AHEAD OF THE STORM

Site: Thorp Brook Headwaters Restoration

Location: Big Oak Lane Neighborhood, Charlotte, Vermont

Primary Problem

A small residential neighborhood and farm are located on Big Oak Lane in Charlotte, Vermont. Runoff from the agricultural field, gravel roads, and residential lawns (drainage area = 16.9 acres, 11.4 acres from project site) currently flows overland, through swales, in culverts under the road, and concentrates in an eroding gully before entering a headwater channel of Thorp Brook. The concentration of stormwater has caused gully erosion up to 4 feet deep and 7 feet wide close to the home and garage at #95 Big Oak Lane. Soils are highly erodible Vergennes clay and will likely continue to erode without active stabilization. A majority of the flow is routed through an existing fire pond that has limited extra storage since it is typically full and is thus unable to store or slow down stormwater. Residents report that the culverts are not large enough and runoff overtops the road during storms. (*See existing conditions site summary and plan.*)

The primary goals are to improve water quality protection and flood resiliency by slowing runoff, reducing erosion, and enhancing vegetation. This project will improve water quality where past sampling has shown high levels of suspended solids, nitrogen, and phosphorus in streams. The project will also help stabilize the Thorp Brook river corridor and begin to reverse the cumulative impacts of incremental development in the Thorp Brook watershed.

Final Treatment Recommendations

Four Optimal Conservation Practices (OCPs) are recommended to mitigate stormwater runoff at the site.

1. Create a bio-retention area by excavating a temporary ponding area around the existing fire pond to increase storage capacity and slow runoff. The outlet will slow runoff reaching the eroding gully and retain sediment.
2. Install a vegetated buffer between the agricultural field and the bio-retention area to slow runoff and reduce the movement of sediment and pollutants.
3. Improve swales and culverts leading from the fire pond to the eroding gully.
4. Stabilize the gully erosion by installing logs, brush, and vegetation to reduce erosion and downcutting, filter runoff, and retain sediment before it leaves the site.

Site Constraints and Design Basis

Tight soils and high groundwater do not allow infiltration to take place or underground treatment practices to be effective. The design maximizes treatment while largely maintaining current land use, site features, and maintenance needs. The concept design proposes the OCPs using a portion of mowed meadow and 0.2 acres of agricultural field. Runoff calculations indicate that all of the 1-inch rain storm (i.e., the Water Quality Volume – WQv) and all of the 1-year, 24-hour rain storm (i.e., the Channel Protection Volume – CPv) can be treated in the bio-retention area (Table 1). The design minimizes long-term maintenance procedures and costs. *(See attached concept design plans.)*

Table 1: Summary of Hydrology Calculations

Drainage Location	Total Drainage Area (Acres)	Drainage Area on the Site (Acres)	Impervious Area on the Site (%)	WQv Generated on the Site (Cubic Feet)	Channel Protection Volume, CPv (Cubic Feet)	10-yr Volume (Cubic Feet)	Treatment Volume (Cubic Feet)	Treatment Volume (%)
To Gully	16.9	11.40	9.0	5,421	33,490	76,924	33,500	100% of the CPv

Cost

Final engineering design, construction, and engineering oversight for the four recommended OCPs is estimated to cost $77,000.

Ahead of the Storm
Existing Conditions Site Summary
Big Oak Lane Neighborhood

Site Description

A small neighborhood and farm were established along Big Oak Lane in Charlotte with six homes built between 2008 and 2013 (Figure 1). Currently stormwater runoff from a farm field, gravel roads, and a portion of the residential properties is collected in a series of swales and concentrated into one small stream leaving the neighborhood untreated. The concentration of stormwater has caused gully erosion in the stream near one of the homes. This project will address gully erosion and reduce velocity and volume of runoff leaving the site to improve water quality and flood resiliency.

Drainage Patterns

Water generally flows northwest across the neighborhood originating on a wooded hillside, passing through a farm field, flowing over or under gravel roads, and then entering a small stream channel. Some small rill erosion has occurred in the field where water has concentrated. No major erosion is visible in the field or as the water leaves the field.

