; http://www.wv.gov/Offsite.aspx?u=http://www.wvdep.org

210-VI-EFH Amendment 45, WV5 Preparation of Engineering Plans

210-V-NEM Part 505 – Non-NRCS Engineering Services

WV NRCS Engineering Field Handbook

WV NRCS Conservation Resources "Planning Criteria for livestock Heavy Use Areas"

Agricultural Waste Characteristics of the Agricultural Waste Management Field Handbook, Chapter 4 (AWMFH)

CP 313 -Table A for livestock manure volumes (CF).

ASTM C33; Standard Specifications for Concrete Aggregates

AASHTO M43: Standard Specification for Sizes of Aggregate for Road and Bridge Construction.

North Dakota State Univ. Extension Service NM-1155, 10/2006

Oregon State Univ.-Extension EC 1610-07

The Midwest Plan Service (MWPS) - 6; Beef Housing and Equipment Handbook 4th Ed. 1987 MWPS-18 Section 2; Manure Storages 2001

Using All-Weather Geotextile Lanes and Pads; MWPS Ag. Eng. Digest AED45, 07/99

All-Weather Horse Paddocks Ohio DNR, 2005.

Penn State Agricultural and Biological Engineering; Sheep Housing Design Criteria G-5, PSU/92

NRCS Soil Data Mart Information, Engineering Properties, Water Features, Flood Duration, Hydrologic Soil Group, Risk of Corrosion –concrete, Water Table Depth, Physical Soil Properties etc.: http://soildatamart.nrcs.usda.gov/

PLANS AND SPECIFICATIONS

Plans and specifications for heavy use area protection shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. Plans and specifications shall include construction plans, drawings, job sheets, ***utility notification, construction specifications including method of material disposal***, or other similar documents. These documents shall specify the requirements for installing the practice, including the kind, amount and quality of materials to be used.

NRCS shall be notified prior to commencement of construction.

All materials shall be inspected by NRCS personnel prior to installation.

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) plan shall be prepared for and reviewed with the landowner or operator. The plan shall specify that the treated areas and associated practices are inspected annually and after significant storm events to identify repair and maintenance needs.

The O&M plan shall detail the level of repairs needed to maintain the effectiveness and useful life of the practice.

For livestock operations, the O&M plan for heavy use areas may be included as a part of the overall waste management plan.

Periodic removal and management of manure accumulations will be addressed in the O&M plan.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FILTER STRIP

(Ac.)

CODE 393

DEFINITION

A strip or area of herbaceous vegetation that removes contaminants from overland flow.

PURPOSE

- Reduce suspended solids and associated contaminants in runoff.
- Reduce dissolved contaminant loadings in runoff.
- Reduce suspended solids and associated contaminants in irrigation tailwater.

CONDITIONS WHERE PRACTICE APPLIES

Filter strips are established where environmentally-sensitive areas need to be protected from sediment; other suspended solids and dissolved contaminants in runoff.

This practice applies: 1) in areas situated below cropland, grazing land, forest land, or disturbed land; 2) where sediment, particulate organic matter and/or dissolved contaminants may leave these areas and enter environmentally sensitive areas; 3) in areas where permanent vegetative establishment is needed to enhance wildlife and beneficial insects, or maintain or enhance watershed function.

This practice <u>does not</u> apply to components of a planned agricultural waste management system, the treatment of runoff from such areas as feedlots, barnyards, and other livestock holding areas; or effluent and diluted silage leachate. Refer to WV conservation practice standard (635) Vegetative Treatment Area.

This practice <u>should not</u> be used alone to address resource concerns associated with logging operations. Refer to Field Office Technical Guide reference <u>BMP's for Controlling Soil Erosion and Sediment from Logging Operations in WV</u>.

CRITERIA

<u>General Criteria Applicable to All Purposes</u>

Filter strips shall be designated as vegetated areas to treat runoff and are not part of the adjacent cropland rotation.

Concentrated flow shall be dispersed before it enters the filter strip.

Overland flow entering the filter strip shall be primarily sheet flow. Concentrated flow shall be dispersed.

The maximum gradient along the leading edge of the filter strip shall not exceed one-half of the up-and-down hill slope percent, immediately upslope from the filter strip, up to a maximum of 5%.

If present, noxious weeds shall be controlled within the filter strip.

Filter strip establishment shall comply with local, state and federal regulations.

Pesticide application within a field may require a specific filter flow length as indicated on product labels or state regulations. These requirements for filter flow length will always be used if greater than the minimum criteria in this standard.

Frequent vehicular traffic shall be excluded from the filter strip and shall not be utilized as access areas, roadways or travel lanes.

Only viable, high quality and regionally adapted seed will be used to plant filter strips.

Where appropriate, fences or other exclusionary measures may be necessary. Refer to WV Conservation Practice Standard Access Control (472).

The minimum flow length shall be 20 feet.

The filter strip shall be located along the downslope edge of a field or disturbed area. To the extent practical, it shall be established on the contour. Variation in placement on the contour should not exceed a 0.5 percent longitudinal (perpendicular to the flow length) gradient.

The immediate drainage area above the filter strip shall have greater than 1 percent but less than a 10 percent slope.

Additional Criteria to Reduce Suspended Solids and Associated Contaminants in Runoff

Filter strip flow length required to reduce dissolved contaminants in runoff shall be based on management objectives, contaminants of concern, and the volume of runoff from the filter strip's drainage area compared with the filter strip's area and infiltration capacity.

The filter strip will be designed to have a 10-year life span, following the procedure in the Agronomy Technical Note No. 2 (Using RUSLE2 for the Design and Predicted Effectiveness of Vegetative Filter Strips (VFS) for Sediment), based on the sediment delivery in RUSLE2 to the upper edge of the filter strip and ratio of the filter strip flow length to the length of the flow path from the contributing area. The minimum flow length through the filter strip shall be 20 feet.

The filter strip shall be located immediately downslope from the source area of contaminants.

The drainage area above the filter strip shall have a slope of 1% or greater.

Vegetation

The filter strip shall be established to permanent herbaceous vegetation consisting of a single species or a mixture of grasses, legumes, and/or other forbs adapted to the soil, climate, nutrients, chemicals, and cultural practices used in the current management system.

Species selected shall be:

- able to withstand partial burial from sediment deposition and
- tolerant of herbicides used on the area that contributes runoff to the filter strip.

Species selected shall have stiff stems and a high stem density near the ground surface.

Vigorous vegetative cover with adequate stem density will be established and/or maintained. Permanent herbaceous cover shall be established using the seeding recommendations, seedbed and site preparation methods outlined in the WV conservation practice standard Critical Area Planting (342) or Forage and Biomass Planting (512).

Species, rates of seeding or planting, minimum quality of planting stock, such as PLS or stem caliper, and method of establishment shall be specified before application. Only viable, high quality seed or planting stock will be used.

Table 1 below lists species that may be utilized in addition to those listed in WV conservation practice standard Critical Area Planting (342).

SPECIES/MIX [1/]	RATE (lbs/ac) PLS	Drainage
Eastern gamagrass	**10**	**Well – Moderately Well**
switchgrass	**10**	**Well – Somewhat Poorly**
switchgrass **big bluestem** **Indiangrass**	**3** **4** **2**	**Well – Moderately Well**

SPECIES/MIX [1/]	RATE (lbs/ac) PLS	Drainage
Eastern gamagrass little bluestem costal panicgrass	**3 3 2**	
big bluestem Indiangrass little bluestem sideoats grama switchgrass	**2 2 3 2 2**	**Well – Somewhat Poorly**
big bluestem little bluestem Indiangrass	**1 3 3**	**Well – Moderately Well**
switchgrass big bluestem Indiangrass	**4 2 2**	**Well – Moderately Well**

Table 1. Warm season grass mixtures for use in filter strips.

