Final Report

Cacapon Institute

Tuscarora Creek Dirt and Gravel Road Remediation Prioritization

A project funded by Clean Water Act, title 319(h) funding

The West Virginia Department of Environmental Protection

Division of Water and Waste Management

Nonpoint Source Program

In collaboration with the WV Chesapeake Bay Potomac Tributary Team

October 21, 2014

Watershed information

8-digit HUC Code 02070004 Conococheague-Opequon Watershed

10-digit HUC Code 0207000409, Opequon Creek

12-digit HUC Code 020700040907 Tuscarora Creek

TMDL (USEPA, 2008) Potomac Direct Drains

303(d) list stream code WVP-4-C (Tuscarora Creek)

303(d) list stream code WVP-4-M (Mill Creek)

Project summary

1. **Background.** Sediment is one of the three priority pollutants identified by the Chesapeake Bay Program as being key to restoration. The focus of this CWA 319 funding request was sedimentation from Dirt and Gravel Roads (D&GR). Cacapon Institute (CI) conducted a pilot study of D&GR road prioritization techniques in two Potomac Highlands watersheds, Tuscarora Creek and the project was expanded to include Mill Creek of the Opequon.

2. **Goals and objectives**. The purpose of this project was to demonstrate and build capacity for prioritizing sections of dirt and gravel road remediation using techniques developed at Penn State. Approximately 15 people from agencies, municipal employees and watershed groups will participate in a one day workshop on assessment techniques. We will submit articles to local and regional media presenting results to an estimated audience of 10,000. A flyer will be prepared and delivered via saturation mailing to all rural residents in the target area

3. **Methods employed (measures of success).** Two methods were employed: field assessment and GIS prescreening plus field assessment. The field assessments were carried out using the Center for Dirt and Gravel Road Studies at Penn State's "dirty dozen" assessment tool. The GIS prescreening plus field assessment method utilized ARC-GIS and other GIS tools to identify roads that were likely candidates for sediment runoff issues. This report provides the results of the field assessment study and assesses the utility of the GIS prescreening approach.

Background

Since 2003, the WV Chesapeake Bay Tributary Team has been working on strategies and implementing practices to improve water quality in West Virginia's Potomac Highlands region and to contribute substantively to the restoration of the Chesapeake Bay. Sediment is one of the three priority pollutants identified by the Chesapeake Bay Program as being key to restoration. The focus of this CWA 319 funding request was sedimentation from Dirt and Gravel Roads (D&GR). Specifically, CI worked with partners to conduct a pilot study of D&G road prioritization techniques in two Potomac Highlands watershed, Tuscarora Creek and expanded to include Mill Creek of the Opequon. This project occurred between March and September 2014.

The Tuscarora Creek (tributary of Opequon River) Watershed Based Plan contains the following language, taken in large part from the TMDL:

> Urban/residential/road impervious area: Stormwater runoff from residential and urbanized areas that are not subject to MS4 permitting requirements can be a significant source of sediment (West Virginia Division of Water and Waste Management, 2007). There is only a small (0.8%) reduction prescribed for this source, but, as with pasture and cropland, implementing sediment BMPs on these lands will contribute to load reductions overall. These should include BMPs that reduce the volume of stormwater runoff into streams, such as bioretention (rain gardens), wetlands, downspout disconnections, and impervious surface reduction.
>
> Sediment loads from roads are considered part of the MS4. Runoff from paved and unpaved roadways can contribute significant sediment loads to nearby streams. Heightened stormwater runoff from paved roads (impervious surface) can increase erosion potential. Unpaved roads can contribute sediment through precipitation-driven runoff. Roads that traverse stream paths elevate the potential for direct-deposition of sediment. Road construction and repair can further increase sediment loads if BMPs are not properly employed (West Virginia Division of Water and Waste Management, 2007). Therefore, sediment reduction BMPs for roads

not included in the three MS4 permittee's' Stormwater Management Plans should also be eligible for Section 319 funding.

Cacapon Institute was the lead organization on this project.

Watershed information and location: This project occurred in the Potomac Direct Drains region, in the Opequon Creek Watershed, 8-digit HUC – 0207000409, specifically in Tuscarora Creek, HUC – 12-digit HUC Code 020700040907, Potomac Direct Drains Watershed TMDL Report (2008), and 303(d) list stream code WVP-4-C. An additional Opequon Creek tributary, Mill Creek, was added to the study when it was determined that Tuscarora Creek had a very small number of dirt and gravel roads to assess.

Methods

We conducted a pilot study of dirt and gravel (D&G) road upgrade prioritization techniques in the Tuscarora Creek and Mill Creek watersheds. Two methods were employed, field assessment and GIS prescreening plus field assessment.

The field assessments were carried out using the Penn State Center for Dirt and Gravel Road Studies' "dirty dozen" assessment tool that delivers a "pollution potential" score for any stretch of road from 0 to 100, based on the following factors:

1. Road sediment in stream;
2. Wetsite conditions;
3. Road surface material;
4. Road slope/grade;
5. Road shape;
6. Slope to stream;
7. Distance to stream;
8. Outlet to stream;
9. Outlet bleeder stability;
10. Road ditch stability;
11. Road bank stability;
12. Average canopy cover.

Factor 1 (road sediment in stream) focuses this assessment method narrowly on identifying segments of D&G roads that deliver sediment from the road surface and the adjoining ditches to drainage features on the landscape, not just perennial streams. Roads that are actively eroding but deliver sediment to woodlands or fields more than 100 feet from streams are not considered. Each of the additional factors (2-12) identify factors that can increase the amount of sediment delivered and help focus future remediation on specific problem areas.

The following methodology was utilized: 1. Find a road that is unpaved; 2. Begin driving slowly on road looking at drainage patterns; 3. Stop at any place where road drainage may reach stream (any drainage feature), paying close attention where stream is near or springs cross road (bleeders and culvert outlets are most likely polluters); 4. If road runoff reaches a drainage feature, make it a worksite; 5. New worksite includes the entire length of unpaved road that is contributing to pollution; 6. Enter data for new worksite using the field sheet (Appendix 1); 7. Repeat for any other potential worksites on road; and 8. Continue to next unpaved road. This method is described in more detail here: http://www.dirtandgravel.psu.edu/pa_program/gis/gis_help/worksites/assessment.htm

The GIS prescreening assessment method utilized ARC-GIS and Q-GIS tools to identify roads that were likely candidates for sediment runoff issues. Specifically, the process involved: determine road surface status of all public roads, determine the road slope, road intersections with drainage features, road distance to stream, and tree canopy. GIS methods are described in more detail below in Results. Accuracy of GIS results were field-verified using a random sampling approach.

Results & Discussion

It quickly became apparent via field assessment that existing highway GIS layers did not accurately identify the surface type of roads in this area. Specifically, many of the roads identified as D&G in the Tuscarora Watershed were actually paved, and some of the roads identified as paved were D&G. This resulted in the decision to add Mill Creek of the Opequon watershed to this study so that a reasonable number of D&G roads would be available for assessment. Mill Creek was selected because it also had a watershed based plan that included D&G roads as a sediment source.

Field Assessment Results. Field assessments conducted by Cacapon Institute, WVDEP and WV DOF personnel occurred on 9/11/2014 and 9/16/2014. Three D&G roads in the Tuscarora watershed (Copperhead Lane, Rams Lane, Harvest Mountain Lane) and five D&G roads in the Mill Creek watershed (Ronald Lane, Stacey Lane, T&S Road, Norris Gap Road, Plank Bridge Road) were identified as having segments that contributed sediment to streams (drainage features). These roads were a mixture of public and privately maintained roads.

The table below (next page) summarizes the results of this assessment (complete results in Appendix 2). Priority scores ranged from a low of 16 (Stacey Lane) to a high of 66 (Plank Bridge Road), out of a maximum score of 100. None of the identified segments had apparent wetsite conditions. After ranking the amount of sediment deposited in streams, the factors most likely to contribute to a high score were road material, slope and shape.

The site rated highest for sedimentation potential, Plank Bridge Road, was steep, largely maintained with local soft stone material that breaks down to readily eroded material, had a badly eroded ditch without side culverts, and a road surface that channeled water down the road rather than to the sides. A substantial amount of road material was observed in Mill Creek, the receiving stream, at the plank bridge for which the road was named. It did not receive a higher score because it lacked wet site conditions, had a reasonably stable road bank, and had an optimal tree canopy of about 50%.

The site rated lowest for sedimentation potential, Stacey Lane, delivered little sediment, but crossed the receiving stream and had no tree canopy.

