

Great Lakes Better Backroads Guidebook

Clean Water by Design



September 2007, 3rd Edition
Prepared by:

Huron Pines

501 Norway Street
Grayling, MI 49738
www.huronpines.org

Conserving the Forests, Lakes and Streams of Northeast Michigan

Good design and maintenance
will save \$\$\$
by decreasing road problems
and untimely repairs.

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Steering Committee for the 3rd Edition:

Amy Beyer, Conservation Resource Alliance, Traverse City, MI
Duke Domke, Michigan Department of Environmental Quality, Land & Water Management Division, Gaylord, MI
Howard Haselschwardt, Northwest Design Group, Petoskey, MI
Steve Holden, Michigan Department of Environmental Quality - Water Bureau, Lansing, MI
Tyler Kitchel, Michigan Department of Environmental Quality - Water Bureau, Lansing, MI
Steve Largent, Grand Traverse Conservation District, Traverse City, MI
Keith Noble, Michigan Department of Environmental Quality - Water Bureau, Lansing, MI
Daniel Pearson, Michigan Department of Natural Resources, Natural Rivers Program, Gaylord, MI
Heather Rawlings, U.S. Fish & Wildlife Service, Alpena, MI
Lee Sherwood, Michigan Department of Transportation, Alpena, MI
Dan Sikarskie, Huron Pines, Grayling, MI
Jeff Silagy, Michigan Department of Environmental Quality - Land & Water Management Division, Cadillac, MI
Tom Torongo, Michigan Department of Environmental Quality - Water Bureau, Lansing, MI
Todd Zielinski, USDA Natural Resources Conservation Service, Grayling, MI

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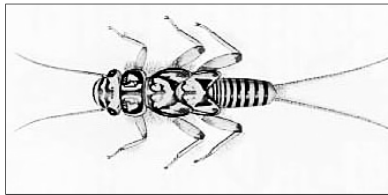
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1.0 INTRODUCTION

**Insects that are indicators of excellent water quality
and provide nutrition for stream trout**

Stonefly Nymphs
Common Stonefly Nymph
Order Plecoptera, Family Perlidae



- Measures 8-15 mm in length (not including tails)
- 2 tails
- 2 sets of wing pads
- Branched gills between legs on underside of body
- Yellow to brown in color; often patterned yellow and brown when mature
- Superficially similar to certain flattened mayfly nymphs, however, stonefly nymphs always have two tails, prominent antennae, and two claws at the end of each leg.
- Stoneflies are not tolerant of low levels of dissolved oxygen and therefore prefer cold, swift-moving streams. The streamlined, flattened bodies of stonefly nymphs enable them to move about the rocky streambed in rapid currents.

Great Lakes Trivia Test (answers on back):

- 1) Name the five Great Lakes.
- 2) What popular song immortalized the sinking of a Great Lakes ship?
- 3) Name the eight U.S. states that border the Great Lakes.
- 4) Name the two Canadian provinces that border the Great Lakes.
- 5) Name the two major shipping ports on the Great Lakes that begin with the letter "D."

GUIDING PRINCIPLES

1. **Plan projects. (All projects should be planned!)**
2. Move water off road surfaces as soon as possible.
3. Direct runoff into vegetated filter areas or rock-lined turnouts.
4. Address road runoff from the top of both approaches.
5. Avoid directing runoff into surface waters.
6. Stabilize bare areas.
7. Keep runoff velocities low and avoid concentrating runoff.
8. Minimize areas of disturbance.
9. Revegetate disturbed areas ASAP.
10. Maintain and monitor all practices.

Answers:

- 1) Erie, Huron, Michigan, Ontario, and Superior
- 2) "The Wreck of the Edmund Fitzgerald"
- 3) Michigan, Wisconsin, Minnesota, Illinois, Indiana, Ohio, Pennsylvania, and New York
- 4) Ontario and Quebec
- 5) Detroit and Duluth

1.0 INTRODUCTION

1.1 Purpose

The overall purpose of this program is to improve the water quality in the Great Lakes region by providing cost effective techniques and hands-on instructions for the design and maintenance of non-paved backroads. County road managers and crews, private road maintenance and construction companies, lake associations, and the general citizenry can all effectively use this manual.

