Vermont Better Backroads -
Road Erosion Inventory Assessment Manual

A tool for the evaluation and ranking of water quality related road erosion projects for funding under the Vermont Better Backroads Program.

Better Backroads
Clean Water You Can Afford

VERMONT DEPARTMENT OF
ENVIRONMENTAL CONSERVATION
WATERSHED
MANAGEMENT DIVISION
ECOSYSTEM RESTORATION PROGRAM

Contents

Introduction and Purpose:

The purpose of this manual to is to teach you how to assess the relative severity of water quality road erosion issues on Vermont's Class III and IV roads for the purpose of prioritizing them for Better Backroads (BBR) grants.

In Vermont we've learned that road ways and water bodies are often close together, as roads are typically built on the flattest available surface. Those surfaces are often near water. We've learned that there can be some negative consequences of this relationship. One is that water bodies, particularly streams and rivers, naturally change their course over time. This can often lead to situations where the water body begins to infringe on the road corridor, resulting in damage or destruction. We've also learned that road surfaces can generate pollutant-laden runoff during rain storms which can run down the surface of the road or its ditches and enter the water body. The generation of pollutant-laden runoff can be especially bad on unpaved roads as the road or ditch material will mobilize more readily than on a paved surface. Road or ditch material carries pollutants like phosphorus into the water body, which can lead to issues such as toxic algae blooms. The material itself can also choke out smaller streams, destroying valuable fish and bug habitat.

In summary, water can have a negative effect on roads and roads can have a negative effect on water.

The Road Erosion Inventory Manual is meant to address potential negative effects that roads have on water, not the negative effects of water on roads. For those effects, such as when a river corridor moves into the road corridor, you should consult the Vermont Rivers and Road Manual. That field manual is a guide to recognizing river instability and restoring the river to a stable condition as part of road construction projects along rivers. These are complex issues not meant to be addressed in the Road Erosion Inventory Manual. For further guidance on river and road interactions and how it relates to road construction and maintenance, please see the VT DEC's 'Vermont Rivers and Roads Field Manual'.

In the Road Erosion Inventory Manual the emphasis is on water quality - does road or ditch material reach the water body? If it does, or could, this is considered a water quality road erosion issue. While assessing sites you should keep in mind that **routine road maintenance issues that do not affect water quality are not the focus** - only road erosion issues that a) affect water quality and b) require work that would necessitate a special outlay within a town's capital budget and could use BBR Category A grant funding to accomplish part or all of the required work.

A note about 'water bodies': What is a water body? For the purposes of this manual we consider mapped waters of the State of Vermont to be 'water bodies'. These include perennial (aka 'blueline') streams, lakes/ponds, wetlands (all classes), ephemeral streams (often un-mapped), as well as dry channels that lead directly to other water bodies.

If the road erosion issue does not threaten water quality, it should not be assessed using the criteria in this manual.

The ultimate outcome of this assessment will be a list of water quality related road erosion repair projects that towns should use in planning future capital budget outlays and BBR Category A grant requests. This manual is not intended to be used for work related to the Municipal Road General Permit.

Inventory Criteria Explanation and Illustrations:

Use the following reference photos and diagrams to assist in your inventory of each erosion site. While every effort has been made to provide quantified, easily repeatable measurements for field personnel conducting the assessments, and reference photos and diagrams have been selected or designed to provide the most accurate information possible, there is still a good deal of 'gray area'. There may often be no clear-cut distinction between a Low and Medium volume erosion drainage area or a U-Shaped and Box-Shaped ditch.

It will be up to the individual or team surveying each site to make the most accurate assessment possible.

The most important criteria in this evaluation is the presence or possibility of road surface or ditch material connection to the water body. If there is no connection present or a connection is not possible under typical precipitation conditions, the segment should not be a candidate for a Detailed Assessment.

