APPENDICES

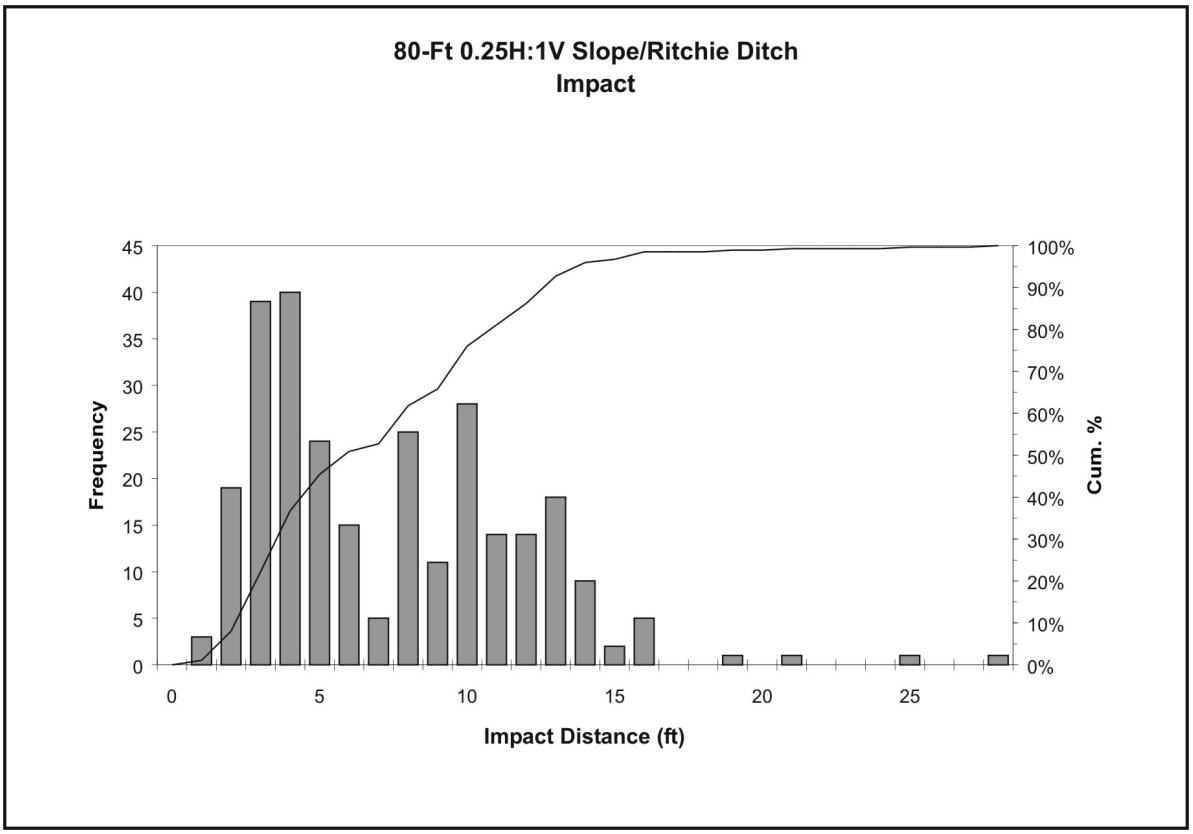
APPENDIX A: RITCHIE TEST CATCHMENT AREA COMPARISON

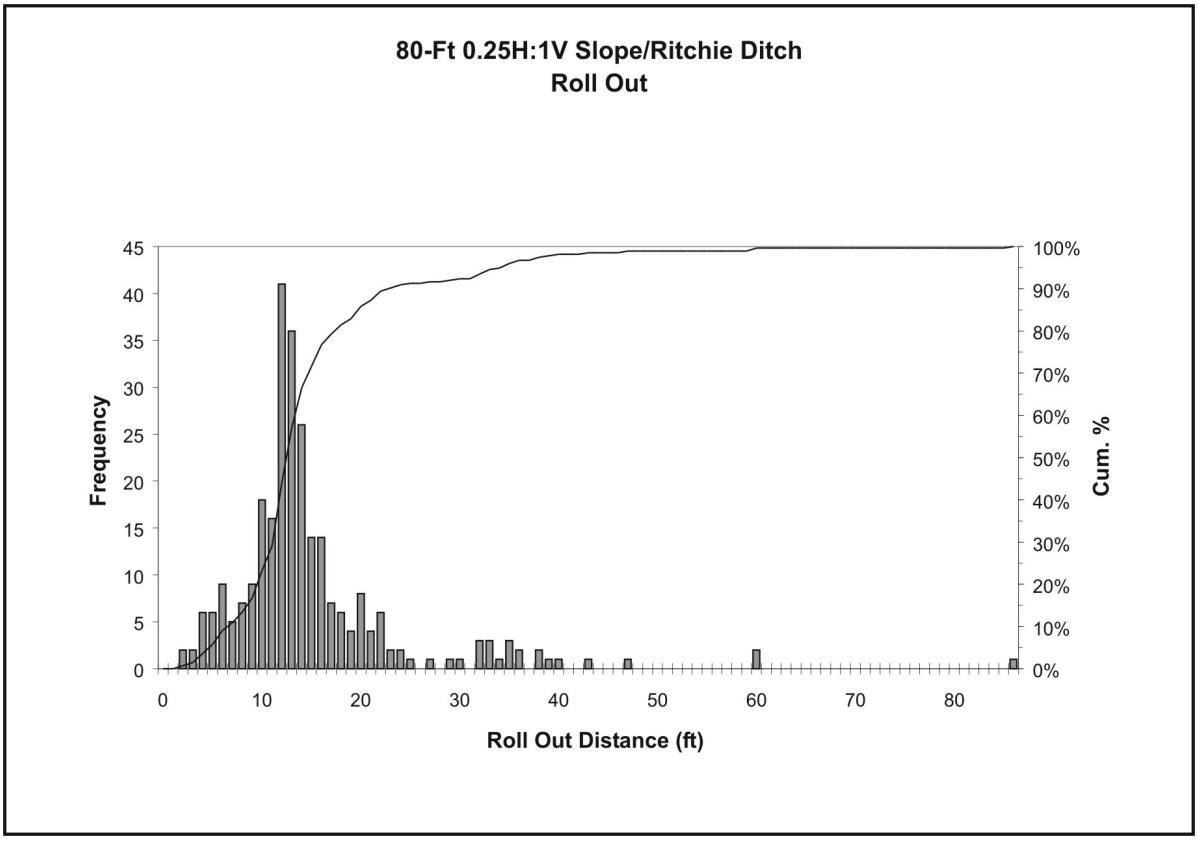
RITCHIE TEST CATCHMENT AREA COMPARISON

During the initial pilot research effort, a full suite of 250 rocks were rolled into a Ritchie catchment area from the 80-foot high, 0.25H:1V cutslope. For comparison purposes, the tested "Ritchie" catchment area was sloped and sized for an 80-foot high slope according to the Ritchie design chart contained in the FHWA Rock Slopes Manual (*FHWA 1989*), (see Figure 2.2). The Ritchie chart contained in the FHWA manual is slightly more conservative for higher slopes than is the original Ritchie criteria. The width of the tested Ritchie catchment area was 24 feet, with 6-foot depth and 1H:1V foreslope.

The most effective features of the tested Ritchie catchment area are its 6-foot depth and steep 1H:1V foreslope. Eight percent of the rocks (22 out of 275) escaped the limits of the tested catchment area; i.e., 92 percent of the rocks were retained. A catchment area designed to an exact Ritchie width would have been 20 feet wide, which would have allowed 41 rocks or about 15 percent of the total to roll through the catchment area; i.e., it would have retained 85 percent of the rocks. Of the 41 rocks, three would have landed (impacted) beyond the catchment area and the remaining 38 would have rolled through.

Refer to Section 2.3.2 of this report for further details and discussion of the tested Ritchie catchment area comparison.


80-Ft 0.25H:1V Slope/Ritchie Ditch
Impact
Frequency
Cum. %
Impact Distance (ft)
0
5
10
15
20
25
30
35
40
45
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


80-Ft 0.25H:1V Slope/Ritchie Ditch
Roll Out
Frequency
Cum. %
Roll Out Distance (ft)
0
10
20
30
40
50
60
70
80
0
5
10
15
20
25
30
35
40
45
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

APPENDIX B: ROCK ROLLING FIELD DATA

ROCK ROLLING FIELD DATA

This appendix contains the field data from the 11,250 rocks that were rolled off the five slope angles tested. The slopes were vertical, 0.25H:1V, 0.5H:1V, 0.75H:1V, and 1H:1V rock cutslopes. Each slope was tested from three heights at 40, 60 and 80 feet. Three catchment area slopes were compared for each slope height tested. The catchment area slopes included a flat catchment area and two inclined catchment areas that sloped downward toward the toe of the cutslope at a 6H:1V and 4H:1V. A standard suite of 250 rocks were rolled into each catchment area. This number included 100 rocks averaging one foot in diameter, 75 rocks averaging two feet in diameter and 75 rocks averaging three feet in diameter. The diameter dimension was measured along the longest axis. The actual diameter dimensions for each size category ranged within plus or minus 6 inches. For example, the two-foot rocks varied from 1.5 to 2.5 feet in diameter along the longest axis.

The impact and roll out distances in the following tables are the field measured slope distances. Field data was measured to the nearest foot.

NOTE: Also included at the end of Appendix B is a limited set of data gathered from a 40-foot high, 1.25H:1V slope. The rocks rolled from this slope fell into a 4H:1V catchment area. The results were recorded but not compiled into catchment area percent retention graphs or design charts, because there were not sufficient funds to test the full suite of slope heights and catchment area inclinations for the 1.25H:1V test slope.

Field Data for Vertical Slopes

40-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
4	4	11	11	8	8
6	10	12	12	8	8
5	5	15	15	11	11
5	5	9	9	11	11
14	17	7	7	13	13
9	9	10	10	11	11
9	11	10	10	12	12
9	9	10	11	7	7
11	11	11	14	11	11
5	5	5	9	14	14
9	9	9	9	12	12
12	13	9	9	9	9
7	7	8	8	11	11
8	8	9	9	11	11
8	10	15	15	13	13
9	9	11	11	13	13
11	11	7	7	11	11
9	9	11	11	14	15
7	7	7	7	13	14
8	8	12	12	13	13
10	10	8	8	12	12
9	9	8	8	10	10
8	8	11	11	17	17
10	10	13	13	15	15
6	6	10	10	11	11
9	9	8	8	16	16
9	9	10	10	11	13
8	8	7	7	9	9
5	5	10	10	13	15
11	11	11	11	12	12
5	5	7	7	7	7
8	8	12	12	11	11
10	10	11	11	10	10
10	10	12	12	7	7
7	8	12	12	12	12
2	3	10	10	14	14
8	8	10	10	12	12
5	7	8	8	12	13
7	8	8	8	9	10
5	5	8	8	13	13
6	7	11	13	11	11
9	9	7	7	9	9
8	8	9	11	14	14
5	6	12	12	10	10
7	7	10	10	11	11
11	11	10	10	13	13
5	5	12	12	13	13
5	5	10	10	11	11
17	17	11	11	10	10
4	4	12	12	12	12

40-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
8	8				
6	7	10	10		
8	9	9	9		
8	9	10	13		
5	5	12	12		
7	7	10	10		
3	3	13	13		
7	7	15	15		
6	8	10	10		
11	14	14	14		
9	9	8	8		
5	7	11	11		
4	4	11	11		
8	8	13	13		
6	6	8	8		
11	11	12	12		
7	7	11	11		
6	6	10	10		
10	10	11	11		
11	11	9	9		
11	11	10	10		
11	11	10	10		
10	10	12	12		
6	6	11	11		
6	7	7	7		
6	8				
8	8				
11	12				
5	5				
11	11				
8	10				
13	13				
6	8				
12	12				
8	8				
7	7				
12	12				
9	9				
7	8				
7	7				
13	13				
8	8				
8	8				
7	8				
7	7				
8	8				
5	7				
7	7				
14	14				
10	10				

Field Data for Vertical Slopes

40-Foot Slope with a 6H:1V Catchment Area					
1-foot	1-foot	2-foot	2-foot	3-foot	3-foot
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
9	9	11	11	8	8
9	10	13	13	10	10
8	8	13	16	3	8
11	11	7	7	3	3
10	10	13	13	15	15
8	8	10	10	10	13
6	8	5	5	13	13
7	8	4	4	12	12
6	6	8	8	5	8
11	12	11	11	10	11
6	6	11	11	9	10
10	10	9	9	9	11
9	9	10	10	12	12
6	6	3	3	8	8
8	8	11	11	12	12
11	11	10	10	7	9
9	12	8	8	11	11
8	8	11	11	7	7
3	3	4	4	7	7
7	7	11	14	3	6
2	3	10	10	5	5
7	7	11	16	8	13
7	7	10	12	11	11
11	11	10	10	8	8
8	8	6	6	9	9
14	17	8	12	13	13
9	14	6	6	8	11
7	7	5	8	8	8
7	7	10	10	8	13
4	4	9	9	11	11
10	12	7	11	10	13
6	6	11	11	5	5
8	8	7	7	7	7
10	11	13	18	7	7
10	11	8	10	5	7
5	5	11	11	7	9
7	7	7	7	10	10
5	5	11	13	12	12
8	10	10	10	9	9
8	8	11	11	13	13
10	10	7	7	7	7
10	14	11	11	10	10
10	13	8	8	9	10
6	6	5	5	8	10
8	9	9	9	7	8
5	5	11	11	6	8
6	8	12	12	9	9
4	7	12	12	7	9
8	8	15	15	8	8
4	4	7	7	14	14

40-Foot Slope with a 6H:1V Catchment Area					
1-foot	1-foot	2-foot	2-foot	3-foot	3-foot
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
9	9	10	11	10	10
3	3	15	15	7	7
10	10	10	10	13	15
5	6	7	8	10	10
5	5	8	8	7	7
9	9	8	8	7	7
6	6	5	5	4	5
8	8	3	3	7	7
9	9	5	5	11	11
7	7	6	6	9	13
7	9	11	11	11	11
8	10	9	9	11	11
12	12	7	7	8	8
12	14	9	9	14	14
8	10	12	12	9	9
6	6	10	10	9	9
5	5	10	11	7	10
4	4	13	18	5	5
14	14	7	7	7	7
14	17	11	11	7	7
7	8	9	9	10	10
12	12	10	10	11	16
8	8	10	10	8	8
7	7	8	8	11	11
7	7	5	5	13	13
9	9			9	9
7	7			10	10
4	8			8	8
8	8			8	8
6	6			12	12
9	9				
11	11				
6	6				
8	8				
8	8				
9	9				
6	6				
4	4				
7	7				
9	12				
8	11				
7	8				
10	10				
9	9				
12	12				
12	12				
10	10				
10	10				
7	7				
6	6				

Field Data for Vertical Slopes

40-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
6	8	10	20	14	14
8	10	12	20	13	13
8	8	10	13	7	29
11	18	10	18	10	28
5	5	7	7	9	25
10	20	11	17	9	25
9	10	10	20	8	20
7	7	8	8	13	17
9	12	9	14	10	19
6	6	10	30	6	12
7	7	9	13	7	7
9	9	8	12	9	22
9	17	10	10	13	23
5	5	8	18	11	17
8	18	9	18	10	11
10	17	6	9	11	16
5	5	9	9	10	16
9	17	8	13	8	8
3	3	8	15	9	9
5	5	9	9	5	10
5	5	8	11	8	17
8	8	7	15	9	11
14	14	9	9	8	14
8	8	7	10	9	14
8	10	8	8	10	29
8	8	10	10	10	19
6	6	7	7	5	11
8	11	9	12	8	8
3	7	12	15	11	11
8	11	12	12	12	17
7	7	9	12	10	10
12	12	10	10	7	14
5	6	8	8	9	16
8	11	8	9	6	10
10	13	10	15	5	5
13	13	8	18	13	13
8	8	10	18	11	29
5	5	8	17	14	14
9	17	7	18	10	10
5	5	7	7	13	16
7	11	7	10	6	16
7	9	7	7	9	14
8	10	11	11	8	11
5	5	12	12	7	14
9	9	7	10	13	22
6	6	12	17	13	13
7	7	8	8	8	17
5	5	5	9	10	10
5	5	4	11	10	20
11	12	6	6	11	11

40-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
8	21	10	25	8	18
8	22	8	12	10	16
10	17	10	10	11	11
5	5	9	9	7	15
5	8	7	7	13	13
5	6	14	16	8	13
5	5	9	31	13	13
10	19	7	9	11	11
9	10	11	14	10	18
6	6	9	9	7	7
10	10	12	12	8	25
8	9	6	8	10	10
8	8	6	10	8	8
8	28	7	11	9	9
8	14	7	7	8	8
11	11	9	11	13	31
6	6	10	16	8	23
5	5	11	14	11	11
7	7	8	8	9	9
3	3	7	25	8	10
5	5	10	20	5	5
7	7	6	10	7	13
12	25	6	13	5	10
8	8	9	13	8	13
12	23	7	7	8	22
8	8				
8	10				
12	12				
9	17				
10	10				
8	8				
14	14				
5	8				
5	5				
9	9				
3	13				
7	7				
11	17				
10	13				
9	9				
7	10				
8	8				
7	9				
9	16				
12	12				
8	12				
11	14				
7	7				
8	11				
8	11				

Field Data for Vertical Slopes

60-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
6	6	11	11	9	9
12	12	10	10	8	8
7	7	13	13	11	11
11	11	10	10	9	9
7	7	13	13	6	6
11	11	14	14	8	8
4	4	10	10	14	14
11	11	5	5	10	10
10	10	13	13	11	11
15	15	8	8	11	11
10	10	13	13	16	16
15	15	10	10	14	14
11	11	12	12	10	10
8	8	12	12	11	11
13	14	9	9	12	12
8	8	9	9	8	11
12	12	7	7	19	19
11	11	13	13	10	10
9	9	14	14	14	14
8	8	9	9	8	8
7	7	8	9	7	7
10	10	13	13	8	8
10	10	10	10	15	15
6	6	8	8	11	11
8	8	8	8	12	12
12	12	9	9	15	15
12	12	9	9	13	13
12	12	12	12	11	11
10	10	18	18	11	11
9	9	11	11	13	13
11	11	9	9	10	10
12	12	9	9	13	13
14	14	14	14	6	14
13	13	12	12	13	13
10	10	12	12	11	11
11	11	11	11	14	14
11	11	9	9	18	18
16	16	12	12	10	10
10	11	7	7	13	13
10	10	9	9	13	13
8	8	6	9	7	11
10	10	6	10	10	10
6	6	11	11	13	13
5	5	15	15	8	8
5	5	13	13	9	9
4	4	12	12	11	11
10	10	14	14	6	11
16	16	8	8	14	14
11	11	13	13	14	14
4	4	10	10	12	12

60-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
11	11	5	19	11	11
8	8	9	9	6	11
6	6	9	9	9	9
15	15	8	8	9	9
6	6	12	12	9	9
13	13	11	11	13	13
9	9	9	11	13	13
11	11	8	8	13	13
10	10	9	9	14	14
9	9	9	9	13	13
8	8	5	5	10	10
9	9	11	11	11	11
8	8	9	9	7	7
13	13	14	14	7	7
8	8	11	11	13	13
6	6	6	6	8	16
8	8	10	10	7	9
11	11	11	11	8	8
11	11	7	7	11	11
12	12	9	9	10	10
19	19	10	10	13	13
10	10	7	7	9	9
10	10	10	10	14	14
8	8	14	14	8	18
9	9	11	11	6	6
8	8				
10	10				
7	7				
7	7				
11	11				
10	10				
5	11				
8	11				
5	5				
8	8				
10	10				
9	11				
13	13				
8	8				
16	16				
10	10				
8	8				
11	11				
7	7				
10	10				
12	12				
12	12				
7	7				
10	10				
11	11				

Field Data for Vertical Slopes

60-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
7	7	10	10	12	12
4	4	8	8	14	14
4	4	12	12	13	13
3	3	11	14	8	8
6	6	8	8	10	10
4	4	7	7	9	9
9	9	6	6	7	7
4	4	9	9	7	7
8	8	9	9	9	9
4	4	11	11	9	9
7	7	10	10	10	10
5	5	13	13	13	13
5	5	9	9	9	9
8	10	9	9	11	11
6	6	15	15	10	10
3	3	15	15	8	8
4	4	8	8	8	8
7	7	12	12	5	5
2	2	9	9	11	11
4	4	5	5	11	11
3	3	16	16	16	16
2	2	7	7	15	15
5	5	6	6	10	10
12	15	11	11	15	15
7	7	8	8	12	12
2	2	12	14	5	5
6	6	10	10	15	15
5	5	8	8	6	6
1	1	10	10	11	11
5	5	7	7	9	9
9	9	8	8	8	8
4	4	8	8	9	9
3	3	5	7	11	11
5	5	8	8	16	16
7	7	11	11	10	10
2	2	8	8	5	11
2	2	5	5	11	11
6	6	11	11	7	7
6	6	6	6	10	10
6	6	11	11	10	10
5	5	13	13	13	13
6	9	8	8	7	7
5	5	9	9	7	7
14	14	9	9	11	11
2	2	5	5	16	16
2	2	9	9	13	13
3	3	5	5	8	8
5	5	8	8	10	10
5	5	10	10	13	13
6	6	9	9	6	6

60-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
6	6	11	11	11	11
2	2	8	8	11	11
4	4	11	11	12	12
5	5	11	11	16	16
11	13	12	12	7	7
5	5	11	11	16	16
11	11	10	10	8	8
8	8	5	5	12	12
16	16	5	5	5	5
6	6	7	7	10	10
9	9	5	5	7	7
5	5	9	9	7	7
5	5	14	17	8	8
5	5	11	11	8	8
7	7	6	6	7	7
9	9	9	9	5	5
7	7	13	13	9	9
8	8	10	10	10	10
16	16	5	5	4	4
5	5	8	8	9	9
7	7	11	11	8	11
9	9	6	8	11	11
8	8	13	13	8	8
6	6	6	6	9	9
6	6	7	7	9	9
5	5				
9	9				
5	5				
9	9				
13	13				
14	16				
5	5				
7	7				
9	11				
6	6				
6	6				
9	9				
4	4				
12	12				
5	5				
5	5				
6	6				
7	7				
7	8				
3	3				
10	10				
9	9				
3	3				
3	3				
8	8				

Field Data for Vertical Slopes

60-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
9	10	10	10	10	10
10	10	10	10	8	8
9	10	14	15	5	5
7	8	5	5	12	12
8	9	9	9	10	14
10	10	6	6	10	10
7	7	11	13	6	10
10	10	14	24	8	11
17	18	10	10	13	13
6	6	6	7	10	10
5	5	5	6	10	10
12	12	10	13	9	11
9	9	8	12	5	5
4	4	9	9	6	6
5	5	10	10	11	12
4	5	9	9	12	13
6	6	13	13	10	10
8	8	10	10	11	13
7	10	9	11	8	10
10	10	10	10	5	5
16	18	11	11	11	11
11	11	14	15	13	13
4	4	10	10	16	16
4	4	9	9	8	12
6	6	10	10	11	11
10	11	1	1	10	10
5	5	10	10	5	14
7	7	9	9	9	9
10	10	8	8	12	14
18	18	7	7	13	13
7	7	6	6	13	13
13	13	9	13	13	13
7	7	11	11	9	15
9	9	13	13	12	12
4	4	11	11	9	9
6	6	16	20	9	9
10	10	10	10	13	13
8	8	15	15	13	13
3	3	16	20	15	16
10	10	6	8	10	10
10	10	7	7	9	9
11	11	7	7	5	5
8	8	10	10	13	13
15	15	4	4	15	15
6	6	8	8	12	12
4	4	13	14	8	8
13	13	8	8	10	10
4	6	14	14	10	10
13	13	9	9	9	9
3	3	10	10	8	10

60-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
7	7	7	7	11	11
4	5	16	21	11	11
15	15	12	12	13	13
9	9	13	17	8	8
3	5	13	13	9	9
8	8	15	15	6	9
9	9	10	14	14	16
6	6	8	8	12	12
8	8	8	8	16	21
3	3	11	11	8	14
5	5	9	9	9	12
7	7	9	9	8	8
18	20	14	14	18	18
6	6	10	10	9	9
9	9	7	8	8	8
8	8	12	14	6	6
5	5	11	11	13	13
5	5	14	22	15	15
8	8	8	9	13	14
14	14	7	10	9	9
5	5	9	9	15	15
6	7	7	9	11	11
14	18	8	8	15	19
10	10	11	15	11	11
10	10	11	13	12	12
6	6				
7	7				
5	5				
5	5				
9	9				
9	10				
10	11				
9	9				
6	7				
8	8				
8	8				
5	5				
3	3				
5	5				
8	8				
5	8				
7	7				
10	10				
4	5				
8	8				
5	5				
3	3				
12	12				
9	9				
7	7				

Field Data for Vertical Slopes

80-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
3	3	10	10	10	10
12	12	10	10	8	8
11	11	14	15	5	5
11	11	5	5	12	12
10	10	9	9	10	14
13	13	6	6	10	10
11	11	11	13	6	10
20	20	14	24	8	11
11	11	10	10	13	13
15	15	6	7	10	10
11	11	5	6	10	10
10	10	10	13	9	11
15	15	8	12	5	5
11	11	9	9	6	6
17	17	10	10	11	12
10	10	9	9	12	13
11	11	13	13	10	10
19	19	10	10	11	13
13	13	9	11	8	10
8	8	10	10	5	5
3	3	11	11	11	11
14	14	14	15	13	13
2	2	10	10	16	16
10	10	9	9	8	12
10	10	10	10	11	11
12	12	1	1	10	10
5	5	10	10	5	14
5	5	9	9	9	9
9	9	8	8	12	14
8	8	7	7	13	13
10	10	6	6	13	13
6	6	9	13	13	13
17	17	11	11	9	15
11	11	13	13	12	12
14	14	11	11	9	9
10	10	16	20	9	9
5	5	10	10	13	13
11	11	15	15	13	13
11	11	16	20	15	16
16	16	6	8	10	10
9	9	7	7	9	9
11	11	7	7	5	5
10	10	10	10	13	13
10	10	4	4	15	15
20	20	8	8	12	12
5	5	13	14	8	8
8	8	8	8	10	10
10	11	14	14	10	10
18	18	9	9	9	9
16	16	10	10	8	10

80-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
8	8	7	7	11	11
12	12	16	21	11	11
8	8	12	12	13	13
9	9	13	17	8	8
3	3	13	13	9	9
7	7	15	15	6	9
13	13	10	14	14	16
12	12	8	8	12	12
5	5	8	8	16	21
7	7	11	11	8	14
8	8	9	9	9	12
6	6	9	9	8	8
14	14	14	14	18	18
15	15	10	10	9	9
11	11	7	8	8	8
11	11	12	14	6	6
11	11	11	11	13	13
15	15	14	22	15	15
17	17	8	9	13	14
9	9	7	10	9	9
14	14	9	9	15	15
10	10	7	9	11	11
15	15	8	8	15	19
15	15	11	15	11	11
10	10	11	13	12	12
7	7				
11	11				
10	10				
14	14				
14	14				
13	13				
7	7				
6	6				
3	3				
5	5				
15	15				
13	13				
8	8				
3	3				
16	16				
9	9				
11	11				
10	10				
10	10				
4	4				
12	12				
11	11				
16	16				
17	17				
6	6				

Field Data for Vertical Slopes

80-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
21	21	8	8	14	14
13	15	6	6	11	11
15	15	6	6	11	11
11	11	8	8	10	10
14	14	14	14	12	12
10	11	9	9	10	10
8	8	15	15	9	9
14	14	8	8	12	12
13	13	10	10	13	13
8	8	12	12	10	10
9	9	12	12	6	6
14	14	5	5	8	8
6	6	8	8	10	10
12	12	11	11	9	9
5	5	7	7	18	18
15	15	11	11	10	10
8	8	13	13	15	15
11	11	11	11	8	8
16	16	22	22	10	10
8	8	8	8	6	6
6	6	15	15	14	14
6	6	18	18	8	8
9	9	13	13	12	12
9	9	8	8	10	10
15	15	9	9	13	13
18	18	3	6	15	15
18	18	8	8	15	15
14	14	9	12	11	11
8	8	13	13	13	13
11	11	11	11	8	8
9	9	15	18	11	11
11	11	5	5	7	7
13	13	8	8	7	7
8	8	6	6	7	7
10	10	16	16	12	12
10	10	12	12	8	8
16	16	14	14	5	8
11	11	7	7	14	14
14	14	6	6	19	21
10	10	15	15	14	14
11	11	10	10	10	10
13	13	5	5	11	11
14	14	4	7	7	7
11	11	8	8	10	10
18	18	8	8	6	6
10	10	9	9	10	10
6	6	11	11	10	10
11	11	12	12	11	11
5	6	9	9	9	9
8	8	5	5	13	13

80-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
12	12	11	11	11	15
6	6	11	14	13	13
8	8	8	8	10	10
14	14	14	14	14	14
10	10	6	6	11	11
10	10	6	6	7	7
6	6	4	6	7	7
18	18	11	11	13	13
19	21	6	6	10	10
11	11	11	11	13	13
15	16	3	3	13	13
7	7	1	34	16	16
12	12	11	11	17	17
10	10	16	16	2	7
10	10	12	12	7	7
11	11	6	6	7	7
15	15	8	8	12	12
12	12	12	12	15	15
21	21	9	9	10	13
14	14	14	14	15	15
9	11	7	7	17	17
18	18	12	12	16	16
9	9	6	6	9	9
14	14	10	10	7	7
8	8	10	10	10	10
19	19				
8	8				
16	16				
18	18				
11	11				
8	8				
11	14				
11	11				
15	15				
10	10				
14	14				
18	18				
12	12				
7	7				
18	18				
14	14				
5	5				
12	12				
13	13				
14	14				
8	10				
15	15				
13	13				
8	8				
16	16				

Field Data for Vertical Slopes

80-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
15	17	7	7	9	11
15	15	8	8	15	15
8	8	3	3	13	13
10	12	4	4	13	13
8	8	6	6	15	17
10	10	5	5	7	7
3	3	13	13	8	9
3	3	15	15	6	6
5	5	12	12	6	14
5	5	11	11	11	15
7	7	8	8	10	10
16	16	5	5	9	10
6	6	6	6	15	20
8	8	10	10	13	16
10	10	18	18	9	9
13	13	10	10	12	12
5	5	4	4	12	12
7	7	10	10	9	11
5	5	18	18	14	15
8	10	8	12	7	7
8	8	14	14	12	22
11	11	11	11	10	10
12	15	13	13	6	6
12	12	14	14	8	8
11	11	11	14	7	7
13	13	8	8	8	11
11	11	7	7	8	8
15	22	3	4	8	8
14	15	8	12	14	14
19	22	5	5	9	9
10	11	5	5	20	20
11	12	6	6	12	13
10	10	10	10	8	19
10	12	12	12	10	12
14	18	15	15	12	12
12	12	15	15	15	17
8	8	20	25	14	21
10	15	7	7	17	18
13	14	17	17	10	10
11	17	10	10	8	14
20	24	8	8	8	12
12	14	7	7	8	15
17	19	16	17	12	15
15	19	9	14	11	11
16	18	2	2	18	18
10	13	8	11	15	16
10	15	11	11	8	8
10	10	10	11	7	7
13	16	10	10	10	10
14	14	14	15	7	8

80-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
19	20	15	15	11	12
13	14	15	18	15	15
18	18	7	9	13	14
12	13	8	8	20	20
20	21	15	15	15	16
13	21	6	6	7	7
10	12	10	14	10	10
4	4	11	11	8	10
6	6	10	10	14	14
3	3	10	10	8	8
17	17	7	10	14	14
17	21	11	13	8	8
23	25	14	14	14	19
5	8	13	15	16	22
7	14	11	11	8	10
10	12	11	11	7	9
10	10	11	15	10	10
5	5	6	6	10	10
9	9	10	10	10	10
10	14	5	5	12	12
13	16	10	10	17	17
10	16	12	12	10	10
18	19	16	17	5	5
4	4	12	12	9	9
18	18	6	6	5	19
15	30				
14	15				
8	8				
14	14				
15	15				
15	16				
10	10				
15	15				
16	18				
16	18				
14	17				
14	14				
13	13				
10	11				
9	10				
8	8				
12	14				
12	20				
14	14				
12	12				
18	19				
5	8				
13	17				
4	4				
8	8				

Field Data for 0.25H:1V Slopes

40-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
1	4	5	6	2	2
3	4	3	1	7	8
9	11	7	9	2	2
2	4	2	3	4	3
7	12	3	1	5	7
2	2	5	7	3	5
1	3	1	3	7	3
7	20	1	19	3	4
1	4	1	3	1	10
5	6	4	5	1	10
2	5	2	3	6	5
4	7	3	2	2	5
2	2	4	4	3	4
2	2	2	5	2	6
1	3	2	3	2	12
1	5	1	2	3	3
5	5	5	3	2	3
3	4	1	8	3	2
1	2	1	14	6	6
3	1	1	14	2	10
2	2	7	5	1	17
3	3	1	9	1	13
3	2	7	6	7	7
3	8	1	13	3	3
4	5	1	14	3	2
2	3	2	2	2	3
3	7	5	7	7	3
1	11	1	12	5	9
2	1	4	3	1	20
2	10	4	2	7	6
1	23	2	2	1	18
6	6	6	3	7	4
1	3	2	2	2	2
8	4	2	5	7	8
7	8	3	3	2	2
6	7	3	1	4	3
2	3	5	5	2	4
5	2	2	2	4	6
4	12	7	9	5	5
4	3	5	12	3	5
3	3	1	8	2	16
2	1	2	11	4	4
1	2	2	2	1	5
1	3	2	4	3	7
3	13	1	9	1	17
2	6	5	3	1	1
4	4	3	2	2	1
3	3	5	3	2	2
3	3	2	4	2	14
2	2	4	4	1	13

40-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
2	7	5	6	2	1
2	3	2	2	2	2
2	4	4	4	1	21
3	3	4	3	3	1
5	5	2	2	4	4
2	2	9	14	1	1
1	2	3	3	9	9
2	2	1	11	2	9
4	1	1	12	2	2
5	10	7	6	2	2
3	3	1	7	4	3
5	5	3	2	3	5
4	4	3	5	3	3
2	3	2	3	2	7
1	4	2	8	3	3
3	5	1	13	3	2
4	1	4	2	2	1
3	9	3	4	3	3
2	8	3	6	2	1
3	3	2	2	4	5
2	1	3	2	3	3
1	16	5	2	2	1
1	15	3	2	2	3
1	1	4	8	2	3
2	1	1	12	2	7
2	2	1	13		
5	7	7	9		
1	2	2	7		
1	6	2	13		
2	3	6	5		
3	4	2	5		
1	14	4	6		
7	10	3	3		
1	5	2	4		
7	9	3	5		
7	9	1	22		
1	1	5	10		
1	8	2	4		
1	3	4	4		
3	4	3	4		
5	5	2	10		
6	10	1	9		
3	4	2	5		
4	1	5	3		
6	6	2	7		
2	4	4	6		
4	9	4	2		
2	9	4	4		
4	4	2	2		
2	2	5	7		

Field Data for 0.25H:1V Slopes

40-Foot Slope with a 6H:1V Catchment Area					
1-foot	1-foot	2-foot	2-foot	3-foot	3-foot
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
5	6	3	3	7	7
5	6	7	4	2	8
1	6	1	1	4	2
5	5	2	14	7	4
4	4	3	7	7	7
1	12	3	5	7	7
3	6	1	5	2	16
5	6	1	6	7	7
4	9	3	3	5	6
4	4	1	5	2	8
1	4	4	1	3	3
9	10	5	5	1	10
4	4	5	5	5	5
5	3	4	4	6	4
1	1	3	1	2	7
4	2	2	8	2	1
1	5	2	14	2	5
2	2	4	4	5	3
2	1	3	3	3	5
1	4	5	8	2	2
1	6	4	2	5	3
1	2	3	2	3	6
1	1	2	11	3	5
2	2	1	1	2	3
4	4	3	5	1	16
3	3	4	6	2	3
1	6	4	9	3	4
1	3	4	4	3	7
1	1	5	6	3	3
1	4	5	5	4	4
5	2	4	3	3	3
2	2	5	5	6	7
1	4	8	9	4	2
1	2	3	4	5	12
6	2	2	4	3	14
4	7	1	2	3	9
1	1	1	6	3	3
4	9	3	3	6	6
15	16	5	1	4	9
3	4	4	5	6	8
1	3	3	7	2	1
2	3	2	4	4	4
3	4	7	7	4	6
1	3	4	3	3	2
3	4	3	5	3	7
3	1	7	7	8	11
3	6	6	7	5	6
8	5	3	7	6	5
5	7	5	8	4	4
1	1	3	4	5	5

40-Foot Slope with a 6H:1V Catchment Area					
1-foot	1-foot	2-foot	2-foot	3-foot	3-foot
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
9	13	2	5	4	3
2	11	1	1	1	10
2	3	3	7	7	6
6	5	4	7	5	6
8	7	8	13	6	2
6	4	2	7	1	3
8	17	1	7	4	4
2	2	5	2	4	4
10	13	5	5	4	10
5	5	5	5	2	2
1	2	10	15	5	3
3	4	4	4	7	2
1	4	5	5	8	15
1	4	3	8	3	3
1	8	5	8	4	3
7	8	5	17	4	4
1	1	3	4	3	3
2	1	5	5	3	3
11	12	2	2	2	6
5	3	3	8	4	11
6	6	5	5	3	8
3	3	4	2	4	3
10	17	2	4	2	2
1	8	1	12	3	5
7	8	4	5	8	2
3	9				
1	2				
2	4				
1	6				
4	5				
3	5				
2	6				
1	5				
3	6				
1	7				
3	4				
2	7				
1	1				
2	1				
2	3				
3	4				
4	4				
2	11				
4	8				
6	5				
2	4				
4	3				
1	3				
2	4				
1	5				

Field Data for 0.25H:1V Slopes

40-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
5	11	2	10	7	12
3	5	4	8	1	20
1	3	2	18	4	11
8	18	1	3	5	9
2	5	1	7	5	7
3	7	1	30	3	6
3	3	3	6	6	22
1	1	2	26	12	25
3	10	3	13	5	6
5	8	6	13	5	5
3	8	1	8	3	11
5	8	1	19	7	7
3	7	2	7	5	5
3	3	3	6	3	6
2	2	5	9	8	12
4	9	3	3	7	15
3	3	6	10	1	15
1	4	3	7	2	8
6	13	1	5	1	3
5	12	6	9	1	19
4	13	2	13	3	13
5	6	4	10	4	9
1	4	3	20	8	14
2	3	3	12	3	3
4	6	8	11	9	22
8	13	2	8	5	5
6	7	7	11	3	5
2	3	7	7	3	6
3	4	7	9	3	18
13	17	7	14	4	9
3	8	2	2	5	14
2	6	4	4	2	2
5	11	6	11	4	6
2	5	2	8	3	21
4	7	6	6	6	6
2	6	3	3	3	8
3	3	1	2	2	6
5	7	3	6	9	11
2	2	3	3	4	4
1	1	5	21	7	7
4	4	3	4	1	13
4	16	8	11	2	12
5	5	4	4	3	8
7	7	2	15	8	28
10	10	4	7	4	4
10	16	5	8	5	18
5	6	3	9	1	11
3	3	1	2	3	7
2	3	3	10	3	3
3	3	5	13	8	33

40-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
2	4	4	16	3	3
3	3	7	8	4	10
7	17	7	13	4	17
2	6	1	13	2	5
3	12	7	8	2	11
4	4	5	6	2	13
6	9	3	3	2	6
4	4	5	10	3	9
8	8	2	6	2	2
6	10	6	9	4	4
5	5	2	5	5	7
4	4	4	29	8	11
5	10	3	8	4	6
6	8	2	7	3	3
5	5	3	3	2	2
1	3	5	4	6	7
6	6	3	3	7	8
8	12	4	5	6	7
4	5	3	8	4	24
7	7	2	2	3	3
4	10	7	21	3	3
4	4	5	14	7	7
5	8	5	5	1	21
1	6	5	20	3	13
1	4	6	19	3	20
3	8	3	3		
4	10	3	14		
3	13	4	14		
3	13	3	17		
6	7	8	6		
1	3	3	10		
5	8	5	12		
2	2	3	8		
2	3	4	7		
5	11	4	11		
9	10	2	14		
3	7	4	13		
7	8	2	4		
5	7	2	8		
1	3	2	12		
1	18	2	13		
3	5	5	7		
1	1	3	8		
4	11	1	5		
1	1	1	33		
7	10	4	14		
10	11	2	5		
7	17	2	2		
1	1	2	34		
2	2	5	18		

Field Data for 0.25H:1V Slopes

60-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
5	4	6	3	3	7
3	4	12	15	9	6
2	2	1	9	3	3
4	8	18	19	8	1
5	3	6	10	4	3
15	17	11	12	13	21
15	20	3	5	2	11
15	12	1	1	4	3
1	1	2	28	7	10
5	7	11	11	12	19
1	1	2	5	2	10
15	27	8	8	5	5
2	2	12	13	6	15
5	7	3	5	6	7
8	5	7	1	7	12
7	12	1	7	8	5
2	7	2	2	5	4
2	3	5	2	11	11
7	11	5	5	3	2
6	6	10	7	9	8
1	6	4	15	12	9
10	15	3	2	3	2
1	2	2	8	4	5
1	1	5	2	3	3
5	1	2	8	10	10
2	1	2	14	8	5
5	10	10	17	6	4
3	2	1	8	4	17
7	5	6	11	2	4
9	9	2	8	13	17
14	16	4	3	5	10
14	22	11	11	5	3
5	4	4	6	5	2
10	10	2	2	11	13
10	15	2	7	5	9
17	17	2	4	6	4
6	4	6	4	6	4
10	10	13	30	3	18
3	2	1	10	5	2
5	7	9	7	6	4
2	2	5	2	3	18
1	6	7	2	5	2
2	8	14	21	3	4
5	6	3	4	3	9
6	6	2	6	9	13
4	4	12	12	12	16
3	4	7	7	4	6
2	2	11	19	4	5
5	7	3	4	4	7
2	2	11	17	3	14

60-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
4	3	7	15	2	6
12	13	5	5	5	10
10	10	9	17	2	2
10	15	4	9	3	11
14	14	7	7	7	8
3	6	2	2	8	5
12	19	5	4	9	14
4	7	1	6	3	5
17	30	2	4	5	15
1	7	13	28	5	5
7	7	2	13	8	10
5	11	9	8	6	14
5	5	2	3	8	10
2	3	2	1	4	2
6	5	10	14	3	13
6	4	8	10	7	5
8	11	3	9	2	15
4	7	4	7	2	2
4	5	1	13	9	9
14	14	5	5	5	10
12	16	5	3	3	20
4	3	3	8	3	23
14	21	3	2	13	15
2	1	10	12	5	6
6	8	16	28	7	7
6	16	9	8		
8	15	3	8		
5	10	4	17		
2	2	3	3		
4	4	1	9		
5	5	5	1		
9	16	6	7		
3	5	5	3		
15	17	2	4		
9	14	4	10		
12	11	5	12		
15	15	2	2		
3	7	14	20		
2	1	5	12		
10	12	1	2		
1	6	1	6		
2	2	10	10		
4	7	3	1		
6	7	2	3		
1	1	2	3		
16	16	5	5		
7	9	2	15		
4	4	13	14		
1	6	2	8		
2	10	2	2		

Field Data for 0.25H:1V Slopes

60-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
6	7	2	2	5	4
6	9	3	4	2	4
1	6	14	24	2	3
8	10	2	10	8	12
10	15	5	21	2	15
5	8	7	15	6	15
1	4	7	7	2	19
3	4	7	21	5	19
12	12	7	10	2	7
2	5	2	2	4	26
5	5	2	15	6	5
4	12	6	7	7	7
2	1	6	12	4	4
8	8	6	12	8	11
5	10	2	17	11	17
4	5	2	8	5	18
2	22	2	11	3	43
1	5	2	2	25	30
1	3	14	22	2	7
15	16	2	3	2	16
5	8	10	17	2	7
1	1	10	22	1	28
13	16	10	8	2	16
9	9	3	9	4	10
5	12	3	1	2	5
5	5	1	2	6	12
5	6	8	8	4	9
5	6	3	3	3	5
3	5	2	2	2	3
1	1	2	3	1	35
12	28	6	17	1	30
12	15	2	2	5	12
16	18	3	6	2	3
10	16	3	3	11	22
9	11	4	6	6	4
11	17	2	2	2	17
7	10	8	7	2	6
2	2	5	8	2	19
13	26	7	14	2	10
4	5	9	15	2	16
4	5	7	18	2	17
13	14	8	10	1	19
5	10	12	21	1	14
5	14	1	14	4	4
2	1	1	24	1	19
6	7	6	7	9	21
7	20	1	26	2	20
1	1	2	12	4	24
7	1	4	4	9	17
6	10	1	1	4	5

60-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
12	15	6	6	8	8
1	9	4	2	1	49
7	7	2	8	8	8
6	8	5	5	1	32
12	30	10	13	3	15
12	19	5	1	2	20
5	4	1	28	7	9
12	17	4	23	6	20
2	1	4	17	3	2
12	17	12	33	3	10
7	12	7	25	3	15
7	7	3	6	3	3
12	20	6	10	12	33
2	7	4	15	4	5
1	1	7	9	4	20
3	3	3	21	6	7
10	7	13	23	2	34
3	6	20	34	7	5
4	15	8	22	3	28
2	3	9	21	7	7
2	2	12	28	12	19
12	26	3	9	3	23
3	1	2	6	9	7
3	10	1	7	9	8
4	12	6	25	7	11
1	24	3	17	2	15
6	6	9	27		
2	3	1	21		
16	19	8	8		
2	4	11	31		
3	3	7	14		
6	5	3	3		
8	8	1	15		
3	2	1	13		
6	8	3	12		
4	1	5	24		
4	9	1	16		
3	10	9	17		
3	2	3	3		
12	17	6	23		
7	15	5	5		
11	16	14	28		
10	19	8	23		
2	1	7	15		
7	23	3	4		
1	4	6	6		
1	5	7	7		
14	17	4	7		
3	9	1	3		
7	18	1	4		

Field Data for 0.25H:1V Slopes

60-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
2	40	3	16	4	15
6	7	16	36	3	24
3	20	4	50	3	35
3	9	11	15	4	2
2	30	4	15	10	35
1	22	4	23	3	37
10	34	4	14	7	7
3	8	8	11	7	8
2	6	4	15	15	71
9	4	6	14	3	8
9	14	6	44	10	32
3	4	2	3	4	4
8	8	7	24	4	36
2	5	12	49	5	22
7	14	14	27	6	65
2	13	6	31	3	1
4	21	12	45	10	31
15	29	2	8	4	24
7	26	3	18	6	37
7	24	5	40	4	70
2	14	3	25	5	21
2	7	13	37	6	47
5	6	2	20	6	55
3	7	15	45	5	19
9	14	3	12	3	36
7	9	5	5	12	20
7	8	2	34	2	18
7	7	10	15	14	46
2	2	2	3	5	76
2	3	11	30	5	4
2	10	4	8	7	65
3	3	11	53	6	6
2	16	4	27	3	29
2	3	5	5	10	10
4	16	7	37	3	37
9	36	11	20	6	8
11	15	4	5	7	48
12	39	7	14	8	12
13	21	2	20	3	8
3	4	5	35	5	4
5	5	5	17	9	14
3	3	4	25	4	42
3	7	3	5	3	8
7	14	3	5	6	36
3	25	5	8	4	4
3	20	5	7	3	13
2	5	7	24	5	22
4	13	4	11	4	32
2	9	15	37	3	26
10	31	2	9	6	1

60-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
2	14	9	45	3	17
2	21	3	16	3	44
5	8	4	4	16	35
4	23	4	9	6	10
2	2	7	55	7	17
14	32	6	23	4	32
6	22	3	20	3	25
7	16	7	38	3	49
3	17	10	17	4	16
6	6	7	27	5	7
3	13	15	28	9	35
1	22	7	8	7	8
15	37	4	9	6	50
6	28	4	5	6	14
2	23	8	22	3	15
11	13	5	49	2	51
10	27	10	27	2	54
6	4	6	10	2	15
7	12	4	28	6	2
19	21	5	19	14	58
2	14	5	34	2	7
2	11	7	28	5	9
6	28	3	17	4	31
10	27	7	65	3	23
5	31	5	24	9	27
5	14	9	16		
5	9	7	67		
4	12	4	17		
10	35	4	6		
6	6	9	18		
2	6	3	17		
6	11	7	41		
3	8	3	27		
6	18	7	41		
2	14	3	27		
2	19	5	21		
4	4	5	35		
4	16	10	16		
8	8	6	54		
4	9	2	32		
6	13	10	43		
17	38	10	14		
3	5	3	24		
10	10	9	40		
5	12	3	21		
5	6	5	16		
9	27	3	6		
3	2	7	13		
10	41	3	7		
3	5	5	40		

Field Data for 0.25H:1V Slopes

80-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
1	14	3	6	5	22
12	14	3	6	3	16
8	8	19	17	4	22
1	16	3	28	6	41
12	15	2	24	9	27
7	24	14	13	9	9
5	8	4	12	6	14
11	12	10	7	5	13
7	7	4	18	4	5
12	14	3	3	3	12
8	17	2	7	10	14
7	7	1	21	18	18
14	19	1	28	12	20
7	3	12	16	19	19
16	17	1	6	3	12
5	3	15	21	4	48
3	3	5	7	7	7
6	11	7	17	9	9
1	16	6	19	3	31
7	7	3	7	5	17
8	10	3	12	3	36
7	7	3	13	3	47
2	27	4	17	10	11
4	7	18	12	8	8
2	29	2	8	10	17
4	4	15	17	9	21
15	12	2	2	5	24
4	6	13	11	6	22
4	5	6	2	3	14
4	5	4	15	4	21
2	2	2	7	6	6
2	25	1	22	11	11
3	7	17	21	5	5
7	5	2	3	3	11
5	4	2	19	9	13
8	12	5	17	14	14
7	3	2	24	3	11
14	16	4	16	9	11
22	34	2	11	9	9
3	7	6	12	3	23
9	10	3	4	2	6
5	3	5	15	4	4
10	11	4	3	2	30
2	2	14	22	6	15
14	12	3	11	5	6
10	12	3	7	12	22
14	14	5	14	5	5
9	8	1	3	14	14
10	8	2	25	2	12
20	9	2	32	2	23

80-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
12	13	6	9	2	20
2	15	10	8	9	9
7	7	9	13	2	23
6	17	3	4	10	14
7	6	3	17	6	6
16	18	4	5	3	8
7	6	14	10	8	8
1	21	4	31	5	17
4	19	14	10	2	20
7	10	3	3	11	25
2	11	2	4	3	4
4	3	2	23	1	50
11	11	2	7	4	4
9	8	8	12	17	21
12	14	1	24	9	14
11	13	7	11	4	4
4	13	12	17	2	20
17	11	17	23	2	11
19	24	2	38	5	5
7	21	6	12	2	21
7	6	16	24	2	38
21	26	4	17	3	13
10	13	7	12	11	14
10	10	2	19	6	25
10	8	6	20	3	6
6	23	17	26		
2	11	2	4		
8	8	3	16		
13	13	3	16		
13	14	3	17		
10	11	2	36		
1	2	10	10		
13	13	22	30		
13	14	2	29		
10	11	1	30		
1	14	10	26		
2	2	10	12		
17	13	1	5		
8	16	17	15		
14	21	14	15		
20	21	3	27		
6	10	3	20		
2	4	12	17		
9	7	7	6		
1	16	2	17		
9	8	14	5		
15	22	10	5		
4	2	11	15		
2	6	5	3		
6	13	15	15		

Field Data for 0.25H:1V Slopes

80-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
4	4	19	20	3	26
16	23	7	7	11	20
16	29	7	9	6	19
1	28	11	13	3	23
3	9	4	15	9	11
14	19	8	16	5	10
7	14	9	9	9	23
3	3	4	34	7	18
5	5	2	56	3	7
6	6	7	11	5	10
1	17	5	10	1	43
4	18	5	11	10	15
1	21	4	4	20	20
9	9	12	32	5	27
5	7	4	9	5	7
1	11	18	27	1	8
25	38	2	24	2	43
3	4	8	10	10	23
6	20	2	23	4	7
10	11	10	10	10	20
17	18	12	18	4	42
20	22	14	18	9	24
3	3	4	7	11	11
1	15	11	30	5	6
23	47	10	27	18	37
13	16	2	21	7	14
10	12	1	5	2	30
16	21	1	5	2	27
17	18	14	14	12	12
7	13	9	15	5	5
10	10	7	7	2	27
25	26	5	6	6	30
1	17	3	7	3	14
12	12	23	23	4	25
1	17	2	13	10	12
5	5	3	14	5	5
9	17	23	28	4	36
1	30	7	11	12	26
3	16	4	5	10	12
2	8	10	27	7	7
4	10	8	9	8	28
14	18	5	7	2	45
10	12	9	27	9	16
17	19	2	31	5	7
8	8	2	22	3	55
10	12	3	18	6	10
1	17	2	33	3	40
8	8	4	14	7	25
6	18	3	16	3	30
4	14	3	11	4	38

80-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
2	18	10	23	14	17
3	14	3	3	13	19
2	16	2	60	2	13
1	36	17	18	10	14
4	20	5	10	10	15
11	11	2	12	5	9
17	21	3	21	2	31
18	20	5	22	17	30
16	16	5	30	4	14
3	27	1	15	3	3
5	14	4	10	3	41
10	23	11	17	12	22
16	19	15	39	15	20
4	10	2	31	3	5
20	20	24	24	14	14
3	33	2	20	10	12
3	13	2	24	2	38
7	9	5	10	5	20
3	7	2	7	14	24
19	29	2	29	15	21
10	15	23	43	4	12
3	14	2	25	4	16
3	11	11	19	3	20
1	10	2	28	4	48
4	13	10	13	4	4
2	22	3	3		
3	20	2	6		
16	20	3	12		
10	14	3	8		
10	23	10	20		
1	14	9	36		
13	13	14	17		
3	9	5	6		
7	7	3	37		
2	10	4	5		
11	12	4	18		
3	13	11	25		
10	11	2	23		
7	9	15	20		
7	11	4	33		
7	11	10	12		
22	31	3	32		
4	16	10	25		
7	10	9	19		
24	31	15	31		
12	15	4	4		
8	9	6	15		
4	14	2	32		
14	14	10	25		
9	9	15	17		

Field Data for 0.25H:1V Slopes

80-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
2	2	7	61	10	37
4	34	14	69	3	99
1	41	1	48	5	34
4	4	16	20	2	53
1	41	2	31	11	32
4	4	1	10	4	25
7	14	8	11	4	32
5	14	2	20	5	35
1	37	9	28	3	20
1	29	2	18	3	25
20	27	2	17	3	12
5	24	2	43	7	15
6	14	7	29	7	15
15	67	2	44	12	65
3	6	6	33	3	77
15	17	2	70	3	32
14	24	2	7	3	53
5	17	21	33	8	24
9	10	11	33	4	4
2	9	2	2	4	10
2	29	6	13	6	37
4	4	7	26	17	61
5	17	2	6	14	71
2	7	1	13	3	3
3	12	2	10	5	17
6	20	6	30	5	5
4	10	3	44	2	33
2	14	4	3	7	7
5	5	1	26	5	20
1	18	1	72	15	42
2	2	16	43	2	36
1	49	5	22	9	18
1	8	8	12	3	84
6	28	2	18	9	57
10	37	6	15	6	15
7	15	7	11	6	34
8	25	1	80	3	21
1	34	5	19	2	38
14	39	4	28	5	34
4	4	6	15	7	7
2	8	3	4	5	30
12	20	2	15	7	10
3	6	3	3	3	56
17	21	11	15	3	25
4	15	5	5	15	28
7	16	4	20	4	20
3	7	7	11	3	23
16	37	7	34	3	5
2	3	15	19	11	40
2	2	15	22	15	53

80-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
2	4	14	72	7	10
10	45	10	17	3	28
3	9	2	23	3	53
4	8	3	21	7	30
9	37	7	23	3	40
6	38	7	38	7	7
4	5	3	2	6	70
3	10	4	19	11	49
5	34	11	29	9	10
15	44	4	35	10	17
18	28	11	21	5	5
16	30	5	24	9	29
5	5	14	37	6	13
3	9	1	48	2	55
4	13	5	17	4	75
3	5	3	12	10	12
1	34	3	4	6	49
10	11	2	39	3	55
2	26	9	35	3	70
1	5	3	7	4	5
5	39	10	28	3	17
9	29	5	12	3	34
15	18	3	9	5	40
14	52	10	41	5	10
2	15	5	14	3	7
2	17	9	7		
6	8	2	7		
1	17	2	44		
15	57	3	13		
14	21	5	16		
2	28	2	6		
7	10	10	10		
7	12	15	63		
8	22	15	37		
1	46	4	22		
8	13	5	40		
5	44	3	46		
5	10	5	20		
2	2	5	31		
12	15	11	15		
15	34	5	25		
20	45	5	8		
1	6	2	2		
11	17	10	12		
7	12	2	62		
4	4	2	61		
7	24	11	30		
15	15	12	41		
6	11	2	20		
18	55	6	35		

Field Data for 0.5H:1V Slopes

40-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	5	0	17	7	7
0	5	3	10	5	5
0	4	2	4	2	12
0	5	0	11	3	11
0	7	0	17	4	7
0	10	0	13	2	17
3	3	3	3	3	4
0	3	0	6	1	4
2	4	3	3	3	8
0	3	0	9	2	14
5	7	4	12	3	5
3	5	0	6	4	4
0	5	0	15	4	7
0	5	0	6	1	9
0	5	5	8	2	9
0	7	6	6	2	13
0	4	4	9	3	9
0	6	5	8	3	3
0	9	0	16	2	11
0	5	0	9	5	5
3	3	1	5	2	10
0	0	2	9	3	6
0	3	0	5	3	3
0	8	0	10	2	16
0	4	5	5	2	9
0	9	0	7	4	12
0	5	0	12	1	4
0	8	0	7	3	3
1	3	3	10	5	5
0	8	0	8	2	6
0	7	0	5	3	8
4	4	0	6	6	11
0	5	2	6	3	3
0	4	1	8	3	8
0	5	4	7	2	9
3	3	1	1	1	10
6	6	4	6	5	9
3	3	4	10	3	15
4	4	0	11	4	6
0	1	0	13	4	15
0	0	5	5	3	8
4	7	5	5	6	6
0	4	2	6	5	5
5	8	0	7	3	14
0	7	0	14	4	12
0	5	0	9	2	9
0	3	0	15	2	9
0	4	0	16	4	10
0	9	0	12	5	5
0	7	5	10	2	15
0	3	0	9	2	10

40-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	4	0	15	3	7
2	2	3	7	2	2
0	9	5	9	5	5
0	3	3	3	3	7
0	9	3	11	3	10
8	8	0	7	1	10
3	3	5	5	1	6
0	2	0	14	4	8
0	5	6	6	4	8
2	2	0	11	4	4
7	7	0	10	2	16
0	4	1	4	2	3
0	3	0	12	4	7
0	11	2	7	4	11
4	9	0	8	6	11
0	5	0	14	6	11
0	7	0	9	7	7
0	5	0	16	4	4
0	5	0	8	3	3
0	10	0	8	3	7
0	11	0	12	5	13
4	4	0	8	2	10
0	3	0	10	3	7
0	5	0	20	5	6
0	12				
5	5				
3	3				
0	3				
0	5				
0	6				
5	8				
0	4				
0	5				
0	9				
0	7				
0	4				
5	5				
0	8				
4	10				
0	0				
5	5				
3	3				
0	2				
0	5				
0	6				
4	4				
2	2				
4	8				
0	10				

Field Data for 0.5H:1V Slopes

40-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	3	4	6	0	16
3	5	3	11	0	18
0	11	2	8	0	12
0	9	0	10	0	10
0	8	0	26	0	15
0	8	0	20	0	12
1	6	1	12	0	17
1	6	0	16	1	3
0	16	1	4	0	25
0	7	3	6	0	13
0	3	4	13	0	17
0	12	0	8	0	3
0	10	2	10	0	11
0	8	0	10	0	10
0	16	0	12	0	15
4	7	0	10	0	8
0	8	0	10	0	13
0	16	0	8	3	5
0	5	0	20	0	16
0	12	1	1	0	10
4	7	0	12	0	5
2	2	0	7	0	12
3	9	0	14	0	12
1	1	0	11	0	25
0	5	2	8	1	2
1	3	0	15	0	10
3	3	0	16	1	6
1	3	0	20	0	16
1	3	2	6	0	20
0	12	0	10	0	12
0	9	0	16	0	16
2	2	0	22	0	17
0	3	0	13	0	5
4	16	3	7	1	11
0	9	0	17	1	6
4	6	0	10	1	5
7	15	0	17	0	8
4	7	0	8	3	6
0	11	0	13	0	5
0	12	0	5	4	10
0	9	1	4	0	12
0	16	0	19	0	5
2	2	0	15	0	10
0	4	0	10	0	17
0	7	3	3	0	20
0	21	0	7	4	8
0	4	0	23	0	18
0	8	0	17	0	7
1	7	0	17	0	13
0	7	4	8	0	13
0	3	0	23	0	13

