

Practice: 468 - Lined Waterway or Outlet

Scenario: #1 - Turf Reinforced Matting

Scenario Description:

Existing channel has excessive erosion and design velocities exceed the use of vegetation. Rock riprap is not readily available or too costly. TRM(Turf Reinforced Matting) works with vegetation to provide a long term solution for high velocity situations. TRM is typically installed over 100% of the width of the waterway to prevent scour and aid in waterway establishment. Cost include excavation, spoiling of excess material, and furnishing, installing TRM and vegetation establishment. Lined waterway width is measured from top of bank to top of bank. If non-TRM areas exist use Mulching (484).

Associated practices are Subsurface Drain (606), Underground Outlet (620), Structure for Water Control (587), Grassed Waterway (412), Lined Outlet (468),and Critical Area Seeding (342).

Before Situation:

Excessive sedimentation and soil erosion as a result of ephemeral or classic gully erosion. Effective soil stress and velocities are generally too high to establish a grassed waterway.

After Situation:

A 300 ' long by 15' wide by 1.5' deep trapezoidal or parabolic shaped waterway lined was installed with Turf Reinforced Matting (TRM). 1/2 the channel is excavated. Excess excavation is spoiled in the immediate area. The practice is installed using a dozer, loader, or excavator. Site prepared for vegetation establishment including seed, lime, fert., etc. TRM is installed by laborers. If non-TRM areas exist, use Mulching (484). The material provides immediate and long-term protection against scouring of the channel.

Scenario Feature Measure: Square Foot of Waterway

Scenario Unit: Square Feet

Scenario Typical Size: 4,500

Scenario Cost: \$4,375.95

Scenario Cost/Unit: \$0.97

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price (\$/unit)	Quantity	Cost
Equipment/Installation						
Excavation, Common Earth, side cast, small equipment	48	Bulk excavation and side casting of common earth with hydraulic excavator with less than 1 CY capacity. Includes equipment and labor.	Cubic yard	\$2.36	125	\$295.00
Tillage, Light	945	Includes light disking (tandem) or field cultivator. Includes equipment, power unit and labor costs.	Acre	\$10.70	0.1	\$1.07
Fertilizer, ground application, dry bulk	950	Dry bulk fertilizer application performed by ground equipment. Includes equipment, power unit and labor costs.	Acre	\$6.54	0.1	\$0.65
Seeding Operation, No Till/Grass Drill	960	No Till drill or grass drill for seeding. Includes equipment, power unit and labor costs.	Acre	\$20.51	0.1	\$2.05
Cultipacking	1100	Includes equipment, power unit and labor costs.	Acre	\$8.14	0.1	\$0.81
Stripping and stockpiling, topsoil	1199	Stripping and stockpiling of topsoil adjacent to stripping area. Includes equipment and labor.	Cubic Yard	\$0.87	83	\$72.21
Labor						
Supervisor or Manager	234	Labor involving supervision or management activities. Includes crew supervisors, foremen and farm/ranch managers time required for adopting new technology, etc.	Hour	\$42.74	1	\$42.74
Materials						
Phosphorus, P2O5	73	Price per pound of P2O5 supplied by Superphosphate. Price is not per pound of total product applied, no conversion is needed.	Pound	\$0.93	6	\$5.58
Potassium, K2O	74	K2O supplied by Muriate Of Potash. Price is not per pound of total product applied, no conversion is needed.	Pound	\$0.51	6	\$3.06
Lime, ENM	75	Fertilizer: Limestone Spread on field.	Ton	\$133.79	0.2	\$26.76
Turf reinforcement mat	1212	Synthetic turf reinforcement mat with staple anchoring. Includes materials, equipment and labor.	Square Yard	\$6.97	500	\$3,485.00
Four Species Mix, Cool Season, Introduced Perennial (2 grasses, 2 legumes)	2317	Cool season grass and legume mix. Includes material and shipping only.	Acre	\$49.65	0.1	\$4.97