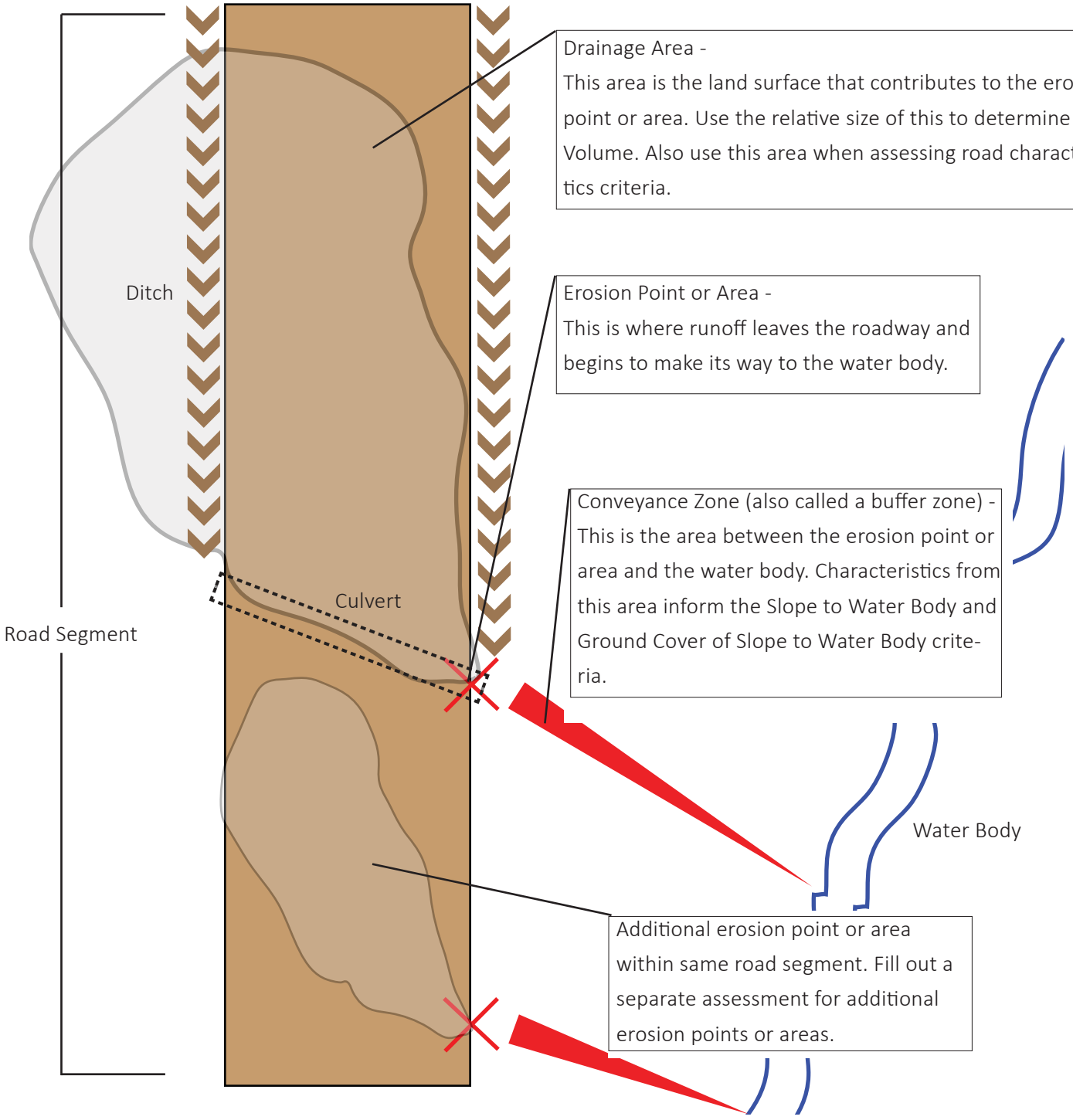
Please note that 'typical precipitation conditions' are defined as any event that would produce runoff, though not events that will produce significant flooding. While there may be road or ditch erosion occurring, if material does not reach an adjacent water body, it shouldn't be a priority site. If there is deposition occurring or deposition is likely to occur in the future under normal precipitation conditions, the site should be evaluated using the Detailed Assessment criteria.

Does material from road surfaces and ditches reach the water body?

Could it easily do so?

If Yes, it should be evaluated.

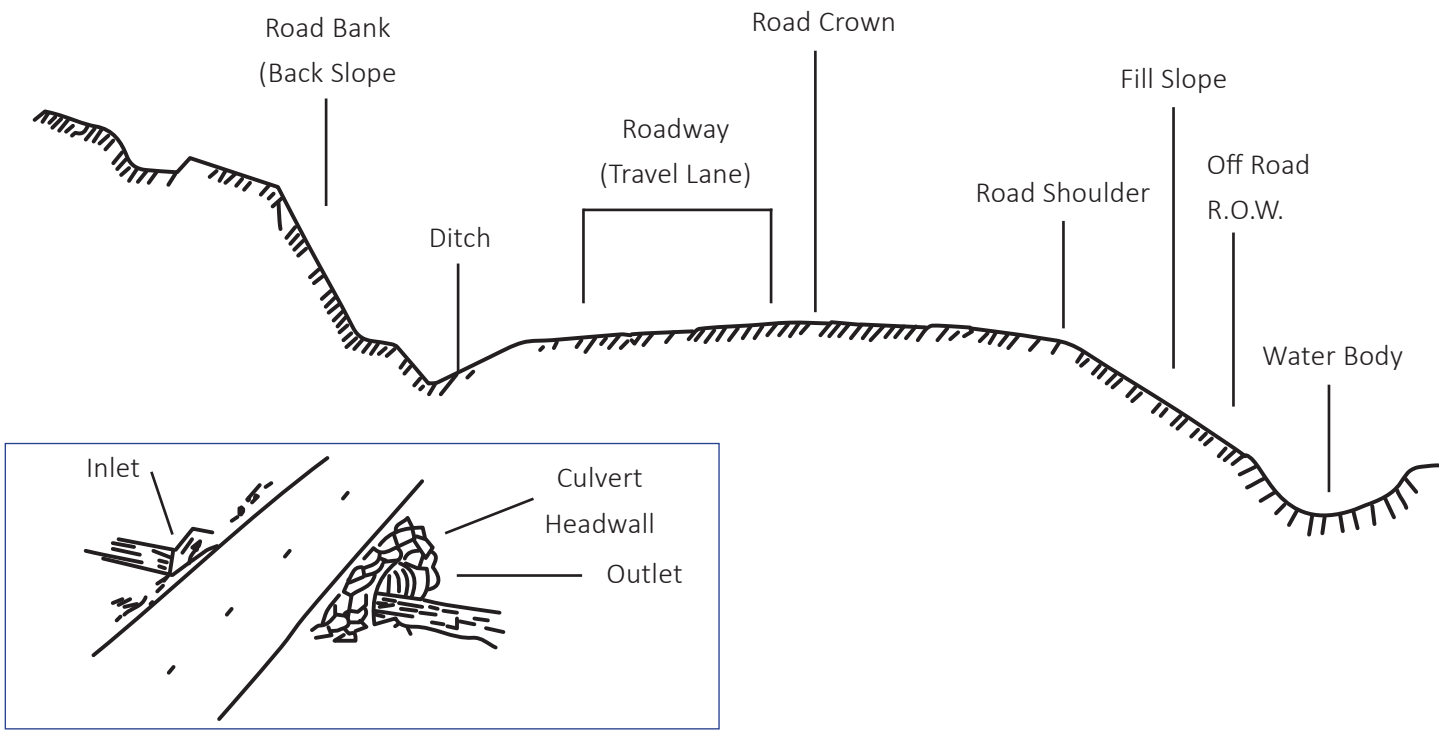
Drainage Area Terminology and Diagram:



Road Erosion - Drainage Area Terminology:

The simple diagram above shows the main areas of concern when assessing road erosion sites where there is a water quality issue. The Drainage Area contributes to the Erosion Point or Area. The Erosion Point or Area concentrates runoff and routes it through a Conveyance (Buffer) Zone towards the water body. Note that there may be multiple erosion points or areas in a road segment. If they have separate drainage areas, they should be inventoried separately. An example of this is when a culvert cuts a road segment into two drainage areas - everything uphill of the culvert is one drainage area while everything downhill is another.