40-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
4	7	0	7	0	11
0	5	0	7	0	10
0	8	0	9	0	10
0	10	0	19	0	12
0	13	0	7	0	17
0	7	0	8	0	20
0	13	0	17	0	7
0	7	0	13	2	7
0	15	0	13	0	22
3	5	0	7	0	15
0	13	5	9	3	8
0	7	0	15	0	15
0	9	0	11	0	18
3	7	0	6	0	10
0	5	0	15	0	15
0	14	0	17	0	11
2	3	1	1	3	3
0	0	0	10	0	7
0	13	0	11	5	24
0	10	0	17	0	17
0	5	0	10	0	17
0	11	0	15	0	12
0	16	0	11	0	7
0	8	0	6	0	12
0	8				
2	11				
0	10				
1	1				
2	2				
2	4				
2	6				
0	10				
0	6				
0	14				
0	13				
0	8				
2	2				
3	13				
2	2				
0	12				
5	11				
0	6				
1	4				
0	8				
3	14				
0	6				
1	1				
1	1				
1	4				

Field Data for 0.5H:1V Slopes

40-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	12	3	23	0	25
0	2	0	16	0	35
0	10	0	6	3	35
0	17	4	9	0	40
1	26	3	30	0	3
5	15	3	20	0	17
5	10	3	38	0	16
5	7	4	35	0	25
0	8	3	25	0	12
3	30	0	28	5	21
2	12	0	20	0	30
2	18	5	21	5	35
4	8	5	27	4	40
0	18	3	44	3	28
0	7	0	33	0	45
0	8	3	28	5	22
3	18	3	26	4	23
2	18	3	7	3	20
4	22	5	26	0	23
1	10	0	23	2	12
4	15	0	17	2	15
3	18	0	23	3	3
5	21	3	14	2	35
4	10	2	15	0	35
5	19	0	20	0	40
2	13	3	22	0	47
0	17	5	20	3	34
3	7	3	17	0	28
4	9	2	5	5	12
10	22	5	15	3	28
2	8	0	18	7	18
3	7	3	10	0	8
3	3	3	19	2	13
3	8	5	6	0	35
5	8	4	17	2	20
0	8	3	48	1	20
3	11	5	14	3	30
2	16	4	23	0	34
0	8	5	34	0	27
3	5	0	23	2	27
3	3	3	13	5	34
3	6	0	20	4	37
2	25	3	18	2	30
0	23	0	15	0	15
1	35	0	20	0	23
3	20	0	16	3	16
2	20	5	38	0	57
3	8	2	7	0	35
0	30	0	17	2	42
0	29	0	25	0	15
0	16	0	20	5	18

40-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
3	6	0	17	6	45
2	19	1	40	2	18
0	25	4	35	0	24
2	20	3	40	0	30
5	15	3	33	0	15
6	27	0	29	2	8
2	5	0	24	3	20
0	23	0	25	0	25
3	11	2	40	5	23
4	8	3	19	0	48
3	3	0	41	2	15
0	30	5	6	0	30
3	17	3	20	5	30
1	4	3	38	2	17
5	28	3	31	5	17
5	16	2	25	0	36
3	37	2	37	2	30
2	27	2	25	3	33
1	10	3	14	0	25
1	22	5	34	5	48
5	25	0	40	2	25
3	3			3	30
2	8				
2	28				
4	18				
1	4				
0	8				
0	6				
0	4				
5	23				
5	18				
3	5				
3	20				
2	14				
5	17				
0	10				
0	4				
0	11				
0	28				
4	8				
0	12				
5	27				
4	10				
2	10				
0	4				
5	24				
0	37				
0	13				
1	34				

Field Data for 0.5H:1V Slopes

60-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	5	10	12	6	9
9	10	0	5	11	17
11	16	12	17	6	6
12	13	7	11	8	8
10	10	0	15	6	14
7	7	0	8	11	15
5	7	5	6	11	16
8	17	4	7	8	8
1	1	6	8	11	18
8	16	0	11	8	15
8	10	1	5	8	12
3	3	14	14	0	15
8	8	5	9	10	17
9	11	8	8	5	9
13	21	8	15	8	8
10	13	8	8	7	16
9	13	5	18	8	17
1	1	10	16	10	13
7	10	5	15	8	8
10	16	7	17	7	11
3	9	7	11	8	8
7	9	12	12	12	16
7	8	7	7	8	12
0	13	5	5	4	4
0	7	13	25	8	11
0	6	9	14	7	13
0	6	8	8	15	25
7	7	9	12	3	10
7	7	10	12	11	11
0	1	6	8	10	10
10	14	7	13	0	12
3	4	10	13	8	17
2	3	10	17	0	13
2	5	7	7	12	18
1	1	12	22	0	10
5	7	0	10	8	9
6	7	10	12	7	16
7	7	10	12	6	11
6	8	8	14	0	16
1	2	0	12	0	12
2	2	5	9	12	17
4	5	9	10	0	17
5	16	6	12	5	18
3	6	9	16	8	11
5	6	8	11	5	5
0	6	0	7	18	23
0	1	5	12	0	11
3	5	7	13	0	12
14	20	5	7	10	16
8	10	6	11	5	17
10	12	5	11	8	18

60-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
12	15	5	11	3	7
0	7	10	17	1	11
5	5	0	15	1	1
8	10	0	22	13	16
4	4	7	8	10	17
14	20	11	11	7	12
0	2	7	12	7	7
9	13	6	13	4	7
0	3	10	12	0	8
8	8	11	12	6	11
4	6	5	9	8	11
6	7	7	15	0	14
6	11	7	8	5	22
2	2	7	22	8	10
6	6	11	11	0	8
5	6	8	10	10	16
0	5	5	15	10	12
3	3	5	8	6	10
5	7	6	13	10	12
8	11	0	8	11	15
7	11	5	15	8	14
10	10	7	7		
0	1	15	17		
2	2	10	12		
0	3				
5	6				
6	7				
10	11				
6	13				
13	18				
5	7				
7	7				
9	12				
3	5				
5	7				
0	5				
7	7				
6	6				
9	10				
0	0				
12	16				
7	10				
8	8				
0	1				
4	5				
15	17				
4	7				
5	5				
6	6				

Field Data for 0.5H:1V Slopes

60-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
11	14	5	9	7	17
10	15	7	9	5	8
3	10	6	12	7	10
4	10	0	21	10	18
9	22	0	12	12	20
4	8	12	17	0	18
2	9	10	17	10	20
10	10	0	8	5	12
10	12	11	16	10	13
2	8	8	12	10	28
2	4	10	13	7	7
8	15	0	12	12	23
10	10	0	8	4	4
4	8	5	10	12	17
11	13	11	14	0	10
15	17	10	14	12	28
14	18	13	23	7	14
3	13	0	12	8	13
3	8	4	10	5	17
6	6	4	7	13	23
13	18	0	4	10	21
12	12	8	15	5	8
14	14	12	17	11	11
9	9	6	16	7	13
5	5	8	14	10	17
0	7	7	16	10	12
8	12	11	13	10	10
8	13	15	37	9	12
14	16	12	12	12	35
8	8	12	21	7	10
8	13	0	11	10	20
8	13	6	10	0	6
5	6	6	10	6	10
9	11	7	17	6	15
7	8	11	14	5	13
6	19	5	12	7	11
7	13	6	17	8	8
15	15	7	13	7	12
4	8	5	7	8	8
16	22	8	19	5	12
11	13	6	12	7	14
9	13	6	16	6	10
11	23	4	8	7	11
5	22	8	16	0	23
2	6	8	26	12	17
3	4	8	16	0	12
12	17	12	25	0	33
8	8	11	11	0	13
0	16	7	13	7	10
11	15	6	8	15	32
0	13	9	16	7	24

60-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	15	12	19	7	26
6	8	7	7	11	27
3	6	7	13	7	16
3	5	7	12	7	16
0	1	6	13	10	10
11	12	8	27	10	22
0	8	12	18	10	10
0	18	0	26	8	8
0	13	4	10	7	16
0	10	8	30	8	8
0	17	13	19	8	17
3	8	8	22	5	20
0	10	8	14	9	11
3	16	6	12	8	17
11	16	0	5	0	7
12	12	0	8	8	10
8	12	10	17	10	21
6	9	13	20	6	6
3	3	9	12	5	7
2	3	0	23	0	8
0	4	5	12	12	24
10	10	10	24	10	16
5	5			6	11
6	18				
10	12				
0	15				
10	10				
10	16				
12	12				
7	15				
9	13				
0	17				
0	7				
12	12				
3	10				
8	15				
5	8				
5	6				
8	12				
4	6				
5	5				
9	16				
7	10				
8	11				
0	13				
9	10				
0	7				
5	5				
0	9				

Field Data for 0.5H:1V Slopes

60-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
9	11	3	42	9	26
7	7	9	30	0	21
3	14	6	16	8	27
12	27	9	30	7	32
10	22	2	34	6	46
9	16	14	39	0	16
5	8	8	12	7	7
5	8	2	50	0	38
2	12	10	25	12	15
11	15	7	23	7	25
10	30	15	22	0	50
13	32	10	24	5	26
5	10	14	52	5	26
12	15	12	30	0	32
4	16	16	31	7	12
16	41	6	31	4	15
8	15	6	14	6	21
8	15	7	35	10	16
11	15	7	7	7	43
7	27	6	17	11	39
17	23	5	15	12	30
12	22	10	14	8	31
5	10	14	34	8	28
10	15	9	31	4	37
12	22	15	30	7	23
10	14	9	28	15	26
10	40	7	37	15	32
6	28	3	23	0	52
5	18	7	31	4	10
0	11	5	14	9	23
9	21	10	14	10	22
3	5	10	26	3	45
5	15	4	19	0	16
5	15	8	20	3	25
4	10	7	7	10	21
8	38	3	16	8	22
5	17	14	34	22	32
5	6	0	29	5	32
6	11	10	17	4	15
7	38	5	15	8	54
9	15	2	10	0	10
5	7	5	26	0	8
8	15	3	5	10	16
5	10	4	25	12	34
4	10	5	25	5	34
11	15	9	26	0	5
7	22	10	16	10	42
5	9	11	42	7	27
0	25	7	28	0	32
4	21	8	10	17	43
7	21	11	23	0	56

60-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
12	16	11	34	15	60
9	20	7	24	0	23
4	7	7	48	2	7
7	15	11	24	0	74
10	20	5	37	10	30
5	9	12	28	11	37
6	13	10	32	0	34
1	5	6	14	0	29
11	11	9	18	0	40
2	11	9	29	2	27
6	12	16	39	2	50
10	25	11	14	3	27
11	18	10	19	4	9
5	5	6	17	3	59
9	24	13	26	9	23
7	12	4	4	0	53
2	17	15	30	6	66
5	9	9	57	2	25
8	21	3	41	8	65
2	16	7	26	5	28
9	16	5	21	4	26
10	47	3	20	7	19
4	16	10	55	0	15
6	7	8	35	9	69
10	16				
8	21				
8	11				
16	37				
4	10				
15	23				
5	24				
6	14				
10	30				
6	7				
7	15				
11	20				
7	24				
7	10				
8	47				
3	40				
8	15				
0	10				
9	24				
7	23				
15	31				
0	16				
4	16				
6	20				
7	13				

Field Data for 0.5H:1V Slopes

80-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
6	7	7	7	2	16
6	6	7	11	2	19
16	16	13	13	12	12
4	6	6	12	13	13
15	21	11	20	5	11
7	8	4	4	11	11
0	28	6	22	7	7
12	13	13	13	6	6
11	11	5	17	9	9
0	7	18	24	2	22
4	4	10	10	18	18
3	4	13	13	15	15
6	9	5	9	16	16
5	11	5	7	9	10
5	6	5	10	5	6
3	10	13	13	5	10
6	6	13	13	5	8
1	2	0	20	12	26
9	10	6	8	10	10
7	7	5	15	11	17
9	9	7	16	20	24
11	18	5	6	19	27
15	15	4	13	14	20
3	3	6	7	4	9
9	13	6	9	8	8
14	17	3	12	10	16
18	21	4	20	2	29
7	7	2	4	3	14
0	6	1	3	0	36
1	7	3	20	14	16
3	3	21	22	14	14
0	16	3	5	10	18
5	5	4	4	5	15
3	6	6	6	5	8
3	4	10	13	8	8
6	8	5	18	10	10
5	7	9	17	9	12
4	15	0	16	6	18
0	6	19	19	7	22
4	4	8	8	10	12
13	13	4	6	10	15
13	13	3	3	9	14
12	13	0	0	2	16
9	14	7	7	1	3
11	11	10	15	15	22
2	4	11	17	10	11
4	5	7	9	10	20
3	5	10	16	3	27
3	3	8	10	7	7
0	8	9	14	15	25
12	15	7	16	11	11

80-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
3	3	3	4	3	22
3	3	4	10	13	17
3	6	0	6	9	17
11	14	13	13	13	13
6	6	3	7	5	5
6	6	0	12	3	11
14	14	15	27	10	16
13	13	17	17	9	17
13	13	2	3	13	17
7	7	11	16	3	16
5	10	5	6	0	23
3	4	1	9	2	18
3	5	3	5	0	6
5	5	11	16	6	6
9	9	14	23	10	15
11	11	0	4	14	14
13	13	11	12	3	13
5	14	20	23	0	15
3	5	10	10	4	4
7	7	4	4	7	7
3	3	11	11	5	11
3	5			3	13
3	3			9	13
3	5			18	18
3	5				
11	11				
5	7				
1	3				
3	4				
5	8				
4	5				
11	11				
5	6				
4	5				
0	16				
10	14				
4	7				
2	3				
0	14				
3	3				
11	11				
10	14				
15	15				
3	5				
3	9				
4	10				
3	5				
4	4				

Field Data for 0.5H:1V Slopes

80-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
4	11	15	30	17	23
5	5	10	15	0	2
4	4	9	20	7	9
5	10	13	13	11	29
7	7	8	10	7	7
0	5	10	17	11	12
0	30	10	23	0	34
2	4	3	8	11	13
14	24	9	9	10	21
0	18	5	7	20	27
8	11	0	14	6	8
3	3	4	23	14	18
0	18	10	15	11	20
0	2	13	17	3	5
3	3	16	20	13	14
0	10	7	7	9	9
0	26	9	9	8	8
2	3	0	30	9	13
13	17	8	19	5	8
10	27	12	16	7	7
7	7	0	16	7	17
0	14	0	19	10	13
4	4	0	15	6	11
4	4	0	0	9	14
3	3	12	25	7	7
7	7	2	2	15	27
5	9	3	3	2	11
7	8	0	0	0	8
8	13	2	23	4	6
10	18	2	5	11	27
3	3	14	17	9	21
6	6	9	12	10	13
4	6	17	22	0	50
4	4	0	25	10	19
4	9	0	32	4	10
11	13	9	11	8	30
6	6	8	8	8	15
5	5	7	10	0	10
9	11	8	8	10	10
0	17	9	9	5	8
0	13	0	19	10	19
4	4	4	10	11	16
6	8	9	9	5	10
0	3	6	12	7	7
8	8	8	11	10	13
10	14	7	9	5	5
6	13	10	17	0	28
0	12	8	8	12	12
12	13	6	9	11	26
8	8	4	8	8	14
2	9	7	11	5	8

80-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
15	15	6	12	4	10
9	12	12	18	12	12
11	12	14	17	11	19
10	10	8	8	7	10
1	16	0	16	4	12
9	10	6	7	15	15
5	12	5	5	7	7
3	6	15	20	5	6
7	11	0	24	8	9
0	11	0	13	0	29
8	8	2	12	5	24
15	18	3	6	5	10
2	2	0	14	7	17
0	19	18	21	5	10
1	1	6	10	5	11
7	7	12	24	4	7
0	13	9	9	21	21
5	5	0	13	15	23
6	6	7	7	0	17
15	26	6	9	7	9
10	16	8	11	8	10
6	6	3	10	0	27
10	14	5	9	5	9
10	18	6	9	15	22
4	5				
3	3				
15	24				
0	13				
11	14				
2	16				
1	5				
8	10				
0	22				
5	7				
2	2				
11	11				
2	4				
14	18				
8	9				
13	16				
6	14				
8	12				
1	1				
4	6				
7	11				
2	7				
9	14				
7	7				
0	9				

Field Data for 0.5H:1V Slopes

80-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
11	17	0	30	11	19
10	14	0	14	12	17
2	2	12	12	8	20
1	1	20	52	5	14
3	18	10	32	10	18
1	14	10	15	0	43
0	11	5	20	10	33
13	13	14	22	13	17
9	16	11	24	18	28
9	17	14	15	4	12
8	16	5	14	10	21
5	19	0	5	0	6
3	3	4	4	0	21
4	11	0	28	8	10
15	19	3	13	11	58
9	12	8	14	4	14
0	11	0	2	4	4
0	37	5	15	5	10
3	6	0	16	5	39
3	6	0	39	6	11
3	18	3	20	18	43
2	8	5	10	5	14
3	4	6	13	10	17
11	14	3	12	11	11
8	9	0	10	7	23
4	17	5	13	3	4
14	16	4	9	6	21
9	9	9	34	10	20
15	17	15	35	8	14
6	7	2	10	8	9
10	12	0	5	7	8
5	8	7	29	8	8
11	16	5	32	0	28
4	7	10	24	14	19
4	18	4	13	12	21
9	32	8	14	15	17
5	10	0	9	8	8
9	9	4	8	12	12
7	8	9	31	3	55
9	28	20	36	18	38
10	18	4	10	7	22
14	26	5	5	18	41
0	16	10	16	4	4
3	5	5	11	5	23
5	7	8	16	12	17
10	11	3	6	6	22
5	9	10	30	5	18
0	21	10	20	7	10
1	1	7	7	5	9
2	13	3	7	0	60
5	15	10	12	7	22

80-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	9	8	23	15	17
2	12	10	45	8	20
3	11	5	5	3	3
5	30	10	10	5	28
17	36	10	41	7	21
3	8	0	15	10	12
12	12	15	27	5	25
0	6	3	3	0	30
0	5	3	26	7	16
10	13	3	7	3	14
3	12	16	43	5	23
14	19	14	14	4	20
12	18	8	8	9	27
6	8	10	14	7	13
16	22	10	16	14	27
5	8	4	9	15	32
3	13	18	30	5	15
2	3	9	9	3	32
0	11	0	18	10	38
4	16	0	19	15	24
0	4	11	11	5	13
11	15	6	22	7	35
13	25	3	16	10	15
5	7	10	21	13	48
17	26				
6	10				
9	17				
5	9				
1	10				
2	9				
6	9				
9	10				
4	4				
10	16				
5	6				
8	17				
10	11				
0	5				
0	13				
4	9				
16	36				
0	7				
10	19				
3	3				
0	8				
7	7				
14	14				
2	3				
9	12				

Field Data for 0.75H:1V Slopes

40-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	1	0	13	0	10
0	2	0	4	0	5
0	4	2	11	2	2
1	1	2	2	3	13
0	2	1	4	0	10
0	4	0	3	0	12
0	3	0	6	0	3
0	5	0	10	0	11
0	4	2	2	0	12
0	2	2	2	0	12
1	6	0	4	0	9
0	5	0	8	0	6
1	1	0	5	2	4
0	0	0	7	2	4
0	2	0	7	0	5
0	3	0	4	0	6
1	1	0	5	3	3
0	3	3	7	0	11
0	0	0	5	0	19
0	4	3	3	0	3
0	3	4	4	2	4
0	1	2	6	0	13
0	0	0	11	2	5
0	0	3	3	2	4
0	1	2	4	0	17
0	2	1	3	2	11
0	3	0	13	2	6
0	4	0	4	0	14
0	6	0	7	0	9
0	7	0	7	0	17
0	1	1	4	0	7
4	5	0	5	0	8
1	4	0	5	3	7
0	2	0	6	2	9
0	2	0	8	3	3
1	2	0	15	3	3
0	2	4	12	0	9
0	2	3	7	0	7
0	3	0	23	1	5
0	2	1	6	3	3
0	10	3	3	0	14
0	3	0	8	0	9
2	2	2	2	4	8
0	3	0	4	3	7
0	5	0	5	0	7
0	2	1	6	1	4
0	2	0	6	0	17
0	1	1	1	0	4
0	1	2	6	0	11
0	3	1	3	2	6
0	2	0	7	0	10

40-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	4	0	6	0	10
0	5	0	6	2	4
0	3	0	4	3	3
0	2	0	6	0	11
0	4	0	7	3	3
0	5	0	14	0	13
0	8	0	7	1	1
0	3	0	9	0	9
0	4	0	5	2	2
0	1	1	4	2	5
0	5	2	2	0	12
0	2	0	7	4	4
0	0	0	6	0	7
0	4	0	6	2	5
1	1	0	10	0	7
0	2	0	10	0	7
0	3	0	12	0	5
1	1	0	9	1	4
0	8	0	6	4	4
0	3	3	3	3	3
0	3	2	4	2	5
1	3	0	8	0	13
0	5	0	10	4	4
0	6	0	9	1	3
0	6				
0	4				
0	0				
0	2				
0	2				
0	2				
2	2				
0	2				
0	1				
0	2				
0	3				
0	5				
0	6				
3	5				
0	3				
1	1				
0	10				
0	11				
0	2				
0	3				
0	2				
0	3				
0	1				
0	3				
0	3				

Field Data for 0.75H:1V Slopes

40-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	2	2	8	3	16
0	4	0	19	0	10
3	4	0	3	0	5
2	3	1	6	0	12
0	4	0	7	0	18
3	16	1	4	2	4
0	3	0	9	0	6
0	3	0	4	0	7
0	2	0	4	4	4
0	5	0	10	0	13
0	3	0	10	0	8
0	2	0	7	0	6
0	6	0	13	0	8
0	9	0	18	0	16
1	3	0	8	4	4
0	6	0	14	0	16
0	3	0	7	0	5
0	4	1	3	0	5
0	4	0	4	1	11
0	3	0	3	3	7
3	5	0	4	0	11
0	9	0	5	0	9
2	7	0	15	0	5
0	7	0	8	0	5
0	3	0	12	0	16
0	6	0	18	0	5
0	4	0	14	0	8
0	2	0	10	3	17
0	5	0	9	4	4
0	3	0	4	0	5
0	9	0	6	0	10
0	3	3	3	0	5
0	2	0	4	0	12
0	3	0	14	1	4
0	6	0	13	0	14
0	3	1	11	0	5
2	3	0	6	1	5
2	3	0	7	1	5
1	1	0	0	1	5
0	5	1	6	0	17
0	5	0	5	0	6
0	5	0	6	3	3
0	3	3	3	0	13
0	5	3	10	0	12
0	3	0	16	0	17
0	6	0	12	0	10
0	3	0	9	0	9
0	9	3	5	7	7
0	5	0	7	0	7
0	3	0	11	0	6
0	3	0	3	0	7

40-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	2	3	5	4	12
2	3	0	7	0	10
0	3	0	7	0	15
0	9	0	12	0	18
3	3	3	13	2	5
0	1	3	7	0	12
0	6	3	13	0	9
3	5	1	3	3	3
2	6	3	5	4	4
2	3	0	10	4	10
1	4	0	18	5	5
0	6	1	10	0	14
0	4	0	9	3	5
0	5	2	4	0	10
0	10	0	6	4	16
0	3	0	7	0	7
2	2	0	10	0	15
0	3	1	4	0	7
1	1	0	5	0	7
0	3	2	6	0	5
0	8	0	5	0	7
0	3	0	6	4	4
0	5	0	20	0	10
0	2	4	8	0	8
1	1				
3	3				
0	3				
0	7				
0	2				
0	2				
3	3				
0	3				
0	5				
3	3				
0	3				
0	3				
0	7				
0	4				
0	3				
0	7				
0	4				
0	3				
0	3				
0	2				
0	1				
0	5				
0	6				
0	10				
0	6				

Field Data for 0.75H:1V Slopes

40-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
3	17	3	13	3	42
3	9	5	25	3	24
0	10	1	6	5	22
0	4	2	17	0	38
0	7	6	18	0	5
0	6	3	8	0	14
3	22	2	13	0	16
3	12	4	15	5	25
0	5	4	18	0	22
0	15	4	35	0	5
3	16	2	18	0	29
0	11	0	7	0	45
0	13	3	17	3	13
3	17	3	6	2	13
0	4	0	40	5	22
0	14	0	21	3	20
3	8	4	15	0	11
2	10	4	21	4	43
0	16	0	4	3	27
0	13	3	7	3	28
2	6	0	38	3	32
2	7	0	38	3	20
3	14	2	23	5	19
3	14	4	22	4	15
4	20	0	28	0	30
0	17	0	27	2	12
3	16	0	1	5	33
2	6	0	21	2	19
3	14	0	30	3	30
0	3	0	15	3	25
2	14	0	5	3	22
0	6	4	19	2	25
0	13	0	40	3	33
6	17	3	23	0	25
0	14	0	23	0	12
0	7	0	22	0	23
2	6	0	48	2	28
0	14	0	27	0	17
3	13	0	22	4	24
5	14	0	17	3	28
5	22	0	21	0	12
0	7	5	14	3	25
0	10	0	20	4	19
0	10	0	7	5	28
0	20	0	37	0	26
0	13	0	27	0	13
0	6	0	25	2	30
2	16	0	23	0	22
3	16	4	23	0	27
0	8	0	15	0	29
3	15	0	5	3	18

40-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
1	10	0	36	3	9
0	16	0	23	5	32
3	13	0	27	3	11
2	16	0	6	3	18
2	18	0	20	4	10
5	26	1	34	3	19
3	13	1	3	2	12
0	5	0	34	3	10
5	18	0	19	3	5
3	24	0	7	0	21
4	20	0	11	2	32
4	4	5	22	3	13
0	12	2	8	0	26
0	8	2	12	0	10
0	15	0	7	5	8
0	17	0	17	1	7
4	15	0	7	3	9
0	8	0	12	0	20
0	5	0	17	0	27
4	15	6	12	5	45
3	13	0	6	0	5
0	10	0	12	4	33
4	12	0	26		
0	15	2	10		
3	7	0	10		
0	15				
5	15				
0	4				
3	10				
4	7				
0	20				
0	6				
0	7				
3	8				
0	10				
3	13				
3	8				
2	12				
3	17				
0	10				
4	20				
3	6				
2	8				
3	23				
4	7				
5	30				
2	15				
2	27				
2	16				

Field Data for 0.75H:1V Slopes

60-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
9	10	0	29	12	33
7	13	10	17	6	10
7	9	0	21	0	21
6	7	0	12	6	14
6	10	0	11	0	15
8	8	5	8	0	15
7	10	0	16	0	19
7	7	5	6	0	18
9	15	0	17	0	17
0	10	0	11	0	24
0	12	2	10	3	17
0	18	0	12	5	12
0	7	5	7	0	24
6	7	6	18	0	12
11	13	0	17	4	7
10	16	10	11	8	24
6	13	0	13	0	10
0	8	0	22	5	15
7	7	0	12	5	20
0	8	5	8	0	10
8	16	0	16	0	27
11	12	5	9	0	24
3	12	0	12	0	21
0	19	0	12	0	22
6	11	0	11	2	17
0	6	3	12	5	8
4	5	5	13	0	35
5	7	0	15	0	31
4	12	4	9	8	20
0	12	0	17	0	27
7	11	0	14	5	7
4	4	8	10	0	20
1	6	0	19	0	7
7	7	0	5	4	12
6	8	5	11	0	17
7	12	0	12	0	43
9	11	7	12	5	8
0	7	7	12	5	16
5	12	7	8	0	15
0	26	5	7	0	32
7	11	10	17	0	20
0	9	5	13	6	19
15	15	5	15	9	11
6	11	7	13	5	16
7	9	5	7	0	14
7	14	5	10	0	30
0	8	0	33	0	29
6	17	12	14	5	26
5	9	10	18	0	20
0	7	4	19	5	5
3	3	5	10	0	16

60-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	6	4	16	0	26
0	4	9	12	0	15
0	9	7	25	0	25
0	8	0	15	0	15
4	7	0	11	8	14
5	7	0	17	4	16
3	4	0	24	0	13
10	12	0	28	0	15
0	13	0	12	8	12
0	6	0	27	0	25
8	11	0	20	0	20
6	10	10	18	0	20
5	5	15	16	0	20
6	18	7	11	0	10
0	7	0	15	0	17
6	6	0	12	0	16
3	5	4	29	5	12
8	9	11	13	0	20
0	10	4	20	0	7
0	7	0	21	5	14
0	18	0	22	5	10
7	10	4	15	0	15
0	2	5	13	0	20
3	7			0	15
8	8				
0	8				
0	5				
0	5				
0	8				
2	3				
5	6				
0	7				
0	13				
7	8				
0	9				
5	7				
3	4				
7	11				
0	1				
0	1				
0	8				
6	6				
1	2				
0	1				
0	6				
5	5				
2	2				
0	1				
7	10				

Field Data for 0.75H:1V Slopes

60-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
7	12	5	12	0	24
0	9	0	12	11	16
0	25	5	25	6	13
0	12	0	8	0	15
0	18	6	11	0	15
13	18	0	25	0	24
0	27	0	20	0	10
5	15	1	2	7	21
2	5	5	25	0	27
5	13	0	13	0	22
1	13	5	29	6	30
7	16	6	6	7	22
6	15	0	12	0	13
0	14	0	25	0	11
0	13	4	20	0	16
12	29	0	34	0	56
5	15	0	17	6	25
0	16	0	15	5	34
6	11	0	10	7	13
0	7	5	17	4	9
12	12	0	13	9	22
7	13	0	12	0	19
8	12	0	15	0	26
2	2	5	17	0	18
9	15	5	15	0	10
8	16	0	18	6	6
8	9	0	7	7	7
0	21	0	12	0	9
0	22	5	7	0	16
5	8	0	21	0	9
6	13	0	18	0	17
0	26	5	11	0	10
5	12	5	10	0	8
10	18	5	5	5	11
7	10	0	5	10	27
10	13	5	12	5	24
0	17	0	32	5	7
0	11	0	33	7	13
2	4	6	16	5	12
0	24	5	8	0	7
0	25	7	7	0	16
0	7	5	5	0	13
0	21	4	8	0	10
10	12	0	19	5	5
0	19	0	32	14	26
1	8	6	6	0	18
0	22	10	19	0	13
7	17	0	10	0	22
3	8	0	7	10	14
5	6	17	25	0	27
5	23	8	19	5	15

60-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	14	5	26	5	14
9	23	5	13	0	8
6	14	0	24	0	9
6	15	6	8	0	22
7	13	5	34	0	17
6	11	7	13	0	28
4	17	0	15	6	20
0	23	0	25	0	32
1	5	3	24	0	16
4	8	6	18	8	12
6	19	3	10	8	18
5	18	0	5	6	12
11	20	8	24	0	15
0	25	7	16	5	13
0	28	5	27	5	26
6	7	5	26	6	16
12	27	0	9	5	7
0	7	5	7	6	37
0	6	5	16	0	17
3	18	0	17	0	20
0	12	5	17	5	8
5	12	0	8	5	8
9	18	0	14		
0	27				
1	2				
0	11				
7	7				
0	7				
4	8				
0	18				
4	17				
8	18				
3	10				
6	9				
6	6				
0	16				
6	14				
9	23				
7	12				
0	5				
3	6				
0	28				
6	12				
7	17				
0	19				
0	21				
6	9				
5	17				
6	11				

Field Data for 0.75H:1V Slopes

60-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
4	25	7	57	0	47
6	15	2	18	0	52
2	4	10	32	7	15
4	19	2	33	3	31
10	20	3	12	5	33
7	30	0	48	0	37
6	21	6	37	0	20
3	28	4	15	0	36
0	1	4	52	5	23
6	23	11	44	0	26
7	27	3	15	0	15
5	8	5	41	4	41
5	10	6	18	9	46
4	20	1	17	0	36
8	28	0	26	0	28
0	36	3	18	0	16
8	10	6	37	0	48
6	14	11	43	0	46
6	21	5	42	0	51
1	14	6	14	2	70
8	23	7	43	0	32
9	12	5	73	8	33
4	7	1	46	0	56
0	16	5	42	0	15
16	42	6	40	0	30
3	15	4	44	5	26
4	6	10	33	0	27
0	7	5	25	0	46
0	10	0	21	0	28
7	24	0	10	0	22
4	13	7	40	8	61
1	22	2	28	0	37
4	16	5	55	1	17
0	16	5	25	1	20
2	26	9	15	0	52
3	33	1	25	0	62
8	13	4	47	1	16
1	11	3	10	0	32
6	27	8	15	0	36
9	17	7	28	0	15
0	16	5	49	8	16
0	1	4	21	0	54
10	16	4	16	0	37
1	1	4	41	0	23
3	10	6	28	0	25
4	12	5	46	2	25
3	12	2	16	0	15
11	30	3	21	0	52
0	8	6	27	0	40
6	13	2	26	0	49
7	11	7	65	8	31

60-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
2	22	5	42	16	29
7	16	2	30	6	23
8	14	2	55	7	15
7	12	2	12	4	7
5	22	4	15	12	14
7	23	3	50	1	5
6	9	7	56	13	50
1	5	7	25	8	21
4	24	7	22	8	17
4	11	5	31	14	42
6	9	7	47	11	45
7	7	5	48	14	35
4	15	1	29	4	13
21	59	0	53	15	19
4	7	3	40	9	27
14	43	3	19	2	64
7	27	3	16	5	17
2	4	4	38	3	5
6	15	2	12	11	39
4	25	10	54	4	31
9	22	7	31	11	34
5	17	5	48	17	46
2	13	4	40	11	46
5	14	6	22	14	23
6	29				
4	27				
5	25				
2	41				
9	12				
1	21				
2	53				
4	28				
3	48				
0	36				
6	20				
10	35				
4	27				
4	25				
11	20				
2	17				
9	25				
2	21				
3	19				
5	29				
4	12				
11	41				
1	41				
4	14				
0	12				

Field Data for 0.75H:1V Slopes

80-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	14	0	36	5	16
5	5	5	5	2	2
1	1	1	25	10	13
5	7	5	35	10	30
7	13	2	17	3	12
0	5	6	6	4	8
0	9	5	37	5	20
0	7	4	16	3	34
0	3	3	11	6	6
0	14	5	32	5	36
4	5	2	9	4	42
0	3	4	18	3	3
0	11	3	8	5	39
2	11	4	18	4	45
0	6	4	4	4	4
6	6	2	22	2	12
4	4	3	17	14	18
2	30	3	5	8	8
1	3	3	16	3	23
0	17	5	14	4	36
0	4	4	19	5	8
2	8	6	15	5	5
5	20	4	12	5	28
13	13	6	18	2	23
3	6	3	18	5	14
0	26	3	22	15	23
3	22	1	18	2	3
4	5	2	11	2	4
4	4	0	24	4	5
3	11	4	9	2	18
4	10	2	3	6	14
0	3	3	17	2	4
1	4	4	16	2	6
0	9	1	13	4	25
0	8	2	11	4	16
6	14	5	20	3	20
4	4	7	21	2	35
0	13	6	22	8	18
3	3	4	18	1	19
1	7	7	12	7	10
1	3	2	10	2	19
2	6	3	16	5	10
7	13	3	24	3	18
1	5	5	9	5	5
5	5	5	34	3	3
11	13	6	16	5	24
5	11	0	23	4	15
2	6	5	5	0	15
0	16	13	17	6	21
0	13	4	12	7	7
0	10	3	12	0	5

80-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
4	4	0	22	2	7
1	21	2	14	5	14
2	12	0	30	2	15
4	9	5	7	2	39
8	14	1	13	3	17
4	4	5	12	13	15
0	7	0	32	7	24
3	19	2	4	3	20
2	12	5	16	4	14
0	8	4	4	4	14
3	5	3	13	7	7
3	11	4	4	3	9
0	8	3	10	2	20
0	5	3	14	6	15
3	18	4	10	0	12
2	9	3	5	6	12
5	5	7	7	4	27
4	16	0	14	0	10
3	12	4	5	6	14
7	7	5	6	2	15
0	8	6	7	3	13
5	12	4	21	5	23
10	11	3	5	4	20
5	18	1	2	3	27
3	3				
6	6				
3	8				
0	2				
1	13				
4	8				
6	12				
8	8				
14	17				
4	9				
8	20				
4	4				
12	18				
0	19				
6	6				
5	16				
3	5				
0	17				
4	16				
0	8				
5	5				
7	7				
4	10				
3	14				
7	8				

Field Data for 0.75H:1V Slopes

80-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
2	32	0	4	5	20
4	12	11	14	5	23
3	17	0	38	2	29
9	10	4	11	0	42
2	7	2	22	3	8
3	11	6	8	5	11
4	13	0	15	0	13
5	17	3	3	0	7
3	11	0	24	3	22
3	10	0	7	1	39
5	16	0	14	3	9
2	10	5	13	5	10
4	9	5	42	3	11
1	5	0	33	0	12
1	7	0	8	3	49
5	10	4	12	0	36
1	10	6	18	0	21
9	26	1	26	4	11
2	11	0	4	0	12
2	5	2	3	0	11
3	15	0	4	6	20
5	27	0	14	0	3
7	9	10	23	0	37
1	6	0	9	0	6
7	10	0	37	4	8
4	9	0	12	3	17
2	4	7	62	5	17
9	22	3	5	0	38
4	13	0	49	0	17
4	8	0	15	5	9
4	8	9	14	6	23
3	9	5	13	3	16
4	20	0	5	0	25
6	12	6	11	5	33
0	11	5	17	0	26
0	12	5	24	0	16
0	17	2	2	5	20
0	5	8	8	0	36
0	2	0	7	3	19
0	22	0	60	3	25
3	3	5	29	10	22
5	19	0	24	0	14
7	29	0	28	0	23
2	12	3	9	8	16
3	17	2	2	0	21
1	3	3	22	0	19
0	7	0	10	0	22
3	9	0	39	0	37
10	19	0	23	2	14
0	4	0	10	0	15
3	7	5	9	2	22

80-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
1	1	0	14	3	43
4	5	3	18	0	22
8	8	2	14	0	17
2	4	0	9	0	27
7	13	6	26	0	27
2	9	0	30	0	30
0	7	0	18	0	21
0	11	2	12	2	12
2	13	4	10	5	7
4	15	1	1	7	10
3	18	10	13	0	51
0	24	0	29	0	28
0	10	2	15	0	23
5	5	0	9	3	44
3	10	0	18	0	24
0	0	0	11	5	17
0	17	2	6	4	4
0	31	3	7	0	24
2	4	0	4	4	4
0	3	6	17	2	17
12	16	5	8	0	32
0	5	0	16	0	23
5	23	3	13	0	20
4	13	4	4	10	14
0	21				
5	8				
0	7				
10	16				
3	14				
4	7				
0	6				
0	4				
3	27				
2	19				
0	15				
5	11				
2	24				
2	10				
5	15				
5	5				
4	6				
0	18				
0	6				
3	12				
3	6				
2	2				
3	10				
3	7				
0	13				

Field Data for 0.75H:1V Slopes

80-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
5	7	5	47	5	52
4	12	5	69	0	25
0	17	5	15	0	65
0	10	0	27	0	52
6	6	5	23	5	18
0	22	7	16	5	46
5	19	0	52	3	14
4	32	5	35	1	16
0	19	0	33	4	37
2	21	0	42	3	42
0	2	0	26	1	23
1	46	5	5	0	69
15	26	5	45	9	12
0	6	0	18	0	33
4	11	0	27	9	25
10	20	0	16	0	33
2	10	0	40	0	19
6	7	10	44	2	8
11	25	5	19	1	26
6	8	0	60	1	2
0	7	0	38	5	21
0	24	0	39	0	26
4	9	4	35	5	22
1	1	6	35	11	52
0	4	12	36	0	63
0	14	0	23	0	27
0	30	5	6	0	24
0	8	10	28	10	37
4	13	5	18	9	28
5	38	0	0	0	18
0	3	4	46	5	38
0	15	0	36	9	15
0	4	0	62	0	58
0	48	5	27	9	29
0	19	4	30	0	21
0	26	3	22	0	52
15	30	3	14	4	29
0	14	4	30	0	37
0	26	0	48	0	45
0	13	8	29	0	37
0	1	0	19	5	9
5	18	3	24	0	15
0	3	0	45	0	14
9	27	0	60	4	8
0	14	4	15	0	30
3	16	4	6	2	16
0	3	6	15	3	10
0	6	0	32	0	65
0	17	0	20	13	34
3	16	5	23	5	28
0	20	3	22	5	26

80-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	8	0	14	3	23
15	19	0	19	4	28
0	23	0	4	0	39
0	3	0	57	2	27
0	2	0	12	5	37
0	17	0	11	5	68
4	11	5	20	0	4
0	23	5	32	0	33
0	7	0	10	0	11
3	6	0	10	2	20
3	4	5	31	0	17
0	17	10	10	0	13
4	7	5	23	0	2
0	6	5	10	0	68
3	11	5	20	0	6
3	17	10	28	0	55
2	20	3	19	0	61
3	13	4	10	3	3
0	27	5	15	6	59
3	3	0	45	4	38
0	9	10	24	3	75
5	24	3	27	6	65
0	8	10	22	4	13
5	29	6	42	3	34
0	2				
0	42				
0	11				
4	22				
1	1				
1	1				
4	4				
1	8				
6	34				
4	23				
0	19				
0	36				
3	24				
0	13				
3	45				
7	30				
0	33				
0	18				
0	26				
0	13				
0	4				
0	12				
15	19				
9	58				
5	26				

Field Data for 1H:1V Slopes

40-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	3	0	12	0	13
0	4	0	10	0	11
0	7	0	13	0	16
0	6	0	7	0	8
0	5	0	15	0	12
0	6	0	8	0	9
0	5	0	5	0	3
0	0	0	3	0	15
0	8	0	7	0	13
0	4	0	8	0	11
0	3	0	7	0	9
0	10	0	4	0	5
0	5	0	5	0	6
0	8	0	9	0	8
0	10	0	7	2	10
0	6	0	16	0	5
0	7	0	21	0	10
0	8	0	14	0	12
0	5	0	8	0	13
0	8	0	13	0	6
0	6	0	10	0	11
0	7	0	11	0	7
0	8	0	11	0	6
0	5	0	17	0	8
0	6	0	15	0	8
0	3	0	7	0	7
0	3	0	13	0	5
0	5	0	6	0	11
0	7	0	10	0	4
3	2	0	12	0	8
0	3	0	16	0	10
0	3	0	10	0	12
0	6	0	0	0	3
0	5	0	17	0	11
0	3	0	8	0	9
0	7	0	15	0	9
0	4	0	7	0	16
3	4	0	8	0	15
0	5	0	9	0	12
0	3	0	7	0	9
0	7	0	5	0	8
0	6	0	11	0	12
0	3	0	8	0	5
0	1	0	12	0	8
0	4	0	13	0	9
0	1	0	12	0	23
0	0	0	9	0	7
0	0	0	11	0	10
0	5	0	4	0	11
0	4	0	8	0	3
0	1	0	8	0	12

40-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	4	0	7	0	6
0	2	0	6	0	13
0	4	0	8	0	10
0	0	0	7	0	8
0	5	0	11	0	15
0	3	0	7	0	10
0	3	0	8	0	9
0	1	0	7	0	8
0	2	0	10	0	10
0	2	0	6	0	9
0	0	0	14	0	8
0	4	0	12	0	5
0	2	0	3	0	8
0	1	0	7	0	13
0	2	0	9	0	10
0	6	0	8	0	5
0	5	0	11	0	13
0	8	0	9	0	12
0	3	0	13	0	11
0	6	0	7	0	0
0	3	0	9	0	5
0	2	0	12	0	7
0	4	0	7	0	11
0	3	0	5	0	15
0	1			0	10
0	5			0	4
0	1			0	9
0	5			0	8
0	3			0	14
0	4			0	7
0	3			0	14
0	5				
0	2				
0	9				
0	4				
0	3				
0	4				
0	3				
0	4				
0	0				
0	3				
0	4				
0	3				
0	5				
0	2				
0	3				
0	4				
0	3				
0	5				

Field Data for 1H:1V Slopes

40-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	10	0	26	0	25
0	14	0	13	0	38
0	4	0	32	0	12
0	8	0	22	0	19
0	13	0	27	0	9
0	18	0	18	0	8
0	19	0	6	0	6
0	17	0	19	0	30
0	14	0	20	0	18
0	13	0	24	0	16
0	12	0	17	0	22
0	14	0	12	0	21
0	9	0	13	0	23
0	3	0	9	0	14
0	5	0	23	0	19
0	24	0	14	0	8
0	11	0	19	0	18
0	13	0	17	0	16
0	12	0	11	0	14
0	13	2	16	0	10
0	23	0	23	0	11
0	5	0	3	0	16
0	11	0	22	0	22
0	12	0	19	0	9
0	13	0	9	0	8
0	13	0	16	0	29
0	14	0	22	0	24
0	7	0	15	0	18
0	27	0	17	0	11
0	15	0	11	0	16
0	14	0	14	0	19
0	13	0	7	0	13
0	14	0	12	0	18
0	16	0	5	0	16
0	16	0	7	0	22
0	5	0	13	0	23
0	13	0	20	0	13
0	4	0	29	0	16
0	6	0	15	0	24
0	5	0	15	0	18
0	5	0	7	0	7
0	7	0	12	0	33
0	5	0	23	0	14
0	8	0	15	0	14
0	11	0	18	0	15
0	19	0	12	0	10
0	16	0	8	0	12
0	9	0	16	0	16
0	10	0	10	0	13
0	10	0	14	0	14

40-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	9	0	14	0	17
0	11	0	16	0	9
0	16	0	13	0	8
0	8	0	18	0	10
0	12	0	8	0	24
0	13	0	17	0	32
0	16	0	9	0	30
0	11	0	21	0	37
0	12	0	17	0	29
0	4	0	22	0	24
0	15	0	11	0	12
0	13	0	14	0	25
0	12	0	7	0	10
0	8	0	17	0	15
0	6	0	14	0	19
0	17	0	16	0	10
0	8	0	18	0	18
0	6	0	15	0	9
0	5	0	4	0	11
0	10	0	16	0	14
0	4	0	17	0	14
0	12	0	15	0	16
0	10	0	6	0	15
0	12	0	11	0	12
0	11	0	10	0	13
0	4				
0	3				
0	7				
0	10				
0	8				
0	14				
0	3				
0	7				
0	8				
0	11				
0	5				
0	7				
0	4				
0	3				
0	4				
0	6				
0	12				
0	14				
0	11				
0	15				
0	8				
0	3				
0	11				
0	7				
0	14				

Field Data for 1H:1V Slopes

40-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	27	0	56	0	70
0	33	0	61	0	52
0	16	0	52	0	35
0	16	0	43	0	60
0	33	0	42	0	45
0	20	0	58	0	34
0	5	0	26	0	38
0	23	0	18	0	24
0	33	0	54	0	13
0	3	0	32	0	15
0	29	0	34	0	27
0	22	0	60	0	40
0	8	0	53	0	19
0	33	0	16	0	51
0	38	0	35	0	22
0	26	0	20	0	18
0	38	0	39	0	3
0	22	0	44	0	3
0	48	0	33	0	32
0	27	2	35	0	22
0	24	0	45	0	40
0	20	0	24	0	44
0	26	0	21	0	22
0	44	0	27	0	28
0	19	0	22	0	8
0	13	0	20	0	20
0	2	0	42	0	27
0	7	0	23	0	9
0	10	0	45	0	17
0	23	0	25	0	52
0	32	0	31	0	18
0	24	0	50	0	17
0	7	0	26	0	32
0	12	0	11	0	14
0	29	0	12	0	28
0	13	0	17	0	29
0	9	0	37	0	19
0	30	0	19	0	25
0	17	0	33	0	23
0	16	0	42	0	0
0	38	0	43	0	60
0	8	0	51	0	23
0	31	0	37	0	30
0	23	0	48	0	35
0	24	0	20	0	37
0	41	0	23	0	30
0	29	0	23	0	18
0	34	0	11	0	30
0	11	0	13	0	20
0	21	0	29	0	58
0	18	0	25	0	34

40-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	50	0	46	0	51
0	22	0	30	0	36
0	21	0	17	0	32
0	15	0	38	0	29
0	25	0	16	0	22
0	6	0	32	0	15
0	13	0	37	0	36
0	21	0	20	0	22
0	33	0	33	0	38
0	23	0	29	0	23
0	29	0	36	0	20
0	24	0	21	0	29
0	23	0	19	0	14
0	22	0	33	0	21
0	26	0	35	0	22
0	25	0	27	0	44
0	14	0	38	0	18
0	39	0	33	0	28
0	23	0	12	0	32
0	5	0	24	0	30
0	20	0	8	0	28
0	28	0	31	0	27
0	19	0	12	0	33
0	27	0	44	0	18
0	19				
0	26				
0	5				
0	18				
0	13				
0	23				
0	25				
0	18				
0	24				
0	30				
0	24				
0	19				
0	8				
0	17				
0	16				
0	26				
0	8				
0	12				
0	36				
0	24				
0	12				
0	27				
0	16				
0	18				
0	24				

Field Data for 1H:1V Slopes

60-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	5	0	10	0	10
0	6	0	9	0	5
0	8	3	3	0	15
0	4	0	25	0	14
0	6	0	14	0	22
4	4	0	13	0	13
1	4	0	11	0	14
0	5	2	4	0	9
0	7	0	16	0	5
3	4	0	11	0	10
0	11	0	5	0	3
0	9	0	6	0	4
0	7	0	8	0	15
0	2	0	9	0	14
0	10	0	15	0	13
0	4	0	10	0	14
0	7	0	22	0	4
0	3	0	17	0	15
3	5	0	11	0	14
0	3	0	12	0	8
1	3	3	5	4	9
2	4	0	7	0	13
0	5	0	14	4	9
0	1	0	13	3	10
0	5	0	12	2	10
0	7	0	15	0	11
0	6	0	14	1	13
0	5	0	14	0	17
0	5	4	4	0	14
0	8	0	12	0	10
0	2	0	8	2	6
0	8	0	12	0	21
0	1	0	18	0	11
0	4	0	11	0	7
0	6	0	16	0	20
0	11	0	24	0	13
0	8	0	14	0	28
0	2	0	17	0	14
0	6	0	29	0	8
0	6	0	10	0	12
1	2	0	11	0	9
0	3	0	6	0	25
2	4	0	16	0	13
1	7	0	21	0	8
3	5	0	12	0	7
2	4	0	13	0	8
1	8	0	11	5	5
1	10	0	4	0	16
0	8	0	10	4	4
4	4	0	8	0	13
0	7	0	1	0	11

60-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	7	0	7	2	5
0	6	0	22	0	14
0	5	0	13	0	16
2	3	0	15	0	31
0	7	0	19	0	14
0	5	0	13	0	14
1	6	0	13	0	17
0	3	0	5	0	15
2	4	0	11	0	12
1	3	0	29	0	22
1	5	0	15	0	15
0	5	0	14	0	14
0	3	0	10	0	19
0	2	0	15	0	17
0	0	5	10	0	16
0	4	0	8	0	18
0	9	0	13	0	14
0	3	0	12	0	13
0	7	0	10	0	10
0	8	0	24	0	14
0	4	0	31	0	16
0	6	0	23	0	11
0	7	4	4	0	14
0	6	0	9	0	17
0	8	0	20		
1	5				
0	4				
0	7				
0	5				
0	4				
0	6				
0	8				
0	9				
0	6				
0	9				
0	4				
0	7				
0	9				
0	7				
0	16				
0	4				
0	3				
0	5				
0	6				
4	4				
0	11				
0	7				
0	7				
0	6				

Field Data for 1H:1V Slopes

60-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	27	4	11	4	16
0	11	5	12	3	22
0	19	0	12	3	8
0	9	0	9	7	13
3	3	0	12	5	5
3	5	3	9	5	16
0	9	0	8	3	15
0	6	7	16	0	17
2	3	0	3	1	22
0	18	0	24	3	11
0	7	0	27	0	11
0	15	0	21	0	15
3	3	0	16	4	8
0	6	0	14	2	3
0	9	0	14	3	12
9	11	0	10	1	23
4	8	0	22	4	4
4	7	4	6	0	18
3	5	4	23	2	4
0	8	2	11	4	7
0	7	4	28	0	19
5	5	5	17	0	21
5	8	0	16	0	35
0	11	0	19	4	13
3	4	0	17	3	10
3	11	0	22	0	12
4	6	0	17	0	21
3	5	0	16	5	13
4	11	3	19	0	12
4	10	4	13	2	15
0	9	3	17	3	18
2	3	0	24	5	9
4	6	0	27	0	9
0	11	0	40	0	17
3	7	5	22	3	14
4	7	0	21	5	9
2	9	0	9	8	8
3	6	0	8	4	11
0	10	0	29	5	12
4	12	0	21	0	6
0	8	0	17	0	9
0	5	0	20	0	18
7	16	5	10	6	6
0	10	5	12	0	14
1	8	0	22	0	19
4	6	0	11	0	16
0	10	0	15	0	5
0	12	0	14	0	12
0	7	0	17	4	4
4	9	0	7	0	8
0	15	4	9	2	22

60-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	18	3	12	0	6
3	5	0	31	0	14
3	4	0	12	0	20
0	13	0	38	0	17
0	11	5	9	0	12
0	15	0	17	0	11
0	11	3	11	0	22
10	14	4	16	4	6
4	9	0	24	0	15
8	8	0	14	4	4
0	24	1	13	0	22
0	5	0	14	7	12
0	11	0	15	0	13
0	17	0	15	3	11
0	5	2	19	0	25
0	1	0	17	4	11
0	11	5	14	3	20
0	8	0	13	3	24
0	15	0	17	0	16
5	7	0	18	0	21
0	6	0	13	5	13
4	12	4	8	0	7
0	13	5	10	0	9
0	14	0	24	0	37
0	13				
4	10				
0	13				
0	12				
0	5				
0	11				
0	13				
0	12				
7	10				
4	5				
5	5				
0	8				
4	12				
0	9				
0	10				
0	8				
0	7				
0	13				
0	11				
0	9				
0	4				
0	23				
0	25				
0	13				
0	7				

Field Data for 1H:1V Slopes

60-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
1	24	3	38	0	68
3	15	4	37	0	40
0	14	1	35	4	34
0	4	0	55	0	23
9	30	0	14	0	19
0	19	0	32	4	20
0	41	0	31	6	41
4	14	0	30	7	19
0	12	0	37	0	17
0	23	0	40	0	40
0	24	0	12	0	23
3	14	0	33	0	37
0	45	3	33	3	13
0	45	0	52	0	36
0	21	0	36	0	22
0	15	0	12	0	35
0	15	0	25	0	16
3	5	0	13	0	46
1	2	5	17	0	24
5	8	0	27	5	15
4	28	0	24	0	24
0	22	3	17	0	25
0	9	0	43	0	19
3	18	0	31	0	13
0	14	0	28	4	13
6	20	4	36	4	14
0	21	2	37	0	27
0	14	0	53	0	24
2	3	9	19	0	15
1	15	0	32	5	20
0	3	0	24	0	39
0	40	0	29	5	9
3	28	0	18	0	17
0	20	0	17	4	70
0	28	4	26	5	57
1	1	0	33	0	18
1	25	5	11	0	31
3	14	0	11	3	22
0	19	7	47	3	24
4	12	0	56	4	17
0	14	3	33	3	35
4	17	0	33	5	25
10	34	0	60	0	16
0	21	4	37	0	50
3	3	0	44	5	21
9	32	0	41	4	36
3	5	0	32	7	23
7	16	5	27	5	42
0	8	3	20	8	12
1	22	0	44	0	33
3	17	0	26	0	33

60-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	4	0	53	0	14
0	13	5	11	0	42
0	9	4	23	0	58
0	35	4	38	0	33
0	14	0	70	0	29
0	13	0	41	0	22
4	30	2	32	8	13
0	20	0	40	4	20
0	21	0	48	3	8
1	16	0	33	4	46
0	54	0	42	8	23
0	8	0	11	0	23
4	22	0	26	0	18
3	26	0	24	3	15
4	22	0	18	4	41
0	32	0	19	4	65
0	18	0	14	1	58
1	7	0	25	3	47
6	16	0	18	5	18
4	13	3	23	0	26
3	22	0	26	11	60
0	7	0	28	9	25
2	12	5	25	0	36
12	17	0	34	4	53
5	8				
4	11				
0	28				
4	31				
3	6				
0	23				
1	22				
5	6				
4	10				
4	12				
0	13				
0	22				
4	10				
4	12				
1	17				
3	22				
3	25				
0	27				
3	18				
0	22				
3	5				
0	25				
0	19				
3	18				
5	19				

Field Data for 1H:1V Slopes

80-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	8	0	5	0	7
0	5	0	22	4	20
0	2	4	20	0	10
0	1	0	26	6	6
0	4	4	22	3	8
0	7	0	8	1	2
0	7	0	21	0	5
0	5	4	10	4	17
0	12	3	14	0	18
0	1	0	12	0	23
0	10	5	15	0	17
0	6	0	29	0	37
0	3	0	28	0	38
0	5	3	10	0	14
5	13	4	8	0	13
0	4	3	29	0	20
0	2	5	34	5	8
6	10	0	18	3	6
1	10	4	6	0	14
0	4	0	17	0	17
1	21	0	13	0	21
0	15	0	19	0	13
0	11	0	14	0	15
0	8	0	21	0	16
0	2	0	0	0	5
1	3	0	12	0	24
0	0	0	4	0	24
0	6	0	22	0	6
1	1	0	21	0	33
0	7	4	23	2	28
1	0	3	19	0	24
0	0	0	13	5	16
0	4	3	16	0	14
0	3	0	18	0	21
0	3	5	15	0	15
0	7	4	17	0	5
0	5	0	15	0	22
0	9	3	27	0	20
0	13	4	8	0	30
0	6	0	24	0	5
0	6	0	16	0	20
0	3	0	18	5	13
0	8	4	38	0	13
0	15	2	5	2	11
5	8	0	17	2	25
2	6	5	14	0	30
0	7	4	20	0	15
0	4	0	23	0	21
0	10	0	19	2	28
0	1	0	7	5	15
0	7	0	21	0	28

80-Foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	9	0	13	0	38
0	19	5	16	2	6
0	7	0	17	0	25
0	8	0	12	0	16
0	6	0	9	0	22
0	6	0	10	0	12
0	6	0	15	5	15
0	2	0	11	0	14
0	8	0	13	0	18
1	1	0	19	0	13
0	4	0	34	0	25
5	5	0	21	0	23
1	22	0	15	0	16
0	9	0	13	5	20
3	3	0	17	4	32
0	9	0	18	0	34
1	11	3	12	0	33
0	16	4	9	0	29
0	2	3	18	0	9
0	12	4	7	0	27
0	5	4	14	0	24
0	14	6	16	0	17
1	2	0	11	0	20
2	3	0	12	0	18
0	1				
0	6				
0	7				
0	0				
2	7				
0	6				
0	7				
0	8				
0	9				
1	2				
0	3				
0	7				
0	16				
0	5				
1	3				
1	13				
0	3				
0	7				
1	1				
0	6				
4	5				
0	4				
0	2				
3	3				
2	9				

Field Data for 1H:1V Slopes

80-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	16	3	16	0	33
3	3	0	33	0	18
0	12	0	18	0	32
0	11	3	22	0	11
1	5	5	9	0	50
0	8	3	34	0	32
0	22	3	21	0	45
3	4	0	18	0	23
0	14	0	22	0	20
2	4	0	17	0	50
0	4	0	30	0	37
0	17	0	32	0	38
4	15	0	23	0	19
0	4	0	28	0	24
4	5	3	8	0	13
0	18	0	26	0	30
0	13	4	13	3	34
0	12	0	19	6	15
0	17	0	17	0	42
3	18	4	23	0	42
0	25	0	31	2	35
0	19	0	30	0	45
5	6	3	25	3	18
0	39	0	17	3	17
0	0	0	15	2	23
1	5	0	24	0	12
0	14	7	11	0	52
0	30	0	11	0	28
4	6	5	21	0	13
3	9	0	15	4	9
5	5	0	36	0	16
3	21	0	12	0	23
3	13	0	18	0	35
0	10	0	16	5	20
0	28	0	17	0	58
1	3	5	17	0	24
0	16	12	14	0	8
0	14	3	27	0	18
0	13	0	11	0	26
0	15	0	28	0	36
0	22	0	12	0	21
0	37	0	37	0	16
4	16	4	16	0	31
3	10	3	15	0	37
0	42	0	17	0	38
0	13	0	33	0	49
0	15	0	23	0	42
0	8	5	14	0	33
7	10	0	25	4	23
0	9	4	18	0	35
0	28	0	19	0	39

80-Foot Slope with a 6H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	8	3	9	4	24
0	14	2	14	0	26
0	7	0	19	0	28
0	0	4	8	3	17
0	4	4	6	0	31
0	5	0	15	0	20
0	15	5	11	3	40
0	16	0	23	4	30
2	3	7	22	2	32
2	7	0	16	0	14
0	11	0	15	4	17
3	5	0	22	4	4
6	10	0	14	8	22
0	7	0	9	0	22
0	0	0	14	4	13
3	3	0	18	3	24
3	8	5	10	0	27
0	3	5	19	0	38
0	22	0	18	0	32
0	5	0	24	0	19
1	4	0	13	8	8
0	10	0	16	0	40
1	5	0	5	0	21
0	18	0	35	0	35
0	26				
0	19				
0	12				
0	15				
4	5				
5	15				
0	16				
2	3				
4	11				
0	19				
0	17				
0	14				
3	9				
0	8				
0	3				
3	4				
0	8				
0	9				
0	19				
0	6				
0	15				
0	4				
1	2				
0	13				
4	12				

Field Data for 1H:1V Slopes

80-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	4	0	22	0	43
0	33	0	26	4	69
0	52	0	25	0	80
0	13	0	46	0	68
0	40	0	42	0	41
0	14	0	38	5	70
0	29	0	28	5	62
0	12	0	25	0	76
4	32	0	37	0	49
0	12	0	30	4	33
5	17	0	39	0	24
3	12	0	51	0	38
0	6	0	57	0	33
4	35	0	44	0	28
3	26	0	31	0	50
5	28	0	33	0	57
5	28	0	32	0	80
2	34	0	31	0	53
2	15	0	48	0	57
3	42	0	46	0	43
0	8	0	20	0	44
0	16	3	35	6	23
0	8	0	32	6	31
0	35	0	49	0	30
1	4	0	23	0	47
0	16	0	33	0	80
2	13	0	37	0	38
0	14	0	44	0	42
0	33	0	28	0	32
5	32	0	29	8	52
0	33	0	39	0	31
0	18	0	32	0	80
5	33	0	37	0	78
0	33	2	29	0	80
3	30	0	36	0	70
4	54	0	51	0	38
0	27	5	49	0	44
0	32	5	26	0	66
3	28	8	24	0	80
0	8	0	12	0	29
4	31	0	32	0	36
0	34	5	5	0	52
4	10	0	35	0	56
0	10	0	29	0	75
0	38	0	13	6	31
0	14	0	25	5	30
0	40	0	30	5	40
7	28	0	50	0	22
4	31	0	8	0	44
3	20	0	51	0	36
6	34	0	23	0	40

80-Foot Slope with a Flat Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	33	0	19	0	35
5	45	0	11	0	25
0	32	0	58	0	16
0	14	0	22	0	28
0	43	0	47	0	21
0	37	0	34	0	39
0	33	0	39	0	60
0	50	0	44	5	38
0	46	0	37	5	37
0	37	0	27	0	63
1	32	0	38	0	58
0	27	0	64	0	72
11	22	0	30	0	80
0	21	0	31	0	80
6	24	0	15	0	58
0	42	0	21	0	78
0	5	0	8	0	80
0	16	0	2	0	78
3	15	0	34	0	18
0	19	0	55	0	48
4	39	0	34	0	55
4	17	0	35	0	72
3	8	0	14	0	80
0	17	0	50	0	60
0	10				
3	10				
0	41				
5	14				
0	27				
0	10				
0	31				
0	28				
4	11				
4	8				
2	14				
0	20				
0	8				
0	32				
0	14				
0	11				
0	15				
0	31				
0	39				
0	28				
0	21				
0	9				
0	18				
3	41				
0	22				

Field Data for 1.25H:1V Slopes

40-foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	5	0	12	3	5
0	7	0	8	0	8
0	8	0	15	3	7
0	7	0	15	0	10
0	6	0	13	0	0
0	0	0	12	0	4
0	4	0	6	6	8
0	7	4	6	0	8
0	3	0	14	0	9
0	7	0	12	0	5
0	4	0	8	0	4
0	0	0	7	0	11
0	5	0	9	0	14
0	0	0	7	0	13
0	6	0	5	0	6
0	5	4	10	0	16
0	0	4	10	0	14
0	0	3	6	0	17
0	4	0	8	0	13
0	8	0	7	0	14
0	6	0	12	0	10
0	4	0	9	0	6
0	7	0	7	0	16
0	0	0	11	0	8
0	8	0	12	0	0
3	7	0	6	0	10
0	6	0	10	0	4
0	8	3	3	0	4
0	6	2	4	0	6
3	5	0	6	0	5
0	3	0	8	0	5
0	7	0	12	0	22
0	0	0	15	0	15
0	6	0	12	0	10
0	5	0	13	0	18
0	2	0	6	0	13
0	7	0	9	0	11
2	6	0	6	0	16
0	4	0	7	0	13
0	3	0	6	0	12
0	0	0	0	0	9
0	3	0	14	0	9
0	1	0	8	0	11
0	5	0	7	0	7
0	4	0	10	0	11
0	6	0	9	0	7
0	5	0	8	0	12
0	7	0	13	0	8
0	6	0	4	0	14
0	5	0	12	0	13
0	0	0	13	0	12

40-foot Slope with a 4H:1V Catchment Area					
1-foot		2-foot		3-foot	
Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)	Impact (ft)	Roll Out (ft)
0	6	0	15	0	17
0	5	0	6	0	15
0	5	0	12	0	11
0	4	0	14	0	0
0	9	0	14	0	10
0	5	0	13	0	14
0	4	0	3	0	8
0	4	0	9	0	16
0	5	0	12	0	12
0	8	0	5	0	13
0	7	0	9	0	14
0	8	0	12	0	9
0	3	0	0	0	11
0	5	0	12	0	8
0	7	0	18	0	4
0	3	0	12	0	11
0	7	0	8	0	9
0	6	0	11	0	16
0	0	0	11	0	20
0	3	0	9	0	6
0	5	0	4	0	8
0	4	0	14	0	4
0	0			0	6
0	6			0	4
0	4				
0	8				
0	2				
0	7				
0	3				
0	9				
0	6				
0	7				
0	5				
0	6				
0	4				
0	4				
0	8				
2	2				
0	5				
0	9				
0	8				
0	6				
0	9				
0	7				
0	3				
0	6				
0	3				
0	0				
0	3				

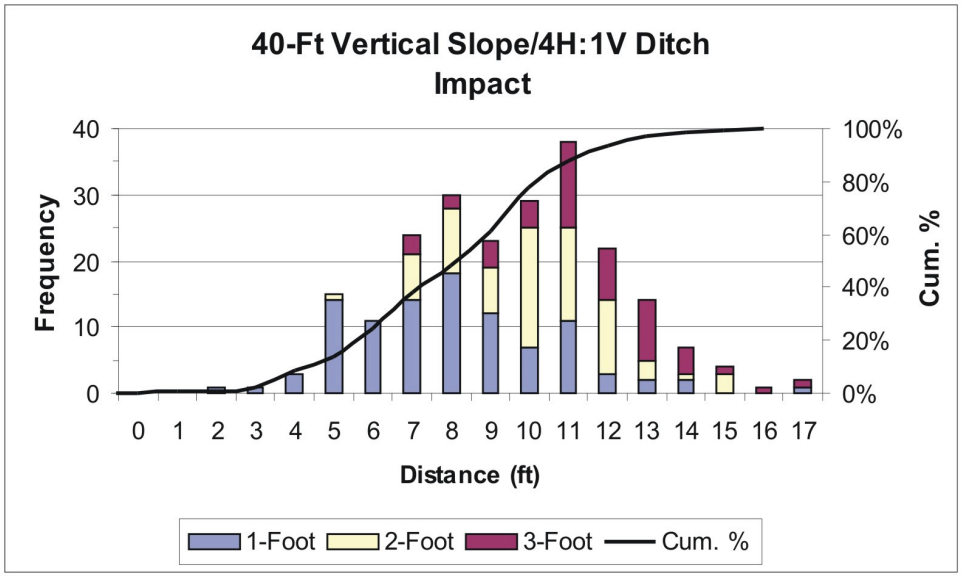
Note: This was the only 1.25H:1V slope tested. Insufficient funds were available to test additional slopes.

