MINNESOTA DEPARTMENT OF TRANSPORTATION
Engineering Services Division
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To: Electronic Distribution Recipients

From: Jon M. Chiglo, P.E.
Division Director, Engineering Services

Subject: Storm Water Infiltration System location guidelines for MnDOT ROW

Expiration
This is a new Technical Memorandum and will remain in effect until July 9, 2019 unless superseded prior to that date.

Implementation
The guidance in this memorandum shall be effective immediately for projects in the design phase.

Introduction
Changes to the storm water runoff requirements for the NPDES Construction General Permit will likely cause an increase in the number of storm water infiltration practices designed on MnDOT right-of-way. While the permit requirements provide options, MnDOT will need to further clarify acceptable options for use in order to protect our environment, preserve our infrastructure, and provide safe storm water Best Management Practices (BMPs).

Purpose
This memorandum will provide guidance to designers where to locate infiltration BMP's within the right-of –way. This will also provide direction to areas considered infeasible within the right-of- way that impact the roadway, bridge, or retaining wall structure, and structural foundations.

Guidelines

Bridge Foundations, Structural Walls, and Reinforced Soil Slopes (RSS)
Bridge foundations and structural walls are not designed to accommodate the additional groundwater flow that could result from stormwater infiltration. To protect investment in this infrastructure and for the safety of the traveling public, the recommended placement and design criteria for infiltration BMPs are as follows:

- Do not infiltrate into structural backfill associated with a wall or structural elements including the reinforced zone behind a Mechanically Stabilized Earth (MSE) wall or the structural backfill behind a cantilever wall.
- Do not increase subsurface flows toward structures.
- Do not increase hydrostatic pressure behind a wall, RSS, or foundation.
- Do not locate infiltration BMPs adjacent to a wall, RSS, or foundation.
- Infiltrate only into native soils capable of infiltration or engineered materials designed to facilitate infiltration.

See MnDOT Geotechnical Manual, Appendix H for additional background information and minimum distances of separation graphic. The link to this manual is:
http://www.dot.state.mn.us/materials/geotmanual.html.

Pavement Sections
Saturated soils under the pavement reduce the structural life of the pavement. Pavement design includes practices to draw water away from the pavement structure which includes the base, sub-

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base and subgrade. Infiltration BMPs designed and built incorrectly will cause accelerated pavement structure deterioration.

Interstate and Trunk Highway systems (including associated ramps and frontage roads) are typically high volume, high speed roadways where accelerated deterioration is not acceptable. Infiltration BMPs locations need to be outside the pavement structure of the roadway. These locations are as follows:

- Rural cross-sections: Outside a 1:2 (vertical to horizontal) slope from the shoulder PI to top of the groundwater table and below the base & sub-base.
- Urban cross-sections: Outside the back of curb a distance of 12 feet to the top of the ground water table and below the pavement base & sub-base.

See *Attachment A* of this document for pavement section background information and figures.

Environmental Considerations
The following locations identify where infiltration is prohibited due to site conditions or where infiltration of stormwater could have negative environmental consequences. These are identified in the MPCA 2013 NPDES Construction Stormwater General Permit. Stormwater infiltration is not allowed at the following locations:

- Locations that receive discharge from vehicle fueling and maintenance, for example the portion of truck stations where fueling or chemical storage or handling occurs.
- Locations with less than three (3) feet of separation distance from the bottom of a proposed infiltration system to the elevation of the seasonally saturated soils or the top of bedrock.
- Locations with contaminated soil and/or groundwater.
- Locations of predominately Hydrologic Soil Group D (clay) soils.
- Locations within 1,000 feet up-gradient, or 100 feet down-gradient of karst terrain.
- Locations within a Drinking Water Supply Management Area (DWSMA) where the vulnerability is high or very high. Areas with a vulnerability level of moderate, low, or very low must be discussed with the city/township first to receive approval. Document whether approval is received or denied and design accordingly.
- Locations where soil infiltration rates are more than 8.3 inches per hour and cannot be designed and modified to be less than 8.3 inches per hour.