Erosion Location: Rural dirt roads come in many shapes and sizes but they all share the same basic characteristics. The diagram below shows a typical crowned road with uphill ditch and downhill slope. Please note that sites can have erosion in more than one location!



The photo to the right shows a typical rural dirt road. There is a ditch on either side of the road, meaning there is potential for erosion issues in each. The road is slightly crowned but notice the rill erosion on the right hand side of the photo. This is likely caused by the slight elevation at the road's edge. These are commonly called 'grader berms' and trap runoff on the road surface. The road bank, also called a cut bank, is to the extreme right of the photo, is well vegetated and low-gradient, meaning there is little chance of erosion.

Erosion Location does not necessarily influence the severity of the water quality erosion problem. It serves primarily to inform the choice of solution used to alleviate the issue.

Erosion Type: There are four main types of erosion. Rill and Incision erosion can occur at any location on a roadway. Slump erosion is usually limited to road shoulders or road banks, while Scour erosion typically occurs in ditches or at culvert outlets. **Sites can have more than one type!**

Rill:
Small, shallow, braided channels that do not cut much below the upper road surface.

Incision Erosion:
Erosion that is actively down-cutting through the road surface and sometimes into the road sub-base.

Scour:
Erosion where the velocity of runoff has eaten away at either the bank or the bed surface. Commonly found at culvert outlets.

Slump:
Usually a point, not a linear, feature. Slumps occur when either water undercuts the soil or runoff water saturates a steep bank, leading to a collapse in a certain location.

Erosion type does not necessarily influence the severity of the water quality problem. Instead, Type serves as a descriptor which will inform how a solution to the issue is ultimately chosen.

Road/Ditch Material in Water Body: Presence or absence of road or ditch material in the water body, ***or the likelihood of a future connection***, is the most important factor in determining the severity of the Water Quality Road Erosion Risk. Likelihood of connection is based on a typical rain storm - a storm which would produce runoff but would not result in significant flooding.

None:

No road or ditch material in water body and no connection possible. There is an adequate buffer between any possible road or ditch material transport and the water body. Slopes are low and/or ground cover is sufficient to filter out road-based material. *Under normal rain conditions, there would be no chance of material from the road or ditch reaching the stream*. **If your assessment is None - this site should not be evaluated further.**

Slight:

There is evidence that a small amount of road or ditch material reaches the water body. This is usually inferred by small channels leading up to, or nearly up to, the edge of the water body. There may be obvious tracking to the water body. There may be evidence of road or ditch material in the water body. If tracking is present within less than 25 feet of the water body, it is likely that material does reach the water body.

Moderate:

Ditches, or runoff-created channels drain to the water body, or road bank is slumping directly into the water body. Some road or ditch material is visible in the water body, or, if not visible, the connection has already made and will continue to transport material into the water body. Under normal rain fall conditions material transport is assured, though not in large quantities.

Severe:

A single large channel or multiple channels drain to water body. Channels are well-defined and may themselves be sources of material, as well as the road or ditch material they transport. There is evidence of significant amount of road-based material in the water body, such that it is potentially altering the aquatic habitat in the specific location.

If there's no road or ditch material in the water body, and no likelihood of a future connection under normal rain fall conditions, the site does not merit Detailed Assessment.

Runoff Volume: The volume of runoff water going to and through the erosion point. This measurement is site-specific and relative to the drainage area being evaluated. The larger the drainage area to the erosion point or area is, the larger the runoff volume will be.

Low:

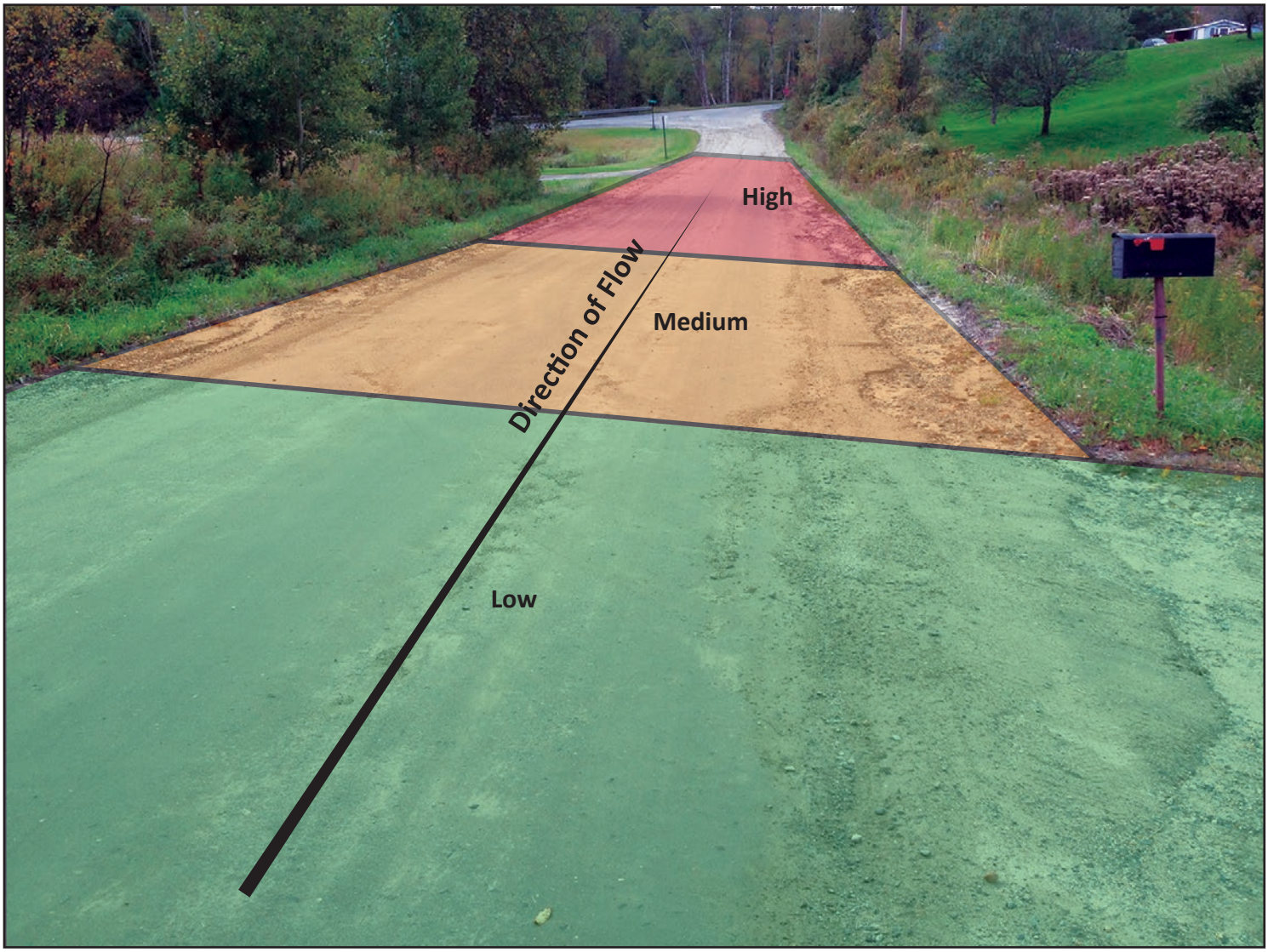
The erosion point or area is in the 'headwaters' of the road segment drainage area – the top third of the site-specific drainage. Usually only the road surface will drain to and through this point. It is unlikely that any other drainage area contributes.

Medium:

The erosion point is in the middle third of the road segment's drainage area. It may be influenced by non-road drainage from adjacent hill slopes.

High:

The erosion point or area is located in the bottom third of the road segment's drainage area. Typically high volume areas are found near the receiving water body. High volume areas may also have additional non-road drainage areas contributing.



Runoff Volume estimates should try to take into account the surrounding drainage area coming to and through the erosion point. If there's a large slope uphill of the road that may affect your estimate, make sure to take it into account. Seeps mays also be present - these should be accounted for as well.

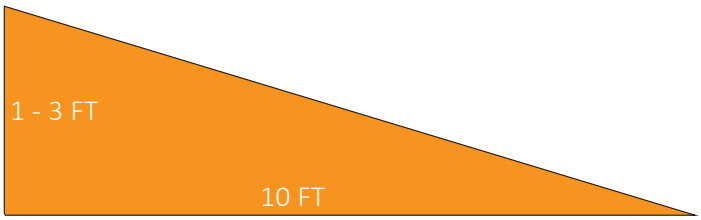
Slope to Water Body: Slope at and downstream of the erosion point or area - not the slope of the road adjacent or above the erosion point or area. This slope is the conveyance of runoff from the road drainage area to the water body.

Low (0 - 10% average):

Low gradient slopes are less likely to transport material to the water body. A 5% slope has less than 6 inches of rise for every 10 feet of run.

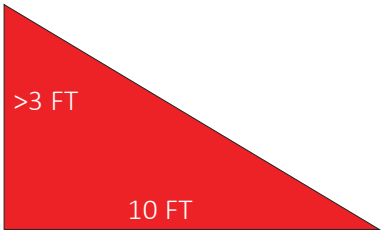
Medium (10 - 30% average):

Medium slopes will have more potential to transport material to the water body. 5-10% slopes have more than 6 inches to 1 foot of rise for every 10 feet of run.



High(>30% average):

High slopes will have the most potential to transport material to the water body. >10%% slopes have 1 or more feet of rise for every 10 feet of run.



Slope estimates are for the slope from the erosion point to the water body, not for the road surface. If the erosion occurs on the road before turning towards the water body, only consider the slope from the edge of the road to the water body.

Ground Cover of Slope to Water Body: Ground cover downstream of erosion point or area to natural surface water body. Only ground cover below knee height should be considered - features at that level and below will interrupt runoff flow and potentially filter out sediment.

>50% Vegetated:

Native soil is >50% covered in vegetation where erosion point or area leaves road surface and flows on to adjacent slopes to water body. Note that vegetative cover does not refer to vegetation above knee-height. The presence of taller vegetation, such as trees or leafy shrubs, will not necessarily affect runoff. An intact duff layer (a thick mat of partially decomposed leaves or needles) also qualify under this category. Flows in this condition tend to be sheet, rather than channel, flows.

<50% Vegetated:

Native soil is <50% covered in vegetation where erosion point or area leaves road surface and flows on to adjacent slopes to water body. Note that vegetative cover does not refer to vegetation above knee-height. The presence of taller vegetation, such as trees or leafy shrubs, will not necessarily affect runoff. Flows in this condition tend to be sheet, rather than channel, flows.

Bare Channel:

Native soil is exposed at point of erosion to the water body. 'Bare' can also describe a bedrock surface that has been exposed by erosion and will allow for rapid, unimpeded transport of road material from road or ditch surfaces.