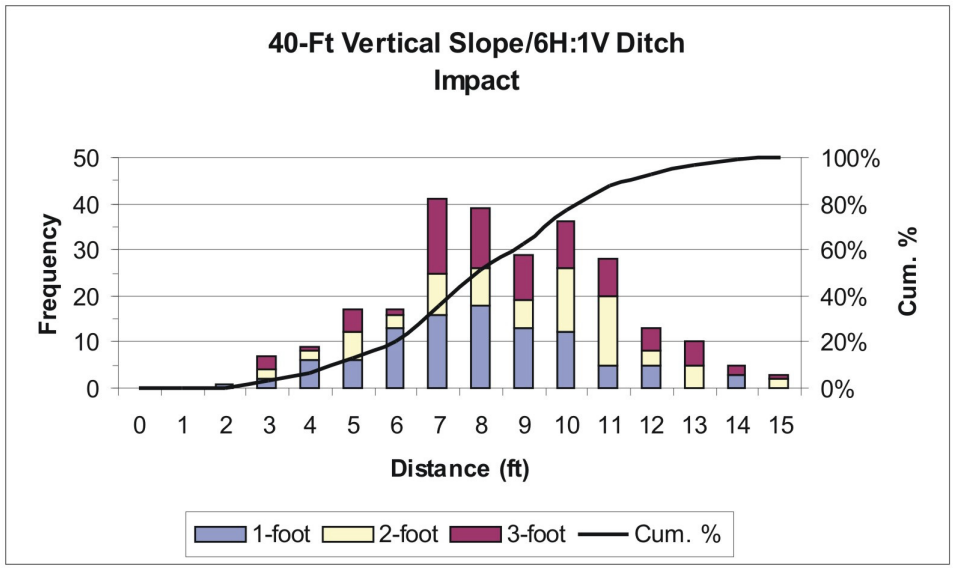
APPENDIX C: ROCKFALL IMPACT DISTANCE HISTOGRAMS

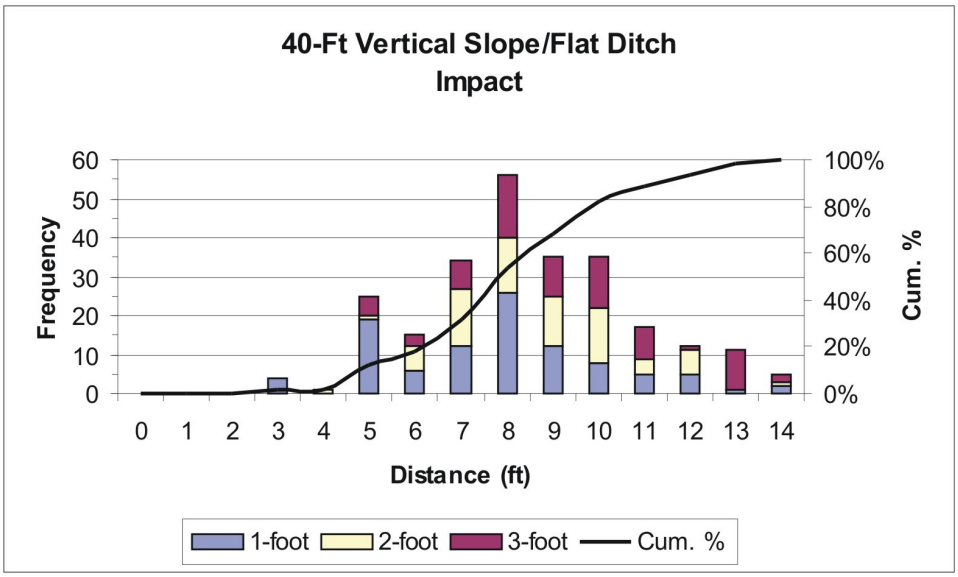
ROCKFALL IMPACT DISTANCE HISTOGRAMS

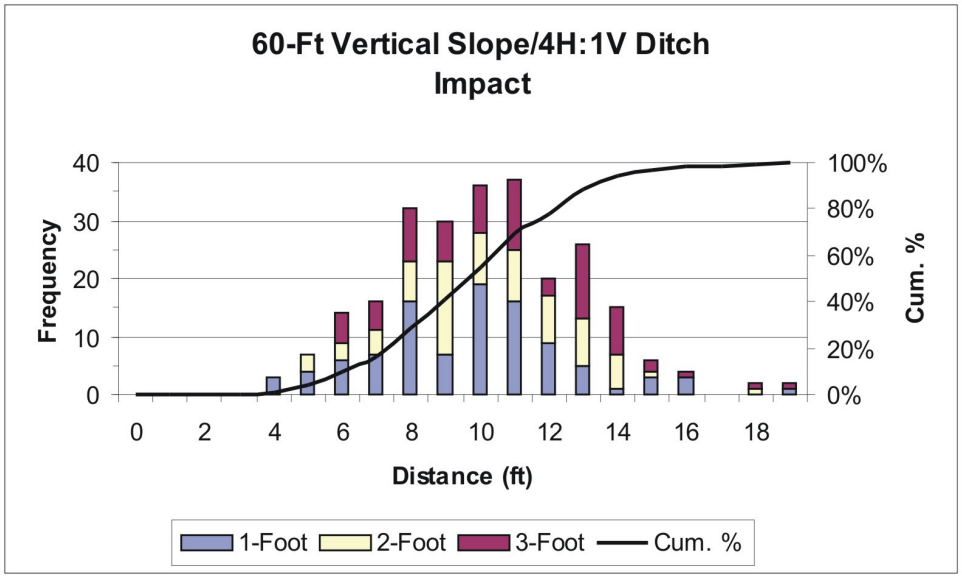
Impact histograms show the tabulated rockfall impact data from Appendix B in a graphical manner. The frequency bars show the relative number of one-, two-, and three-foot rocks that comprise them. The histograms include a cumulative frequency line. This line provides a quick reference for determining the percentage of rocks rolled that landed within a specific width. On steep slopes the rocks rarely impacted (first contacted the catchment area) near the toe of the slope. Conversely, rockfalls on the flatter slopes commonly entered the catchment area in a rolling manner, resulting in many recorded impact distances of zero feet. The impact distances are the field measured slope distances. Field data was recorded to the nearest foot.

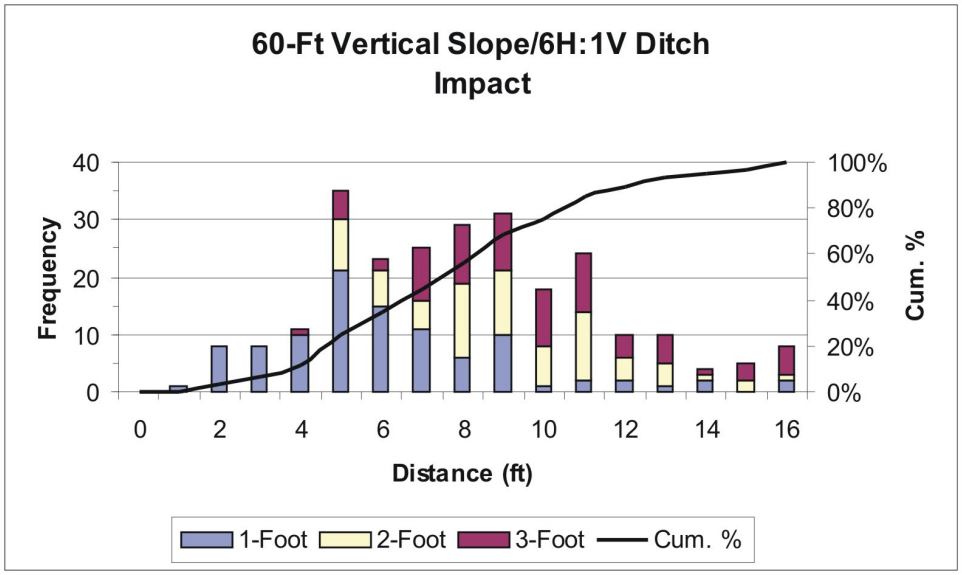
NOTE: Also included at the end of Appendix C is a limited set of data gathered from a 40-foot high, 1.25H:1V slope. The rocks rolled from this slope fell into a 4H:1V catchment area. The results were recorded but not compiled into catchment area percent retention graphs or design charts, because there were not sufficient funds to test the full suite of slope heights and catchment area inclinations for the 1.25H:1V test slope.

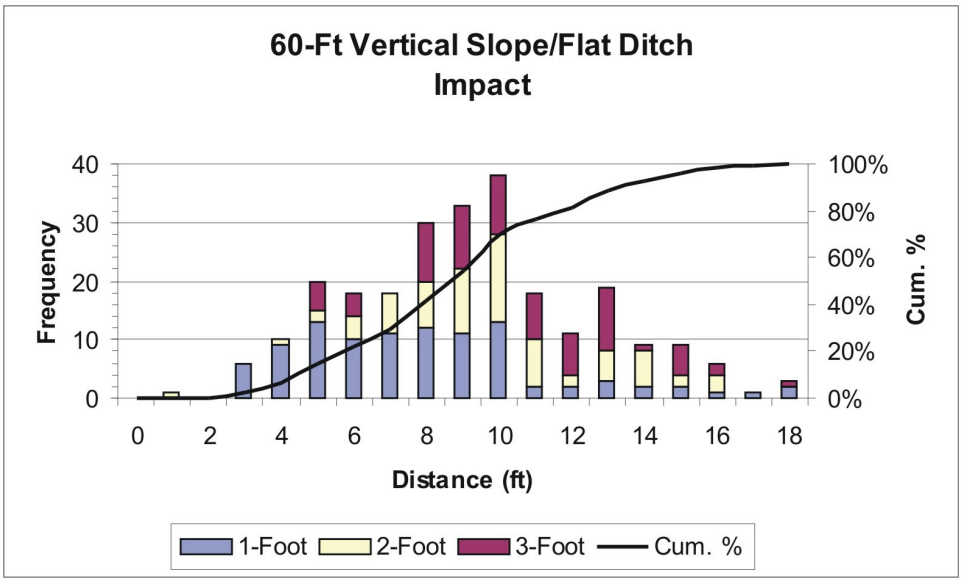

40-Ft Vertical Slope/4H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

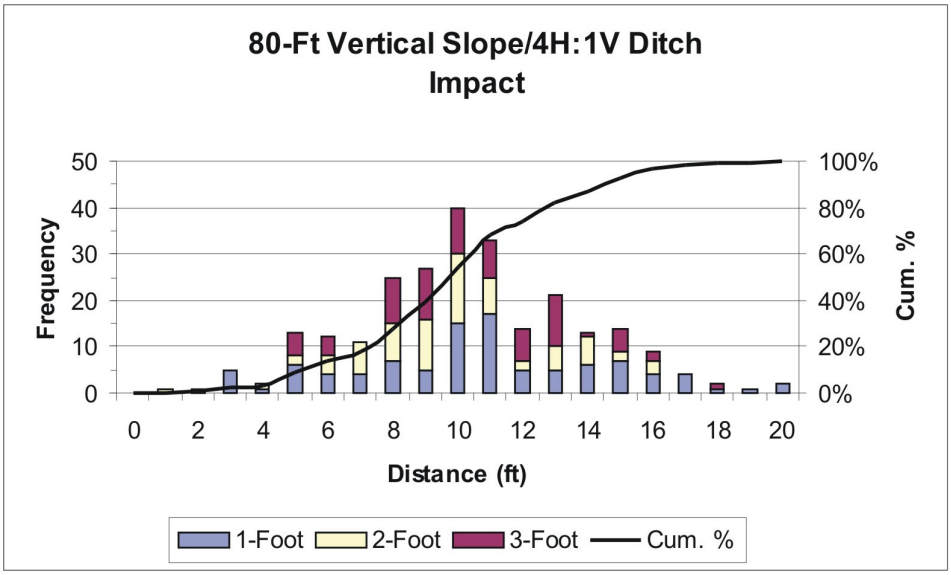

40-Ft Vertical Slope/6H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-foot
2-foot
3-foot
Cum. %

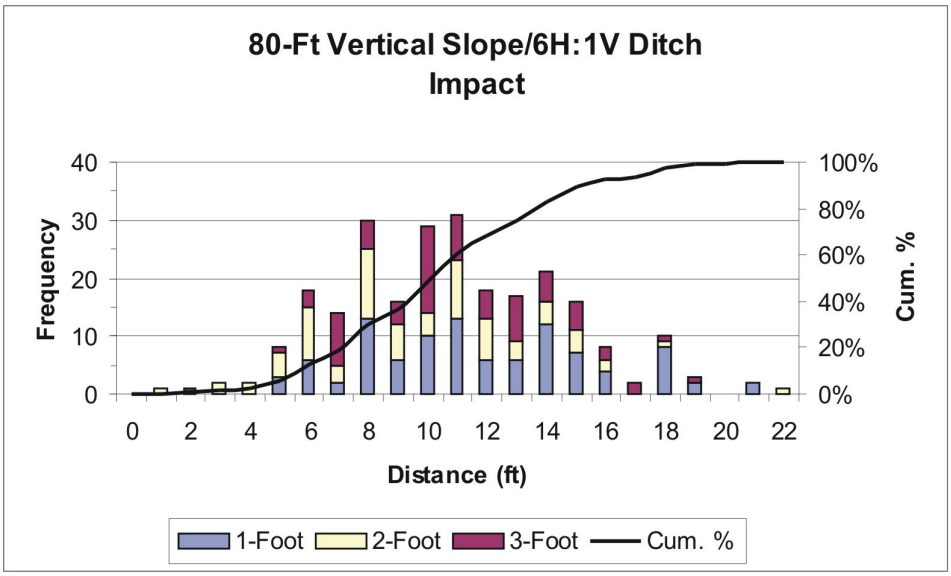

40-Ft Vertical Slope/Flat Ditch Impact
Frequency
Cum. %
Distance (ft)
1-foot
2-foot
3-foot
Cum. %

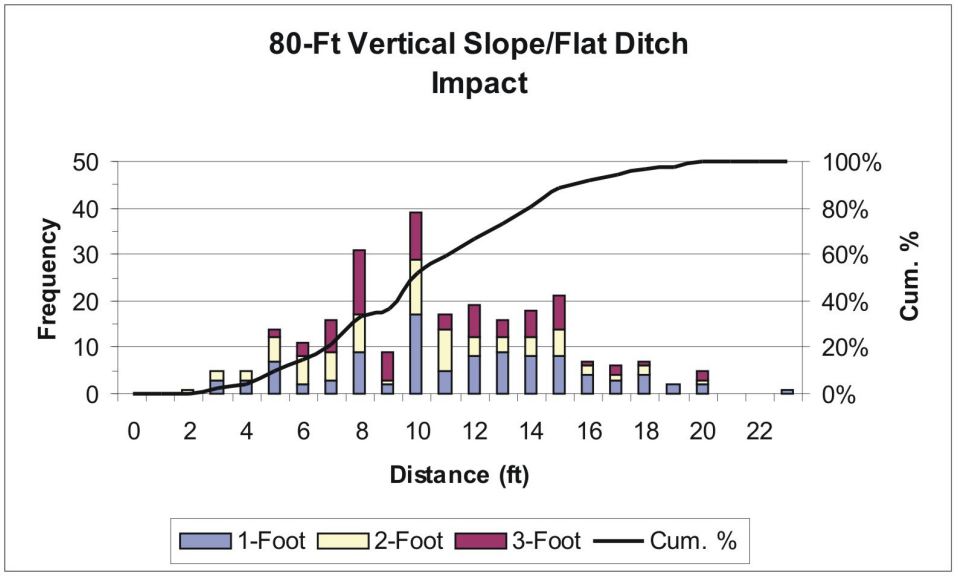

60-Ft Vertical Slope/4H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

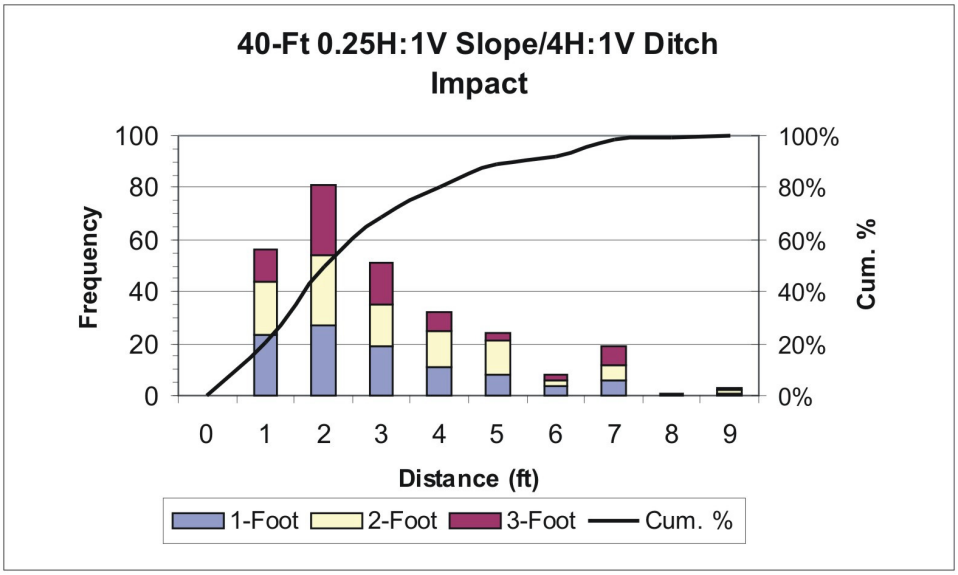

60-Ft Vertical Slope/6H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

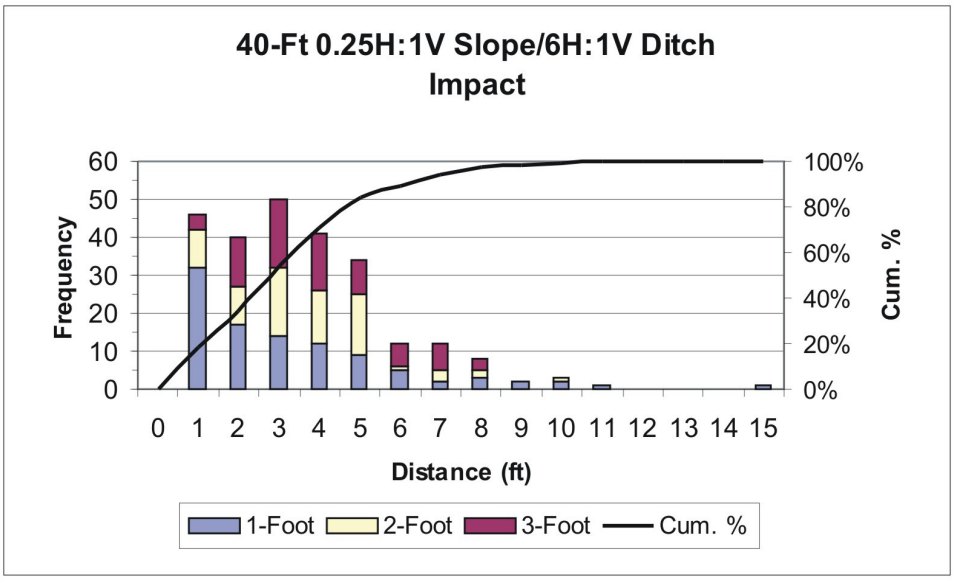

60-Ft Vertical Slope/Flat Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

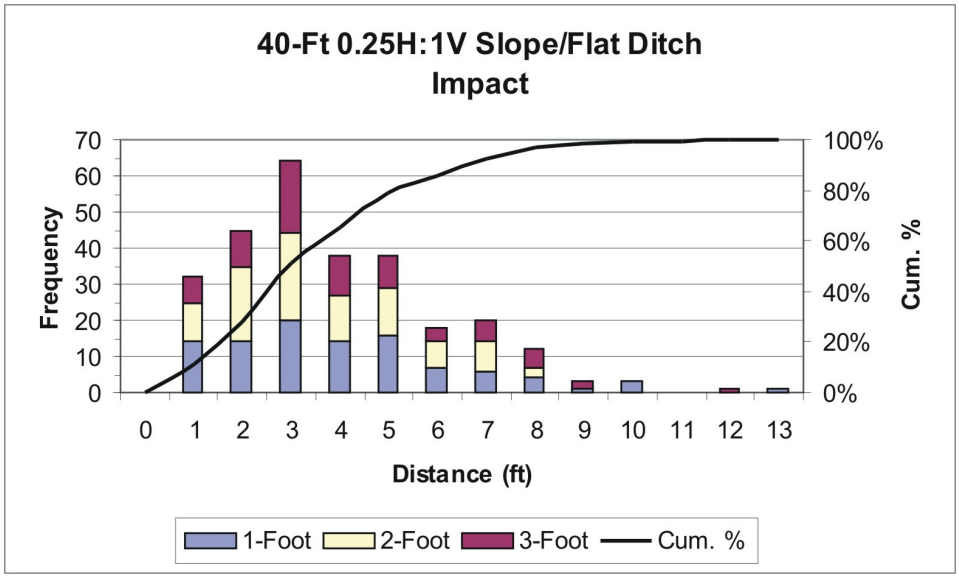

80-Ft Vertical Slope/4H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

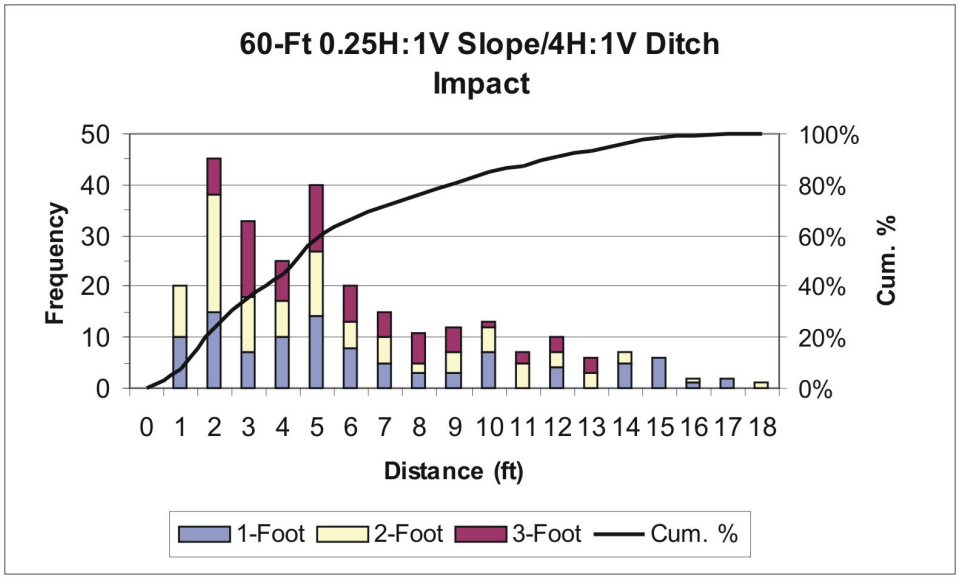

80-Ft Vertical Slope/6H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

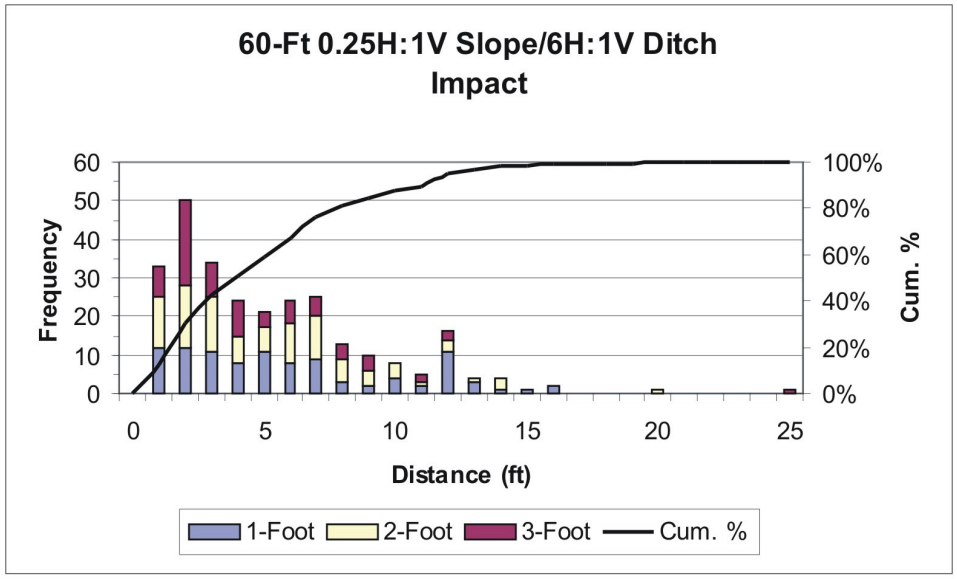

80-Ft Vertical Slope/Flat Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

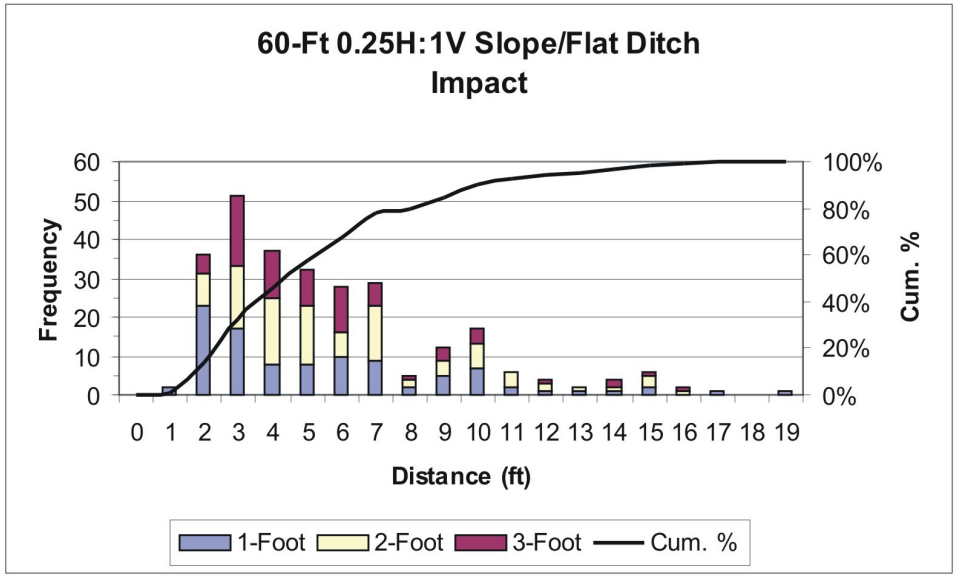

40-Ft 0.25H:1V Slope/4H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

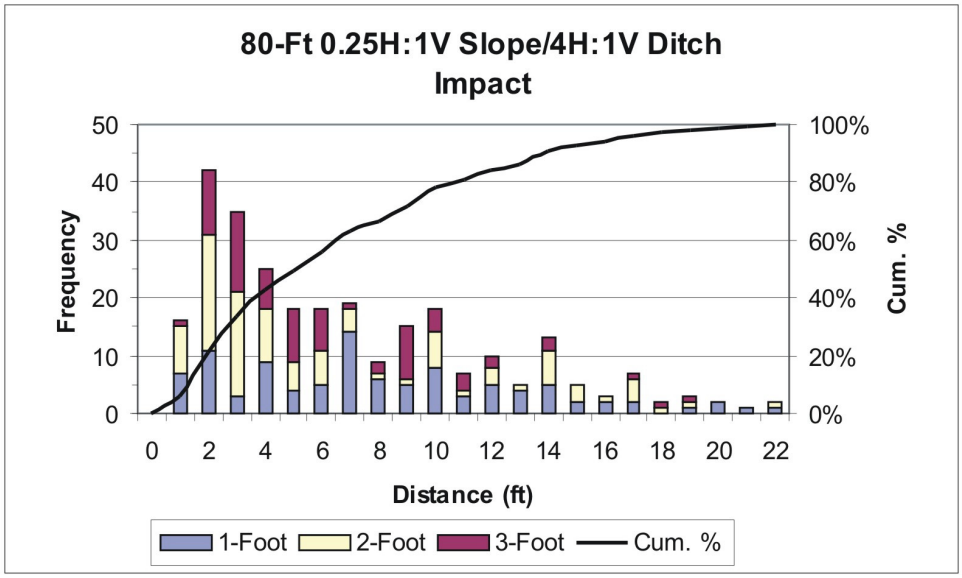

40-Ft 0.25H:1V Slope/6H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

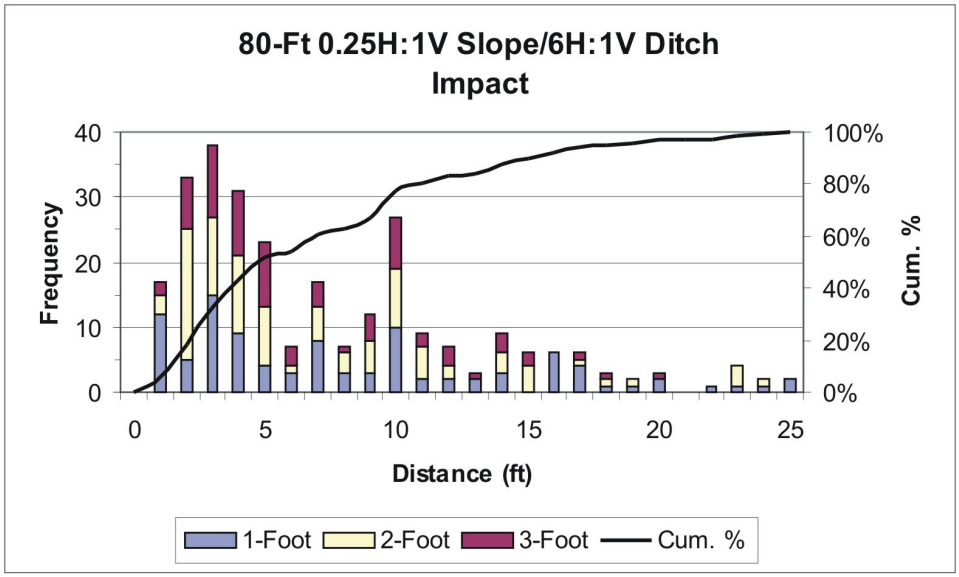

40-Ft 0.25H:1V Slope/Flat Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

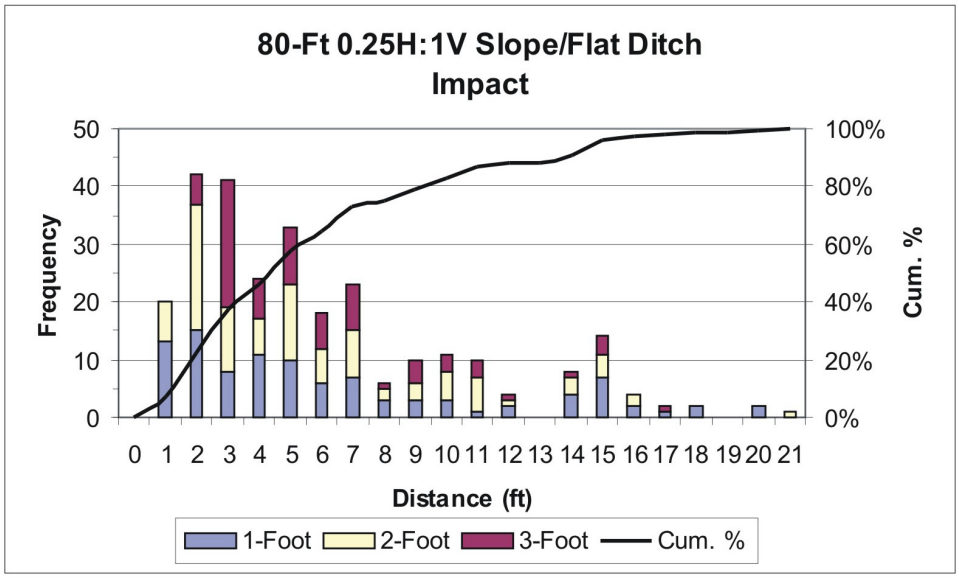

60-Ft 0.25H:1V Slope/4H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

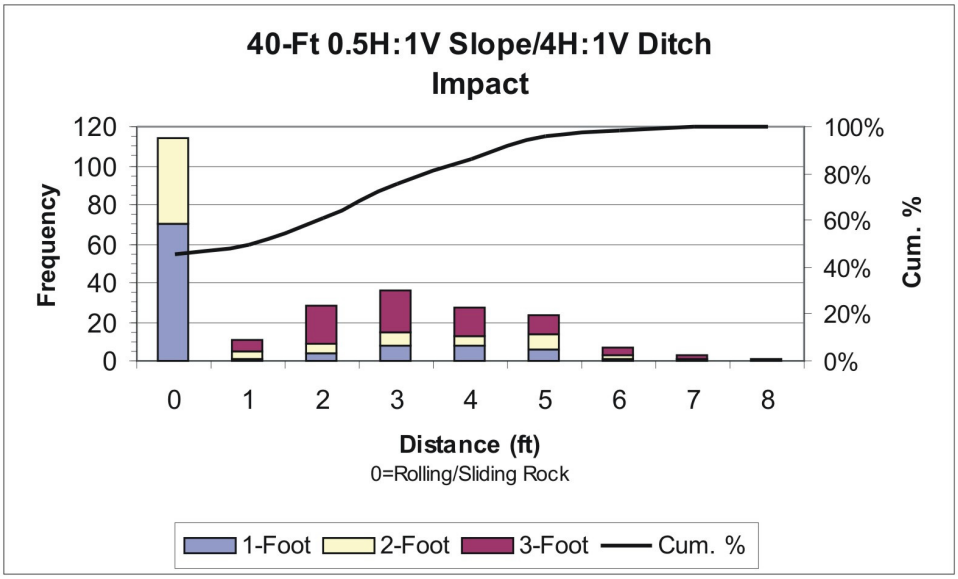

60-Ft 0.25H:1V Slope/6H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

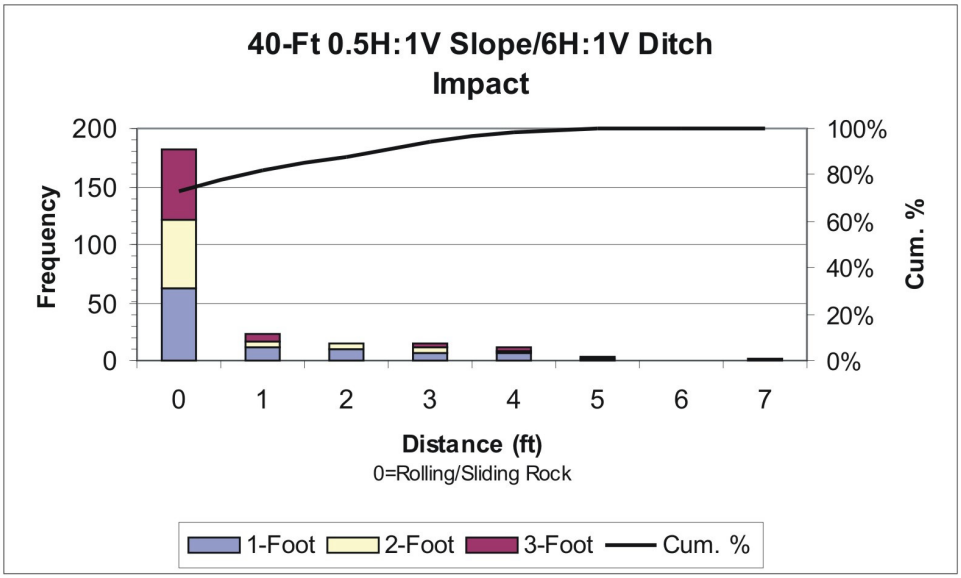

60-Ft 0.25H:1V Slope/Flat Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

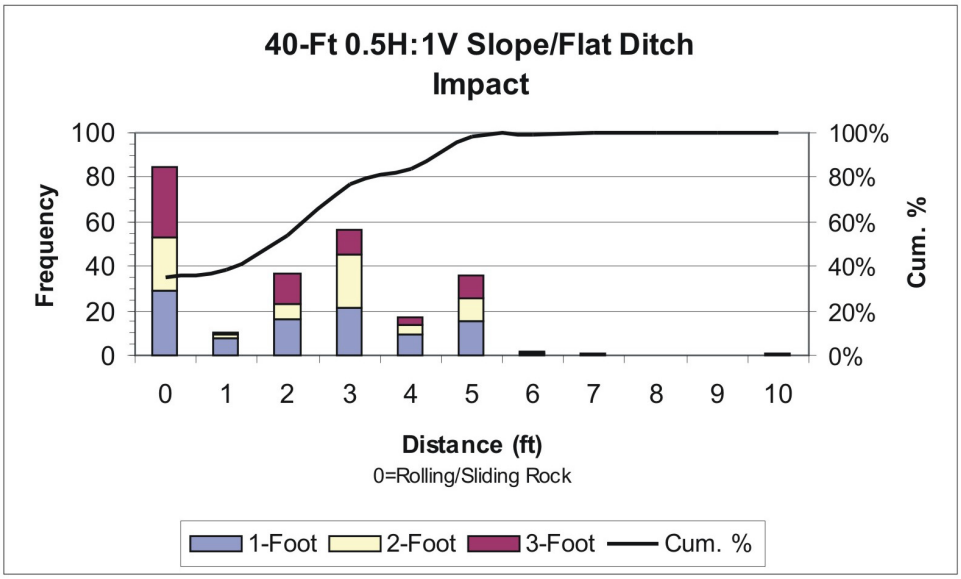

80-Ft 0.25H:1V Slope/4H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

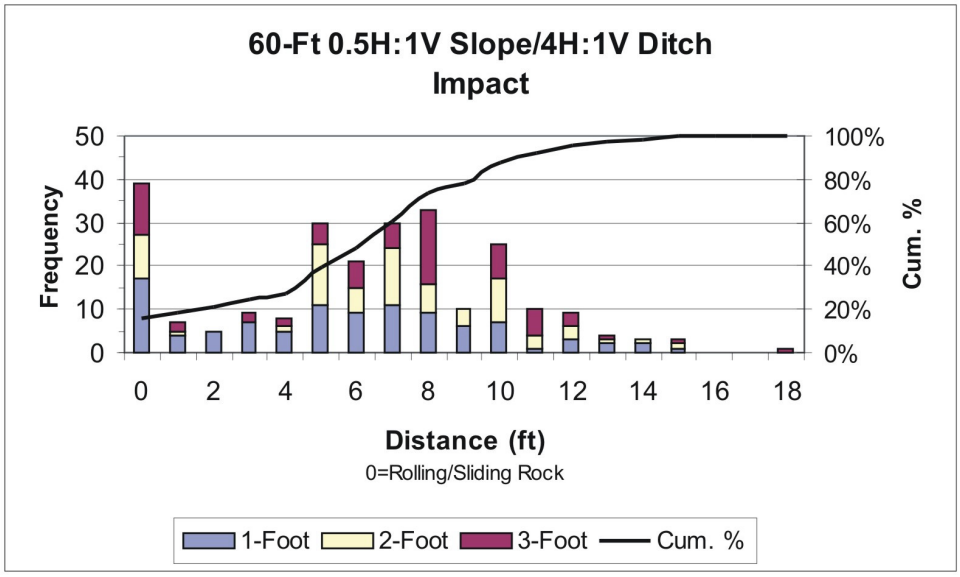

80-Ft 0.25H:1V Slope/6H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

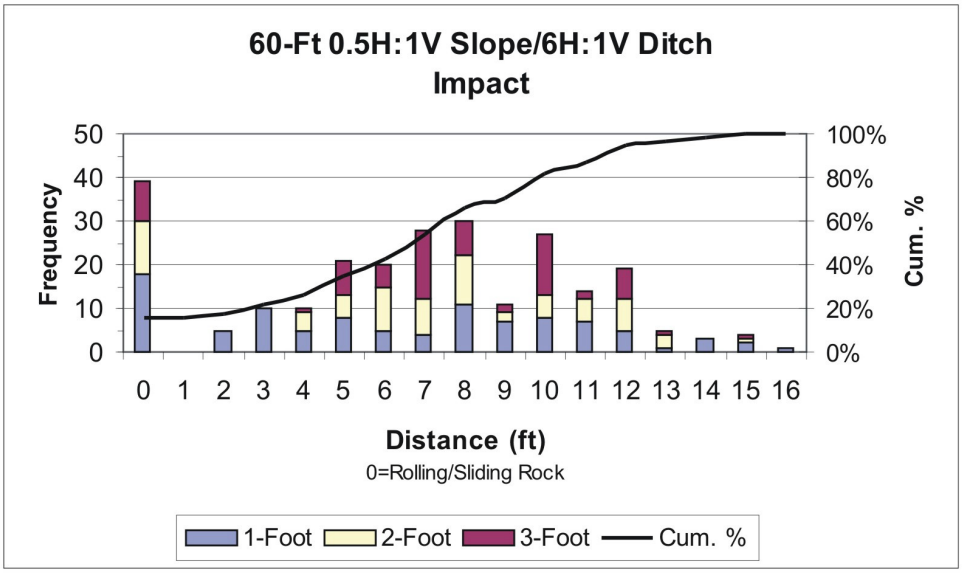

80-Ft 0.25H:1V Slope/Flat Ditch Impact
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

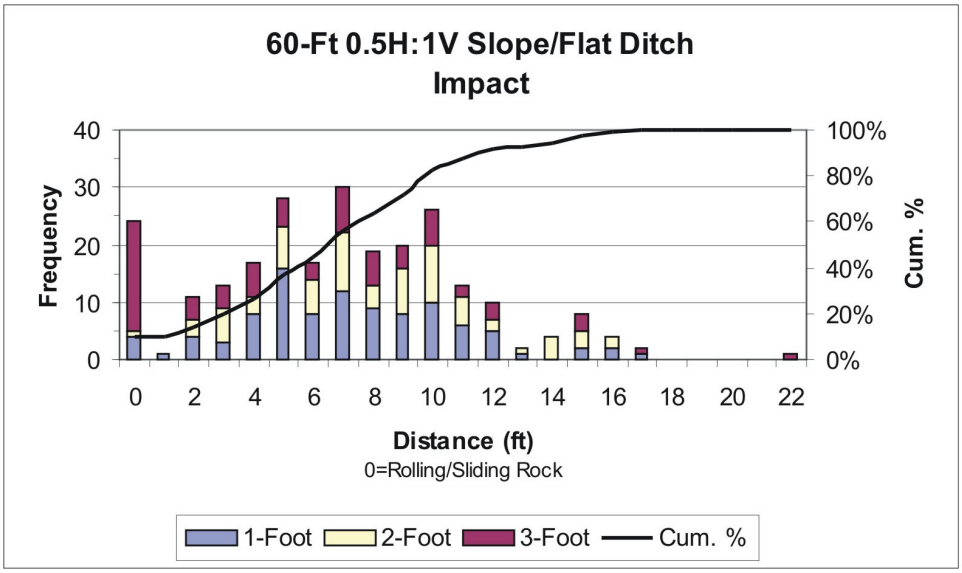

40-Ft 0.5H:1V Slope/4H:1V Ditch Impact
Frequency
Cum. %
120
100
80
60
40
20
0
100%
80%
60%
40%
20%
0%
0 1 2 3 4 5 6 7 8
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

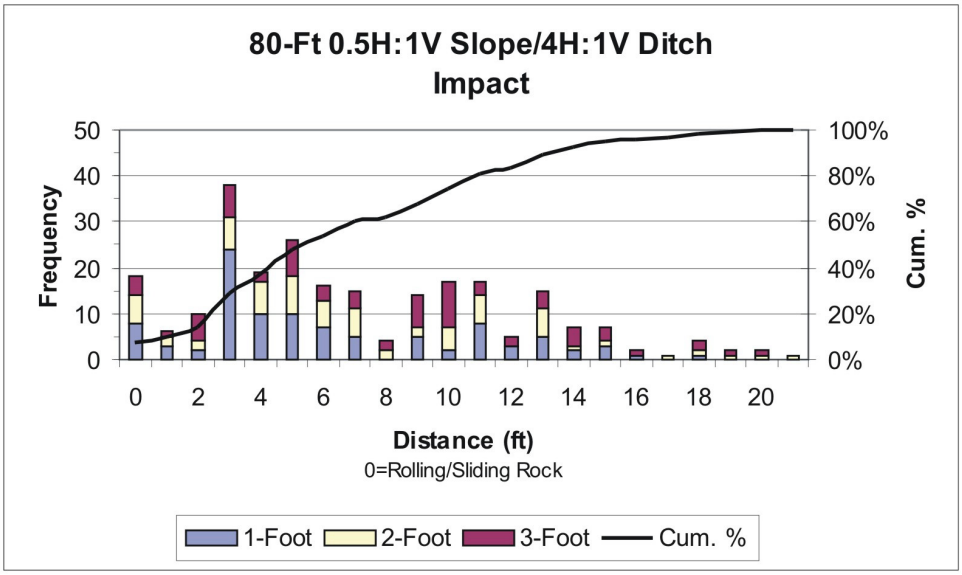

40-Ft 0.5H:1V Slope/6H:1V Ditch Impact
Frequency
Cum. %
200
150
100
50
0
100%
80%
60%
40%
20%
0%
0 1 2 3 4 5 6 7
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

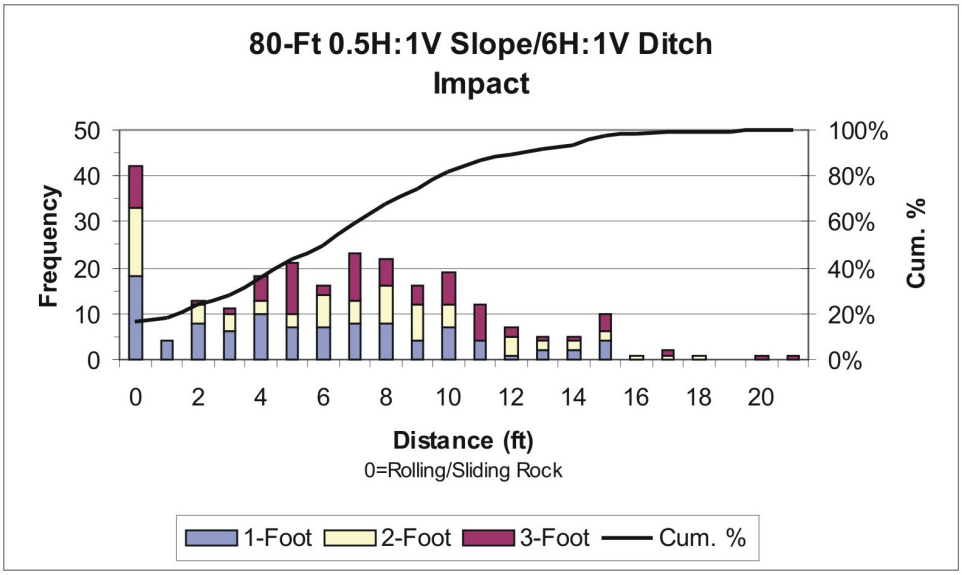

40-Ft 0.5H:1V Slope/Flat Ditch Impact
Frequency
Cum. %
100
80
60
40
20
0
100%
80%
60%
40%
20%
0%
0 1 2 3 4 5 6 7 8 9 10
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

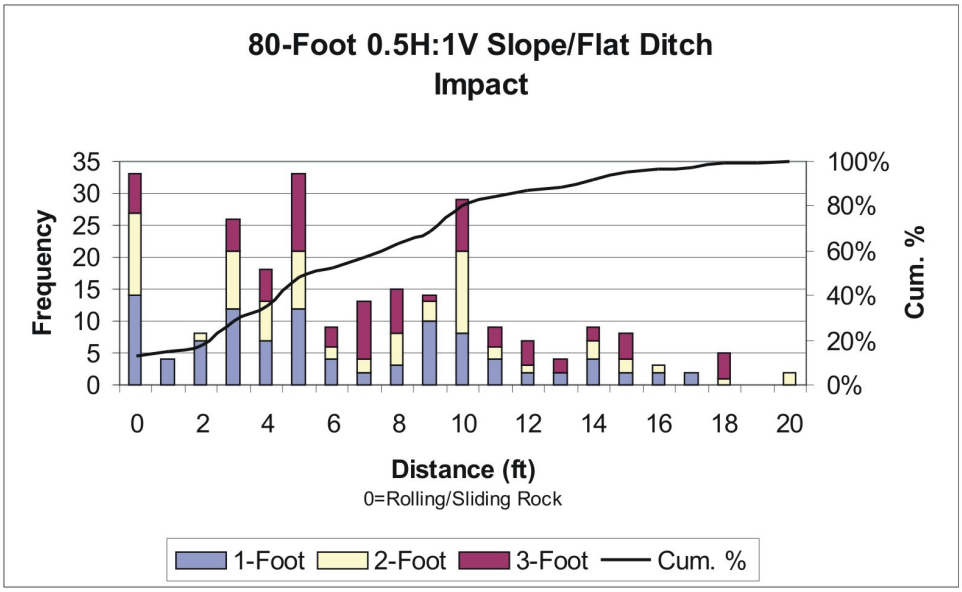

60-Ft 0.5H:1V Slope/4H:1V Ditch
Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

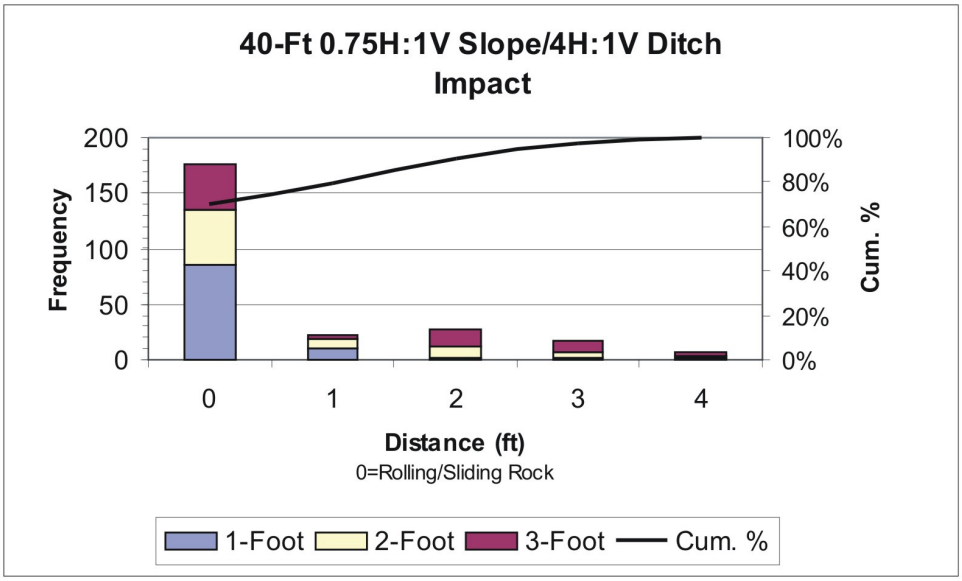

60-Ft 0.5H:1V Slope/6H:1V Ditch
Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

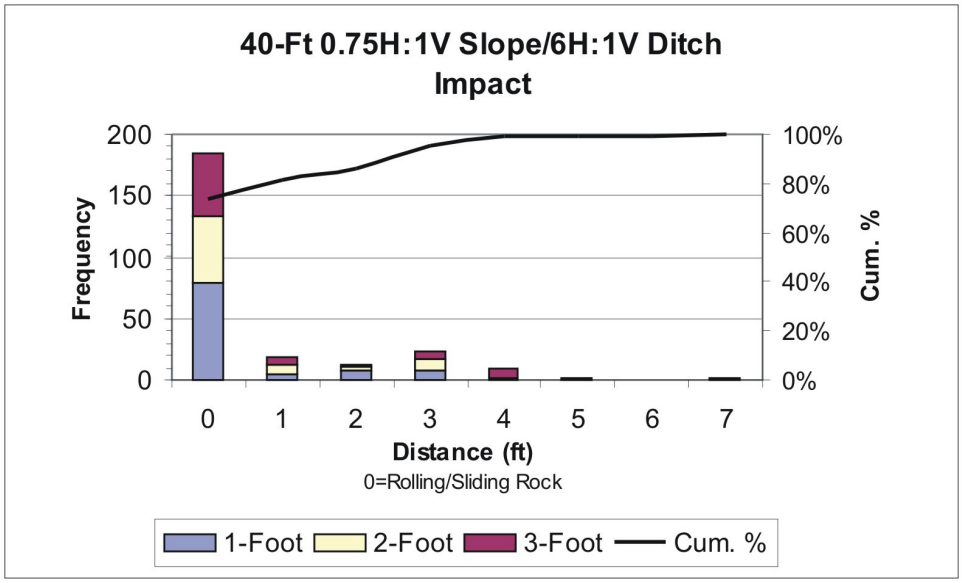

60-Ft 0.5H:1V Slope/Flat Ditch
Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