Maintenance and General Design Considerations

Many infiltration sites require regular maintenance to function properly. Locations should be selected that are accessible. Only use infiltration BMPs where the following design criteria can be met or mitigated.

- Design to accommodate maintenance activities including safe access and mowing.
- Select infiltration BMP's that will not interfere with the snow and ice control needed to protect the safety of the traveling public.
- Provide a maintenance plan, including a section on how to identify and fix infiltration BMPs that are not operating as designed.
- Verify that sufficient operations resources are available to maintain operation of stormwater infiltration BMP.
- Provide pretreatment before discharging into an infiltration BMP.

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- Design site to accommodate flows greater than the water quality volume and the design discharge.
- Locate Infiltration BMPs that create a road hazard outside the clear zone.
- Locate 200 feet or more from a private water supply well.
- Locate 100 feet or more from a septic system.
- Locate 100 feet or more from buildings or building foundations.
- Design to protect infiltration areas from sediment and compaction during construction.

Questions
Any questions regarding the technical provisions of this Technical Memorandum can be addressed to either of the following:

- **Brett Troyer,** Office of Environmental Stewardship, at **(651) 366-3629**
- **Andrea Hendrickson,** State Hydraulics Engineer, at **(651) 366-4466**

Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards Unit, DesignStandards.DOT@state.mn.us. A link to all active and historical Technical Memoranda can be found at http://techmemos.dot.state.mn.us/techmemo.aspx.

To add, remove, or change your name on the Technical Memoranda mailing list, please visit the web page http://techmemos.dot.state.mn.us/subscribe.aspx

Attachments:
Attachment A: Guidelines for Storm-Water Infiltration Location with Regard to Pavement Sections

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Guidelines for Storm-Water Infiltration Location with Regard to Pavement Sections

Introduction

Changes to storm-water runoff standards will likely cause an increase in the design of storm-water infiltration on MnDOT projects. The Pavement Design Unit has been requested to give guidance on acceptable locations for storm-water infiltration that will not negatively affect the life of the pavement.

Effect of Water on Pavement Design

The effect of water on pavements is a major concern of pavement design and maintenance. Water has a detrimental effect on both Hot Mixed Asphalt (HMA) and Portland Cement Concrete (PCC) pavements and the subsurface structure. It reduces the strength of base and subgrade causing pavement to crack, further deterioration of pavement cracks and joints, and it is necessary for frost heave to occur.

Pavement crack and joint deterioration is a major cause of HMA and PCC pavement distress and roughness. Cracks and joints are routinely sealed to prevent water from entering them and into the rest of the pavement structure. New pavements are built on aggregate bases to prevent water from being drawn-up from below the HMA or PCC pavement. Research (Report No. MN/RC 2010-18) has shown that PCC joints perform best when sealed and built on drainable bases. In the past, it was allowable to construct HMA pavements directly on the subgrade, but due to poor performance HMA pavements are now always built on aggregate. To improve drainage, edge drains are often installed to drain the base and subgrade.

The reduction of the strength of the base and subgrade from water is the reason roads in Minnesota have a spring load restriction. Melting snow and ice saturates the pavements subsurface and is trapped by frost that has not yet thawed. This results in reduced strength and an increase in pavement distresses. Many roads have the maximum allowable load restricted during this period to reduce distress unless the roadway was built thicker to handle normal maximum loads.

MnPAVE

MnPAVE is the program that MnDOT uses to design HMA pavements and can be used to model the effects of a saturated pavement section. A typical MnPAVE pavement design uses a reduced strength for the base and subgrade during the spring thaw period to model the temporary saturated condition. Permanently saturated base and subgrade may be modeled by applying reduced strengths to the base and subgrade for the rest of the year. In the attached example, a typical HMA pavement design has a fatigue life of 25 years; but with the base and subgrade modeled as saturated in the spring, summer, and fall (winter is assumed to be frozen) the fatigue life was only 8 years.