The Norris Gap Road segment highlights the way this assessment approach focuses narrowly on “pollution potential” rather than broadly on road maintenance issues. As noted in the table’s comments, this was a very long “site” with the road incised for much of its length before finally reaching an outlet to a stream. The conditions along the road were highly variable, with very steep badly eroding sections alternating with nearly level sections where most of the eroded material slowed and was deposited beside the road before the road finally reached an outlet to a stream. At that point, most of the sediment that was generated by the poor road design had already been shunted to the side of the road to be “absorbed” by grassy and wooded areas that did not contribute sediment to a stream.

"Dirty Dozen" Road Assessment Evaluation							
Date	Watershed	Road:	Stream:	Top Coordinate	Bottom Coordinate	Priority Score	Comments:
9/11/14	Tuscarora	Copperhead Lane	Dry Run Tributary	39.48471 & -78.03571	39.48458 & -78.03482	49	culvert under road appears to discharge to ephemeral channel; road has become ditch
9/11/14	Tuscarora	Rams Lane	Tuscarora tributary	39.45689 & -78.05576	39.45638 & -78.05487	55	Discharge to ephemeral stream, road is ditch
9/11/14	Tuscarora	Rams Lane	Tuscarora tributary	39.45638 & -78.05487	39.45542 & -78.05294	59	
9/11/14	Tuscarora	Rams Lane	Tuscarora tributary	39.45542 & -78.05294	39.45501 & -78.05209	49	sheet flow exiting road before outlet; side road not rated because discharge tp field; Herb noted runoff from 180 acre property between Rams Lane and Side Road drains largely to a sinkhole
9/11/14	Tuscarora	Harvest Mountain	Tuscarora tributary	39.44421 & -78.06561	39.44435 & -78.06498	44	
9/11/14	Mill Creek	Ronald Lane	Mill Creek Tributary	39.36389 & -78.11053	39.36225 & -78.10654	40	Bottom at Dominion Road. Road generally in god condition
9/11/14	Mill Creek	Stacey Lane	Mill Creek Tributary	39.36342 & -78.11086	39.36237 & -78.11149	16	Stream feeds to pond
9/11/14	Mill Creek	T&S Road	Mill Creek Tributary	39.36199 & -78.11329	39.3607 & -78.10865	27	
9/11/14	Mill Creek	Norris Gap Rd.	Mill Creek Tributary	39.35861 & -78.13125	39.35051 & -78.11712	48	Very long site before finally reaching an outlet, road incised for much of length, highly variable with steep badly eroding sections and nearly level sections where eroded material is deposited along road side before reaching an outlet
9/16/14	Mill Creek	Plank Bridge Road	Mill Creek	39.31623 & -78.01389	39.3154 & -78.01546	33	Outlet is above stream crossing discharge to woods and pasture. Probably doesn't reach stream.
9/16/14	Mill Creek	Plank Bridge Road	Mill Creek	39.31314 & -78.01437	39.31496 & -78.01561	66	Outlet into stream. Outlet bleeder might have been cut by equipment. Considerable road material in stream.

GIS Results. As noted above, we quickly learned that existing highway data layers did not accurately identify road surface. The error rate was so high that we determined the only way to reliably identify roads as D&G was to drive the watershed and look at them. This issue made suspect the underlying concept of using a GIS pre-screen as a cost saving measure to identify D&G roads that were likely contributors to sedimentation problems. However, because road layers may not always be this error ridden, we decided to proceed with a GIS assessment of all the roads in the rural part of the Tuscarora watershed to test the viability of GIS prescreening roads for likely sedimentation issues. Parameters selected were: road distance from stream, road slope, tree canopy. Specifically, we:

- Augmented existing "blue line" streams layers to generate detailed drainage patterns using DEMs for all watershed areas ten acres or greater.
- Selected freeware QGIS for the primary analysis.
- Identified road segments within 100' of streams (all drainage features for 10 acres or greater). This defined 1578 AOIs (Areas of Interest) for GIS screening.
- Buffered roads at 20' from centerline to define polygons (areas) used to assess slope using DEMs.
- Ran a filter for 10% or greater road slope within the Stream/Road Buffer AOI intersect. This created a subset of roads (590) within the AOI that had an increased potential for erosion.
- Within the AOI's, we calculated Tree Canopy and the percentage of the AOI with >20% slope as attributes that were then used to rank each segment.

Post GIS data manipulation:

- Removed all AOI segments without 10% pixels. From an AOI total of 1578, 590 segments remained.
- Removed all segments with AOI 10% area smaller than 42 sq meters. This equals a road section 6 meters (20 feet) in length and road width 7 meters (6x7=42 sq m). 294 segments remained.
- Estimated road area in square meters for remaining segments, assume road width 7 meters.
- Rank each segment. Rank equals (pct_road_area_>10)+(pct_road_area_>20*0.7)+(ABS(50-pct_TC)*0.6). Max score would be 200, with 100% road area >10%, 100% road area >20%, and tree canopy at 0% or 100%. Higher score indicates a greater probability of erosion issues affecting a stream.
  - Road area >10 = worth 100 points
  - Road area >20 = worth 70 points
  - Tree canopy = worth 30 points
    - Scores ranged from 2.8 to 118.6, with an average score of 36.3 and median of 33.1.

These results are provided in Appendix 3. Starting with the highest ranked sites, ranked locations were viewed in Google Earth (with scores ranging from 66.7 to 118.6). Low rank number indicates higher probability of erosion issues, as does a higher score. It quickly became apparent that not all were actually roads. Of the 20 top ranked sites, six were in a quarry, two were in the middle of fields, one was an old, apparently abandoned jeep trail, two appeared to be private driveways, and one was on the roof of a house. Locations of D&G roads that had previously been identified in the field as having high potential for sedimentation problems were identified as potential problem sites using this method.

Thirteen actual road sites were selected for field verification; ranks 3, 5, 11, 14, 17, 18, 20, 45, 52, 99, 135, 176, and 244. Field verification was conducted by Neil Gillies on 9/25/2014. The first site visited was ranked low at 135 with a score of

34.4. Field conditions were consistent with the GIS analysis. There was a drainage feature that was not on the DNR blue line streams layer, the road was modestly sloped, the tree canopy was minimal. This site also highlighted, as all other site visits this day would, fundamental weaknesses in the GIS approach. First, the road itself sloped at < 10%; the only areas that were at least 10% slope were road shoulders that were included in the 20’ buffer area. The second issue was obvious on the main road leading into the study area. This road (Showers Lane) was steep as it approached the drainage feature on both sides, but the slope was very shallow within 100’ of the stream, meaning that it was not picked up in the analysis that filtered for road slope.

The pattern repeated itself in site after site and, in the end, only six ranked sites were visited. Each site was characterized reasonably well by the GIS analysis, with the exception that the tree canopy result was wrong at several sites. It was clear that many roads that could contribute sediment to streams were not included in the ranking because, even if much of the road was steep, the area within 100’ of drainage features had shallow to no slope. It was also likely that the slope of road banks, rather than the roads, was contributing to segments being included in the ranking. This could be managed by narrowing the road buffer width for assessing road slope. However, without road layers that are perfectly aligned with the actual geospatial center of the road, narrower road buffers could end up including less of the actual road area. The first problem (steep road away from stream) could be addressed with a much more complex GIS analysis that began by identifying all roads that fall within 100’ of drainage features, working backwards to extend these road segments to capture the entire road area that drains toward the stream, and then applying the slope assessments for that entire section. We do not have a solution for the data quality problem (such as road center location not exactly aligned with elevation layer).

The primary issues that limit any potential utility of a GIS pre-screen approach to increasing efficiency of D&G road field assessments relate to data quality. First, the DOH roads GIS data does not reliably identify road surface. Secondly, small differences between data sources can have large impacts on outcomes. For example, an image with the roads layer and aerial imagery can show the road 10-30’ off at times from the actual road centerline. This also applies to the DNR stream layer – it’s not always “right on” the actual geospatial location of a stream.

Conclusions

Field assessments carried out using the Penn State Center for Dirt and Gravel Road Studies’ “dirty dozen” assessment tool provided a useful way to identify segments of dirt and gravel roads that contribute sediment to area streams. All of the people who participated in the workshop and in the actual field assessments found the method to be understandable and to have changed their perception of D&G roads. During actual field assessments, it could be challenging to accurately identify obscure drainage features. Also, the ability to determine if road material was reaching a stream was sometimes impossible due to private property.

As noted in the results section above, any potential utility of a GIS pre-screen approach to increase efficiency of D&G road field assessments is severely impacted by data quality. If all of the data quality issues could be resolved, a much more complex GIS analysis than we attempted that began by identifying all roads that fall within 100’ of drainage features, working backwards to extend these road segments to capture the entire road area that drains toward the stream, and then applying the slope assessments for that entire section might prove useful. However, it is far from clear that such an analysis would be cost effective.

