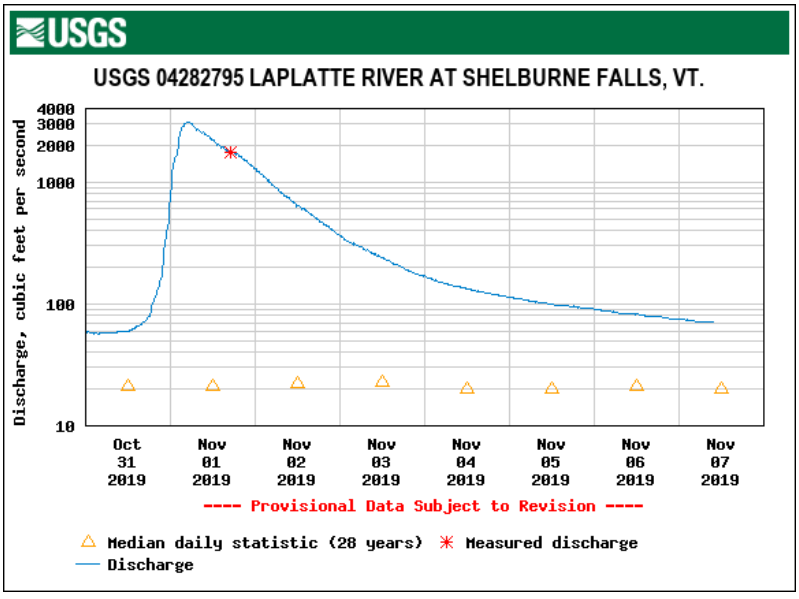
Water Matters
Landowner Steps to Ahead of the Storm

Presented By: Jessica Louisos, MS, PE

November 7, 2019 -- Funded by the Lake Champlain Basin Program - L-2019-032 EO AOTS Project

Extreme Storms



Source: USGS Water Data, 2019

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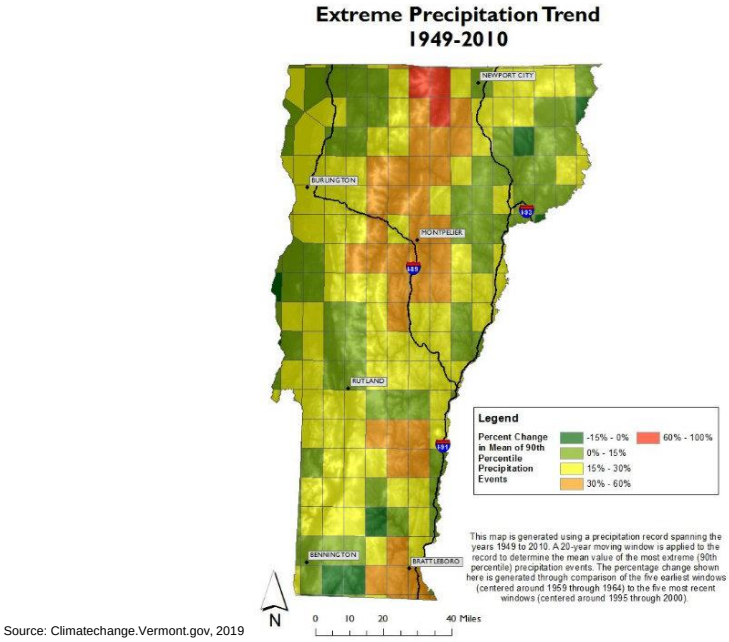
November 1, 2019

50 – 100-year flow compared to downstream LaPlatte River gauge in Shelburne

Storms are happening more frequently and we need to be prepared so that we are not needing costly repairs all the time.

Extreme Storms and Climate Change



Source: Climatechange.Vermont.gov, 2019

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WETTER- Hinesburg – 15- 30% more rainfall over last 60 years

Larger storms

Extreme storms are more frequent storms – flooding happens more often

More extremes – including more drought

What can you do?