Materials

Nitrogen (N), Urea	71	Price per pound of N supplied by Urea. Price is not per pound of total product applied, no conversion is needed.	Pound	\$0.71	3	\$2.13
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Mobilization

Mobilization, small equipment	1138	Equipment <70 HP but can't be transported by a pick-up truck or with typical weights between 3,500 to 14,000 pounds.	Each	\$174.49	1	\$174.49
Mobilization, medium equipment	1139	Equipment with 70-150 HP or typical weights between 14,000 and 30,000 pounds.	Each	\$259.43	1	\$259.43

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Scenario: #2 - Rock Lined - 12"

Scenario Description:

Rock Riprap is installed over 100% of the width of the waterway to prevent scour. Velocity of around 8'/sec dictates 9" rock. Cost includes excavation, spoiling of excess material, geotextile underlayment and installing Rock Riprap. Lined waterway width is measured from inside top to inside top of lined channel, typically top of bank.

Associated practices are Subsurface Drain (606), Underground Outlet (620), Structure for Water Control (587), Grassed Waterway (412), Lined Outlet (468),and Critical Area Seeding (342).

Before Situation:

Excessive sedimentation and soil erosion as a result of ephemeral or classic gully erosion. Effective soil stress and velocities are generally too high or saturated soil conditions make it difficult to establish a grassed waterway.

After Situation:

Installed a 300' long by 15' wide by 1.5' deep trapezoidal or parabolic shaped waterway lined with riprap (D100 = 12", Velocity ~ 8 ft/sec). 3/4 the channel depth is excavated. Excess excavation is spoiled in the immediate area. Geotextile underlayment is installed by laborers. Completed rock protects channel against future scour and keeps sediment out of the water course and water bodies.

Scenario Feature Measure: Square Foot of Waterway

Scenario Unit: Square Feet

Scenario Typical Size: 4,500

Scenario Cost: \$19,357.23

Scenario Cost/Unit: \$4.30

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price (\$/unit)	Quantity	Cost
Equipment/Installation						
Excavation, Common Earth, side cast, small equipment	48	Bulk excavation and side casting of common earth with hydraulic excavator with less than 1 CY capacity. Includes equipment and labor.	Cubic yard	\$2.36	250	\$590.00
Hydraulic Excavator, 2 CY	932	Track mounted hydraulic excavator with bucket capacity range of 1.5 to 2.5 CY. Equipment and power unit costs. Labor not included.	Hour	\$193.45	21	\$4,062.45
Track Loader, 95HP	935	Equipment and power unit costs. Labor not included.	Hour	\$89.84	21	\$1,886.64
Labor						
General Labor	231	Labor performed using basic tools such as power tool, shovels, and other tools that do not require extensive training. Ex. pipe layer, herder, concrete placement, materials spreader, flagger, etc.	Hour	\$22.22	21	\$466.62
Equipment Operators, Heavy	233	Includes: Cranes, Hydraulic Excavators >=50 HP, Dozers, Paving Machines, Rock Trenchers, Trenchers >=12", Dump Trucks, Ag Equipment >=150 HP, Scrapers, Water Wagons.	Hour	\$37.38	42	\$1,569.96
Supervisor or Manager	234	Labor involving supervision or management activities. Includes crew supervisors, foremen and farm/ranch managers time required for adopting new technology, etc.	Hour	\$42.74	3	\$128.22
Materials						
Aggregate, Gravel, Ungraded, Quarry Run	1099	Includes materials, equipment and labor	Cubic yard	\$24.78	100	\$2,478.00
Rock Riprap, graded, angular, material and shipping	1200	Graded Rock Riprap for all gradation ranges. Includes materials and delivery only.	Ton	\$24.54	312	\$7,656.48
Mobilization						
Mobilization, medium equipment	1139	Equipment with 70-150 HP or typical weights between 14,000 and 30,000 pounds.	Each	\$259.43	2	\$518.86

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Scenario: #3 - Rock Lined - 24"

Scenario Description:

Riprap is installed over 100% of the width of the waterway to prevent scour. Velocity of around 11'/sec dictates 18" rock. Cost include excavation, spoiling of excess material, geotextile underlayment and installing 18" Rock Riprap. Lined waterway width is measured from inside top to inside top of lined channel, typically top of bank.