Partner involvement: CI was the lead organization and was responsible for all field assessments, much of the GIS work, project coordination, educational activities, and reporting. WV DEP and WV DOF personnel also participated in the field assessments. The Conservation Funds Freshwater Institute assisted in GIS analysis, in particular helping identify dirt and gravel roads using WVDOH GIS databases and using GIS Digital Elevation Models (DEM) to identify drainage pathways on a much smaller scale than the usual “blue line” stream layers. We contracted with another individual to develop assessment methodologies using the Q-GIS freeware. The Center for Dirt and Gravel Road Studies at Penn State provided training and technical support in use of their assessment tools.

Education and outreach: Agency, municipal, and NGO employees attended a one day workshop on assessment techniques. We also introduced the issue of sedimentation from D&G roads and announced the workshop to watershed groups through various networks, and to the community via the local newspaper (estimated audience of 18,000), but none attended the workshop. David Creamer (The Center for Dirt and Gravel Roads) conducted the workshop. Ten people representing seven organizations (WVDEP, WVCA, WVDNR, WVDOF, City of Martinsburg, HEPMPO, Canaan Valley Institute, Cacapon Institute). A flyer describing the need for proper construction and maintenance of dirt and gravel roads and that identified specific actions that individuals can take was prepared and delivered via saturation mailing to all 5335 rural addresses in the Tuscarora and Mill Creek target areas (Appendix 4). In consultation with WVDEP, we decided that this flyer should be general and should not present the specific results of the assessment.

Contact: Frank Rodgers, Executive Director, frodgers@cacaponinstitute.org.

Appendices

Appendix 1

"Dirty Dozen" Road Assessment Evaluation- Short Form

Name(s):

Date: State: County: Watershed:

	1	2	3
Road:			
Stream:			
Top coordinates:			
Bottom coordinates:			
1. Road Sediment in Stream			
2. Wet Site Conditions			
3. Road Surface Material			
4. Road Slope (Grade)			
5. Road Shape			
6. Slope to Stream			
7. Distance to Stream			
8. Outlets to Stream			
9. Outlet Bleeder Stability			
10;. Road Ditch Stability			
11. Road Bank Stability			
12. Average Canopy Cover			

Comments:

APPENDIX 2

“Dirty Dozen” Road Assessment Evaluation

Field Personnel	**Gillies, Hartman, Rodgers, Peddicord**	**Gillies, Hartman, Rodgers, Peddicord**	**Gillies, Hartman, Rodgers, Peddicord**
Date	9/11/2014	9/11/2014	9/11/2014
Time	1028	1038	1130
State	WV	WV	WV
County	Berkeley	Berkeley	Berkeley
Watershed	Tuscarora	Tuscarora	Tuscarora
Road:	Copperhead Lane	Copperhead Lane	Rams Lane
Stream:	Dry Run Tributary	Dry Run Tributary	Tuscarora tributary
Top coordinates: N	39.4837	39.48471	39.45689
Top coordinates: W	-78.03415	-78.03571	-78.05576
Low Point coordinates: N			
Low Point coordinates: W			
Bottom coordinates: N		39.48458	39.45638
Bottom coordinates: W		-78.03482	-78.05487
1. Road Sediment in Stream		10	15
2. Wet Site Conditions		0	0
3. Road Surface Material		10	7
4. Road Slope (Grade)		5	5
5. Road Shape		5	5
6. Slope to Stream		0	0
7. Distance to Stream		5	5
8. Outlets to Stream		5	5
9. Outlet Bleeder Stability		3	5
10;. Road Ditch Stability		3	3
11. Road Bank Stability		0	0
12. Average Canopy Cover		3	5
Priority Score	0	49	55
Comments:	Discharges to woods. Not scored	culvert under road appears to discharge to ephemeral channel; road has become ditch	Dischare to ephemeral stream, road is ditch

“Dirty Dozen” Road Assessme

Field Personnel	**Gillies, Hartman, Rodgers, Peddicord**	**Gillies, Hartman, Rodgers, Peddicord**	**Gillies, Hartman, Rodgers, Peddicord**
Date	9/11/2014	9/11/2014	9/11/2014
Time	1153	1205	1250
State	WV	WV	WV
County	Berkeley	Berkeley	Berkeley
Watershed	Tuscarora	Tuscarora	Tuscarora
Road:	Rams Lane	Rams Lane	Harvest Mountain
Stream:	Tuscarora tributary	Tuscarora tributary	Tuscarora tributary
Top coordinates: N	39.45638	39.45542	39.44421
Top coordinates: W	-78.05487	-78.05294	-78.06561
Low Point coordinates: N			39.44446
Low Point coordinates: W			-78.06523
Bottom coordinates: N	39.45542	39.45501	39.44435
Bottom coordinates: W	-78.05294	-78.05209	-78.06498
1. Road Sediment in Stream	10	15	10
2. Wet Site Conditions	0	0	0
3. Road Surface Material	10	0	0
4. Road Slope (Grade)	5	5	5
5. Road Shape	5	0	0
6. Slope to Stream	3	3	3
7. Distance to Stream	5	5	5
8. Outlets to Stream	5	5	5
9. Outlet Bleeder Stability	3	3	3
10;. Road Ditch Stability	7	0	0
11. Road Bank Stability	3	10	10
12. Average Canopy Cover	3	3	3
Priority Score	59	49	44
Comments:		sheet flow exiting road befpre outlet; side road not rated because discharge tp field; Herb noted runoff from 180 acre property between Rams Lane and Side Road drains largely to a sinkhole	

“Dirty Dozen” Road Assessme

Field Personnel	**Gillies, Hartman, Rodgers, Peddicord**	**Gillies, Hartman**	**Gillies, Hartman**
Date	9/11/2014	9/11/2014	9/11/2014
Time	1257	1441	1456
State	WV	WV	WV
County	Berkeley	Berkeley	Berkeley
Watershed	Tuscarora	Mill Creek	Mill Creek
Road:	Harvest Mountain	Ronald Lane	Stacey Lane
Stream:	Tuscarora tributary	Mill Creek Tributary	Mill Creek Tributary
Top coordinates: N	39.44392	39.36389	39.36342
Top coordinates: W	-78.06355	-78.11053	-78.11086
Low Point coordinates: N		39.3628	39.36289
Low Point coordinates: W		-78.10835	-78.11117
Bottom coordinates: N	39.4434	39.36225	39.36237
Bottom coordinates: W	-78.06184	-78.10654	-78.11149
1. Road Sediment in Stream		15	5
2. Wet Site Conditions		0	0
3. Road Surface Material		0	0
4. Road Slope (Grade)		5	0
5. Road Shape		0	0
6. Slope to Stream		3	0
7. Distance to Stream		5	5
8. Outlets to Stream		3	3
9. Outlet Bleeder Stability		3	0
10;. Road Ditch Stability		3	0
11. Road Bank Stability		0	0
12. Average Canopy Cover		3	3
Priority Score	0	40	16
Comments:	Not rated. Spring crosses beneath, but no visible erosion	Bottom at Dominion Road. Road generally in god condition	Stream feeds to pond

“Dirty Dozen” Road Assessme

Field Personnel	**Gillies, Hartman**	**Gillies, Hartman**	**Gillies**
Date	9/11/2014	9/11/2014	9/16/2014
Time	1508	1520	940
State	WV	WV	WV
County	Berkeley	Berkeley	Berkeley
Watershed	Mill Creek	Mill Creek	Mill Creek
Road:	T&S Road	Norris Gap Rd.	Plank Bridge Road
Stream:	Mill Creek Tributary	Mill Creek Tributary	Mill Creek
Top coordinates: N	39.36199	39.35861	39.31623
Top coordinates: W	-78.11329	-78.13125	-78.01389
Low Point coordinates: N	39.36124	39.35193	
Low Point coordinates: W	-78.10985	-78.12121	
Bottom coordinates: N	39.3607	39.35051	39.3154
Bottom coordinates: W	-78.10865	-78.11712	-78.01546
1. Road Sediment in Stream	10	10	0
2. Wet Site Conditions	0	0	0
3. Road Surface Material	0	5	10
4. Road Slope (Grade)	0	5	5
5. Road Shape	0	5	5
6. Slope to Stream	0	0	0
7. Distance to Stream	5	5	3
8. Outlets to Stream	3	5	0
9. Outlet Bleeder Stability	3	3	0
10;. Road Ditch Stability	3	3	10
11. Road Bank Stability	0	7	0
12. Average Canopy Cover	3	0	0
Priority Score	27	48	33
Comments:		Very long site before finally reaching an outlet, road incised for much of length, highly variable with steep badly eroding sections and nealry level sections where eroded material is deposited along road side before reaching an	Outlet is above stream crossing discharge to woods and pasture. Probably doesn't reach stream.