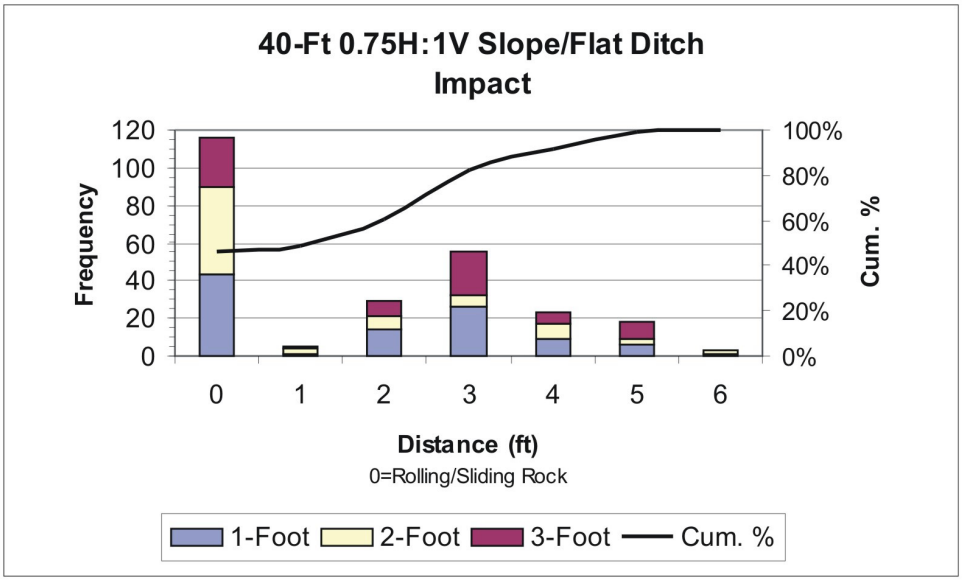

80-Ft 0.5H:1V Slope/4H:1V Ditch
Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

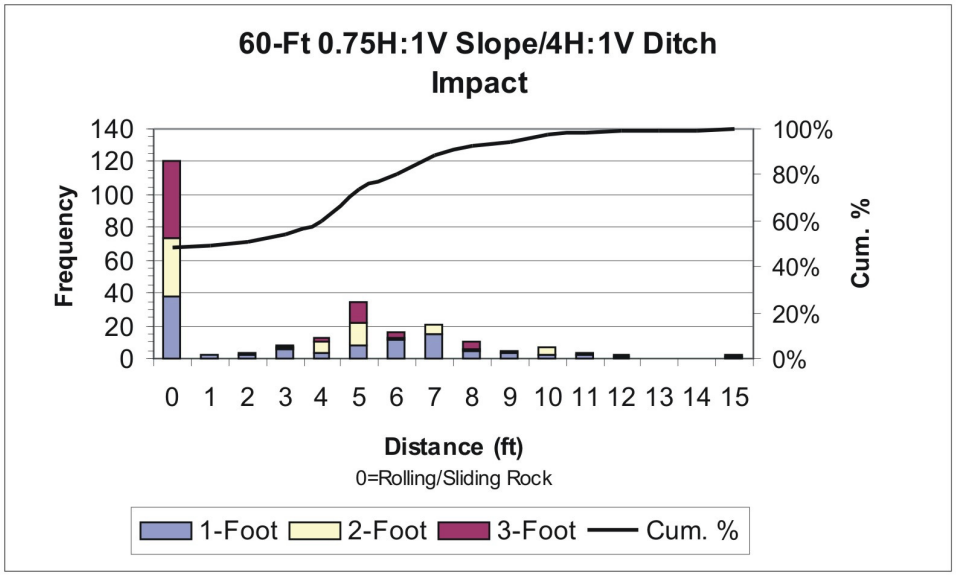

80-Ft 0.5H:1V Slope/6H:1V Ditch
Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

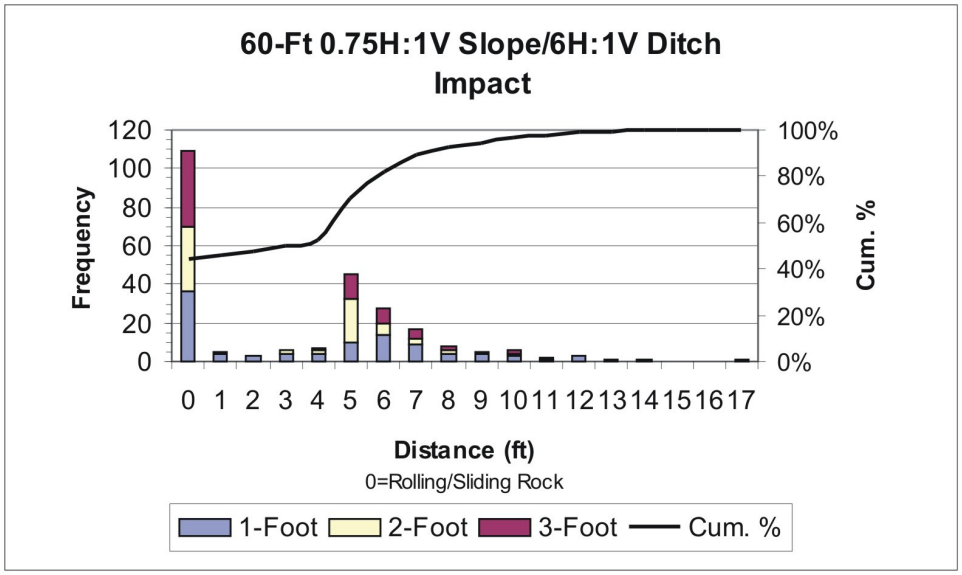

80-Foot 0.5H:1V Slope/Flat Ditch
Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

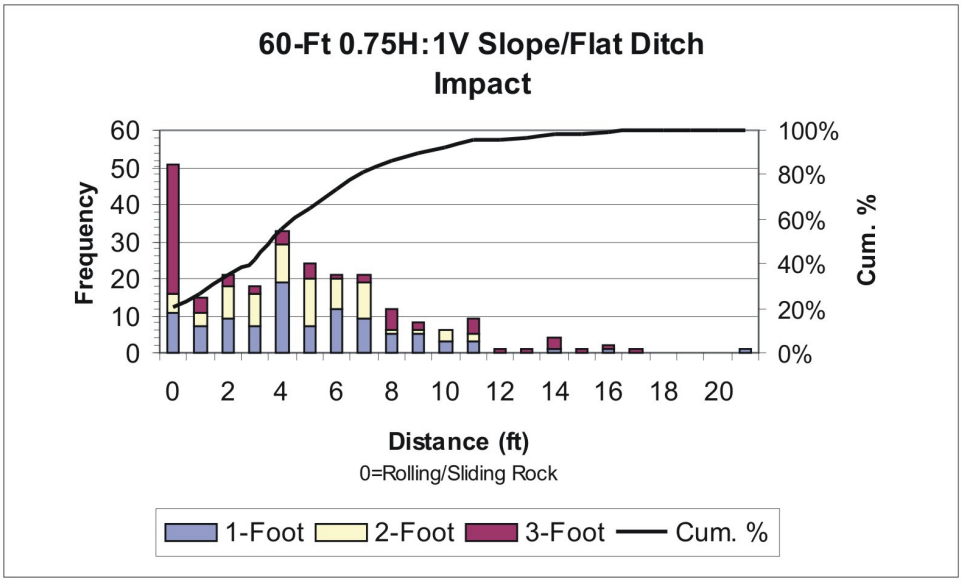

40-Ft 0.75H:1V Slope/4H:1V Ditch Impact
Frequency
Cum. %
200
150
100
50
0
100%
80%
60%
40%
20%
0%
0
1
2
3
4
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

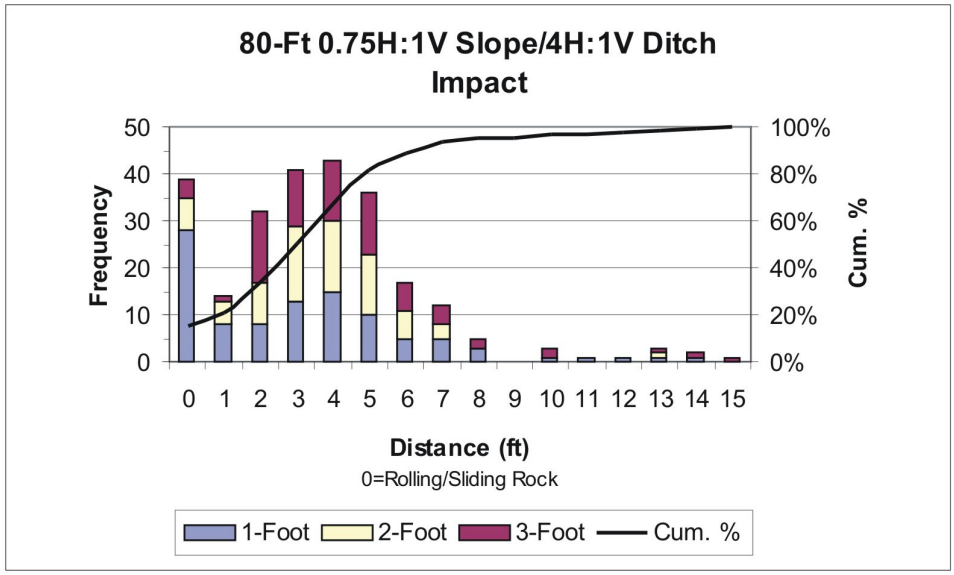

40-Ft 0.75H:1V Slope/6H:1V Ditch Impact
Frequency
Cum. %
200
150
100
50
0
100%
80%
60%
40%
20%
0%
0
1
2
3
4
5
6
7
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

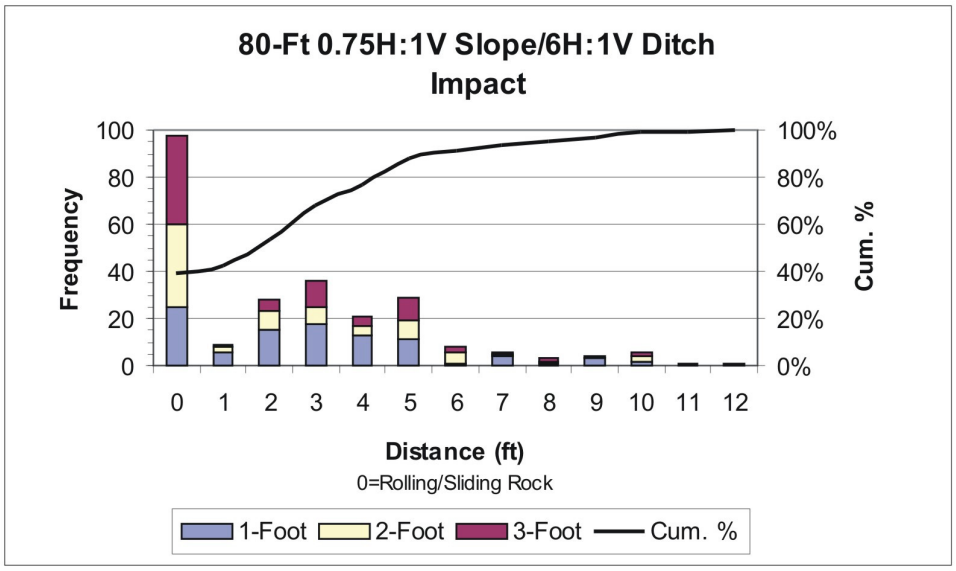

40-Ft 0.75H:1V Slope/Flat Ditch Impact
Frequency
Cum. %
120
100
80
60
40
20
0
100%
80%
60%
40%
20%
0%
0
1
2
3
4
5
6
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

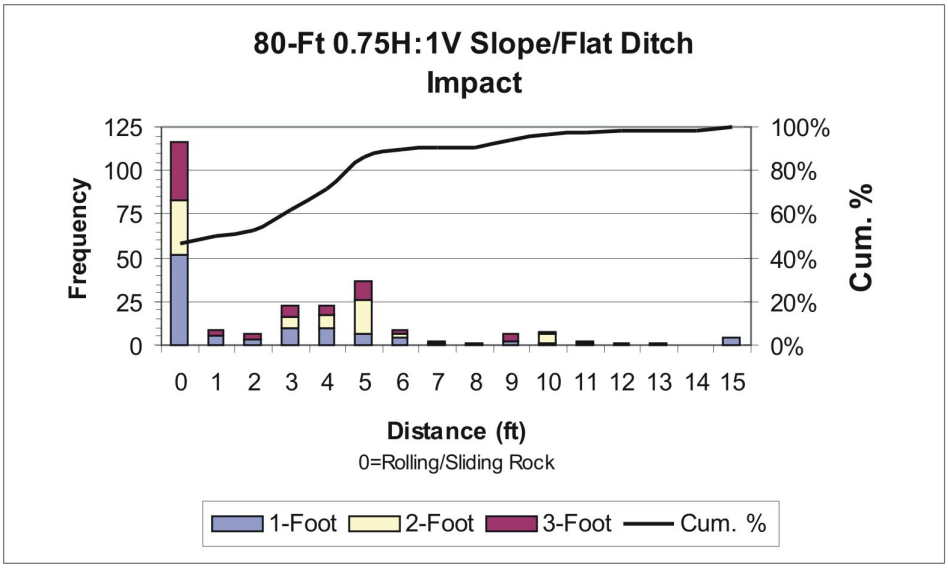

60-Ft 0.75H:1V Slope/4H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

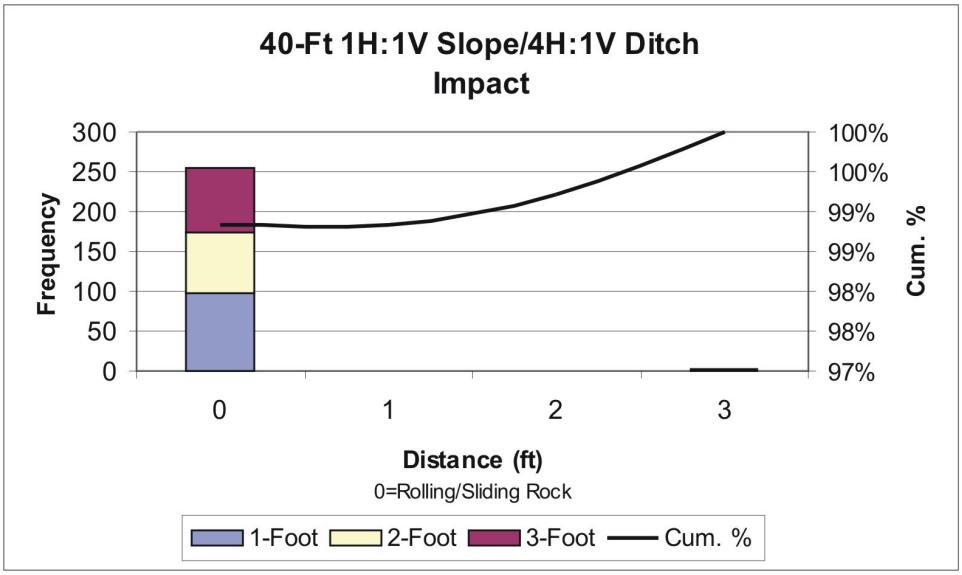

60-Ft 0.75H:1V Slope/6H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

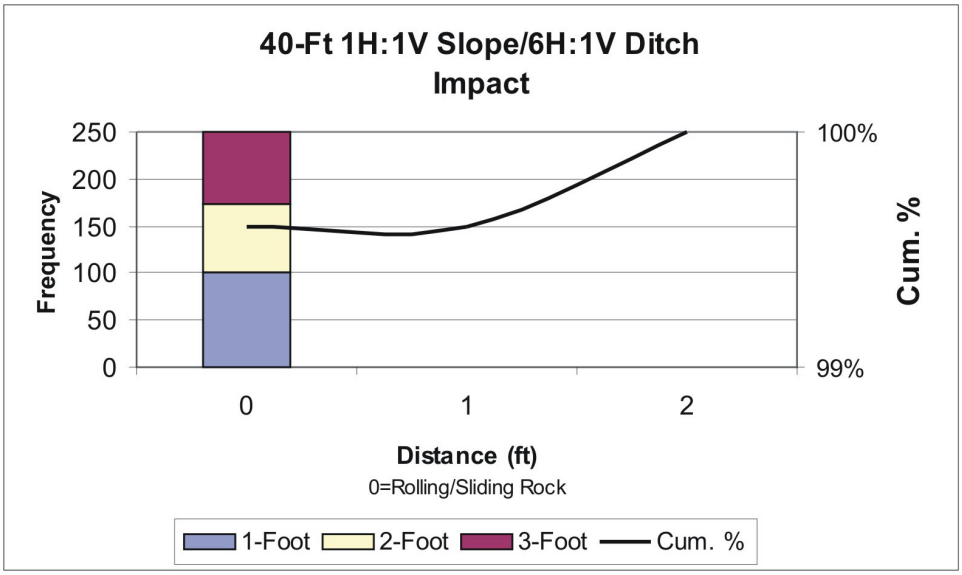

60-Ft 0.75H:1V Slope/Flat Ditch Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

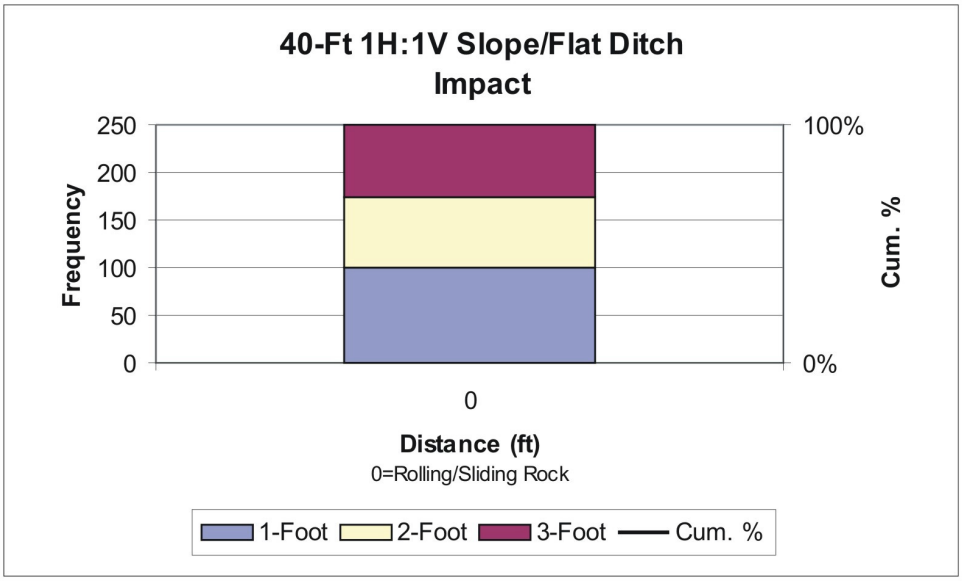

80-Ft 0.75H:1V Slope/4H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

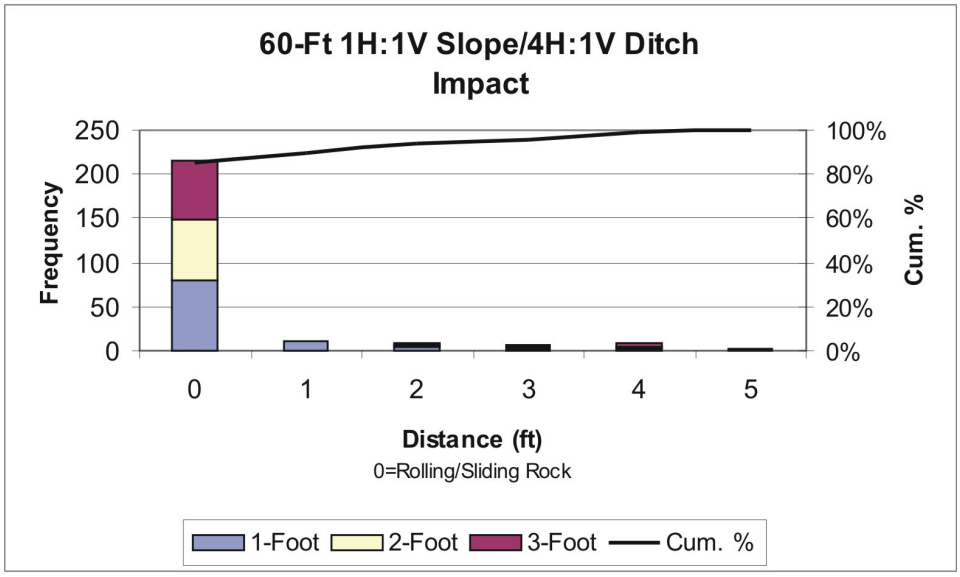

80-Ft 0.75H:1V Slope/6H:1V Ditch Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

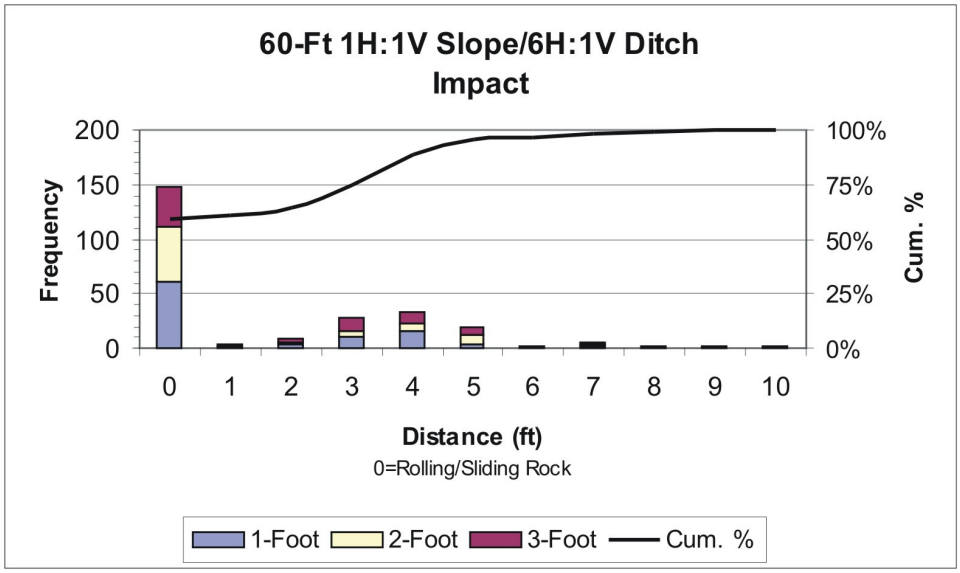

80-Ft 0.75H:1V Slope/Flat Ditch Impact
Frequency
Cum. %
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

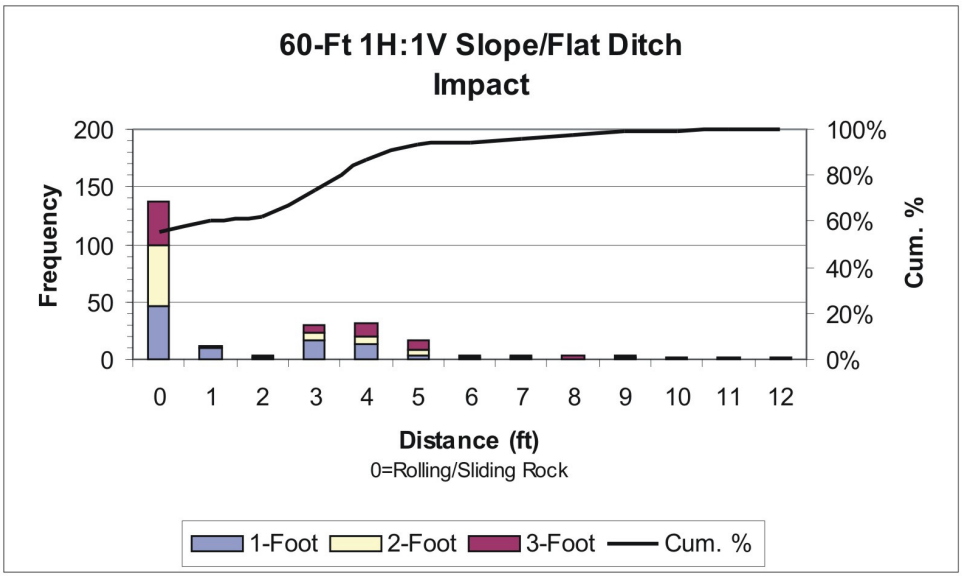

40-Ft 1H:1V Slope/4H:1V Ditch Impact
Frequency
300
250
200
150
100
50
0
100%
100%
99%
99%
98%
98%
97%
Cum. %
0
1
2
3
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

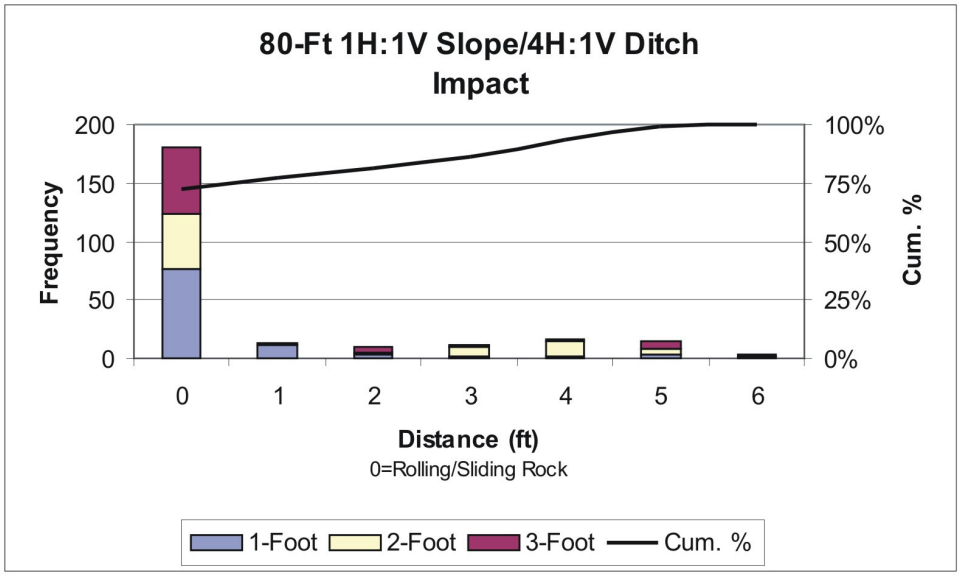

40-Ft 1H:1V Slope/6H:1V Ditch Impact
Frequency
250
200
150
100
50
0
100%
99%
Cum. %
0
1
2
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

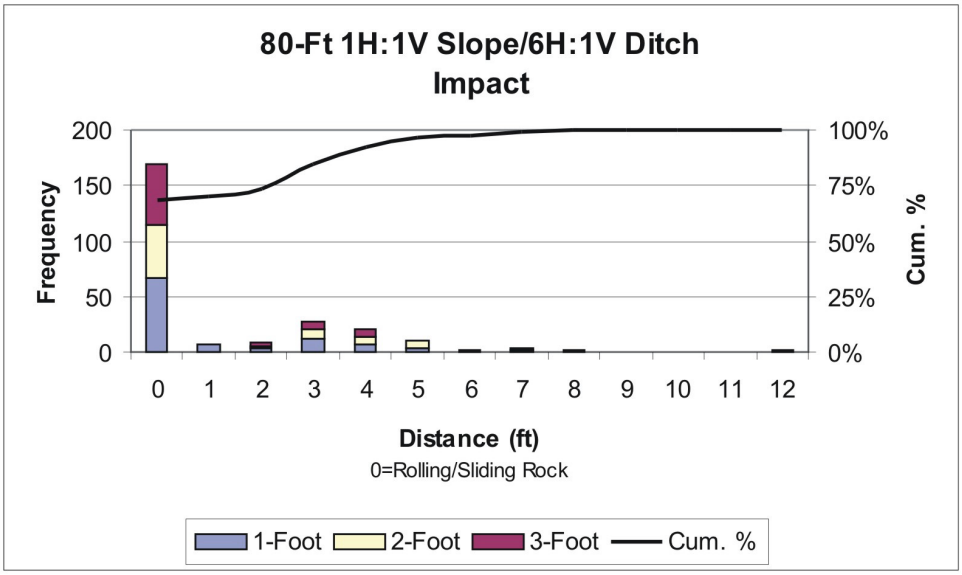

40-Ft 1H:1V Slope/Flat Ditch Impact
Frequency
250
200
150
100
50
0
100%
0%
Cum. %
0
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

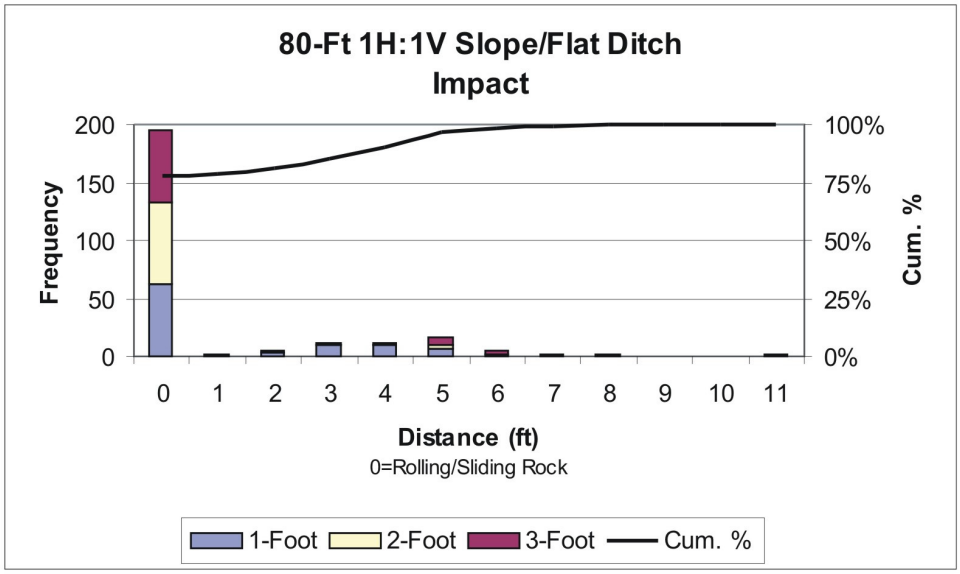

60-Ft 1H:1V Slope/4H:1V Ditch
Impact
Frequency
250
200
150
100
50
0
100%
80%
60%
40%
20%
0%
Cum. %
0
1
2
3
4
5
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %

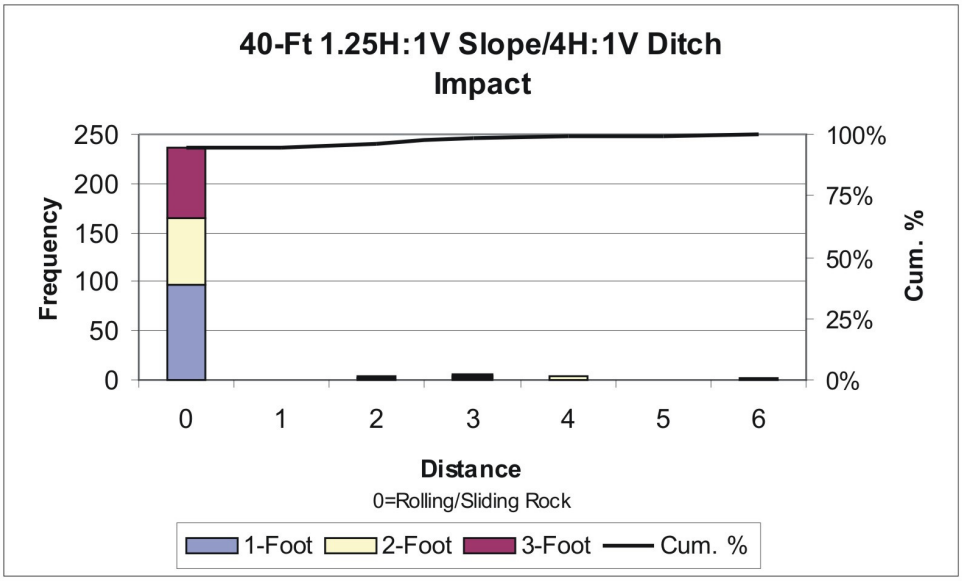

60-Ft 1H:1V Slope/6H:1V Ditch
Impact
Frequency
200
150
100
50
0
100%
75%
50%
25%
0%
Cum. %
0
1
2
3
4
5
6
7
8
9
10
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %


60-Ft 1H:1V Slope/Flat Ditch
Impact
Frequency
200
150
100
50
0
100%
80%
60%
40%
20%
0%
Cum. %
0
1
2
3
4
5
6
7
8
9
10
11
12
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %


80-Ft 1H:1V Slope/4H:1V Ditch
Impact
Frequency
Cum. %
200
150
100
50
0
100%
75%
50%
25%
0%
0
1
2
3
4
5
6
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %


80-Ft 1H:1V Slope/6H:1V Ditch
Impact
Frequency
Cum. %
200
150
100
50
0
100%
75%
50%
25%
0%
0
1
2
3
4
5
6
7
8
9
10
11
12
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %


80-Ft 1H:1V Slope/Flat Ditch
Impact
Frequency
Cum. %
200
150
100
50
0
100%
75%
50%
25%
0%
0
1
2
3
4
5
6
7
8
9
10
11
Distance (ft)
0=Rolling/Sliding Rock
1-Foot
2-Foot
3-Foot
Cum. %



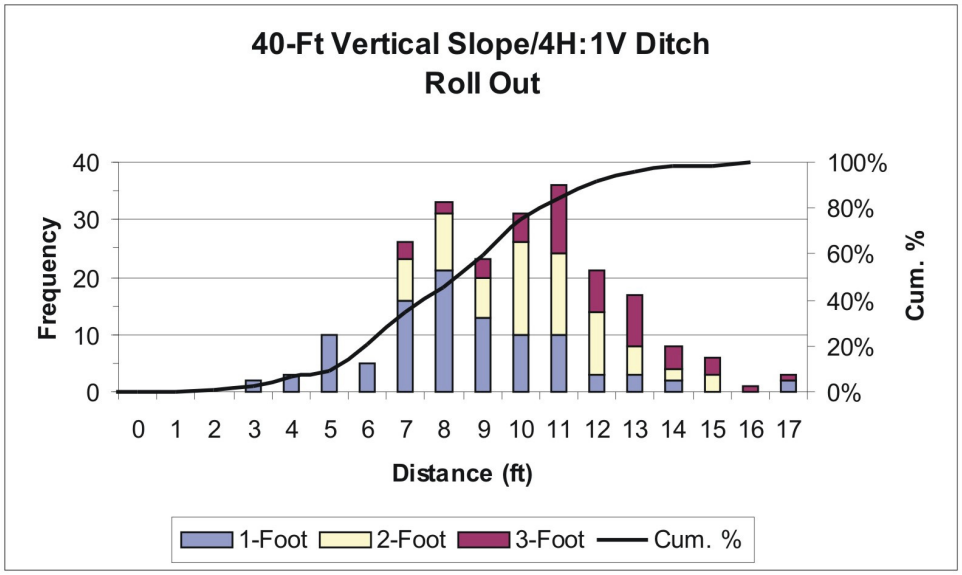
Note: This was the only 1.25H:1V slope tested. Insufficient funds were available to test additional slopes.

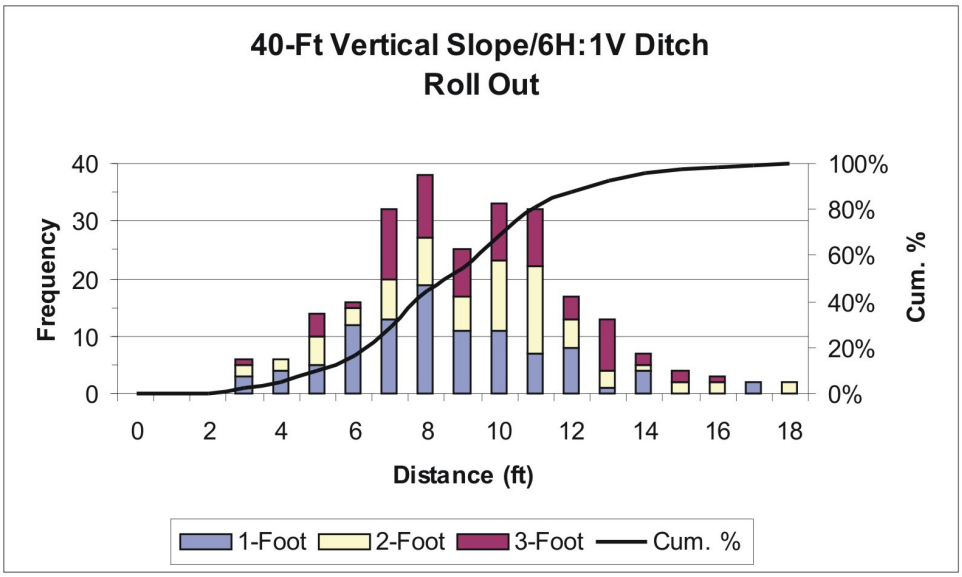
APPENDIX D: ROCKFALL ROLL OUT DISTANCE HISTOGRAMS

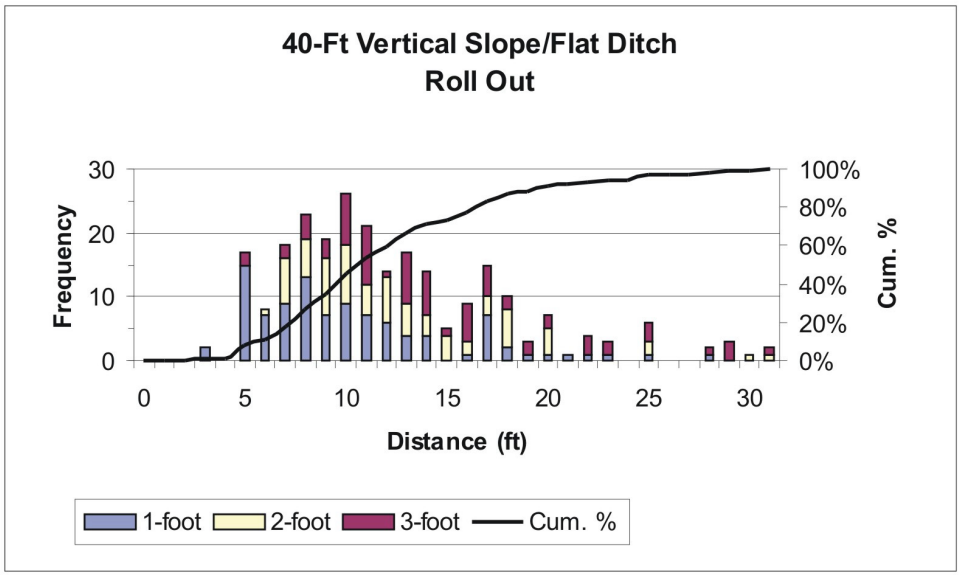
ROCKFALL ROLL OUT DISTANCE HISTOGRAMS

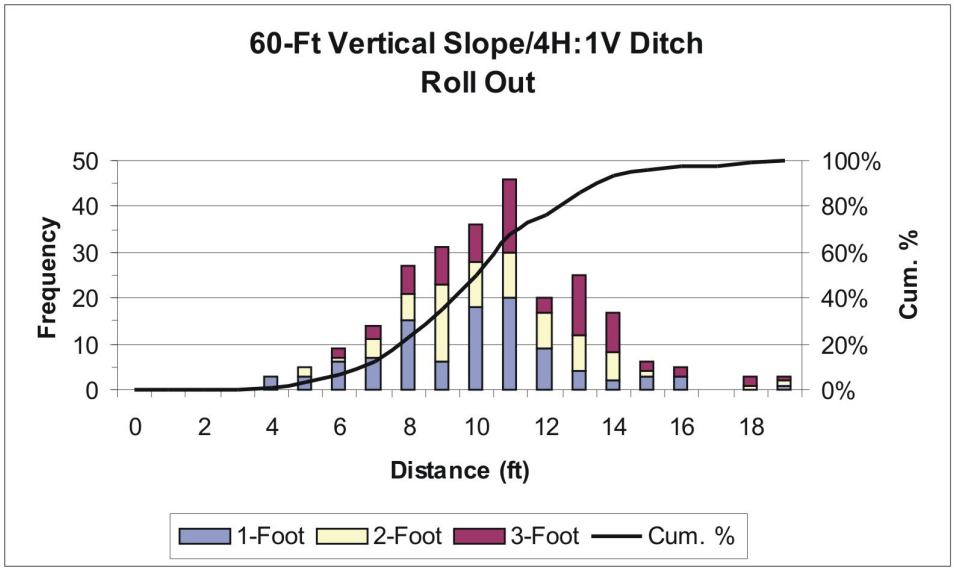
The roll out histograms have a similar appearance to the impact histograms but instead graphically represent the maximum distance each test-rock obtained from the toe of the slope as the rock rolled through the catchment area after impact. In some cases the rockfalls created a crater and did not move beyond the impact distance. This was more common with the steeper slopes. For flatter slopes, a zero distance roll out value was very rare. These general observations of rockfall roll out behavior should not be construed to mean that rockfalls from steep slopes would not result in large roll out values. The largest roll out measured was from a 0.25H:1V, 80-foot high slope. That distance was 99 feet. The roll out distances are the field measured slope distances. Field data was recorded to the nearest foot.

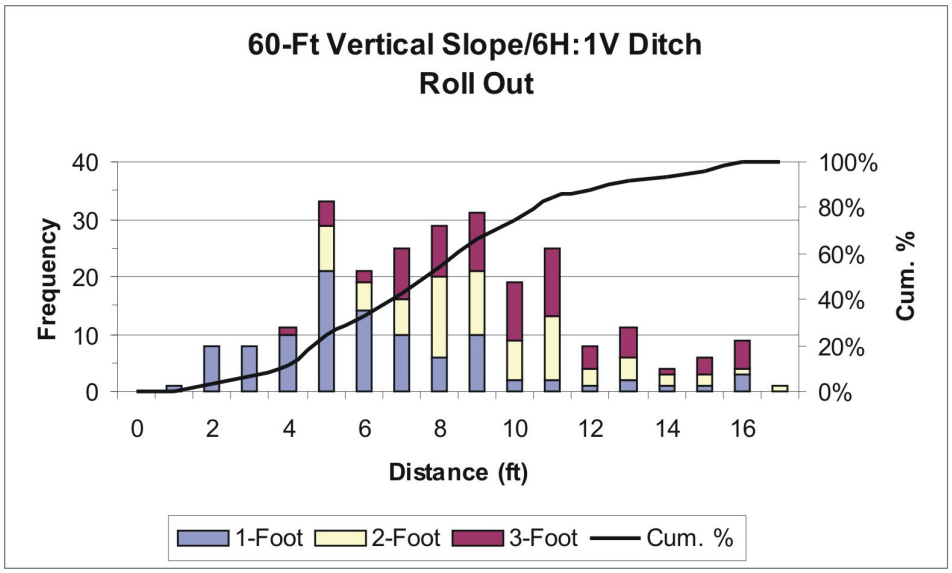
NOTE: Also included at the end of Appendix D is a limited set of data gathered from a 40-foot high, 1.25H:1V slope. The rocks rolled from this slope fell into a 4H:1V catchment area. The results were recorded but not compiled into catchment area percent retention graphs or design charts, because there were not sufficient funds to test the full suite of slope heights and catchment area inclinations for the 1.25H:1V test slope.

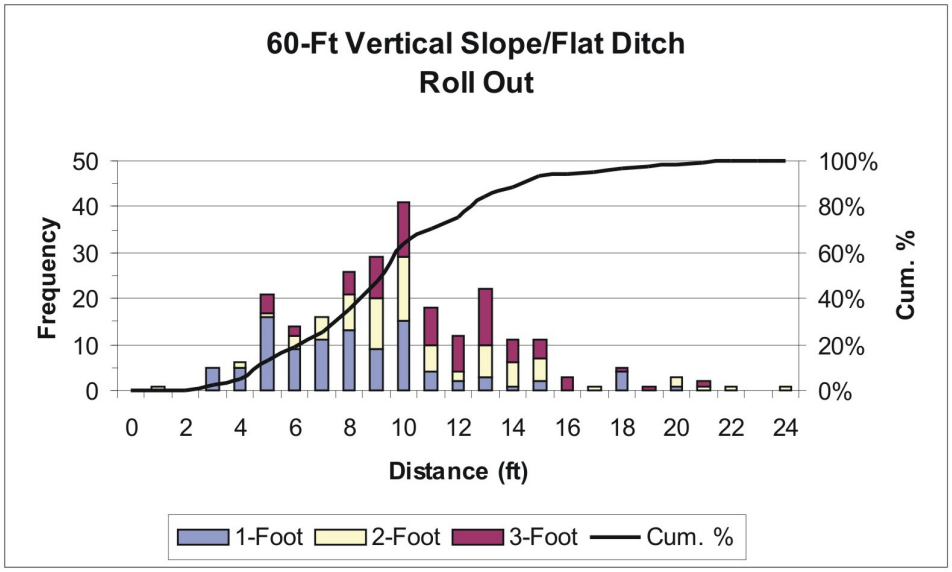

40-Ft Vertical Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

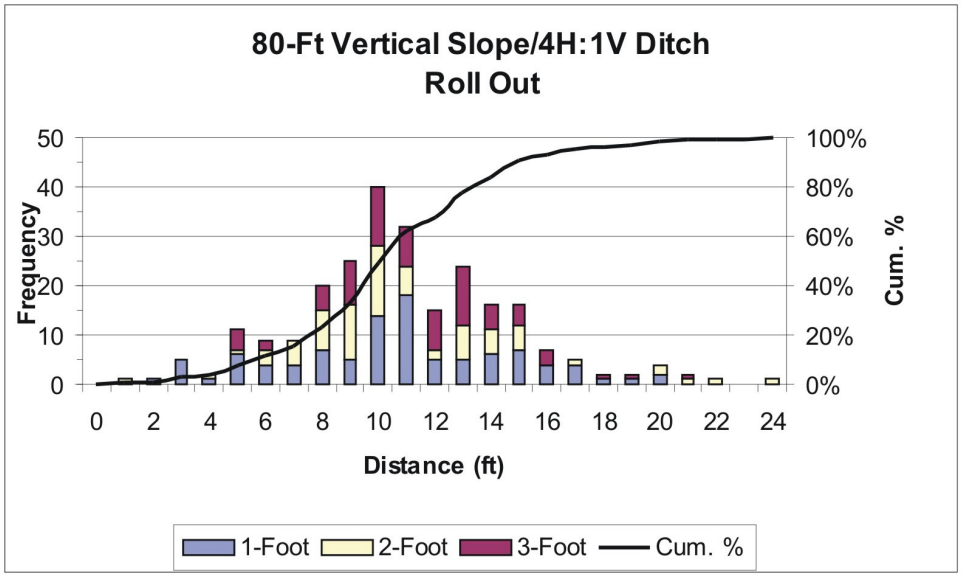

40-Ft Vertical Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

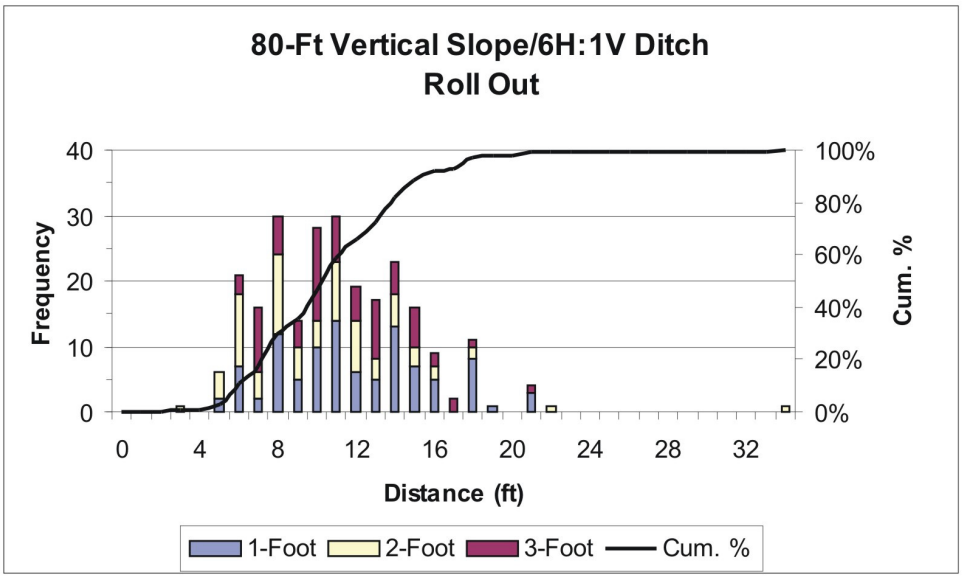

40-Ft Vertical Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-foot
2-foot
3-foot
Cum. %