Properly constructed and maintained road/stream crossings and roadways will lead to long-term savings by decreasing the amount of repairs and replacements that will be required “down the road.” At the same time, properly constructed road/stream crossings and roadways will control erosion and reduce sediment and road contaminant pollution entering into our waters.

1.2 Need

Soil erosion occurs when soil particles are carried away from the road surface, road bank, ditch, or road base by water, wind, ice, or gravity. Exposed soil, rapid water velocity, and sand and silt soils all increase the potential for soil erosion. Other pollutants such as oils, greases, and salts can also be washed from roads. These sediments and pollutants are then carried away into nearby streams, ponds, and wetlands. Graveled roads, by nature of their topography and design, can, if not properly managed, contribute heavily to this significant water pollution problem.

1.3 Effects of Increased Sediments

Small quantities of sediment generated at a road/stream crossing increase overall sedimentation downstream by shallowing and widening the channel, thereby increasing streambank erosion. The increased streambank erosion contributes more sediment, causing a domino effect at a geometric rate.

Sediments impact surface water ecosystems by

- Smothering spawning, rearing, and feeding habitat.
- Disturbing the reproductive cycle of many water organisms.
- Disrupting the food chain.
- Adding excess nutrients.
- Warming the water.

Large quantities of sediments and other pollutants can

- Destroy small bottom-dwelling stream animals which provide food for fish.
- Destroy fish habitats (fish eggs need a clean, gravel/cobble/boulder stream bottom for incubation).
- Irritate the gills of fish making them more prone to disease.
- Increase the frequency of flooding by filling river channels.
- Drastically change water quality.
- Diminish recreational uses.
- Destroy the aesthetic value of a stream.

1.4 Site Planning

Planning is the most important step in beginning a road maintenance or construction project. It is essential because

- Good planning saves money in the long run.
- Planning ensures improved protection of water quality.
- Planning allows a holistic look at a project. Every factor (including water quality) is carefully considered.
- Basic road siting concepts can avoid environmentally sensitive areas where possible.

The reader must understand that this guidebook needs to be considered in its entirety. Although made up of ten separate chapters dealing with different practices, a holistic viewpoint must be taken so that not only the structure is considered, but all the Best Management Practices involved in the process are considered in order to maintain and protect clean water. This can only be assured through good planning. Planning must start with an attempt to integrate all the Best Management Practices found within the guidebook into each project.

The following serves as a step-by-step example of holistic project planning for any road construction procedure:

Step 1. What You Need to Know

- a) Whether the structure needs replacement or renovation
- b) If the site is a source of pollution or concern
- c) Specific sources or causes of concern (i.e. gullies)
- d) Watershed hydrology and site hydrology
- e) Stability, texture, and limitations of soil
- f) Relevant slopes
- g) Users of waterbody and roadway
- h) Interest level of project stakeholders/landowners
- i) Whether project is consistent with watershed goals
- j) What permits are needed

Step 2. Plan Development

- a) List the necessary Best Management Practices (BMP's)
- b) Estimate a budget for each BMP and for the system
- c) Schedule the implementation
- d) Identify the funding sources
- e) Prepare a conceptual drawing of the site
- f) Take pre-construction photographs
- g) Seek a maintenance agreement (unless it is provided by the manager)
- h) Make application for necessary permits

Step 3. Detailed Plan

- a) Water quality practices must be in the plan
- b) Specifications for all BMP's must be listed
- c) Detailed drawings showing elevation and natural features
- d) Engineered drawings (if needed)
- e) Basis of designs (including calculations)
- f) Maintenance plan (if not provided by manager)
- g) Schedule of implementation
- h) Final costs
- i) Who covers each specific cost

At the beginning of each chapter of the guidebook we have listed our Ten Guiding Principles and have **bolded** those that apply to that chapter. These Guiding Principles are essential to planning a successful project and should be considered when reading each chapter.

