Washington State Department of Transportation

Memorandum

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SUBJECT: **Project Delivery Memo** #02-03-Interim Infiltration Design Guidance

Purpose and Direction

This memo represents the best available science and current guidance for infiltration design. This memorandum has been prepared following discussion with the Highway Runoff Manual Technical Committee and the Stormwater Rapid Response Team.

Stormwater regulations are evolving, especially now with the Department of Ecology's (DOE) Western Washington Stormwater Management Manual release, August 2001. This memo is to bring WSDOT into conformance with the changes to the testing and design procedures for infiltration. The objective of this memo is to provide interim guidance since the Draft version of the 1995 Highway Runoff Manual (HRM) does not adequately reflect or address these issues. The goal is to include all this information in the re-write of the HRM.

The infiltration design guidance in the 1995 Highway Runoff Manual for water quantity standards is not applicable with the infiltration rate assessment procedure provided in the DOE Western Washington Stormwater Management Manual release. The DOE manual procedure provides a correlation between the $\mathbf{D_{10}}$ size of the soils below the infiltration facility, as determined from a soil gradation test, and the infiltration rate, as shown in Table 1, which can be used to estimate the infiltration rate.

Table 1 -- Recommended Infiltration Rates based on ASTM Gradation Testing.

D_{10} Size from ASTM D422 Soil Gradation Test (mm)	Estimated Long-Term (Design) Infiltration Rate (in./hr)
≥ 0.4	9
0.3	6.5
0.2	3.5
0.1	2.0
0.05	0.8

Figure 1 provides a plot of this relationship between the infiltration rate and the $\mathbf{D_{10}}$ of the soil, showing the empirical data upon which it is based. The figure provides an upper and lower bound range for this relationship based on that empirical data. These upper and lower bound ranges can be used to adjust the design infiltration rate to account for site-specific issues and conditions. The long-term rates provided in Table 1 represent average conditions regarding site variability, the degree of long-term maintenance and pretreatment for Total Suspended Solid control. The long-term infiltration rates in Table 1 may need to be decreased (i.e., toward the lower bound in Figure 1) if the site is highly variable, if the ground water table is shallow, there is fine layering present that would not be captured by the soil gradation testing, or if maintenance and influent characteristics are not well controlled. If, however, influent control is good (e.g., water entering the pond is pretreated through a biofiltration swale, pre-sedimentation pond, etc.), a good long-term maintenance plan will be implemented, then an infiltration rate toward the upper bound in the figure could be used. The data that forms the basis for Table 1 was from soils that would be classified as sands or sandy gravels. No data was available for finer soils at the time the table was developed. However, additional data based on recent research (Massmann, 2002) for these finer soils is now available and is shown in Figure 1.

