AHEAD OF THE STORM

Site: Charlotte Park and Wildlife Refuge

Location: U.S. Route 7 and Greenbush Road, Charlotte, Vermont

Primary Problem

The Charlotte Park and Wildlife Refuge is a 290-acre property with 2.25 miles of gravel trails, 1 mile of hiking trail, 95 acres of active agriculture, 24 acres of meadows, and significant forested areas. Gully erosion is occurring at two sites where stormwater runoff is concentrated. Runoff carrying sediment from both locations eventually flows to a tributary of Holmes Creek. Both sites are at the beginning stages of gully formation and are expected to continue to erode. Site 1 is located at the edge of a hay field just beyond the brushline where concentrated flow from the field and upper portions of the property have caused rill and gully erosion along a swale. Erosion is occurring where a horsepath crosses the swale. The edge of the field is wet and has significant rutting. Site 2 is a cross-slope swale parallel to the Byington Trail that collects 2.1 acres of runoff and is eroding. Active headcutting is occurring in the swale, along with less deep erosion upstream of the headcut. *(See existing conditions site summary and plan.)*

Two Optimal Conservation Practices (OCPs) are recommended increase water quality and flood resiliency at the Park. The primary goal is to improve water quality protection by slowing runoff, reducing erosion, and enhancing vegetation. This project will begin to reverse the amount of sediment suspended in stormwater and reaching Holmes Creek where past water quality sampling found high turbidity, nitrogen, and phosphorus levels in streams.

Final Treatment Recommendations

1. Stabilize gully erosion by installing logs, brush, and vegetation to reduce erosion and downcutting, filter runoff, and retain sediment before it leaves the site. Install log check dams and log trail crossing at locations of concentrated erosion or headcutting.
2. Increase the vegetated buffer between the hay field and existing swale to act as a filter, slow runoff, and capture sediment and pollutants. This will reduce field rutting by reducing tractor traffic in the wettest portion of the field.

Site Constraints and Design Basis

The design has been chosen to maintain the natural aesthetic of the Park and use as many local materials as possible in order to minimize initial and long-term costs of the project. The OCPs maximize water quality improvements while largely maintaining current land use, site features, and maintenance needs. The gully stabilization techniques mimic nature by using a combination of logs and vegetation while minimizing rock and other hard techniques.

Runoff calculations are not appropriate for this site, as the check dams and log trail crossing are sized based on existing gully shape. It is important to proactively address rill and gully erosion while it is still manageable and not wait until it has grown into a large gully requiring more expensive reactionary fixes. Each of the practices has been designed to safely pass large storm events without damage. The design minimizes long-term maintenance procedures and costs. The log check dams were chosen to allow for additional applications within the Park if gully erosion is observed in other locations or within the existing sites. Ongoing monitoring of these sites and other locations within the Park is important for identifying erosion and installing similar nature-like stabilization prior to export of large amounts of sediment. *(See attached concept design plans, including operation & maintenance notes.)*

Cost

Construction and engineering assistance for the recommended OCPs is estimated to cost $2,500 for site 1 and $3,200 for site 2, assuming that labor and materials are purchased at the market rate through a bid process from a construction contractor. Cost savings for this small project may be achieved through volunteers, donations, or sole-source contracting.

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Ahead of the Storm
Existing Conditions Site Summary
Charlotte Park and Wildlife Refuge - Site 1

Site Description

Two sites have been identified within the Park and Wildlife Refuge where stormwater runoff is concentrated and gully erosion is occurring. Both locations are in the beginning stages of gully formation and recommendations will focus on stopping continued erosion. Site 1 is along the brushline edge of a sloped mowed meadow (Figure 1-1). Site 2 is along a cross-slope swale that was installed to reduce washouts along a park road (Figure 2-1).

Site 1 Drainage Patterns

Two 10-inch HDPE culverts pass water from an upper field under Byington Trail and onto the hay field at the project site. The water then distributes across the field in an overland flow pattern. The northeast corner of the field accumulates water during wet periods of the year and after storm events, and allows the water to spread out. There are no concentrated flow paths at the culvert outlets.