- **Apply the Ahead of the Storm Approach to your property**

- **Naturalize stormwater runoff across the land**
- **Enhance flood resiliency**
- **Protect water quality**

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On your property, your neighborhood, or along your private road you can do this evaluation

Site Assessment

- **Document Existing Conditions**
  - **Flow path lines**
  - **Erosion areas**
  - **Existing stormwater infrastructure**
  - **Notes on impervious and landuse**
  - **Think about constraints**
- **Identify problem areas**
- **Identify potential treatment areas**
- **Use mapping from VTANR Atlas: https://anr.vermont.gov/maps/nr-atlas**

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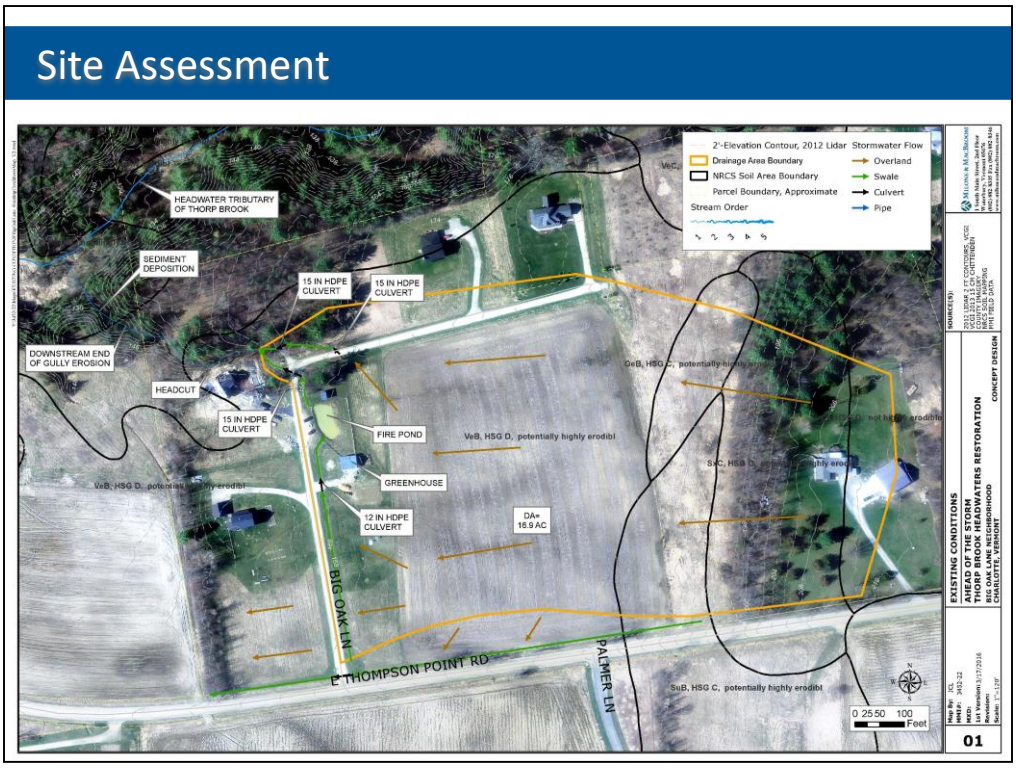
Site Assessment



Example Site Assessment from neighborhood in Charlotte

Mapped Flowpaths

Erosion

Undersized culverts and swales

Like here in Hinesburg many private roads do not meet town or state standards and set neighborhoods up for maintenance issues

You can do this yourself – maybe use ANR Atlas website to make map and look for important natural resources like wetlands

Ahead of the Storm – Optimal Conservation Practice

YOU can do this!

Example Site Assessment from neighborhood in Charlotte – with Private Road

Right-sized culverts and swales

Rock-lined eroding swale

Changed landuse to increase vegetation

Added wood and roughness to gully to stop erosion and catch sediment

Ahead of the Storm - Optimal Conservation Practices

The 3 S's….

- **SLOW IT DOWN**
- **SPREAD IT OUT**
- **SOAK IT IN**

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Our goal is to identify locations where water is collected and concentrated or where dirty water is running off impervious surface.

Once identified we will want to consider ways to Slow, Spread, and Soak. Next time we get together we will review specific ways to do that.

For now, just consider if there is space available where the problem exists to try to fix it at that location.

Rainbarrel / Cistern

Vermont LID Manual, VTDEC, 2010

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Rainwater harvesting = storage and reuse

Can use water for irrigation, gardening

I use my home rainbarrel for watering my indoor plants too.

Pervious Pavement or Concrete

Dartmouth College, Connecticut River Edge, Hanover, NH,
Summer 2013

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Limit impervious surface – consider pervious surfaces

Infiltration - This could also be pavers (like bricks)

It is a hard surface that has pores so that water can run though it and into the ground below.