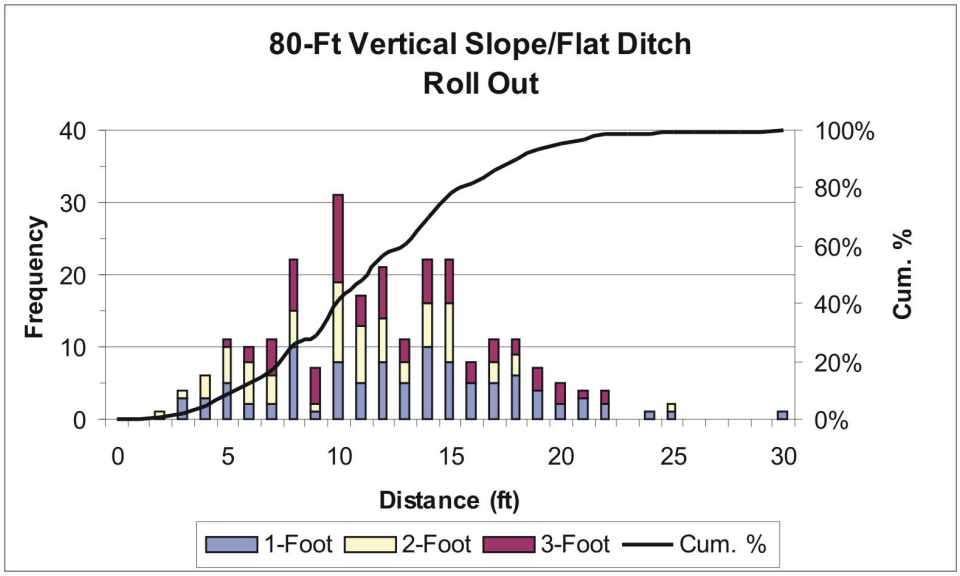

60-Ft Vertical Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

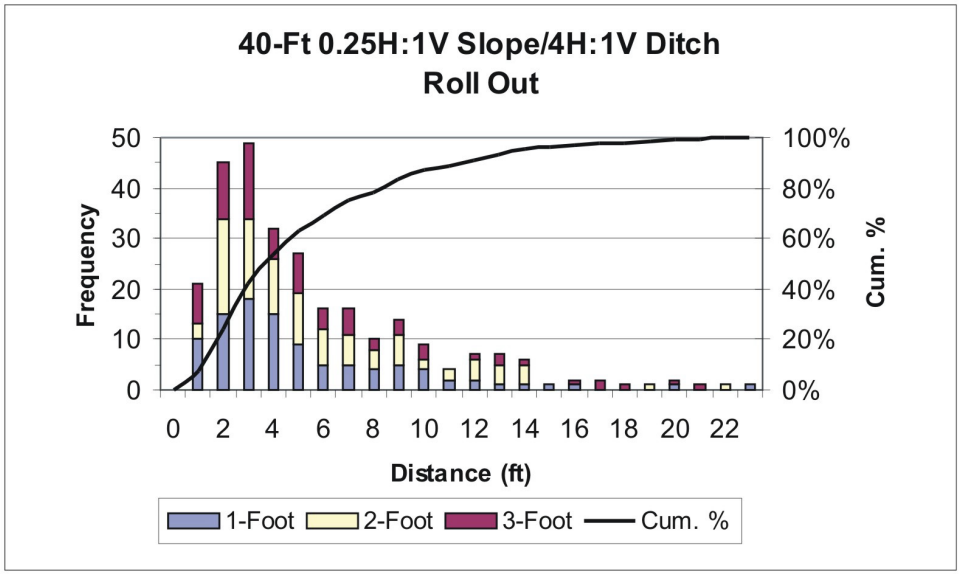

60-Ft Vertical Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

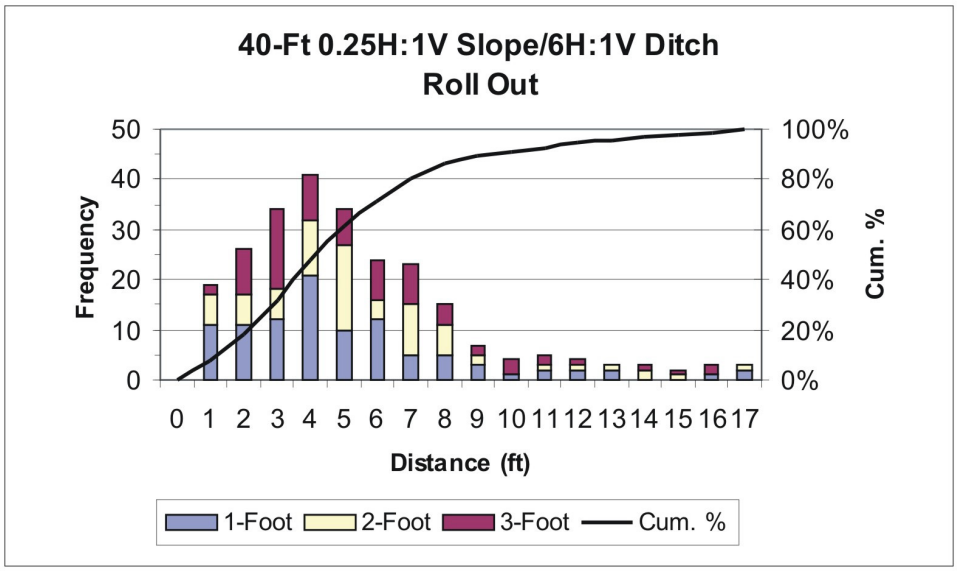

60-Ft Vertical Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

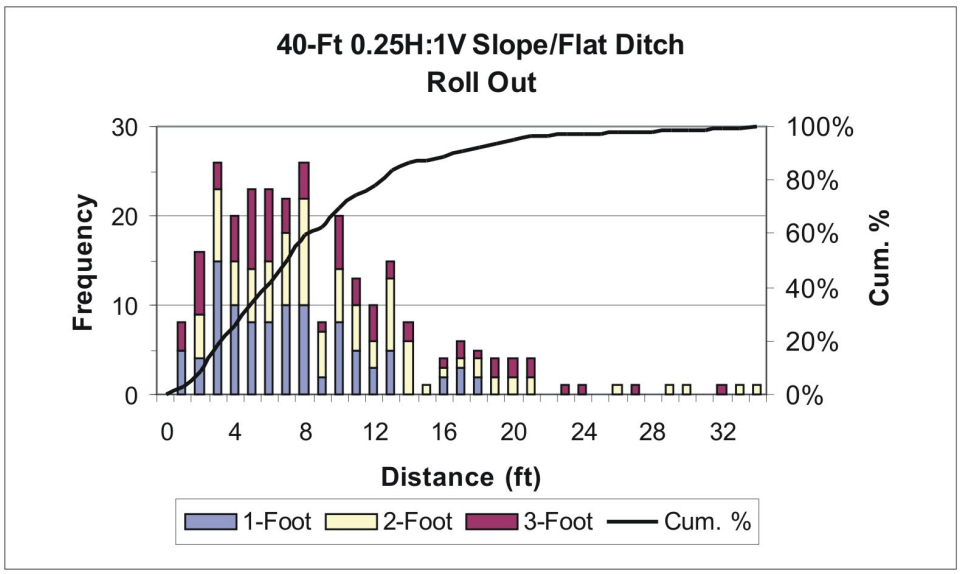

80-Ft Vertical Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

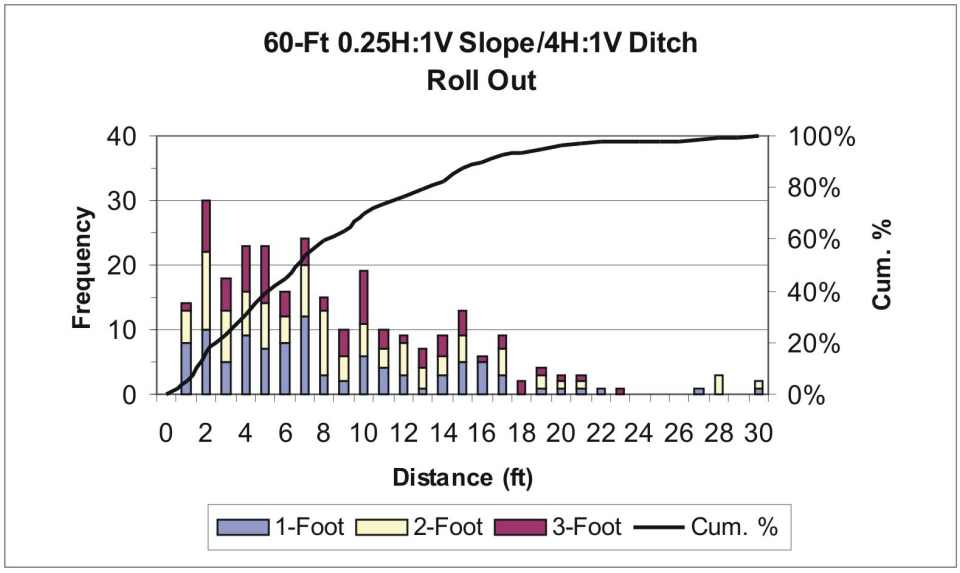

80-Ft Vertical Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

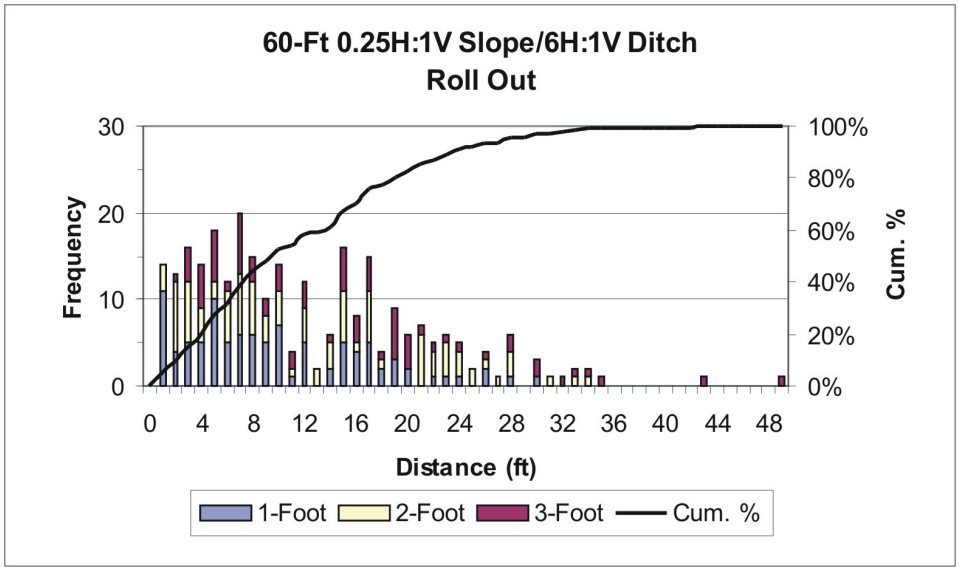

80-Ft Vertical Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

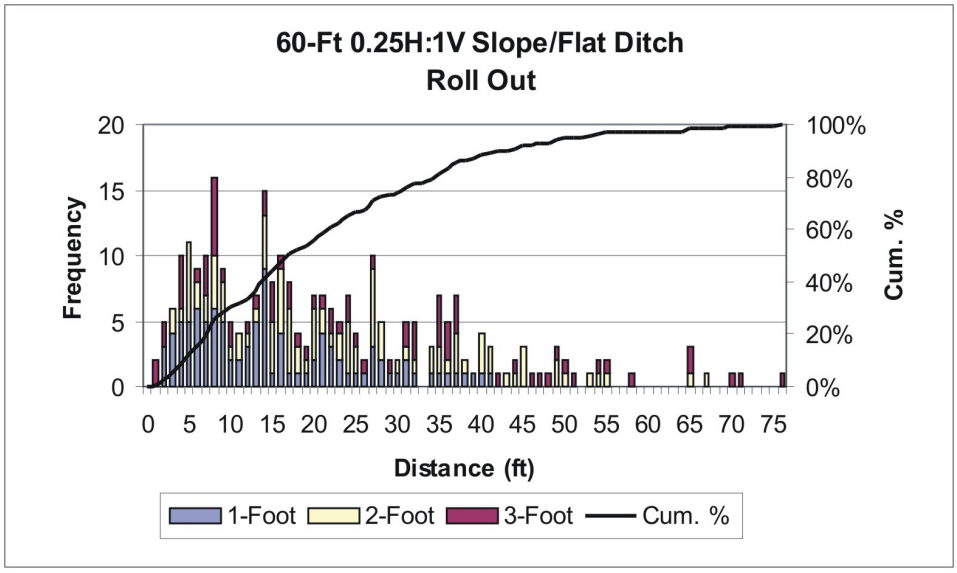

40-Ft 0.25H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

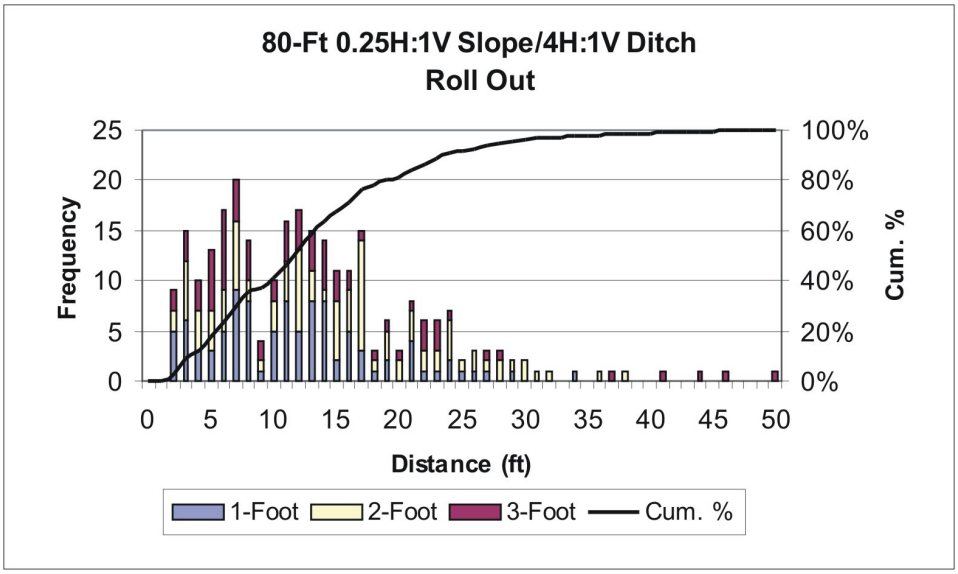

40-Ft 0.25H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

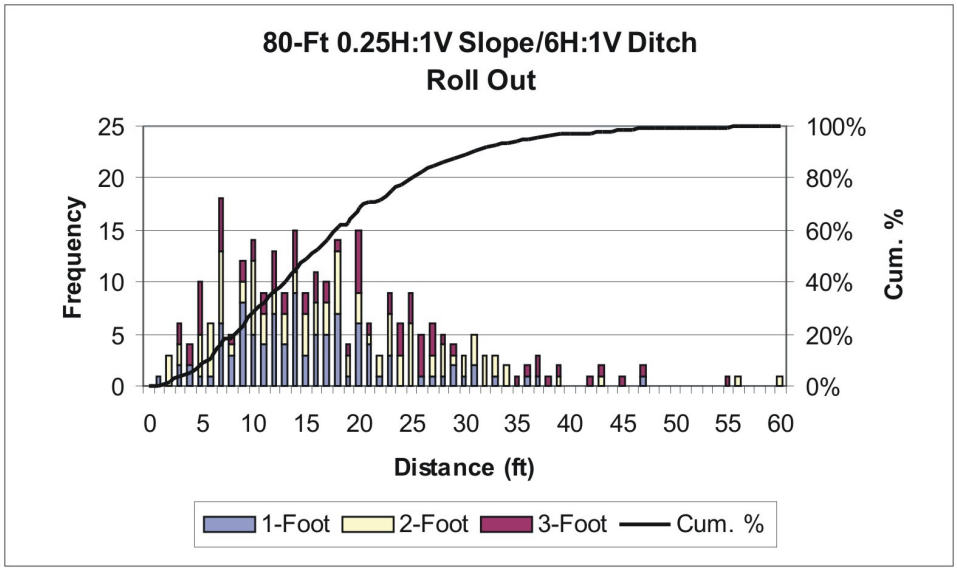

40-Ft 0.25H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

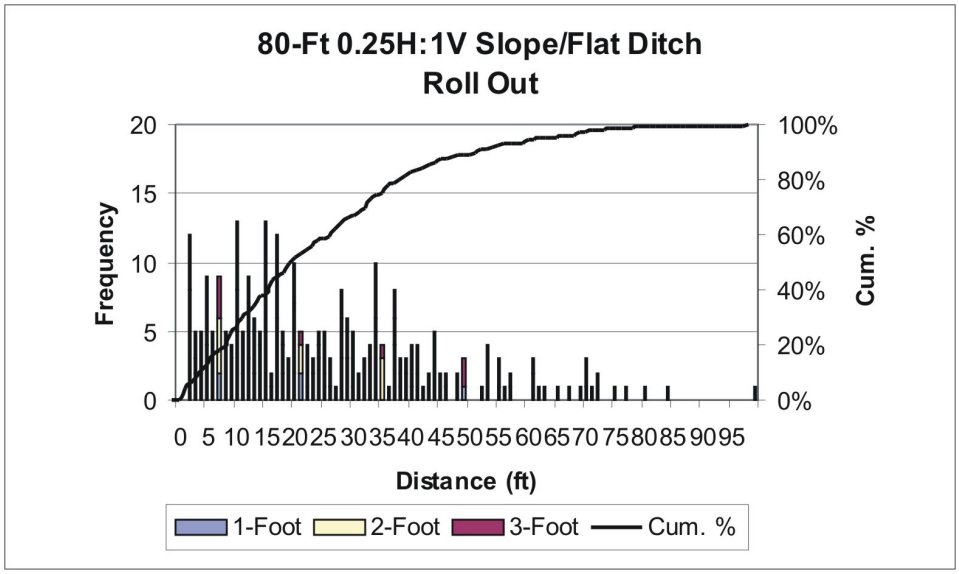

60-Ft 0.25H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

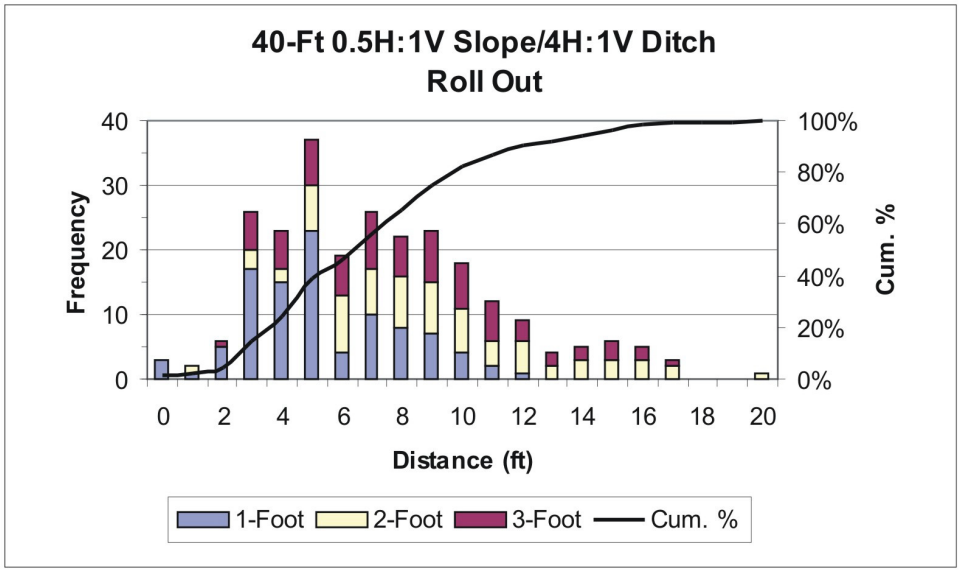

60-Ft 0.25H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

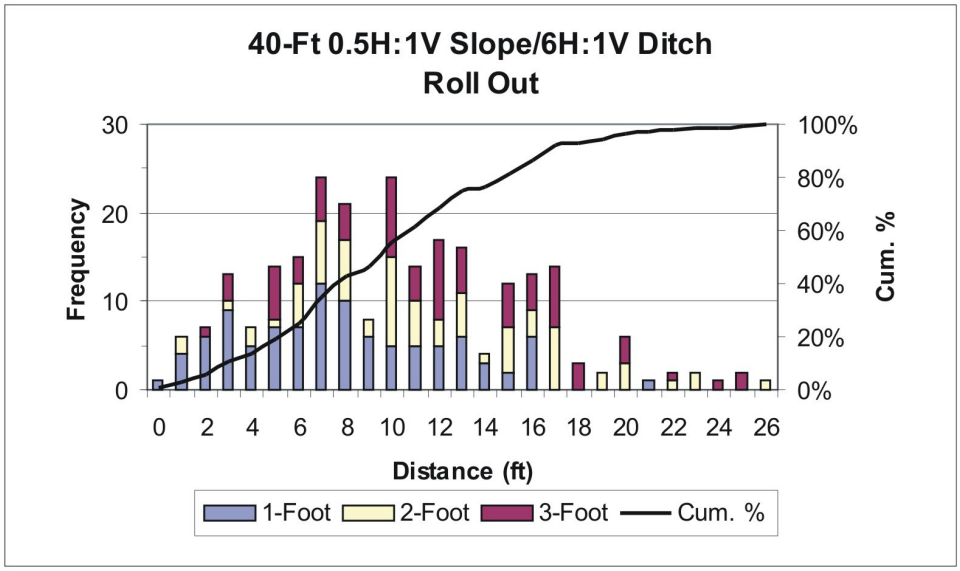

60-Ft 0.25H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

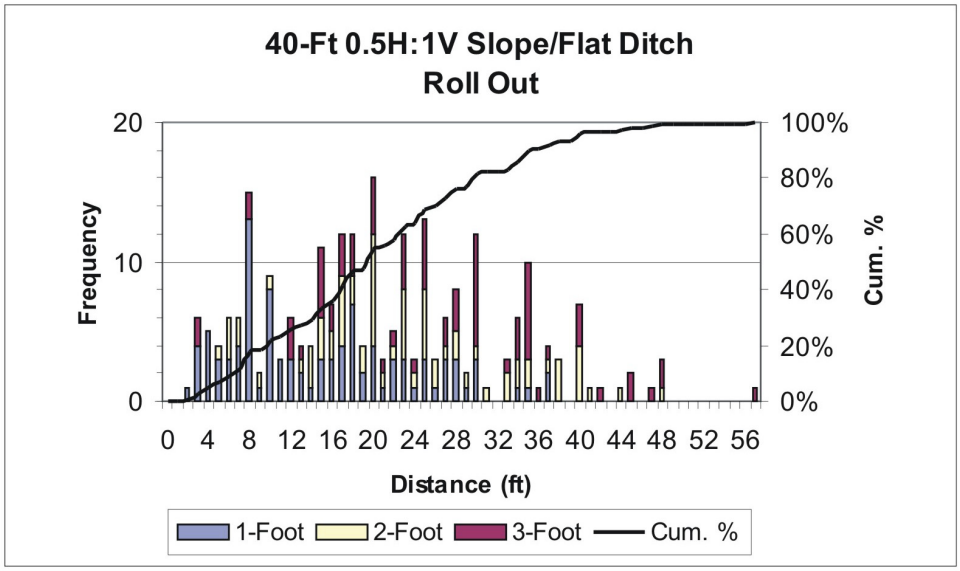

80-Ft 0.25H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

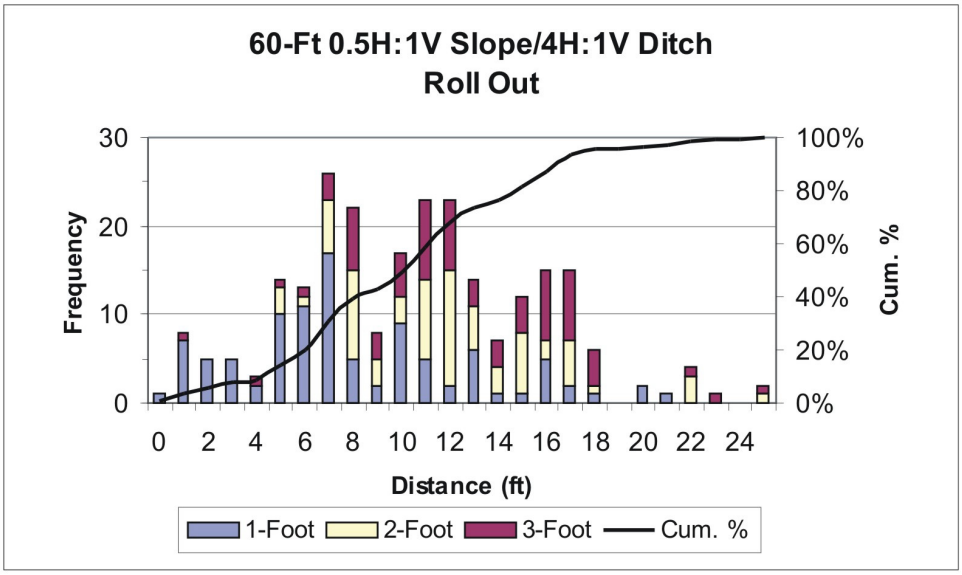

80-Ft 0.25H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

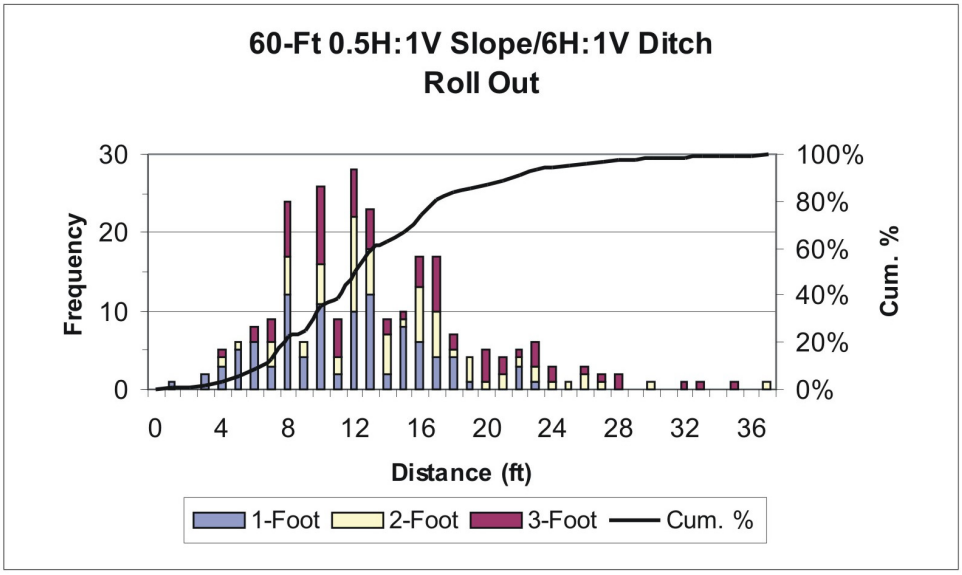

80-Ft 0.25H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

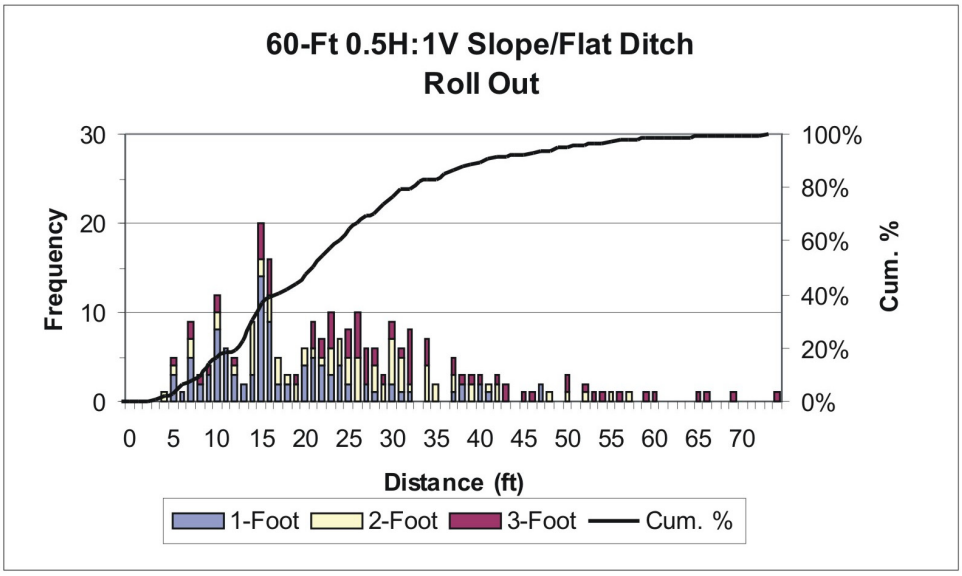

40-Ft 0.5H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

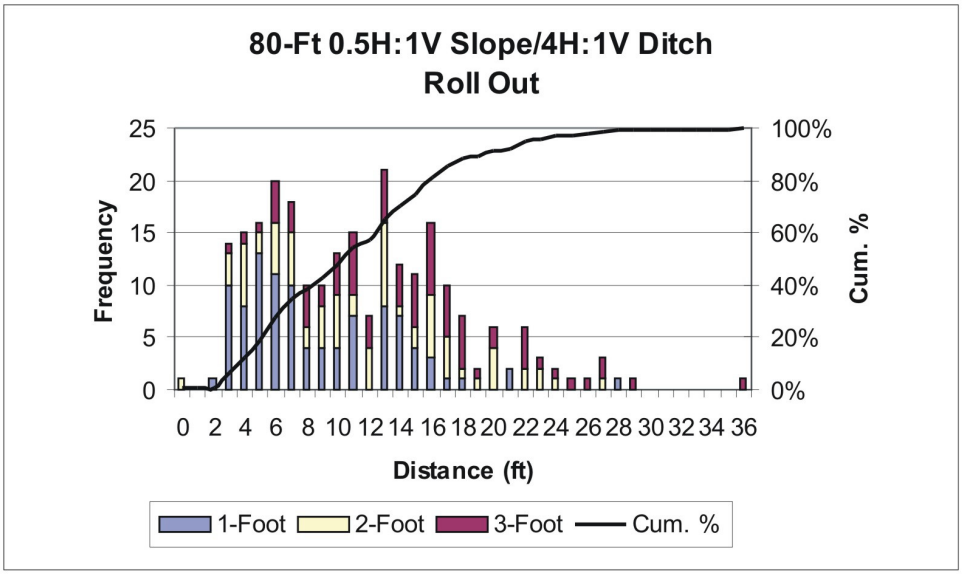

40-Ft 0.5H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

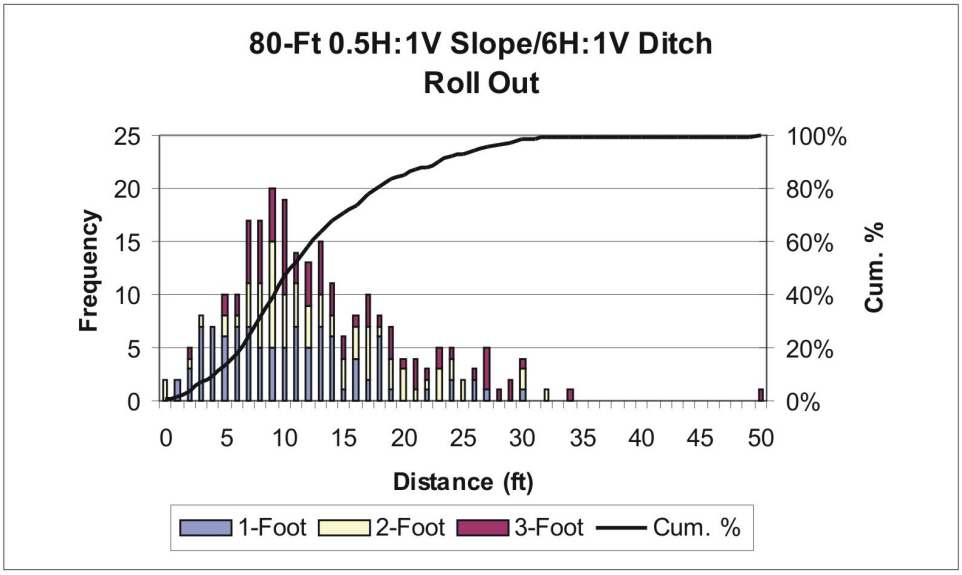

40-Ft 0.5H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

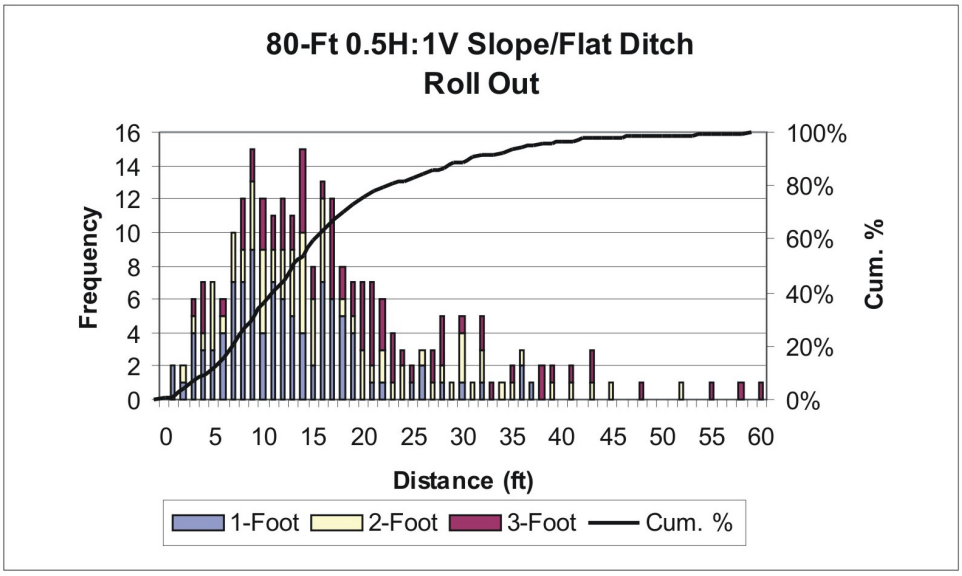

60-Ft 0.5H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

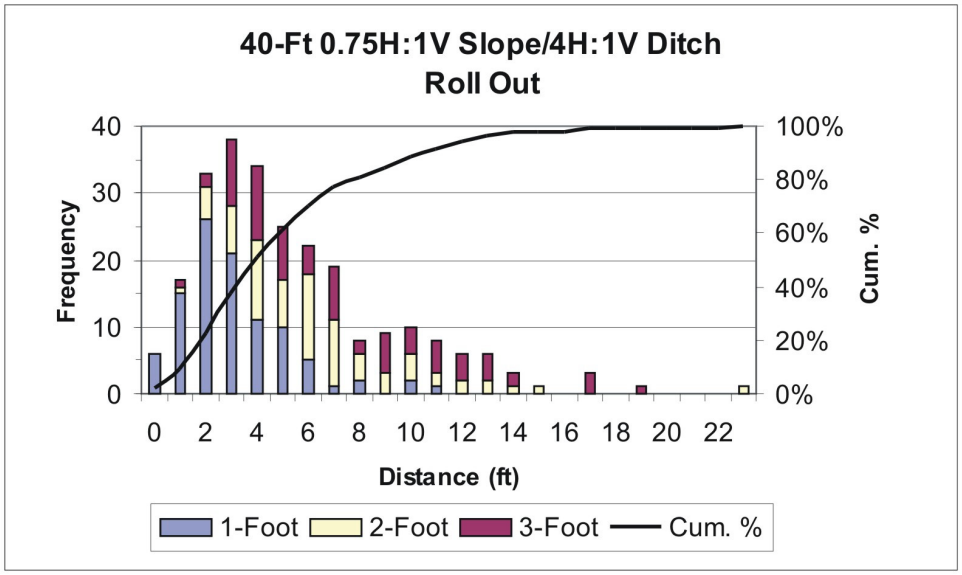

60-Ft 0.5H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

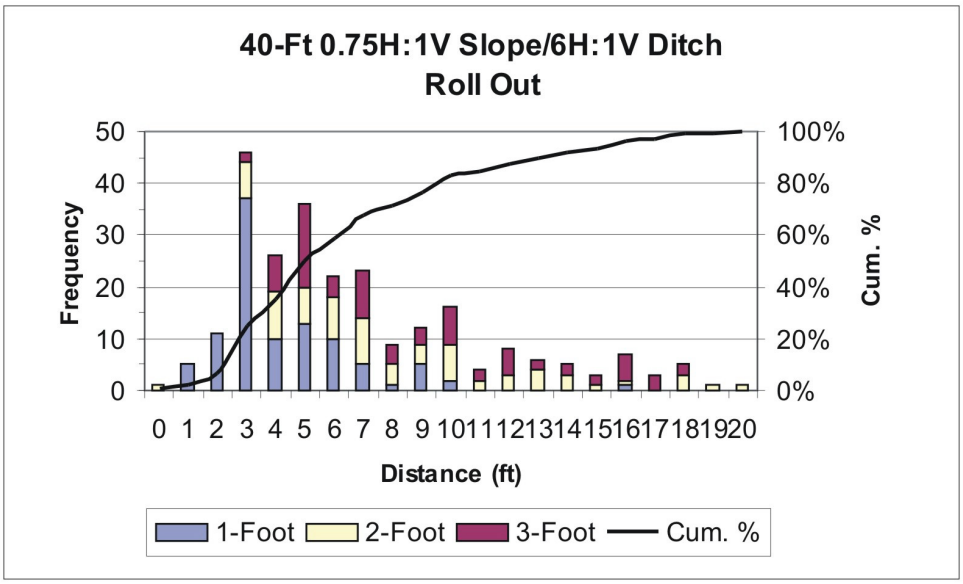

60-Ft 0.5H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

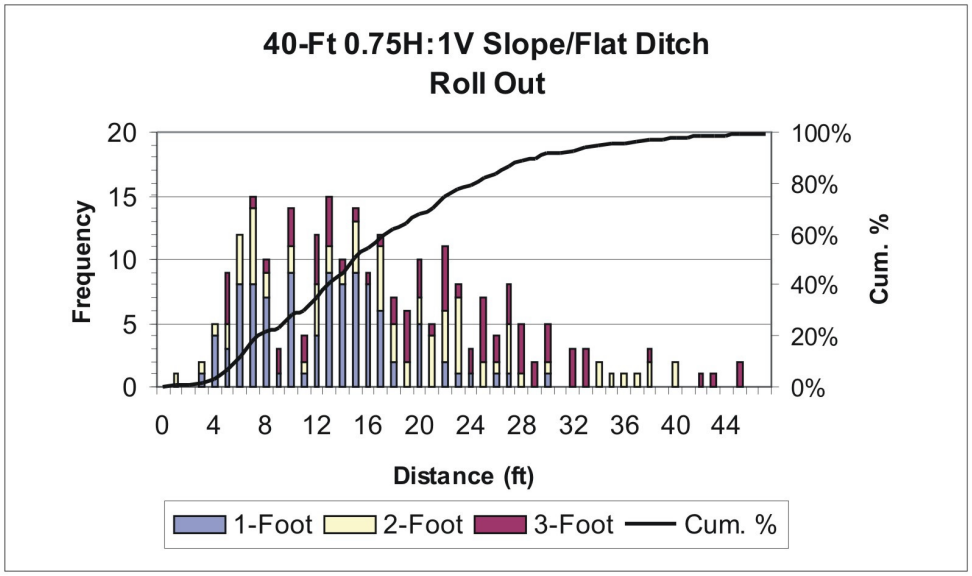

80-Ft 0.5H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

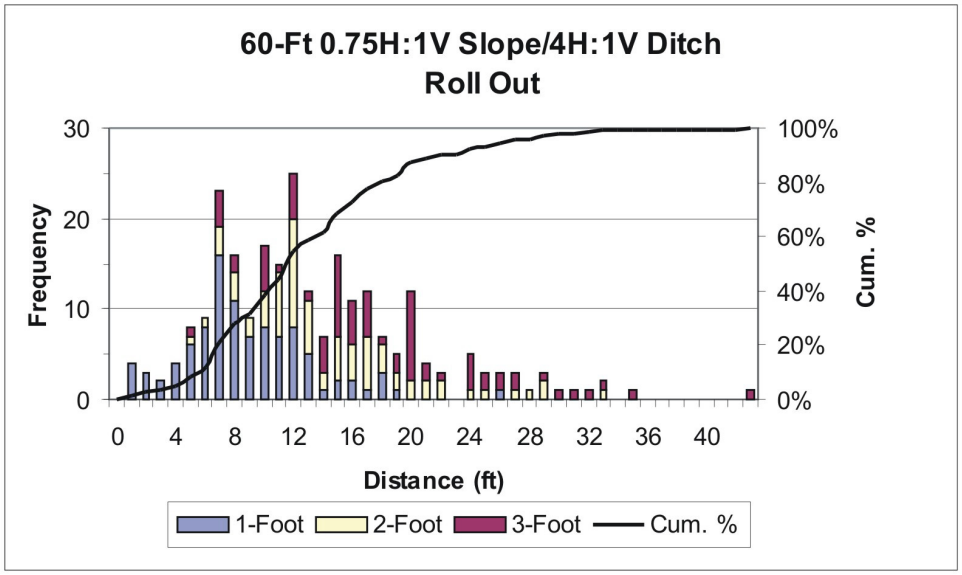

80-Ft 0.5H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

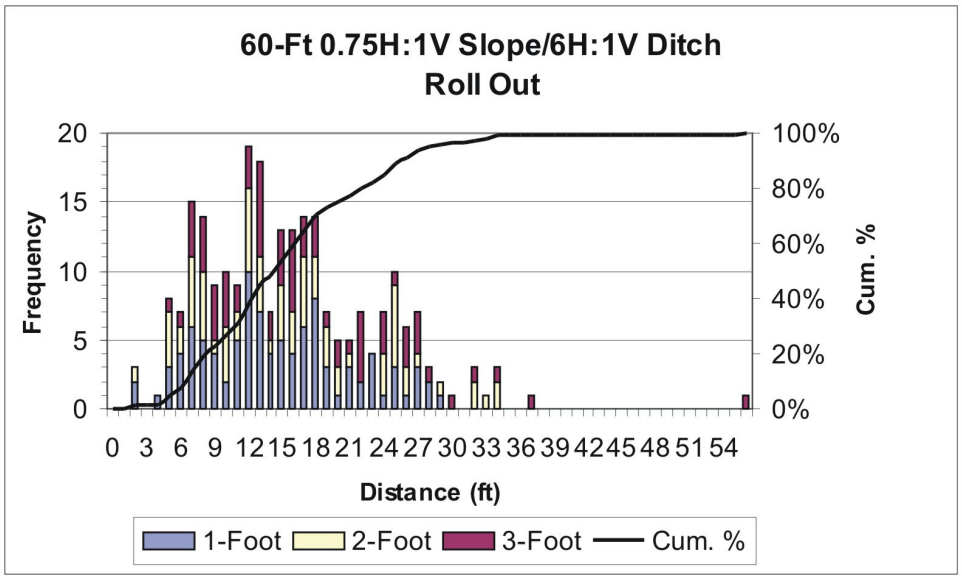

80-Ft 0.5H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

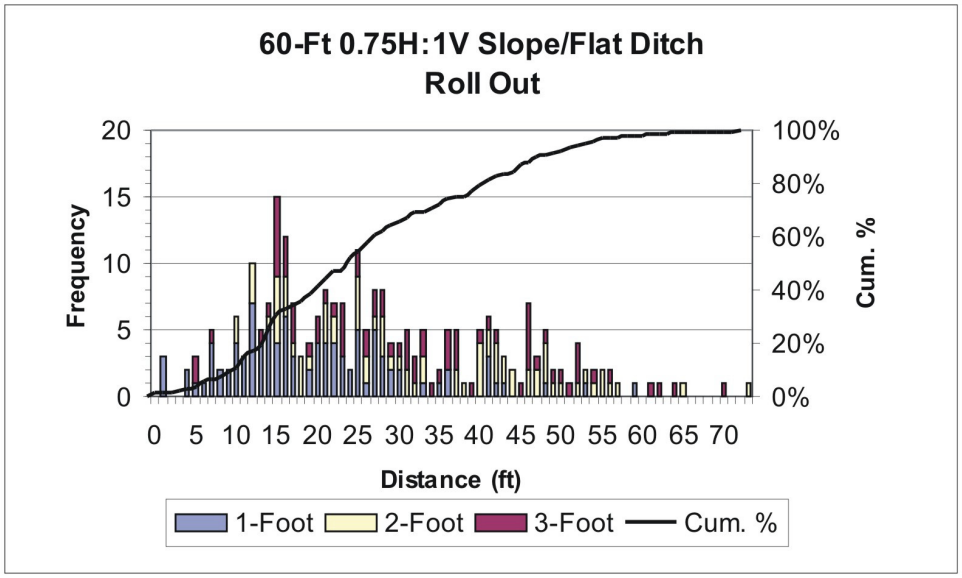

40-Ft 0.75H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

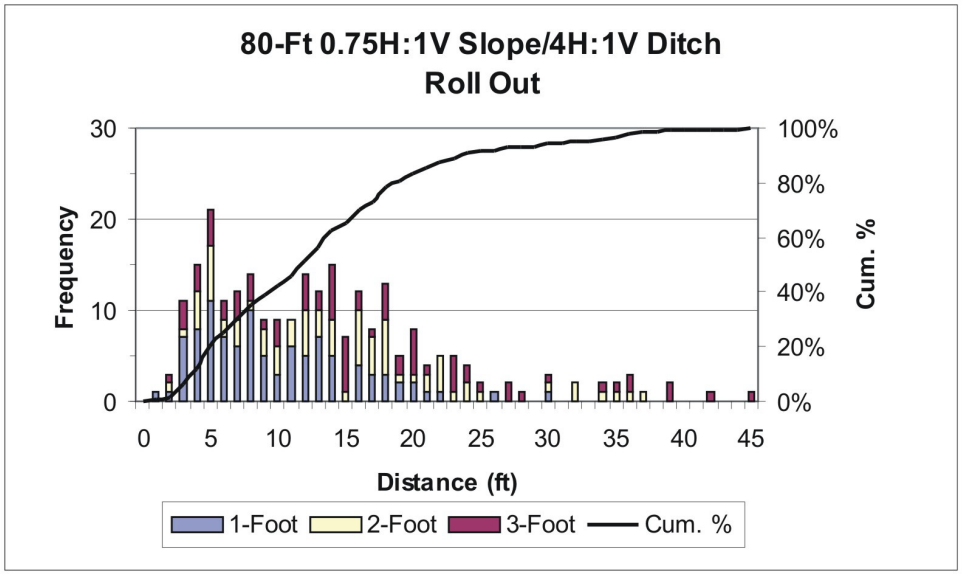

40-Ft 0.75H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

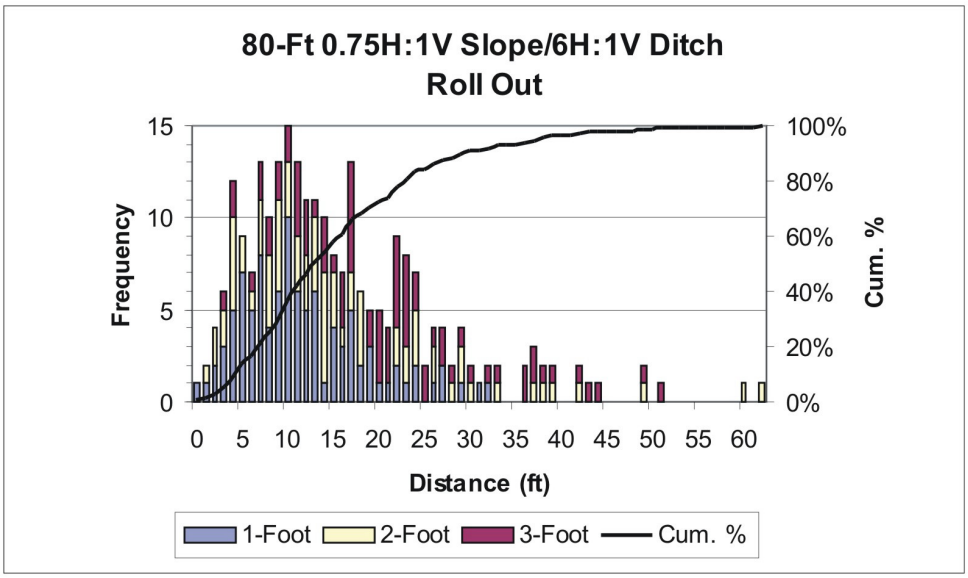

40-Ft 0.75H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

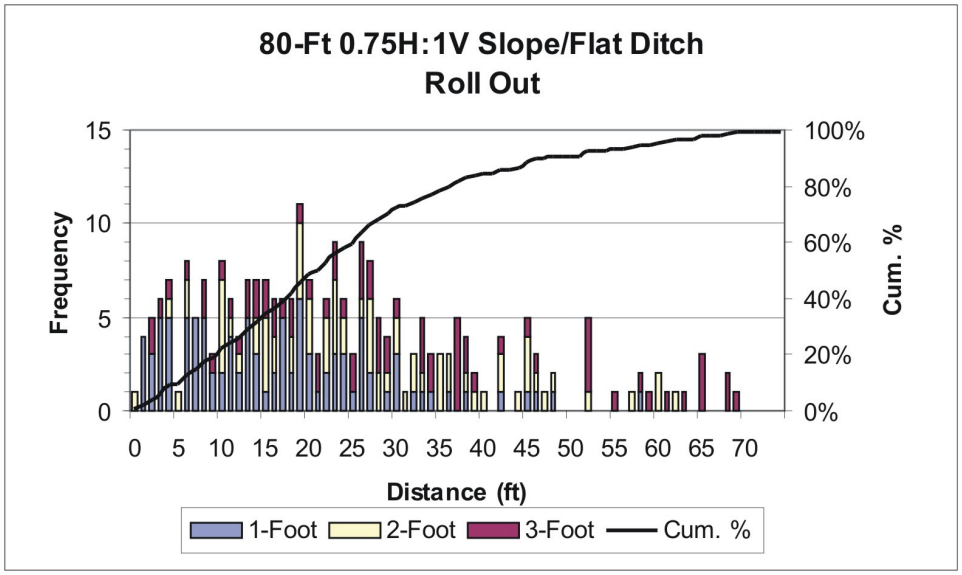

60-Ft 0.75H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

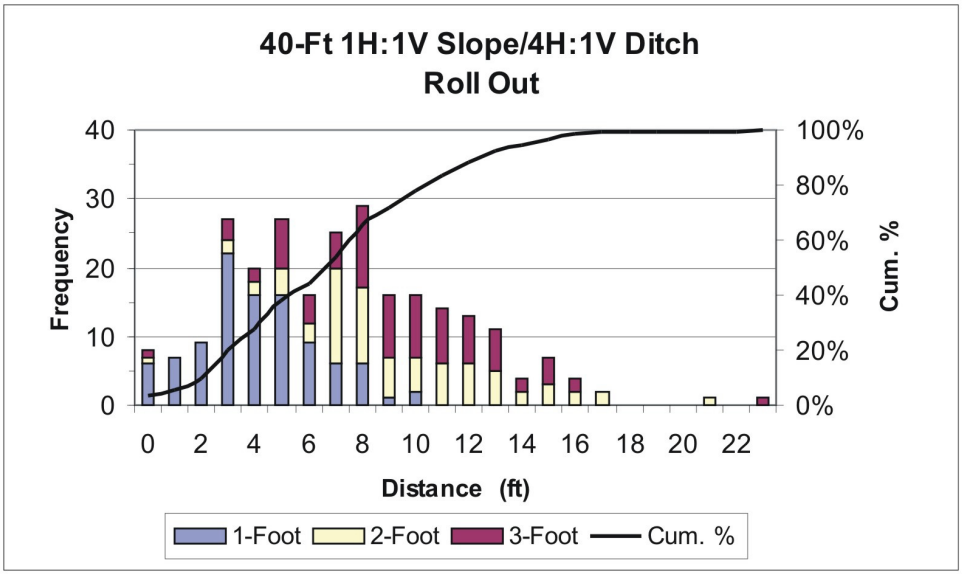

60-Ft 0.75H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

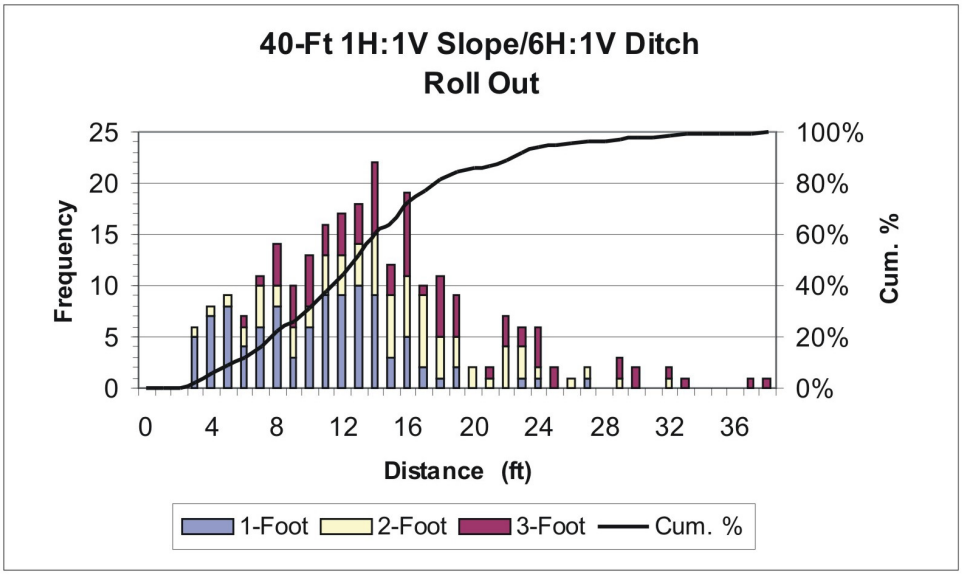

60-Ft 0.75H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

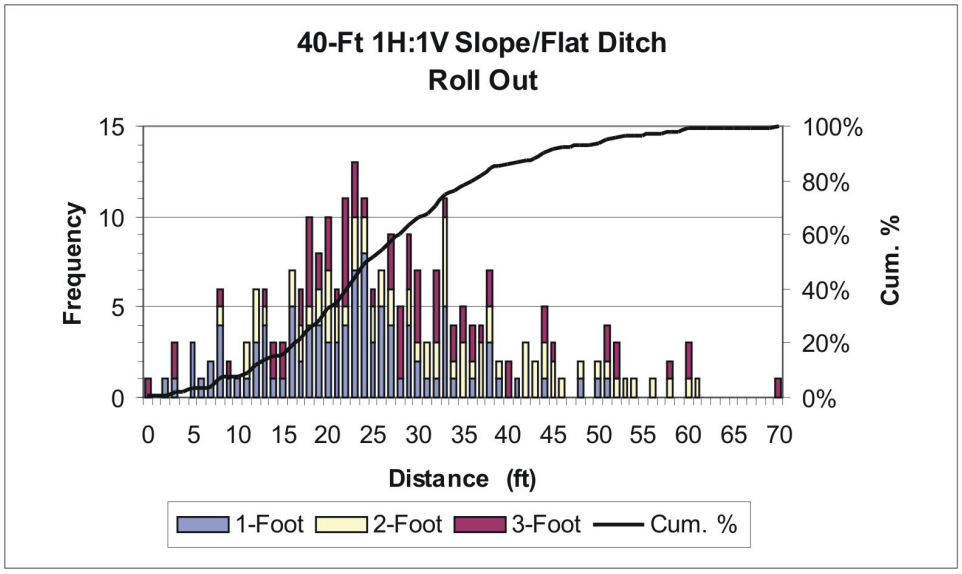

80-Ft 0.75H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

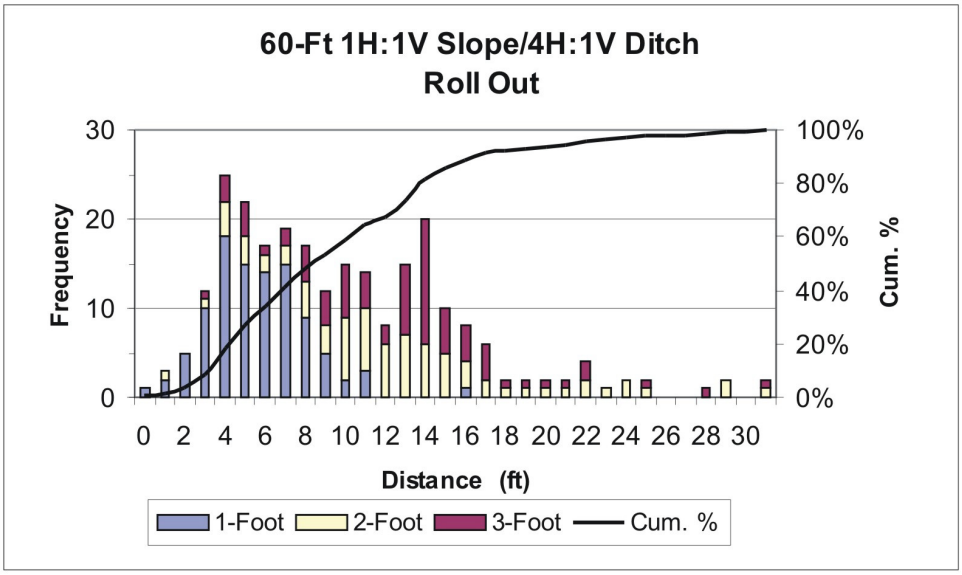

80-Ft 0.75H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

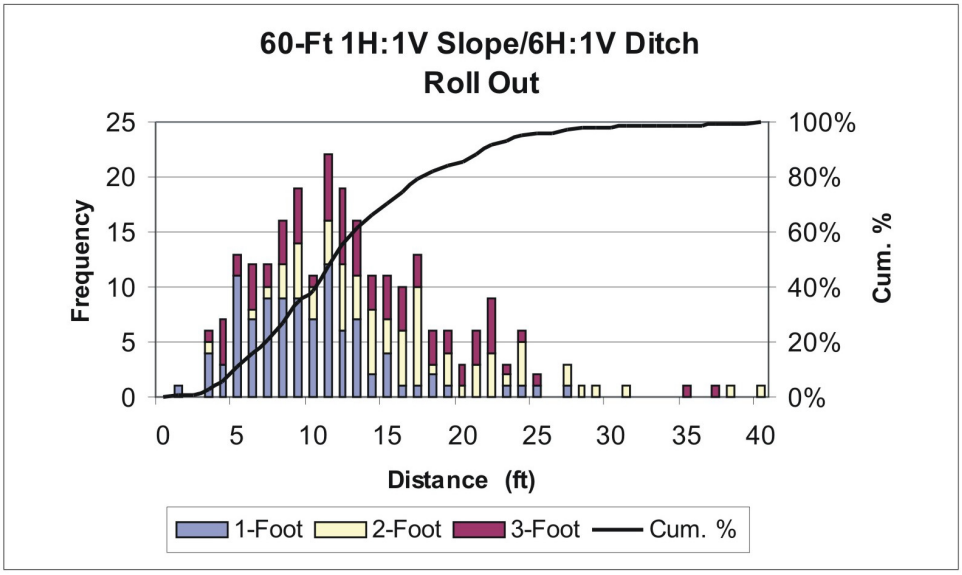

80-Ft 0.75H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

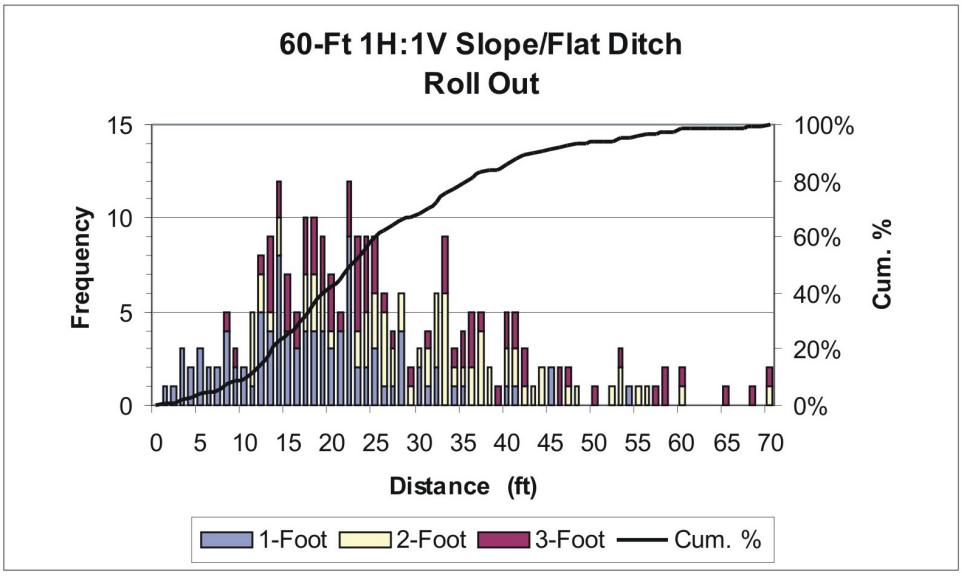

40-Ft 1H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

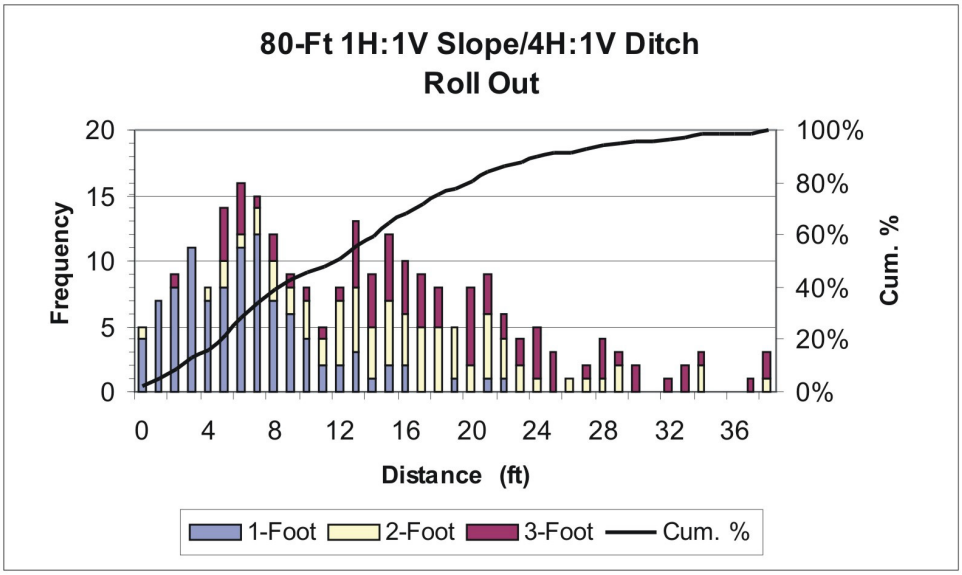

40-Ft 1H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

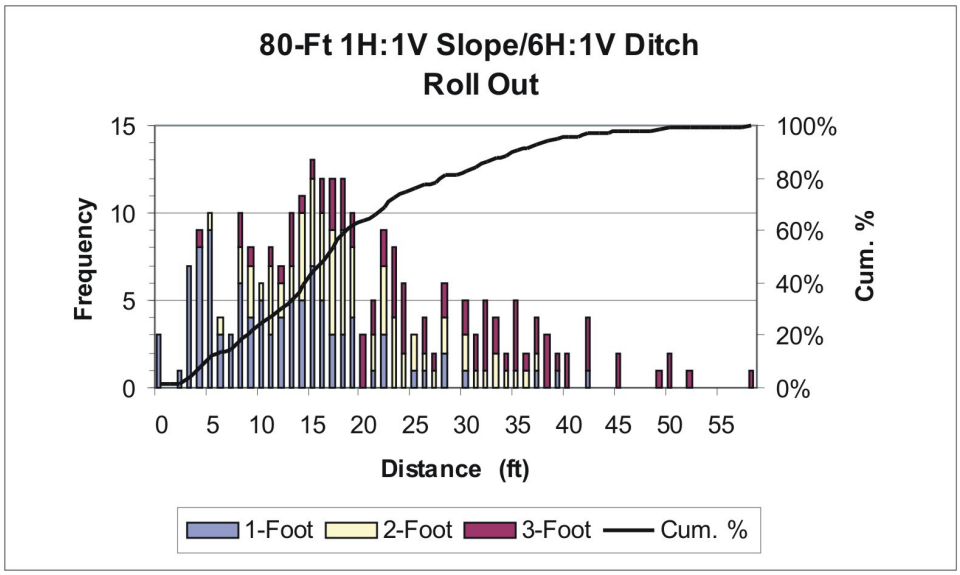

40-Ft 1H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

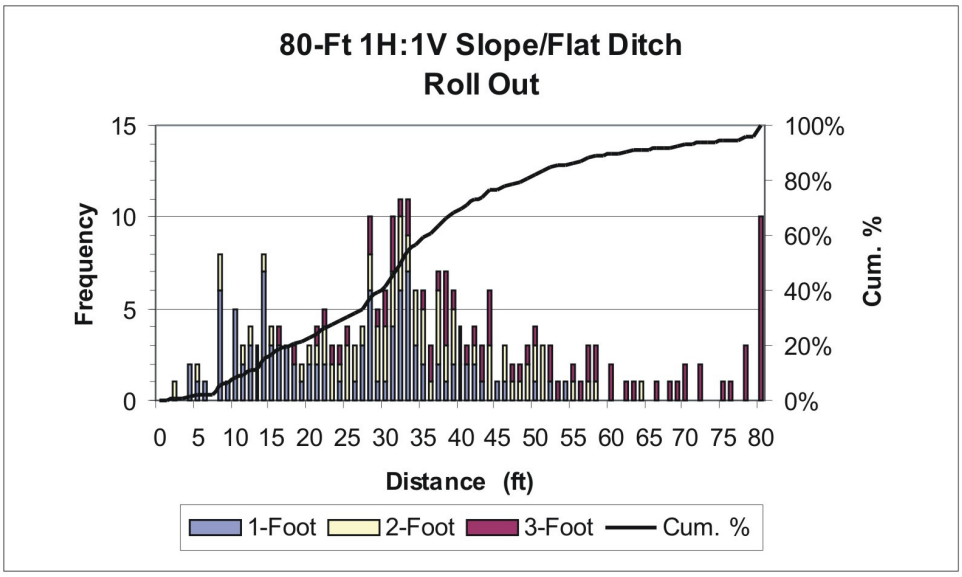

60-Ft 1H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %

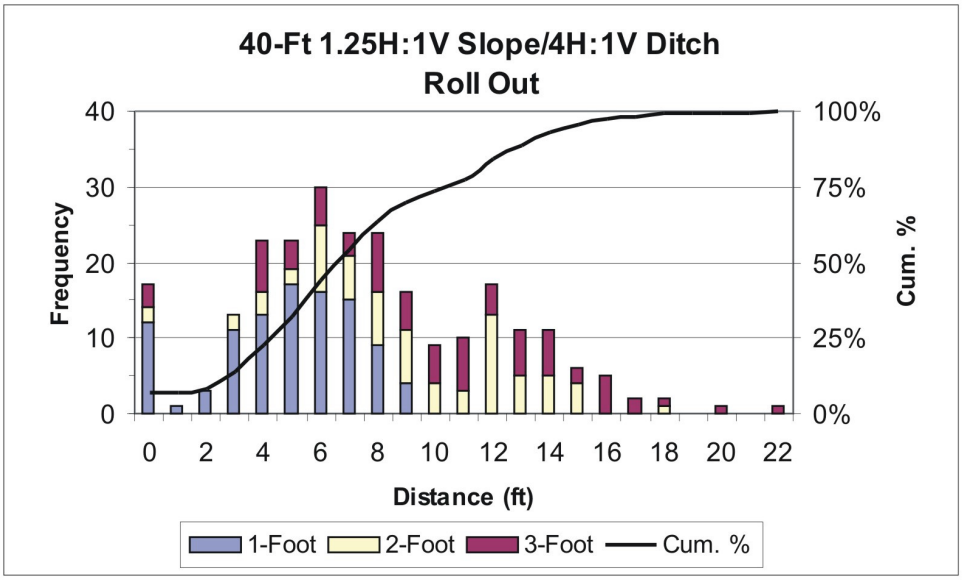

60-Ft 1H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %


60-Ft 1H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %


80-Ft 1H:1V Slope/4H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %


80-Ft 1H:1V Slope/6H:1V Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %


80-Ft 1H:1V Slope/Flat Ditch
Roll Out
Frequency
Cum. %
Distance (ft)
1-Foot
2-Foot
3-Foot
Cum. %



Note: This was the only 1.25H:1V slope tested. Insufficient funds available to test additional slopes.

APPENDIX E: ROCKFALL ENERGY DATA

ROCKFALL ENERGY DATA

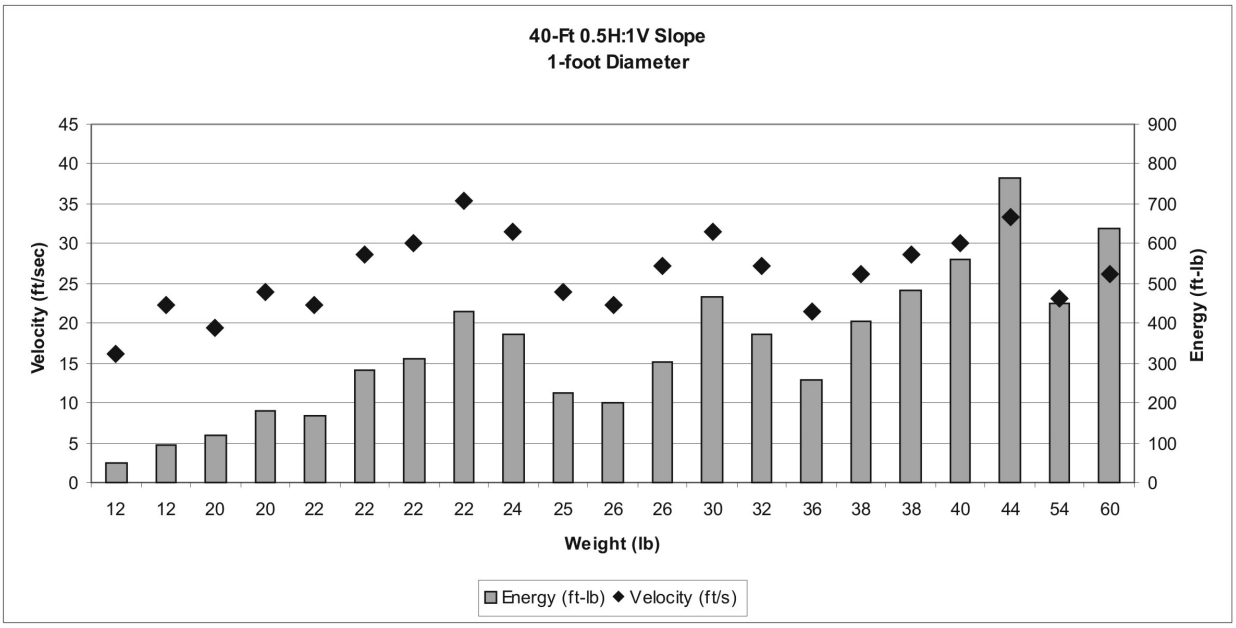
Selected rockfall energy data was recorded for the 0.5H:1V and 0.75H:1V slopes from the three heights tested. Sets of reference marks were placed on the slopes just above the toe of slope. Rocks within the one, two, and three-foot categories were weighed and video taped during rolling. By analyzing the video data, the time it took the rolling rocks to pass through the reference marks was used to determine the rockfall velocity. The weight and velocity data was used to calculate the kinetic energy of the falling rocks upon entering the catchment area.

The rockfall velocities are a function of cutslope angle and height and the amount of time the rocks are in contact with the slope. Velocities tended to be within a narrow range of values for each of the two slope angles tested with slight increases as the slope height increased. The variations are primarily attributable to the path taken by the rockfall during descent.

In general, when in contact with the slope, friction slows the rocks and lowers the resulting energies. Because the rocks are less often in contact with the slope (bouncing not rolling) on the 0.5H:1V slopes, the resulting velocities and energies are higher than for the 0.75H:1V slopes. This relationship explains why rolling rocks will come to a complete stop on flatter slopes and not make it to the catchment area.