Small sections of rill erosion exist off of the edge of the field in the northern brushline that act as swales. These swales concentrate runoff for a short distance then lose definition allowing runoff to spread and flow into the wooded area to the north as sheet flow. The three sections of erosion are each approximately 70 feet long and vary in depth from 4 inches to 18 inches.

Tire ruts from tractor tires in the adjacent field may change drainage patterns and concentrate portions of the overland flow at specific locations.

The most severe erosion area near the horsepath has a drainage area of 0.4 acres. The other two locations have varying drainage patterns based on current ruts in the field.

All runoff leaves the site via unconcentrated overland flow and eventually enters a headwater tributary of Holmes Brook.

Site 1 Site Constraints

The edge of the field where some water concentration and erosion is seen is at the edge of two soil types. Both are stony loams that are potentially highly erodible. Both have been classified as Hydrologic Soil Group (HSG) C indicating moderate runoff potential and slow infiltration rates when thoroughly wet.

The field is leased to a farmer who cuts hay from it. This function is expected to continue.

Site 1 Possible Treatment Options Identified

1. Continue to allow water leaving the culverts under Byington Road to flow overland in sheet flow.
2. Improve the horsepath entrance area with buried logs and check dams.
3. Improve rill erosion areas with check dams and increased vegetative buffer to prevent further gully formation.

Ahead of the Storm
Existing Conditions Photo Documentation Summary
Charlotte Park and Wildlife Refuge – Site #1

Figure 1: Looking south along the roadway at the east end of the field, two culverts concentrate water (at stakes).

Figure 4: Looking east along a horsepath leading into the field from adjacent property.

Figure 2: Looking west along the northern edge of the field along the brushline near the east end of field.

Figure 5: Erosion is actively occurring along the horsepath and in the adjacent swale (hidden in vegetation).

Figure 3: Looking east across the field along the north brushline.

Figure 6: Active erosion in the swale adjacent to the horsepath, partially hidden by vegetation.

Ahead of the Storm
Existing Conditions Site Summary
Charlotte Park and Wildlife Refuge - Site 2

Site 2 Drainage Patterns

Byington Trail has experienced washouts from stormwater runoff in the past. Runoff would flow from the upper farm fields onto the trail causing erosion. Two swales were installed to control the flow of water off of the hillside and direct it away from Byington Trail.

The cross-slope swale parallel to Byington Trail collects runoff from 2.1 acres and is now experiencing erosion. This swale drains to the southwest discharging to a headwater tributary of the Holmes Brook. Just before entering the Holmes Brook tributary, the runoff in the swale runs through a small historic farm junkyard of mostly metal.

The downstream end of the cross-slope swale has eroded where an active headcut is forming. Active erosion in the swale is approximately 75 feet long, between 8 and 18 inches deep, and up to 1.5 feet wide.

Site 2 Site Constraints

The cross slope swale is located in an extremely stony loam soil type that is highly erodible. This soil has been classified as Hydrologic Soil Group (HSG) C indicating moderate runoff potential and slow infiltration rates when thoroughly wet.

Site 2 Possible Treatment Options Identified

1. Arrest gully erosion and headcutting before it worsens using applications of log structures and vegetation.

Ahead of the Storm
Existing Conditions Photo Documentation Summary
Charlotte Park and Wildlife Refuge – Site #2

Figure 7: Looking northeast along a cross-slope swale running parallel to the Byington Trail.

Figure 10: Active gully erosion is occurring near where the cross-slope swale meets the stream.

Figure 8: Looking east across the upper field that drains to the cross-slope swale.

Figure 11: Active gully erosion in the cross-slope swale, partially hidden by vegetation.

Figure 9: A small farm dump is located where the swale meets the stream.

Figure 12: Gully erosion is migrating farther to the northeast along the swale (between the two people).

