



Understanding Barrier Effects and Crossing Designs

BUCKSHOT VERSUS THE SILVER BULLET, A REGULATORY PERSPECTIVE: UTILIZING LOW COST WILDLIFE FRIENDLY DESIGNS EVERYWHERE VS. CONSTRUCTING A FEW EXPENSIVE CROSSINGS

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ABSTRACT

The Minnesota Department of Transportation (MnDOT) and the Minnesota Department of Natural Resources (DNR) has been working within agreements set forth in an interagency Memorandum of Understanding (MOU) for each department to provide thorough knowledge of the other's programs and projects in order to evaluate possible impacts and identify opportunities for collaboration. This has resulted in an increase in environmental compliance, increased consistency, and reduced delay of project timelines. One unforeseen product of these agreements has been the development of a 'Best Practices' guidance manual for meeting state environmental regulations. This manual is an incentive based guidance document and is being utilized as a comprehensive communication tool and implementation guide for the designer, construction manager, and contractor.

www.dnr.state.mn.us/waters/watermgmt_section/pwpermits/gp_2004_0001_manual.html

This manual has typical procedures and examples of how to address various issues relating to natural resource regulations. While much of these 'Best Practices' provide guidance on meeting permit provisions, other portions offer illustrations of recommended construction practices and also provide typical designs that can mitigate construction impacts to ecological resources in the project area. These include simple engineered design modifications to allow for riparian continuity at roads, as well as curb and storm drain design to reduce animal mortality on curbed roads, selection of native vegetation for roadsides, invasive species control, and hydrologic improvements. Many are now typical designs that are being applied to the road infrastructure in non-regulatory situations, substantiating that this manual has a set of design combinations and incentives that benefit the interests of both transportation and environmental agencies.

BACKGROUND

The Commissioners of the Minnesota Department of Transportation (MnDOT) and Department of Natural Resources (DNR) originally signed a Memorandum of Understanding (MOU) between the two agencies in 1971. Since then, the MOU has been updated several times, most recently in 1999. A major purpose of the MOU is for each department to be provided thorough knowledge of the other's programs and projects in order to evaluate possible impacts and/or opportunities for collaboration. The MOU and its current usage direct the two agencies to look for streamlining opportunities while at the same time assuring that there is a value added process as well as consistency of regulatory applications across the state in dealing with issues affecting the two agencies. In 2001, a pilot 'Transportation Team' project was funded by MnDOT. The DNR Team consisted of a Planner, an Ecologist, and a Hydrologist. This team conducted environmental reviews and permit reviews for MnDOT's projects statewide. It also began an effort to provide incentives for 'what can be done' rather than the conventional 'what can't be done' regarding regulatory constraints. This pilot project ended in 2003. However, a single position of 'DNR Transportation Hydrologist' position continues to this day through an Inter-Agency Agreement. The position is an agency liaison position and acts on the behalf of many DNR programs for all MnDOT Transportation projects.

One of the most important aspects of the Transportation Hydrologist position is the freedom to act independently and make accountable decisions within the framework of departmental policy and legislative mandates. The freedom to act is necessary to enable the Transportation Hydrologist to solve complicated and controversial issues, negotiate effective

compromises, enforce regulatory mandates, develop creative and innovative solutions, and serve the public as a representative of the DNR in an efficient and effective manner. The Transportation Hydrologist has been delegated the regulatory authority to issue most public waters and appropriation permits pertaining to MnDOT transportation projects. This position has the authority to communicate directly with stakeholders and negotiate resolutions to problems, certify regulatory compliance, develop grant opportunities, set priorities, and coach resource management activities meeting DNR objectives. Because of the sensitivity associated with water resource issues, decisions and actions by the Transportation Hydrologist has resulted in statewide significance. An important tool has been the continued incentive based integration of ecological concerns with transportation needs that began with the 'Transportation Team'. This tool is the manual 'Best Practices for Meeting DNR General Public Waters Permit GP2004-0001'.

THE BEST PRACTICES MANUAL

The manual 'Best Practices for Meeting DNR General Public Waters Work Permit GP2004-0001 (MnDOT Projects with Bridges, Culverts, or Outfalls)' has been developed to be utilized as a guide to address DNR regulations and rules for protection of water resources for fisheries, wildlife, ecological systems, rare features, and recreational opportunity. It is an open document that is continuing to evolve. It also recognizes that other technical references, standards, and regulations may apply. However the manual is referred to during the evaluation, design, and construction phases of transportation projects.