“Dirty Dozen” Road Assessme

Field Personnel	**Gillies**
Date	9/16/2014
Time	950
State	WV
County	Berkeley
Watershed	Mill Creek
Road:	Plank Bridge Road
Stream:	Mill Creek
Top coordinates: N	39.31314
Top coordinates: W	-78.01437
Low Point coordinates: N	
Low Point coordinates: W	
Bottom coordinates: N	39.31496
Bottom coordinates: W	-78.01561
1. Road Sediment in Stream	15
2. Wet Site Conditions	0
3. Road Surface Material	10
4. Road Slope (Grade)	5
5. Road Shape	5
6. Slope to Stream	3
7. Distance to Stream	5
8. Outlets to Stream	5
9. Outlet Bleeder Stability	5
10;. Road Ditch Stability	10
11. Road Bank Stability	3
12. Average Canopy Cover	0
Priority Score	66
Comments:	Outlet into stream. Outlet bleeder might have been cut by equipment. Considerable road material in stream.

APPENDIX 3: GIS RANKING RESULTS

FIRST_FULL	UID	Area_10	Area_20	TC_area	pct_road-area_>10	pct_10area>20	pct_road-area_>20	pct_tc	Score	RANK	Latitude	Longitude
QUARRY OUTSKIRTS	892	690.98	459.98		60.4	66.6	40.2		118.56	1	39.43100	-77.97950
QUARRY	422	309.99	245.99	106.8	61.9	79.4	49.1	34.45	105.62	2	39.42932	-77.97405
ROOFTOP, OLD MILL RD	227	191.99	169	76.27	60.6	88.0	53.3	39.73	104.04	3	39.46992	-77.98587
MIDDLE OF FIELD	228	227.99			71.9		0.0		101.91	4	39.49453	-77.97928
Rams Lane****	826	575.99	223		56.6	38.7	21.9		101.89	5	39.45634	-78.05474
QUARRY	1317	1346.96	864.97		47.0	64.2	30.2		98.17	6	39.42959	-77.97612
ROAD TO 2 HOUSES	408	312.99	52	22.11	63.9	16.6	10.6	7.06	97.11	7	39.49012	-78.03019
QUARRY	626	291.99	248.99		39.9	85.3	34.0		93.75	8	39.42994	-77.97447
Harvest Mountain Rd	1148	891.98	183		47.9	20.5	9.8		84.78	9	39.43811	-78.06391
2 WHEEL PATH IN FIELD	162	130			51.4		0.0		81.38	10	39.44494	-77.94834
Forgotten Rd = PENNILESS LANE	1273	1144.97	190.99		45.8	16.7	7.6		81.12	11	39.43065	-78.07307
	274	146	47	143.14	41.6	32.2	13.4	98.04	79.81	12	39.46250	-77.94911
QUARRY	1262	765.98	617.98		31.7	80.7	25.6		79.60	13	39.42973	-77.97339
TUSCARORA PIKE RT 18	259	124	84	16.43	36.7	67.7	24.9	13.25	76.21	14	39.47037	-78.04828
OLD JEEP TRAIL	1393	1213.97	617.98		33.7	50.9	17.1		75.69	15	39.45124	-78.05728
QUARRY	999	411.99	390.99	36	29.1	94.9	27.7	8.74	73.25	16	39.43130	-77.96941
Rams Ln	1354	1058.97	348.99		33.1	33.0	10.9		70.71	17	39.45555	-78.05318
COPPERHEAD LANE	589	229.99	117	208.06	33.7	50.9	17.1	90.46	69.92	18	39.48431	-78.03469
Cedar St PRIVATE DRIVEWAY	1116	464.98	285.99	459.88	26.1	61.5	16.1	98.9	66.69	19	39.45209	-77.95743
Carroll St	1129	538.98	152.99		29.8	28.4	8.5		65.73	20	39.46066	-77.95825
QUARRY	1297	1143.97	620.98	459.66	42.8	54.3	23.2	40.18	64.95	21	39.43061	-77.98201
NOT A ROAD, BEHIND HOUSES	438	157.99	57	10.1	30.8	36.1	11.1	6.39	64.75	22	39.45414	-77.96271
QUARRY	1226	468.99	404.99		21.6	86.4	18.6		64.62	23	39.43076	-77.97334
WOODS NOT ROAD	1319	790.98	253.99		27.5	32.1	8.8		63.69	24	39.48454	-78.03348
DRIVEWAY	537	226.99	28	26.8	37.3	12.3	4.6	11.81	63.48	25	39.45461	-77.96015
	541	258.99	113	91.58	41.9	43.6	18.3	35.36	63.47	26	39.46388	-77.95299
	392	142	20	142	30.2	14.1	4.2	100	63.14	27	39.49084	-78.02887
Poplar St DRIVEWAY	161	92	32	18.9	36.4	34.8	12.7	20.54	62.95	28	39.44738	-77.95933
	1460	1340.96	275		28.8	20.5	5.9		62.93	29	39.44141	-78.06479
	707	266	27	256.62	31.7	10.2	3.2	96.47	61.83	30	39.50644	-78.01743
	1359	811.98	265.99		25.0	32.8	8.2		60.74	31	39.43104	-77.97698
Loraine Ave	972	322.99	107.99		24.0	33.4	8.0		59.57	32	39.44767	-77.98089
	1310	474.99	454.99		17.1	95.8	16.4		58.56	33	39.43104	-77.97138
Side Hill Rd	1517	1778.95	470.99		23.7	26.5	6.3		58.05	34	39.44372	-78.06327
	550	148.99	41	147	23.7	27.5	6.5	98.66	57.46	35	39.48308	-77.96692
Hopes Ct	954	336.99	112	308.14	25.9	33.2	8.6	91.44	56.85	36	39.45595	-77.94163
	1222	394.99	307.99	9.88	18.3	78.0	14.2	2.5	56.75	37	39.42935	-77.97388
	976	288.99	102		21.3	35.3	7.5		56.59	38	39.46823	-78.02601
Cty Rt 30/1	489	176.99	11	20.82	31.8	6.2	2.0	11.76	56.17	39	39.43644	-78.07090
	504	91	79		15.9	86.8	13.8		55.52	40	39.43022	-77.97214
S Raleigh St	307	104	6	5.56	27.3	5.8	1.6	5.35	55.17	41	39.44450	-77.97285
	475	131	2		24.4	1.5	0.4		54.61	42	39.47270	-78.00421
Viking Way	1435	676.98	503.98		16.0	74.5	11.9		54.29	43	39.46371	-77.98908
Juicy Grape Ct	1058	295	82		18.7	27.8	5.2		52.31	44	39.50067	-77.99198
Mount Rock Farm Rd	1339	568.99	136		18.8	23.9	4.5		51.94	45	39.44131	-77.99957
	342	86	8		20.4	9.3	1.9		51.75	46	39.44185	-77.97190
	281	67	13		18.8	19.4	3.7		51.40	47	39.44857	-77.98626
	1252	645.98	471.99	423.06	27.7	73.1	20.2	65.49	51.15	48	39.43031	-77.98083
Treasure Dr	1197	530.99	93	82.17	25.9	17.5	4.5	15.47	49.83	49	39.45319	-78.02772