[1/] Use stratified seed and inoculate all legumes. Warm season grasses should be planted April 1 – May 15. Some species may require special seeding techniques and equipment.

Site preparation and seeding or planting shall be done at a time and in a manner that best ensures survival and growth of the selected species. What constitutes successful establishment, e.g. minimum percent ground/canopy cover, percent survival, stand density, etc. shall be specified before application.

Planting dates shall be scheduled during periods when soil moisture is adequate for germination and/or establishment.

The minimum seeding and stem density shall be equivalent to a high quality grass hay seeding rate for the climate area or the density of vegetation selected in RUSLE2 to determine trapping efficiency, whichever is the higher seeding rate.

Additional Criteria to Reduce Dissolved Contaminants in Runoff

The criteria given in "Additional criteria to reduce suspended solids and associated contaminants in runoff" for location, drainage area and vegetation characteristics also apply to this purpose.

The minimum flow length for this purpose shall be 30 feet.

Additional Criteria to Reduce Suspended Solids and Associated Contaminants in Irrigation Tailwater

Filter strip vegetation shall be a small grain or other suitable annual plant

The seeding rate shall be sufficient to ensure that the plant spacing does not exceed 4 inches.

Filter strips shall be established early enough prior to the irrigation season so that the vegetation is mature enough to filter sediment from the first irrigation.

The minimum flow length for this purpose shall be 20 feet.

Additional Criteria to Restore, Create or Enhance Herbaceous Habitat for Wildlife Pollinators and Beneficial Insects

This purpose is intended to be used in combination with one or more of the previous purposes and should not be utilized as a primary single purpose. The minimum criteria for the primary purpose(s) must be met initially.

Additional filter strip flow length devoted to this purpose must be added to the flow length required for the other purpose(s). The minimum additional flow length shall be 10 feet.

Any addition to the flow length for pollinators, wildlife or beneficial insects may be added to the downhill slope of the filter strip.

Vegetation to enhance wildlife habitat may be added to that portion of the filter strip devoted to other purposes to the extent this vegetation does not detract from the primary functions.

Plant species selected for this purpose shall be permanent vegetation adapted to the targeted wildlife or beneficial insect

populations. Refer to the West Virginia Pollinator Handbook (WVPH) or the WV Wildlife Habitat Evaluation Technique (WVWHET) for herbaceous species that benefit certain wildlife species or as recommended by state staff specialists.

A total of ten species shall be established for pollinators. Including a minimum of one native grass species and three species of forbs in each of the very early and/or early, mid and late bloom periods.

Density of the vegetative stand established for this purpose shall consider targeted wildlife habitat requirements and encourage plant diversity. Dispersed woody vegetation may be used to the extent it does not interfere with herbaceous vegetative growth the primary purpose or the operation and maintenance of the filter strip.

Pesticide use shall be minimized and applied with the most targeted method and only to control noxious weeds or crop damaging pests.

The filter strip shall not be harvested during the nesting season for avian species from March 15 to July 15 or during critical pollinating periods (i.e. during crop bloom)

Filter strips shall be strategically located to maximize the connectivity of corridors and non-cultivated patches of vegetation to facilitate dispersal and movement of wildlife and species populations.

Filter strips shall be strategically located to enhance aesthetics of the watershed.

CONSIDERATIONS

General. Filter strip width (flow length) can be increased as necessary to accommodate harvest and maintenance equipment.

Filters strips with the leading edge on the contour will function better than those with a gradient along the leading edge.

Seeding rates that establish a higher stem density than the normal density for a high quality grass hay crop will be more effective in trapping and treating contaminants.

Consider the type and density of vegetation and how it influences filter effectiveness.

Stem diameter (inches)	Number of stems (stems per square foot)
0.10	50
0.25	25
0.50	12
0.75	8
1.00	5

Table 2. Recommended stem densities of vegetation for filter strips.

Consider using this practice to protect National Register listed or eligible (significant) archaeological and traditional cultural properties from potential damaging contaminants.

Filter strip size should be adjusted to accommodate harvest and maintenance equipment.

Consider the use of this practice to sequester more carbon. **Increasing the width of filter strip will increase the potential for carbon sequestration.**

Consider the amount of time to establish some species of vegetation. In some instances this may be as long as 3 years (i.e. warm season grasses).

Consider the effectiveness of the filter strips outside of the growing season and determine the need for additional conservation practices.

The design width should consider the soils permeability to ensure satisfactory performance.

Hydrologic soil groups (A, B, C, and D) are indicative of the infiltration and runoff potential. Soil groups A and B have higher infiltration potential; therefore, less runoff than groups C and D. Soil drainage class also determines the extent of soil moisture conditions and water storage available in a soil. Filter strips located on hydrologic soil groups C and D are less effective than filter

areas on A and B soils. Refer to the local soil survey for information regarding the hydrologic soil group for a particular soil.

Consider the use of filter strips in conjunction with other practices such as Contour Farming (330) and Contour Buffer Strips (332).

Considerations for Reducing Suspended Solids and Associated Contaminants in Runoff

Increasing the width of the filter strip beyond the minimum required will increase the potential for capturing contaminants in runoff.

Considerations for Creating, Restoring or Enhancing Herbaceous Habitat for Wildlife and Beneficial Insects and Pollinators

Filter strips are often the only break in the monotony of intensively-cropped areas. The wildlife and pollinator benefits of this herbaceous cover can be enhanced by:

Increasing the width beyond the minimum required, and planting this additional area to species that can provide food and cover for wildlife and pollinators. This additional width should be added on the downslope side of the filter strip.

Adding even one or two herbaceous plant species to the filter strip seeding mix that are beneficial to wildlife and pollinators. Changing the seeding mix should not detract from the purpose for which the filter strip was established.

Considerations for Maintaining or Enhancing Watershed Functions and Values

Filter strips can:

- enhance connectivity of corridors and non-cultivated patches of vegetation within the watershed.
- enhance the aesthetics of a watershed.
- be strategically located to reduce runoff, and increase infiltration and ground water recharge throughout the watershed.

Considerations for Air Quality

Increasing the width of a filter strip beyond the minimum required will increase the potential for carbon sequestration.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared for each field site where a filter strip will be installed. A plan includes information about the location, construction sequence, vegetation establishment, and management and maintenance requirements.

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

At a minimum, specifications shall include (as applicable):

- ***Length, width, and slope of the filter strip and the contributing area to accomplish the planned purpose (width refers to flow length across the filter strip).***
- ***Species and seeding rates***
- ***Planting dates, methods, care, and handling of seed.***
- Site preparation sufficient to establish and grow selected species
- A statement that only viable, high quality and regionally adapted seed will be used
- ***CPA-52 or similar acceptable environmental evaluation***
- ***Operation and maintenance requirements***

OPERATION AND MAINTENANCE

For the purposes of filtering contaminants, permanent filter strip vegetative plantings should be harvested as appropriate to encourage dense growth, maintain an upright growth habit and remove nutrients and other contaminants that are contained in the plant tissue.

Control weeds or undesirable plants within the filter strip.

Inspect the filter strip after storm events and repair any gullies that have formed, remove unevenly deposited sediment accumulation that will disrupt sheet flow, reseed disturbed areas and take other measures to prevent concentrated flow through the filter strip.

Apply supplemental nutrients according to soil test to maintain the desired species composition and stand density of the filter strip.

Avoid maintenance activities during the primary nesting season (March 15- July 15). If mowing is necessary to maintain the filter strip, mow between July 15 and August 15. Exceptions may be granted for filter strip renovation and repair. Disturb no more than 50% of the entire area of the filter strip at one time if feasible.

Periodically re-grade and re-establish the filter strip area when sediment deposition at the filter strip-field interface jeopardizes its function. Reestablish the filter strip vegetation in these re-graded areas, if needed.