Ice, salt, and sand can be issues with this type of treatment because it can get clogged and is flat, so rain has to get into it quickly or runs off

Raingarden / Bio-Retention

Town Property, Silver Street, Hinesburg, Summer 2014

A Family's Home, Charlotte, Summer 2018

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Shallow, vegetated basins that collect and absorb runoff

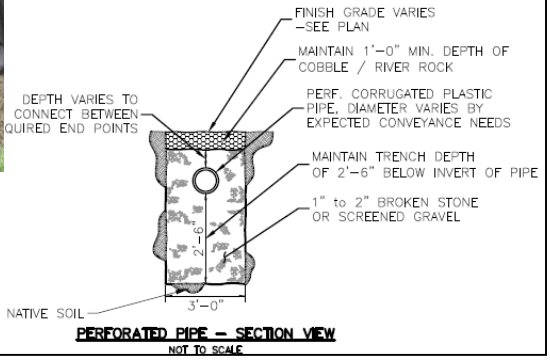
Includes evapotranspiration – water released to the air when plants breath

If possible infiltration,

but if soils are poor – can have underdrain that collects water after it filters through the soils

Infiltration Trench

Brook Lane, Shelburne, Vermont, Summer 2016



Allows water to seep through the stone and out into the ground

Stone provides filtering

If there is a pipe, it would have holes in it to allow the water to get into the ground

NOT just an underdrain- the purpose is to sink the water into the ground so the pipe is at the top of the gravel trench.

Green Roofs

UVM Aiken Building, photo taken June 2013

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A roof of a building covered with special soil and plants

Stores and treats water on the roof, where it lands.

Absorbs, Stores, Evapotranspire

Most cost-effective where there isn't much land available – like in cities

Not all roofs are strong enough to hold the extra weight

Water flows off of an impervious surface and spreads out over a vegetated area

Sometimes a gravel strip is included to slow down water and do some filtering

Important that the water is spread out

Protect Existing Resources - Wetlands

Wetland in Hinesburg Village – November 1, 2019

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Non-Engineered Solutions are very important also.

Wetlands, Floodplains, and natural forested riparian areas around our rivers and streams

Slow water, hold in uneven ground surface, infiltrate, filter pollutants

Protect Existing Resources - Floodplains

LaPlatte Floodplain – November 1, 2019

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Non-Engineered Solutions are very important also.

Wetlands, Floodplains, and natural forested riparian areas around our rivers and streams

Slow water, hold in uneven ground surface, infiltrate, filter pollutants

Riparian Buffer Planting / Reforestation

Trees act as natural reservoirs – intercept and store rainfall

Reduces stormwater runoff

Need to be planted in uncompacted soils

Design Resources

The Vermont Rain Garden Manual “Gardening to Absorb the Storm”
http://www.uvm.edu/seagrant/sites/default/files/uploads/publication/VTRainGardenManual_Full.pdf

Vermont Low Impact Development Guide for Residential and Small Sites
https://anrweb.vt.gov/PubDocs/DEC/WSMD/stormwater/docs/sw_LID%20Guide.pdf

Vermont Green Stormwater Infrastructure (GSI) Simplified Sizing Tool for Small Projects
http://www.vpic.info/GreenInfrastructureCalculatorsAndSizingTools.html

Vermont DEC Stormwater Program
http://dec.vermont.gov/watershed/stormwater

University of New Hampshire Stormwater Center
http://www.unh.edu/unhsc/

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Vegetated Swales

Reconstructed grass swale, East Thompson Point Road, Charlotte, Vermont, Summer 2016

Grass-line if Slope < 5%

Swale with Raingarden, Woodbine Road, Shelburne, 2017

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Provide treatment and retention as they move water

Slow, infiltrate, and filter better than narrow unvevegetated swales

Wide bottom, shallow slopes, vegetated

If steep, need rock to slow the water down and prevent erosion

Stone-Lined Swales

Reconstructed stone swale, East Thompson Point Road, Charlotte, Vermont, May 17, 2017

Stone-line if Slope > 5%

Hinesburg Town Garage, October 10, 2018

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Provide treatment and retention as they move water

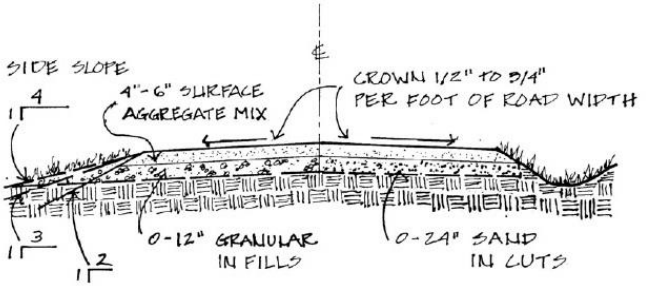
If steep, need rock to slow the water down and prevent erosion