FIRST_FULL	UID	Area_10	Area_20	TC_area	pct_road-area_>10	pct_10area>20	pct_road-area_>20	pct_tc	Score	RANK	Latitude	Longitude
Old Arden Rd	1041	350.99	100.99	302.11	23.1	28.8	6.6	86.07	49.35	50	39.44537	-77.98213
White Ave	768	316.99	174.99	146.8	34.0	55.2	18.7	46.31	49.30	51	39.45771	-77.96095
	859	283.99	10	38.02	26.4	3.5	0.9	13.39	48.99	52	39.45422	-77.94092
Eakins Ln	1010	271.99			18.7		0.0		48.70	53	39.43794	-77.96651
	511	87	28		15.0	32.2	4.8		48.40	54	39.45161	-77.97851
	717	240.99	104	166.5	28.4	43.2	12.2	69.09	48.37	55	39.46459	-77.95277
Stone St	1172	311.99	56		16.0	18.0	2.9		48.01	56	39.45155	-77.97881
	1136	282.99	63		15.4	22.3	3.4		47.85	57	39.44127	-78.05585
	752	158	53	11.07	17.6	33.5	5.9	7.01	47.50	58	39.46173	-78.04785
	1405	581.98	132.99		14.9	22.9	3.4		47.31	59	39.45744	-78.04211
Crest St	237	54			16.6		0.0		46.59	60	39.44300	-77.97317
Brookside Ct	823	186	5	7.69	18.3	2.7	0.5	4.13	46.21	61	39.46562	-78.01675
Chagall Ln	1078	250.99	18		15.3	7.2	1.1		46.07	62	39.44634	-77.99905
S Raleigh St	347	59	12		13.8	20.3	2.8		45.78	63	39.44328	-77.97324
Lambert St	692	115	18		14.2	15.7	2.2		45.73	64	39.47071	-77.95470
Exchange Pl	1009	182	71	1.05	12.5	39.0	4.9	0.58	45.58	65	39.46182	-77.96286
Gulkana Glacier Ln	805	143	14		14.5	9.8	1.4		45.46	66	39.49571	-78.00599
	1248	226.99	157	226.86	9.8	69.2	6.8	99.94	44.50	67	39.44778	-78.02585
	636	94	19		12.7	20.2	2.6		44.45	68	39.44217	-78.03237
State Rte 9	1094	195	59		11.5	30.3	3.5		43.97	69	39.47055	-77.95523
	625	106	11	3.32	14.6	10.4	1.5	3.13	43.74	70	39.46908	-77.95501
	834	113	38		11.0	33.6	3.7		43.55	71	39.43051	-77.97933
3rd St	529	92	15	6.33	15.2	16.3	2.5	6.88	42.85	72	39.46838	-77.95423
Parron Dr	945	155	13		12.1	8.4	1.0		42.84	73	39.49595	-78.00573
	526	66	37	2.99	11.0	56.1	6.2	4.53	42.64	74	39.47068	-77.98029
Wellington Dr	309	42	6		10.9	14.3	1.6		42.03	75	39.48388	-77.99212
	301	45		0.01	11.9		0.0	0.02	41.93	76	39.46049	-77.97796
Water St	935	114	76	111	9.1	66.7	6.1	97.37	41.79	77	39.45252	-77.96333
	647	165	9	30.3	21.7	5.5	1.2	18.36	41.52	78	39.49009	-78.02949
E Commerce St	928	107	72	2.93	8.7	67.3	5.8	2.74	41.13	79	39.46027	-77.96150
Queen St	1388	350.99	62	0.52	9.9	17.7	1.7	0.15	41.01	80	39.43897	-77.97351
	740	216	43	155.73	24.3	19.9	4.8	72.1	40.97	81	39.44155	-77.99635
Ryneal St	1349	815.97	141	569.04	25.8	17.3	4.5	69.74	40.80	82	39.44663	-77.95918
Hazel St	1101	209.99	77	16.76	12.2	36.7	4.5	7.98	40.59	83	39.47711	-77.95230
Kilmer Ct	827	107			10.5		0.0		40.50	84	39.46943	-77.98644
	445	78	1	6.94	15.1	1.3	0.2	8.9	39.86	85	39.44857	-77.98598
	843	74	38		7.1	51.4	3.6		39.60	86	39.44192	-77.96965
Hopes Ct	811	94	2		9.4	2.1	0.2		39.58	87	39.45322	-77.93973
Sopwith Way	1048	144	3		9.3	2.1	0.2		39.47	88	39.44261	-77.96763
	1151	271	258	66.17	14.4	95.2	13.7	24.42	39.36	89	39.43285	-77.97344
Boarman Pl	699	77			9.3		0.0		39.26	90	39.44507	-77.96041
	741	61	29		6.9	47.5	3.3		39.13	91	39.48226	-77.96755
Brentwood St	1006	88	60		6.1	68.2	4.2		39.00	92	39.47846	-77.94906
	1121	506.98	179.99	282.11	28.4	35.5	10.1	55.65	38.81	93	39.50664	-78.01864
Galloway Dr	1459	342.99	74		7.5	21.6	1.6		38.61	94	39.48840	-78.02955
Chagall Ln	861	71	27		6.6	38.0	2.5		38.31	95	39.44697	-77.99924
	754	45	37		5.0	82.2	4.1		37.87	96	39.45233	-77.96086
Foxcroft Ave	1450	328.99	26		7.4	7.9	0.6		37.83	97	39.44633	-77.98658
	814	68	14		6.8	20.6	1.4		37.80	98	39.44532	-77.97466

FIRST_FULL	UID	Area_10	Area_20	TC_area	pct_road-area_>10	pct_10area>20	pct_road-area_>20	pct_tc	Score	RANK	Latitude	Longitude
Memorial Park Ave	775	70			7.4		0.0		37.41	99	39.46581	-77.97936
Orchard St	1338	218.99	4		7.2	1.8	0.1		37.34	100	39.45190	-77.95870
Hannis St	563	148.99	67	92.56	22.7	45.0	10.2	62.12	37.16	101	39.46238	-77.96342
N Centre St	1436	260.99	55		6.2	21.1	1.3		37.06	102	39.46091	-77.95756
Co Rte 18	1569	1576.94	93.99		6.6	6.0	0.4		36.87	103	39.47209	-78.04582
	1195	174	16	6.99	8.5	9.2	0.8	4.02	36.65	104	39.44196	-77.97076
	1054	103			6.6		0.0		36.59	105	39.49491	-77.97929
	1074	112.99	32	3.32	7.0	28.3	2.0	2.94	36.58	106	39.44382	-78.06149
Babbling Brook Ln	1394	200.99	54		5.5	26.9	1.5		36.58	107	39.47111	-77.99614
	1201	125	11		6.0	8.8	0.5		36.42	108	39.43576	-78.07205
S Raleigh St	481	66	10	7.79	12.1	15.2	1.8	11.8	36.29	109	39.44266	-77.97343
Sierra Dr	1303	142	49	0.56	5.2	34.5	1.8	0.39	36.28	110	39.45991	-78.00458
Bruce Dr	936	80	6	0.61	6.4	7.5	0.5	0.76	36.27	111	39.46408	-77.94375
Mall Dr	825	112	14	11.03	11.0	12.5	1.4	9.85	36.06	112	39.45239	-77.98403
Seurat Ln	1219	129			6.0		0.0		35.99	113	39.44816	-78.00205
	862	207.99	56	58.17	19.2	26.9	5.2	27.97	35.98	114	39.43583	-78.07040
Tanner Ln	789	72	5	2.18	7.4	6.9	0.5	3.03	35.95	115	39.48055	-77.97200
	622	54	13	2.54	7.5	24.1	1.8	4.7	35.90	116	39.45991	-77.96762
Tamsens Ct	925	79		0.76	6.4		0.0	0.96	35.84	117	39.45950	-77.99988
Cranberry Ct	1147	101	10		5.4	9.9	0.5		35.82	118	39.49841	-77.99268
	909	64	5		5.5	7.8	0.4		35.75	119	39.46422	-77.95279
	1155	214	78	30.06	11.3	36.5	4.1	14.05	35.72	120	39.44232	-77.99206
Ridge Rd	1510	407.99	6	0.88	5.7	1.5	0.1	0.22	35.65	121	39.49492	-78.00574
Klee Dr	1558	891.97	127.99		5.0	14.4	0.7		35.51	122	39.44688	-78.00393
Marquette Dr	1139	91	10		4.9	11.0	0.5		35.32	123	39.44167	-77.96070
Co Rte 15	1401	132.99	92		3.5	69.2	2.4		35.25	124	39.46495	-77.99066
Bovey Ridge Rd	977	138	10	12.58	10.2	7.3	0.7	9.12	35.22	125	39.44955	-78.02867
Martin St E	1028	78			5.2		0.0		35.21	126	39.45824	-77.96089
	868	90.99	1	4.98	8.3	1.1	0.1	5.47	35.12	127	39.44632	-77.96475
Shellbark Ln	1449	287.99	31	9.29	6.5	10.8	0.7	3.23	35.08	128	39.47771	-77.98411
State Rte 9	1571	1057.98	228.99		4.4	21.6	0.9		35.03	129	39.44994	-77.96566
O'Keefe Dr	865	53.99			5.0		0.0		34.96	130	39.44834	-78.00163
Rubens Cir	1544	529.99	85		4.3	16.0	0.7		34.79	131	39.44793	-77.99954
Highland Pl	857	79	24	73.43	7.4	30.4	2.2	92.95	34.71	132	39.45072	-77.97990
Hinton Ct	1106	63	26		3.6	41.3	1.5		34.66	133	39.47777	-77.95435
Turf Dr N	1112	81			4.6		0.0		34.56	134	39.43534	-77.99015
Tuscarora Creek Rd WOOLEN MILL RO/	1508	299.99	12		4.3	4.0	0.2		34.42	135	39.47090	-77.99425
Co Rte 13	1563	757.98	37		4.1	4.9	0.2		34.21	136	39.49994	-78.01224
Castanea Dr	1520	324.99			4.2		0.0		34.19	137	39.47363	-78.01749
N 3rd St	1062	68		0.45	4.3		0.0	0.66	33.86	138	39.46165	-77.95800
Rimel St	1132	113	45	105.29	6.2	39.8	2.5	93.18	33.86	139	39.46314	-77.94744
	1259	92	32	90.49	3.8	34.8	1.3	98.36	33.76	140	39.46360	-78.02094
	1169	70			3.6		0.0		33.60	141	39.48470	-77.96725
Pennsylvania Ave	1176	70			3.6		0.0		33.55	142	39.46343	-77.95818
E Stephen St	1440	152.99			3.5		0.0		33.55	143	39.45224	-77.96099
Prune Ln	1122	57	1		3.2	1.8	0.1		33.22	144	39.49486	-77.99435
US Rte 11	1555	272	240		2.0	88.2	1.7		33.17	145	39.47439	-77.95615
E Burke St	1037	48			3.2		0.0		33.17	146	39.45703	-77.96116
North St	1464	149	3		3.1	2.0	0.1		33.16	147	39.46631	-77.98497