Slopes with low-lying vegetation will have the greatest opportunity to filter our sediment. Bare slopes or channels will provide no filtration and may themselves begin to erode over time.

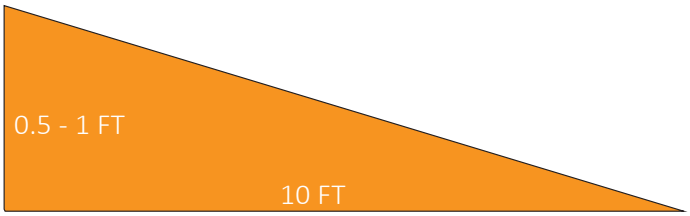
Road Slope: Average slope of the road segment containing the erosion point or area. It may help to use a hand-held clinometer to measure this, though the categories are designed to be relatively easy to quantify in the field without measurement.

Low (<5% average):

Road is relatively flat. 0-5% slope represents 0 - 0.5 feet of rise for every 10 feet of run. Low gradient roads don't allow runoff to build up enough velocity to cause erosion problems either on the road surface or in ditches, under normal conditions.

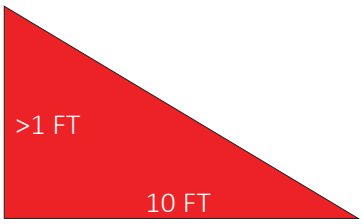
Medium (5-10% average):

The road is fairly steep. These roads have greater than 0.5 to 1 foot of rise for every 10 feet of run. Roads with this slope will have the potential for more erosion and sediment transport and, if left unmanaged, will create severe erosion problems over time.



High (>10% average):

Roads with these slopes are extremely steep with greater than 1 foot of rise for every 10 feet of run. Most roads are typically not built at this slope but where they do exist, they have the potential to create severe erosion problems.

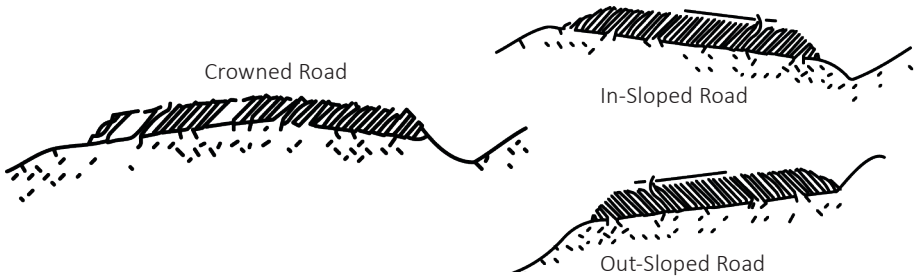


Average road slope indicates the potential for future erosion problems, or the potential to keep increasing the severity of existing problems.

Road Shape: How well the road surface will shed water through adequate crowning (or sloping). Good cross-section slope is ½" to ¾" of drop per foot of width.

Good:

Needs no grading work for proper runoff patterns, including crowning, in-slope, and out-slope. Proper road shape is often indicated by lack of washboarding, potholes, or other features indicating that runoff remains pooled on the road surface.



Moderate:

Needs grading to reestablish proper runoff patterns – small wheel ruts or grader berm traps runoff on road. The road is often flat with little to no crown, in-, or out-slope to shed water. Grader berms, formed when the road surface is lower than the road edge, trap runoff and form 'secondary ditches' that run along the road surface, allowing runoff to build up speed and cause greater erosion problems than they otherwise would. The road may also be slightly sunken relative to the surrounding area.

Poor:

Road is almost flat with no crown or sloping to shed runoff off the road surface. The road surface has erosion channels where runoff flows during rain events, Other evidence of pooling runoff, such as potholes and washboards, are prevalent. The road is likely sunken relative to the surrounding land surfaces.

Road cross sections should be designed to shed runoff, whether crowned, in-, or out-sloped depending on the travel lane. If the road surface is flattened, runoff will pool and run down the surface, causing erosion.

Road Surface Material: The approximate composition of material used to build the travel surface of the road.

Processed Ledge or Clean Bank Material:

Material is densely packed and non-erodible under normal conditions (typical rain storms). Typically this is a material derived from crushed ledge or bank material that has been sifted to eliminate larger (>1") material. Materials in this category include SurePack, Stay-Mat, or plant mix. Processed ledge may appear blue-ish in color as it is often derived from blue slate ledge. Typically ledge product will have no material >3/4".

Unprocessed Bank Gravel:

Road surface is made of unprocessed bank material. Though it will be free of silt and overburden, there will be material >1" in the mix. There are many variations of this type of material. It will have a wide variety of particle sizes and will likely be more erodible than a hard-packed processed ledge or clean bank material. Road sub-base may also be mixed in. Native soil may also be present.

Wikipedia Commons

Unsuitable:

Material is composed largely of native soil found locally on-site. No processed aggregate is mixed in at all. Road sub-base is also likely to be pure native soil – erosion is highly likely under typical precipitation conditions. Road shape will also be adversely affected as soil won't hold graded shape for long.

Road surface material can greatly influence the amount of sediment transported from the road and ditch to the water body. At times simply re-surfacing a road can eliminate sediment transport to adjacent water bodies.

Road Bank Stability: Stability of bank on back slope (uphill) side of road considering ground cover. Road banks often have ditches at the toe of their slope but not always - road banks often terminate on the road. Careful - road bank stability and ditch stability are not the same.

Not Applicable:

No slope above road, therefore no uphill bank is present.

Stable:

Minimal to no erosion due to generally good ground cover (>75% vegetated or rip-rapped). Bedrock can also be considered to be stable.

Fair:

Minor erosion is expected regularly due to good-to-moderate ground cover (~50% vegetated or rip-rapped). Banks may have some bare soil, but soil loss is moderate overall.