The manual was originally developed for meeting specific provisions of the Minnesota Department of Natural Resources (DNR) General Public Waters Work Permit (GP) 2004-0001. This general permit has been issued to MnDOT for the repair or reconstruction of culverts, bridges, or stormwater outfalls impacting Public Waters. Its current use is much broader than originally intended. County and local road authorities now also look to this manual for guidance to meet the state environmental regulations. The latest version of the manual includes a growing number of best practices to protect not just the ecology of Public Waters, but also many terrestrial ecological concerns that DNR oversees. Some Best Practices in the manual are for guidance in design, others illustrate recommended construction practices. The manual is only available electronically and thus information can easily be copied and inserted directly into project documents and construction plans. The information in this manual is not to be considered the only method for which a project may be designed and constructed. However its ease of use is an incentive to apply it into a project in order to meet DNR regulatory requirements.

The manual's focus is on state regulatory requirements of the DNR Public Waters Permit process. Public Waters are designated as the lakes, wetlands, and watercourses over which DNR has regulatory jurisdiction. It is recognized that the manual does not contain enough information to release the user from requirements of any rules, regulations, requirements, or standards of any applicable federal or state agencies; including, but not limited to the, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, other MN Department of Natural Resources programs, Board of Water and Soil Resources, Minnesota Wetland Conservation Act, MN Pollution Control Agency, or Watershed Districts. However during its development there have been efforts to integrate many requirements of other agencies, such as the Minnesota Pollution Control Agency's General Permit for Authorization to Discharge Stormwater Associated with Construction Activity (MN R100001) and the DNR Temporary Appropriations for Construction Dewatering General Permit (GP 97-0005). With agency collaboration on the practices in this manual, the likelihood of them meeting other agency requirements is very high. This adds incentive for its use, and a comfort level for the project manager with tight project timelines.

The manual is organized into four chapters. It is to be utilized as a comprehensive communication tool and implementation guide for the designer, construction manager, and on-site contractor. Pages show needed steps, checklists, procedures, or examples of how to address various issues and to meet regulations. It is considered as a sample plan for DNR constraints near a watercourse, lake, wetland or rare feature. During early inter-agency coordination of a project, as identified in MnDOT's Highway Project Development Process (<http://www.dot.state.mn.us/planning/hpdp/scoping.html>), DNR will identify which best practices should be incorporated into project documents for guidance to meet DNR regulations. The entire document is not expected to be incorporated into every project. In fact, each Best Practice is written to be utilized as a stand-alone document. With early project communication between MnDOT and DNR, appropriate Best Practices are identified as being applicable to a specific project.

- **Chapter 1 (Species Protection)** provides information about protection of game fish, other aquatic or terrestrial species and sensitive native vegetation. There is also guidance to prevent the spread of invasive species. This chapter also contains many options for ecological enhancements and/or protection to include in final design or construction methods. Much of this guidance is required under permit conditions, and if not, can qualify for mitigation measures for a projects impact to resources in the area.

- **Chapter 2 (Hydraulic and Hydrologic Recommendations)** contains several detail illustrations, notes and guidance of Best Practice options for Hydraulic and Hydrologic design of structures impacting Public Waters. Additional information is also provided to improve or repair stream stability and local habitat.
- **Chapter 3 (Methods of In-stream Construction)** offers illustrations, notes, and guidance on best practices for in-water construction work. These methods have been pre-approved by the DNR for use in the field; however, not all methods are appropriate for all work sites. Due to the variability of concerns from one work site to another site the DNR Hydrologist will have to approve a method prior to construction. For this reason project designers, construction engineers, project managers, or contractors work in consultation with the DNR for selection and approval of the appropriate method of in-water construction. It should be pointed out that the DNR will authorize a projects final design prior to a project going to bid, with the details for construction to be approved at a later date (after the contract is awarded).
- **Chapter 4 (Examples of Worksite Sediment and Erosion Control)** focuses on photos and examples of best practices for erosion and sediment control in or adjacent to Public Waters. Most erosion and sediment control requirements have been developed by the MPCA; however, these field examples show proven methods to meet them.
- **Appendix (Contacts, Permits, and miscellaneous documents)** contains copies of contact lists, permits, and typical specifications related to material in the manual.