FIRST_FULL	UID	Area_10	Area_20	TC_area	pct_road-area_>10	pct_10area>20	pct_road-area_>20	pct_tc	Score	RANK	Latitude	Longitude
Brockton Ln	1402	88	41		2.3	46.6	1.1		33.10	148	39.48528	-78.01982
State Rte 45	1574	755.98	15		3.0	2.0	0.1		33.04	149	39.44120	-77.98663
	1061	254.99	109	179.43	16.0	42.8	6.8	70.37	32.99	150	39.46430	-78.01336
Springdale Dr	1550	354.99	43		2.7	12.1	0.3		32.95	151	39.47157	-78.01378
	1215	64	2	0.16	3.0	3.1	0.1	0.25	32.92	152	39.45141	-77.97667
Co Rte 9/10	1046	44			2.9		0.0		32.86	153	39.50762	-78.01499
	1521	131	125		1.7	95.4	1.6		32.78	154	39.43183	-77.97049
Braeburn Dr	1524	182	57		2.2	31.3	0.7		32.74	155	39.49310	-77.99895
	1120	46			2.6		0.0		32.57	156	39.43094	-77.97811
Faulkner Ave	1441	111			2.6		0.0		32.56	157	39.45279	-77.97393
	1566	331.99	266.99		1.6	80.4	1.3		32.56	158	39.47061	-77.98860
E Liberty St	1389	82	12		2.3	14.6	0.3		32.54	159	39.46137	-77.95847
Renaissance Dr	1488	137	3		2.4	2.2	0.1		32.46	160	39.45523	-77.99804
	1381	78	6		2.2	7.7	0.2		32.35	161	39.44766	-78.03046
Wyeth Ave	1382	81			2.3		0.0		32.32	162	39.43872	-77.96727
	706	204	70	108.94	24.3	34.3	8.3	53.4	32.20	163	39.45933	-78.05088
I- 81	1578	740.99	423.99		1.6	57.2	0.9		32.19	164	39.45657	-77.98940
	507	104	34	34.92	18.1	32.7	5.9	33.58	32.06	165	39.44862	-77.98641
S Water St	1335	76	11	1	2.5	14.5	0.4	1.32	32.00	166	39.45689	-77.96094
Crushed Apple Dr	1547	222.99	29		1.8	13.0	0.2		31.94	167	39.49865	-77.99316
	1290	125	25	7.56	4.8	20.0	1.0	6.05	31.83	168	39.45319	-78.04867
	1538	807.98	377.99	111.08	7.6	46.8	3.5	13.75	31.80	169	39.43585	-77.97792
Red Crest Dr	1434	74	3	0	1.7	4.1	0.1	0	31.80	170	39.46155	-78.02470
Old Courthouse Sq	975	184	57	45.28	13.6	31.0	4.2	24.61	31.78	171	39.47371	-77.95647
	1511	126			1.8		0.0		31.76	172	39.46623	-77.98973
Universe Dr	1466	82			1.7		0.0		31.71	173	39.45482	-77.93330
W Burke St	1526	133			1.6		0.0		31.58	174	39.45972	-77.97396
Miracle la	1322	651.98	139	263.69	22.5	21.3	4.8	40.44	31.56	175	39.48499	-78.03535
Pitzers Chapel Rd	1532	159	22	0.57	1.6	13.8	0.2	0.36	31.56	176	39.43612	-78.05828
	1553	210.99			1.6		0.0		31.55	177	39.44171	-77.98967
Sierra Dr	1461	97	1	1.11	2.1	1.0	0.0	1.14	31.41	178	39.46386	-78.00434
Galloway Dr	798	49		2.95	5.0		0.0	6.02	31.40	179	39.48998	-78.02990
E South St	648	59		6.25	7.7		0.0	10.59	31.39	180	39.45236	-77.96435
	339	104	1	62.65	24.9	1.0	0.2	60.24	31.26	181	39.43967	-77.98538
	929	86	9	9	7.0	10.5	0.7	10.47	31.19	182	39.47762	-77.95161
W King St	1535	261.99	127	9.7	2.5	48.5	1.2	3.7	31.18	183	39.46388	-77.98776
Showers Ln	1554	275	39	4.6	2.0	14.2	0.3	1.67	31.18	184	39.48911	-77.97846
Berry St	1408	80		1.24	2.0		0.0	1.55	31.11	185	39.44943	-77.97658
W Stephen St	1404	103.99		3	2.7		0.0	2.88	30.95	186	39.45397	-77.96584
S College St	1334	57	1	1	1.9	1.8	0.0	1.75	30.88	187	39.45483	-77.96573
	1533	51	49		0.5	96.1	0.5		30.87	188	39.44344	-77.98913
Elegant Dr	1515	53	1		0.7	1.9	0.0		30.72	189	39.46550	-78.02901
Co Rte 10	1562	117.99		0.08	0.6		0.0	0.07	30.59	190	39.47541	-77.96946
Co Rte 45/8	1422	63		1	1.5		0.0	1.59	30.58	191	39.43217	-78.06650
Union Ave	1362	85	1	2.94	2.6	1.2	0.0	3.46	30.55	192	39.46457	-77.95717
Co Rte 45/7	1572	183		1	0.7		0.0	0.55	30.41	193	39.45405	-77.99671
	1340	89	32	5.01	2.9	36.0	1.1	5.63	30.29	194	39.46634	-77.96221
S Kentucky Ave	801	69	16	9.06	7.0	23.2	1.6	13.13	30.27	195	39.45819	-77.97469
	731	55	12	6.56	6.3	21.8	1.4	11.93	30.15	196	39.46006	-77.97640