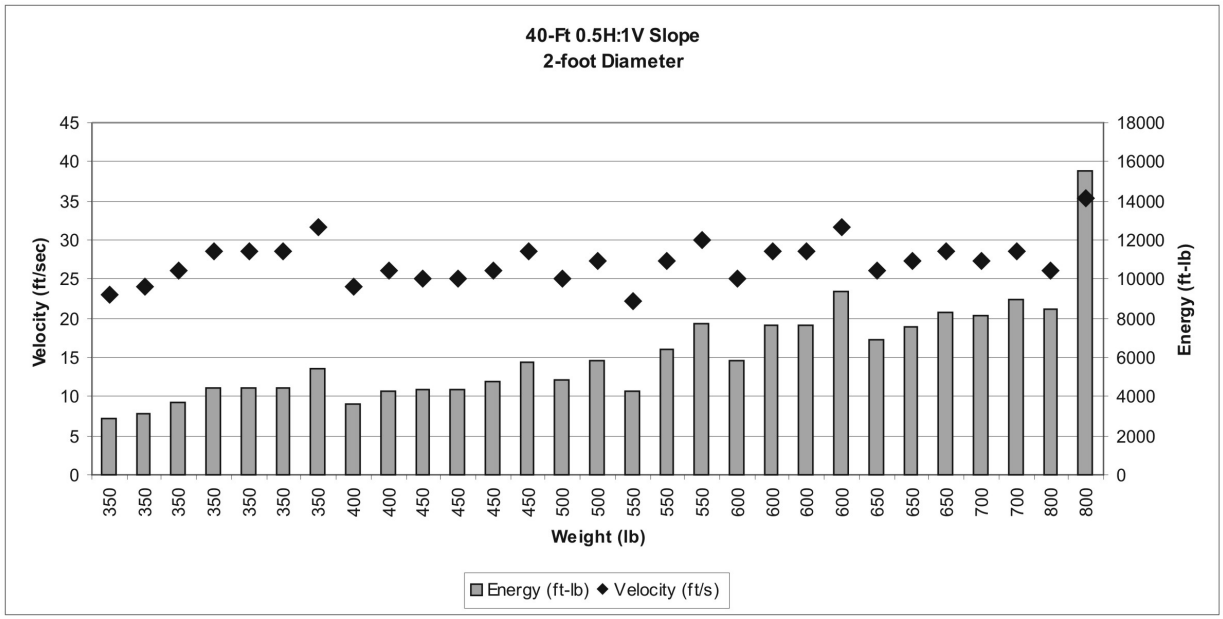
ENERGY OF 1-FOOT DIAMETER ROCKS
40-FOOT, 0.5H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
12	20	37	1.23	16.22	49
12	20	27	0.90	22.22	93
20	20	31	1.03	19.35	117
20	20	25	0.83	24.00	180
22	20	27	0.90	22.22	170
22	20	21	0.70	28.57	281
22	20	20	0.67	30.00	309
22	20	17	0.57	35.29	428
24	20	19	0.63	31.58	374
25	20	25	0.83	24.00	225
26	20	27	0.90	22.22	201
26	20	22	0.73	27.27	302
30	20	19	0.63	31.58	467
32	20	22	0.73	27.27	372
36	20	28	0.93	21.43	258
38	20	23	0.77	26.09	404
38	20	21	0.70	28.57	485
40	20	20	0.67	30.00	563
44	20	18	0.60	33.33	764
54	20	26	0.87	23.08	449
60	20	23	0.77	26.09	638



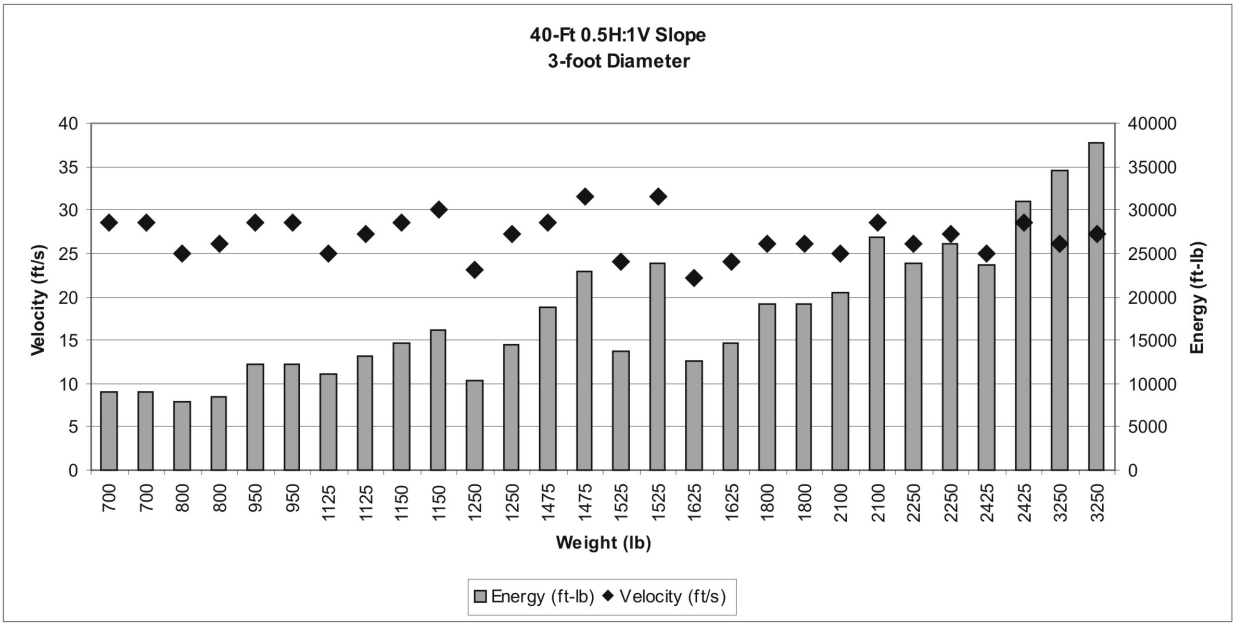
ENERGY OF 2-FOOT DIAMETER ROCKS
40-FOOT, 0.5H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
350	20	26	0.87	23.08	2912
350	20	25	0.83	24.00	3150
350	20	23	0.77	26.09	3722
350	20	21	0.70	28.57	4464
350	20	21	0.70	28.57	4464
350	20	21	0.70	28.57	4464
350	20	19	0.63	31.58	5454
400	20	25	0.83	24.00	3600
400	20	23	0.77	26.09	4253
450	20	24	0.80	25.00	4395
450	20	24	0.80	25.00	4395
450	20	23	0.77	26.09	4785
450	20	21	0.70	28.57	5740
500	20	24	0.80	25.00	4883
500	20	22	0.73	27.27	5811
550	20	27	0.90	22.22	4244
550	20	22	0.73	27.27	6392
550	20	20	0.67	30.00	7734
600	20	24	0.80	25.00	5859
600	20	21	0.70	28.57	7653
600	20	21	0.70	28.57	7653
600	20	19	0.63	31.58	9349
650	20	23	0.77	26.09	6912
650	20	22	0.73	27.27	7554
650	20	21	0.70	28.57	8291
700	20	22	0.73	27.27	8135
700	20	21	0.70	28.57	8929
800	20	23	0.77	26.09	8507
800	20	17	0.57	35.29	15571



ENERGY OF 3-FOOT DIAMETER ROCKS
40-FOOT, 0.5H:1V SLOPE

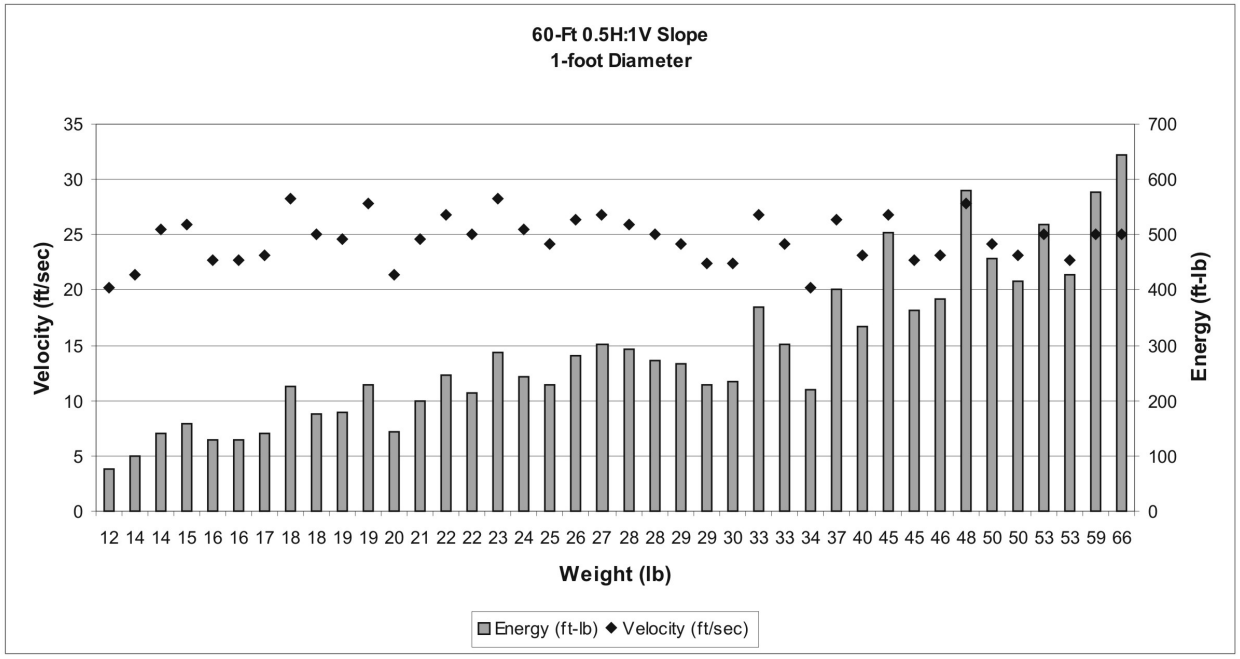
Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
700	20	21	0.70	28.57	8929
700	20	21	0.70	28.57	8929
800	20	24	0.80	25.00	7813
800	20	23	0.77	26.09	8507
950	20	21	0.70	28.57	12117
950	20	21	0.70	28.57	12117
1125	20	24	0.80	25.00	10986
1125	20	22	0.73	27.27	13075
1150	20	21	0.70	28.57	14668
1150	20	20	0.67	30.00	16172
1250	20	26	0.87	23.08	10401
1250	20	22	0.73	27.27	14527
1475	20	21	0.70	28.57	18814
1475	20	19	0.63	31.58	22983
1525	20	25	0.83	24.00	13725
1525	20	19	0.63	31.58	23762
1625	20	27	0.90	22.22	12539
1625	20	25	0.83	24.00	14625
1800	20	23	0.77	26.09	19140
1800	20	23	0.77	26.09	19140
2100	20	24	0.80	25.00	20508
2100	20	21	0.70	28.57	26786
2250	20	23	0.77	26.09	23925
2250	20	22	0.73	27.27	26149
2425	20	24	0.80	25.00	23682
2425	20	21	0.70	28.57	30931
3250	20	23	0.77	26.09	34558
3250	20	22	0.73	27.27	37771



ENERGY OF 1-FOOT DIAMETER ROCKS
60-FOOT, 0.5H:1V SLOPE

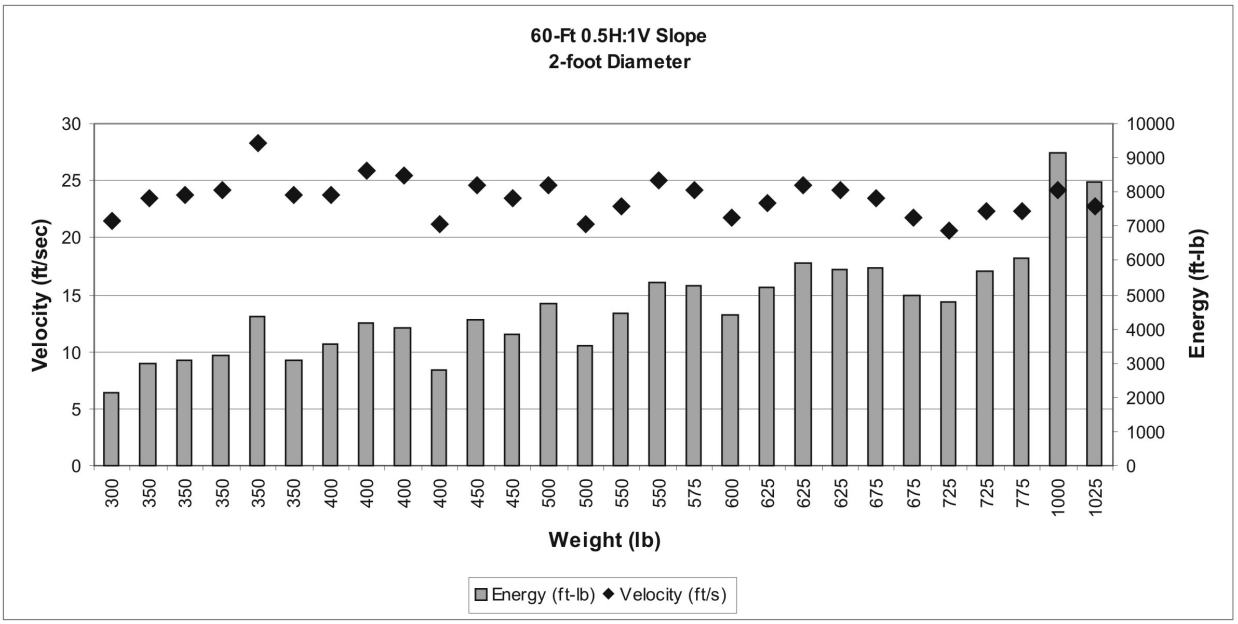
Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
12	50	74	2.47	20.27	77
14	50	70	2.33	21.43	100
14	50	59	1.97	25.42	141
15	50	58	1.93	25.86	157
16	50	66	2.20	22.73	129
16	50	66	2.20	22.73	129
17	50	65	2.17	23.08	141
18	50	53	1.77	28.30	225
18	50	60	2.00	25.00	176
19	50	61	2.03	24.59	180
19	50	54	1.80	27.78	229
20	50	70	2.33	21.43	143
21	50	61	2.03	24.59	198
22	50	56	1.87	26.79	247
22	50	60	2.00	25.00	215
23	50	53	1.77	28.30	288
24	50	59	1.97	25.42	242
25	50	62	2.07	24.19	229
26	50	57	1.90	26.32	281
27	50	56	1.87	26.79	303
28	50	58	1.93	25.86	293
28	50	60	2.00	25.00	273
29	50	62	2.07	24.19	265
29	50	67	2.23	22.39	227
30	50	67	2.23	22.39	235
33	50	56	1.87	26.79	370
33	50	62	2.07	24.19	302
34	50	74	2.47	20.27	218
37	50	57	1.90	26.32	400
40	50	65	2.17	23.08	333
45	50	56	1.87	26.79	504
45	50	66	2.20	22.73	363
46	50	65	2.17	23.08	383
48	50	54	1.80	27.78	579
50	50	62	2.07	24.19	457
50	50	65	2.17	23.08	416
53	50	60	2.00	25.00	518
53	50	66	2.20	22.73	428
59	50	60	2.00	25.00	576
66	50	60	2.00	25.00	645

ENERGY OF 1-FOOT DIAMETER ROCKS
60-FOOT, 0.5H:1V SLOPE



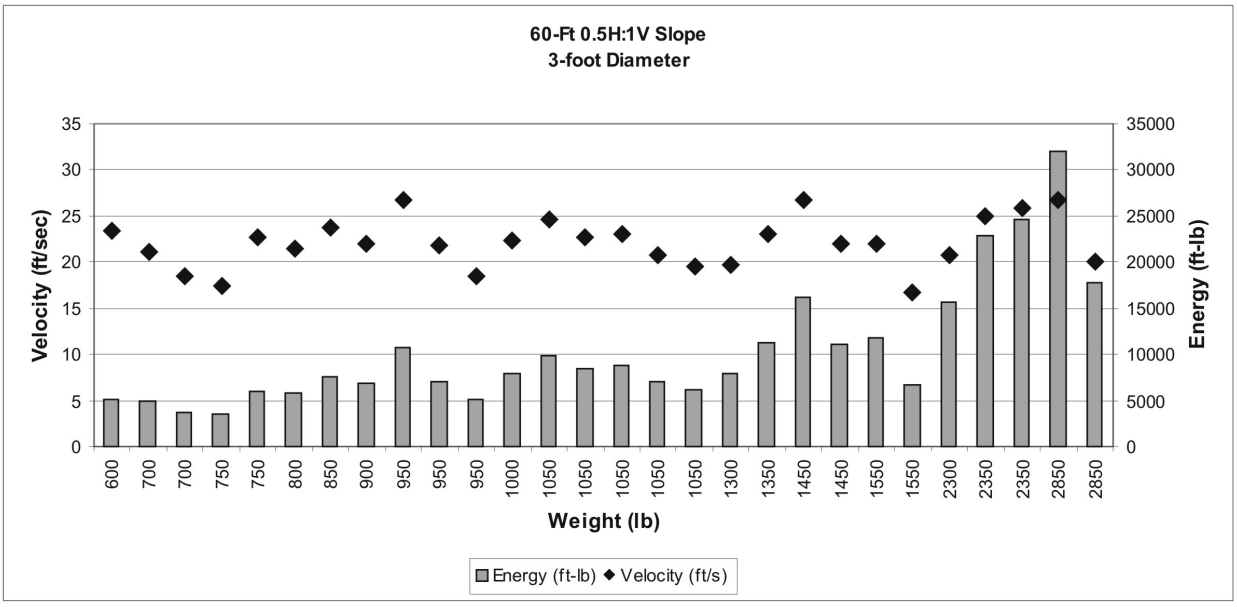
ENERGY OF 2-FOOT DIAMETER ROCKS
60-FOOT, 0.5H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
300	50	70	2.33	21.43	2152
350	50	64	2.13	23.44	3004
350	50	63	2.10	23.81	3100
350	50	62	2.07	24.19	3201
350	50	53	1.77	28.30	4380
350	50	63	2.10	23.81	3100
400	50	63	2.10	23.81	3543
400	50	58	1.93	25.86	4180
400	50	59	1.97	25.42	4040
400	50	71	2.37	21.13	2790
450	50	61	2.03	24.59	4252
450	50	64	2.13	23.44	3862
500	50	61	2.03	24.59	4724
500	50	71	2.37	21.13	3487
550	50	66	2.20	22.73	4439
550	50	60	2.00	25.00	5371
575	50	62	2.07	24.19	5259
600	50	69	2.30	21.74	4431
625	50	65	2.17	23.08	5201
625	50	61	2.03	24.59	5905
625	50	62	2.07	24.19	5716
675	50	64	2.13	23.44	5794
675	50	69	2.30	21.74	4984
725	50	73	2.43	20.55	4783
725	50	67	2.23	22.39	5678
775	50	67	2.23	22.39	6070
1000	50	62	2.07	24.19	9146
1025	50	66	2.20	22.73	8273



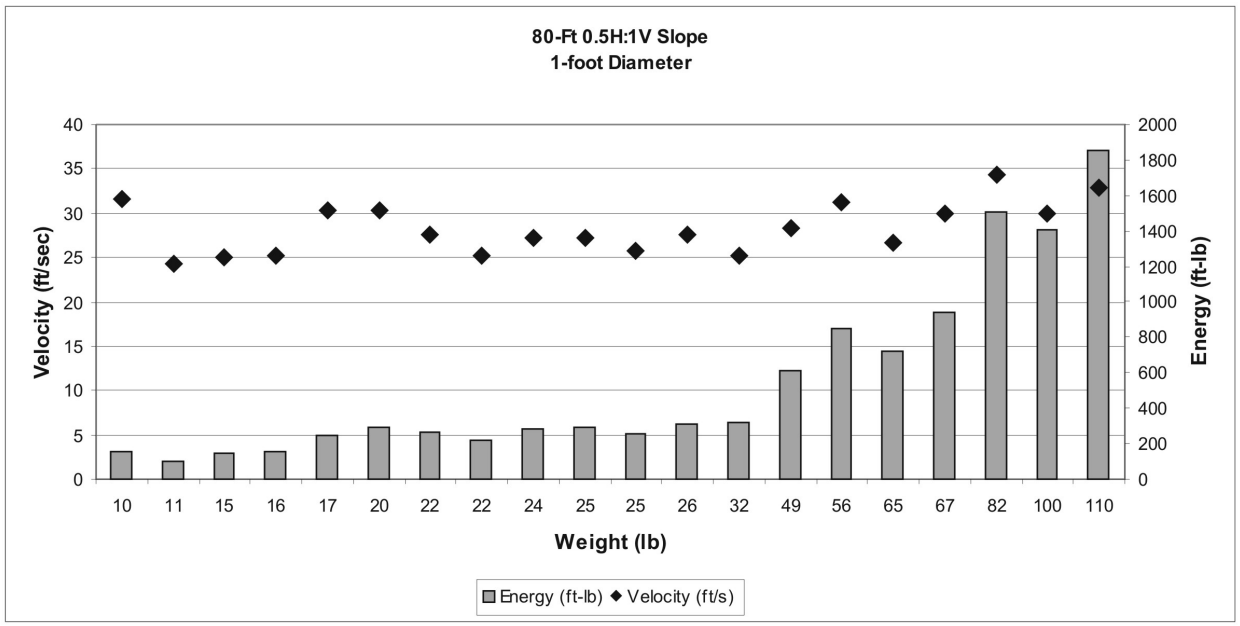
ENERGY OF 3-FOOT DIAMETER ROCKS
60-FOOT, 0.5H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
600	50	64	2.13	23.44	5150
700	50	71	2.37	21.13	4882
700	50	81	2.70	18.52	3751
750	50	86	2.87	17.44	3565
750	50	66	2.20	22.73	6053
800	50	70	2.33	21.43	5740
850	50	63	2.10	23.81	7529
900	50	68	2.27	22.06	6843
950	50	56	1.87	26.79	10650
950	50	69	2.30	21.74	7015
950	50	81	2.70	18.52	5090
1000	50	67	2.23	22.39	7832
1050	50	61	2.03	24.59	9920
1050	50	66	2.20	22.73	8474
1050	50	65	2.17	23.08	8737
1050	50	72	2.40	20.83	7121
1050	50	77	2.57	19.48	6226
1300	50	76	2.53	19.74	7913
1350	50	65	2.17	23.08	11233
1450	50	56	1.87	26.79	16255
1450	50	68	2.27	22.06	11024
1550	50	68	2.27	22.06	11785
1550	50	90	3.00	16.67	6727
2300	50	72	2.40	20.83	15598
2350	50	60	2.00	25.00	22949
2350	50	58	1.93	25.86	24559
2850	50	56	1.87	26.79	31950
2850	50	75	2.50	20.00	17813



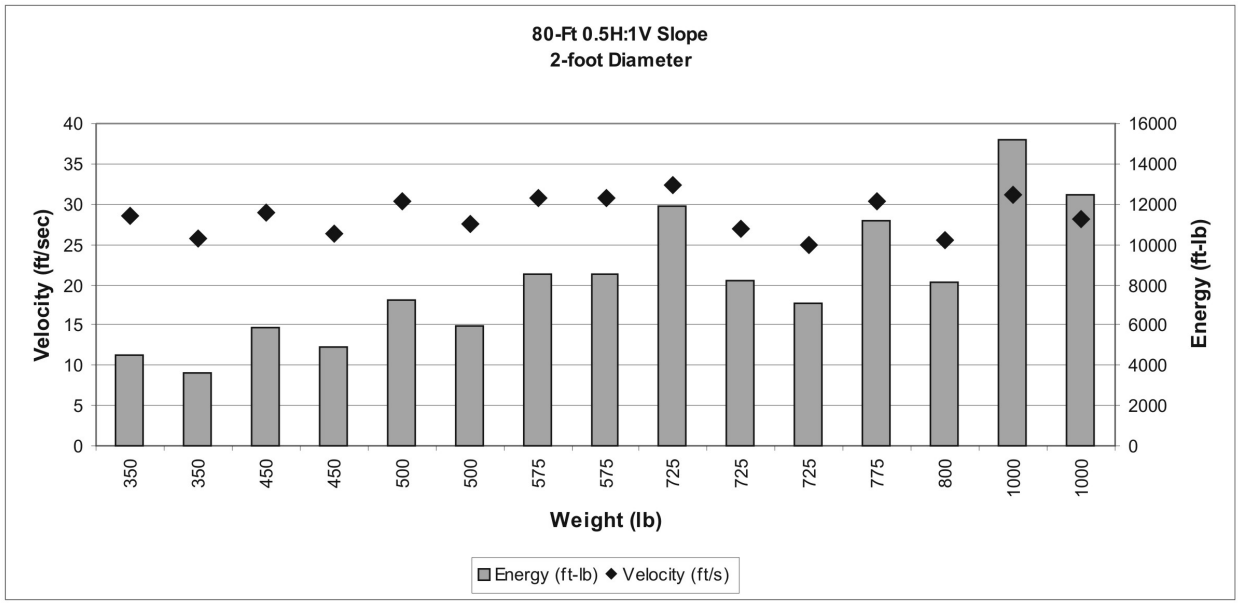
ENERGY OF 1-FOOT DIAMETER ROCKS
80-FOOT, 0.5H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
10	80	76	2.53	31.58	156
11	80	99	3.30	24.24	101
15	80	96	3.20	25.00	146
16	80	95	3.17	25.26	160
17	80	79	2.63	30.38	245
20	80	79	2.63	30.38	288
22	80	87	2.90	27.59	262
22	80	95	3.17	25.26	219
24	80	88	2.93	27.27	279
25	80	88	2.93	27.27	291
25	80	93	3.10	25.81	260
26	80	87	2.90	27.59	309
32	80	95	3.17	25.26	319
49	80	85	2.83	28.24	610
56	80	77	2.57	31.17	850
65	80	90	3.00	26.67	722
67	80	80	2.67	30.00	942
82	80	70	2.33	34.29	1506
100	80	80	2.67	30.00	1406
110	80	73	2.43	32.88	1858



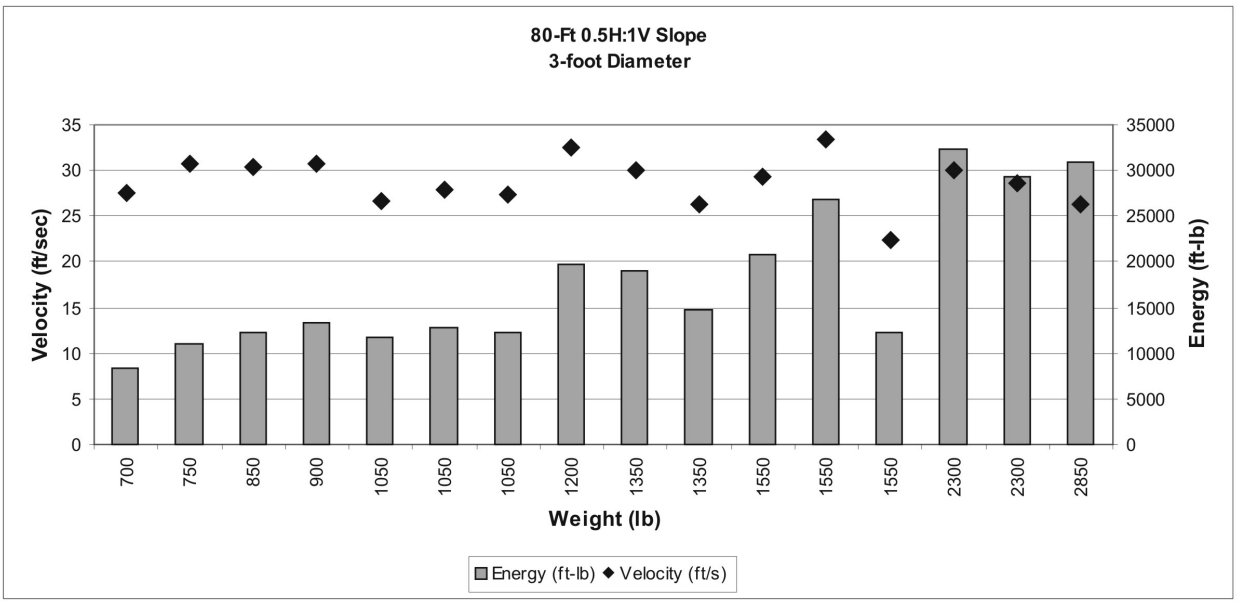
ENERGY OF 2-FOOT DIAMETER ROCKS
80-FOOT, 0.5H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
350	80	84	2.80	28.57	4464
350	80	93	3.10	25.81	3642
450	80	83	2.77	28.92	5879
450	80	91	3.03	26.37	4891
500	80	79	2.63	30.38	7210
500	80	87	2.90	27.59	5945
575	80	78	2.60	30.77	8506
575	80	78	2.60	30.77	8506
725	80	74	2.47	32.43	11916
725	80	89	2.97	26.97	8238
725	80	96	3.20	25.00	7080
775	80	79	2.63	30.38	11176
800	80	94	3.13	25.53	8148
1000	80	77	2.57	31.17	15180
1000	80	85	2.83	28.24	12457



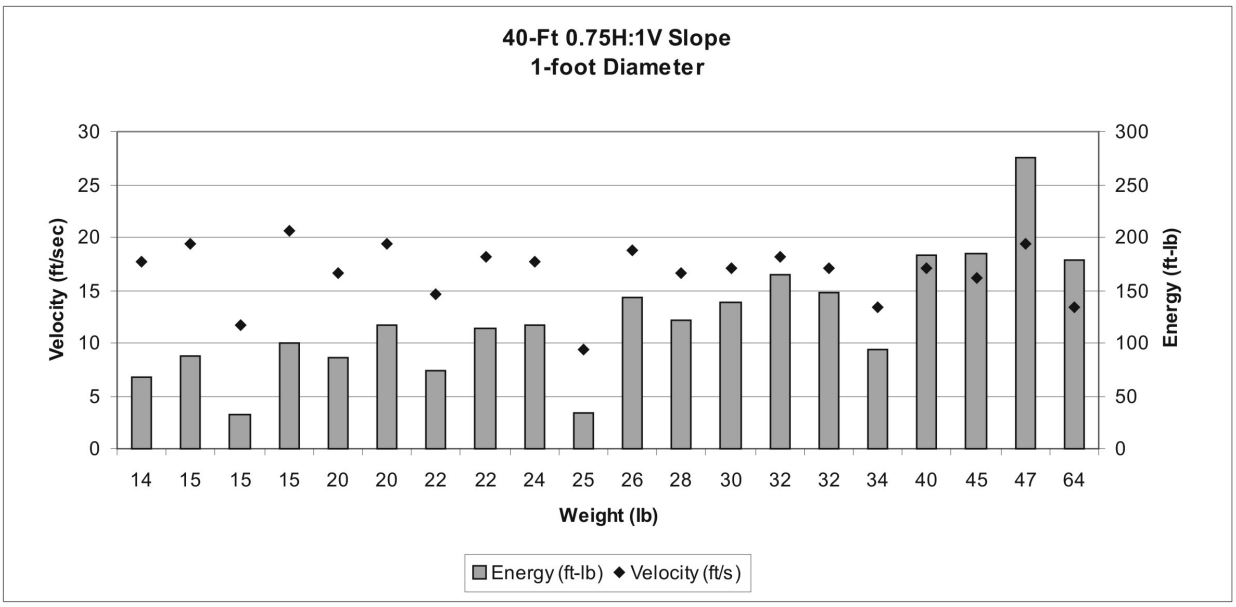
ENERGY OF 3-FOOT DIAMETER ROCKS
80-FOOT, 0.5H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
700	80	87	2.90	27.59	8323
750	80	78	2.60	30.77	11095
850	80	79	2.63	30.38	12258
900	80	78	2.60	30.77	13314
1050	80	90	3.00	26.67	11667
1050	80	86	2.87	27.91	12777
1050	80	88	2.93	27.27	12203
1200	80	74	2.47	32.43	19722
1350	80	80	2.67	30.00	18984
1350	80	91	3.03	26.37	14672
1550	80	82	2.73	29.27	20747
1550	80	72	2.40	33.33	26910
1550	80	107	3.57	22.43	12184
2300	80	80	2.67	30.00	32344
2300	80	84	2.80	28.57	29337
2850	80	91	3.03	26.37	30975



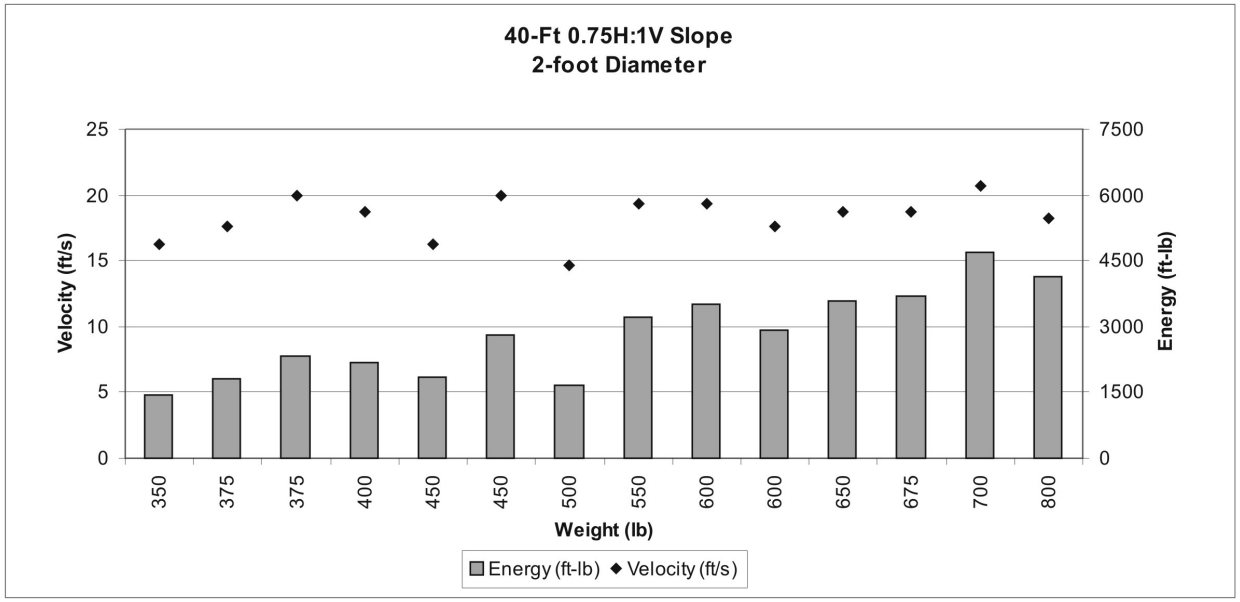
ENERGY OF 1-FOOT DIAMETER ROCKS
40-FOOT, 0.75H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
14	20	34	1.13	17.65	68
15	20	31	1.03	19.35	88
15	20	51	1.70	11.76	32
15	20	29	0.97	20.69	100
20	20	36	1.20	16.67	87
20	20	31	1.03	19.35	117
22	20	41	1.37	14.63	74
22	20	33	1.10	18.18	114
24	20	34	1.13	17.65	117
25	20	64	2.13	9.38	34
26	20	32	1.07	18.75	143
28	20	36	1.20	16.67	122
30	20	35	1.17	17.14	138
32	20	33	1.10	18.18	165
32	20	35	1.17	17.14	147
34	20	45	1.50	13.33	94
40	20	35	1.17	17.14	184
45	20	37	1.23	16.22	185
47	20	31	1.03	19.35	275
64	20	45	1.50	13.33	178



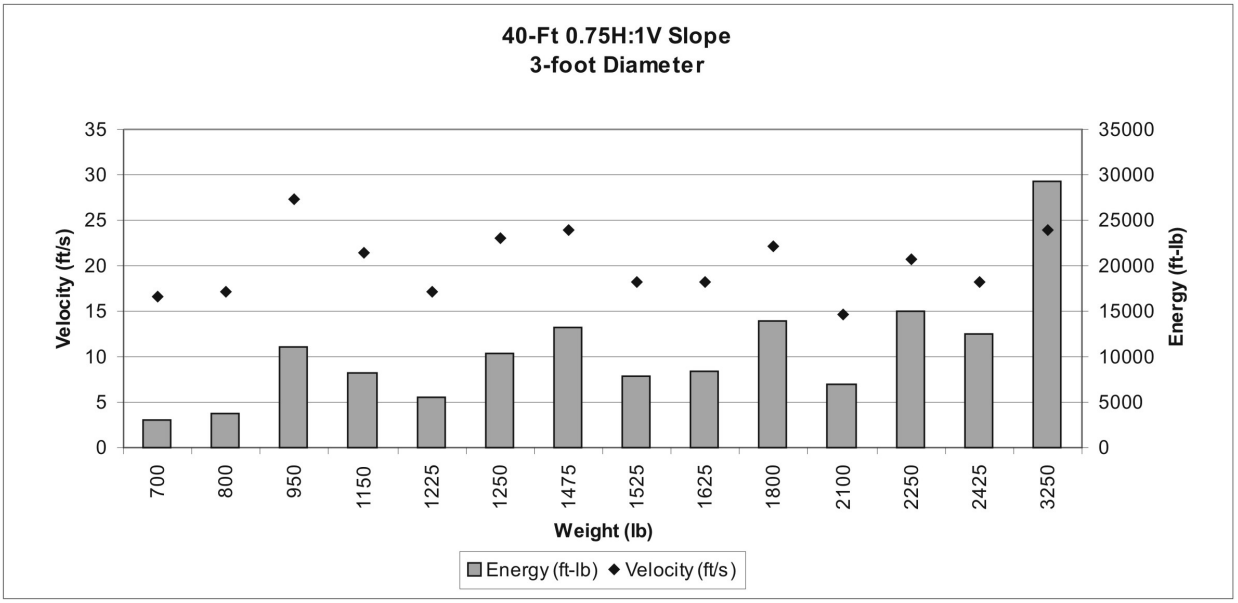
ENERGY OF 2-FOOT DIAMETER ROCKS
40-FOOT, 0.75H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
350	20	37	1.23	16.22	1438
375	20	34	1.13	17.65	1825
375	20	30	1.00	20.00	2344
400	20	32	1.07	18.75	2197
450	20	37	1.23	16.22	1849
450	20	30	1.00	20.00	2813
500	20	41	1.37	14.63	1673
550	20	31	1.03	19.35	3219
600	20	31	1.03	19.35	3512
600	20	34	1.13	17.65	2920
650	20	32	1.07	18.75	3571
675	20	32	1.07	18.75	3708
700	20	29	0.97	20.69	4682
800	20	33	1.10	18.18	4132



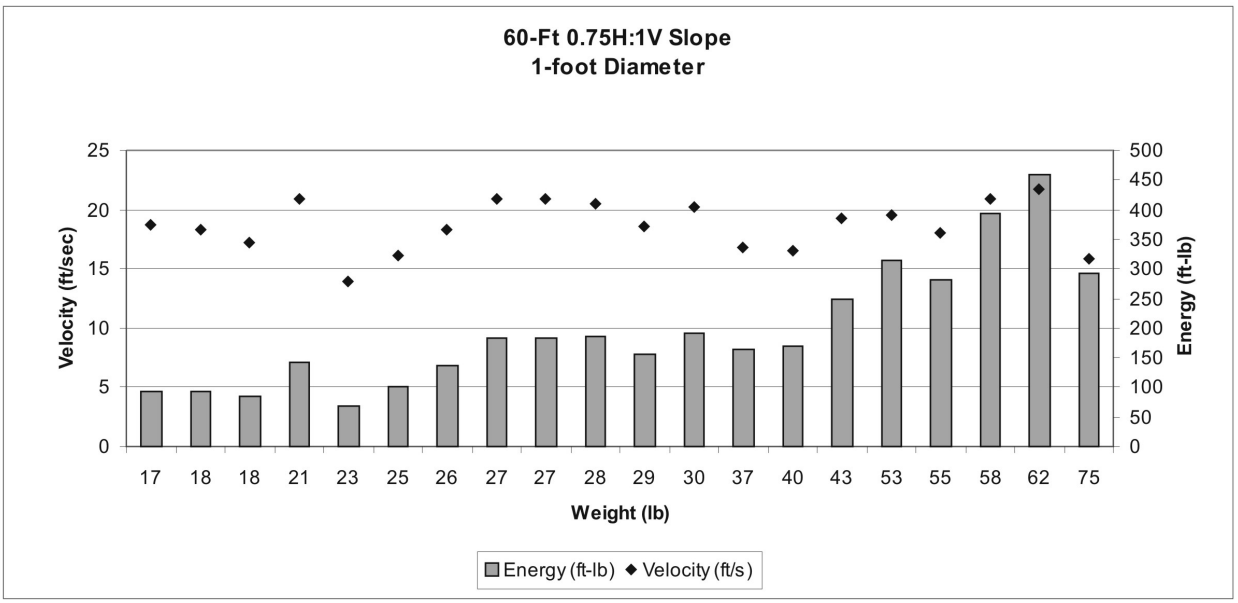
ENERGY OF 3-FOOT DIAMETER ROCKS
40-FOOT, 0.75H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
700	20	36	1.20	16.67	3038
800	20	35	1.17	17.14	3673
950	20	22	0.73	27.27	11041
1150	20	28	0.93	21.43	8251
1225	20	35	1.17	17.14	5625
1250	20	26	0.87	23.08	10401
1475	20	25	0.83	24.00	13275
1525	20	33	1.10	18.18	7877
1625	20	33	1.10	18.18	8394
1800	20	27	0.90	22.22	13889
2100	20	41	1.37	14.63	7027
2250	20	29	0.97	20.69	15049
2425	20	33	1.10	18.18	12526
3250	20	25	0.83	24.00	29250



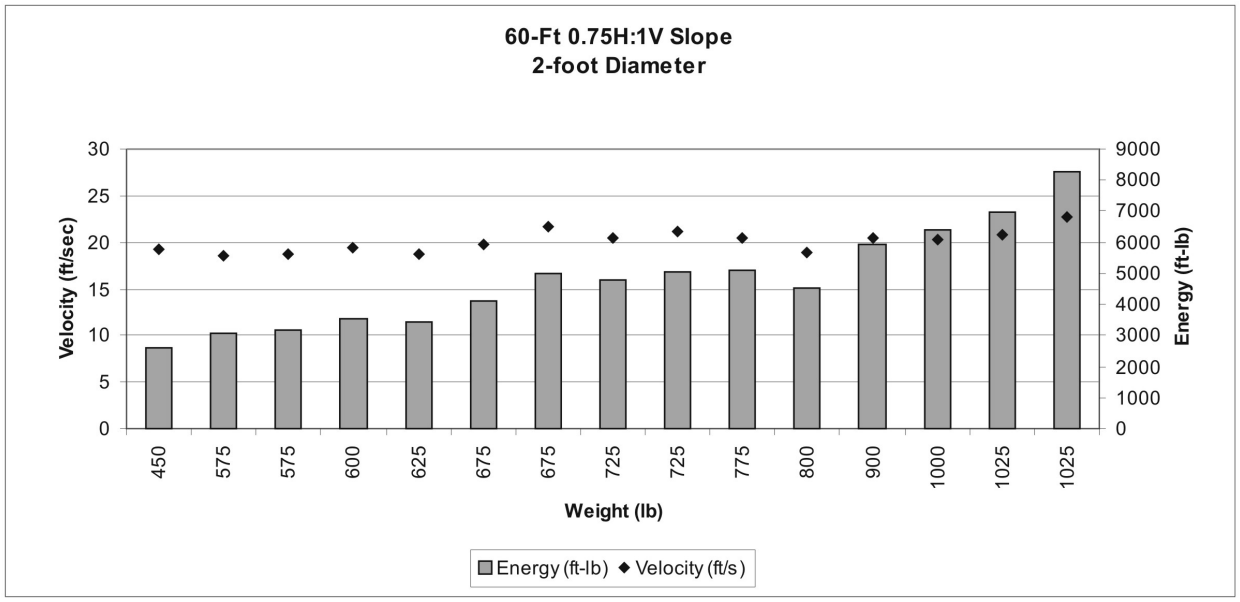
ENERGY OF 1-FOOT DIAMETER ROCKS
60-FOOT, 0.75H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
17	50	80	2.67	18.75	93
18	50	82	2.73	18.29	94
18	50	87	2.90	17.24	84
21	50	72	2.40	20.83	142
23	50	108	3.60	13.89	69
25	50	93	3.10	16.13	102
26	50	82	2.73	18.29	136
27	50	72	2.40	20.83	183
27	50	72	2.40	20.83	183
28	50	73	2.43	20.55	185
29	50	81	2.70	18.52	155
30	50	74	2.47	20.27	193
37	50	89	2.97	16.85	164
40	50	91	3.03	16.48	170
43	50	78	2.60	19.23	248
53	50	77	2.57	19.48	314
55	50	83	2.77	18.07	281
58	50	72	2.40	20.83	393
62	50	69	2.30	21.74	458
75	50	95	3.17	15.79	292



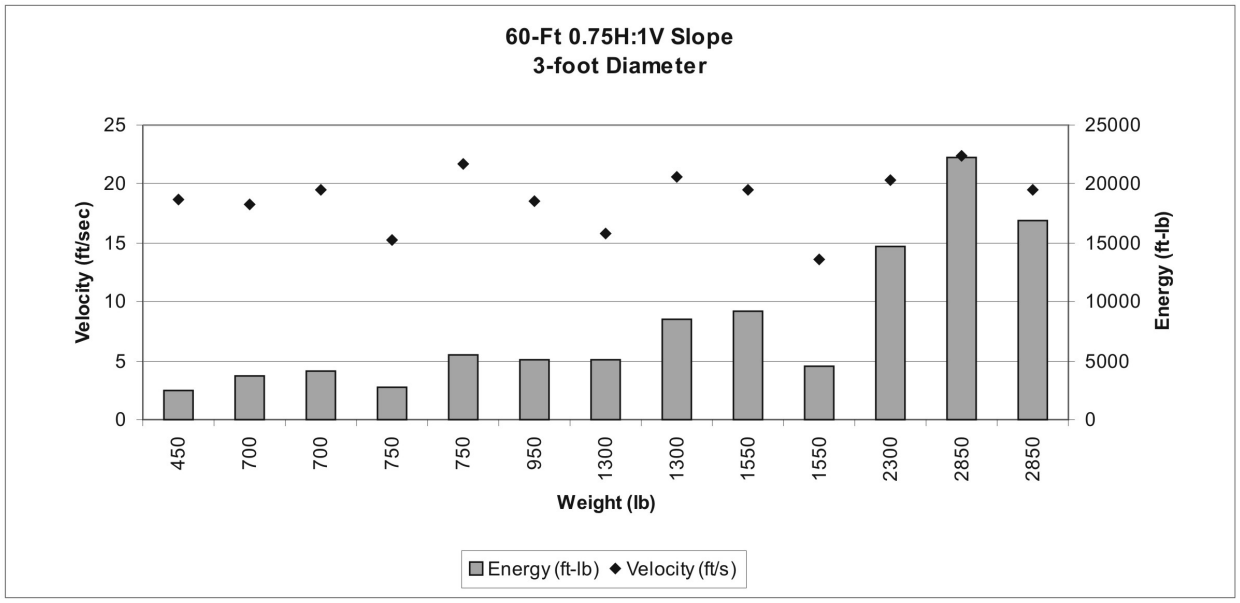
ENERGY OF 2-FOOT DIAMETER ROCKS
60-FOOT, 0.75H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
450	50	78	2.60	19.23	2600
575	50	81	2.70	18.52	3081
575	50	80	2.67	18.75	3159
600	50	77	2.57	19.48	3558
625	50	80	2.67	18.75	3433
675	50	76	2.53	19.74	4108
675	50	69	2.30	21.74	4984
725	50	73	2.43	20.55	4783
725	50	71	2.37	21.13	5056
775	50	73	2.43	20.55	5113
800	50	79	2.63	18.99	4506
900	50	73	2.43	20.55	5937
1000	50	74	2.47	20.27	6420
1025	50	72	2.40	20.83	6951
1025	50	66	2.20	22.73	8273



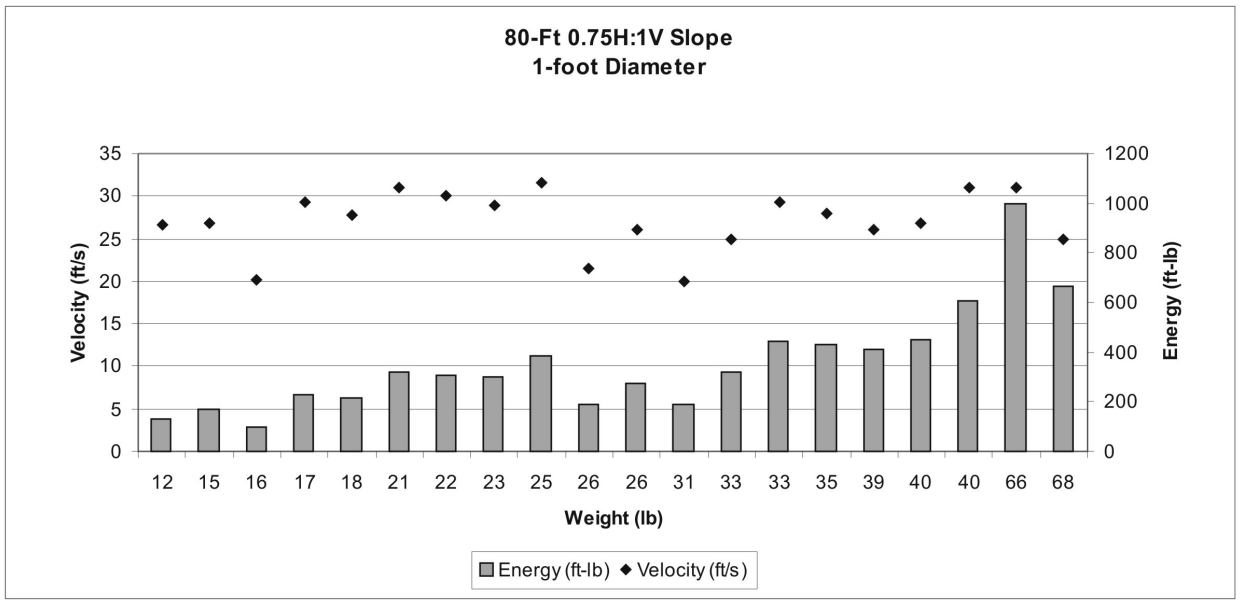
ENERGY OF 3-FOOT DIAMETER ROCKS
60-FOOT, 0.75H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
450	50	80	2.67	18.75	2472
700	50	82	2.73	18.29	3660
700	50	77	2.57	19.48	4151
750	50	98	3.27	15.31	2745
750	50	69	2.30	21.74	5538
950	50	81	2.70	18.52	5090
1300	50	95	3.17	15.79	5064
1300	50	73	2.43	20.55	8576
1550	50	77	2.57	19.48	9191
1550	50	110	3.67	13.64	4503
2300	50	74	2.47	20.27	14766
2850	50	67	2.23	22.39	22320
2850	50	77	2.57	19.48	16899



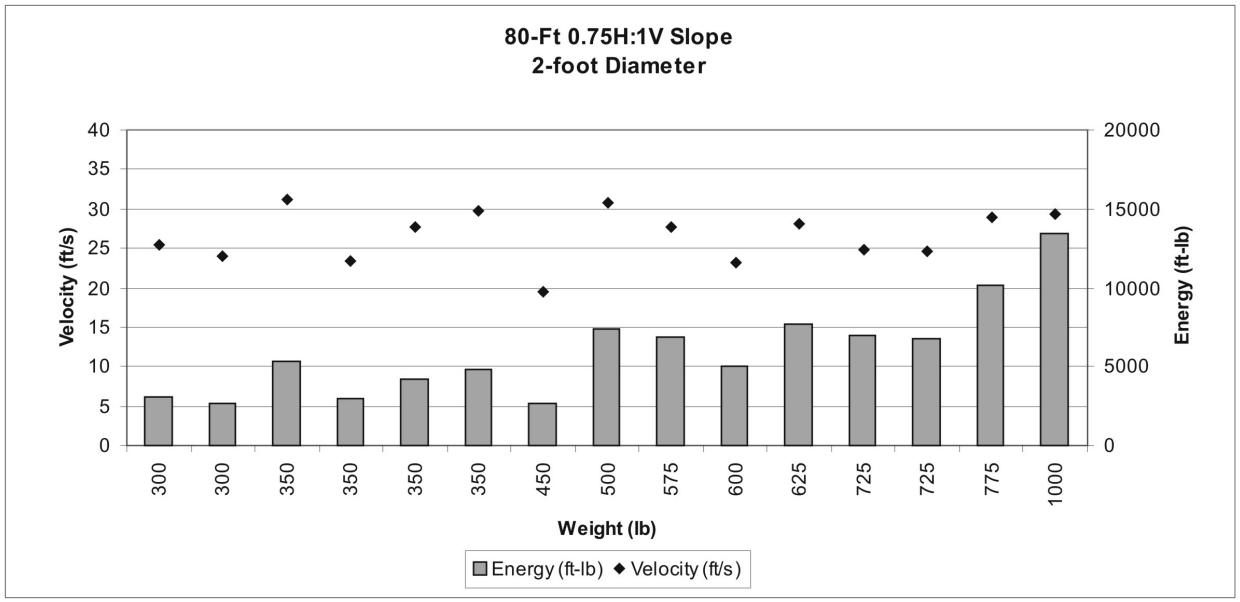
ENERGY OF 1-FOOT DIAMETER ROCKS
80-FOOT, 0.75H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
12	85	96	3.20	26.56	132
15	85	95	3.17	26.84	169
16	85	127	4.23	20.08	101
17	85	87	2.90	29.31	228
18	85	92	3.07	27.72	216
21	85	82	2.73	31.10	317
22	85	85	2.83	30.00	309
23	85	88	2.93	28.98	302
25	85	81	2.70	31.48	387
26	85	119	3.97	21.43	187
26	85	98	3.27	26.02	275
31	85	128	4.27	19.92	192
33	85	102	3.40	25.00	322
33	85	87	2.90	29.31	443
35	85	91	3.03	28.02	429
39	85	98	3.27	26.02	413
40	85	95	3.17	26.84	450
40	85	82	2.73	31.10	604
66	85	82	2.73	31.10	997
68	85	102	3.40	25.00	664



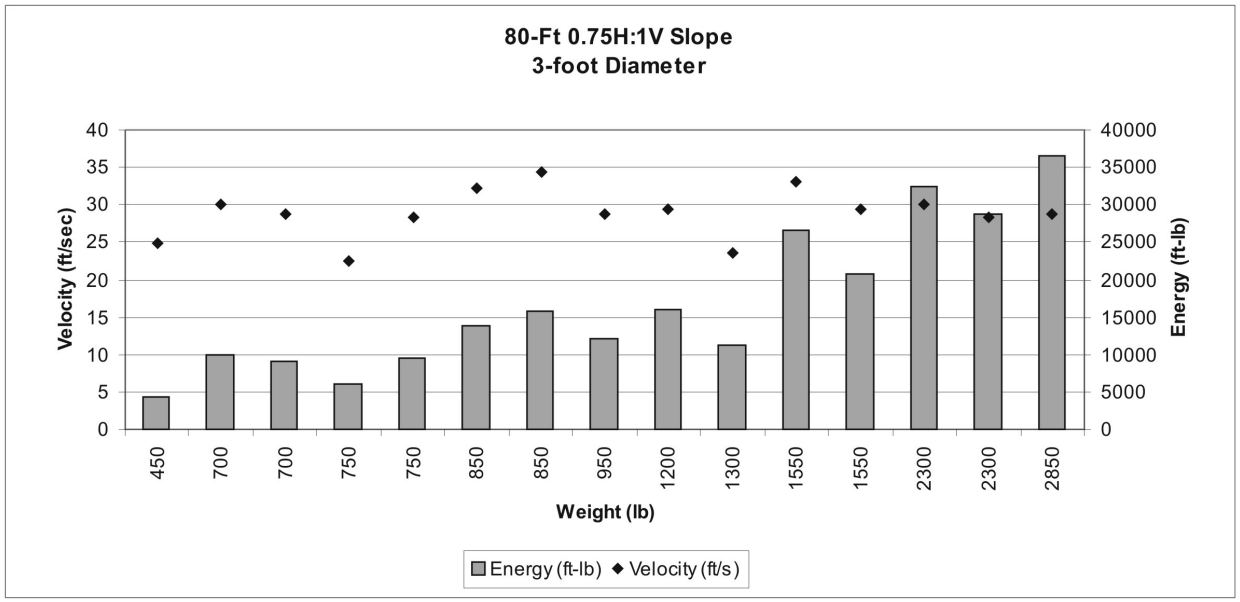
ENERGY OF 2-FOOT DIAMETER ROCKS
80-FOOT, 0.75H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
300	85	100	3.33	25.50	3048
300	85	106	3.53	24.06	2713
350	85	82	2.73	31.10	5289
350	85	109	3.63	23.39	2993
350	85	92	3.07	27.72	4201
350	85	86	2.87	29.65	4808
450	85	131	4.37	19.47	2664
500	85	83	2.77	30.72	7374
575	85	92	3.07	27.72	6902
600	85	110	3.67	23.18	5038
625	85	91	3.03	28.02	7668
725	85	103	3.43	24.76	6943
725	85	104	3.47	24.52	6810
775	85	88	2.93	28.98	10168
1000	85	87	2.90	29.31	13423



ENERGY OF 3-FOOT DIAMETER ROCKS
80-FOOT, 0.75H:1V SLOPE

Wt	Distance (ft)	Frames	Time (sec)	Velocity (ft/sec)	Energy (ft-lb)
450	85	103	3.43	24.76	4310
700	85	85	2.83	30.00	9844
700	85	89	2.97	28.65	8979
750	85	113	3.77	22.57	5968
750	85	90	3.00	28.33	9408
850	85	79	2.63	32.28	13838
850	85	74	2.47	34.46	15771
950	85	89	2.97	28.65	12186
1200	85	87	2.90	29.31	16108
1300	85	108	3.60	23.61	11324
1550	85	77	2.57	33.12	26561
1550	85	87	2.90	29.31	20806
2300	85	85	2.83	30.00	32344
2300	85	90	3.00	28.33	28850
2850	85	89	2.97	28.65	36557



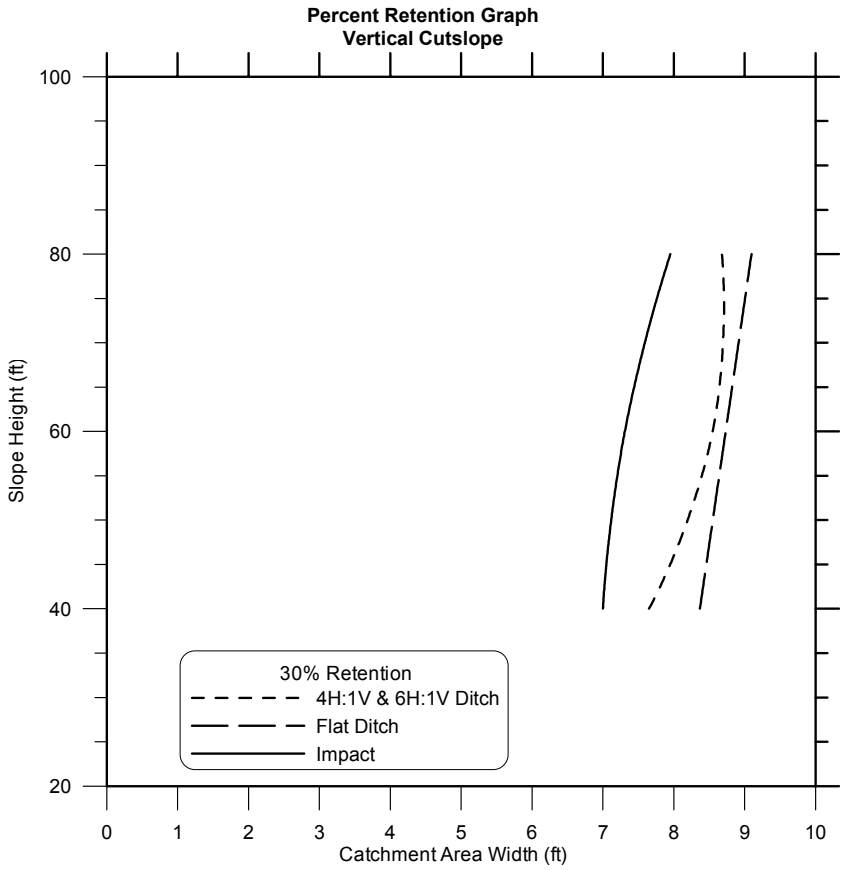
APPENDIX F: CATCHMENT AREA PERCENT RETENTION GRAPHS

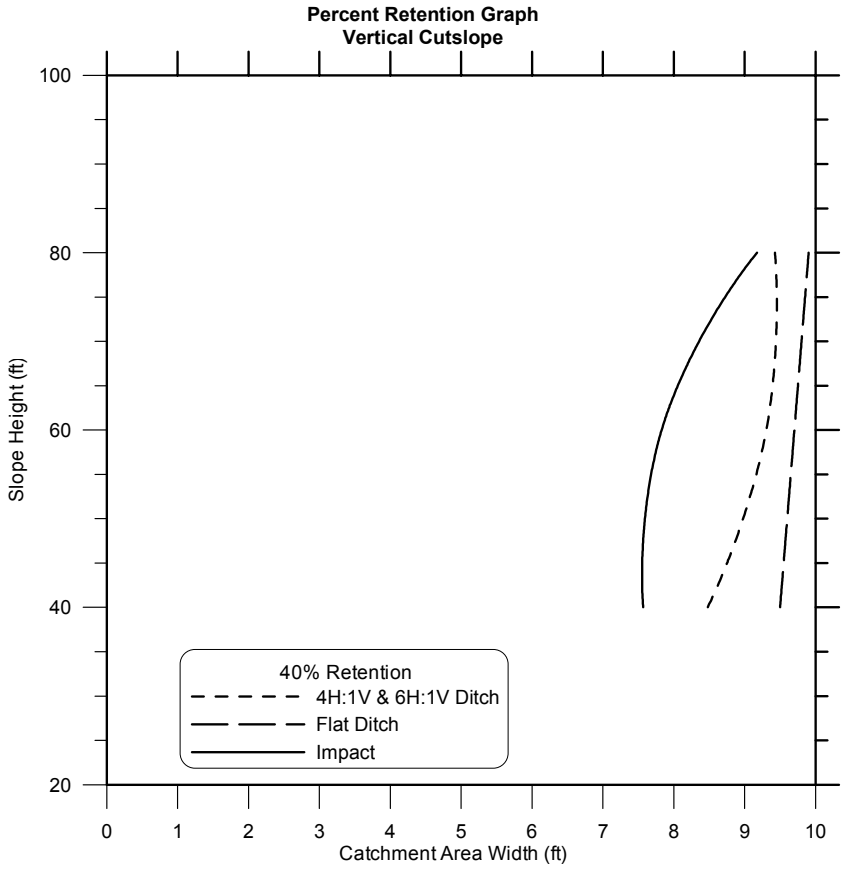
CATCHMENT AREA PERCENT RETENTION GRAPHS

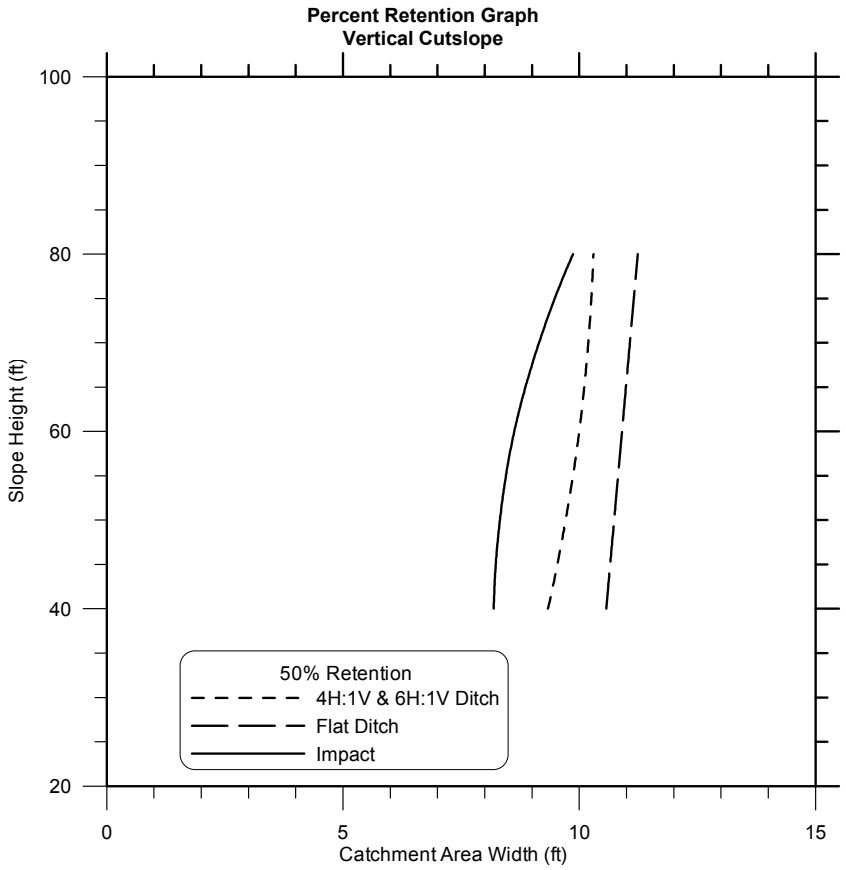
Complete sets of Catchment Area Percent Retention Graphs are included here for the vertical, 0.25H:1V, 0.5H:1V, 0.75H:1V, and 1H:1V cutslopes. These graphs are a compilation of the research results from the 40-, 60- and 80-foot high slopes for the flat-bottom, 6H:1V and 4H:1V slope catchment area configurations. The retention graphs incorporate the maximum impact and roll out measurements for each percentage indicated as described in the text in Section 4.2.

