Stormwater Report

Prepared For

Woodstock Public Works Department

Paine Road - Woodstock, CT

March 6, 2024

Prepared by:

J & D **Civil Engineers, LLC**

401 Ravenelle Road
N. Grosvenordale, CT 06255

Project Description

Paine Road is a steep (10% - 12%) gravel road with an erosion problem. Approximately 4.8 acres of land drains to a drainage ditch on the west side of Paine Road. The ditch flows south and then east toward Peckham Brook. The gravel road bed continuously erodes into the ditch and the eroded gravel washes into Peckham Brook onto property owned by Ron and Stacy Petro. There are two culverts in the ditch and both have issues with sediment clogging them and the capacities being overwhelmed.

The town is looking for a solution to improve the situation. The goal is to significantly reduce the amount of eroded gravel that enters the brook. Currently, the best mechanism for that is for the Town to construct a sediment basin adjacent to the road upstream of the brook. This can be constructed on land (Map 5165, Block 8, Lot 4-7) owned by Paine District Estates. It is the Town's understanding that they can obtain a drainage easement over this property. The sediment basin will reduce the velocity of runoff allowing fine particles to settle out. The Town will have to remove accumulated sediment as needed, probably several times per year.

There are other long-term solutions that the Town could consider in the future to address the problems. The road could be paved which would eliminate gravel erosion. It is generally recommended that roads or driveways be paved if their slopes exceed 10% in order to eliminate erosion. Also, it would be very beneficial to install a few cross culverts under the road to drain water from the west side to the east side. Currently there are no cross culverts in over 1200' of road. Culverts could be installed every few hundred feet in the steep section which would greatly reduce the quantity of flow and sediment transport in the drainage ditch. The Public Works Department is currently looking into this.

Stormwater Management

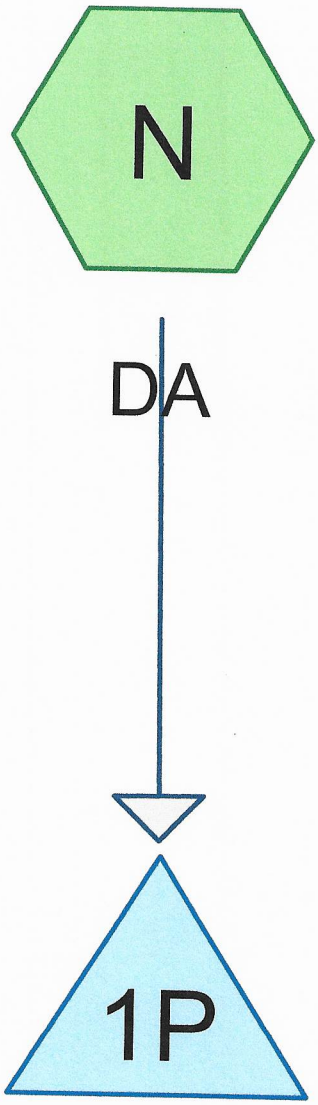
CT DEEP released new versions of the Stormwater Quality Manual and Soil Erosion and Sediment Control Guide in 2023. Typically, structural measures such as sediment traps or basins are meant for short term use during the duration of construction of a project. Although this is not a construction project, J & D recommends that a sediment basin be constructed as per the typical sections recommended by the E & S Guide. The reason is that the gravel eroding from the steep road is similar to sediment eroding from a construction site.

Structural measures are sized based upon a certain volume of storage required per acre of the watershed assuming that that land within the watershed will be disturbed by construction and subject to erosion. Sediment traps have pervious berms, similar to check dams, for outlets. Sediment basins have a soil berm with a principal spillway and an emergency spillway. The size of the drainage area is small enough (<5 acres) that a sediment trap could be considered for this site. However, the structure is not temporary and the pervious outlet would clog too fast. Therefore a sediment basin is proposed.

Sediment Basin Design

The sediment basin was designed using guidance from the CT E&S Standards. Sizing was based upon the percent of the drainage area that is eroding as per sediment basin sizing guidelines. Calculations are attached. Hydraulic calculations for the 10 and 50 year storm were performed. The 50 year storm can pass through the emergency spillway with 1' of freeboard.

The Woodstock Public Works Department will be responsible for constructing and maintaining the sediment basin. The owner has agreed to grant a drainage easement to the Town over the land the basin will be constructed on. Although a larger basin would provide more settling time, the sediment basin proposed was designed to fit into the size of the area available as per the agreement between the Town and property owner. Its construction should significantly reduce the amount of gravel eroding into Peckham Brook.