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2'-Elevation Contour, 2012 Lidar
2'-Elevation Contour, 2009 Lidar
Drainage Area Boundary
NRCS Soil Area Boundary
Parcel Boundary, Approximate

Stormwater Flow
Overland
Swale
Culvert
Pipe

SWALE WITH SOME EROSION 4 - 12 INCHES DEEP 1- 3 FEET WIDE

SWALE WITH SOME EROSION 6 INCHES DEEP 1.5 FEET WIDE

BENCH

10-INCH HDPE CULVERT

GgC, HSG C, potentially highly erodibl

HORSE PATH FROM ADJACENT PROPERTY, WITH ACTIVE EROSION

SWALE WITH SOME EROSION 12 INCHES DEEP 2 FEET WIDE

FIELD WET AND RUTTED

10-INCH HDPE CULVERT

DA = 0.4 AC

SWALE WITH SOME EROSION 12 - 18 INCHES DEEP 2 FEET WIDE

GeB, HSG C, potentially highly erodibl

SuC, HSG C, potentially highly erodibl

HAY FIELD

BYINGTON TRAIL

N
W E
S

0 20 40 80 Feet

bing

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SOURCE(S):
2012, 2009 LIDAR 2 FT CONTOURS, VCGI
BING AERIAL
NRCS SOIL MAPPING
MMI FIELD DATA

EXISTING CONDITIONS - SITE 1

AHEAD OF THE STORM
CHARLOTTE PARK AND WILDLIFE REFUGE

U.S. ROUTE 7 AND GREENBUSH ROAD
CHARLOTTE, VERMONT

CONCEPT DESIGN

Map By: JCL
MMI#: 3452-22
MXD:
1st Version: 7/12/2016
Revision:
Scale: 1"=40'

01

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BYINGTON TRAIL

DA=
2.1 AC

SuB, HSG C, potentially highly erodibl

SxE, HSG C, highly erodible

Cv, HSG D, not highly erodible

HEADCUT

HEADCUT

END OF EROSION

FARM
JUNKYARD

HEADWATER TRIBUTARY
OF HOLMES BROOK

VeB, HSG D, potentially highly erodibl

2'-Elevation Contour, 2012 Lidar
Drainage Area Boundary
NRCS Soil Area Boundary
Parcel Boundary, Approximate
Stream Order
1 2 3 4 5

Stormwater Flow
Overland
Swale
Culvert
Pipe

0 20 40 80 Feet

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EXISTING CONDITIONS - SITE 2

AHEAD OF THE STORM
CHARLOTTE PARK AND WILDLIFE REFUGE

U.S. ROUTE 7 AND GREENBUSH ROAD
CHARLOTTE, VERMONT

CONCEPT DESIGN

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02

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Proposed Log Check Dam
Proposed Vegetated Filter
2'-Elevation Contour, 2012 Lidar
2'-Elevation Contour, 2009 Lidar
Drainage Area Boundary
NRCS Soil Area Boundary
Parcel Boundary, Approximate

Stormwater Flow
Pipe
Overland
Swale
Culvert

INSTALL LOG CHECK DAM -SEE DETAIL

INSTALL LOG CHECK DAM -SEE DETAIL

SWALE WITH SOME EROSION 4 - 12 INCHES DEEP 1- 3 FEET WIDE

SWALE WITH SOME EROSION 6 INCHES DEEP 1.5 FEET WIDE

INSTALL LOG TRAIL CROSSING TO DIRECT WATER TO EXISTING DOWNSTREAM SWALE - SEE DETAIL

BENCH

10-INCH HDPE CULVERT

HORSE PATH FROM ADJACENT PROPERTY, WITH ACTIVE EROSION

SWALE WITH SOME EROSION 12 INCHES DEEP 2 FEET WIDE

FIELD WET AND RUTTED

10-INCH HDPE CULVERT

DA = 0.4 AC

GeB, HSG C, potentially highly erodibl

SWALE WITH SOME EROSION 12 - 18 INCHES DEEP 2 FEET WIDE

INSTALL LOG CHECK DAM -SEE DETAIL

INCREASE VEGETATED FILTER BETWEEN HAY FIELD AND EXISTING SWALE BY 10 FEET

SuC, HSG C, potentially highly erodibl

HAY FIELD

BYINGTON TRAIL

INSTALL LOG CHECK DAM -SEE DETAIL

NOTE: FINAL LOCATION AND HEIGHT OF LOG CHECK DAMS TO BE APPROVED BY ENGINEER IN THE FIELD.