If grazing is used to harvest vegetation from the filter strip, the grazing plan must insure that the integrity and function of the filter strip is not adversely affected. ***Refer to practices such as Prescribed Grazing (528) or Forage Harvest Management (511) for relevant information including a grazing schedule specifying timing and intensity.***

REFERENCES

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**** Bold italics indicate changes made or information added to the national standard by West Virginia.***

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

RIPARIAN HERBACEOUS COVER

(Ac.)

Code 390

DEFINITION

Grasses, sedges, rushes, ferns, legumes, and forbs tolerant of intermittent flooding or saturated soils, established or managed as the dominant vegetation in the transitional zone between upland and aquatic habitats.

PURPOSE

This practice may be applied as part of a conservation management system to accomplish one or more of the following purposes:

- Provide or improve food and cover for fish, wildlife and livestock,
- Improve and maintain water quality.
- Establish and maintain habitat corridors.
- Increase water storage on floodplains.
- Reduce erosion and improve stability to stream banks and shorelines.
- Increase net carbon storage in the biomass and soil.
- Enhance pollen, nectar, and nesting habitat for pollinators.
- Restore, improve or maintain the desired plant communities.
- Dissipate stream energy and trap sediment.
- Enhance stream bank protection as part of stream bank soil bioengineering practices.

CONDITIONS WHERE PRACTICE APPLIES

Areas adjacent to perennial and intermittent watercourses or water bodies where the natural plant community is dominated by herbaceous vegetation that is tolerant of periodic flooding or saturated soils. For seasonal or ephemeral watercourses and water bodies, this zone extends to the center of the channel or basin.

Where channel and stream bank stability is adequate to support this practice.

Where the riparian area has been altered and the potential natural plant community has changed.

This practice does not apply to:

- ***woody establishment in riparian areas for which the conservation practice standard (391) Riparian Forest Buffer is applicable***
- ***plantings for which the primary purpose is to remove pollutants from runoff and wastewater where conservation practice standard***

CRITERIA

General Criteria Applicable to All Purposes

The location, layout, and width of the buffer will be selected to accomplish the intended purpose and function.

The minimum width of riparian herbaceous areas is 35 feet or 1.5 times the width of the stream (based on the horizontal distance between bank-full elevations) whichever is greater and a minimum of 15 feet for water bodies.

Where available, use Ecological Site Description to guide restoration to appropriate vegetative community phase and include appropriate vegetative functional groups.

Select perennial plants that are adapted to site and hydrologic conditions and provide the

structural and functional diversity preferred by fish and wildlife likely to benefit from the installation of the practice.

In areas where native seeds and propagules are present, natural regeneration can be used in lieu of planting. Planting is required if no native seed bank is present.

Protect riparian vegetation and water quality by reducing or excluding haying and grazing until the desired plant community is well established.

Stream type and site hydrology must be considered. Selected plant species must be adapted to the projected duration of saturation ***expected flood velocities*** and inundation of the site.

Harmful pests present on the site will be controlled or eliminated as necessary to achieve and maintain the intended purpose.

Pest management will be conducted in a manner that mitigates impacts to pollinators.

Management systems applied will be designed to maintain or improve the vigor and reproduction of the desired plant community.

Necessary site preparation and planting shall be done at a time and manner to insure survival and growth of selected species. Only viable, high quality and site-adapted planting stock will be used.

Existing underground functional drains that pass through these areas shall be replaced with rigid, non perforated pipe through the buffer or equipped with a management regulating structure to allow control of overflow. ***Refer to WV Conservation Practice Standard (606) Subsurface Drain and/or (587) Structure for Water Control.***

Domestic grazing should be deferred for a minimum of two years or until such time as the desired plant community is established.

For cool season grass mixtures, and rates of single specie stands of warm season grasses refer to guidelines in Table 2 of the conservation practice (342) Critical Area Planting; and/or (512)Forage and Biomass Planting.

If pollinator habitat is concern or consideration utilize the species and methodologies outlined in the West Virginia Pollinator Handbook. Refer to (512) Forage and Biomass Planting for establishment methods. The use of other approved references and job sheets may be appropriate if available.

Use of supplemental nutrients shall be limited to those necessary for establishment and shall be based on soil requirements. If wildlife habitat is a purpose, do not allow stands to become too dense and become overcrowded to the exclusion of other wildlife.

Refer to conservation practice standard (512) Forage and Biomass Planting or herbaceous species listed in (342) Critical Area Planting for a list of species suitable for planting.

Additional Criteria to Maintain or Improve Water Quality and Quantity

Minimum width shall be increased to 2.5 times the stream width (based on the horizontal distance between bank-full elevations) or ***50*** feet for water bodies. Concentrated flow erosion or mass soil movement shall be controlled in the up gradient area prior to establishment of the riparian herbaceous cover.

Species selected shall have stiff stems and high stem density near the ground surface to reduce water velocities and facilitate infiltration into the floodplain.

Refer to conservation practice standard Forage and Biomass Planting or (342) Critical Area Planting for a list of species suitable for planting. Other species may be suitable. Contact appropriate state staff specialist to determine the suitability.

Additional Criteria to Stabilize Streambanks and Shorelines

Select native or accepted, introduced species that provide a deep, binding root mass to strengthen streambanks and improve soil health.

Refer to conservation practice standard Forage and Biomass Planting or (342) Critical Area Planting for a list of species suitable for planting.

Additional Criteria for Increasing Net Carbon Storage in Biomass and Soils

Maximize width and length of the herbaceous riparian cover to fit the site.

Plant species used will have the highest rates of biomass production for the soil and other site conditions, consistent with meeting fish and wildlife habitat requirements. ***Contact appropriate state technical specialists for appropriate species.***

Additional Criteria for Pollinator Habitat

Establishment of pollinator habitat and habitat enhancements shall be in accordance with the West Virginia Pollinator Handbook.

Include forbs and legumes that provide pollen and nectar for native bees. Utilize a diverse mix of plant species that bloom at different times throughout the year.

A minimum of 10 species shall be established which include at least one native grass or sedge. Of the ten species utilized, a minimum of three species shall be established in each of the bloom periods of very early or early, mid and late season. Suitable species and corresponding bloom periods may be found in the plant tables or generalized mixes within the West Virginia Pollinator Handbook.

If used in conjunction with conservation practice standard (391) Riparian Forest Buffer (upslope herbaceous component), the minimum width shall be 35 feet in addition to the minimum width of the forest riparian buffer.

Additional Criteria for Terrestrial Wildlife

Select native species adapted to the site.

Density of the vegetative stand established for this purpose shall be managed for targeted wildlife habitat requirements and shall encourage plant diversity.

If mowing is necessary to maintain herbaceous cover it will occur outside the nesting and fawning season ***(March 15 – July 15)*** and allow for adequate re-growth for winter cover.

To maintain habitat with a diversity of plant structure, a third or less of the site should be disturbed (mowed, grazed, etc.) each year, allowing for recolonization of pollinators from surrounding habitat.

The management plan shall consider habitat and wildlife objectives such as habitat diversity, habitat linkages, daily and seasonal habitat ranges, limiting factors and native plant communities.

Refer to Conservation Practice Standard (645) Upland Wildlife Habitat Management and/or the WV Wildlife Habitat Evaluation Technique (WVWHET) for herbaceous plant species that benefit certain terrestrial wildlife species.

Additional Criteria for Restoring Desired Plant Community

Use Ecological Site Description (ESD) State and Transition models, where available, to determine if proposed actions are ecologically sound and defensible. Treatments need to be congruent with dynamics of the ecological site(s) and keyed to states and plant community phases that have the potential and capability to support the desired plant community. If an ESD is not available, base design criteria on best approximation of the desired plant community composition, structure, and function.