THE 'BUCKSHOT' APPROACH

The first two chapters of the manual contain thirteen (13) Best Practices that provide guidance on available methods for protecting or enhancing ecological and water resources. Very few of these are expensive, and in fact some add no cost to a project at all. Many of these practices have not been quantitatively studied for their true environmental effectiveness. However, collectively they do show evidence of success.

- Chapter 1: Species Protection
 - Work Exclusion Dates to Allow for Fish Spawning and Migration
 - Spawning and Migration Behavior of various fishes
 - Best Practices for prevention of Spread of Invasive Species
 - Protective Measures for Areas of Environmental Sensitivity
 - Information Transplanting Wildflowers and other Plants
 - Selecting a Seed Mix
 - Passage Bench Design
 - Environmental factors of Curb Design
 - Looming issue with Loose Net Plastic Mesh in Erosion Control Products
 - Birds and Bridges
 - Reducing Wildlife – Vehicle Collisions
 - Compost Grouting (Riprap Seeding)
- Chapter 2: Hydraulic and Hydrologic Recommendations
 - Fish Passage and Notes on Culvert Design Criteria

In Minnesota our topography is relatively flat and does not have terrestrial migration corridors that would lend themselves to large wildlife crossing structures. For example, the state's population of white tail deer tends to be everywhere and is able to go anywhere. Identifying a suitable location for a large structure to accommodate deer movement under or over a road location would be difficult if not impossible. Yet we do have three major ecosystems (prairie, northern coniferous forest, and hardwood forest), all of which support differing fish and wildlife species that may be compromised by road systems. With Minnesota's abundance of lakes, rivers, streams and wetlands, we have focused on the riparian corridor and have developed a 'buckshot' approach utilizing multiple low cost designs in order to maintain or restore ecological integrity. Project designers benefit from having this set of typical design specifications by being able to incorporate these low cost measures into road design early in the process for either mitigation purposes or regulatory requirements of environmental agencies. The ease at which these pre-approved practices are available is an added incentive for their use. Many are now typical designs that are being applied to the road infrastructure in non-regulatory situations, substantiating that this manual has a set of design combinations that benefit the interests of both

transportation and environmental agencies. While many practices are small, and often low cost, such a combination is leading to practices being applied many times over a large geographical area. We feel this approach will result in a significant improvement in reducing a road networks impact on natural resources of the state.

Examples

Many designs have been developed with several benefits in order to appeal to multiple interests. The following are just a few.

The Passage Bench

This bench is an alternative design in the riprap under a bridge that mimics a game trail. A one meter (3 foot) wide bench or trail is incorporated into the specified riprap, and then gravel is added to fill voids in the riprap bench. This bench is carried through the riprap and is tied to the natural groundlines outside the bridge. A biologist considers this bench as a 'critter crossing'. A bridge inspector considers it a feature to ease bridge inspection (same with the bridge maintenance crew). A hydrologist can utilize the design to adjust normal channel flow and flood flow characteristics, similar to that of a notched weir. Road safety engineers consider it a beneficial design since animals are not forced up and over the road at the bridge approach panels. Finally, it costs very little, which appeals to those overseeing the budget. With these multiple benefits, the design has received support due to its broader applications and has gone from an experimental practice to a standard design in just a few years.

Curb Design

Ecological factors of curb design are also a noted Best Practice. Traditional curb and gutter can and does inadvertently direct small mammals and reptiles into the storm sewer. Small animals trying to leave the road can be blocked by the steepness and height of the curb and they will travel parallel to it until they find an exit. The storm sewer is the exit they literally fall into, often with fatal consequences. Our remedy does not require a custom design. By pointing out just two typical designs options that already exist as a MnDOT standard design, such as an angled curb or a drop structure design without the side box inlet, roads can provide animals a better chance of moving past the storm sewer to seek a safe way off the road. To the ecologist this allows small animals to leave the road surface at any point. Yet to the road designer, it still provides for an approved method for the collection of stormwater. It's an easier task to request a road designer to utilize an appropriate curb design that already exists, than it is to request a custom design. Coincidentally, these two designs are increasingly being utilized due to reduced installation and maintenance costs. Thus there is a dual incentive for this practice.