A mowed grass swale flows north along the east side of Big Oak Lane from the intersection at East Thomspon Point Road to the fire pond. This swale collects water flowing off of the road. The fire pond has approximately 2 feet of freeboard above the normal water surface elevation before water exits the pond via a stone-lined over flow weir. During a storm event water typically flows out of the pond, under the road through a culvert, and into the small stream causing gully erosion. Residents report that during storm events the culverts have not been able to handle the runoff and flow goes across the road both at the greenhouse and at the sharp bend in the road.

Water from the field and gravel road is also collected along the north side of the field and flows through culverts under Big Oak Lane and under a driveway before reaching the small stream channel.

Water from the two flow paths converge behind #95 Big Oak Lane for a total drainage area of 16.9 acres. Erosion in the small stream channel has created a gully that is up to 4 feet deep and 7 feet wide. Residents report that the severity of erosion is rapidly increasing in recent years. This gully is close to the home at #95 Big Oak Lane and is transporting sediment to the downstream stream channel. The swale discharges to the north to a headwater tributary of Thorp Brook.

Site Constraints

Mature trees exist along portions of the eroding channel that will limit access by large machinery.

Soils at the site are Vergennes clay that are highly erodible. This indicates that erosion will likely continue in the gully unless steps are taken to stabilize the existing gully erosion. The soils have a Hydrologic Soil Group of D, indicating that infiltration potential is low so runoff is likely to continue and increase with larger storms that is predicted for the area.

Utilities exist along the west and north sides of Big Oak Lane that may be in conflict with treatment areas.

Possible Treatment Options Identified

1. Stabilize gully erosion in stream channel by installing logs, brush, and vegetation.
2. Excavate a bioretention area adjacent to the existing swale at the north side of the site, adjacent to the farm field to reduce runoff.
3. Check culvert sizes and possibly recommend installation of larger sizes.
4. Possibly increase fire pond storage capacity above the normal water level.

Ahead of the Storm
Existing Conditions Photo Documentation Summary
Big Oak Lane Neighborhood

Figure 1: This swale is collecting runoff from the gravel road and field.

Figure 3: A fire pond is located on the site, but does not have significant stormwater storage capacity.

Figure 2: The mowed field /open space for neighborhood is shown, looking towards the homes and the swale leaving the neighborhood.

Figure 4: Deposition is occurring at the downstream end of the swale, prior to water joining the tributary.

Ahead of the Storm
Existing Conditions Photo Documentation Summary
Big Oak Lane Neighborhood

Figure 5: Gully erosion occurring in the channel leaving the neighborhood.

Figure 6: Gully erosion occurring in the channel leaving the neighborhood.

Figure 7: Possible location of a bioretention area adjacent to the farm field, gravel road, and existing stand of trees.

Figure 8: Possible location of a bioretention area adjacent to the farm field, gravel road, and existing stand of trees.

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HEADWATER TRIBUTARY OF THORP BROOK

SEDIMENT DEPOSITION

15 IN HDPE CULVERT

15 IN HDPE CULVERT

DOWNSTREAM END OF GULLY EROSION

HEADCUT

15 IN HDPE CULVERT

FIRE POND

GREENHOUSE

12 IN HDPE CULVERT

DA= 16.9 AC

BIG OAK LN

E THOMPSON POINT RD

PALMER LN

VeB, HSG D, potentially highly erodibl

GeB, HSG C, potentially highly erodibl

VeB, HSG D, potentially highly erodibl

SxC, HSG C, potentially highly erodibl

SuB, HSG C, 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 25 50 100 Feet

N W E S

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www.miloneandmacbroom.com

SOURCE(S):

2012 LIDAR 2 FT CONTOURS, VCGI
VCGI 2013 15 CM CHITTENDEN COUNTY IMAGERY
NRCS SOIL MAPPING
MMI FIELD DATA

EXISTING CONDITIONS

AHEAD OF THE STORM
THORP BROOK HEADWATERS RESTORATION

BIG OAK LANE NEIGHBORHOOD
CHARLOTTE, VERMONT

CONCEPT DESIGN

Map By: JCL
MMI#: 3452-22
MXD:
1st Version: 3/17/2016
Revision:
Scale: 1"=120'