CONSIDERATIONS

Selection of native plant species is preferred. All selected species should have multiple values such as those suited for biomass, wintering and nesting cover, aesthetics, forage value for aquatic invertebrates, and tolerance to locally used herbicides.

Other conservation practices that may facilitate the establishment of Riparian Herbaceous Cover or enhance its performance include:

Stream Habitat Improvement and Management – (395)
Streambank and Shoreline Protection – (580)
Fence – (382)
Pasture and Hayland Planting – (512)
Access Control – (472)
Prescribed Grazing – (528)
Brush Management – (314)
Heavy Use Area Protection - (561)
Critical Area Planting - (342)
Riparian Forest Buffer - (391)
Early Successional Habitat Improvement Development and Management – (647)
Conservation Cover - (327)
Restoration and Management of Rare and Declining Habitat - (643)
Stream Crossing - (578)
Watering Facility - (614)

Consider the use of disturbance regimes in conjunction with a management plan (i.e. disking and strip mowing) to meet the intended purpose.

Consider the placement and size of herbaceous vegetation to minimize predation, increase diversity, and inhibit nuisance species.

Considerations should be given to how this practice will complement the functions of adjacent riparian, terrestrial and aquatic habitats.

Consider the effects of upstream and downstream conditions, structures, facilities, and constraints on the planned activities.

Control of invasive trees and shrubs may be required to prevent dominance of the riparian zone by woody plants and maintain openness in riparian system.

Consider establishing alternative water sources or controlled access stream crossings to manage livestock access to the stream and riparian area.

Selection of native plant species is recommended. Introduced species may be used. All selected species should have multiple values such as those suited for biomass, wintering and nesting cover, aesthetics, forage value for aquatic invertebrates, and tolerance to locally used herbicides.

Herbaceous riparian areas can function to link pollinators with adjacent fragmented habitat, and can serve as a conduit to move pollinators into areas requiring insect pollination. Different flower sizes and shapes appeal to different categories of pollinators. To support many species, consider establishing the greatest diversity possible. Consider incorporating nesting habitat, including patches of un-shaded bare soil for ground nesting bees or where bumble bee conservation is a priority, clump forming warm-season native grasses.

Avoid plant species which may be alternate hosts to pests. Species diversity should be considered to avoid loss of function due to species-specific pests.

The location, layout and vegetative structure and composition of the buffer should complement natural features.

Corridor configuration, establishment procedures and management should enhance habitats for threatened, endangered and other plant or animal species of concern, where applicable.

Use plant species that provide full ground coverage to reduce particulate matter generation during establishment and maintenance operations.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for each site. Specification shall be recorded using approved specifications sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

At a minimum the following will be identified (as appropriate):

- ***purpose of buffer***
- ***method of establishment***
- ***planted species selection and rates***
- ***site preparation***
- ***soil amendments***
- ***size of planting including the width length and total acres***
- ***competition suppression methods***
- ***planting date(s)***
- ***any required permits including CPA-52 or similar environmental evaluation documentation;***
- ***Operation and Maintenance Plan***

OPERATION AND MAINTENANCE

The purpose of operation, maintenance and management is to insure that the practice functions as intended over time.

The riparian area will be inspected periodically in order to detect adverse impacts and make adjustments in management to maintain the intended purpose.

Control of concentrated flow erosion or mass soil movement shall be continued in the up-gradient area to maintain riparian function.

Any use of fertilizers, pesticides and other chemicals to assure riparian area function shall not compromise the intended purpose.

Harmful pests present on the site will be controlled or eliminated as necessary to achieve and maintain the intended purpose.

Pest management will be conducted in a manner that mitigates impacts to pollinators.

Avoid haying or grazing when streambanks and riparian areas are vulnerable to livestock or mechanical damage.

Beyond the establishment period, a plan for limited livestock grazing or haying based on the carrying capacity of the area may be designed to protect and enhance established vegetation, stream bank stability or wildlife habitat. Timing of haying or grazing will avoid periods when streambanks are saturated and vulnerable to livestock or mechanical damage. This plan will insure that livestock are excluded from the stream during critical periods for aquatic species; and where wildlife is a primary concern, during critical nesting seasons (March 15 – July 15). Refer to WV Conservation Practice Standard (528) Prescribed Grazing – Riparian Grazing Management or Flash Grazing, (511) Forage Harvest Management for additional information.

Management systems will be designed and applied to maintain or improve the vigor and reproduction of the desired plant community, e.g., the riparian functions and values.

Where the primary purpose of the practice is to provide terrestrial wildlife habitat, the density of the vegetative stand shall be managed for targeted wildlife habitat requirements and shall encourage plant diversity. If mowing is necessary to maintain herbaceous cover, it will occur outside the nesting and fawning season ***(March 15 – July 15)*** and allow for adequate re-growth for winter cover.

To protect pollinators and maintain habitat with a diversity of plant structure, upon establishment a third or less of the site should be disturbed (mowed, grazed, etc.) each year, allowing for recolonization of pollinators from surrounding habitat.

Additional operation and maintenance specifications may be required on a site specific basis to maintain the intended purpose of the practice.

REFERENCES

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http://plants.usda.gov/pollinators/Using_Farm_Bill_Programs_for_Pollinator_Conservation.pdf

Agroforestry Notes on supporting pollinators (General 6, 7, 8 and 9):

http://www.unl.edu/nac/agroforestrynotes.htm

Riparian Forest Buffer (Acre) 391

DEFINITION

An area of predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.

PURPOSES

- Create shade to lower or maintain water temperatures to improve habitat for aquatic organisms.
- Create or improve riparian habitat and provide a source of detritus and large woody debris.
- Reduce excess amounts of sediment, organic material, nutrients and pesticides in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow.
- Reduce pesticide drift entering the water body.
- Restore riparian plant communities.
- Increase carbon storage in plant biomass and soils.

CONDITIONS WHERE PRACTICE APPLIES

Riparian forest buffers are applied on areas adjacent to permanent or intermittent streams, lakes, ponds, and wetlands. They are not applied to stabilize stream banks or shorelines.

CRITERIA

General Criteria Applicable to All Purposes

Comply with all federal, state, and local laws and regulations.

Position and design the riparian forest buffer (RFB) appropriately to achieve sufficient width, length, vertical structure/density and connectivity to accomplish the intended purpose(s).

The minimum width for all purposes shall be at least 35 feet measured horizontally on a line perpendicular to the water body beginning at the bank-full elevation, or the top of the bank.

RFBs may be established within existing forested areas. Assess species and stocking density to determine if the intended purpose(s) will be served. If additional stocking is required, select species adapted to the site that will not compromise the function and purpose(s).

If the existing forest cover width allows, establish the RFB as follows:

Table 1. Forest Buffer Widths Adjusted for Slope

Slope of Land Above Water Body	Minimum Width* of Riparian Forest Buffer
0-10 %	100 feet
10-20%	115 feet
20-30%	135 feet
30-40%	155 feet
40 +	175 feet

*For streams, listed widths are for each side of stream

If the existing forest cover is not wide enough to meet the widths in Table 1, establish the full existing width of the forest cover to a RFB. If the existing forest cover is less than 35 feet wide, plant trees and shrubs to increase the width to a minimum of 35 feet. Consider additional planting to meet the widths in Table 1.

Where RFBs are established with tree/shrub planting, use only native species and viable, high-quality and adapted plant materials. Prepare the site and plant at a time and manner to ensure survival and growth of selected species for achieving the intended purpose(s). Refer to Michigan NRCS Tree/Shrub Establishment (612) for spacing requirements, and additional information. Also refer the Conservation Tree/Shrub Suitability Guide in Section II of the Field Office Technical Guide to determine appropriate species to plant.