N W E S

0 20 40 80 Feet

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LAYOUT - SITE 1

AHEAD OF THE STORM
CHARLOTTE PARK AND WILDLIFE REFUGE
U.S. ROUTE 7 AND GREENBUSH ROAD
CHARLOTTE, VERMONT

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03

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BYINGTON TRAIL

INSTALL LOG CHECK DAM ALONG EXISTING CHANNEL (TYP) -SEE DETAIL

DA= 2.1 AC

NOTE: FINAL LOCATION AND HEIGHT OF LOG CHECK DAMS TO BE APPROVED BY ENGINEER IN THE FIELD.

Cv, HSG D, not highly erodible

SuB, HSG C, potentially highly erodible

SxE, HSG C, highly erodible

HEADCUT

HEADCUT

INSTALL LOG CHECK DAM AT EXISTING HEADCUTS (TYP) -SEE DETAIL

END OF EROSION

HEADWATER TRIBUTARY OF HOLMES BROOK

FARM JUNKYARD

Proposed Log Check Dam
2'-Elevation Contour, 2012 Lidar
Drainage Area Boundary
NRCS Soil Area Boundary
Parcel Boundary, Approximate

Stream Order

1 2 3 4 5

Stormwater Flow
Pipe
Overland
Swale
Culvert

0 20 40 80 Feet

N W E S

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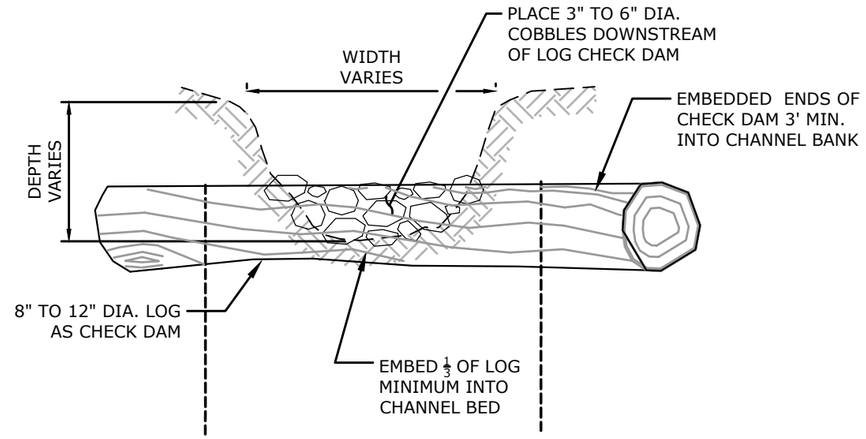
CONCEPT DESIGN

AHEAD OF THE STORM
CHARLOTTE PARK AND WILDLIFE REFUGE
U.S. ROUTE 7 AND GREENBUSH ROAD
CHARLOTTE, VERMONT

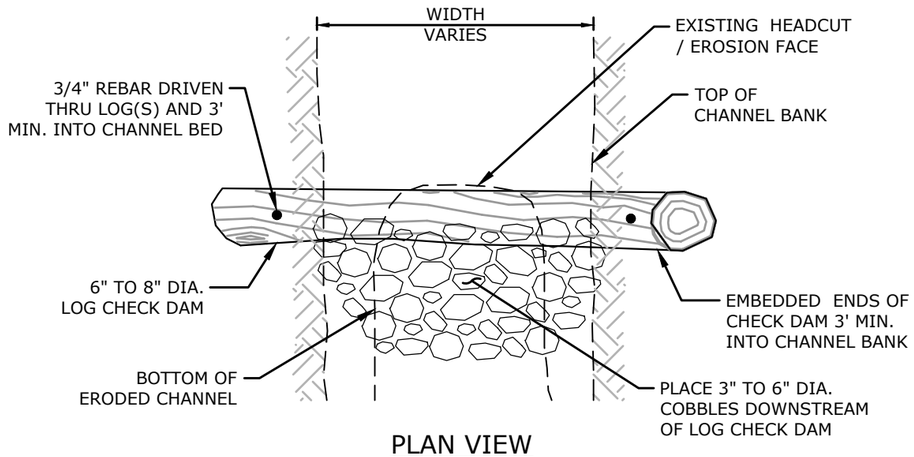
LAYOUT - SITE 2

Map By: JCL / BMC
MMI#: 3452-22
MXD:
1st Version: 7/12/2016
Revision:
Scale: 1"=40'