01

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INSTALL BRUSH & SMALL LOG APPLICATION ALONG 280 FEET OF ERODING GULLY (SEE DETAIL)

INSTALL 4 LOG CHECK DAMS. FINAL PLACEMENT TO BE APPROVED BY ENGINEER DURING CONSTRUCTION. (SEE DETAIL)

CREATE A 60-FOOT BUFFER TO FILTER RUNOFF (CONVERSION OF 0.22 ACRES OF AGRICULTURAL FIELD)

MOWED TRAIL IN BUFFER OR OTHER LOCATION

INSTALL OUTLET STRUCTURE AND IMPROVE SWALE AND CULVERT UNDER ROAD, AS DETERMINED DURING FINAL DESIGN

EXCAVATE TEMPORARY PONDING AREA AROUND EXISTING FIRE POND. DEPRESSION TO DRAIN AFTER STORMS.
DEPTH ~ 2 FEET
AREA ~ 0.35 ACRE
VOLUME ~ CPv ~ 0.77 ACRE-FEET

EXISTING FIRE POND TO REMAIN

A- 0
A- 50
A- 100
A- 150
A- 200
A- 250
B- 50'
B- 100'
B- 150'

Combined Detention Area
Temporary Ponding Area
Existing Fire Pond
Natural Vegetation
Berm
Walking Path
Brush & Small Log Application
Log Check Dam
Drainage Area Boundary
2'-Elevation Contour, 2012 Lidar
Profile / Section Centerline
Stream Order
1 2 3 4 5
Stormwater Flow
Overland
Swale
Culvert
Pipe

N
W E
S

0 25 50 100 Feet

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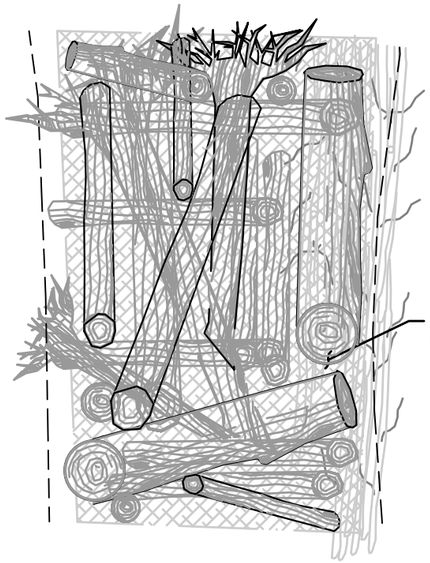
SOURCE(S):
2012 LIDAR 2 FT CONTOURS, VCGI
VCGI 2013 15 CM CHITTENDEN COUNTY IMAGERY
MMI FIELD DATA

CONCEPT DESIGN

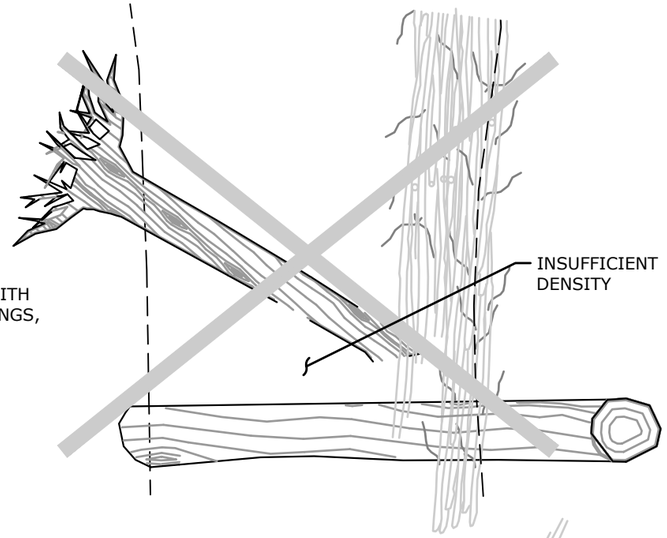
LAYOUT
AHEAD OF THE STORM
THORP BROOK HEADWATERS RESTORATION
BIG OAK LANE NEIGHBORHOOD
CHARLOTTE, VERMONT