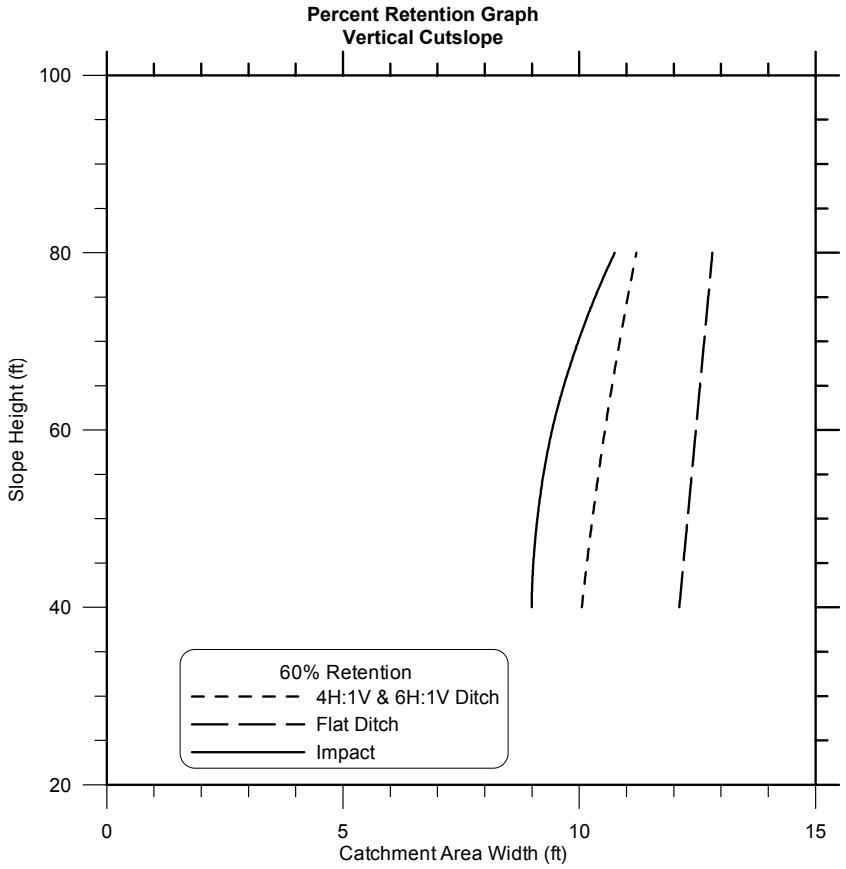
In some cases, the results were similar enough that the results plotted as a single curve. For example, this can be seen on the vertical slope, 99% retention graphs. The results from the 6H:1V and 4H:1V catchment area slopes were very similar. Only one curve was developed for these two catchment area slopes on this graph.

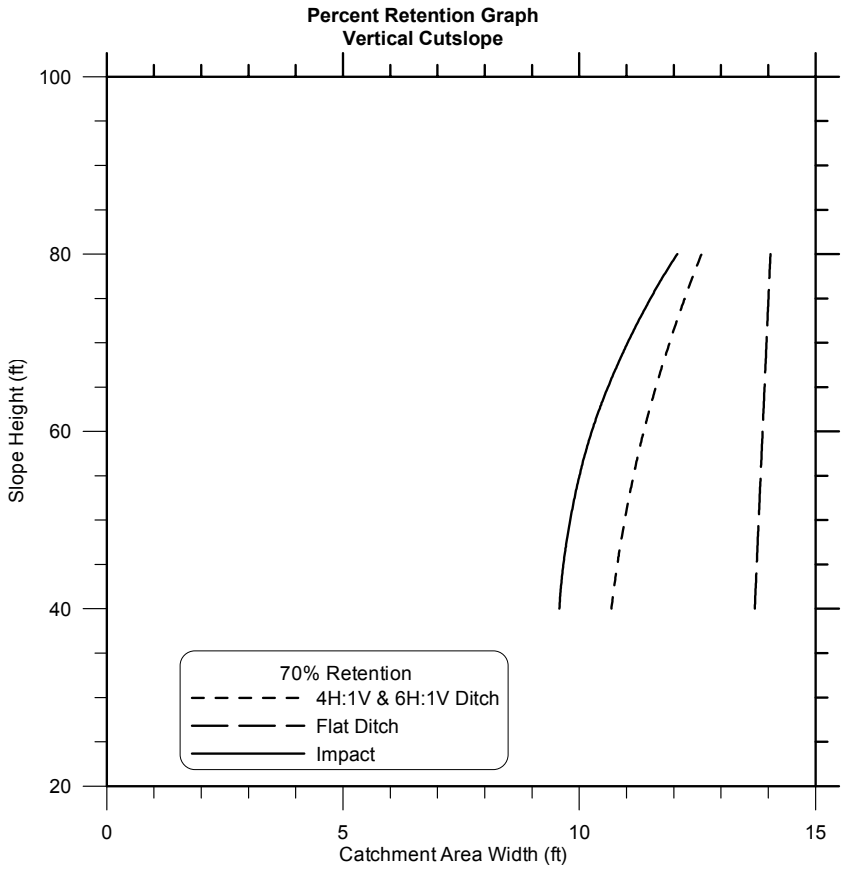
NOTE: To facilitate practical design usage, the field measured catchment area impact and roll out <u>slope</u> distances have been converted to <u>horizontal</u> catchment area width on the percent retention graphs.

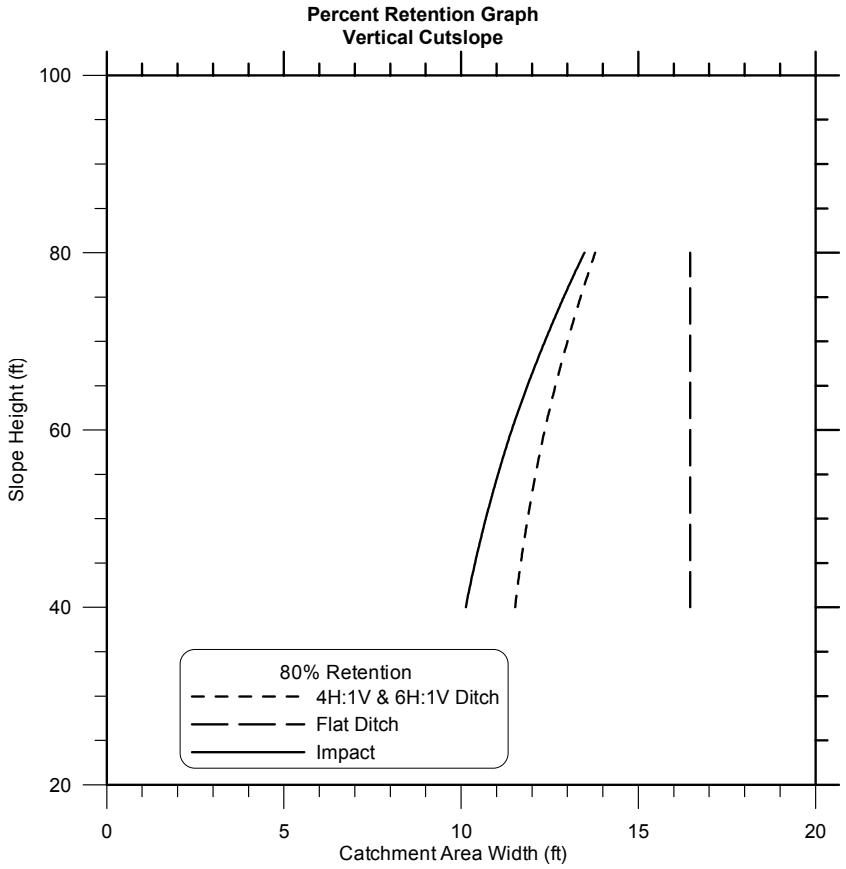

Percent Retention Graph
Vertical Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
30% Retention
4H:1V & 6H:1V Ditch
Flat Ditch
Impact

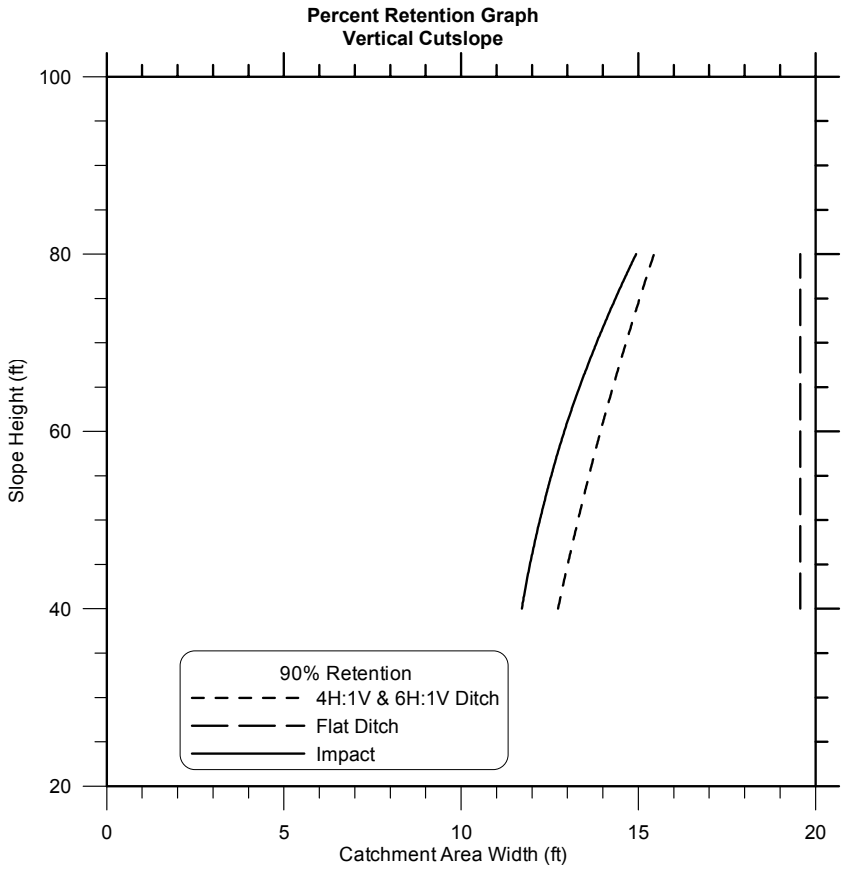

Percent Retention Graph
Vertical Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
40% Retention
4H:1V & 6H:1V Ditch
Flat Ditch
Impact

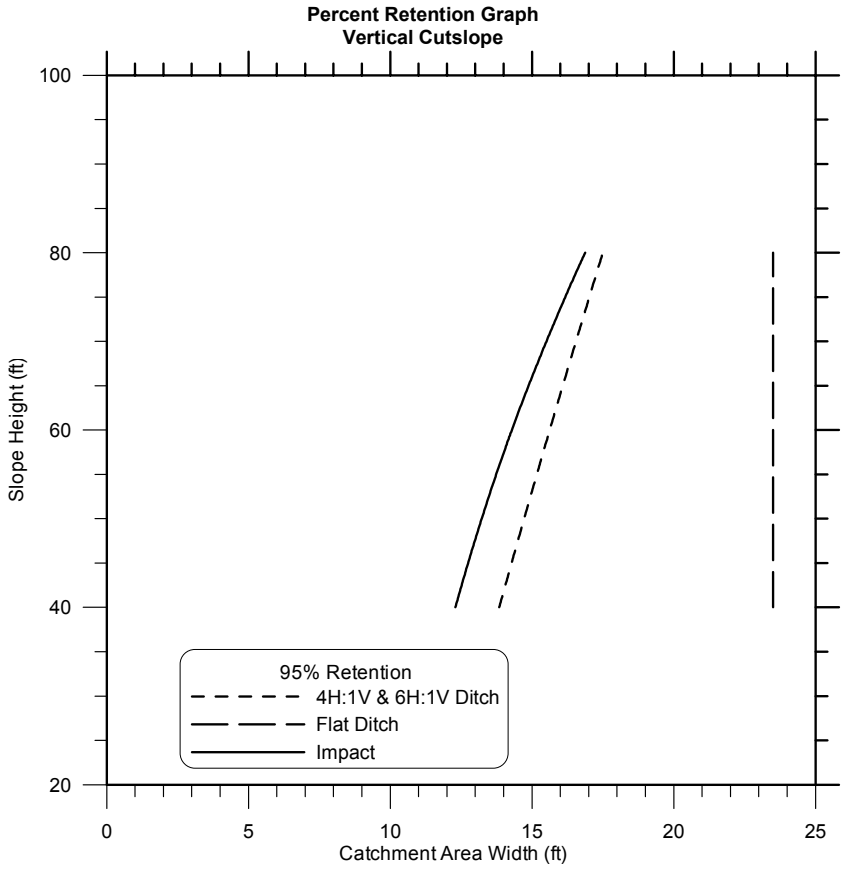

Percent Retention Graph
Vertical Cutslope
100
80
60
40
20
Slope Height (ft)
0
5
10
15
Catchment Area Width (ft)
50% Retention
4H:1V & 6H:1V Ditch
Flat Ditch
Impact

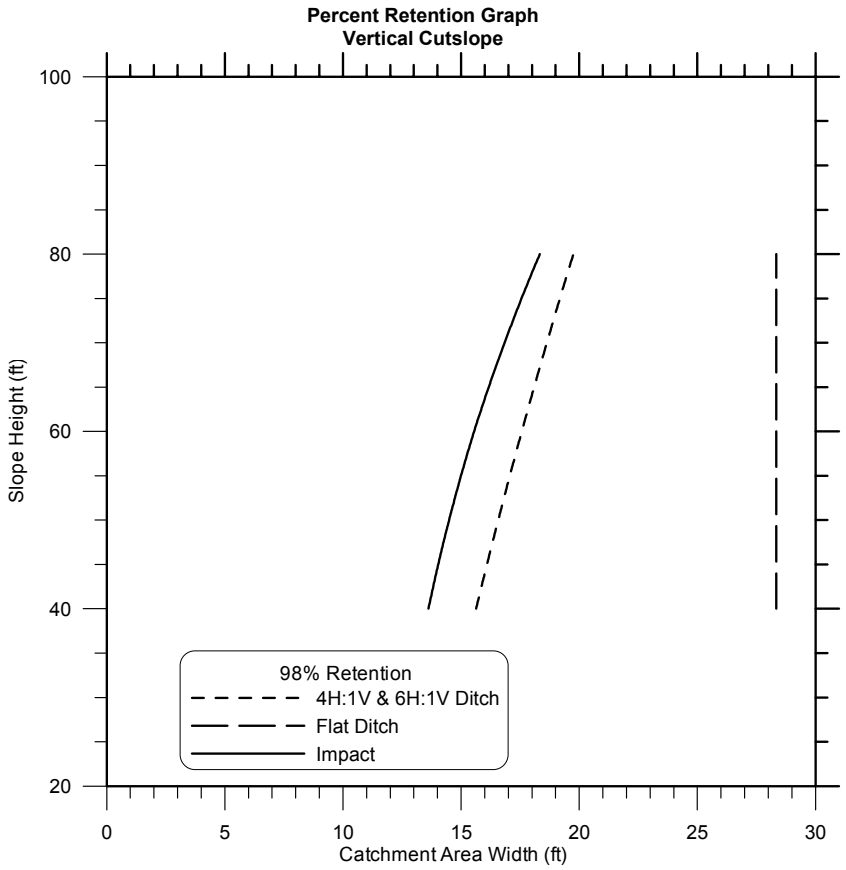

Percent Retention Graph
Vertical Cutslope
100
80
60
40
20
Slope Height (ft)
0
5
10
15
Catchment Area Width (ft)
60% Retention
4H:1V & 6H:1V Ditch
Flat Ditch
Impact

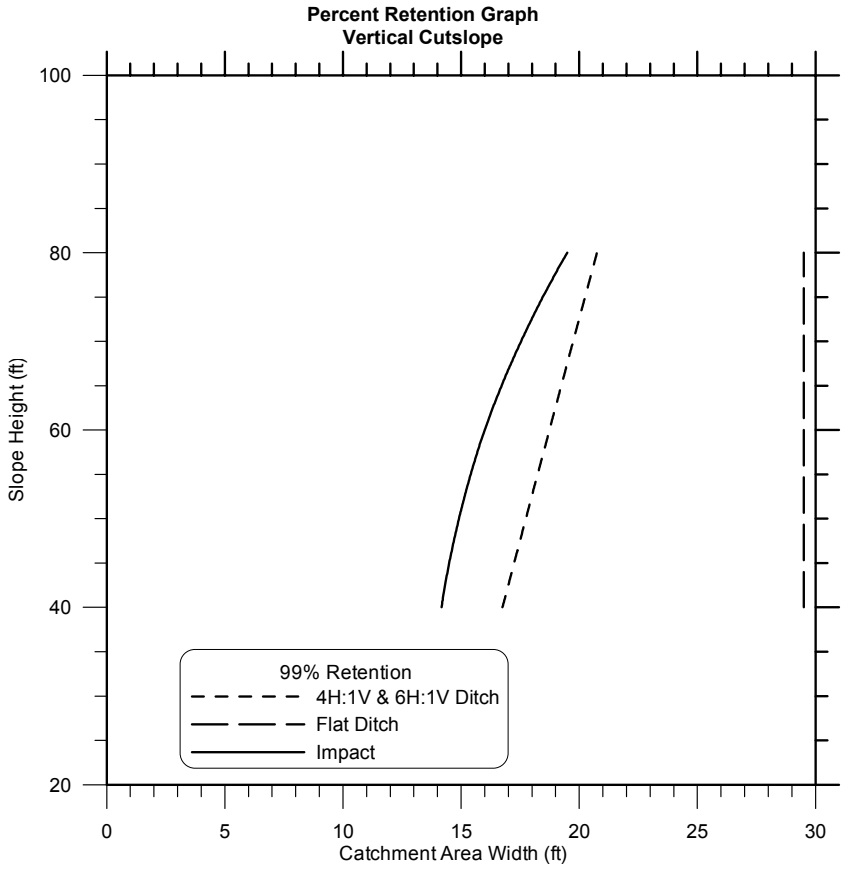

Percent Retention Graph
Vertical Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
70% Retention
4H:1V & 6H:1V Ditch
Flat Ditch
Impact

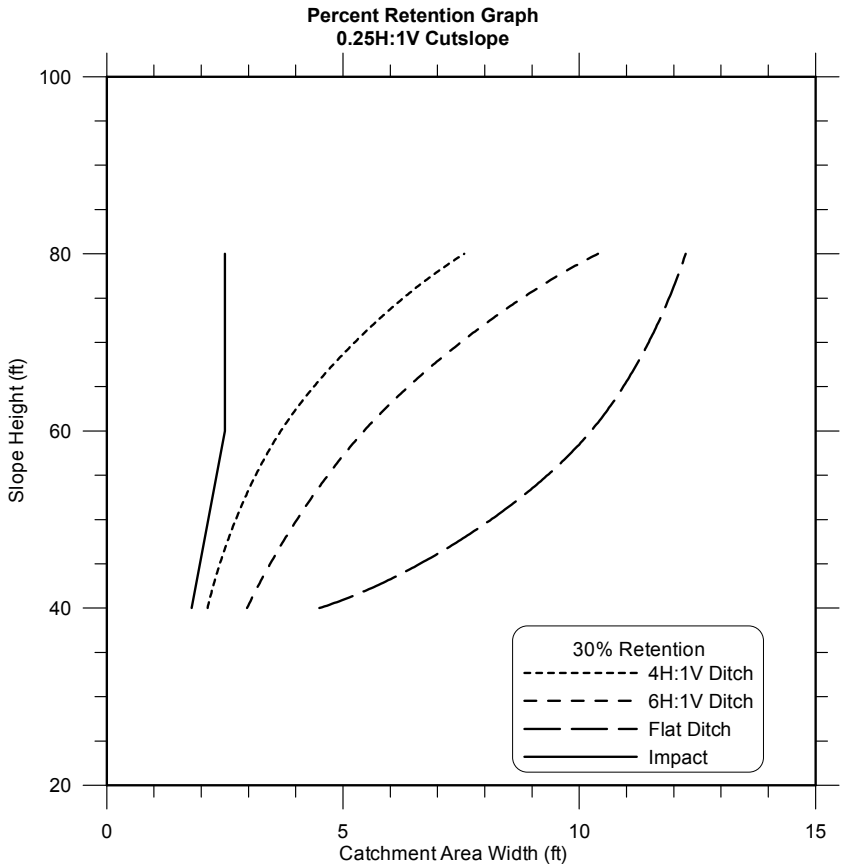

Percent Retention Graph
Vertical Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
80% Retention
4H:1V & 6H:1V Ditch
Flat Ditch
Impact

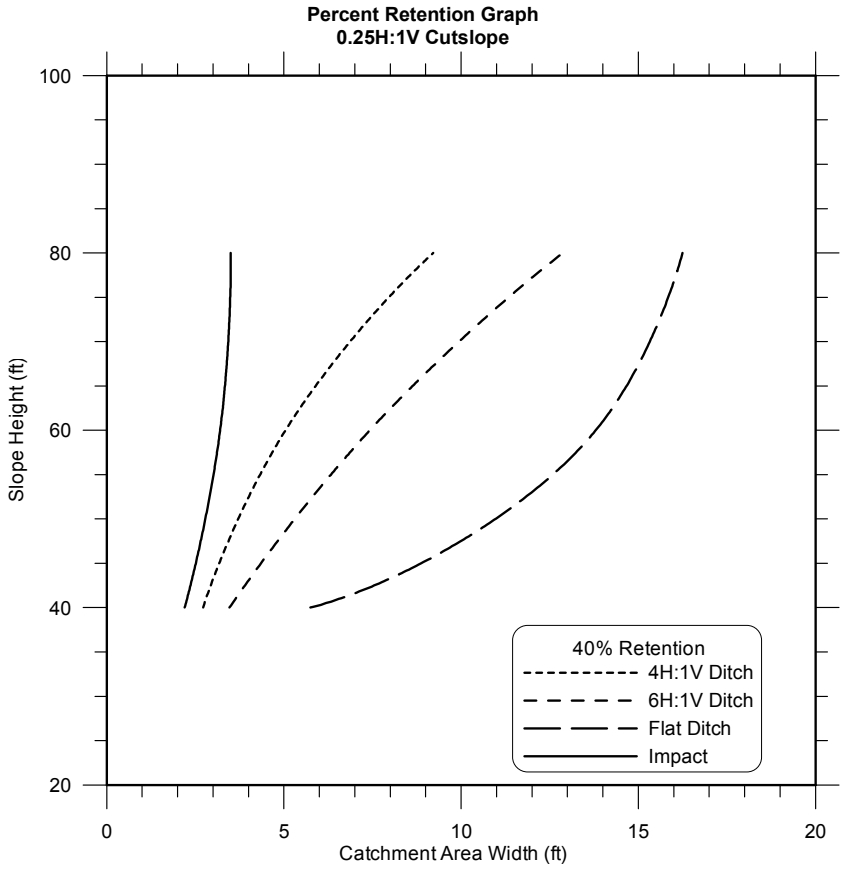

Percent Retention Graph
Vertical Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
90% Retention
4H:1V & 6H:1V Ditch
Flat Ditch
Impact

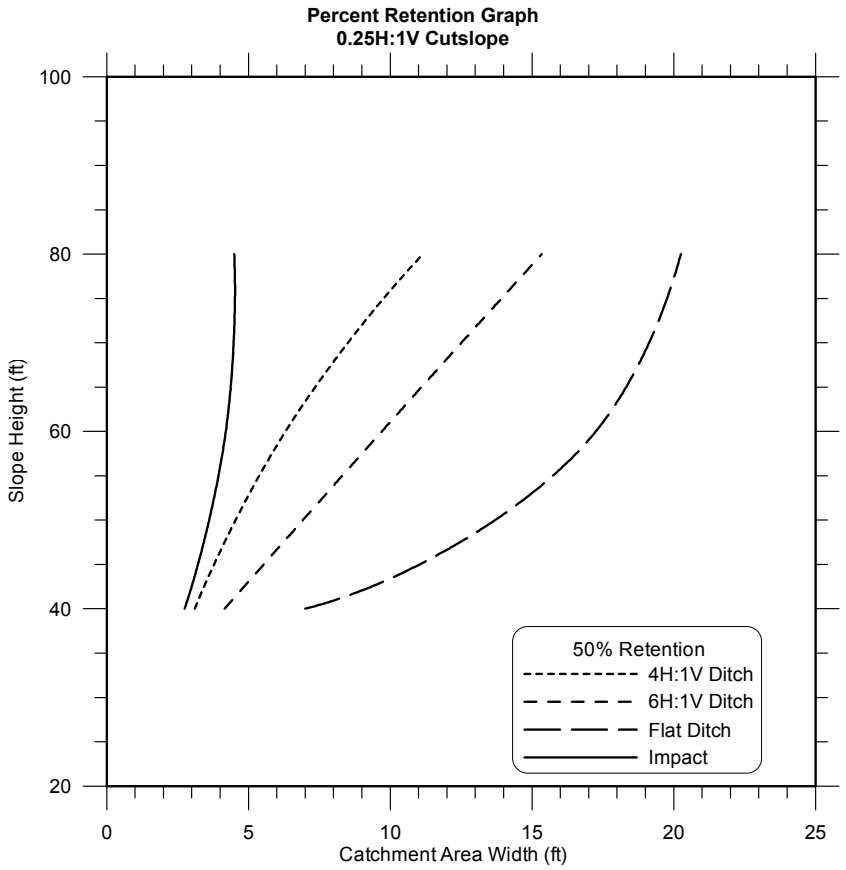

Percent Retention Graph
Vertical Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
95% Retention
4H:1V & 6H:1V Ditch
Flat Ditch
Impact

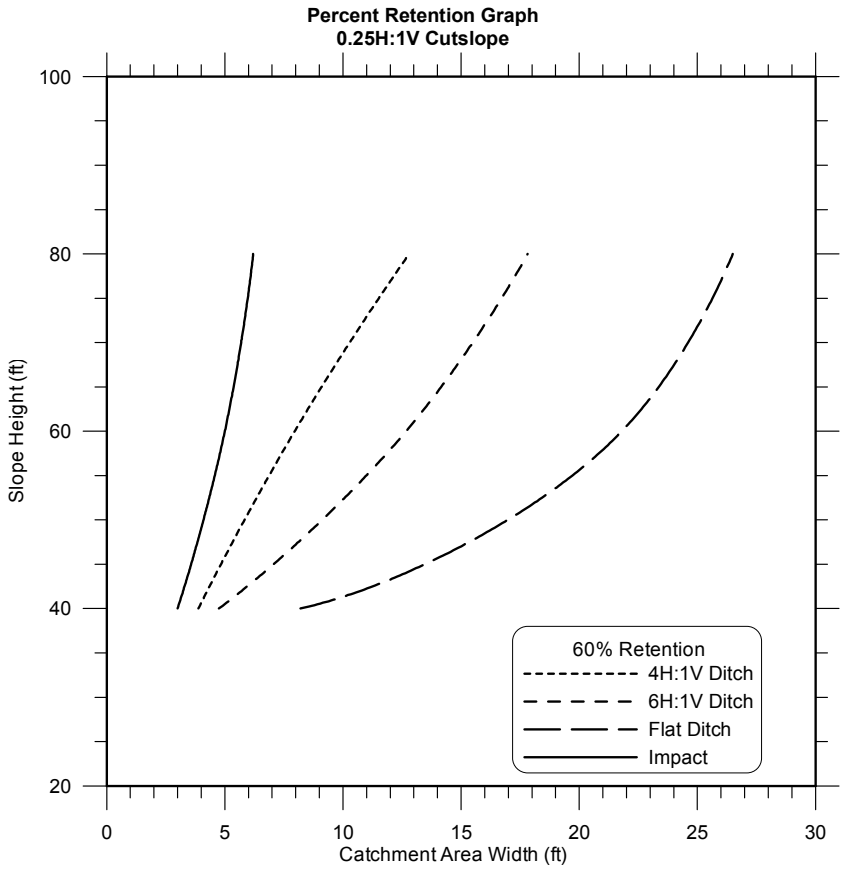

Percent Retention Graph
Vertical Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
98% Retention
4H:1V & 6H:1V Ditch
Flat Ditch
Impact

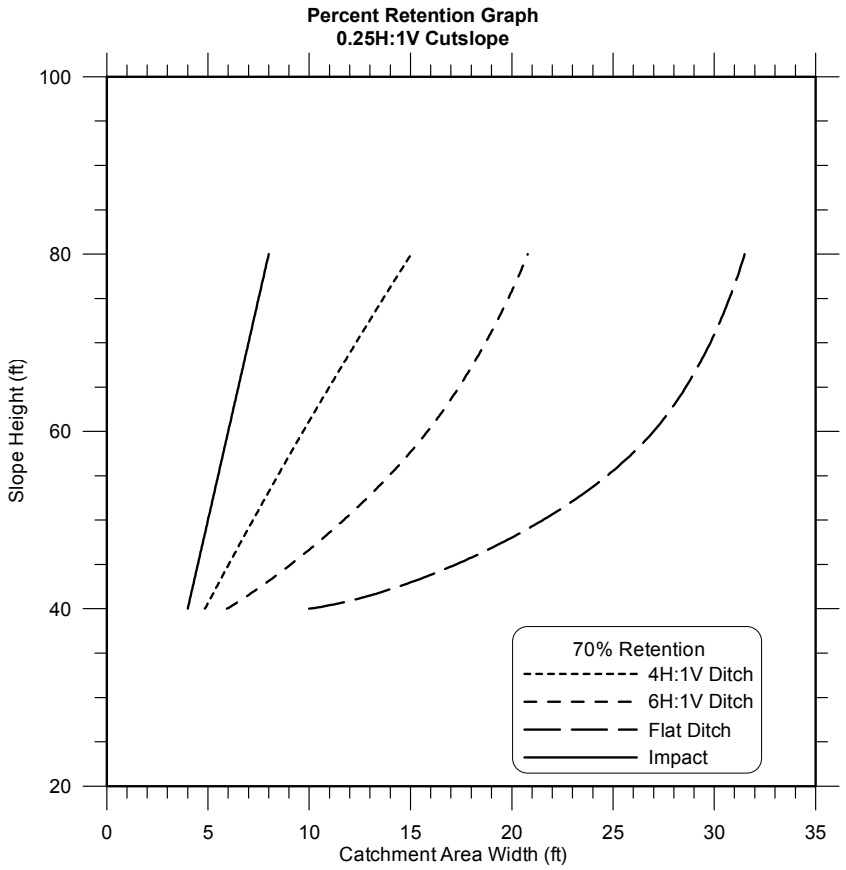

Percent Retention Graph
Vertical Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
99% Retention
4H:1V & 6H:1V Ditch
Flat Ditch
Impact

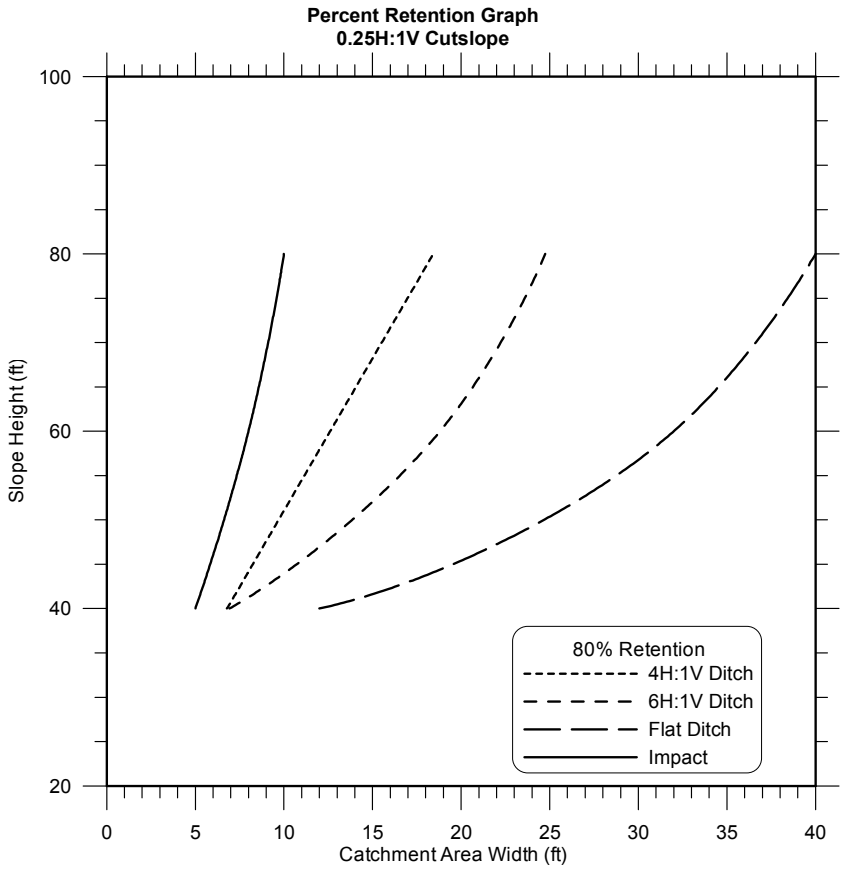

Percent Retention Graph
0.25H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
30% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

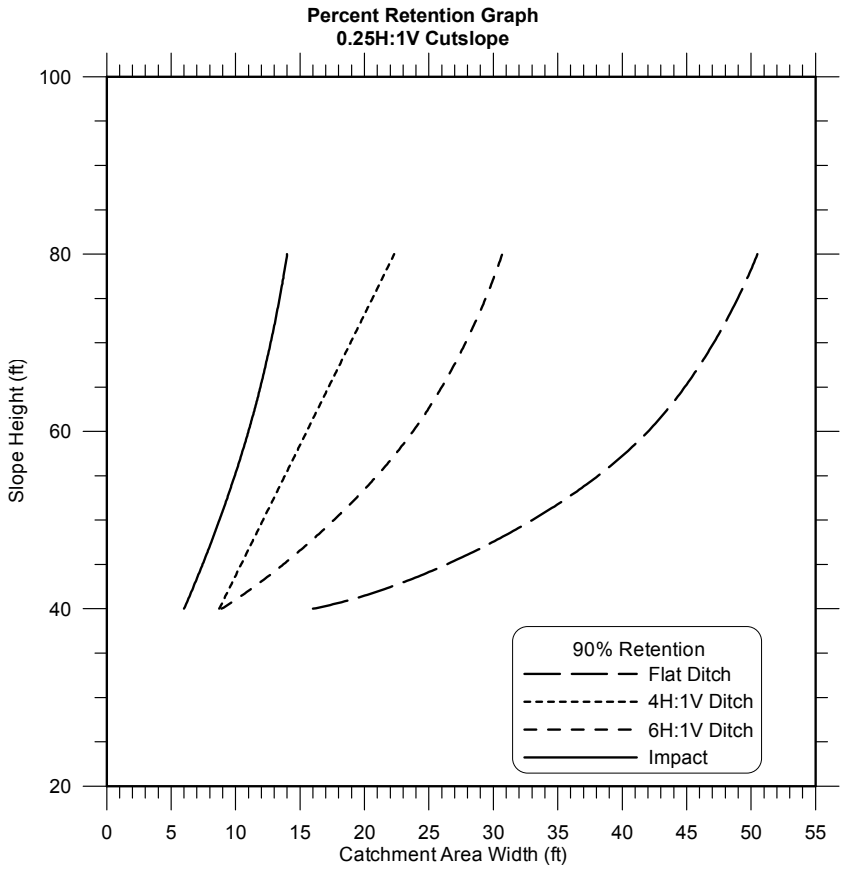

Percent Retention Graph
0.25H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
40% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

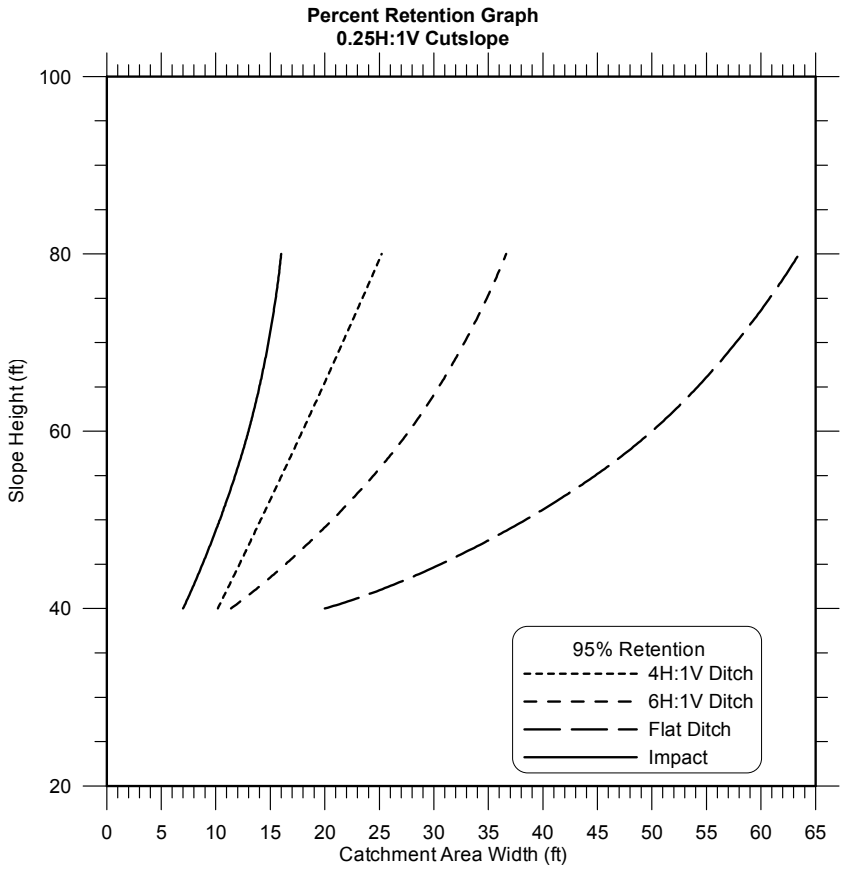

Percent Retention Graph
0.25H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
50% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

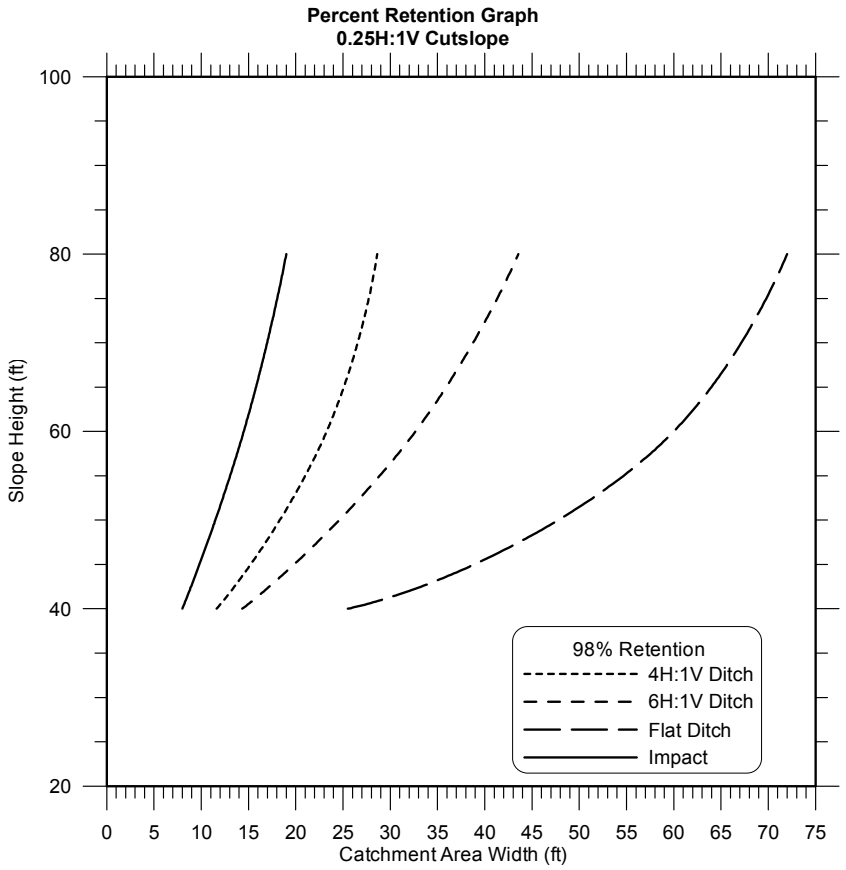

Percent Retention Graph
0.25H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
60% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

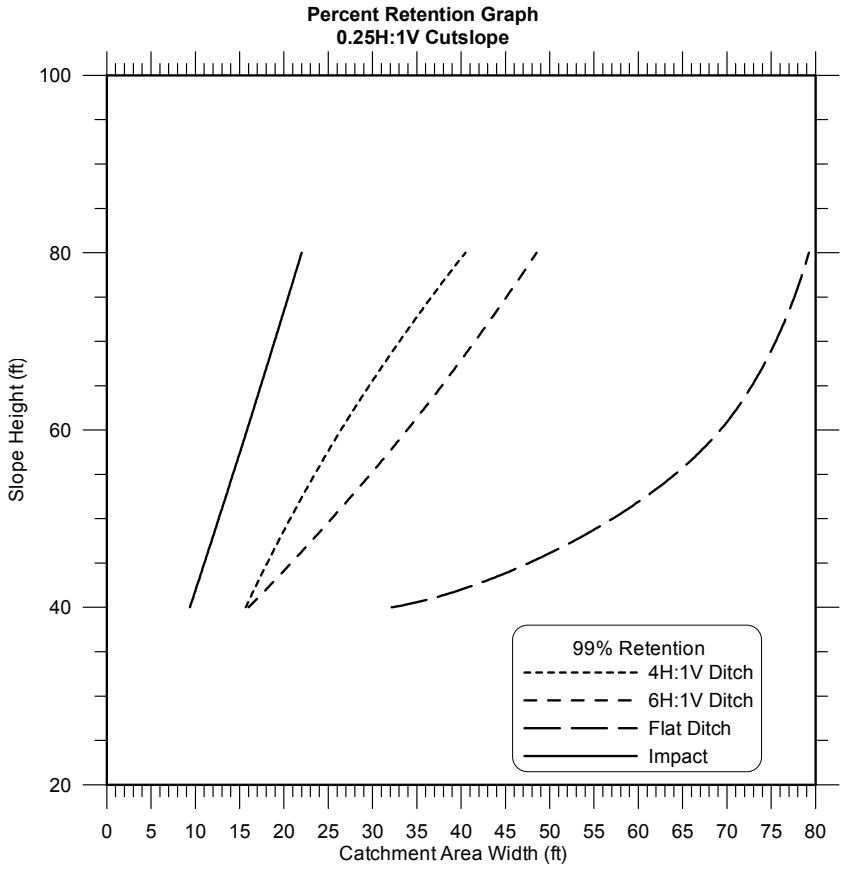

Percent Retention Graph
0.25H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
70% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

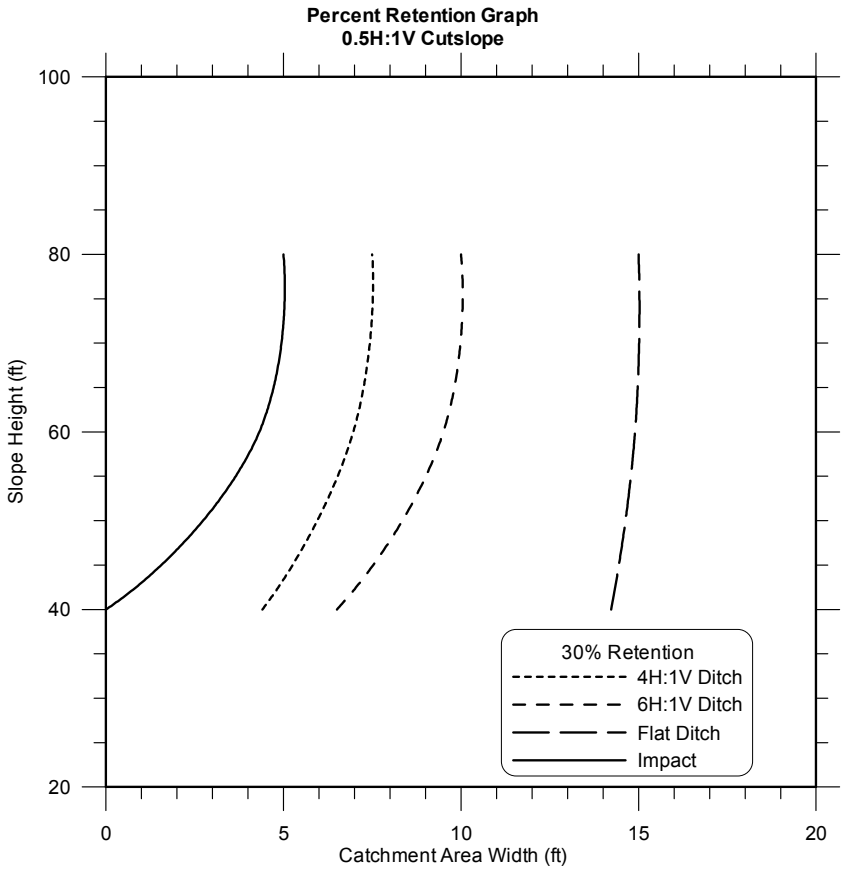

Percent Retention Graph
0.25H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
80% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

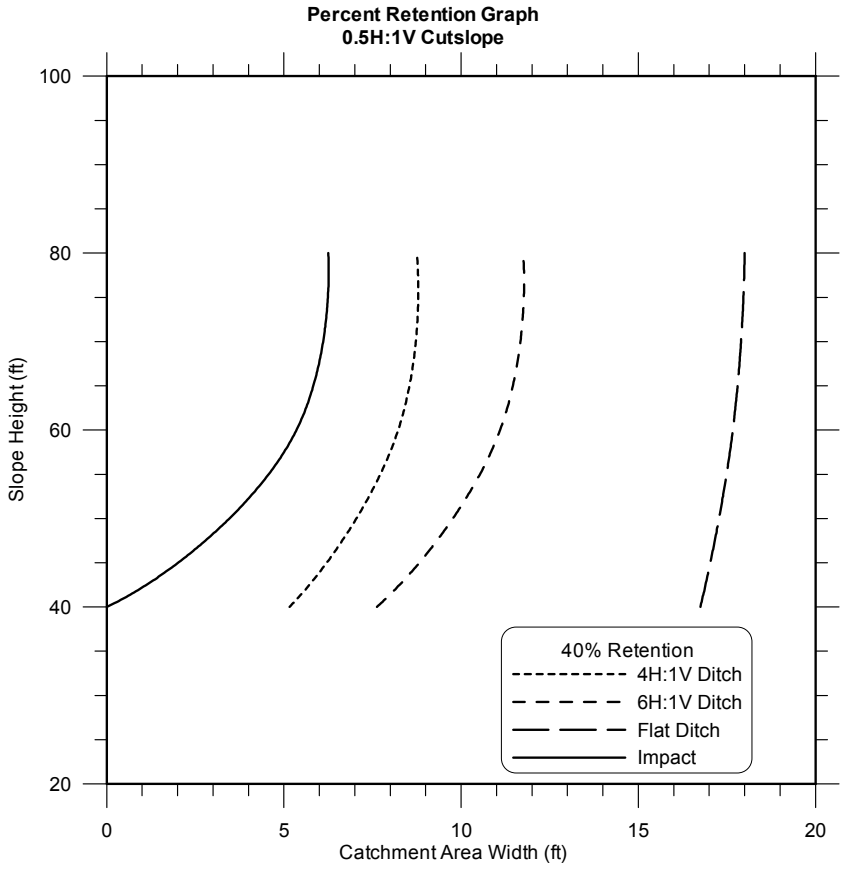

Percent Retention Graph
0.25H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
90% Retention
Flat Ditch
4H:1V Ditch
6H:1V Ditch
Impact

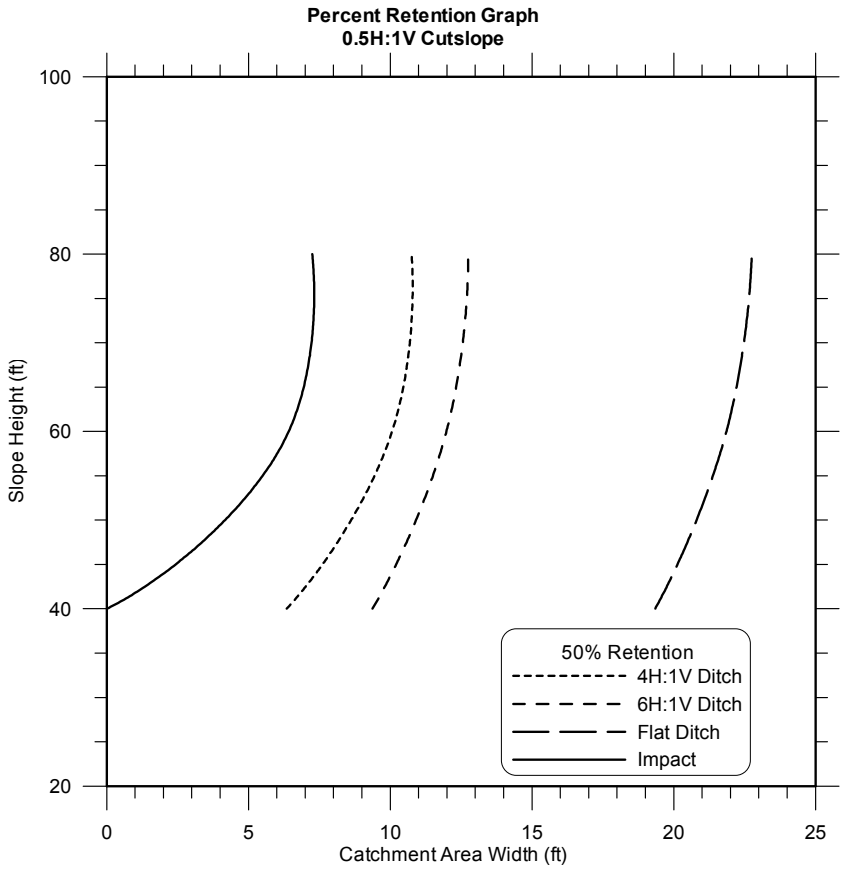

Percent Retention Graph
0.25H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
60
65
95% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

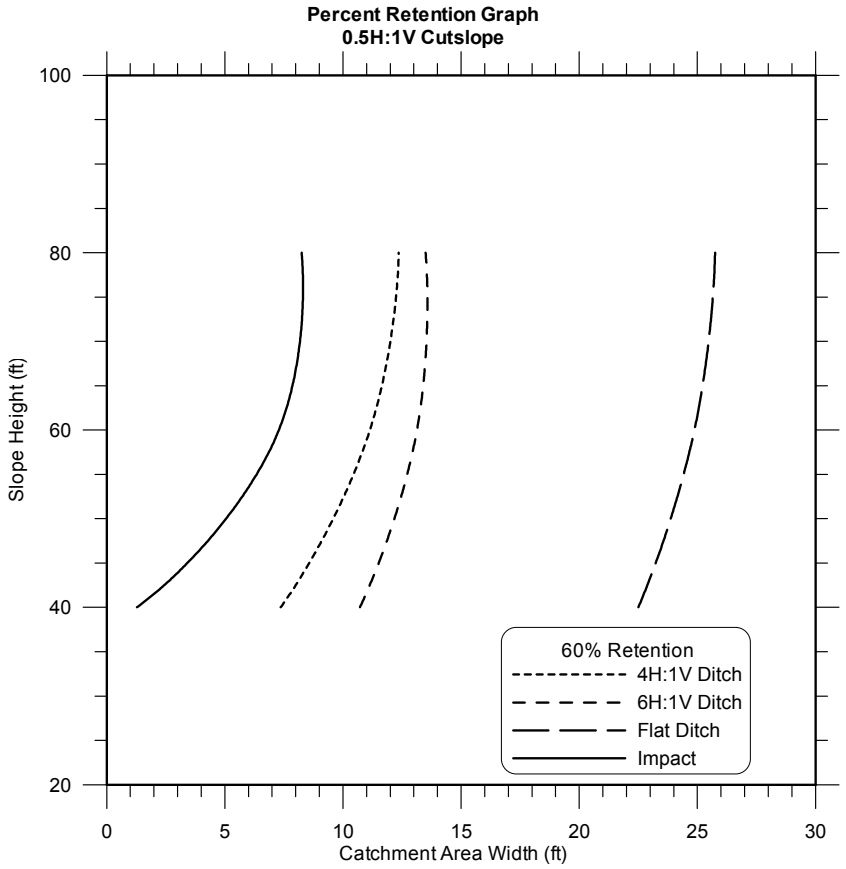

Percent Retention Graph
0.25H:1V Cutslope
Slope Height (ft)
100
80
60
40
20
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
Catchment Area Width (ft)
98% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

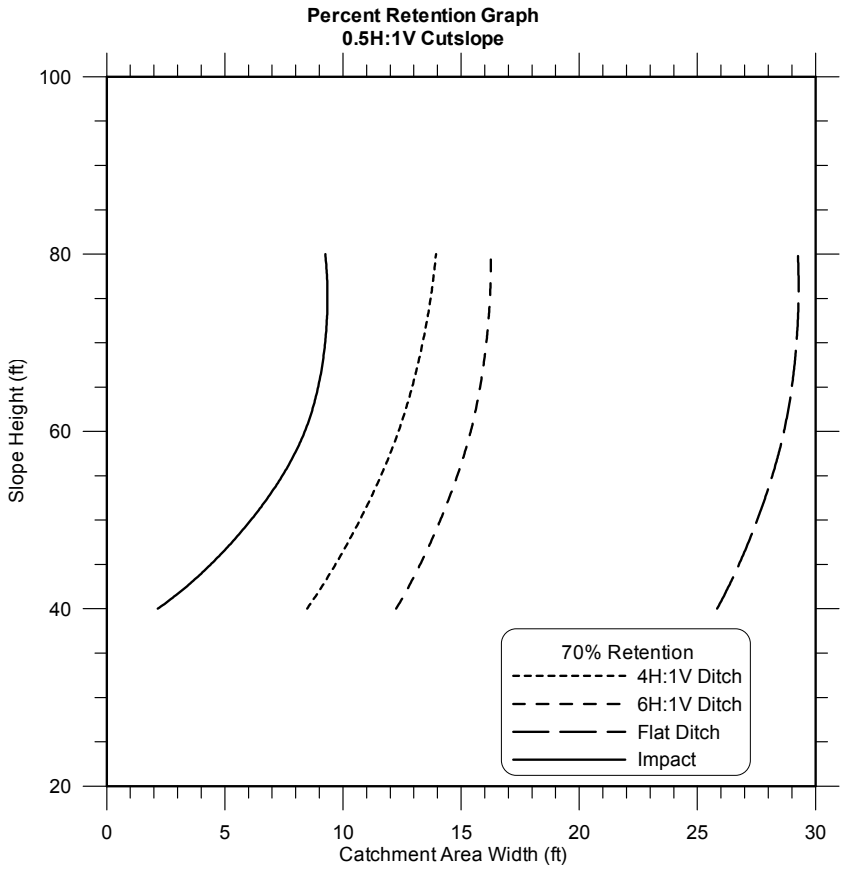

Percent Retention Graph
0.25H:1V Cutslope
Slope Height (ft)
100
80
60
40
20
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Catchment Area Width (ft)
99% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

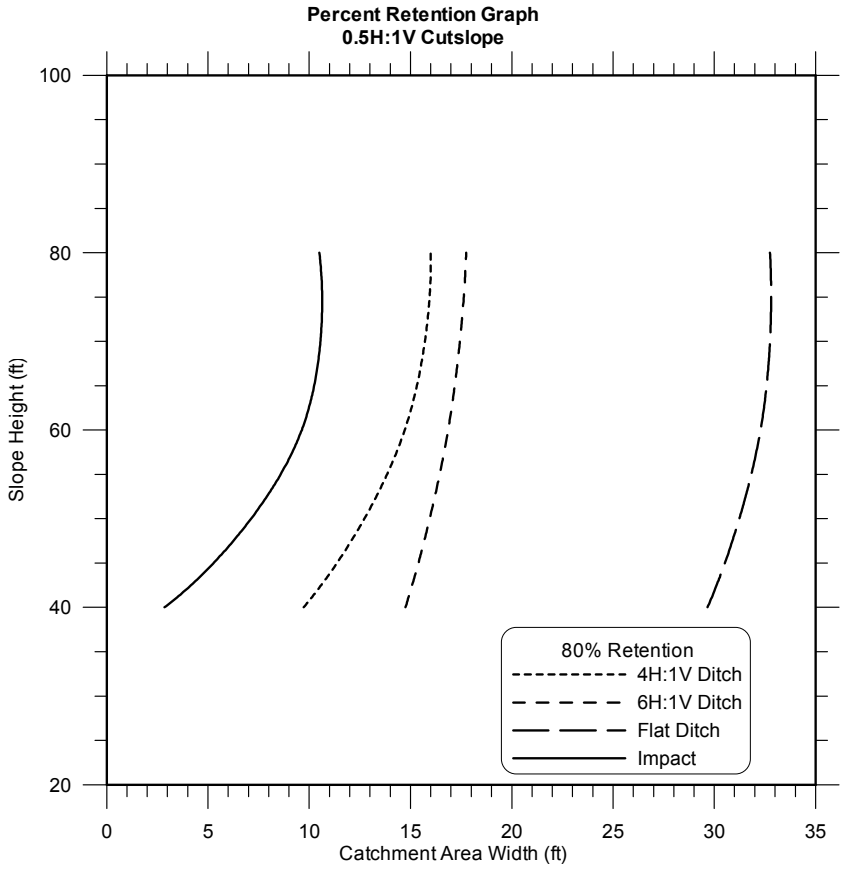

Percent Retention Graph
0.5H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
30% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