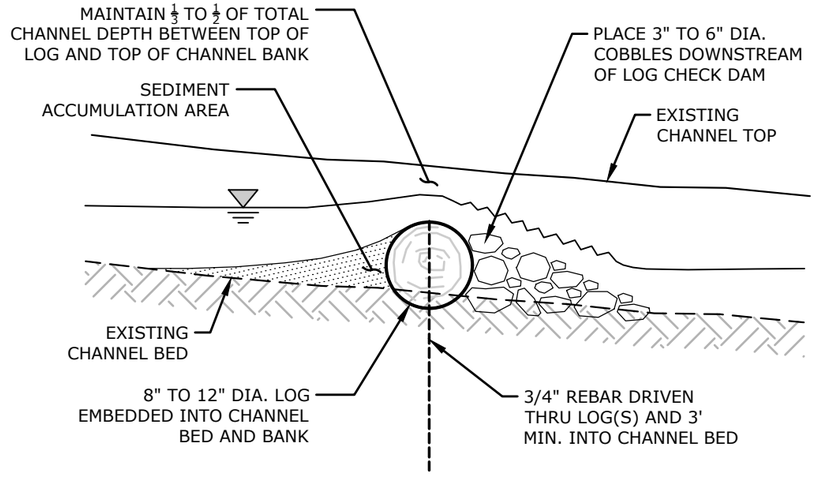
04



SECTION VIEW



PLAN VIEW



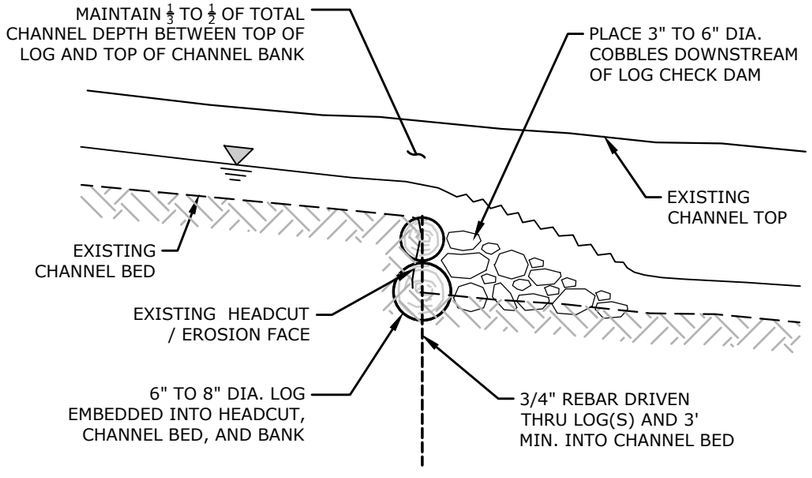
PROFILE VIEW

LOG CHECK DAM - MID CHANNEL

NOT TO SCALE

NOTES:

1. LIMIT HEIGHT OF CHECK DAM TO 2/3 OF THE TOTAL HEIGHT OF THE EXISTING CHANNEL. USE UP TO TWO LOGS IF NECESSARY TO ACHIEVE DESIRED HEIGHT AND PLACE LARGER DIAMETER LOG ON BOTTOM TO INCREASE STABILITY.
2. BOTTOM OF LOG SHALL BE EMBEDDED INTO CHANNEL BED BY A MINIMUM OF 1/3 (33%) OF ITS DIAMETER. EMBED ENDS OF LOGS 3 FEET MINIMUM INTO CHANNEL BANKS.
3. USE EXISTING DOWNED WOOD FOR LOGS WHERE POSSIBLE. USE SOLID AND DURABLE WOOD FREE OF EXCESSIVE ROT AND DETERIORATION.
4. WHERE NEW CUT WOOD IS REQUIRED, SOURCE LOCALLY AND CONSULT WITH LANDOWNER AND FOREST MANAGEMENT PLAN AS NEEDED PRIOR TO FELLING TREES.
5. SOURCE COBBLE LOCALLY WHERE POSSIBLE. EXTEND COBBLE APPROXIMATELY 4X THE HEIGHT OF THE CHECK DAM DOWNSTREAM.
6. EACH LOG SHALL BE PINNED BY TWO PIECES OF 3/4" REBAR DRIVEN A MINIMUM OF 3 FEET BELOW THE EXISTING CHANNEL BED. REBAR SHALL BE DRIVEN THROUGH OVERLAPPING LOGS WHEN POSSIBLE.
7. FINAL LOCATION AND HEIGHT OF THE LOG CHECK DAM TO BE APPROVED BY THE ENGINEER IN THE FIELD.