Map By: JCL
MMI#: 3452-22
MXD:
1st Version: 3/17/2016
Revision:
Scale: 1"=50'

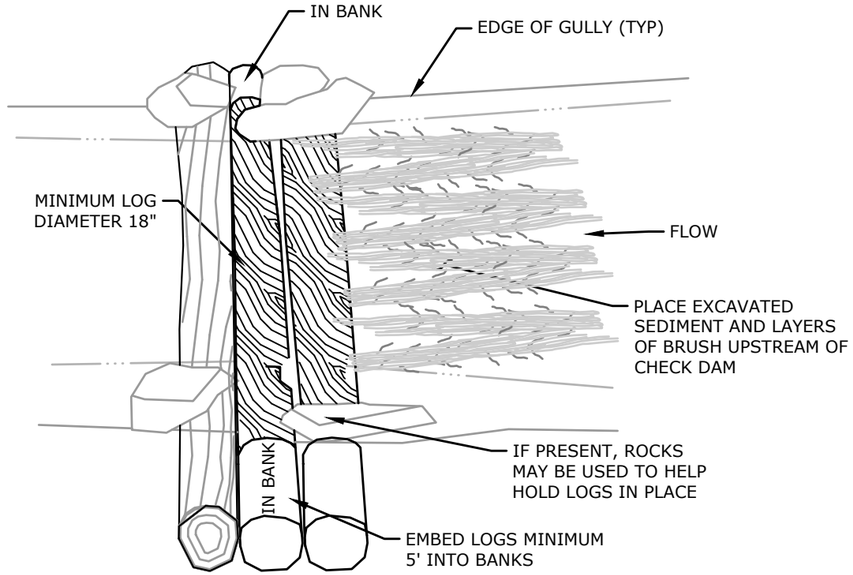
02



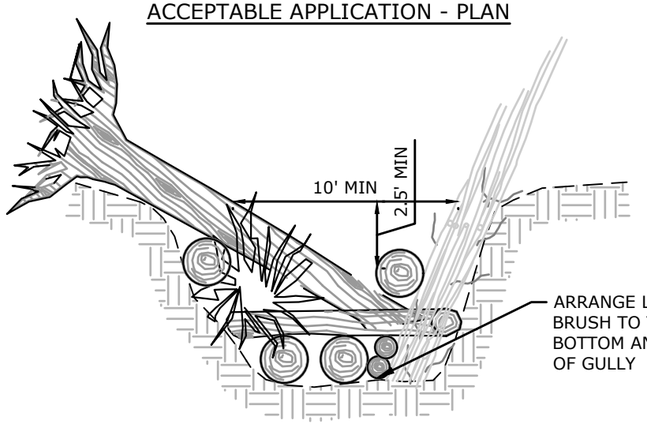
ACCEPTABLE APPLICATION - PLAN



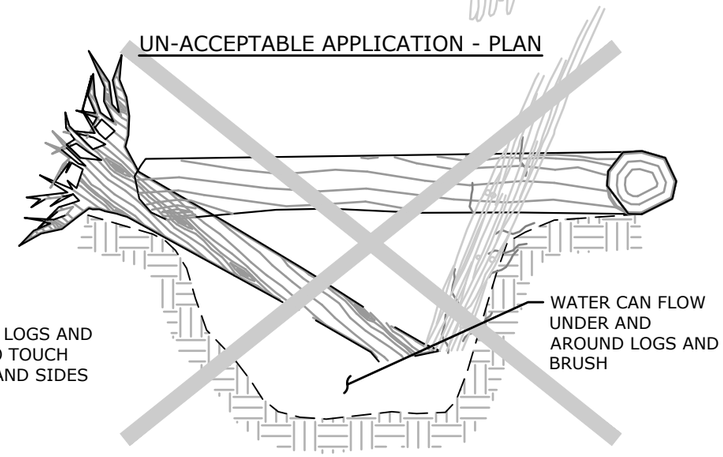
UN-ACCEPTABLE APPLICATION - PLAN



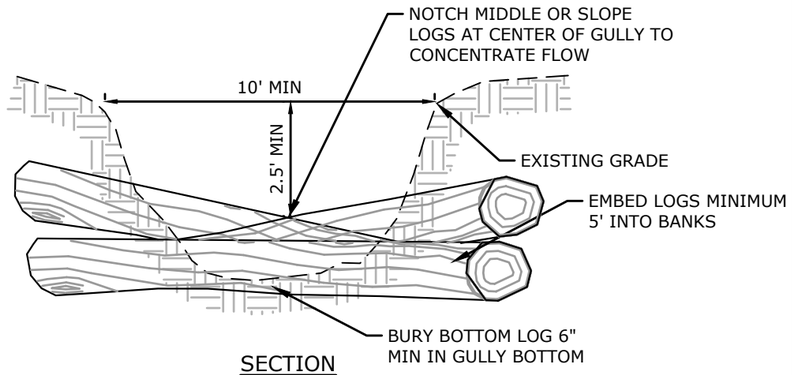
ISOMETRIC VIEW



ACCEPTABLE APPLICATION - SECTION



UN-ACCEPTABLE APPLICATION - SECTION



SECTION

BRUSH AND SMALL LOG APPLICATION

NOT TO SCALE

1. INSTALL SMALL LOGS AND BRUSH IN CHANNEL TO STOP EROSION, SLOW FLOW, AND CATCH SEDIMENT.
2. CUT LOGS TO FIT AND FILL THE CHANNEL, EXPECTED LENGTH IS 4' TO 6' LONG. THIS WILL REQUIRE TURNING PIECES AND STACKING SO THAT INDIVIDUAL PIECES FIT DOWN INTO CHANNEL AND TOUCH THE BOTTOM.