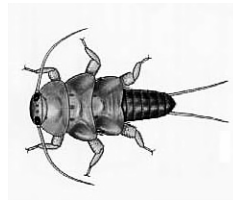
2.0 ROAD SURFACE

**Insects that are indicators of excellent water quality
and provide nutrition for stream trout**

Stonefly Nymphs

Roach-like Stonefly Nymph

Order Plecoptera, Family Peltoperlidae



- Measures 8-15 mm in length not including tails)
- 2 tails
- 2 sets of wing pads
- Flattened and roachlike in appearance
- Brown in color
- Superficially similar to certain flattened mayfly nymphs, however, stonefly nymphs always have two tails, prominent antennae, and two claws at the end of each leg.
- Roach-like stonefly nymphs consume living and decaying plant material and are often found among leafpacks in mountain streams.

Great Lakes Trivia Test (answers on back):

- 1) What is the largest bay on the Great Lakes and what Lake is it in?
- 2) How many gallons of Great Lakes water are used every day for irrigation, public water supplies, industrial and electric power plant uses?
- 3) What is the name of the largest freshwater island in the world and where is it located?
- 4) What is the only island national park in the United States?
- 5) What is the largest island city park in the United States?

GUIDING PRINCIPLES

1. Plan projects. (All projects should be planned!)
2. **Move water off road surfaces as soon as possible.**
3. Direct runoff into vegetated filter areas or rock-lined turnouts.
4. Address road runoff from the top of both approaches.
5. Avoid directing runoff into surface waters.
6. Stabilize bare areas.
7. Keep runoff velocities low and avoid concentrating runoff.
8. Minimize areas of disturbance.
9. Revegetate disturbed areas ASAP.
10. Maintain and monitor all practices.

Answers:

- 1) Georgian Bay in Lake Huron (Canadian waters)
- 2) 1 trillion gallons (about 2.5 billion gallons consumed and not returned)
- 3) Manitoulin Island (in Lake Huron)
- 4) Isle Royale (in Lake Superior)
- 5) Belle Isle (in the Detroit River)

2.0 ROAD SURFACE

2.1 Description

Backroads are unpaved or graveled roads. The top layer of these roads is shaped, compacted and smoothed so that surface water will move quickly from the road surface to established ditches.

Some backroads are maintained year-round and some are seasonal forest roads. Seasonal roads are usually regarded as much less traveled than year-round roads, yet because of tourism in the Upper Great Lakes region, year-round traffic can be considerable. Because many of these year-round and seasonal roads cross small feeder streams and other environmentally sensitive areas, it is important that road/stream crossings are designed to protect water quality.

2.2 Importance to Maintenance & Water Quality

Failure to direct surface water from the road surface to a drainage channel can result in deterioration of the road surface, safety problems (ice), and assorted erosion problems. Immediate removal of runoff from the road surface will prevent erosion and road surface deterioration. This will lessen the frequency and cost of maintenance, thereby lengthening the life of the road surface. It will also decrease the amount of sediment carried into our waters.

2.3 Surface Profile & Grading

Proper crowning and compacting of the road surface quickens the removal of runoff, thereby protecting the road surface from erosion.

- Grade roads in the spring as soon as the frost leaves the ground, or as soon as possible after a rain while the surface materials are still moist but not wet.
- Do not grade if rain is in the forecast (after rain is best).
- The amount of road surface disturbed should be limited to that which can be stabilized by the end of the work day.

Proper equipment for surface maintenance includes: grader (shaping and restoring), rake (smoothing before compaction), steel wheel roller (compaction), and slope board (slope confirmation) if time and equipment is available to road managers.