PROFILE VIEW

LOG CHECK DAM - AT HEADCUT

NOT TO SCALE

NOTES:

1. LOG CHECK DAM SHALL EXTEND TO THE HEIGHT OF THE EXISTING EROSION FACE OF THE HEADCUT. USE UP TO TWO LOGS IF NECESSARY TO ACHIEVE DESIRED HEIGHT AND PLACE LARGER DIAMETER LOG ON BOTTOM TO INCREASE STABILITY.
2. FILL ANY VOID SPACE BEHIND THE LOG CHECK DAM WITH MATERIAL EXCAVATED TO EMBED LOGS TO PREVENT ADDITIONAL SCOUR BEHIND CHECK DAM.
3. BOTTOM LOG SHALL BE EMBEDDED INTO CHANNEL BED BY A MINIMUM OF 1/3 (33%) OF ITS DIAMETER. EMBED ENDS OF LOGS 3 FEET MINIMUM INTO CHANNEL BANKS.
4. USE EXISTING DOWNED WOOD FOR LOGS WHERE POSSIBLE. USE SOLID AND DURABLE WOOD FREE OF EXCESSIVE ROT AND DETERIORATION.
5. WHERE NEW CUT WOOD IS REQUIRED, SOURCE LOCALLY AND CONSULT WITH LANDOWNER AND FOREST MANAGEMENT PLAN AS NEEDED PRIOR TO FELLING TREES.
6. SOURCE COBBLE LOCALLY WHERE POSSIBLE. EXTEND COBBLE APPROXIMATELY 4X THE HEIGHT OF THE CHECK DAM DOWNSTREAM .
7. EACH LOG SHALL BE PINNED BY TWO PIECES OF 3/4" REBAR DRIVEN A MINIMUM OF 3 FEET BELOW THE EXISTING CHANNEL BED. REBAR SHALL BE DRIVEN THROUGH OVERLAPPING LOGS WHEN POSSIBLE.