3. FILL VOIDS WITH BRUSH CUTTINGS.
4. INSTALLATION IS EXPECTED WITH CHAINSAW AND HANDWORK.
5. USE EXISTING DOWNED WOOD WHERE POSSIBLE.
4. WHERE NEW CUT WOOD IS REQUIRED CONSULT WITH LANDOWNER AND FOREST MANAGEMENT PLAN.

LOG CHECK DAM

NOT TO SCALE

1. INSTALL SMALL LOGS AND BRUSH IN CHANNEL TO STOP EROSION, SLOW FLOW, AND CATCH SEDIMENT.
2. INSTALLATION IS EXPECTED WITH CHAINSAW AND SMALL EXCAVATOR.
3. USE EXISTING DOWNED WOOD WHERE POSSIBLE.
4. WHERE NEW CUT WOOD IS REQUIRED CONSULT WITH LANDOWNER AND FOREST MANAGEMENT PLAN.
5. FINAL PLACEMENT TO BE APPROVED BY ENGINEER IN FIELD.
6. ADJUST PLACEMENT TO AVOID CONFLICT WITH HOUSE PERIMETER DRAINS AND TREES IDENTIFIED TO REMAIN BY LANDOWNERS.
7. MAINTAIN SWALE OPENING ABOVE LOGS AS SPECIFIED TO CARRY UP TO 100-YEAR FLOW.