Associated practices are Subsurface Drain (606), Underground Outlet (620), Structure for Water Control (587), Grassed Waterway (412), Lined Outlet (468),and Critical Area Seeding (342).

Before Situation:

Excessive sedimentation and soil erosion as a result of ephemeral or classic gully erosion. Effective soil stress and velocities are generally too high or saturated soil conditions make it difficult to establish a grassed waterway.

After Situation:

Installed a 300 ' long by 15' wide by 1.5' deep trapezoidal or parabolic shaped waterway lined with riprap (D100 = 18", Velocity ~ 11 ft/sec). 3/4 the channel is excavated, before excavation for riprap. Excess excavation is spoiled in the immediate area. Waterway is excavated and rock is placed using a hydraulic excavator. Geotextile underlayment is installed by laborers.

Scenario Feature Measure: Square Foot of Waterway

Scenario Unit: Square Feet

Scenario Typical Size: 4,500

Scenario Cost: \$32,064.48

Scenario Cost/Unit: \$7.13

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price (\$/unit)	Quantity	Cost
Equipment/Installation						
Hydraulic Excavator, 2 CY	932	Track mounted hydraulic excavator with bucket capacity range of 1.5 to 2.5 CY. Equipment and power unit costs. Labor not included.	Hour	\$193.45	38	\$7,351.10
Excavation, Common Earth, side cast, small equipment	48	Bulk excavation and side casting of common earth with hydraulic excavator with less than 1 CY capacity. Includes equipment and labor.	Cubic yard	\$2.36	417	\$984.12
Track Loader, 95HP	935	Equipment and power unit costs. Labor not included.	Hour	\$89.84	38	\$3,413.92
Labor						
General Labor	231	Labor performed using basic tools such as power tool, shovels, and other tools that do not require extensive training. Ex. pipe layer, herder, concrete placement, materials spreader, flagger, etc.	Hour	\$22.22	38	\$844.36
Supervisor or Manager	234	Labor involving supervision or management activities. Includes crew supervisors, foremen and farm/ranch managers time required for adopting new technology, etc.	Hour	\$42.74	5	\$213.70
Equipment Operators, Heavy	233	Includes: Cranes, Hydraulic Excavators >=50 HP, Dozers, Paving Machines, Rock Trenchers, Trenchers >=12", Dump Trucks, Ag Equipment >=150 HP, Scrapers, Water Wagons.	Hour	\$37.38	76	\$2,840.88
Materials						
Rock Riprap, graded, angular, material and shipping	1200	Graded Rock Riprap for all gradation ranges. Includes materials and delivery only.	Ton	\$24.54	563	\$13,816.02
Aggregate, Gravel, Ungraded, Quarry Run	1099	Includes materials, equipment and labor	Cubic yard	\$24.78	84	\$2,081.52
Mobilization						
Mobilization, medium equipment	1139	Equipment with 70-150 HP or typical weights between 14,000 and 30,000 pounds.	Each	\$259.43	2	\$518.86

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Scenario: #4 - Rock, Grouted

Scenario Description:

Rock Riprap is installed over 100% of the width of the waterway to prevent scour. Velocity of around 8'/sec dictates 9" rock. Rock of this size not readily available, therefore must also grout rock with cement. Cost includes excavation, spoiling of excess material, geotextile underlayment installing Rock Riprap and grouting with cement. Lined waterway width is measured from inside top to inside top of lined channel, typically top of bank.

Associated practices are Subsurface Drain (606), Underground Outlet (620), Structure for Water Control (587), Grassed Waterway (412), Lined Outlet (468),and Critical Area Seeding (342).

Before Situation:

Excessive sedimentation and soil erosion as a result of ephemeral or classic gully erosion. Effective soil stress and velocities are generally too high or saturated soil conditions make it difficult to establish a grassed waterway.