Use additional conservation practices, e.g., Tree/Shrub Site Preparation (490), Herbaceous Weed Control (315), Cover Crop (340), as needed to ensure the best chance of tree/shrub establishment.

Favor native tree and shrub species that have multiple values such as those suited for timber, biomass, nuts, fruit, browse, nesting, aesthetics and tolerance to locally used herbicides.

Periodic removal of some forest products such as high value trees, medicinal herbs, nuts, and fruits is permitted, provided the intended purpose is not compromised by the loss of vegetation or harvesting disturbance. Do not remove timber from RFBs with slopes greater than 50%.

Plan any tree harvesting or cutting to leave at least 60 sq. ft. of residual basal area. Do not cut any trees growing along the stream bank.

Control excessive sheet, rill and concentrated flow erosion within the riparian forest buffer and in the areas immediately adjacent to and up-gradient from the buffer site.

Control or exclude livestock as necessary to achieve the intended purpose. Refer to the Michigan NRCS Prescribed Grazing (528) and/or Access Control (472) Conservation Practice Standards, as applicable.

Control or eliminate harmful plant and animal pests present on the site as necessary to achieve and maintain the intended purpose. If pesticides are used, refer to the Michigan NRCS Pest Management (595) Conservation Practice Standard.

Use all fertilizers, pesticides, and other chemicals in accordance with labeling and only if it will not compromise the intended purpose(s).

Additional Criteria to Reduce Excess Amounts of Sediment, Organic Material, Nutrients and Pesticides in Surface Runoff and Reduce Excess Nutrients and Other Chemicals in Shallow Ground Water Flow

Establish a filter strip directly adjacent to and upslope from the RFB, to provide additional filtration. Refer to the Michigan NRCS Filter Strip (393) Conservation Practice Standard. Additionally, extend the width of the RFB in high nutrient, sediment, and animal waste application areas, where the contributing area is not adequately treated or where an additional level of protection is needed.

Assess the severity of bank erosion and its influence on existing or potential riparian trees and shrubs. Watershed-level treatment or bank stability activities may be needed before establishing a riparian forest buffer. Refer to the Michigan NRCS Streambank and Shoreline Protection (580) Conservation Practice Standard, if needed.

Direct drainage (subsurface tiles, etc.) and concentrated flow through the RFB provide a direct conduit of sediment, organic material, nutrients, etc. Use additional conservation measures such as to treat these areas. Refer to the Michigan NRCS Filter Strip (393) Conservation Practice Standard, if needed.

Additional Criteria to Create or Improve Riparian Habitat and Provide a Source of Detritus and Large Woody Debris

The minimum width shall be at least 50 feet measured horizontally on a line perpendicular to the water body beginning at the bank-full elevation, or the top of the bank.

Use the NRCS-Michigan Wildlife Habitat Evaluation or species-specific Habitat Suitability Index Models to evaluate the site. See Michigan Biology Technical Note #12.

Match RFB widths to the requirements of the fish and wildlife species and associated communities of concern, as described in Table 2. Contact the NRCS State Biologist for appropriate widths for other species, if unknown.

Table 2 – Required Total* Riparian Forest Buffer Width for Various Wildlife Species

Species	Desired Width (Ft.)
Bald eagle, cavity nesting ducks, heron, sandhill crane, neotropical migrants	600
Pileated woodpecker, kingfisher	450
Beaver, mink, salmonids	300
Deer	200
Muskrat	165
Frog, salamander, turtle	100

* For buffers along streams, width should include RFBs on both sides of the water course, if possible.

Establish plant communities that address the target aquatic and terrestrial wildlife needs and have multiple values such as pollinator need, habitat, nutrient uptake and shading.

Select species, corridor configuration, and management to enhance habitats for threatened,

endangered, and other species of concern, where applicable.

Create or maintain 4 to 7 snags (standing dead trees) per acre, with at least 1 snag per acre greater than 12" in diameter at breast height (measured 4.5 ft from the ground), if possible.

Additional Criteria for Increasing Carbon Storage in Biomass and Soils

Maximize the width and length of the RFB.

Select plants that have higher rates of carbon sequestration in soils and plant biomass and are adapted to the site to assure strong health and vigor. Plant a minimum of 681 trees per acre (8 feet x 8 feet or equivalent).

CONSIDERATIONS

Design RFBs to meet the Riparian Management Zone (RMZs) guidelines in "Sustainable Soil and Water Quality Practices on Forest Land" (MI DNR and DEQ, 2009).

Avoid tree and shrub species that may be alternate hosts to undesirable pests.

Consider species diversity to avoid loss of function due to species-specific pests.

Use plants from multiple sources to increase genetic diversity.

Consider allelopathic impacts of plants.

Plan the location, layout and density of the buffer to complement natural features, and mimic natural riparian forests.

For sites where continued function of drains is desired, woody root penetration may eventually plug the underground structure. In these cases, consider a setback of woody vegetation planted over the drain maintained in herbaceous cover or using rigid, non-perforated pipe to minimize woody root penetration.

Maximize widths, lengths, and connectivity of riparian forest buffers.

Address riparian forest buffer restoration on a watershed basis to reduce forest fragmentation and provide corridors for wildlife by maintaining continuous streamside vegetation.

The species and plant communities that attain biomass more quickly will sequester carbon faster. The rate of carbon sequestration increases as riparian plants mature and soil organic matter increases.

Species that resprout are generally preferred when establishing new rows nearest to watercourses or waterbodies subject to flooding or ice damage.

Establishment of riparian forest buffers is not advised in areas of extremely high runoff or severe shoreline or streambank erosion unless Michigan NRCS Conservation Practice Standard Streambank and Shoreline Protection (580) can be successfully implemented. In such cases, install these measures prior to the establishment of the riparian forest buffer.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets (See Riparian Forest Buffer (391) Conservation Design Sheet, narrative statements in the conservation plan, or other acceptable documentation.

Specifications will include, but are not limited to, the following items, if applicable:

- Purpose of treatment
- Width and length of the RFB
- Map indicating location of treatment
- Species to be planted
- Number of plants required
- Plant spacing
- Site preparation and planting techniques
- Timing of planting and other activities

OPERATION AND MAINTENANCE

Inspect the RFB periodically and protect from adverse impacts such as excessive vehicular and pedestrian traffic, pest infestations, concentrated flows, pesticides, livestock or wildlife damage and fire.

Replace dead planted trees or shrubs to maintain at least 80% survival with plants evenly distributed over the entire planted area.

Control undesirable vegetative competition until the buffer is, or will progress to, a fully functional condition.

Ensure that any manipulation of species composition, stand structure and stocking by cutting or killing selected trees and understory vegetation will sustain the intended purpose(s). Refer to the Michigan NRCS Forest Stand Improvement (666) Conservation Practice Standard.

Control or exclusion of livestock and harmful wildlife shall continue. Refer to the Michigan NRCS Prescribed Grazing (528) and/or Access Control (472) Conservation Practice Standards, as applicable.

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Michigan Department of Natural Resource and Michigan Department of Environmental Quality. 2009. Sustainable Soil and Water Quality Practices on Forest Land. Lansing, MI. http://www.michigan.gov/documents/dnr/IC4011_SustainableSoilAndWaterQualityPracticesOnForestLand_268417_7.pdf

Schultz, R.C., J.P. Colletti, T.M. Isenhart, W.W. Simpkings, C.W. Mize, and M. L. Thompson. 1995. Design and Placement of a Multi-Species Riparian Buffer Strip, Agroforestry Systems 29:201-225. http://www.springerlink.com/content/j177171645622606/fulltext.pdf

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Welsch, David J. 1991. Riparian Forest Buffers - Function and Design for Protection and Enhancement of Water Resources. NA-PR-07-91. USDA Forest Service, Northeastern Area State and Private Forestry, St. Paul, MN. http://www.na.fs.fed.us/spfo/pubs/n_resource/riparianforests/

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FENCE

(Ft.)