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REVISIONS

CONCEPT DESIGN

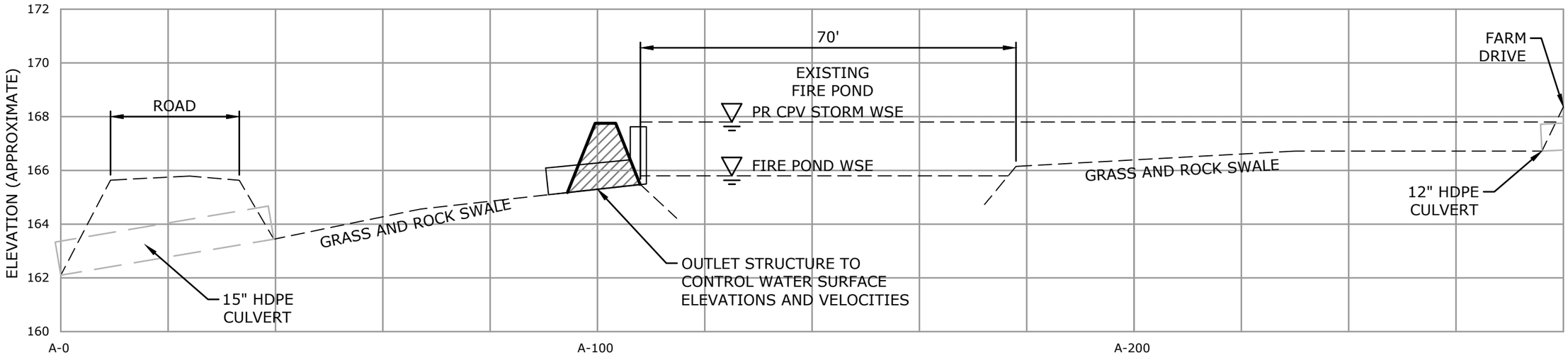
DETAILS - GULLY STABILIZATION

AHEAD OF THE STORM
THORP BROOK HEADWATER RESTORATION
BIG OAK LANE NEIGHBORHOOD
CHARLOTTE, VERMONT

JCL	JCL	RS
DESIGNED	DRAWN	CHECKED

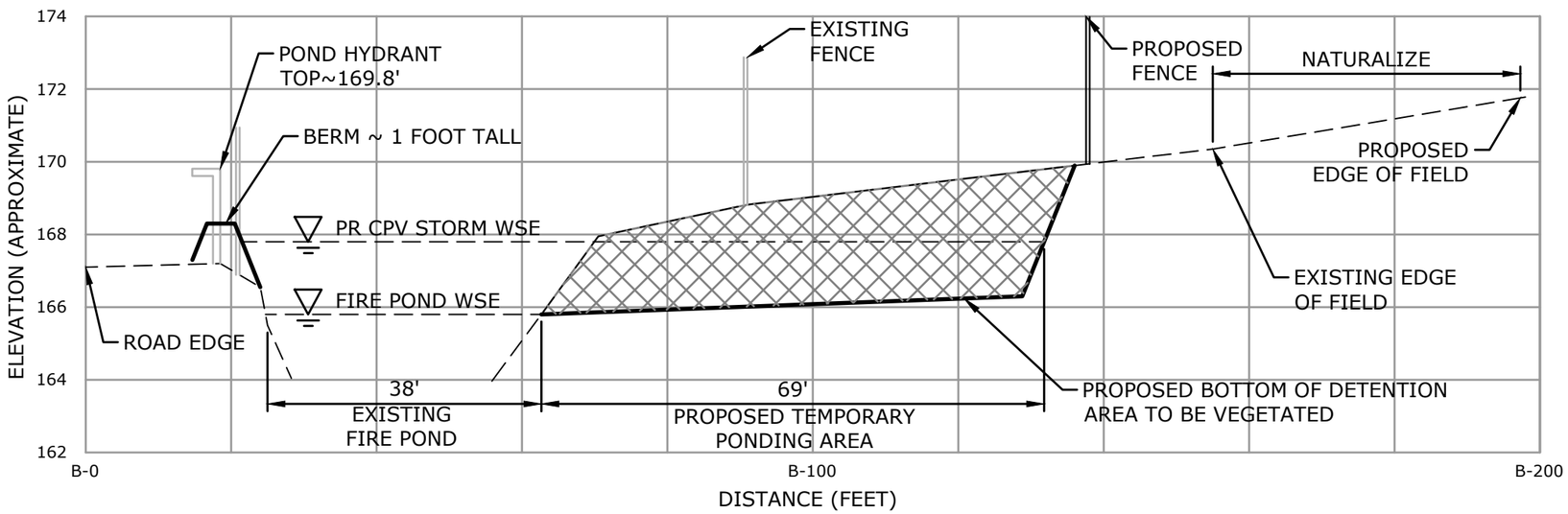
SCALE: NOT TO SCALE
DATE: 3/14/2016
PROJECT NO.: 3452-22
SHEET NO.: 03