After Situation:

Installed a 100' long by 15' wide by 1.5' deep trapezoidal or parabolic shaped waterway lined with riprap (D100 = 12", Velocity ~ 8 ft/sec). 3/4 the channel depth is excavated. Excess excavation is spoiled in the immediate area. Geotextile underlayment is installed by laborers. Completed rock also grouted to protect channel against future scour and keeps sediment out of the water course and water bodies.

Scenario Feature Measure: Square Foot of Waterway

Scenario Unit: Square Feet

Scenario Typical Size: 1,500

Scenario Cost: \$11,296.02

Scenario Cost/Unit: \$7.53

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price (\$/unit)	Quantity	Cost
Equipment/Installation						
Excavation, Common Earth, side cast, small equipment	48	Bulk excavation and side casting of common earth with hydraulic excavator with less than 1 CY capacity. Includes equipment and labor.	Cubic yard	\$2.36	84	\$198.24
Track Loader, 95HP	935	Equipment and power unit costs. Labor not included.	Hour	\$89.84	1	\$89.84
Rock Riprap, grouted	1757	Grouted Rock Riprap, placed, includes materials, equipment and labor to transport and place.	Cubic Yard	\$129.85	70	\$9,089.50
Labor						
Equipment Operators, Heavy	233	Includes: Cranes, Hydraulic Excavators >=50 HP, Dozers, Paving Machines, Rock Trenchers, Trenchers >=12", Dump Trucks, Ag Equipment >=150 HP, Scrapers, Water Wagons.	Hour	\$37.38	1	\$37.38
Supervisor or Manager	234	Labor involving supervision or management activities. Includes crew supervisors, foremen and farm/ranch managers time required for adopting new technology, etc.	Hour	\$42.74	8	\$341.92
General Labor	231	Labor performed using basic tools such as power tool, shovels, and other tools that do not require extensive training. Ex. pipe layer, herder, concrete placement, materials spreader, flagger, etc.	Hour	\$22.22	8	\$177.76
Materials						
Aggregate, Gravel, Ungraded, Quarry Run	1099	Includes materials, equipment and labor	Cubic yard	\$24.78	34	\$842.52
Mobilization						
Mobilization, medium equipment	1139	Equipment with 70-150 HP or typical weights between 14,000 and 30,000 pounds.	Each	\$259.43	2	\$518.86

Practice: 468 - Lined Waterway or Outlet

Scenario: #5 - Grassed waterway with stone center

Scenario Description:

Typical practice is 1244' long by 35' wide by 1.2' deep parabolic channel. 50% of width lined with rock riprap. A waterway that is a shaped or graded channel and is established with suitable vegetation on sides included in cost and center with rock riprap to carry surface water at a non-erosive velocity to a stable outlet. Installation of 50% of width allows higher velocity but size is based on vegetative values. This practice addresses Concentrated Flow Erosion (Classic Gully & Ephemeral Erosion) and Excessive Sediment in surface waters. Waterway area measured from top of bank to Subu top of bank. Costs include excavation and associated work to construct the overall shape and grade of the waterway and install rock. Cost for waterway included SF of installed rock.

Associated Practices: Diversion (362), Critical Area Seeding (342), Mulching (484), Underground Outlet (620), Structure for Water Control (587), Subsurface Drainage (606), Water and Sediment Control Basin (638).

Before Situation:

The field has a small gully which is cutting deeper into the field as time goes on, so it needs to be stopped or controlled. Excessive sedimentation and soil erosion as a result from ephemeral or classic gully erosion. Gully has formed in field as a result of excessive runoff and poor cropping techniques. Stone center waterway is also commonly installed to covey runoff from concentrated flows, terraces, diversions, or water control structures or similar practices to a suitable, stable outlet when velocities are slightly higher than allowed for grassed waterway.