Check dams add additional treatment capacity and capture more sediment

Design Resources

Municipal Roads Program – VTANR DEC
https://dec.vermont.gov/watershed/stormwater/permit-information-applications-fees/municipal-roads-program

Vermont Better Roads Manual, Clean Water You Can Afford
https://vtrans.vermont.gov/sites/aot/files/highway/documents/ltf/Better%20Roads%20Manual%20Final%202019.pdf



ROAD CROWN & PROFILE

Vermont Better Roads Manual, 2014

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MRGP – has guidelines based on slopes to generally address the 3 s's and get water safely off of road surfaces to reduce sediment and erosion

Many roads are taken care of by our municipalities – professionals with a road budget

Others are privately owned and maintained, which can be expensive and out of the expertise of their owners

Many of these roads are hydrologically connected and sediment washed directly into our waterways

Here is a local example of a private gravel road

Many of these things you can do without professional design engineering based on general guidelines

Gravel roads can produce tons and tons of sediment

Many of us have seen areas of gravel near roads where the surface of the road has washed away

Sometimes this goes into our streams

Getting the water off the road is the first step

Ruts from car tires and plows push gravel to the side, making low points for water to accumulate on the road surface.

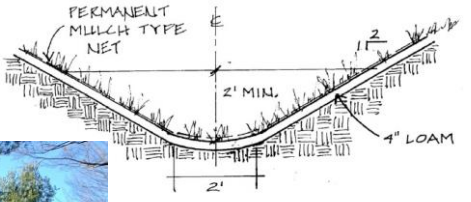
Small berms from graders or plots hold water on the road and cause erosion

Sheet flow water off the road.

Requires regrading –

sometimes extra work to excavate at the side of the road or bring in gravel to build the road up

Partridge Hill Road - Grass-Lined Swales



GRASS LINED DITCH

Vermont Better Roads Manual, 2014

Partridge Hill Road, November 6, 2019

Grass-line if
Slope < 5%

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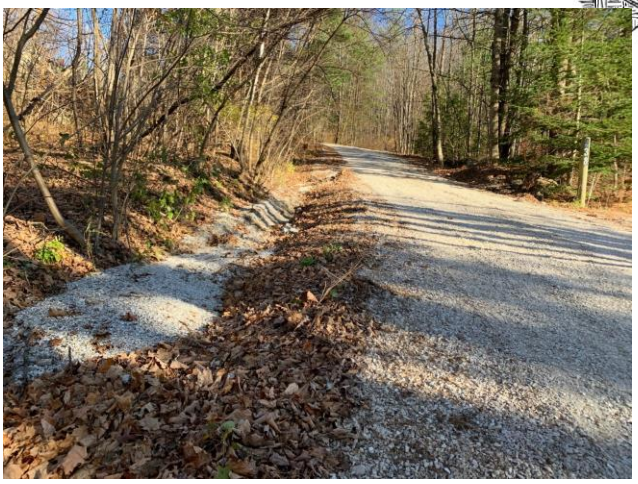
Narrow and deep swale trap the water and cause high velocities and erosion

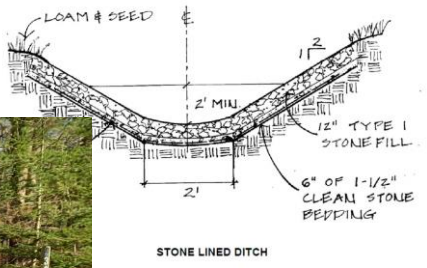
Need wider, shallower swales or sheet flow off of the road

No bare soil

Partridge Hill Road - Stone-Lined Swales



Partridge Hill Road, November 6, 2019



STONE LINED DITCH

Vermont Better Roads Manual, 2014

Stone-line if Slope > 5%
Larger Stone if Slope >10%

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Provide treatment and retention as they move water

If steep, need rock to slow the water down and prevent erosion

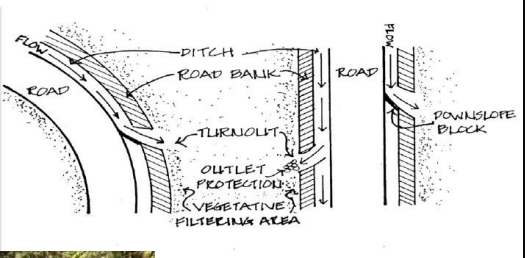
Check dams add additional treatment capacity and capture more sediment