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REVISIONS

CONCEPT DESIGN

DETAILS

AHEAD OF THE STORM
CHARLOTTE PARK AND WILDLIFE REFUGE
U.S. ROUTE 7 AND GREENBUSH ROAD
CHARLOTTE, VERMONT

BMC DESIGNED	BMC DRAWN	JCL CHECKED

SCALE: NOT TO SCALE
DATE: 7/12/2016
PROJECT NO.: 3452-22
SHEET NO.: 05

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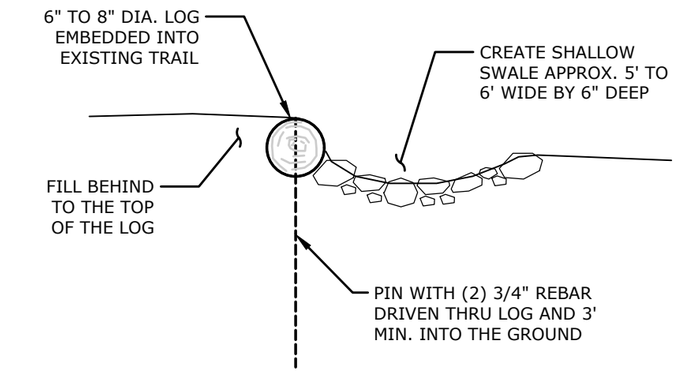
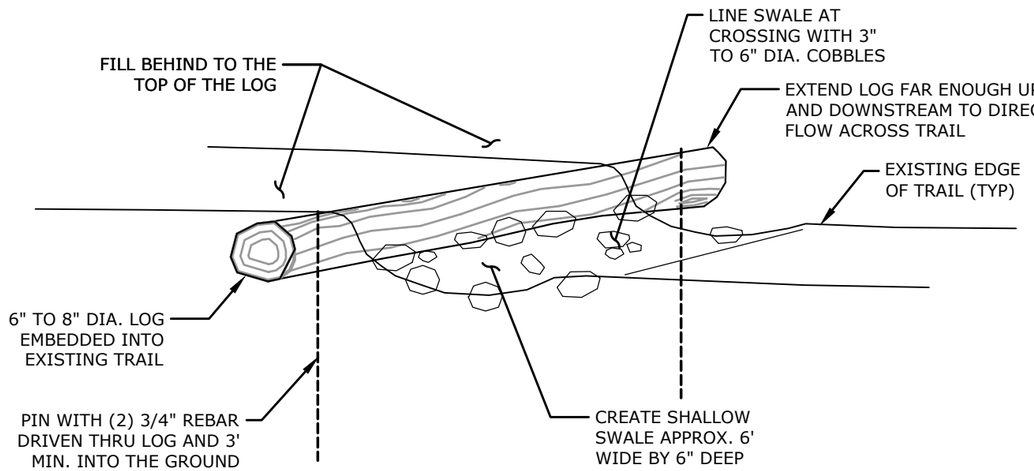


SECTION VIEW



ISOMETRIC VIEW

LOG TRAIL CROSSING

NOT TO SCALE

NOTES:

1. EXTEND THE ENDS OF THE LOG FAR ENOUGH UP AND DOWNSTREAM TO DIRECT WATER ACROSS THE TRAIL TO CONNECT EXISTING CHANNELS.
2. USE EXISTING DOWNED WOOD FOR LOGS WHERE POSSIBLE. USE SOLID AND DURABLE WOOD FREE OF EXCESSIVE ROT AND DETERIORATION.
3. WHERE NEW CUT WOOD IS REQUIRED, SOURCE LOCALLY AND CONSULT WITH LANDOWNER AND FOREST MANAGEMENT PLAN AS NEEDED.
4. SOURCE COBBLE LOCALLY WHERE POSSIBLE. PACK COBBLE TIGHTLY TO ALLOW FOOT TRAFFIC.
5. EACH LOG SHALL BE PINNED BY TWO PIECES OF 3/4" REBAR DRIVEN A MINIMUM OF 3 FEET BELOW EXISTING GRADE.
6. FINAL LOCATION AND LENGTH OF THE LOG TRAIL CROSSING TO BE APPROVED BY THE ENGINEER IN THE FIELD.

OPERATION AND MAINTENANCE NOTES

1. THE CONCEPTUAL STORMWATER PLAN HAS BEEN DESIGNED TO MINIMIZE EFFORT TO OPERATE AND ONLY REQUIRE MAINTENANCE THAT CAN EASILY BE COMPLETED.
2. PERIODICALLY, INCLUDING AFTER LARGE STORMS AND REGULARLY DURING THE FALL, MONITOR THE CONDITION OF EACH LOG CHECK DAM, THE LOG TRAIL CROSSING, EACH DRAINAGE SWALE, AND THE VEGETATED FILTER STRIP.
3. MONITOR EACH LOG CHECK DAM FOR EXCESSIVE EROSION OR OUTFLANKING AT THE ENDS OF THE LOGS. REMOVE ACCUMULATED DEBRIS AT CHECK DAMS. REPAIR EROSION AS NECESSARY.
4. MONITOR STONE COBBLE PROTECTION DOWNSTREAM OF THE LOG CHECK DAM FOR EXCESSIVE EROSION OR DISLODGED STONES. IF EROSION IS PRESENT DOWNSTREAM OF THE STONE PROTECTION, EXTEND FURTHER TO STABILIZE THE DRAINAGE SWALE.
5. MONITOR THE LOG TRAIL CROSSING FOR EXCESSIVE EROSION OR OUTFLANKING AT THE ENDS OF THE LOG. REMOVE DEBRIS ACCUMULATED WITHIN THE SWALE CROSSING THE TRAIL. REPAIR EROSION AS NECESSARY.
6. MONITOR DRAINAGE SWALES FOR NEW EROSION OR HEADCUTTING. ADDRESS ANY NEW EROSION OR HEADCUTTING USING LOG CHECK DAMS.
7. THE VEGETATED FILTER STRIP CAN BE MOWED OR BRUSH-HOGGED AT THE END OF EACH GROWING SEASON.
8. ANNUALLY INSPECT THE VEGETATED FILTER STRIP TO MAKE SURE FLOWS ARE NOT CONCENTRATED, VEGETATIVE COVER STILL EXCEEDS 90%, AND NO INVASIVE SPECIES ARE PRESENT.