CODE 382

DEFINITION

A constructed barrier to animals or people.

PURPOSE

This practice is applied to facilitate the application of conservation practices by providing a means to control movement of animals and people.

Applicable purposes include, but are not limited to:

- Improve distribution and timing of livestock grazing
- Reduce erosion and improve water quality by controlling livestock access to streams, springs, wetlands and ponds
- Facilitate handling, movement and feeding of livestock in a pasture environment
- Protect newly planted areas from disturbance until established
- Protect sensitive environmental areas and their flora from vehicular, pedestrian or animal traffic and use
- Protect the safety of people, livestock and wildlife by limiting or denying access to hazardous areas

CONDITIONS WHERE PRACTICE APPLIES

This practice may be applied on any area where management of animal or people movement is needed. Fences are not needed where natural barriers will serve the purpose.

CRITERIA

General Criteria Applicable to All Purposes

Fencing materials, type and design of fence installed shall be of a high quality and durability. The type and design of fence installed will meet the management objectives and topographic challenges of the site.

Fences shall be positioned to facilitate management requirements. The fence design and installation shall follow all federal, State and local laws and regulations.

Construction shall be performed in a manner that meets the intended management objective. Wire and hardware will be new, galvanized material.

Height, number, and spacing of wires will be installed to facilitate control and management of the animal(s) and people of concern.

Height, size, spacing, and type of posts will be used that best provides the needs for the style of fence required and is best suited for the topography of the landscape.

Manufacturer's guidelines shall be adhered to during installation of each type of fence to ensure proper component assembly.

Follow all manufacturers' safety precautions for handling and installing fencing materials. Place warning signs on electric fences every 150 to 200 feet, wherever the public is expected to encounter the fence.

Wire should be attached on the side of posts that will receive the greatest pressure from animals. Wire will be placed on the outside of posts on curves.

All fence construction shall comply with federal, state and local fencing codes.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

Additional Criteria

1. Non-electric standard woven and barbed wire - See Appendix 1.
2. High tensile electric, high tensile non-electric, light weight high tensile, high tensile for deer control - See FOTG Agronomy References – High-Tensile Wire Fencing and Max-Flex™ - First in Fencing - Since 1978. (Note: The above are to be used as reference material only. They should not be copied and given to a client)
3. Electroplastic twine (polywire) and electrified ribbon fencing - See Appendix 2.
4. Board fence - See Appendix 3.
5. Chain link and ornamental fencing – Install according to manufacturers recommendations.
6. Legal fence – See Appendix 4.

CONSIDERATIONS

The fence design and location should consider: topography, soil properties, safety and management of livestock, wildlife movement, location and adequacy of water facilities, development of potential grazing systems, human access, landscape aesthetics, erosion problems, moisture conditions, flooding potential, stream crossings, and durability of materials.

Where applicable, cleared rights-of-way may be established which would facilitate fence construction and maintenance.

Fences across gullies or streams may require special bracing, designs or approaches.

Fence design and location should consider ease of access for construction, repair and maintenance.

Breakaway fences or swinging water gaps allow debris and water to flow past the fence line without destroying the fence adjacent to the stream or gully. Swinging water gaps or floating water gaps should span running streams.

Any permanent fencing for grazing livestock should allow flexibility to facilitate implementation of the grazing plan and permit land management activities such as nutrient application, pest control, forage harvest, and other appropriate practices.

When possible, install fences across slopes to improve grazing distribution, rainfall infiltration, and reduce soil erosion.

Locate fences to facilitate livestock management, handling, watering, and feeding.

Remove temporary fence during non-grazing season to minimize flood or deer damage. Deer fence should be electrified year-round to train deer to avoid the protected area.

PLANS AND SPECIFICATIONS

Plans and specifications are to be prepared for specific sites based on this standard.

Plans and specifications for installing fences shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve all of its intended purposes.

At a minimum the following will be identified in the conservation plan:

- Type of fence
- Strands of fence (if applicable)
- Type and size of fence posts
- Length of fence
- Operation and maintenance requirements

OPERATION AND MAINTENANCE

Regular inspection of fences should be part of an ongoing maintenance program. Inspection of fences after storm events is necessary to insure the continued proper function of the fence.

For electrified fences, use a voltage tester to ensure adequate charge is being maintained along the entire fence span. Keep heavy vegetation away from fences, especially electrified fences to avoid a loss of charge.

Maintenance and repairs will be performed in a timely manner as needed.

Retain and properly discard all broken fencing material and hardware to prevent ingestion by

animals or injury to equipment, people or animals.

All necessary precautions should be taken to ensure the safety of construction and maintenance crews.

References

High Tensile Wire Fencing, Cooperative Extension Northeast Regional Agricultural Engineering Service, NRAES – 11, September, 1987

Max-Flex™ - First in Fencing - Since 1978, 2002 Version, Max-Flex™ Company, U.S. Rt. 219, Linside, WV 24951, phone: 1-800-356-5458, http://www.maxflex.com

Laws of West Virginia Relating to Agriculture, West Virginia Department of Agriculture, Charleston, WV, 1996

* Note - Bold italics indicate information added to the national standard by West Virginia.

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APPENDIX 1 – NON-ELECTRIC STANDARD WOVEN AND BARBED WIRE

APPENDIX 1

NON-ELECTRIC STANDARD WOVEN AND BARBED WIRE

Fences for large animals (cattle and horses), will be constructed of 5-6 strands of barbed wire but 4 strands may be used for interior pasture and 3 strands for livestock exclusion of woodland.

Fences for mixed livestock will be constructed of woven wire at least 39" high topped with two strands of barbed wire or 47" high topped with one strand of barbed wire.

Materials

a. Barbed wire: Double strand 15-1/2 gauge or larger with 4 point barbs.

b. Woven wire: 11 gauge or larger top and bottom wires, 14 1/2 gauge or larger intermediate line and stay wires. Maximum of 12" between stay wires. Live trees in line with fence and at least 5" in diameter can be used as a substitute for posts. The wire must be attached to a black locust or pressure treated 2x4 nailed to the tree.

c. Posts: Black locust is preferred as the most durable wood to use untreated. Eastern redcedar may also be used untreated. All other woods will be treated with preservative if used.
Steel posts may also be used.

Wood line posts – 6-1/2 feet or longer, 4 inch minimum diameter (3 inch for pressure treated posts).

Wood corner, gate and brace posts – 8 feet or longer, 5 inch minimum diameter.

Steel line posts – Standard "T" Section 1-3/8" X 1-3/8" x 1/8", galvanized or painted, w/anchor plate. Every third or fourth post shall be wood.

d. Braces:
Wood – 3-1/2 inch diameter at small end, or 3-1/2 inches square, 8 feet long.

Brace wire – High tensile, galvanized steel, 9 gauge or 12 ½ gauge high tensile, galvanized, double wrapped

d. Staples: Staples used to fasten fence wire to wooden posts will be 9 gauge galvanized wire with a minimum length of 1-1/2" for softwood and 1" for hardwood. Staples will be driven cross-wise to the grain and will not be driven in tight against wire.

Installation

Wood line posts - maximum of 16.5 ft. apart and set a minimum of 2 feet deep.

Steel line posts - maximum of 16.5 ft. apart and set to top of anchor plate.

Brace assemblies in line - are placed not more than 660 ft. apart on level or gently sloping land; and at any significant change in the land surface - 15° change in alignment or slope.