6-8 inch erosion stone

If > 10% slope need 12” diameter stone

Partridge Hill Road - Turnouts

Partridge Hill Road, November 6, 2019



Vermont Better Roads Manual, 2014

Every approximately 160 feet

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Direct water away from road so not confined in swales

If steep (<5%), need rock to slow the water down and prevent erosion

Especially important at streams to direct flow away

Cleanout to remove gravel so there is space to catch future sediment

Partridge Hill Road - Culvert Sizing

Partridge Hill Road, June 12, 2017

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Right-sizing culverts is extremely important and can prevent washouts

Driveways 15” minimum diameter

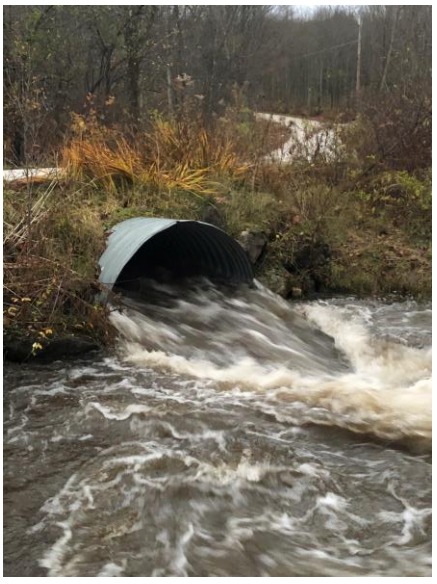
Roadways 18” minimum diameter

Stone armoring and headwalls on both ends

Need to cleanout

This has clearly had flow go over the driveway

Partridge Hill Road - Culvert Sizing



Partridge Hill Road, November 1, 2019 by K. Kelley

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Right-sizing culverts is extremely important and can prevent washouts

If this perennial stream culvert washed out, multiple families would have been stranded on the other side

Engineering help is recommended to make sure perennial stream culverts are properly designed

Poor culverts can also block fish and wildlife and

Cause streams to move off course and flood unexpected areas

Partridge Hill Road - Floodplains

Partridge Hill Road
November 1, 2019
K. Kelley

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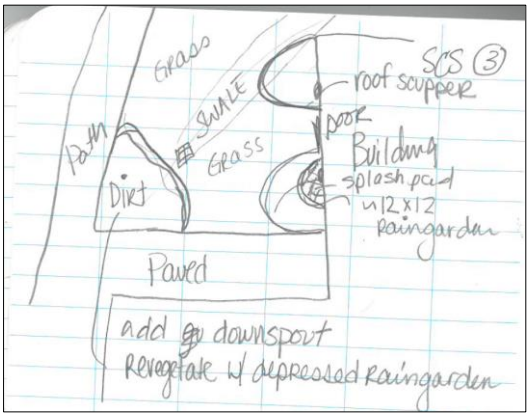
Providing buffers to streams is very important.

This one is providing an area for flood flows to safely travel

Better if they are naturally forested

Alternatives Analysis- Consider OCP Options

- Soils
- Infiltration Capacity
- Appropriate location
- Available space
- Where is water collected
- How much water collected
- Constraints – utilities?
- Maintenance needs
- Type of pollutants present
- Problem areas – Erosion?



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Alternatives Analysis- Calculate Runoff Volume

WATER QUALITY VOLUME

Drainage Area Information					
Pre Development Land Use (acres)					
Landuse	A	B	C	D	Total
Grass	0.000	0.000	0.300	0.000	0.300
Meadow	0.000	0.000	0.000	0.000	0.000
Woods	0.000	0.000	0.000	0.000	0.000
Existing Impervious	0.000	0.000	0.500	0.000	0.500
npervious previously authorized under 2002 VSMM (not included in calculations)					0.000
				Total Pre Site Area	0.800

WQvolume = P * Rv * A / 12

Where

P = precipitation = 1 inch across Vermont = **1**
Rv = runoff coefficient = (0.05 + 0.009 * I) = **(0.05+0.009*62.5) = 0.6125**
I = percent impervious = **62.5%**
A = site area (acres) = **0.8 acres**

WQvolume = (1 * 0.6125 * 0.8) / 12 = 0.0408 acre-feet

= 1,779 cubic feet

Like a 25-foot square room with 3 feet of water

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For volume based practices it is important to calculate how much water there will be to make treatment the right size

Water Quality volume is the amount of water that would runoff the project area during the 1 inch rainfall amount.