Prop basin

Subcat Reach Pond Link

Routing Diagram for 21170 Woodstock-Petro sed basin
Prepared by J & D Civil Engineers, LLC, Printed 3/7/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	CT 10-year	NOAA 24-hr	D	Default	24.00	1	5.23	2

Summary for Subcatchment N: DA

Runoff = 7.88 cfs @ 12.37 hrs, Volume= 0.979 af, Depth= 2.46"
Routed to Pond 1P : Prop basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NOAA 24-hr D CT 10-year Rainfall=5.23"

Area (sf)	CN	Description
141,371	74	Pasture/grassland/range, Good, HSG C
56,297	65	Brush, Good, HSG C
10,096	96	Gravel surface, HSG C
207,764	73	Weighted Average
207,764		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	300	0.0200	0.21		**Sheet Flow,** Cultivated: Residue>20% n= 0.170 P2= 3.72"
1.4	960	0.1000	11.11	16.66	**Channel Flow,** Area= 1.5 sf Perim= 4.0' r= 0.38' n= 0.022 Earth, clean & straight
25.6	1,260	Total			

Summary for Pond 1P: Prop basin

Inflow Area = 4.770 ac, 0.00% Impervious, Inflow Depth = 2.46" for CT 10-year event
Inflow = 7.88 cfs @ 12.37 hrs, Volume= 0.979 af
Outflow = 7.01 cfs @ 12.48 hrs, Volume= 0.900 af, Atten= 11%, Lag= 6.7 min
Primary = 7.01 cfs @ 12.48 hrs, Volume= 0.900 af
Routed to nonexistent node 4R

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 436.55' @ 12.48 hrs Surf.Area= 2,726 sf Storage= 7,131 cf

Plug-Flow detention time= 76.0 min calculated for 0.900 af (92% of inflow)
Center-of-Mass det. time= 34.0 min (900.7 - 866.6)

Volume	Invert	Avail.Storage	Storage Description
#1	433.00'	11,558 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
433.00	1,349	167.0	0	0	1,349
434.00	1,705	180.0	1,524	1,524	1,748
435.00	2,081	193.0	1,890	3,413	2,176
436.00	2,483	207.0	2,279	5,692	2,665
437.00	2,932	220.0	2,704	8,397	3,155
438.00	3,397	234.0	3,162	11,558	3,710

Device	Routing	Invert	Outlet Devices
#1	Primary	436.50'	**10.0' long + 0.5 '/' SideZ x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	435.00'	**18.0" Round Culvert** L= 26.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 435.00' / 431.00' S= 0.1538 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=7.01 cfs @ 12.48 hrs HW=436.55' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.28 cfs @ 0.54 fps)
└─**2=Culvert** (Inlet Controls 6.72 cfs @ 3.81 fps)

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	CT 50-year	NOAA 24-hr	D	Default	24.00	1	7.28	2

Summary for Subcatchment N: DA

Runoff = 13.45 cfs @ 12.37 hrs, Volume= 1.661 af, Depth= 4.18"
Routed to Pond 1P : Prop basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NOAA 24-hr D CT 50-year Rainfall=7.28"

Area (sf)	CN	Description
141,371	74	Pasture/grassland/range, Good, HSG C
56,297	65	Brush, Good, HSG C
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207,764		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	300	0.0200	0.21		**Sheet Flow,** Cultivated: Residue>20% n= 0.170 P2= 3.72"
1.4	960	0.1000	11.11	16.66	**Channel Flow,** Area= 1.5 sf Perim= 4.0' r= 0.38' n= 0.022 Earth, clean & straight
25.6	1,260	Total			

Summary for Pond 1P: Prop basin

Inflow Area = 4.770 ac, 0.00% Impervious, Inflow Depth = 4.18" for CT 50-year event
Inflow = 13.45 cfs @ 12.37 hrs, Volume= 1.661 af
Outflow = 13.27 cfs @ 12.40 hrs, Volume= 1.582 af, Atten= 1%, Lag= 1.6 min
Primary = 13.27 cfs @ 12.40 hrs, Volume= 1.582 af
Routed to nonexistent node 4R

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 436.86' @ 12.40 hrs Surf.Area= 2,866 sf Storage= 7,983 cf

Plug-Flow detention time= 52.5 min calculated for 1.582 af (95% of inflow)
Center-of-Mass det. time= 25.9 min (875.7 - 849.8)