Poor:

Obvious bank erosion is present due to poor ground cover (<50% vegetated or rip-rapped). Ditch maintenance may be contributing to the poor stability through continual cutting of the toe of the slope.

Road bank erosion is from the bank cut into the hillside for the road. Don't confuse this with ditch stability. Ditch stability assessments look at erosion occurring in the ditch, not above it on the road bank.

Ditch Shape: Geometric shape of the ditch running alongside the road. Please note that ditch shape can be obscured by material that has eroded into it. Only choose 'Full' when the ditch is ***completely*** full. Otherwise attempt to ascertain the original ditch shape as best you can.

U-shaped:

Ditch has a wide, relatively flat bottom with gently sloped (<30%) sidewalls. This shape allows for runoff to spread out, dissipating energy and speed and promoting infiltration. The sidewalls of the ditch are unlikely to erode as they are gently sloped.

Box-shaped:

Ditch is box shaped, allowing for some flow dispersal on ditch bottom. However, sidewalls can often be vertical, or nearly vertical, and will contribute to erosion via sidewall slumping. This shape is better than a V-shaped ditch but is still not ideal.

V-shaped:

Ditch is V-shaped and has steep ditch side slopes. The ditch bottom is incised or has potential to incise. This is not a great shape for ditches – runoff has no opportunity to spread out into sheet-like flow and dissipate energy. It will remain concentrated and has the potential to create severe incisions in the ditch, moving material towards the nearest water body.

Full:

Road or road bank sediment (or a combination) has eroded and completely filled the ditch with material. Original ditch shape is obscured, or is being obscured. Ditch filling will reduce surface available for filtration, infiltration, and runoff velocity reduction. The ditch will deliver more runoff volume and sediment load to the receiving water body.

Properly shaped ditches can greatly reduce erosion problems by allowing runoff to slow down and infiltrate back into groundwater before reaching water bodies.

Ditch Stability: Evidence of material within ditches moving towards water bodies. Ditch stability (or instability) is usually linked to proper road shaping and drainage.

Stable:

Ditches are stable, or no ditches are present as all runoff dissipates as sheet flow off the side of the road. There is no erosion and the ditch bottom appears stable. There is little to no evidence that material under 1" is moving toward water bodies. Often vegetation or firmly embedded stone is present, indicating that underlying soil is stable.

Fair:

Minor erosion is present in the ditch with obvious evidence of silt/sand/larger particles moving toward water bodies. Debris racks (branches, etc) will be present in many instances. Some incision or scour is occurring in the ditch bottom. There may also be head-cuts present. Eroding ditch material may not be making it all the way to the water body, but it is likely that it will do so in the near future under normal rain conditions.

Poor:

Erosion is present and worsening with increasing evidence of movement of larger particles (at times greater than 2"). There is obvious evidence of ongoing incision or scour and potentially numerous head-cuts. Material from the ditch is clearly reaching the water body in large quantities. Stabilization is clearly needed.

Ditch stability isn't often a problem in and of itself – it's typically a symptom of other runoff issues. However the material transported in the ditch to the water body is a water quality issue and should be noted.

Please keep in mind that this manual relies on the experience of the individual assessor. It is intended to be the best-available method to assess a wide range of problems in many different locations. While every effort has been made to collect the most relevant information possible using this methodology, it is always possible that there are other factors not addressed.

Methods:

Road Erosion Inventory - Method Overview

There are two ways to conduct this inventory - digital or paper-based. Please see the instructions below for the method that you will use.

Using the Road Erosion Risk Inventory Software Application

The Vermont Agency of Natural Resources Information Technology Department has created a smartphone- or tablet-based application for use in the collection of data pertaining to water quality related road erosion. This is preferred method of collecting information for this inventory as it will synchronize automatically with the State's Natural Resource's Atlas, eliminating the need to enter data collected in the field into the database using a web browser on a desktop computer.

Specific instructions on using the app can be found at the following website:

http://www.watershedmanagement.vt.gov/erp.htm

Using the Road Erosion Risk Inventory Paper Form

Print out the PDF form from the website listed above - you will need ***at least*** as many forms as you have road segments to assess in your town. As it is possible to have multiple road erosion points or areas that may need assessment per Road Erosion Risk Assessment segment, you may need more forms than just the number of segments you plan on visiting. Use the VT DEC's Road Erosion Risk map for your town to determine how many you need. It is a one page form - please try to print double-sided.

Obtain maps showing the road erosion risk analysis segments for your town(s) from the Better Backroads Program. While in the field, make sure to manually place points on the map as close to the actual location of the erosion as you can. You will need this later to enter data into the State erosion inventory database. For segments with no water quality erosion issues - place a point as near as you can to the center of the Road Erosion Risk Assessment segment. Use this point to later update the database. You will not have to fill out a form for these non water quality road erosion risk segments - you can simple indicate that there is no water quality road erosion issue present. This way you can save on printing forms.

For each water quality erosion point or area to be evaluated, please fill out the form using pen as legibly as possible.

Once all segments have been assessed, please go to the following website - http://www.watershedmanagement.vt.gov/erp.htm. Using the map interface, manually place erosion points as close as you can to the points you placed on the paper maps. A dialog box will pop up - fill out the criteria and choices based on the data you collected in the field. Once you're done, the database is automatically updated.