After Situation:

Installed waterway is 1244' long by 35' wide by 1.2' deep parabolic earthen channel. 50% of width has rock rip-rap installed. Non rock area to be seeded, lime, fertilizer, etc to establish vegetation. If erosion control blankets or mulching for seedbed establishment/protection are needed, use conservation practice Mulching (484) for remaining 50%. Rock center generally eliminates need for Drainage tile, but if needed, will be installed accoring to Subsurface Drain (606). Outlets, if needed will be installed using Structure for Water Control (587). If inlet Structures are needed with the drainage tile, then those will be installed using Underground Outlet (620).

Scenario Feature Measure: SF of installed Rock Riprap

Scenario Unit: Square Foot

Scenario Typical Size: 21,780

Scenario Cost: \$62,769.86

Scenario Cost/Unit: \$2.88

Cost Details (by category):

Component Name	ID	Component Description	Unit	Price (\$/unit)	Quantity	Cost
Equipment/Installation						
Seeding Operation, No Till/Grass Drill	960	No Till drill or grass drill for seeding. Includes equipment, power unit and labor costs.	Acre	\$20.51	0.5	\$10.26
Excavation, common earth, large equipment, 50 ft	1222	Bulk excavation of common earth including sand and gravel with dozer >100 HP with average push distance of 50 feet. Includes equipment and labor.	Cubic Yard	\$1.54	776	\$1,195.04
Stripping and stockpiling, topsoil	1199	Stripping and stockpiling of topsoil adjacent to stripping area. Includes equipment and labor.	Cubic Yard	\$0.87	806	\$701.22
Cultipacking	1100	Includes equipment, power unit and labor costs.	Acre	\$8.14	0.5	\$4.07
Hydraulic Excavator, 1 CY	931	Track mounted hydraulic excavator with bucket capacity range of 0.8 to 1.5 CY. Equipment and power unit costs. Labor not included.	Hour	\$115.72	10	\$1,157.20
Tillage, Light	945	Includes light disking (tandem) or field cultivator. Includes equipment, power unit and labor costs.	Acre	\$10.70	0.5	\$5.35
Fertilizer, ground application, dry bulk	950	Dry bulk fertilizer application performed by ground equipment. Includes equipment, power unit and labor costs.	Acre	\$6.54	0.5	\$3.27
Labor						
General Labor	231	Labor performed using basic tools such as power tool, shovels, and other tools that do not require extensive training. Ex. pipe layer, herder, concrete placement, materials spreader, flagger, etc.	Hour	\$22.22	8	\$177.76
Supervisor or Manager	234	Labor involving supervision or management activities. Includes crew supervisors, foremen and farm/ranch managers time required for adopting new technology, etc.	Hour	\$42.74	2	\$85.48
Materials						

Materials

Rock Riprap, Placed with geotextile	44	Rock Riprap, placed with geotextile, includes materials, equipment and labor to transport and place	Cubic yard	\$62.26	940	\$58,524.40
Four Species Mix, Cool Season, Introduced Perennial (2 grasses, 2 legumes)	2317	Cool season grass and legume mix. Includes material and shipping only.	Acre	\$49.65	0.5	\$24.83
Lime, ENM	75	Fertilizer: Limestone Spread on field.	Ton	\$133.79	1	\$133.79
Potassium, K2O	74	K2O supplied by Muriate Of Potash. Price is not per pound of total product applied, no conversion is needed.	Pound	\$0.51	30	\$15.30
Nitrogen (N), Urea	71	Price per pound of N supplied by Urea. Price is not per pound of total product applied, no conversion is needed.	Pound	\$0.71	15	\$10.65
Phosphorus, P2O5	73	Price per pound of P2O5 supplied by Superphosphate. Price is not per pound of total product applied, no conversion is needed.	Pound	\$0.93	30	\$27.90

Mobilization

Mobilization, medium equipment	1139	Equipment with 70-150 HP or typical weights between 14,000 and 30,000 pounds.	Each	\$259.43	2	\$518.86
Mobilization, small equipment	1138	Equipment <70 HP but can't be transported by a pick-up truck or with typical weights between 3,500 to 14,000 pounds.	Each	\$174.49	1	\$174.49