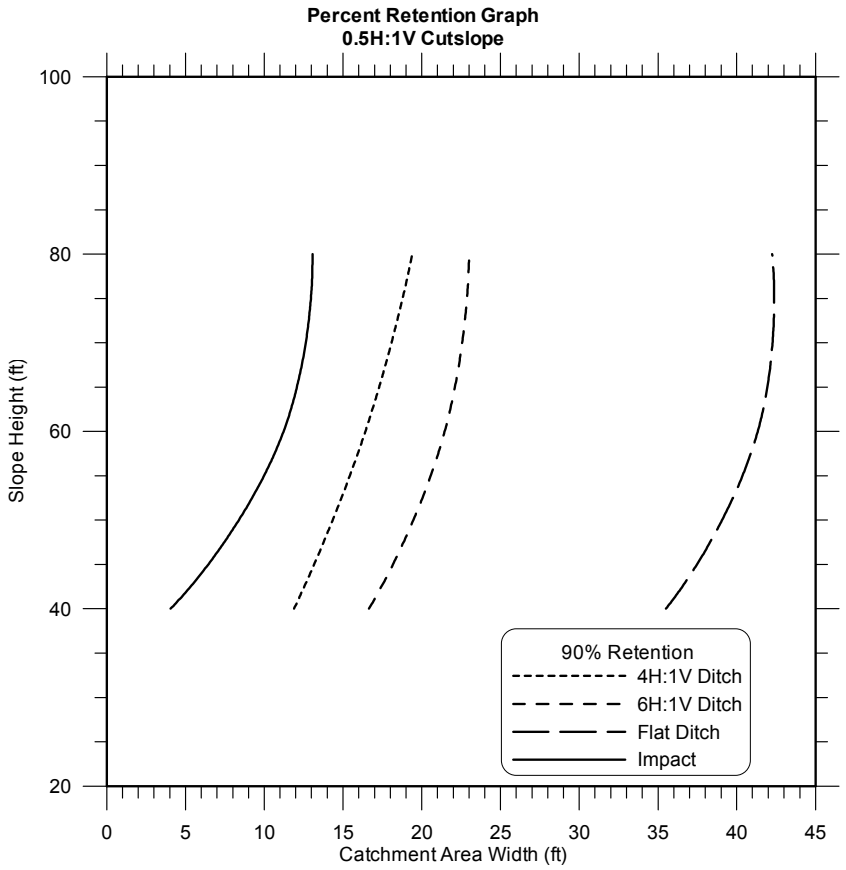

Percent Retention Graph
0.5H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
40% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

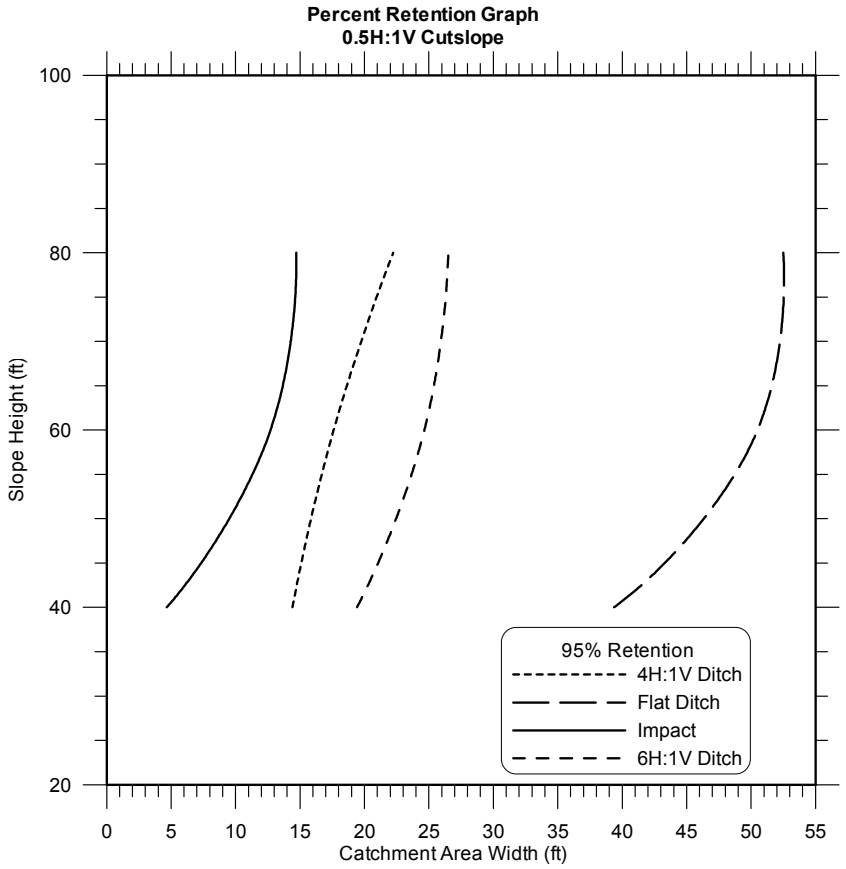

Percent Retention Graph
0.5H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
50% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

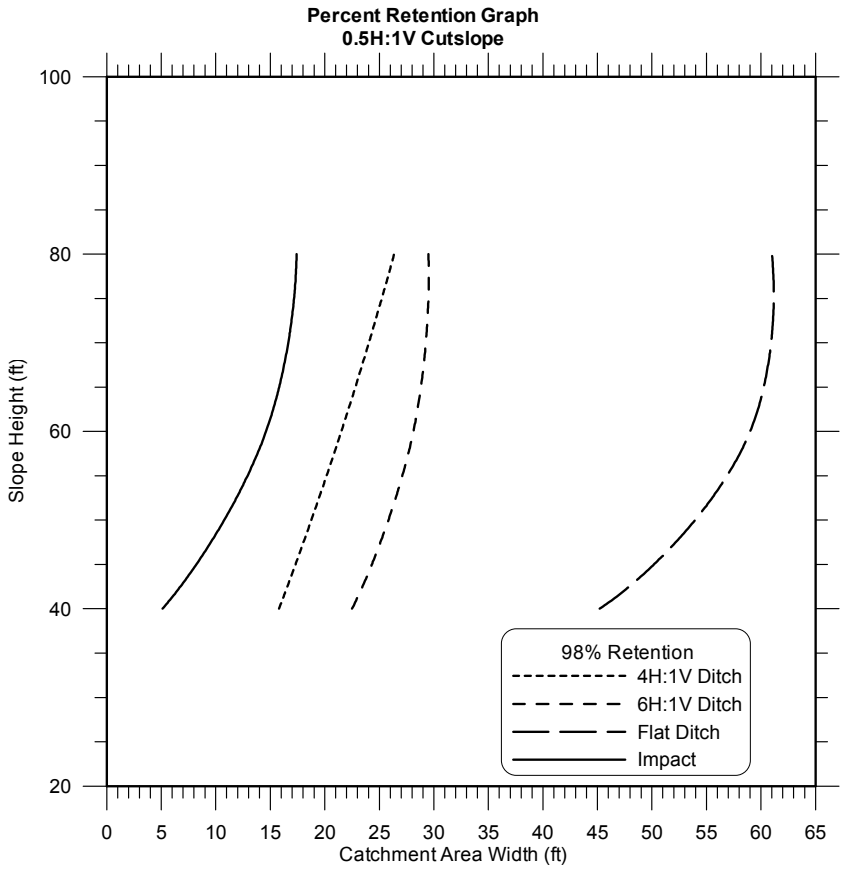

Percent Retention Graph
0.5H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
60% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

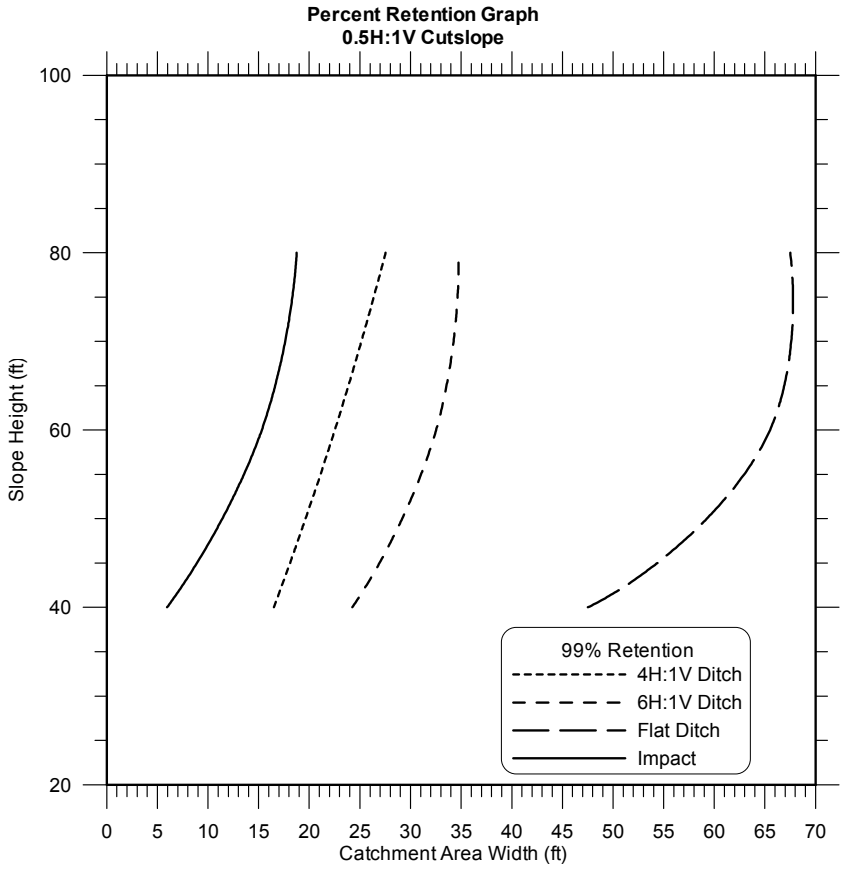

Percent Retention Graph
0.5H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
70% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

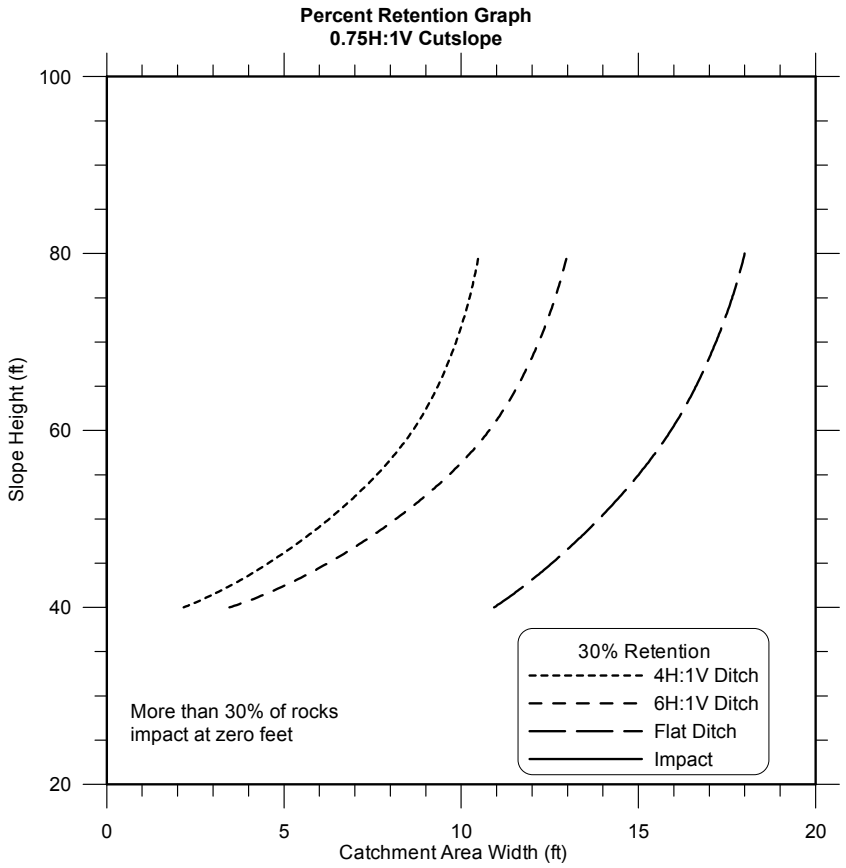

Percent Retention Graph
0.5H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
80% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

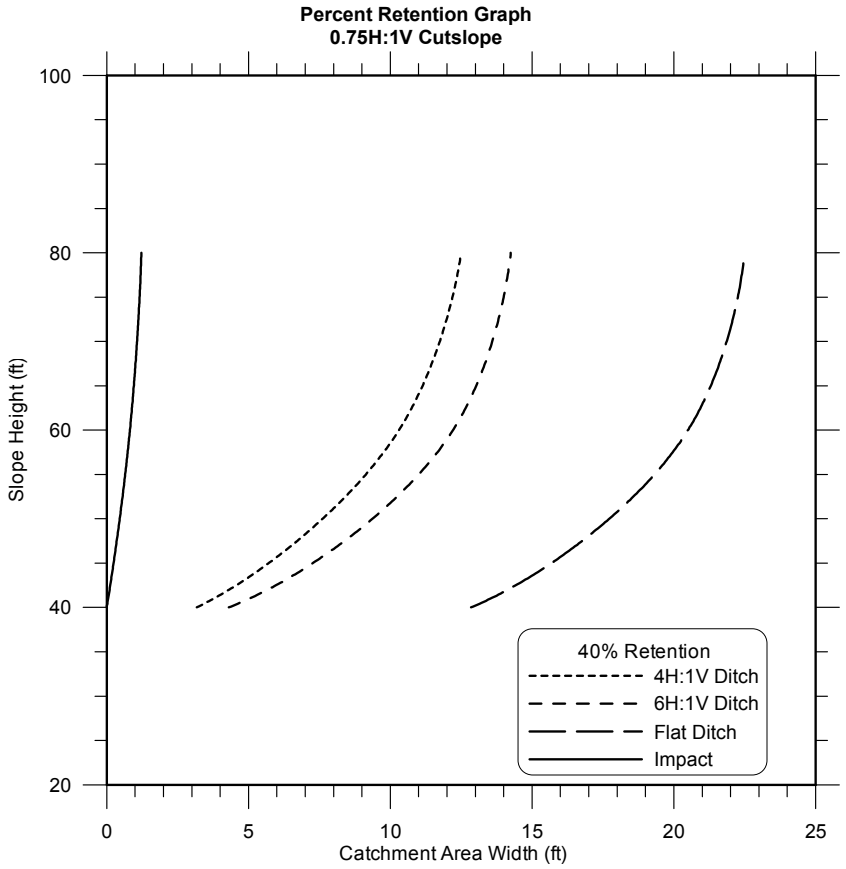

Percent Retention Graph
0.5H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
90% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

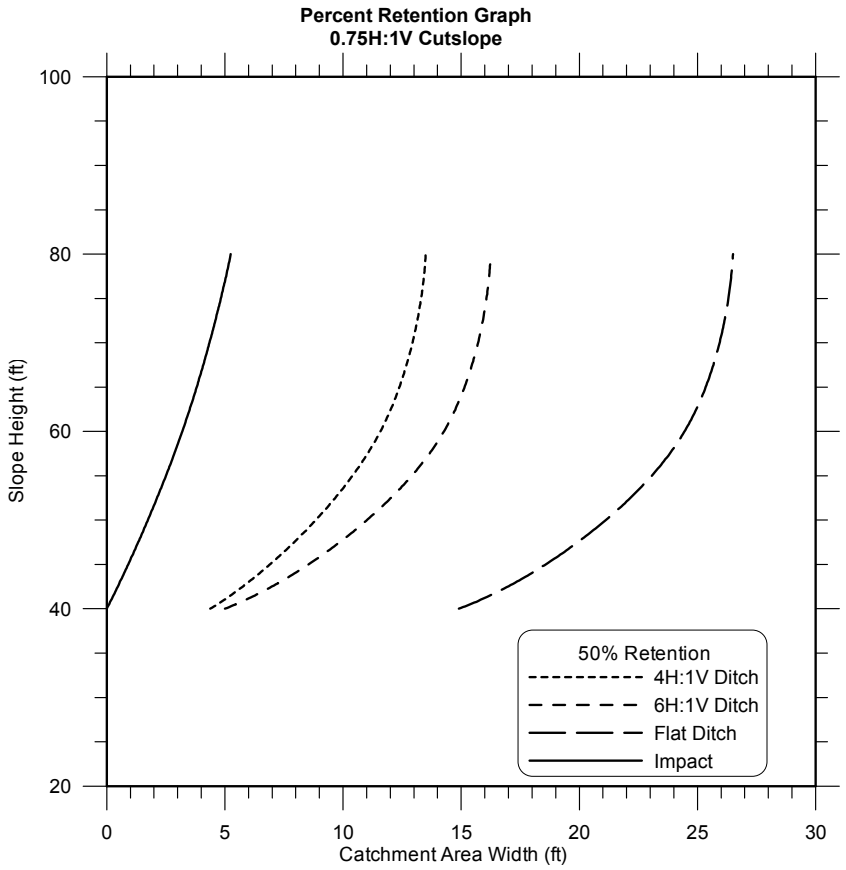

Percent Retention Graph
0.5H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
95% Retention
4H:1V Ditch
Flat Ditch
Impact
6H:1V Ditch

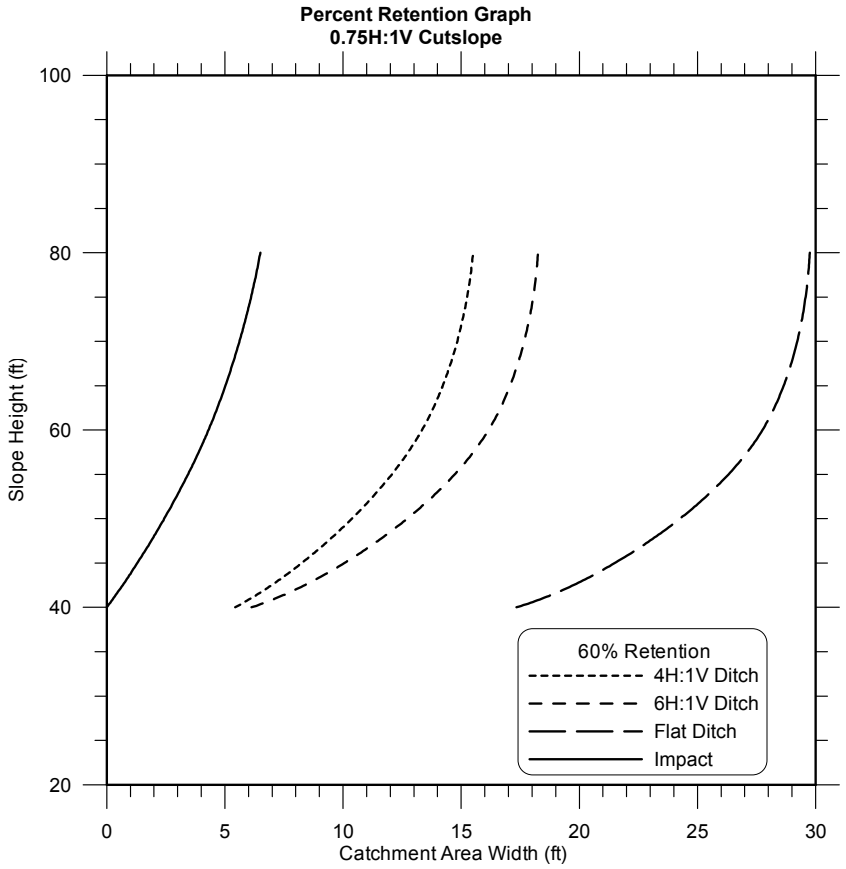

Percent Retention Graph
0.5H:1V Cutslope
Slope Height (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
60
65
Catchment Area Width (ft)
98% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

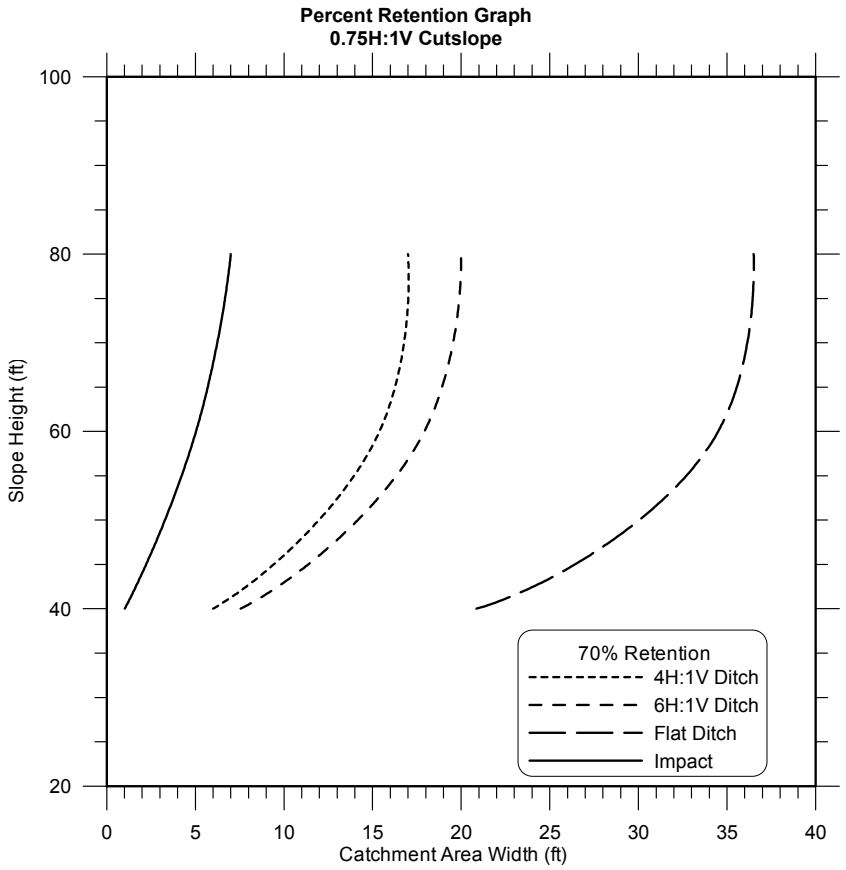

Percent Retention Graph
0.5H:1V Cutslope
Slope Height (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Catchment Area Width (ft)
99% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

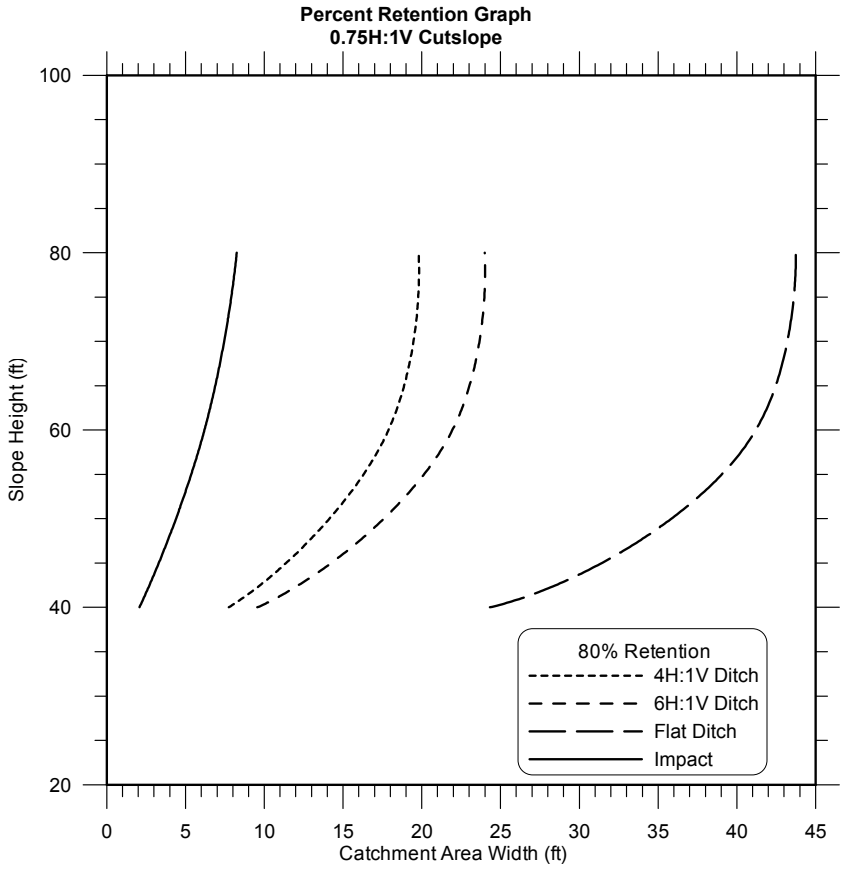

Percent Retention Graph
0.75H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
More than 30% of rocks
impact at zero feet
30% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

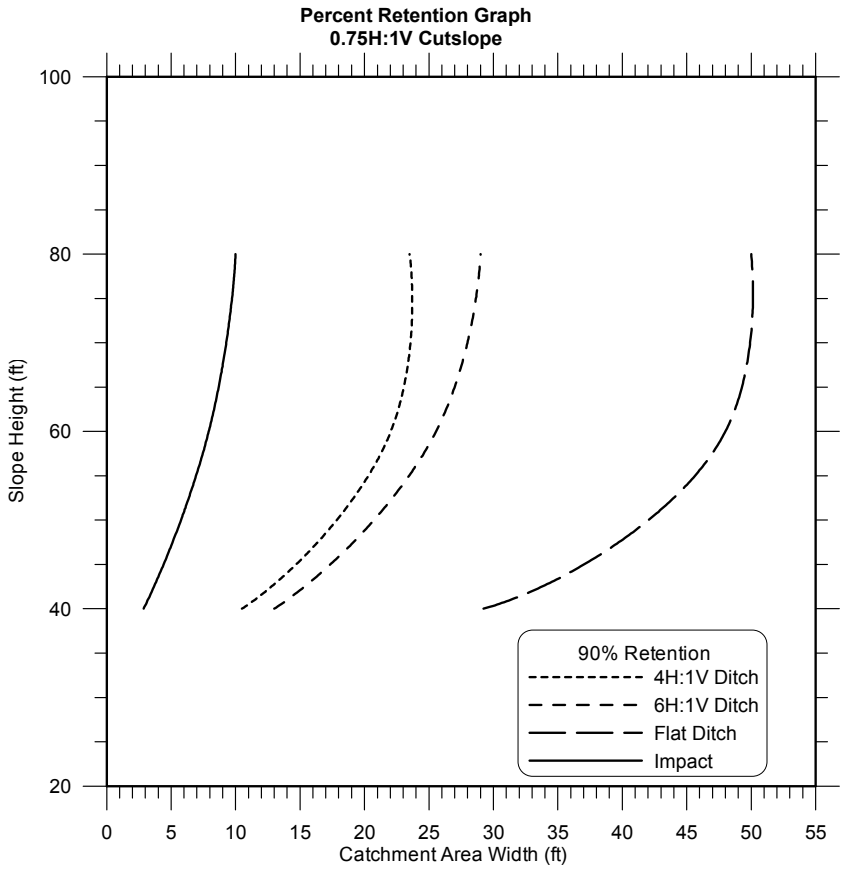

Percent Retention Graph
0.75H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
40% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

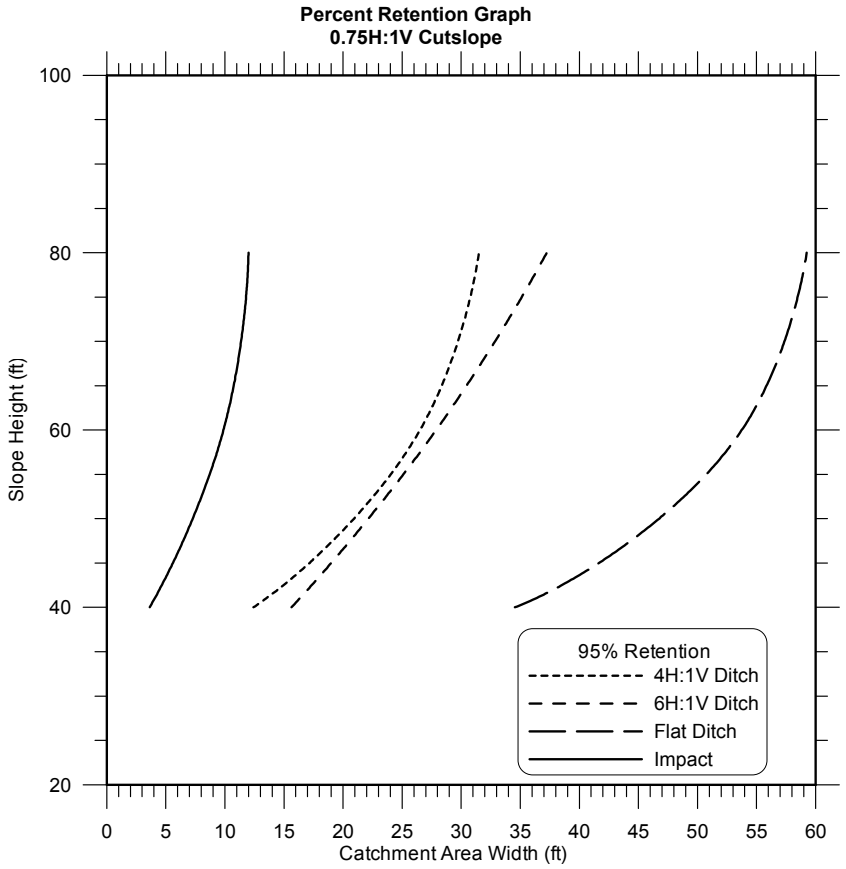

Percent Retention Graph
0.75H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
50% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

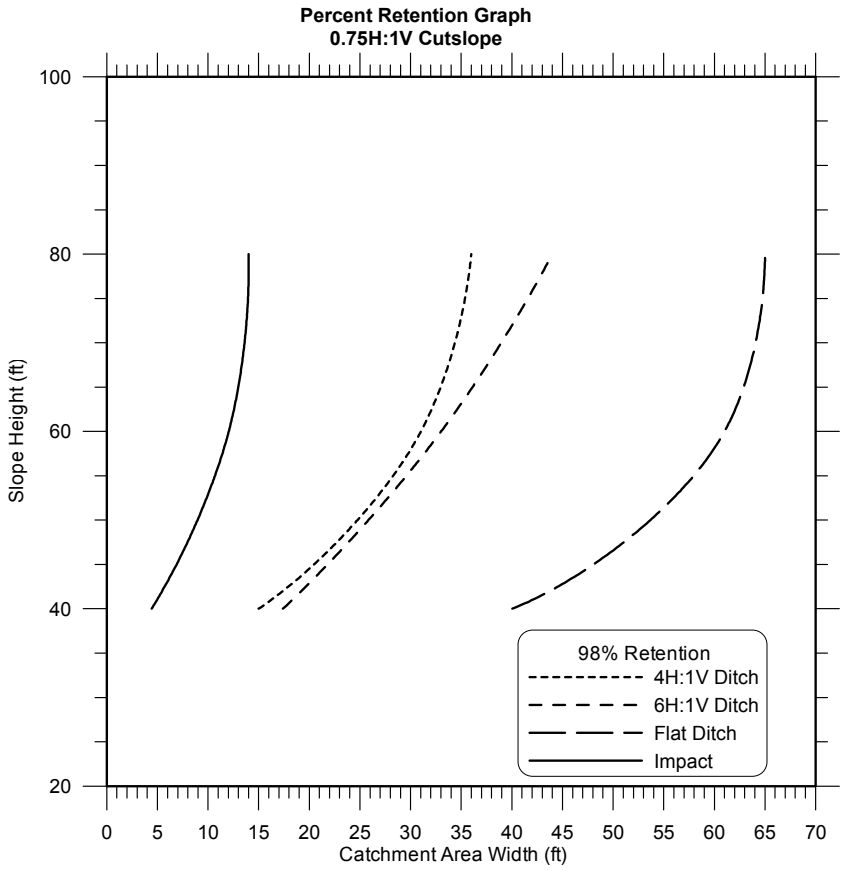

Percent Retention Graph
0.75H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
60% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

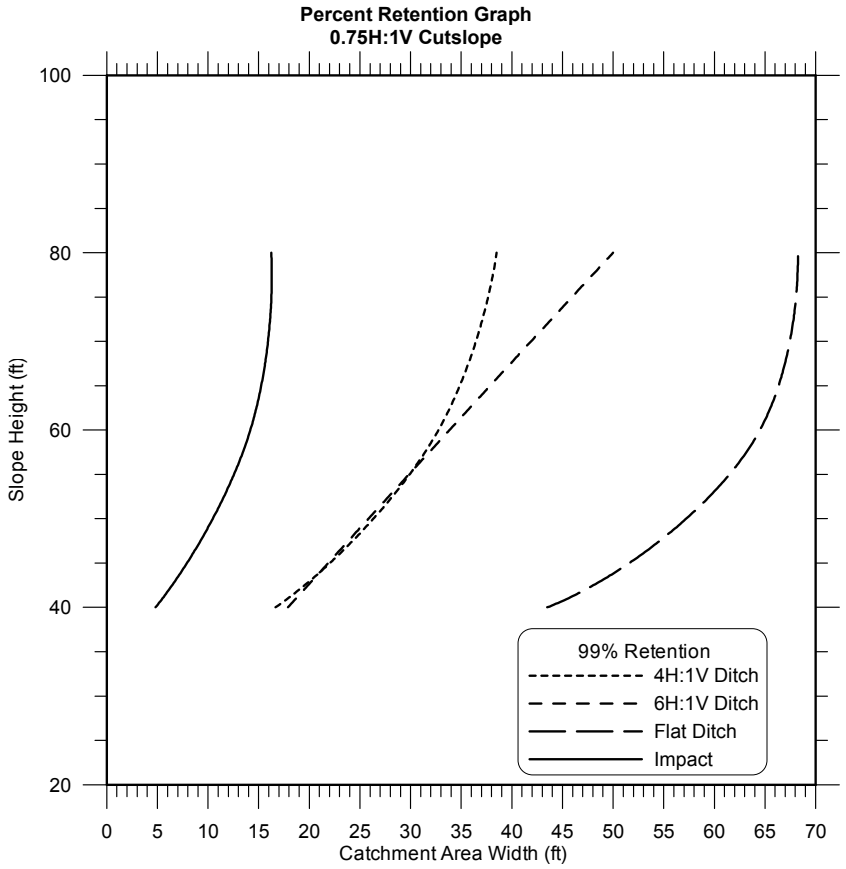

Percent Retention Graph
0.75H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
70% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

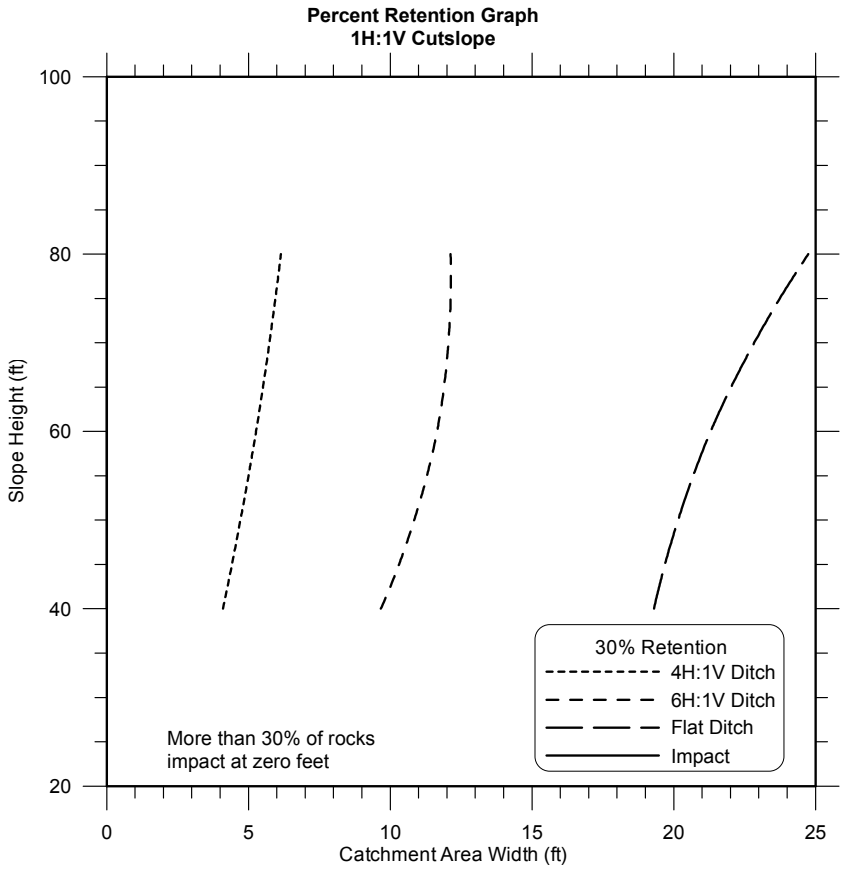

Percent Retention Graph
0.75H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
80% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

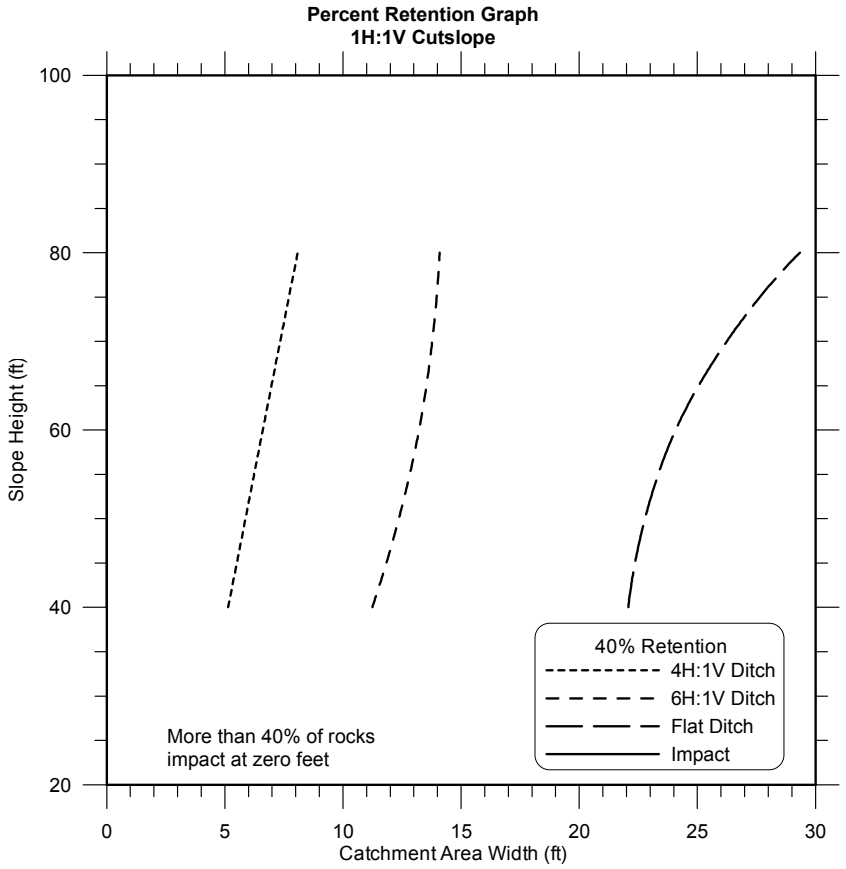

Percent Retention Graph
0.75H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
90% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

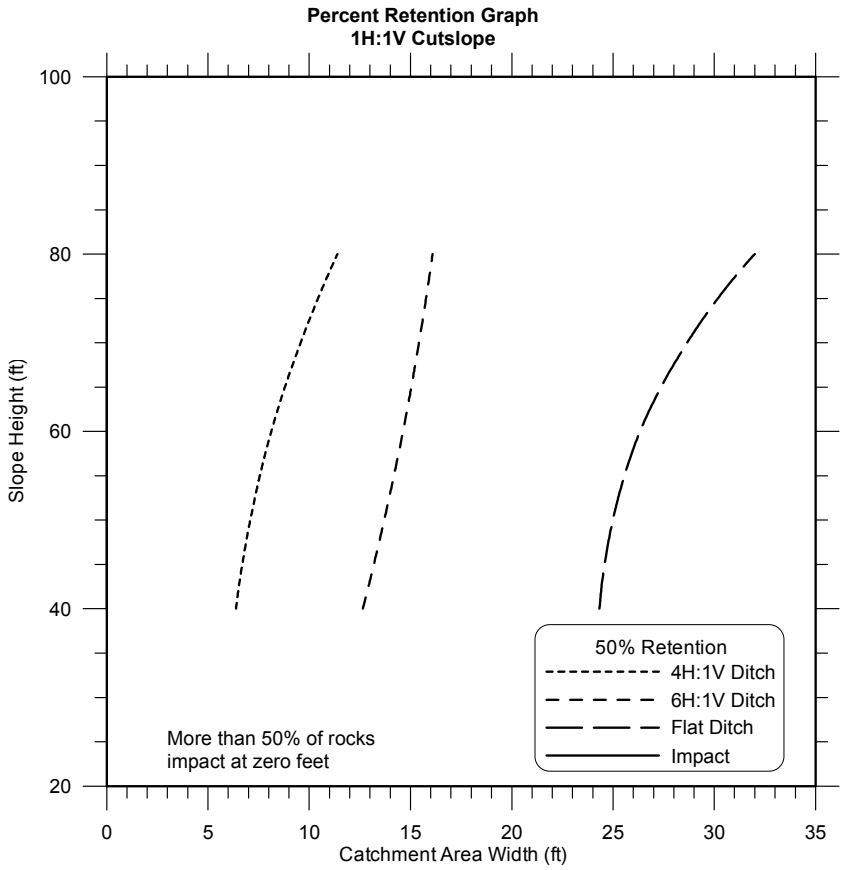

Percent Retention Graph
0.75H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
95% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

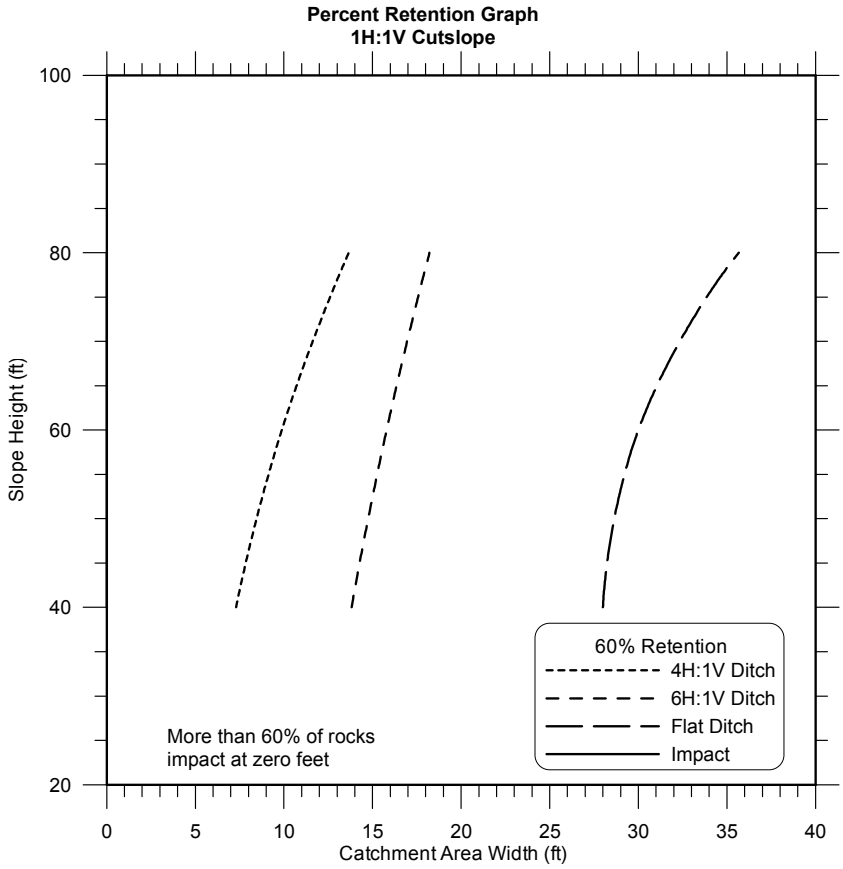

Percent Retention Graph
0.75H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
98% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

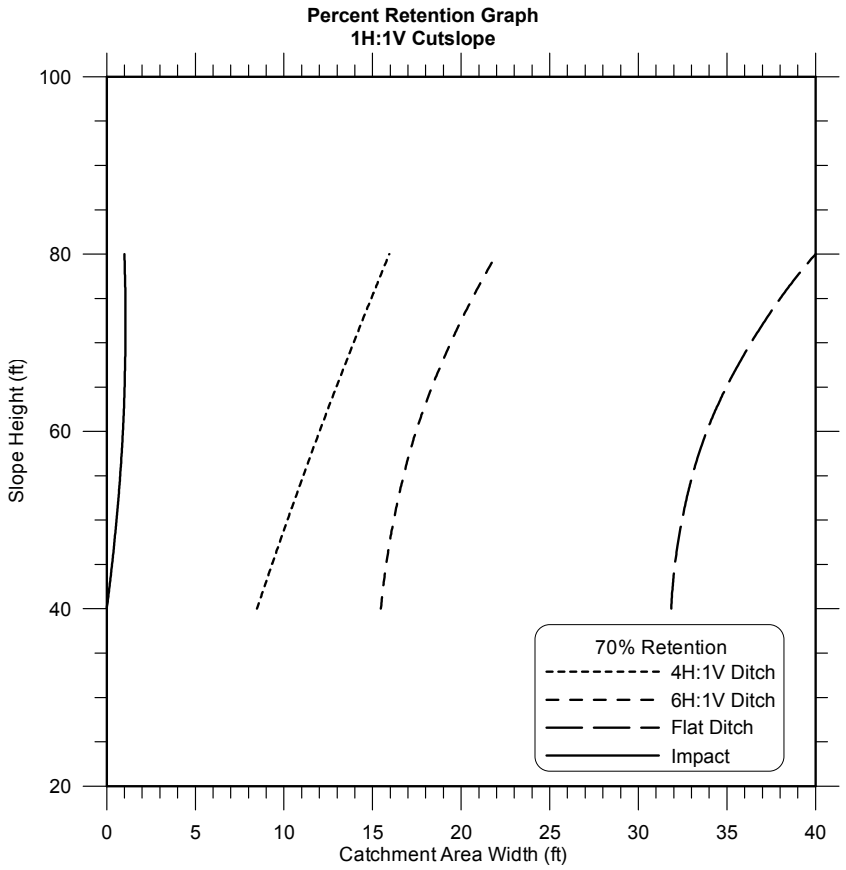

Percent Retention Graph
0.75H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
99% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact

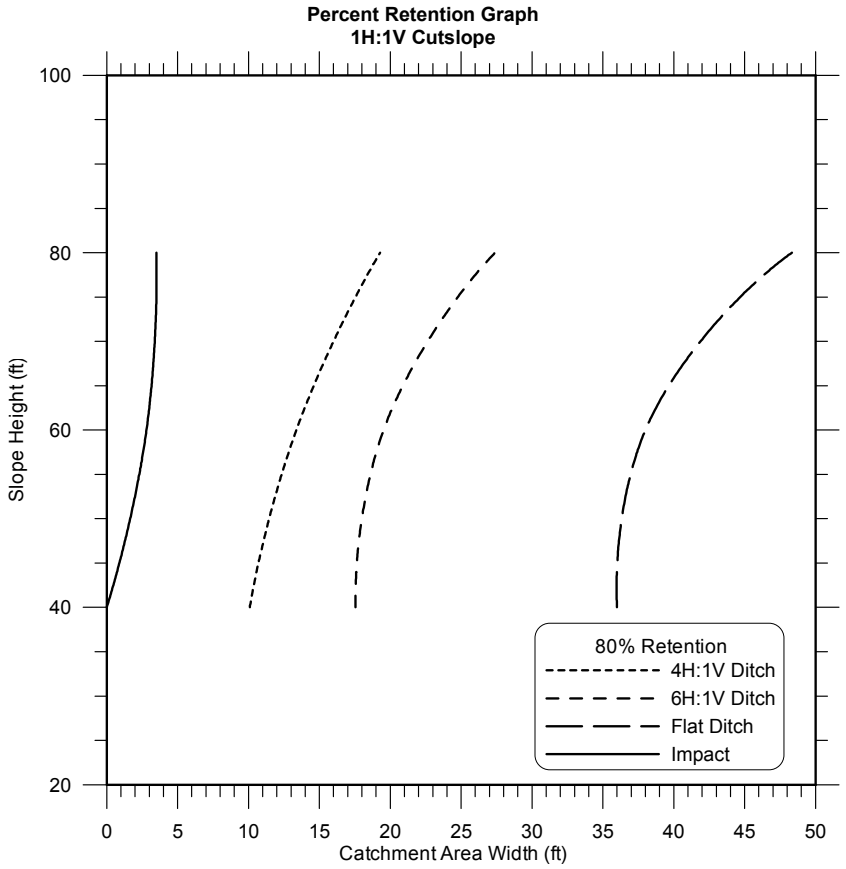

Percent Retention Graph
1H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact
More than 30% of rocks
impact at zero feet

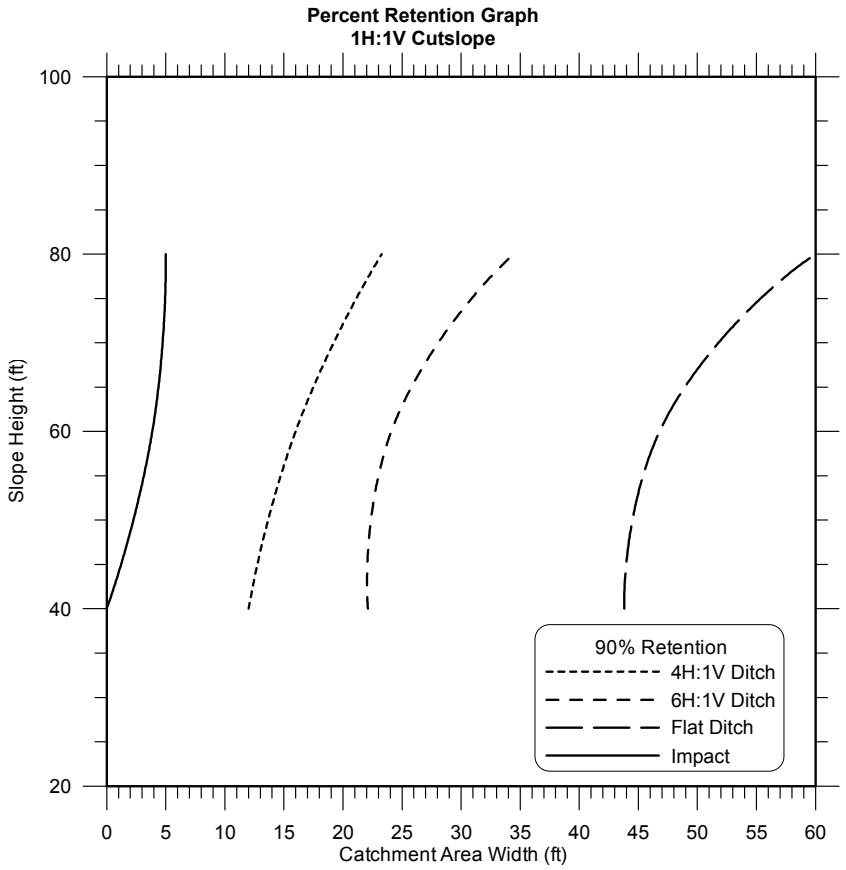

Percent Retention Graph
1H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
40% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact
More than 40% of rocks
impact at zero feet

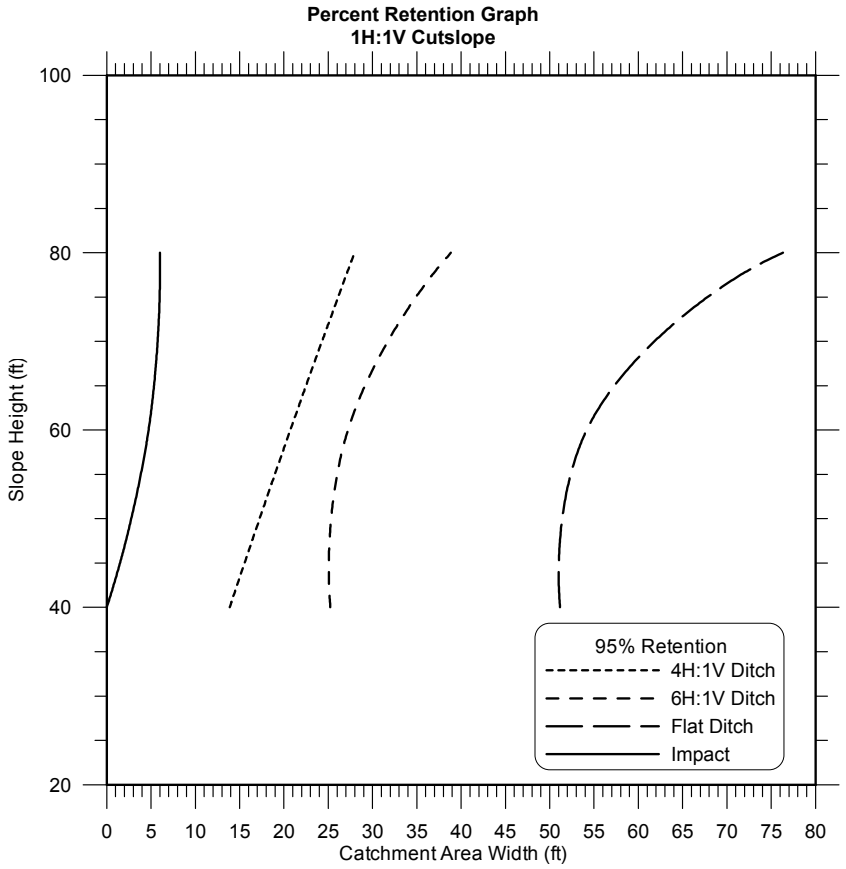

Percent Retention Graph
1H:1V Cutslope
Slope Height (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
Catchment Area Width (ft)
50% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact
More than 50% of rocks
impact at zero feet

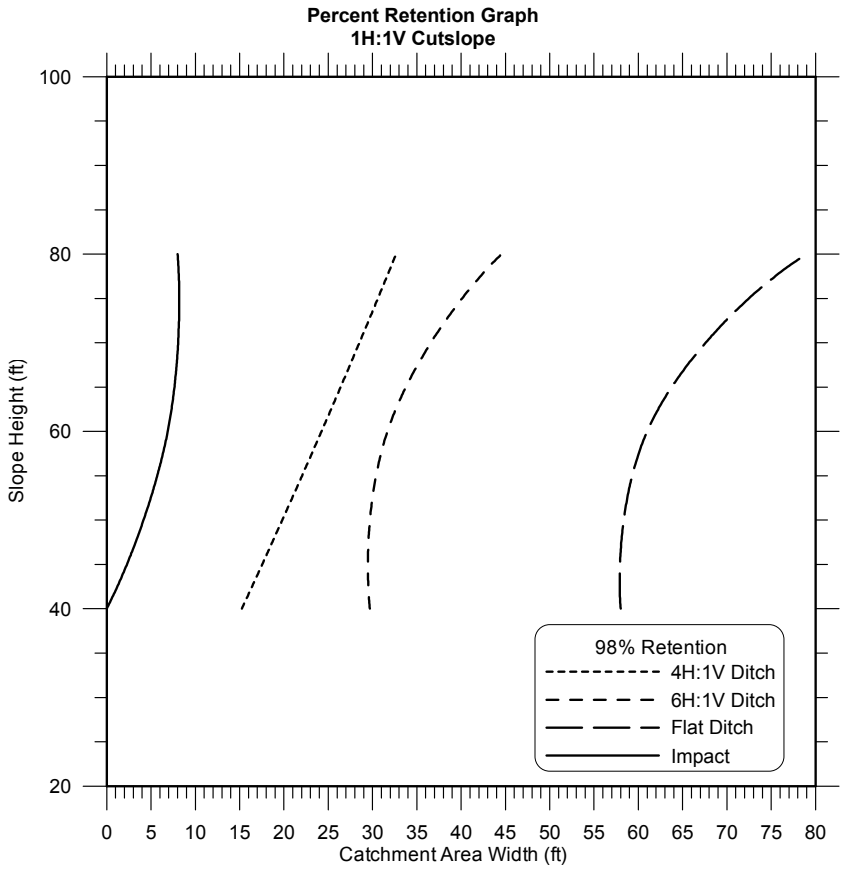

Percent Retention Graph
1H:1V Cutslope
Slope Height (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
Catchment Area Width (ft)
60% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact
More than 60% of rocks
impact at zero feet

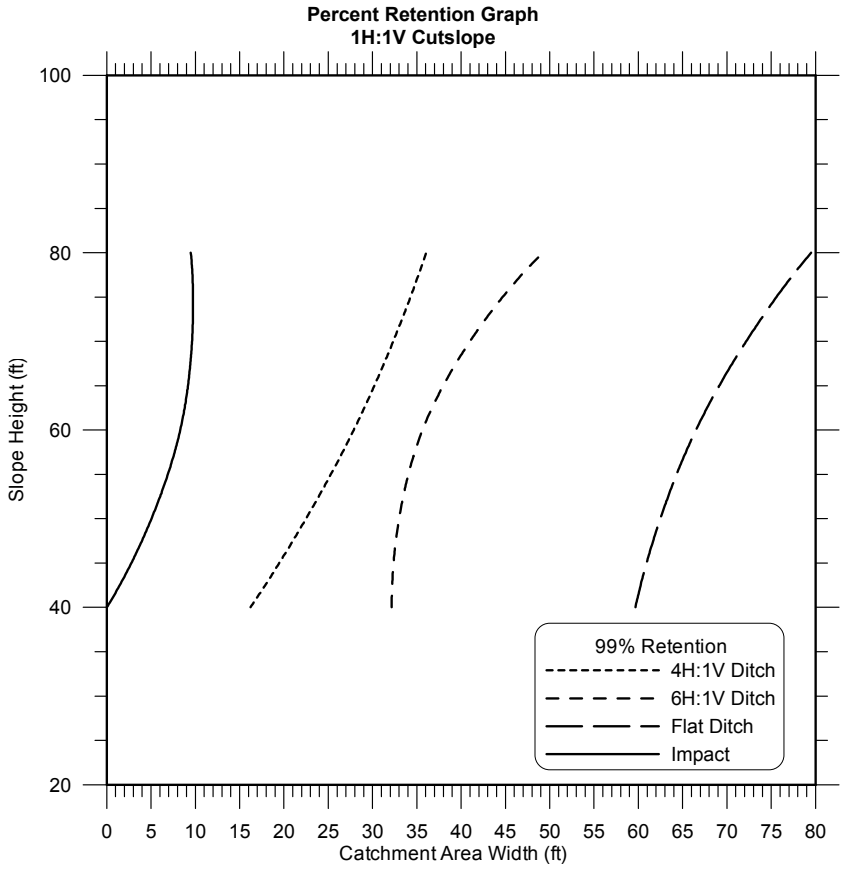

Percent Retention Graph
1H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
70% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact


Percent Retention Graph
1H:1V Cutslope
Slope Height (ft)
Catchment Area Width (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
80% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact


Percent Retention Graph
1H:1V Cutslope
Slope Height (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
60
Catchment Area Width (ft)
90% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact


Percent Retention Graph
1H:1V Cutslope
Slope Height (ft)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Catchment Area Width (ft)
95% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact


Percent Retention Graph
1H:1V Cutslope
Slope Height (ft)
100
80
60
40
20
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Catchment Area Width (ft)
98% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact


Percent Retention Graph
1H:1V Cutslope
Slope Height (ft)
100
80
60
40
20
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Catchment Area Width (ft)
99% Retention
4H:1V Ditch
6H:1V Ditch
Flat Ditch
Impact