Scoring:

Scoring is embedded in the database held online - there is no need to select point amounts as these will be automatically populated in the final database. The scoring uses a scale of up to 100 points with factor applied based on the Road or Ditch Material in Water Body criteria, which can increase the numeric score by 10%, 20%, or 30% based on the severity of the road or ditch material transport to the water body. No factor is applied for the 'None' designation. **If site meets the criteria for a 'None' designation, a Detailed Assessment should not be performed.**

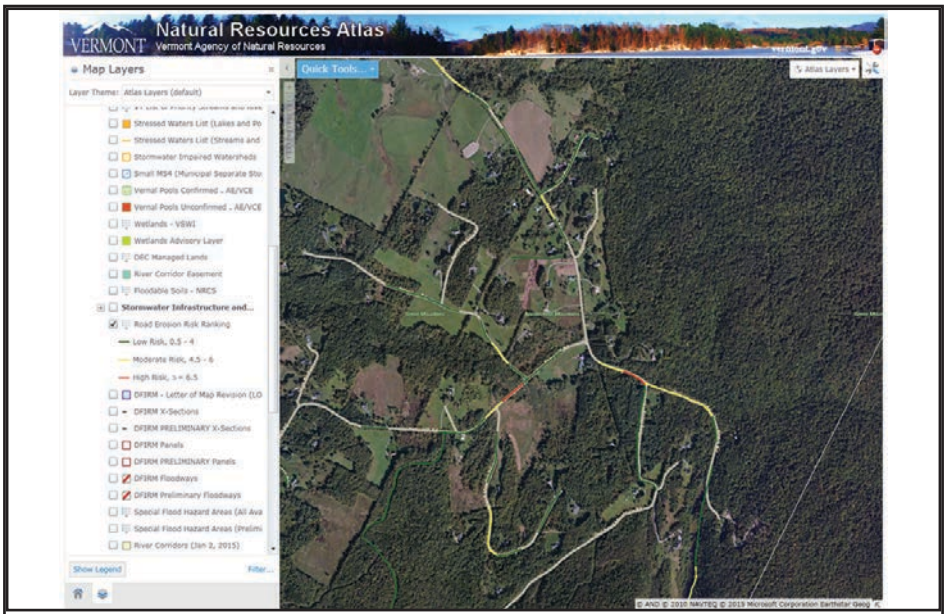
Note that the Water Quality Risk Assessment Criteria have higher point values than the Road Characteristics Criteria *(shown next to each criteria choice in parenthesis)*. This is because the Water Quality Risk Assessment Criteria describe the capacity of the buffer at any given erosion site to mitigate potential water quality erosion issues. For example, if there is severe erosion occurring on the road, but that erosion and the material it transports, is being adequately filtered out by the buffer, the site should be less important than other sites which lack adequate buffers.

Workflow:

This Road Erosion Inventory (REI) is meant to be performed on Vermont's Class 3 and Class 4 dirt roads.

There are four basic steps:

1) Consult Road Erosion Risk Analysis segments
2) Perform Windshield Survey
3) Perform Detailed Assessment
4) Prioritize Assessed Sites and Perform Solution Selection and Cost Estimation for Solutions.



The Vermont Agency of Natural Resources Atlas has the RERA segments. You can access it at www.anrmaps.vermont.gov/websites/anra.

The first part of this inventory process was the creation of the Road Erosion Risk Analysis (RERA) model. This computer-based model predicted the likelihood of erosion from Class 3 and 4 roads into mapped water bodies using factors like slope, erodibility of soil, and proximity to water body as the primary risk factors. The results were grouped into Low, Medium, and High risk segments. Please note that for the purposes of the model, all roads were broken into 100 meter segments. This was to make it easier to analyze all the model factors. These segments are arbitrary. They do not reflect natural topographic breaks, nor do they represent different drainage areas.

It is possible that there will be multiple erosion points or areas within a single segment that affect water quality that have distinct drainage areas and conveyances from the road area to the waterbody. Please evaluate these separately if the drainage areas are truly separate.

For this inventory, you will first consult the RERA segments for your chosen town or area. This will guide you to segments that may have water quality erosion issues. You should also consult with town officials or road crews to determine perennial road erosion issues that may affect water quality. These should also be assessed. They may fall within RERA segments or may not be in the RERA model results, but if it is a known issue, it should be inspected.

Once you have determined where you should look within your area, travel to the sites and conduct the Windshield Survey. This is meant to quickly determine if there are water quality erosion issues on-site. Please see the detailed steps for the Windshield Assessment below.

If there is a water quality road erosion issue - proceed directly to the Detailed Assessment, using all the criteria laid out in this manual to evaluate the site.

The Windshield Assessment and Detailed Assessment are meant to be performed concurrently - that is, the Detailed

Assessment immediately follows the conclusion of the Windshield Assessment while on-site. There is no need to conduct an initial, separate Windshield Assessment, then go back to perform a Detailed Assessment. They can be performed at the same time.

Windshield Assessment:

1. Travel to the ranked erosion risk site (following the State's Road Erosion Risk Assessment (RERA) GIS layer). Please also consult with local officials or road foremen to determine if there are other perennial issues that should be inventoried.
2. Log the Segment ID Code for the RERA segment.
3. Conduct the Windshield Assessment –
    - 3.1 Is there erosion at the mapped site – Yes or No?
    - 3.2 If Yes – Is it a Water Quality Erosion Issue – Yes or No?
        - a. To determine the answer, locate nearest downstream water body and answer the question – **Could runoff from the erosion site reach the water body during a typical storm event?** A typical storm event for this assessment is any storm capable of producing runoff - but not storms that will produce significant flooding, etc.
        - **b. If YES - it IS a Water Quality Erosion Issue.**
        - **c. If NO - it IS NOT a Water Quality Erosion Issue.**
4. If it IS a Water Quality Erosion Issue, proceed immediately to the Detailed Assessment while on-site. When using the app - stand near the erosion point or area to log a GPS point that will later be used to integrate your assessment with the State's database. If using the paper form - please mark on a map of sufficient resolution the location of the erosion point or area on the road segment. If it is a linear area, please only mark the point where the erosion leaves the roadway/ road shoulder towards the water body. You will enter this point into the State's database later using the Web-based map interface.
5. If it IS NOT a Water Quality Erosion Issue, enter 'No' and proceed to next segment. If using the app - please stand in the approximate middle of the segment and enter 'No'. If using the paper form - please mark your point in the approximate middle of the segment. This is important as it will allow an accurate update of the database for future assessments.