Wildlife Fencing

The question of how to reduce the likelihood of Wildlife Vehicle Collisions (WVC) is regularly brought to our attention. However we do not have a definitive set of designs for reducing WVC along our roadways. The current Best Practice is to utilize 'typical' or 'standard' fencing designs in Minnesota. For small animals, chain-link fence installed tight to the ground is recommended. This is one of MnDOT's 'standard' or 'typical' right of way fence designs. For seasonal fencing to protect reptiles and amphibians, standard erosion control fence may be utilized to hinder movement into construction sites, onto roads, or for redirection to safer crossings (nearby culverts or bridges). For deer, a high woven wire or chain link fence is being utilized. There is also a growing trend to utilize vegetation as a deterrent instead of fence (EG for goose control). Typical right of way fence designs were reviewed in order to determine to best option available. These are now recommended over custom designs in order to reduce costs, yet still reduce vehicle animal collisions.

Culvert Design

For decades Minnesota has required culverts to allow for fish passage. Traditionally, culvert design was based on hydrologic and hydraulic models that predict peak runoff from a watershed, with the culvert sized accordingly to pass a specified design storm. The DNR typically required that culvert velocities not exceed two feet per second for a two year event. However, these constraints were not always accomplished with this method. Several alternative design methods have been developed that focus on matching the natural characteristics, and consider sediment transport and fish passage requirements. Currently a variety of design techniques are increasingly being implemented in Minnesota. Minnesota is working towards a stream simulation approach as a standard design requirement; however, those efforts are still in progress. We do not yet have a standard method for design. One design that does have multiple benefits for terrestrial animals is the use of the offset culvert. One culvert is placed at an elevation to carry normal flows, and the other one is set at an invert that would be dry in normal flow conditions. This dry culvert allows for animal use in all

times except flood flow conditions. Thus this design allows for both hydraulic conveyance and animal use, at little or no extra cost over traditional double barrel installations.

Invasive Species

In order to prevent the spread of invasive species into and within the state, all equipment intended for use at a project site must be free of all 'aquatic plants' and 'prohibited invasive species' prior to being transported into or within the state. Best practices have been developed that are specific to construction equipment. This sheet is provided to all contractors working a project where invasive species have been identified.

Native Vegetation

Roadside re-vegetation is also an area that has seen changes lately. To date, the majority of native grasses and forbs being required are for wetland mitigation or for scenic benefits. Native seed mixes appropriate for roadsides are receiving renewed attention. There are several benefits, as native vegetation, if well managed, can help prevent weed infestations by providing a more competitive vegetation type, they can be used to increase road safety by catching snow to reduce drifting and blowing snow problems. Native grasses and forbs also have deeper root systems and can provide a more durable long-term erosion control solution than non-native grasses such as smooth brome. Some evidence suggests that diverse native plantings provide better stormwater infiltration than less diverse and non-native vegetation. These multiple incentives and secondary benefits can reduce opposition to their use.

CONCLUSION

In Minnesota you do not have to travel far before there is a need to cross some type of water feature. Many of the conventional water crossings are impediments to animal and fish movement. In the past, hydrology was the primary design criteria for these installations. Agencies such as MnDOT, DNR, and USFWS, along with various academic groups, have formed partnerships in order to better understand the complex ecological interactions of our road system, develop designs and practices to mitigate adverse impacts, and to develop incentives for incorporating them into transportation planning and construction. The Best Practices that were developed have been incorporated into a single manual: '[Best Practices for Meeting DNR General Public Waters Work Permit GP2004-0001 \(MnDOT Projects with Bridges, Culverts, or Outfalls\)](#)'. This manual that provides multiple design options in or near water that provide for ecological protection or improvement. These designs tend to be low cost methods to accommodate animal or fish passage, and ecological protection. These practices have been created to be integrated in multiple situations and are not site specific. Incentives for their incorporation into projects includes, low cost, confidence in a road design that will meet regulatory approval and have no delay in regulatory review and permitting, and multiple stakeholder benefits. With these incentives, multiple practices are being installed in many locations on a project and around the state. With this set of Best Practices being applied everywhere, we believe we are providing better ecological connectivity than focusing on just a few locations with site specific design. Cooperative efforts also continue to present opportunities for new designs and alternative practices.

BIOGRAPHICAL SKETCHES

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