- Crown roads 1/2 to 3/4 inch for each foot of road width, measured from the center of the roadway to the outside edge to ensure good drainage.
- Slope roads with over-the-bank drainage problems entirely toward the ditched side of the road.

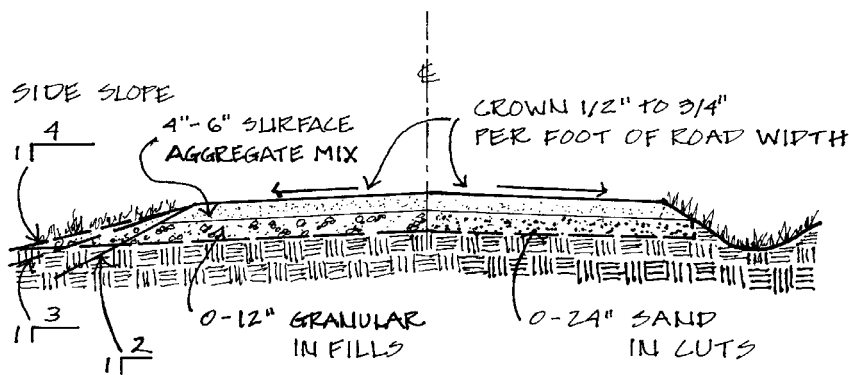


Figure 1—ROAD CROWN & PROFILE

2.3.1 Blading/Dragging

Blading/dragging is a smoothing operation that pulls loose material from the sides of the road or spreads windrowed aggregate to fill surface irregularities and restore the road crown.

- Perform blading/dragging with the moldboard tilted forward with light down pressure on the grader blade. Adjust the angle of the moldboard to between 30 and 45 degrees. In most cases, tilt the front wheels slightly 10 to 15 degrees toward the direction the aggregate should roll.
- Avoid blading during dry periods to minimize the loss of fine aggregates.

2.3.2 Grading

Grading cuts through the road surface crust and is used when reshaping or correcting major surface defects is necessary.

- Perform grading operation with the moldboard tilted backward and with sufficient down pressure on the blade to produce a cutting action. Outer edge of the moldboard should be at the edge of the road surface.
- Keep a minimum of one foot from the ditch line so that vegetation or rock stabilization is not disturbed.
- Modify grading practices near bridge approaches by lifting the blade to prevent furrowing (commonly referred to as "country curbs") and to avoid blockage of turnout drainage.
- Place reflectorized stakes before bridge approaches or prior to surface waters to warn drivers to modify grading operations in these sensitive areas.

2.3.3 Gravel-surfaced Road

To shed water properly, gravel-surfaced roads should have a tight, impervious surface.

- Construct the surface layer with well-graded soils and crushed rock.
- An aggregate mix recommended by your state or local road agency would be uniformly graded from coarse to fine; approximate sizes for surface composition are: silts and clays (<0.074mm), sand (0.074 - 2.0mm), and aggregate (>2.0mm).
- Add approximately 2 to 3 inches of new material to correct any faults.
- Scarifying the existing surface blends the soils and improves compaction.
- Add new material by running a truck down the center of the roadway and dumping; blend the old material with the new using a grader, followed by compaction using a steel wheel roller if feasible.
- Regravel road surface every 4 to 5 years with 2 –3 inches of new gravel, if possible.

2.4 Distress Conditions - Surface Deteriorations

Common types of surface deteriorations include:

2.4.1 Dust

Dust in the air is the loss of fine, binder aggregates (silts and clays) from road surfaces and leads to other types of road distress.

- Sprinkling road surface with water is a very short-term solution.
- Can be minimized by applying calcium chloride which draws moisture from the air to improve fine aggregate cohesion; most effective if applied before roads become too dry and dusty and after any grading actions.
- Liquid calcium chloride is typically applied at a rate of 0.3 gallons per 5 square yards in the spring followed by 0.2 gallons per 5 square yards in the summer; dry calcium chloride is typically applied at 1.2 pounds per square yard in the spring and 0.8 pounds per square yard in the summer.
- NOTE: Calcium chloride should not be used adjacent to surface waters since its long term, extensive use can cause water quality problems. It should not be used within 100 feet of surface waters. Other non-calcium chloride products are now available for dust control.