This is a standard treatment volume in the State stormwater manual and is calculated based on drainage area, impervious area, and constants

It calculates how big our treatment area needs to be to treat the water draining to the site.

We need this for design

Here is an example from the Shelburne Community School raingarden in front of the school

Alternatives Analysis – Calculate Runoff Volume

- Design needs to accommodate safely larger storms than the WQv
- Treatment is typically provided for the Channel Protection Volume
  - 1-year, 24-hour storm
  - Match pre-development timing, volume, flow
- Overbank Protection Standard
  - 10-year, 24-hour storm
  - Match pre-development peak flow rate

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If treating for phosphorus removal – filter or infiltrate a volume greater than the WQv

If flooding and erosion downstream – detain a volume larger than the CPv – try for the 10-year

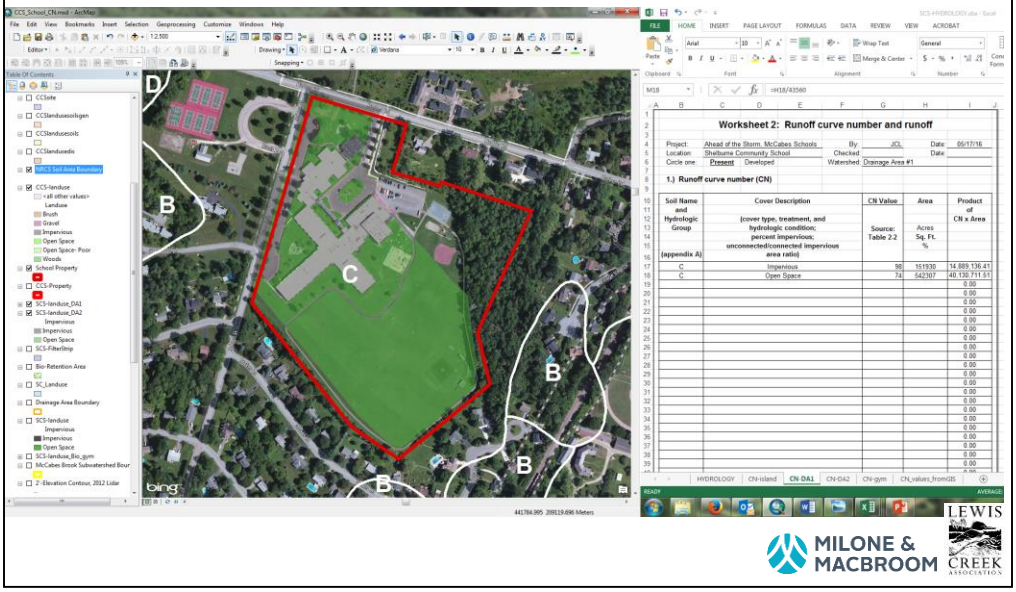
Circle back and see if there are ways to reduce creation of impervious surface, or restore pervious.

Would have to treat the 100-year storm to not increase peak flows if developing more than 10 acres.

Make sure the highest storms can pass without causing damage

Describe general methods for calculating velocity, CPv, and flows for rain events 2, 10, 50, 100 yr = Hydrology modeling by professional

Alternatives Analysis - Calculate Runoff Volume



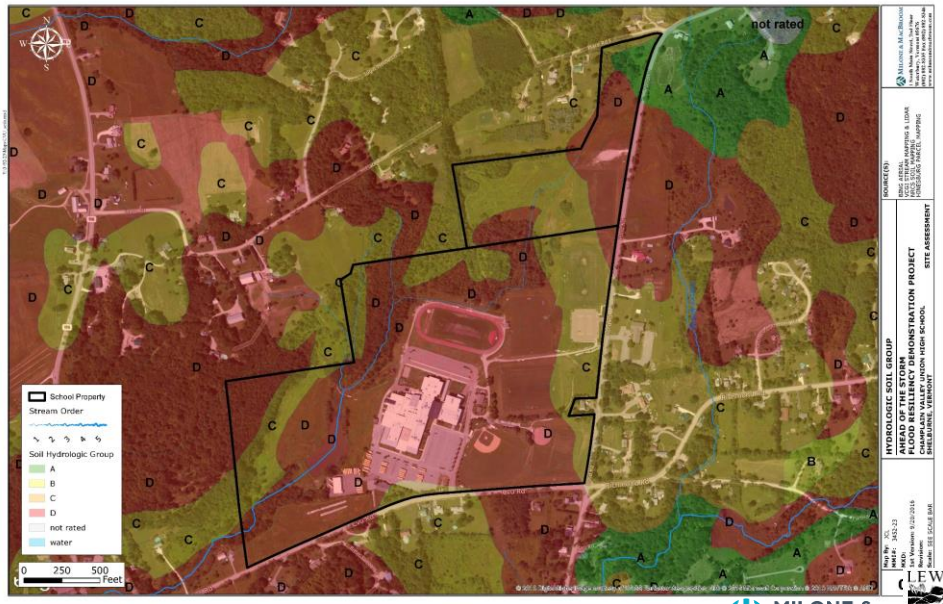
We need to know how much water is going to get to our potential treatment areas so that we can judge what types will work and if there is enough space for them