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CHARLOTTE PARK AND WILDLIFE REFUGE
U.S. ROUTE 7 AND GREENBUSH ROAD
CHARLOTTE, VERMONT

BMC DESIGNED	BMC DRAWN	JCL CHECKED

SCALE: NOT TO SCALE
DATE: 7/12/2016
PROJECT NO.: 3452-22
SHEET NO.: 06

OPINION OF PROBABLE COST - CONCEPTUAL DESIGN

CHARLOTTE PARK & WILDLIFE REFUGE

SITE 1

Charlotte, Vermont

MMI #3452-22

September 27, 2016

Engineering, Landscape Architecture and Environmental Science

MILONE & MACBROOM

Item	ITEM / DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
	CONSTRUCTION LABOR				
	Labor to Install Log Check Dams (4 total)	HR	8	$35	$280
	Labor to Install Log Trail Crossing	HR	4	$35	$140
	Labor to Restore Site	HR	4	$35	$140
	CONSTRUCTION EQUIPTMENT				
	Excavator Rental / Operator	HR	8	$110	$880
	Haul Materials to Site (Hinesburg, 1 hr round trip)	HR	1	$80	$80
	CONSTRUCTION MATERIALS *				
	6-inch Ditch Stone for Overflow Outlet / Splash Pad	TN	5	$20	$100
	Seed & Straw Mulch for Restoring Disturbed Areas	LS	1	$200	$200
	CONSTRUCTION MISCELLANEOUS				
	Mobilization/ Demobilization	LS	1	$200	$200
	ENGINEERING SERVICES				
	Construction Assistance	HR	4	$113	$452
	Construction Subtotal				**$2,020**
	Engineering Services Subtotal				**$452**
	TOTAL (ROUNDED)				**$2,500**

* - assumes that logs for check dams and trail crossing are sourced on-site.

OPINION OF PROBABLE COST - CONCEPTUAL DESIGN

CHARLOTTE PARK & WILDLIFE REFUGE

SITE 2

Charlotte, Vermont

MMI #3452-22

September 27, 2016

Engineering, Landscape Architecture and Environmental Science

MILONE & MACBROOM

Item	ITEM/DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
	CONSTRUCTION LABOR				
	Labor to Install Log Check Dams (8 total)	HR	16	$35	$560
	Labor to Restore Site	HR	6	$35	$210
	CONSTRUCTION EQUIPTMENT				
	Excavator Rental / Operator	HR	12	$110	$1,320
	Haul Materials to Site (Hinesburg, 1 hr round trip)	HR	1	$80	$80
	CONSTRUCTION MATERIALS *				
	6-inch Ditch Stone for Overflow Outlet / Splash Pad	TN	9	$20	$180
	Seed & Straw Mulch for Restoring Disturbed Areas	LS	1	$200	$200
	CONSTRUCTION MISCELLANEOUS				
	Mobilization/ Demobilization	LS	1	$200	$200
	ENGINEERING SERVICES				
	Construction Assistance	HR	4	$113	$452
	Construction Subtotal				**$2,750**
	Engineering Services Subtotal				**$452**
	TOTAL (ROUNDED)				**$3,200**

* - assumes that logs for check dams are sourced on-site.