2.4.2 Raveling

Raveling is the loss of coarse aggregate.

- Correct by grading or blading with the addition of a binder to improve surface composition.

2.4.3 Slipperiness

Surface containing excessive amounts of fine aggregates or soil can cause slippery road surface during wet weather.

- To correct, add coarse aggregate by grading, blading, and compacting.

2.5 Distress Conditions - Surface Deformations

Surface deformation problems are reduced with proper road surface drainage and include:

2.5.1 Rutting

Ruts are longitudinal depressions in the wheel paths cause by high moisture content in the subsurface soil, inadequate surface source thickness, and/or heavy traffic loads.

- Grade, add suitable material, and roll road surface to correct ruts if practical.
- Adding stone is a temporary solution and is not recommended; draining the ruts and filling them with roadbed material is preferred.
- For severe ruts, a layers of geotextile material may be required under at least six inches of crushed gravel.

2.5.2 Corrugations/Washboard

A series of ridges and depressions across the road surface caused by lack of surface cohesion and excessive vehicle speeds.

- Blading is not recommended, since this technique along will not solve the problem.
- Improve the cohesive qualities of the road surface by remixing with good fine percentage, scarify the road surface while damp, regrade, re-crown, and roll the surface if practical.

2.5.3 Depressions

Depressions are localized low areas one or more inches below the surrounding road surface caused by settlement, excessive moisture content, and improper drainage.

- Correct depressions by filling with well graded aggregate, grading, and compacting.

2.5.4 Potholes

Potholes are caused by excessive moisture content, poor drainage, and poorly graded aggregates.

- Repairs involve spot grading or patching with crushed aggregate.

2.5.5 Soft Spots

Soft spots are caused by lack of proper drainage.

- To correct, replace soft spot area with a suitable material such as well-graded stone or gravel.

2.6 Disposal of Excess Materials

Improper disposal of excess material can increase the amount of sediment that enters streams and damages sensitive areas, particularly wetlands. Some guidelines are:

- Excess materials should not be disposed of in: wetlands, drainage ditches and swales, streambanks, areas within 100 feet of (and drain into) a waterway, and slopes that are steeper than 2:1 (refers to 2 foot horizontal distance for a 1 foot change in vertical elevation).
- Ensure the area down slope of the disposal area has an adequate vegetated filter strip to trap sediments.
- Seed or vegetate any fill areas as soon as possible.
- Plan possible disposal areas ahead of time, giving the opportunity to utilize excess materials if possible.

2.7 Surface Treatment

By their nature, backroads are typically gravel. If approach slopes are excessive, or if ditches are not installed, the road surface should be treated by hardening. Hardening, coupled with water conveyance BMP's, will greatly reduce the potential for erosion. Surface hardening also minimizes maintenance and greatly reduces the potential for maintenance-related problems. The following are some general guidelines, in order of preference:

- Use a bituminous mixture as specified by your state or local road agency. Apply asphalt on the entire road surface and include rolled curbing and paved turnouts.
- Applications of seal-coat (tar and chip) are suitable in certain conditions; however, this treatment usually requires sufficient traffic to remain pliable without deteriorating and it requires periodic maintenance.
- A top course of high quality stabilized gravel, 100% crushed with a high binder content (such as crushed limestone gravel with fines), is suitable if funding for hard surfacing is not available. Once the material is sufficiently compacted, maintenance should be limited to periodic gentle grading. Avoid grading practices that develop 'country curbs', which render water conveyance structures nonfunctional.

NOTE: For all treatments, crown road to promote drainage to shoulders and into conveyance structures.