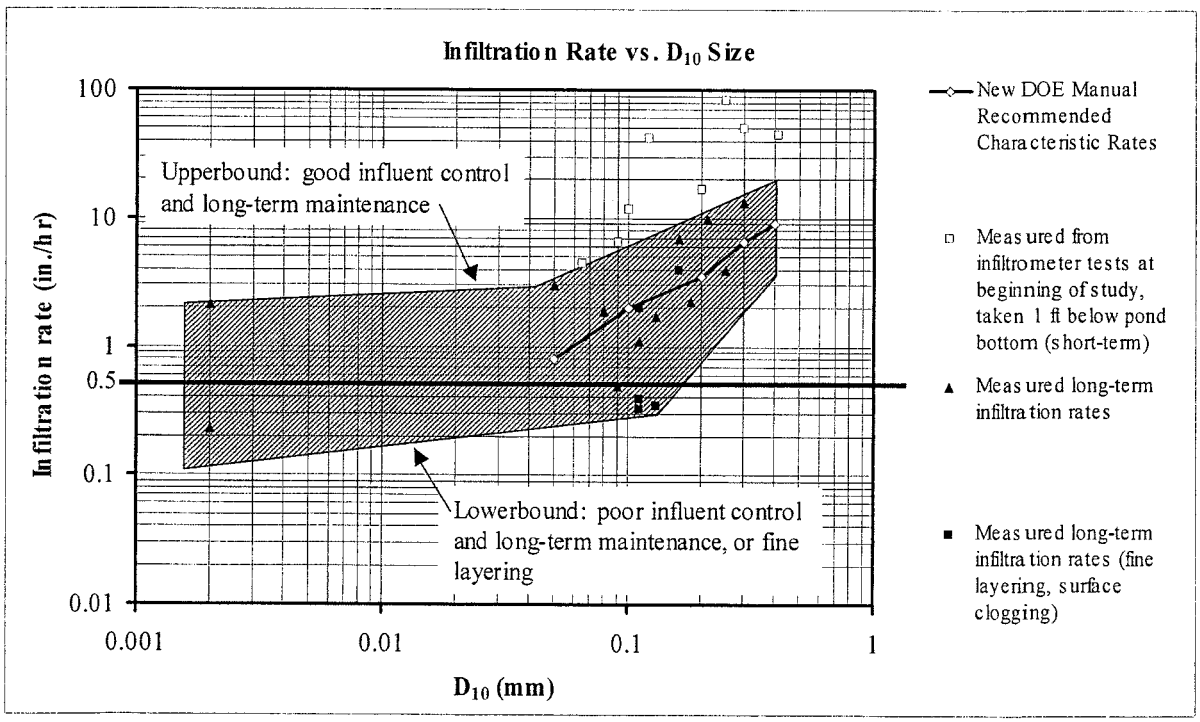

Figure 1

The infiltration rates provided in Figure 1 represent rates for homogeneous soil conditions. Thus, coordination will be required between the Material Lab and the Project Office to determine project infiltration rate.

The rates shown in Table 1 and Figure 1 are long-term design rates. No additional reduction factor or factor of safety is needed.

The minimum infiltration rate to consider infiltration to be the primary function of the facility is 0.5 inches/hr. Infiltration can still be taken into account if the infiltration rate is lower, but it should be considered to be a secondary design parameter for the facility.

In the mean time, it's important to provide the correct infiltration design guidance that correlates with the new infiltration assessment procedures and not eliminate infiltration on projects.

If the infiltration rate does not appear to represent the conditions, a full-scale field test can be performed at the site to measure the infiltration rate. The Pilot Infiltration Test (PIT) described in Appendix V-B of the DOE Stormwater manual for Western Washington, or a flood test in an existing facility such as a ditch, can be used. Small-scale infiltration tests such as the EPA Falling Head or double ring infiltrometer test (ASTM D3385-88) are not recommended. The small-scale infiltration tests tend to seriously overestimate infiltration rates, partly due to scale effects, and partly due to the fact that they do not take into account longer-term effects, which tend to reduce the infiltration rate, and, based on recent experience, are considered unreliable.

The design process would then be as follows:

1. Once a candidate infiltration site is identified, contact the Region Materials laboratory to request that a geotechnical investigation be performed. It is important at this point that information regarding how the influent into the infiltration facility is proposed to be handled be available, as well as how the facility is proposed to be maintained.
2. The Region Materials Laboratory, with assistance from the HQ Geotechnical Branch as needed, will determine the number and depth of borings/test pits required, and any ground water monitoring needed, to characterize the site for infiltration and overall facility design purposes. They will be using the DOE manual recommendations as a guideline, adjusting the investigation program as needed to deal with the site specific conditions.
3. Once soil samples have been obtained and tested, the depth to the water table adequately defined, and the site subsurface characterized, the Region Materials Laboratory will provide an estimated long-term design infiltration rate, considering the issues described above in relation to Figure 1.
4. If it appears that a full scale field test for infiltration will be of benefit, the project office and the materials laboratory (including the HQ Geotechnical Branch as needed) need to coordinate to develop the details of the test, what is to be monitored, and to interpret the data to determine the design infiltration rate.
5. Once the design infiltration rate has been established, the project design office can proceed with the completion of the infiltration facility design.

If you have any questions or concerns, please communicate them to Rocio Peralta in Headquarters Hydraulics or Tony Allen in Headquarters Material Lab.

Action Requested

Project Development

Effective January 1, 2003 the infiltration design guidance should be used by all designers.

Contract Ad and Award

It is not anticipated that any action will be needed for projects currently being advertised for bids.

Construction

It is not anticipated that the implementation of this guidance will effect construction activities.

DN:hp
KJD/HJP
Attachment

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