FIRST_FULL	UID	Area_10	Area_20	TC_area	pct_road-area_>10	pct_10area>20	pct_road-area_>20	pct_tc	Score	RANK	Latitude	Longitude
Secretariat Ln	1336	132		9.69	4.4		0.0	7.34	29.97	197	39.43300	-78.06257
	1137	73	7	67.74	4.0	9.6	0.4	92.79	29.92	198	39.45053	-77.97580
3rd St	835	54		5.1	5.2		0.0	9.44	29.58	199	39.47104	-77.95266
Williamsport Ave	1156	42		2	2.2		0.0	4.76	29.36	200	39.46359	-77.96174
	1254	54	1	51.32	2.3	1.9	0.0	95.04	29.32	201	39.45130	-77.96574
Madison Ave	1267	440.99	193.99	178.65	18.0	44.0	7.9	40.51	29.29	202	39.46449	-77.95732
	778	154	12	46.24	16.3	7.8	1.3	30.03	29.16	203	39.46856	-77.95934
Lupton Dr	1043	58		4.93	3.8		0.0	8.5	28.71	204	39.47109	-77.98171
	1164	63	54	55.84	3.3	85.7	2.8	88.63	28.40	205	39.43077	-77.96854
	530	82	1	60.98	13.6	1.2	0.2	74.37	28.31	206	39.47874	-77.98378
Alley Way	893	92		15.14	8.0		0.0	16.46	28.16	207	39.46328	-77.97853
	980	200	33	61.23	14.5	16.5	2.4	30.61	27.86	208	39.45168	-78.02407
E Addition St	753	86	2	68.97	9.6	2.3	0.2	80.2	27.83	209	39.45107	-77.96436
	535	85	6	60.9	14.0	7.1	1.0	71.65	27.68	210	39.44244	-78.05931
Co Rte 36	1564	639.98	25	63.33	3.4	3.9	0.1	9.9	27.55	211	39.45084	-77.94108
	1291	154	8	131.63	5.9	5.2	0.3	85.47	27.40	212	39.45868	-77.94118
Street of Dreams	1523	293.99	32	34.75	3.7	10.9	0.4	11.82	26.88	213	39.46033	-78.00117
	1272	179	29	145.42	7.2	16.2	1.2	81.24	26.81	214	39.43670	-78.00346
Simpson Rd	1033	353.99	65	178.71	23.5	18.4	4.3	50.48	26.77	215	39.46629	-78.04798
Poorhouse Rd	1576	885.98	68	94.52	2.8	7.7	0.2	10.67	26.52	216	39.45450	-78.04870
	833	130	59	43.89	12.6	45.4	5.7	33.76	26.38	217	39.43100	-77.96842
Cherry Ln	1308	57	13	6.34	2.1	22.8	0.5	11.12	25.73	218	39.46279	-77.94978
	1014	238.99	134	130.5	16.4	56.1	9.2	54.6	25.55	219	39.49477	-78.00777
Tavern Rd	1549	53		4.42	0.4		0.0	8.34	25.40	220	39.47235	-77.96772
	1007	154	25	42.26	10.6	16.2	1.7	27.44	25.35	221	39.45709	-78.02447
	575	75	1	54.72	11.3	1.3	0.2	72.96	25.16	222	39.45147	-78.04565
	325	54	6	17.98	13.6	11.1	1.5	33.3	24.68	223	39.44121	-77.99676
Bernice Ave	1518	73	1	8.2	1.0	1.4	0.0	11.23	24.23	224	39.43793	-77.98668
	1180	59		9	3.0		0.0	15.25	23.82	225	39.49231	-77.97668
	1239	160	24	37.37	7.0	15.0	1.1	23.36	23.77	226	39.45932	-78.05002
John St E	1498	430.98	85	327.04	7.0	19.7	1.4	75.88	23.52	227	39.45258	-77.95651
Co Rte 45/5	1504	45	9	6	0.7	20.0	0.1	13.33	22.77	228	39.46177	-77.93611
Old Mill Rd	1470	301.99	50	70.89	6.0	16.6	1.0	23.47	22.63	229	39.46923	-77.98584
Co Rte 13	1575	418.98	53	63.12	1.5	12.7	0.2	15.07	22.57	230	39.47235	-77.98150
Salem Ch Rd	1531	186.99	17	157.35	1.9	9.1	0.2	84.15	22.53	231	39.46713	-78.04938
Working Deere Dr	1400	156.99	5	30.86	4.2	3.2	0.1	19.66	22.48	232	39.48575	-78.01312
Union Ave	1238	100		20.03	4.4		0.0	20.03	22.40	233	39.46354	-77.95331
Shower Ln	1528	355.99	90	73.91	4.1	25.3	1.0	20.76	22.31	234	39.47542	-77.99368
	1038	53	7	42.71	3.5	13.2	0.5	80.58	22.17	235	39.46363	-78.03727
Capitol Dr	1280	156	7	118.82	6.1	4.5	0.3	76.17	21.98	236	39.44366	-77.96078
	1059	86	30	64.38	5.4	34.9	1.9	74.86	21.68	237	39.46954	-77.97990
	791	82	49	27.83	8.4	59.8	5.0	33.94	21.57	238	39.44836	-77.97914
	1207	129	32	94.32	6.2	24.8	1.5	73.12	21.13	239	39.47792	-77.96344
	958	113	20	35.14	8.6	17.7	1.5	31.1	21.00	240	39.48581	-77.99991
	1329	109	42	24.89	3.7	38.5	1.4	22.83	20.99	241	39.45440	-77.97767
Dry Run Rd Exd	1277	379.99	19	156.53	14.9	5.0	0.7	41.19	20.74	242	39.48507	-77.98498
S Spring St	1469	292.99	64	78.7	5.9	21.8	1.3	26.86	20.69	243	39.45291	-77.96369
Copperhead Ln	1325	191	54	55	6.5	28.3	1.8	28.8	20.54	244	39.48742	-78.03324
Place Dr	802	139		54.76	14.1		0.0	39.4	20.47	245	39.44335	-77.96516

FIRST_FULL	UID	Area_10	Area_20	TC_area	pct_road-area_>10	pct_10area>20	pct_road-area_>20	pct_tc	Score	RANK	Latitude	Longitude
Pa Kath Ln	1516	512.99	143	154.24	6.9	27.9	1.9	30.07	20.22	246	39.50070	-78.01869
Grantham Farm Rd	1105	91		67.98	5.2		0.0	74.7	20.05	247	39.48143	-78.01727
Herb Ln	1111	133	19	92.64	7.5	14.3	1.1	69.65	20.04	248	39.48510	-77.96754
Vicky Bullett St	1374	242.99	2	69.38	7.1	0.8	0.1	28.55	20.02	249	39.46017	-77.95865
Jefferson St	1047	49		38.02	3.2		0.0	77.59	19.74	250	39.44463	-77.97200
	851	144.99	29	62.72	13.6	20.0	2.7	43.26	19.60	251	39.45776	-77.97406
Millpoint Dr	1527	325.98	3	76.95	3.7	0.9	0.0	23.61	19.60	252	39.47838	-77.99666
	1502	186.99	64	141.45	2.9	34.2	1.0	75.65	18.93	253	39.45167	-77.97140
Trinity Church	1514	318.99	19	82.72	4.3	6.0	0.3	25.93	18.93	254	39.43453	-78.07613
	1306	285	103	115.99	10.4	36.1	3.8	40.7	18.60	255	39.47649	-78.03599
N Maple Ave	1326	49		10.88	1.7		0.0	22.2	18.35	256	39.46134	-77.96468
E Burke St	1123	196.99	90	86.48	11.0	45.7	5.0	43.9	18.15	257	39.45693	-77.96030
	435	85	3	41.12	16.6	3.5	0.6	48.38	18.02	258	39.46429	-77.94729
Martinsburg Mall	1543	59	3	12.99	0.5	5.1	0.0	22.02	17.31	259	39.45178	-77.98714
	856	60	7	41	5.6	11.7	0.7	68.33	17.08	260	39.47418	-77.95201
Co Rte 16/1	1040	54	19	15.89	3.6	35.2	1.3	29.43	16.77	261	39.48441	-78.01847
	1075	92		29.08	5.6		0.0	31.61	16.67	262	39.45120	-78.04528
	1472	274.99	72	90.8	5.3	26.2	1.4	33.02	16.50	263	39.45117	-77.97291
	1426	567.98	88	273.61	13.7	15.5	2.1	48.17	16.27	264	39.44170	-78.05212
Co Rte 45/6	1545	652.98	19	219.44	5.3	2.9	0.2	33.61	15.21	265	39.45322	-77.93932
	1241	198.99	26	115.99	8.7	13.1	1.1	58.29	14.52	266	39.46680	-77.97983
Needmore Ln	1513	263.99	25	87.52	3.6	9.5	0.3	33.15	13.96	267	39.43659	-78.07137
	1496	237	40	81.17	4.0	16.9	0.7	34.25	13.94	268	39.45073	-77.97439
Winton Farm Ln	1429	47	10	33.31	1.1	21.3	0.2	70.87	13.82	269	39.49638	-77.98048
Co Rte 16	1570	413.99	19	128.07	1.7	4.6	0.1	30.94	13.22	270	39.48601	-78.01513
	1509	408.99	165.99	166	5.8	40.6	2.4	40.59	13.13	271	39.43482	-77.97357
Old Mill Rd	1227	77.99	19	27.41	3.6	24.4	0.9	35.15	13.11	272	39.47089	-77.98369
	1084	61	4	21.95	3.7	6.6	0.2	35.98	12.28	273	39.47794	-78.03068
S Valley St	780	50		19.6	5.3		0.0	39.2	11.76	274	39.45874	-77.97344
Wall St	1245	60		21.2	2.6		0.0	35.33	11.41	275	39.45317	-77.98131
Rocky Ln	854	105	7	50.81	9.9	6.7	0.7	48.39	11.28	276	39.45243	-77.98487
S Maple Ave	1414	45		15.1	1.1		0.0	33.56	10.98	277	39.45492	-77.96703
Honeysuckle Dr	1417	96.99		61.89	2.4		0.0	63.81	10.69	278	39.47286	-77.97828
Avery St	1328	228.99	42	109.3	7.8	18.3	1.4	47.73	10.14	279	39.45962	-77.95880
Henry St	1165	71	15	42.23	3.7	21.1	0.8	59.48	9.89	280	39.45894	-77.96774
	1373	132	36	59.01	3.9	27.3	1.1	44.7	7.81	281	39.45314	-77.97430
Tuscarora Pike	1577	736.98	102	302.32	2.2	13.8	0.3	41.02	7.81	282	39.47073	-78.03146
S Rosemont Ave	1452	146		83.94	3.3		0.0	57.49	7.77	283	39.45445	-77.97834
Dim St	1166	126	15	64.49	6.5	11.9	0.8	51.18	7.75	284	39.46509	-77.95662
Co Rte 13/1	1568	279.99	86	113.06	1.3	30.7	0.4	40.38	7.37	285	39.47742	-78.00202
	1446	82	5	33.75	1.9	6.1	0.1	41.16	7.26	286	39.48535	-78.02525
Co Rte 11/18	1501	75	2	30.36	1.2	2.7	0.0	40.48	6.92	287	39.43944	-77.98599
	1420	68	4	28.29	1.7	5.9	0.1	41.6	6.78	288	39.44917	-78.05127
Co Rte 45/5	1534	108	11	45	1.1	10.2	0.1	41.67	6.13	289	39.48065	-77.94917
	1525	338.99	29	163.32	4.0	8.6	0.3	48.18	5.38	290	39.49045	-78.02826
Grazier St	1274	42		23.39	1.7		0.0	55.69	5.08	291	39.47113	-77.95358
Cushwa	1551	148	38	78.81	1.1	25.7	0.3	53.25	3.27	292	39.48456	-78.02708
Virginia Ave	1438	78	10	37.58	1.8	12.8	0.2	48.18	3.08	293	39.44222	-77.97508
Showers Ln	1475	88	8	42.46	1.6	9.1	0.1	48.25	2.80	294	39.47095	-77.99215