Drawing: W:\DESIGN\3452-22-DE\CAD\BL-DETAILS.DWG Layout: Tab:GULLY DETAILS
Plotted by: JESSICAL On this date: Thu, 2016 March 17 - 2:52pm



DETENTION AREA PROFILE - FLOW PATH A

SCALE: H: 1"=20', V: 1"=4'



DETENTION AREA SECTION - B

SCALE: H: 1"=20', V: 1"=4'

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CONCEPT DESIGN

DETAILS - DETENTION AREA

AHEAD OF THE STORM
THORP BROOK HEADWATER RESTORATION
BIG OAK LANE NEIGHBORHOOD
CHARLOTTE, VERMONT

JCL	JCL	RS
DESIGNED	DRAWN	CHECKED

SCALE: H: 1"=20', V: 1"=4'

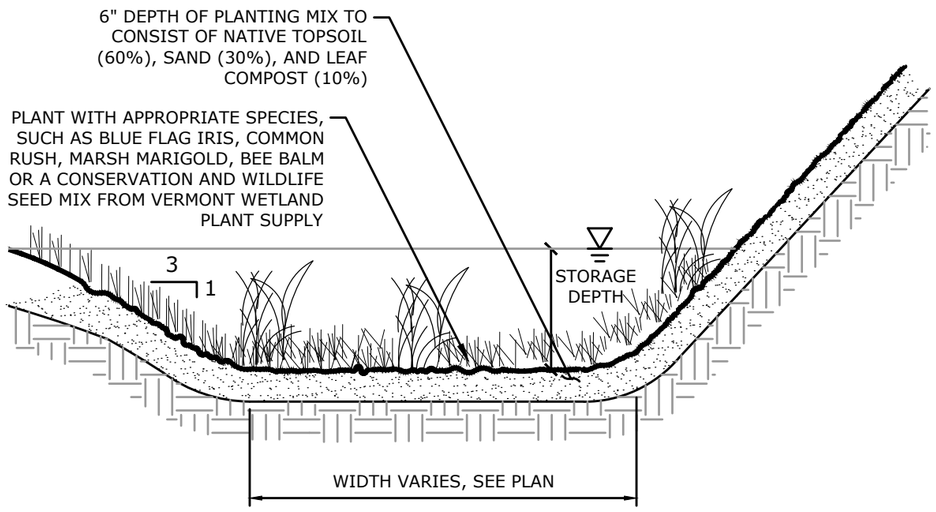
DATE: 3/14/2016

PROJECT NO.: 3452-22

SHEET NO.: 04

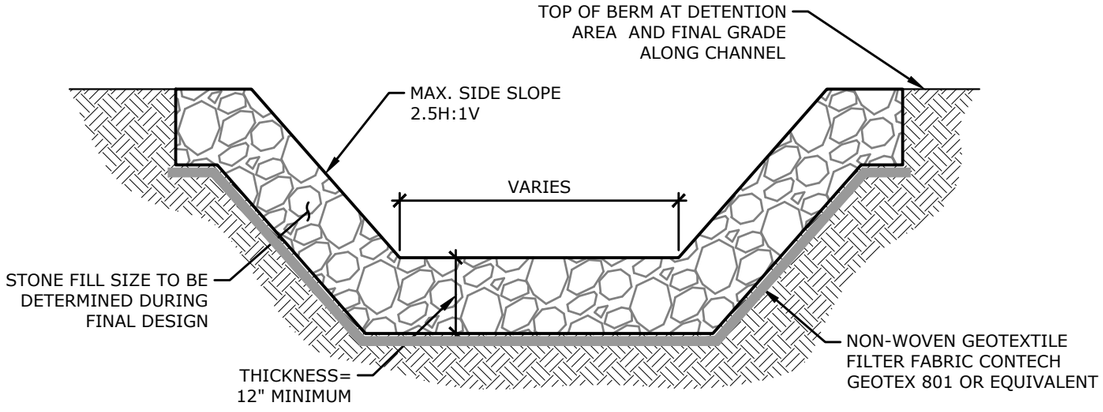
OPERATION AND MAINTENANCE NOTES

1. THE CONCEPTUAL STORMWATER PLAN HAS BEEN DESIGNED TO MINIMIZE MAINTENANCE TO THE SYSTEM AND ONLY REQUIRE MAINTENANCE THAT CAN EASILY BE COMPLETED.
2. PERIODICALLY, INCLUDING AFTER LARGE STORMS AND REGULARLY DURING THE FALL, REMOVE LEAVES AND DEBRIS ACCUMULATED AT CULVERTS AND AT DETENTION AREA INLET AND OUTLET.
3. THE ACCUMULATION OF SEDIMENT WITHIN THE FIRE POND SHOULD BE MONITORED AND INSPECTED A MINIMUM OF ONCE ANNUALLY. REMOVE SEDIMENT AFTER APPROXIMATELY 12 INCHES OF SEDIMENT HAS ACCUMULATED.
4. SWALES ARE EXPECTED TO REQUIRE RESHAPING AND REMOVAL OF SEDIMENT APPROXIMATELY EVERY 5 TO 10 YEARS.
5. THE TEMPORARY PONDING AREA, BERMS, AND SWALES CAN BE MOWED OR BRUSH-HOGGED AT THE END OF EACH GROWING SEASON.
6. RESEEDING OF THE SPECIFIED SEED MIX SHOULD OCCUR AFTER REMOVAL OF SEDIMENT OR RESHAPING OF SWALES.
7. AT LEAST ONCE PER YEAR INSPECT THE EXISTING GULLY AREA. BRUSH & SMALL LOG APPLICATION CAN BE REINSTALLED IF PORTIONS HAVE MOVED.



TERMPORARY PONDING AREA