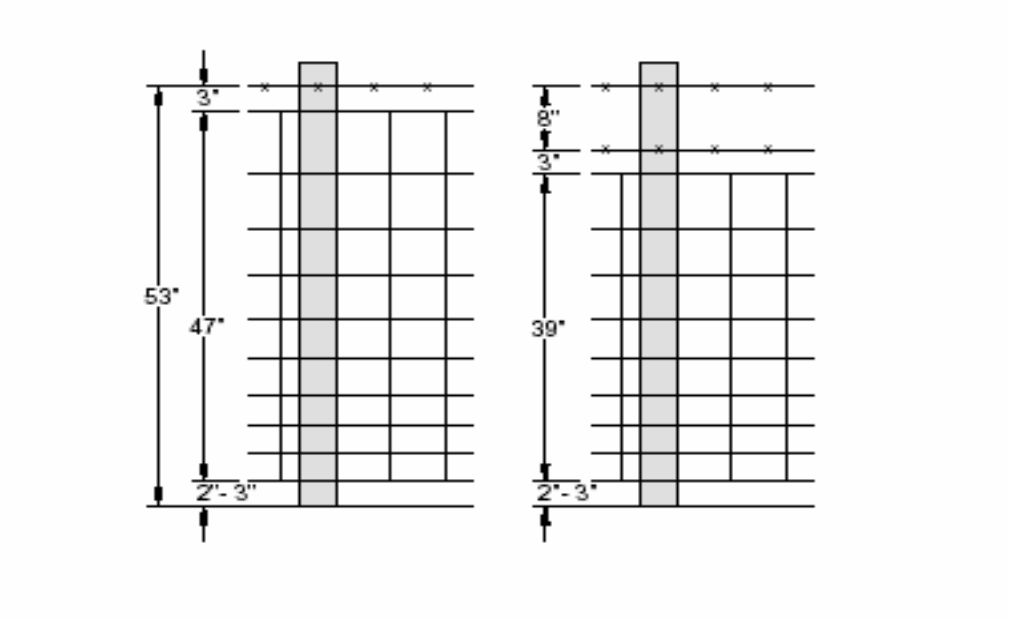
Brace posts - are placed 8 feet from corner posts, end posts, and gate posts; and 8 ft. apart in line brace assemblies.

Corner, gate, and brace posts – are set at least 3 feet deep. Posts may be driven or set in post holes and hand tamped with earth or filled with concrete.

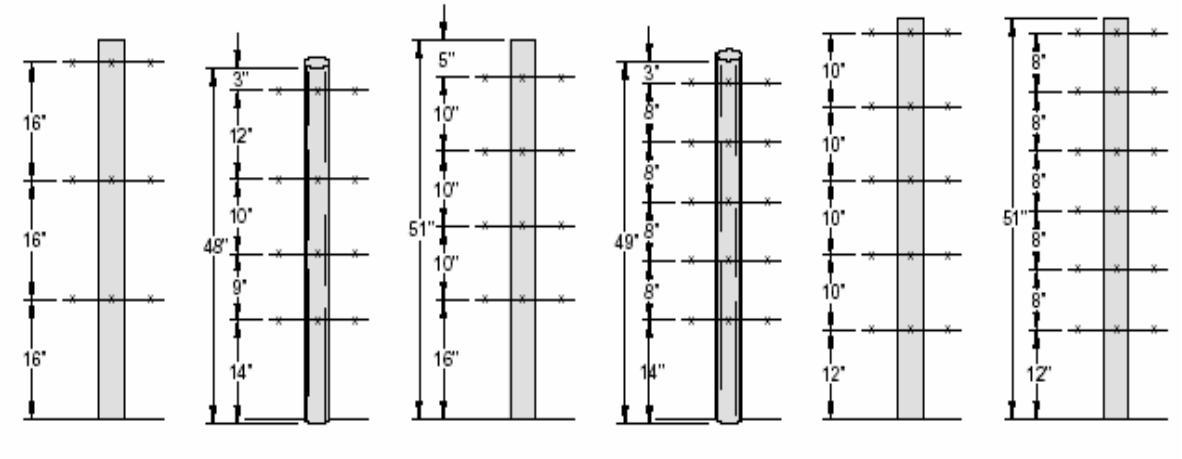
Drawings for wire bracing and control panel construction.

MOUNTING HEIGHTS FOR BARBED WIRE USE WITH WOVEN WIRE FENCE

The first barbed wire above woven wire fence should be within 3” of top line wire. This reduces the possibility of animals getting their heads between woven wire and barbed wire and destroying the fence.



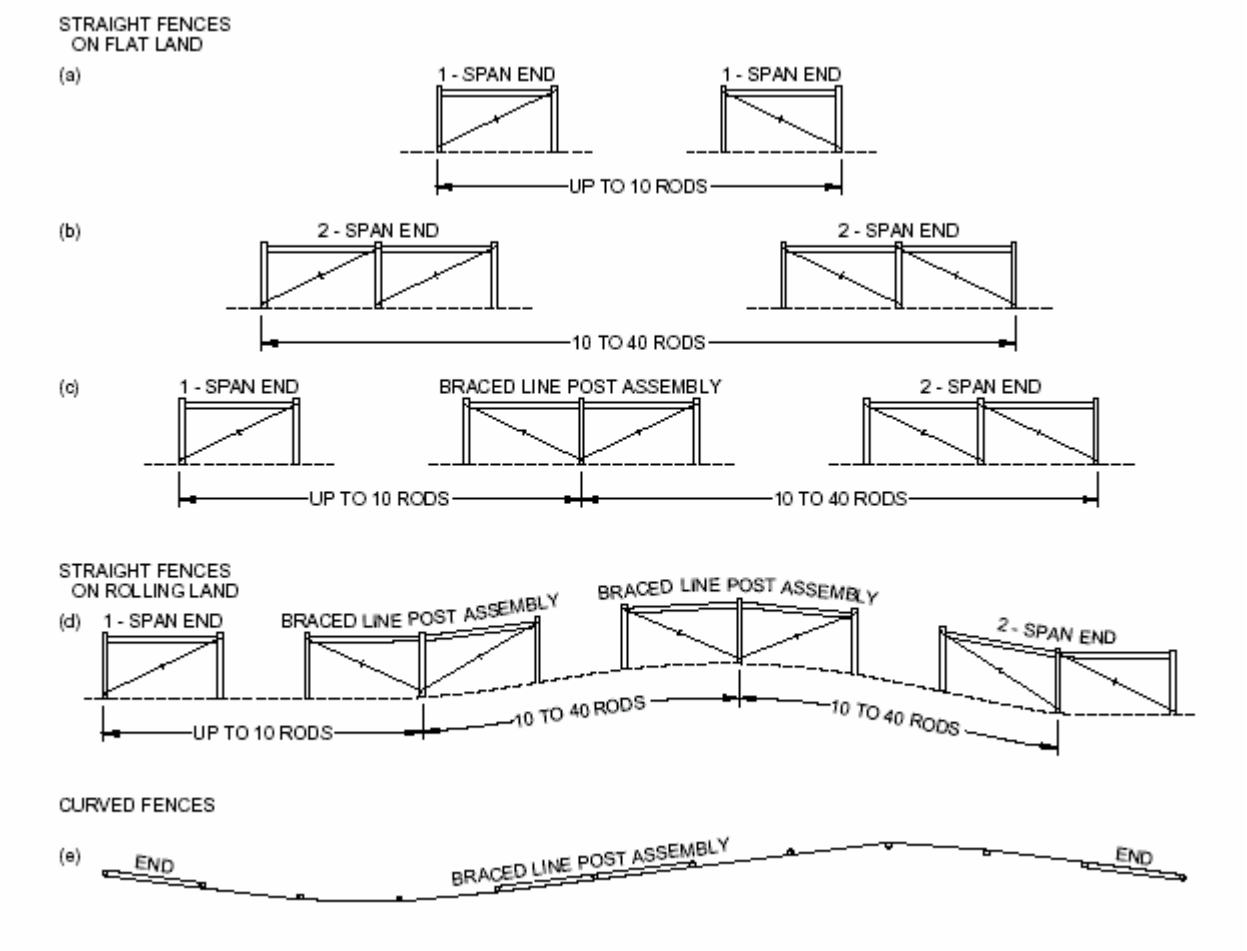
SUGGESTED SPACING FOR BARBED WIRE



ANCHOR-AND-BRACE LOCATIONS FOR FENCES

NRCS, NHCP
March 2003

NRCS, WV
April 2005



Types of anchor-and-brace assembles and where to locate them.