FIRST_FULL	UID	Area_10	Area_20	TC_area	pct_road-area_>10	pct_10area>20	pct_road-area_>20	pct_tc	Score	RANK	Latitude	Longitude
								Average	36.29			
								Median	33.13			

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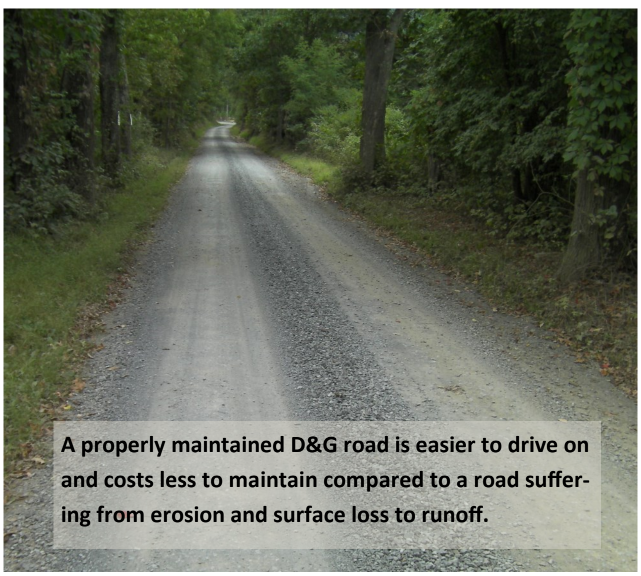
APPENDIX 4

PRSRT STD
ECRWSS
U.S.POSTAGE
PAID
EDDM Retail

Dirt and Gravel Roads in the Tuscarora and Mill Creek Watersheds
Berkeley County, WV

Cacapon Institute, High View, WV
September 2014


A properly maintained D&G road is easier to drive on and costs less to maintain compared to a road suffering from erosion and surface loss to runoff.


Better roads. Cleaner Streams. Less erosion. Less cost.

Summary

West Virginia has many dirt and gravel roads. When these roads and roadside ditches erode, it: costs us money for repair, damages our local streams and harms the Chesapeake Bay, increases to costs of water treatment, and creates fine dust that can cause health problems.

In early September 2014, Cacapon Institute and partners conducted a study of potential pollution from dirt and gravel roads in the Tuscarora Creek and Mill Creek watersheds. The field assessments were carried out using the Center for Dirt and Gravel Road Studies at Penn State University's "dirty dozen" assessment tool.

For problem roads, Environmentally Sensitive Maintenance reduces concentrated drainage, reduces sediment pollution, reduces impact of dirt roads on the land, and reduces long-term maintenance costs. The WV Division of Highways has used ESM methods on some WV roads.

There are some basic ESM principles the public can apply to their own driveways, or on privately maintained roads.

This project was funded by the US EPA 319 Program through the WV DEP.

Cacapon Institute is a 501(c)3 non profit organization protecting Potomac watersheds since 1985. Learn more about Cacapon Institute or donate to this member-supported organization by visiting our website at www.CacaponInstitute.org.

Dirt and Gravel Roads in the Tuscarora and Mill Creek Watersheds, Berkeley County, WV

West Virginia has many dirt and gravel roads. We may use D&G roads everyday, but don't spend much time thinking about them. Well, maybe we should. Watch as road crews and homeowners repair roads and driveways after winter and heavy rains. Some of the material they are replacing ended up in our streams. Improperly maintained D&G roads have real costs on our environment and our wallets.

> **A watershed** is the area of land where water drains to a stream, river, lake or ocean.

Cornell University research found that in some rural areas more than 25 percent of runoff is caught by roadside ditches, impacting the way water flows across our landscapes. Water, which once flowed slowly over a forest floor, now is concentrated, eroding the dirt road or ditch and carrying sediment to our streams.

Why it matters. When our D&G roads and roadside ditches erode, four things happen:

- ◊ It costs us money to bring in new material to repair roads (public money for public roads, private money for privately maintained roads and driveways);
- ◊ It damages our local streams by destroying fish and other aquatic animals habitat, and by raising the stream beds -- increasing flooding risks
- ◊ Not only local streams are harmed. Sediment can be carried hundreds of miles downstream to harm the Potomac River and the Chesapeake Bay.
- ◊ Fine dust from these roads can get deep into the lungs and cause serious health problems.

Prioritization study. In early September, Cacapon Institute (CI) and partners from the Tuscarora Creek Project Team (WVDEP and the WV Division of Forestry) conducted a study of potential stream pollution from D&G roads in the Tuscarora Creek and Mill Creek watersheds. We chose those watersheds because D&G roads in those watersheds had been identified as contributing to sediment pollution in area waterways.

CI looked for D&G roads that were delivering road sediment to streams, including intermittent stream channels that only carry water from runoff after heavy rains and snowmelt. The field assessments were carried out using the Center for Dirt and Gravel Road Studies at Penn State University's "dirty dozen" assessment tool. The dirty dozen generates a "pollution potential" score for any stretch of road by scoring twelve factors. The most important question is: does the sediment from this road section reach a stream? If it doesn't, the assessment stops. If it does, we ask eleven more questions, including:

- ◊ Do springs keep the road base and ditch wet (bad) or is the road dry (good)?
- ◊ Is the road made from hard stone (better) or a mixture of hard and soft stone and dirt (worse)?
- ◊ Is the road flat (better) or steep (worse)?
- ◊ Is the road shaped so that it drains to one or both sides (better), or is it eroding down the middle of the road (worse)?
- ◊ Is the road far from a stream (better) or close to stream (worse)?

You can read our prioritization report for the Tuscarora Creek and Mill Creek watersheds at www.cacaponinstitute.org/D&GR.htm

Penn State's Center for Dirt and Gravel Road Studies (http://www.dirtandgravel.psu.edu/) specializes in Environmentally Sensitive Maintenance of D&G roads. These "ESM" practices can be boiled down to four categories: reduce concentrated drainage; reduce sediment pollution; reduce impact of dirt roads on the land and; and reduce long-term maintenance costs. The Center works throughout Pennsylvania and also conducts educational workshops. The WV Division of Highways has attended their workshops and used their methods on some WV roads.

Over time, steep eroding dirt roads will deliver truck loads of sediment to local streams, destroying fish and aquatic habitat.

What you can do? Even without technical training, there are some basic Environmentally Sensitive Maintenance principles the public can apply to your own driveways, or on privately maintained D&G roads. Shape your road so that it drains to one or both sides so that water doesn't flow down the middle. Roads can become trenches over time, so keep the surface elevated. Use diverts/water bars to move water from the road surface to the low side of the road. Use frequent culverts to move water from the ditch (if there is one) into forested or grassy areas. Never ditch runoff to a stream, let the landscape "absorb" that sediment.

As the PA Center says: "Better Roads, Cleaner Streams."

This project was funded by the US EPA 319 Program through the WV DEP.