First we define the watershed area.

Landuse/ soils analysis – done in GIS

Hydrology modeling – combining landuse, soils, flow path length, and uses modeling software

Hydrology - Soils

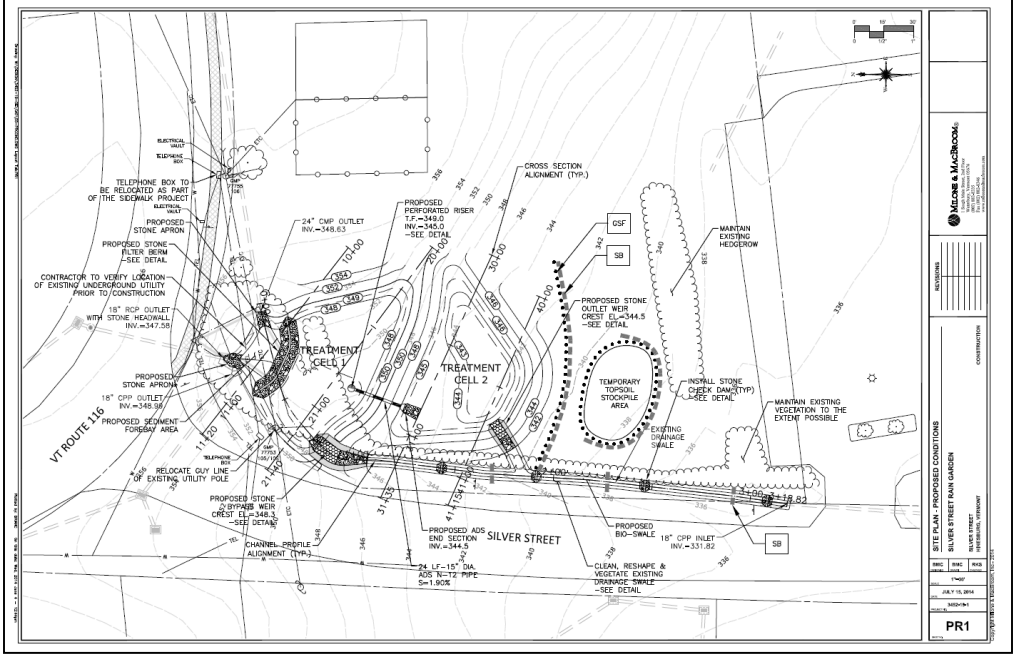


We need to know what type of soils there are.

Soils have different natural infiltration rates that affect how much runoff there is

