

## An Assessment of Bank Erosion Along Indian Run

Throughout the summer of 2004, Lycoming College Clean Water Institute interns hiked the full 2 miles of Indian Run in Danville, Pennsylvania. The interns assessed the Run from its emergence along Indian Run Road to its confluence with Mahoning Creek. All occurrences of erosion were documented using a form identical to the one found in the appendix. In all, 59 disturbances were observed along Indian Run and are presented in Table 1 and Figure 1. Of these, 9 were bridges (15.52% of total disturbances) and 6 were pipes flowing into the Run bed (10.34% of total disturbances). There were 6 instances of rip rap (10.34% of total disturbances) along the banks and 1 concrete wall impeding water flow (1.72% of total disturbances). There were 10 deposition bars (17.24% of total disturbances) throughout the Run bed. There was 1 area (1.72% of total disturbances) where the Run was used as a horse crossing. There were 2 tributaries (3.45% of total disturbances) observed. There were 24 instances of erosion documented along the Run (41.38% of total disturbances), 13 of which were on the right banks (54.17% of total erosion sites), while 11 were on the left banks (45.83% of total erosion sites). The positions of the banks (right or left) were established while facing downstream.

The potential for bank erosion was determined by a combination of bank height, bank angle, density of roots present, and the particle size of the bank substrate. These factors are rate for High, Moderate, or Low erosion potential and rare explained further in Tables 2-16.

The 24 erosion potential sites were determined based on the following analysis:

### Erosion Potential based on Bank Height

Erosion potential based on bank height for total erosion sites, and right and left bank erosion sites are presented in Tables 2-4. A bank up to 6 feet high was considered to have Low erosion potential. Banks 6 to 9 feet high were considered to have Moderate erosion potential, and any bank over 9 feet high had a High erosion potential. Of the 24 banks assessed for bank height, 17 were considered to have Low potential (70.83% of total banks), 5 were Moderate (20.83% of total banks), and 2 were determined to have High erosion potential (8.3% of total banks). Of the 11 right banks, 9 were Low (81.82% of total right banks), 1 was Moderate (9.09% of total right banks), and 1 was of High erosion potential (9.09% of total right banks). Of the 13 left banks, 8 were Low (61.54% of total left banks), 4 were Moderate (38.46% of total left banks), and 1 was of High erosion potential (7.69% of total left banks).

### Erosion Potential based on Bank Angle:

Erosion potential based on bank angle is presented in Tables 5-7. A bank with an angle up to 45 degrees is considered to have Low erosion potential. A bank from 45 to 90 degrees is considered to be of Moderate erosion potential, and an undercut bank (one over 90 degrees) is considered to have High erosion potential. Of the 24 banks assessed, 3 were of Low erosion potential based on bank angle (12.5% of total banks), 13 were of Moderate erosion potential (54.17% of total banks), and 8 were of High erosion potential (33.33% of total banks). On the right banks, 3 of the 11 banks assessed were of Low erosion potential (27.27% of total right banks), 5 were of Moderate erosion potential (45.45% of total right banks), and 3 were of High erosion potential (27.27% of total right banks). On the left banks, 8 of the 13 banks assessed were of Moderate erosion potential (61.54% of total left banks) and 5 were of High erosion potential (38.46% of total left banks).

### Erosion Potential based on Root Density:

Erosion potential based on the root density of the bank is presented in Tables 8-10. A bank of Low erosion potential is one at least 60% covered by vegetation. A bank of Moderate erosion potential is one with 30% to 60% of vegetative cover, while a bank less than 30% covered by vegetation is of High erosion potential. There were 3 of the 24 total banks assessed that were considered to have Low erosion

potential (12.5% of total banks), 10 of the total were of Moderate erosion potential (41.66% of total banks), and 11 of the total were of High erosion potential (45.83% of total banks). On the right banks, 2 of the 11 were of Low erosion potential (18.18% of total right banks), 5 were of Moderate erosion potential (45.45% of total right banks), and 4 were of High erosion potential (36.36% of total right banks). On the left banks, 1 of the 13 was of Low erosion potential (7.69% of total left banks), 5 were of Moderate erosion potential (38.46% of total left banks), and 7 were of High erosion potential (53.84% of total left banks).