Differential frost heave is another cause of pavement distress and roughness. Frost heave is caused by frost lenses forming in the pavement subsurface during freezing temperatures. The requirements for frost heave to occur are freezing temperatures and a source of water. Freezing temperatures can't be prevented and the pavement structure and subgrade will freeze to a certain depth, depending on winter temperatures, but water can be drained out and be prevented from entering the pavement section by using granular materials. To minimize differential frost heaving, it is MnDOT's policy to require a minimum of a 30" or 36" thick pavement section (depending on traffic). This thickness is based on ½ the expected frost depth as recommended by the Army Corps of Engineers (Engineering Manual No. 1110-3-138). The pavement section thickness includes any HMA or PCC pavement and the layers of granular material under it. The intention is that the granular material will provide support when the granular is in a saturated condition, allow water to escape from the pavement structure, and prevent water from being drawn up from the subgrade through capillary action. Additionally, the- 12" below the granular material is typically prepared by being blended; any silt is removed and then re-compacted. In total, the depth of the pavement section that is designed to resist frost is typically 42" to 48".

In some circumstances, the pavement structure may be even deeper than the required minimum depth due to substandard subgrade materials. This may require replacement of the substandard material or building a thicker pavement section. Substandard subgrade may have unacceptably high organic content, low strength, or a high moisture content. This substandard roadway material will make compaction difficult for layers above it, prevent moisture to escape the base layers, and contribute to frost heave. Drains are often used in these areas.

Guidelines for Location of Infiltration with Regard to Pavement Sections

On state highways, no water should be introduced into any area that may be a source of water for the base, sub-base, or existing soil above the groundwater table. In rural cross-sections, this area extends from PI to PI and downward and outward at 1 to 2 (Vertical to Horizontal) slopes (**see Figure 1**) to the top of the groundwater table. For urban cross-sections, the width of this area is 12' beyond the back-side of the curb to the depth of the base and sub-base, and from the back of the curb down to the top of the groundwater table (**see Figure 2**). Infiltration may be allowed within 1' of the back of the curb if an impermeable barrier is used to protect the base, sub-base, and subgrade (**see Figure 2**).

Non-highway pavements, such as sidewalks, driveways, parking lots, utility roads, and some low-speed low-volume city streets may be designed with infiltration under their structure. A minimum of 6" of aggregate material should be placed under the pavement and above any infiltration. This would act to drain the pavement material and keep moisture from being introduced to the pavement from below. It would not act to reduce frost heaving and would have a minimal effect on loss of pavement section strength from saturation.

The previous guidelines only address concerns related to the pavement section. There may be additional considerations related to slope stability, maintenance, and other factors that are not within the scope of this document.

Figure 1-Rural Roadway Section

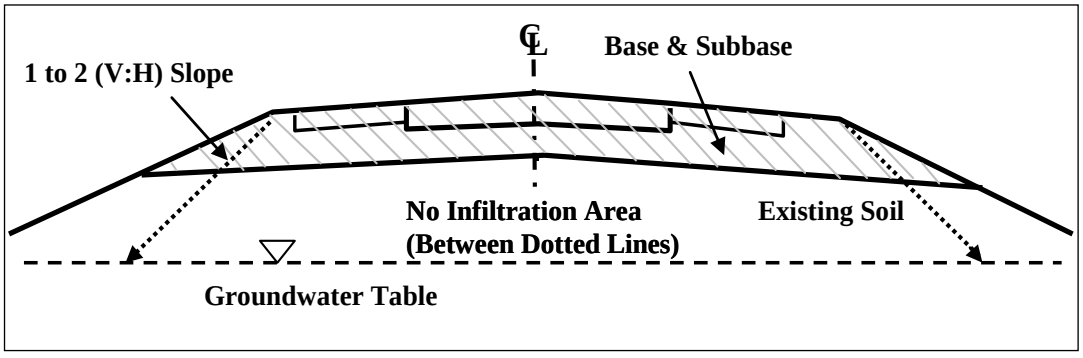

Figure 2-Urban Roadway Section