NOT TO SCALE



STONE OUTLET WEIR AND CHANNEL

NOT TO SCALE

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DETAILS

AHEAD OF THE STORM
THORP BROOK HEADWATER RESTORATION
BIG OAK LANE NEIGHBORHOOD
CHARLOTTE, VERMONT

JCL	JCL	RS
DESIGNED	DRAWN	CHECKED

SCALE: NOT TO SCALE
DATE: 3/14/2016
PROJECT NO.: 3452-22

SHEET NO.: 05

BALLPARK OPINION OF PROBABLE CONSTRUCTION COST

THORP BROOK HEADWATER RESTORATION

BIG OAK LANE NEIGHBORHOOD

AHEAD OF THE STORM

Charlotte, Vermont

MMI #3452-22

MARCH 17, 2016

Engineering, Landscape Architecture and Environmental Science

MILONE & MACBROOM

Item	ITEM/DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
1	Mobilization / Demobilization / Site Recovery	LS	1	$2,000	$2,000
2	Erosion Control and Temporary Stormwater Controls	LS	1	$2,000	$2,000
3	Excavate to Create Temporary Ponding Area	CY	1,500	$10	$15,000
4	Excavate to Create Berm and Compact	CY	100	$15	$1,500
5	Local Haul of Excavated Material	LS	1	$5,000	$5,000
6	Furnish and Install Pond Outlet Structure	LS	1	$5,000	$5,000
7	Stone Outlet Weirs and Channels	LF	140	$25	$3,500
8	Culvert Under Road	EA	1	$2,500	$2,500
9	Install Brush and Small Log Application	LS	1	$1,500	$1,500
10	Install Log Check Dams	EA	4	$500	$2,000
11	Plant Temporary Ponding Area with Seed Mix	LS	1	$2,000	$2,000
12	Plant Naturalized Area with Seed Mix	LS	1	$1,000	$1,000
13	Temporary Erosion Matting in Temporary Ponding Area	SY	1,500	$3	$3,750
	SUB-TOTAL				**$46,750**
	FINAL ENGINEERING DESIGN				**$12,000**
	ENGINEERING OVERSIGHT				**$9,000**
	10% MINOR ADDITIONAL DESIGN ITEMS				**$4,675**
	10% CONSTRUCTION CONTINGENCY				**$4,675**
	TOTAL (ROUNDED)				**$77,000**