### Erosion Potential based on Particle Size:

Erosion potential based on the particle size of the bank substrate is presented in Tables 11-13. Banks composed mainly of bedrock or boulders are considered to have Low erosion potential. Banks made up of basketball-sized rocks to pebbles are considered to have Moderate erosion potential, while banks made of sand or clay have High erosion potential. Of the 24 banks assessed, 2 were of Low erosion potential (8.33% of total banks), 12 were of Moderate erosion potential (50.00% of total banks), and 10 were of High erosion potential (41.66% of total banks). On the right banks, 1 was of Low erosion potential (9.09% of total right banks), 4 were of Moderate erosion potential (36.36% of total right banks), and 6 were of High erosion potential (54.54% of total right banks). On the left banks, there was 1 area with Low erosion potential (7.69% of total left banks), 8 with Moderate erosion potential (61.54% of total left banks), and 4 with High erosion potential (30.77% of total left banks).

### Erosion potential based on Length of Site as Compared to Bank Height:

Erosion potential based on the length of each site as compared to the height is present in Tables 14-16. The sites were divided into Low, Moderate, and High erosion potential based on bank height and then classified into the following categories: 0-50 feet in length, 51-100 feet in length, 101-250 feet in length, 251-500 feet in length, and 501-1000 feet in length. There were 8 erosion potential areas that were 0-50 feet in length (33.33% of total banks). Of these 8 banks, 5 had Low erosion potential based on bank height, 2 had Moderate erosion potential, and 1 had High erosion potential. There were 5 erosion potential areas that were 51-100 feet in length (20.83% of total banks). Of these 5 banks, 4 had Low erosion potential based on bank height and 1 had Moderate erosion potential. There were 11 erosion potential areas that were 101-250 feet in length (45.83% of total banks). Of these 11 banks, 8 had Low erosion potential, 2 had Moderate erosion potential, and 1 had High erosion potential. There were no erosion potential areas observed to be greater than 250 feet in length. Of the 8 erosion potential areas 0-50 feet in length, 3 were found on the right bank (27.27% of total right banks). Of these 3 banks, 2 had Low erosion potential based on bank height and 1 was Moderate. There were 5 erosion potential areas 0-50 feet in length found on the left bank (38.46% of total left banks). Of the 5 areas, 3 were Low erosion potential areas based on bank height, 1 was Moderate, and 1 was High. Of the 5 erosion potential areas 51-100 feet in length, 3 were found on the right bank (27.27% of total right banks). All 3 areas were of Low erosion potential. There were 2 erosion potential areas 51-100 feet in length found on the left bank (15.38% of total left banks). Of the 2 areas, 1 had Low erosion potential and 1 had Moderate erosion potential. Of the 11 erosion potential areas 101-250 feet in length, 5 were found on the right bank (45.45% of total right banks). Of these 5 areas, 4 had Low erosion potential and 1 was High. There were 6 erosion potential areas 101-250 feet in length found on the left bank (46.15% of total left banks). Of the 6 areas, 4 had Low erosion potential and 2 were Moderate.

### Conclusion

There were two sites, site 19 and 36, that showed evidence for a high probability of erosion. Site 19 had moderate erosion potential for bank height and angle, and a high erosion potential for root density and particle size. Site 36 had high erosion potential for bank height, particle size, and root density, and moderate erosion potential for bank angle.

Structures	Amount	Percentage out of 82 sites
Bridges	9	15.52%
Horse Crossing	1	1.72%

Deposition Bars	10	17.24%
Pipes	6	10.34%
Rip Rap	6	10.34%
Tributaries	2	3.45%
Concrete Walls	1	1.72%
Total Erosion sites	24	41.38%
Right Banks	13	54.17%
Left Banks	11	45.83%

Table 1. Summary of disturbances along Indian Run.

Figure 1. Summary of disturbances along Indian Run.