(a) For fence lengths of 10 rods (165 feet) or less, use single span end construction.

(b) For fence lengths of 10 to 40 rods (165 to 660 feet), use double-span end construction.

(c) For fences more than 40 rods (660 feet) long, use a braced-line-post assembly to divide the fence lengths.

(d) On rolling land, fence stretching is easier if braced line-post assemblies are located at the foot and top of each hill.

(e) Contour fences, more than 20 rods (330 feet) long, should have a braced-line-post assembly installed to keep the stretches to 20 rods (330 feet) or less. Install in straight section at least one post span away from a curve. Do not install on a curve.

Note: One rod equals 16 ½ feet.

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APPENDIX 2 – ELECTROPLASTIC TWINE (POLYWIRE) AND ELECTRIFIED TAPE FENCING

APPENDIX 2

ELECTROPLASTIC TWINE (POLYWIRE) AND ELECTRIFIED TAPE FENCING

Temporary, portable electric fence systems are used to control all types of livestock. Fencing may be used to divide large pasture acreage into manageable units.

Materials

a. Wire: Wire shall be polyethylene wire or tape with steel or aluminum wire woven into them. Temporary net fence may be used in crowding areas and for animals such as sheep, goats, and hogs.

Spacing:

One strand – place wire 28 to 34 inches above the ground.

Two strands – place wires a 17 to 22 inches and 32 to 38 inches above the ground.

Three strands – place wires 10 to 17, 20 to 27 and 32 to 38 inches above the ground.

b. Posts:

End Posts: When end posts are needed at each end of a cross fence, they may be untreated wood (locust) or pressure treated softwood, or equivalent, with a top diameter sufficient to anchor the wire. Posts must be long enough to allow them to be set at least 18” in the ground.

Line Posts: Posts in a line of cross fence may be manufactured fiberglass, 48” long, or equivalent, set deep enough in the ground to withstand livestock.

Spacing:

Line posts will be installed on a spacing necessary to control livestock.

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APPENDIX 3 – BOARD FENCE

APPENDIX 3

BOARD FENCE

A wooden board fence shall have a minimum of 3 boards. The maximum board spacing shall be 16-inches center to center. The top edge of the uppermost board will be at least 48" above the ground, and the top edge of the lowest board will be no greater than 16" above the ground. Each board shall be attached to each post with two 16d galvanized or cadmium coated nails.

Unless painting is selected, lumber shall be treated with creosote or comparable preservative. If painting is desired, lumber shall be treated with an approved preservative.

Materials

a. Rails: The rails (horizontal boards) shall be a minimum of 1" x 6" (nominal) x 8' long. Wooden boards (horizontal rails) and posts shall be well seasoned or kiln-dried to minimize warping. Use untreated durable wood of such species as red cedar, black locust or a non-durable wood that is preservative pressure treated. Treated lumber shall be treated with a minimum retention of 0.40 lbs./cubic foot chromated copper arsenate (CCA), type A, B, or C, or equivalent non-CCA treatment. Boards and posts may be painted if desired.

b. Posts: Untreated posts will be black locust. Pressure treated pine or other wood of equal life and strength are acceptable. Line posts will have a minimum top diameter of 3 inches and be of sufficient length to support the height of the fence and be firmly set or driven in the ground a minimum of 2 feet. Corner, gate, end, and brace posts will have a minimum top diameter of 5 inches and be of sufficient length to support the height of the fence and be firmly set or driven in the ground a minimum depth of 3 feet.

   Post Spacing: Posts shall be spaced a maximum of 8 feet apart to accommodate rail lengths.

APPENDIX 4

WEST VIRGINIA AGRICULTURE LAWS

ARTICLE 17.

FENCES.

Article lnappUcable to federallaacU.- Landa of the United Statu are not subject to the provisions ofthia article. United States v. Jolmston, 38 F. Supp. 4 (S.D.W. Va. 1941).

§ 19-17-1. Definition of lawful fence.

Every·fence of the height and description hereinafter mentioned shall be deemed a lawful fence as to any horses, mules, asses, jennets, cattle, sheep, swine, or goats, which could not creep through the same, that is to say:

(a) If built of common rails, known as the worm fence, four and one half feet high;

(b) If built with posts and rails, or posts and plank, or pickets, four feet high;

(c) If built with stone, two feet wide at base, and three and one half feet high;

(d) If a hedge fence, four feet high. If any hedge fence be built upon a mound, the same from the bottom of the ditch shall be included in estimating the height of such fence;

(e) If built with posts and wire, or pickets and wire, four feet high, and shall consist of not less than six strands, the first strand five inches, the second strand ten inches, the third strand seventeen inches, the fourth strand twenty-five inches, the fifth strand thirty-six inches, and the sixth strand forty-eight inches from the ground; and if with more than six strands, the space between the strands shall in no case be greater than hereinbefore provided. The space between the posts shall, in no case, be greater than sixteen feet;

(t) If built with posts and high tensile galvanized wire, forty-six inches high, and shall consist of not less than eight strands, the first strand four inches, the second strand nine inches, the third strand fourteen inches, the fourth strand nineteen inches, the fifth strand twenty-five inches, the sixth strand thirty-one inches, the seventh strand thirty-eight inches, and the eighth strand forty-six inches from the ground. The wire shall be maintained at no less than a two hundred pound tension at all times. The space between posts shall, in no case, be greater than thirty feet, provided that pressure-treated one and one-fourth inch by one and one-half inch by forty-eight inch slotted hardwood or one and one-half inch by two inch by forty-eight inch softwood battens are used between posts at a distance no greater than ten feet; and

(g) 1f built with posts and high tensile gaivamzect wire Sl)d electrified, thirty-eight inches high and shall consist of not less than five strands, the first strand five inches, the second strand ten inches, the third strand seventeen inches, the fourth strand twenty-seven inches, and the fifth strand thirty-eight inches from the ground. The wire shall be maintained at no less than a two-hundred pound tension at all times. The space between posts shall, in no case, be greater than one hundred fifty feet, provided that pressure-treated one and orie-fourth inch by one and one-half inch slotted hardwood or one and one-half inch by two inch softwood battens are used between posts at a distance no greater than thirty-five feet: Provided, That if said fence is constructed to confine only horses, mules, asses, jennets, or cattle, it shall be deemed a legal fence if it·is not less than three strands, the first strand $8Venteen inches, the second strand twenty-seven inches and the third strand thirty-eight inches from the ground. The space between posts shall, in no case, be greater than one hundred fifty feet, provided that pressure-treated one and one-fourth inch by one and one-half inch slotted hardwood or one and one-half inch by two inch softwood battens are used between posts at a distance no greater than thirty-five feet. Only highpowered low impedance fence controllers which comply with international safety standards shall be used to electrify fence.

All fences heretofore built under the existing law and in compliance therewith shall be and remain and may be kept up as lawful fences. (Code 1868, c. 60,§ 1; 1872-S,c. 148,§ 1; 1882,c. 115,§ 1; 1883, c. 32, § 1; 1891, c. 64, § 1; 1895, c. 35, § 1; Code 1923, c. 60, § 1; 1933, c. 55; 1986, c. 1.)