These are combined with the landuse – grass, woods, impervious

Design Plans - Site Layout



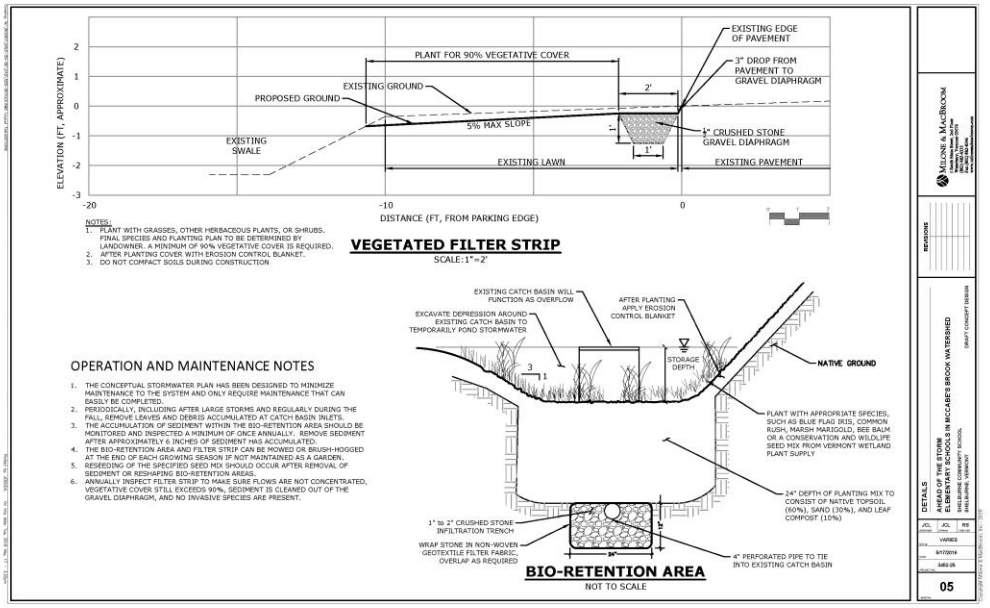
More advanced practices might need engineering completed

Sometimes designs have survey, (blueprints)

Less colorful, but a contractor can follow these for construction

Usually needed for more advanced designs

Design Plans - Details



Engineering details give specific information on how things need to be built

Slopes, depths, angles, size of stone, the type of erosion fabric

Maintenance notes are sometimes included here

Cost of Optimal Conservation Practices

- Dependent on practice
- Proper management of water can prevent costly and inconvenient damages from washouts

March 11, 2015

January 12, 2018

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Private residence in LaPlatte watershed, installed a raingarden. Prevents flooding of garage, driveway, and front of home that frequently occurred

Roads and driveways benefit a lot – many need costly repairs yearly

Installation of OCPs can reduce or eliminate erosion and flood damage by

Slowing, Spreading, Soaking water that would otherwise cause damage

Can save money in the long run and help the Lake!

Maintenance

- Dependent on practice
- Vegetation cutting and removal
- Check and unclog drains and culverts
- Remove accumulated sediment
- Gravel road grading to sheet flow
- Protected wetlands and forests = None!
- Rain barrels – water your plants

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Removing vegetation gets the Phosphorus out of the water system – once a year in fall

After large storm events check inlets

Every few years remove accumulated sediment so there is space in the system for more sediment and detention of water

Do this at Home!

- **The Ahead of the Storm process can be done on any type of property – and has – schools, churches, homes, public buildings, town garage, town forest, private roads…**
- **The design process is transferable**
- **Start at the beginning with a site assessment**

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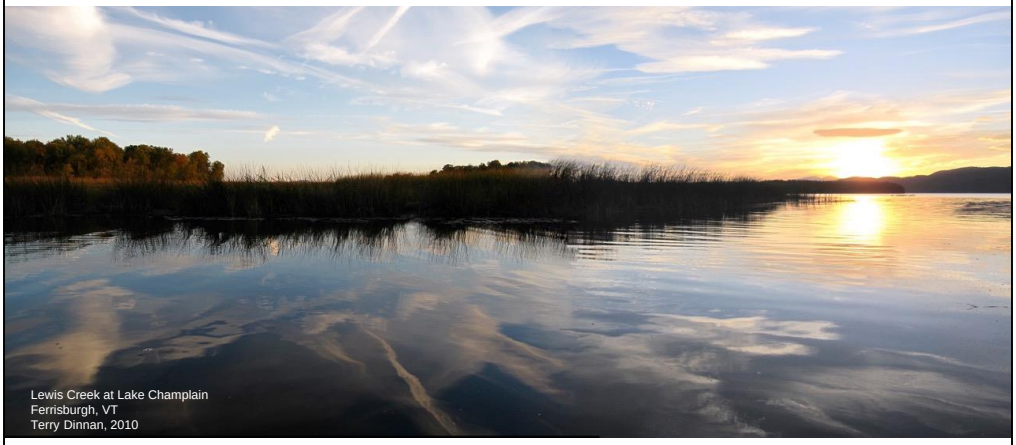
Many of the treatment options are easily implemented and don't need the expertise of an engineer.

Install a rain barrel, spread out water from a downspout or concentrated on a driveway.

Discuss what steps might need to be done by an engineer

Questions?



Lewis Creek at Lake Champlain
Ferrisburgh, VT
Terry Dinnan, 2010