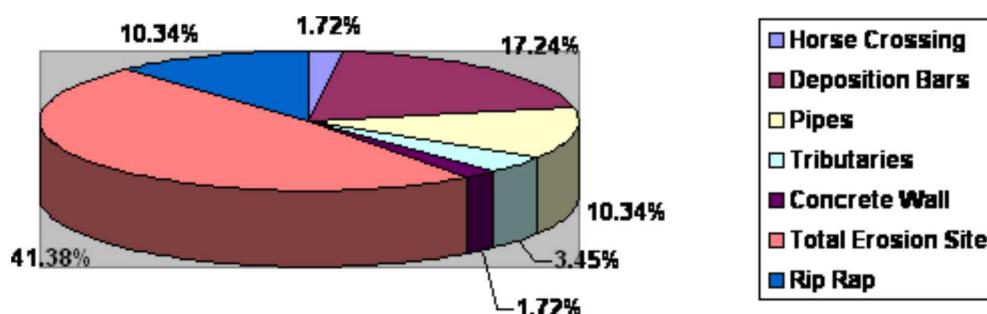


Table 2. Bank height of all erosion sites along Indian Run.

Bank Height	Number	Percent
Low	17	70.83%
Moderate	5	20.83%
High	2	8.3%
Total	24	

Table 3. Bank height of right bank erosion sites along Indian Run.

Height	Number	Percent
Low	9	81.82%
Moderate	1	9.09%
High	1	9.09%
Total	11	

Table 4. Bank height of left bank erosion sites along Indian Run.

Left Banks	Number	Percent
Height	Number	Percent
Low	8	61.54%

Moderate	4	38.46%
High	1	7.69%
Total	13	

**Table 5. Bank angle of all erosion sites along Indian Run.**

Bank Angle	Number	Percent
Low	3	12.5%
Moderate	13	54.17%
High	8	33.33%
Total	24	

**Table 6. Bank angle of right bank erosion sites along Indian Run.**

Bank Angle	Number	Percent
Low	3	27.27%
Moderate	5	45.45%
High	3	27.27%
Total	11	

**Table 7. Bank angle of left bank erosion sites along Indian Run.**

Height	Number	Percent
Low	0	0%
Moderate	8	61.54%
High	5	38.46%
Total	13	

**Table 8. Root density of all erosion sites along Indian Run.**

Root Density	Number	Percent
Low	3	12.5%
Moderate	10	41.66%
High	11	45.83%
Total	24	

**Table 9. Root density of right bank erosion sites along Indian Run.**

Right Banks		
Root Density	Number	Percent
Low	2	18.18%
Moderate	5	45.45%
High	4	36.36%
Total	11	

**Table 10. Root density of left bank erosion sites along Indian Run.**

Root Density	Number	Percent
Low	1	7.69%
Moderate	5	38.46%

High	7	53.84%
Total	13	

**Table 11. Particle size of all erosion sites along Indian Run.**

Particle Size	Number	Percent
Low	2	8.33%
Moderate	12	50.00%
High	10	41.66%
Total	24	

**Table 12. Particle size of right bank erosion sites along Indian Run.**

Particle Size	Number	Percent
Low	1	9.09%
Moderate	4	36.36%
High	6	54.54%
Total	11	

**Table 13. Particle size of left bank erosion sites along Indian Run.**

Particle Size	Number	Percent
Low	1	7.69%
Moderate	8	61.54%
High	4	30.77%
Total	13	

Table 14. Length of erosion sites compared to bank height along Indian Run.

Length in feet	0-50	51-100	101-250	251-500	501-1000
Low Bank Height	5	4	8	0	0
Moderate Bank Height	2	1	2	0	0
High Bank Height	1	0	1	0	0
Total	8	5	11	0	0
Percent out of 24	33.33%	20.83%	45.83%		

Table 15. Length of right bank erosion sites compared to bank height along Indian Run.

Length in feet	0-50	51-100	101-250	251-500	501-1000
Low Bank Height	2	3	4	0	0
Moderate Bank Height	1	0	0	0	0
High Bank Height	0	0	1	0	0
Total	3	3	5	0	0
Percent out of 11	27.27%	27.27%	45.45%		

Table 16. Length of left bank erosion sites compared to bank height along Indian Run.

Length in feet	0-50	51-100	101-250	251-500	501-1000
Low Bank Height	3	1	4	0	0
Moderate Bank Height	1	1	2	0	0
High Bank Height	1	0	0	0	0

Total	5	2	6	0	0
Percent out of 13	38.46%	15.38%	46.15%		