Detailed Assessment:

If you have determined that a Detailed Assessment is necessary, proceed by recording the following information:

Town and Road Name: | Segment ID Code: | Date/Time Assessed:

Notes Section: Please use this section to record basic measurements of any erosion features (length of ditch eroded, length/width of road surface erosion, etc), as well as the presence of seeps or blocked culverts.

Erosion Location:

Road erosion can be located in several distinct spots on a road. Use the diagram on page 12 when evaluating erosion location. You can mark multiple locations for each distinct erosion point or area.

Erosion Type:

There are several types of road erosion illustrated on page 13. It is important to distinguish between them, as this will help assist in capital budget planning for repair. Erosion types include rill, incision, scour, and slump. It is possible that multiple types will occur for any erosion point or area. Mark all that apply. (Scores shown in parenthesis)

Water Quality Risk Assessment Criteria:

1. **Road or Ditch Material in Water Body**: The opportunity for, or presence of, road-based material in the water body.
    a. None (X0.0) - no road/ditch material in water body, site is buffered, no connection possible. **This site should not be evaluated using the Detailed Assessment as there is no water quality risk**.
    b. Slight (X1.1) - some road or ditch material tracking near edge of water body, connection possible or likely.
    c. Moderate (X1.2) - ditches or other channels drain to water body, obvious tracking near water body, some road-based material visible in water body.
    d. Severe (X1.3) - large channel or multiple channels drain to water body, significant tracking near water body, evidence of significant amount of road-based material in water body.
2. **Runoff Volume:** The volume of water from runoff to and through the erosion point or area - this measurement is directly related to the size of the drainage area contributing to the erosion.
    a. Low (8) - erosion point is in the top 30% of the road's drainage area. This contributing area will generate the smallest volume of runoff water.
    b. Medium (15) - erosion point is in the middle 30% of the road's drainage area. This contributing area will generate a moderate volume of runoff water.
    c. High (25) - erosion point is in the lowest 30% of the road's drainage area. This contributing area will generate the largest volume of runoff water.
3. **Slope to Water Body**: Average slope from erosion point or area to the water body - not the road slope.
    a. Low (8) - 0-10% slope average from road to water body below point of erosion.
    b. Medium (15) - 10-30% slope average from road to water body below point of erosion.
    c. High (25)- >30% slope average from road to water body below point of erosion.
4. **Ground Cover of Slope to Water Body**: Covering of native soil material - either vegetation or stone.
    a. >50% Vegetated (8) - native soil is >50% covered in knee-high or lower vegetation from erosion to water body.
    b. <50% Vegetated (15) - native soil is <50% covered in knee-high or lower vegetation from erosion to water body.
    c. Bare Channel (25) - native soil or bedrock is exposed at point of erosion to water body.

Road Characteristics Criteria:

5. **Road Slope**: Average slope of the road surface uphill of the erosion point's drainage area.
    a. Low (1) - <5% - (0 - 6" rise per 10' run).
    b. Medium (2) - 5-10% - (> 6" - 1' rise per 10' run).
    c. High (4) - <10% - (> 1' rise per 10' run).
6. **Road Shape**: How well the road surface will shed water through adequate crowning.
    a. Good (1) - needs no grading work for proper runoff, including crowning, in-slope, and out-slope.
    b. Moderate (2) - needs grading to reestablish proper runoff patterns – small wheel ruts or grader berms trap water on road.
    c. Poor (4) - no specific cross-section, flat, or sunken – road is rutted and showing signs of water retention on surface (potholes, washboard, etc).
7. **Road Surface Material**:
    a. Processed ledge or clean bank material (1)- material is densely packed and non-erodible under normal conditions (typical rain storms) - no stones over 1".
    b. Unprocessed Bank Gravel (2) - clean gravel free from silt and overburden - stones over 1" present. Some erosion is expected during typical rain storms.
    c. Unsuitable (4) - material is native soil material drawn from the area surrounding the road. This material is usually very erodible during typical rain storms.
8. **Road Bank Stability**: Stability of bank on uphill (back slope) side of road (above the ditch if applicable). When this slope slumps into the ditch, this material can easily be transported to downstream water bodies.
    a. N/A (0) - no bank present.
    b. Stable (1) - no to minimal erosion potential, vegetative or rip-rap ground cover >70%.
    c. Fair (2) - minor erosion potential, vegetative or rip-rap ground cover 50-70%.
    d. Poor (4) - bank erosion present, vegetative or rip-rap ground cover is minimal (<50%) or non-existent.
9. **Ditch Shape**: Average shape (or condition) of the ditches alongside the road way.
    a. N/A (0) - no ditch(es) present.
    b. U (1)- ditch has wide, relatively flat bottom with gently sloped (<30%) sidewalls.
    c. Box (2) - ditch is box shaped, some flow dispersal on ditch bottom, nearly vertical sidewalls.
    d. V (3)- ditch is V shaped, has steep ditch slopes, bottom is incised or has potential to incise.
    e. Full (4) - ditch is completely full of eroded material. Ditch shape is irrelevant due to deposition of material.
10. **Ditch Stability**: Stability of material in the ditch. Note that erosion occurring on the slope above the ditch should be assessed under road bank stability.
    a. N/A (0) - no ditch(es) present.
    b. Stable (1) - Adequate or no ditches, no/minimal erosion, ditch bottom stable, vegetation present.
    c. Fair (2) - Minor erosion present in ditch, some evident of silt/sand/larger particles movement, some incision occurring.
    d. Poor (4) - Erosion present and worsening, evidence of movement of larger particles, evidence of ongoing incision.