Volume	Invert	Avail.Storage	Storage Description
#1	433.00'	11,558 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
433.00	1,349	167.0	0	0	1,349
434.00	1,705	180.0	1,524	1,524	1,748
435.00	2,081	193.0	1,890	3,413	2,176
436.00	2,483	207.0	2,279	5,692	2,665
437.00	2,932	220.0	2,704	8,397	3,155
438.00	3,397	234.0	3,162	11,558	3,710

Device	Routing	Invert	Outlet Devices
#1	Primary	436.50'	**10.0' long + 0.5 '/' SideZ x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Primary	435.00'	**18.0" Round Culvert** L= 26.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 435.00' / 431.00' S= 0.1538 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=13.26 cfs @ 12.40 hrs HW=436.86' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 5.37 cfs @ 1.48 fps)
└─**2=Culvert** (Inlet Controls 7.90 cfs @ 4.47 fps)

JOB NO. 21170
DATE 3/6/24
BY JJB
CH'D BY

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SHEET NO. 1
JOB PAINE ROAD
SUBJECT
CLIENT WOODSTOCK

DESIGN SEDIMENT BASIN USING DESIGN CRITERIA IN 2023 CT GUIDELINES FOR EROSION & SED CONTROL

TOTAL D.A. = 4.8 AC = 0.0075 MI^2

Connecticut Guidelines for Soil Erosion & Sediment Control

Dams and Reservoirs, Technical Release 60 (TR-60) may be used to provide a more refined estimate of the actual trap efficiency[62] of a specific sediment basin.

Sediment volume is calculated from the following formula:

$$V = \frac{(DA)(A)(DR)(TE)(\frac{2000lbs}{ton})}{(\gamma)(43{,}560\ sq\frac{ft}{acre})}$$

Where:

V = the volume of sediment trapped in ac. ft./yr.

DA = the total drainage area in acres

A = the average annual erosion in tons per acre per year using either values from the Universal Soil Loss Equation, the Revised Universal Soil Loss Equation, or the values in Table 5. 29 for the listed land use.

DR = the delivery ratio determined from Figure 5- 71. (DECIMAL)

TE = the trap efficiency as given above. (Use 0.8)

γ= the estimated sediment density in the sediment basin in lbs./cu. ft. (from Table 5. 30).

Wet Storage Volume: The volume of the wet storage shall be at least twice the volume of the sediment storage volume (see above) and shall be designed to a minimum depth of 2 feet.

Wet storage volume is the volume in the basin that is located below the invert of the lowest outlet structure for the basin. The wet storage may not provide permanent ponding of water depending on site conditions but will create a permanent pool for settling suspended sediment during a runoff event. The wet storage is intended to minimize the re-suspension of existing trapped sediments during a runoff event. To reduce sediment removal frequency, increase the volume of wet storage which will increase the sediment storage volume.

FOR A: GRAVEL ROAD = CONSTRUCTION AREA (0.23 AC)

- 0.23 AC × 50 TONS/YR = 11.5 TONS

WOODS/FIELDS = 4.57 AC

- 4.47 × 0.2 TONS/YR = 0.91 TONS

∴ DA (A) = 11.5 + 0.9 = 12.4 TONS

FOR DR: SEE FIG 5-71 - 45% = 0.45

TE: 80% USE 0.8

γ : DENSITY (TABLE 5.3) SAND+SILT = 85 LB/FT^3

SOLVE FOR V (VOL SEDIMENT IN AC-FT/YR)

$$V = \frac{12.4 \text{ TONS } (0.45)(0.8)\ 2000 \text{ LB/TON}}{85 \text{ LB/FT}^3\ (43560 \text{ FT}^2/\text{AC})} = 0.0024 \text{ AC-FT}$$

$$V = 0.0024 \text{ AC-FT } (43560 \text{ FT}^2/\text{AC}) = 105 \text{ FT}^3$$

SEDIMENT STORAGE VOLUME
WET VOLUME SHALL BE TWICE SED VOLUME
= 210 FT^3

AS PER HYDROCAD STORAGE VOLUME =

1) BELOW PRINCIPAL SPILLWAY = 3400 FT^3
2) BELOW EMERG SPILLWAY = 7040 FT^3
3) TO TOP OF EMBANKMENT = 11,558 FT^3

VOLUMES EXCEED WET VOLUME REQUIREMENTS

GEOMETRY: MEETS STANDARDS:

6' EMBANKMENT WIDTH
2H:1V SIDE SLOPES
EMB HEIGHT = 538 - 534 = 4' < 15'
∴ NOT A DAM
LENGTH > TWICE WIDTH