Washtenaw County Water Resources Commissioner

Rules and Guidelines

Procedures & Design Criteria
For Stormwater Management Systems

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Notice on Project Approvals:

Approvals and permits issued by our office are valid for a period of one year. Approvals/permits may be extended at the office's discretion for an additional period of one year if requested prior to the expiration date. A maximum of two extensions are permitted per project unless otherwise mitigating circumstances can be demonstrated.

Projects that have not received approvals or permits will be considered inactive if there has not been submittal activity for a period of one year. If a project is inactive, the review process must start over using the current edition of the rules.

All active projects that have not received approvals or permits as of October 17, 2016 may be subject to the current edition of the rules.

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Section I: Introduction

This edition

of the Rules of the Washtenaw County Water Resources Commissioner continues a stormwater management philosophy that considers stream channel protection and stormwater quality management in addition to flood control.

These revisions promote using stormwater as a resource, on-site, where possible, with strategies designed to better mimic the natural hydrology of an undeveloped site by promoting infiltration.

The following discussion outlines basic ideas and principles of stormwater management, and provides a conceptual foundation for the design standards contained in this document.

Significant information for these Rules was taken from the SEMCOG Low Impact Development Manual for Michigan. Best Management Practice (BMP) design requirements, calculations and related figures are integrated throughout the document.

Impacts of Development on Water Quantity

The hydrology of a watershed changes immediately in response to site clearing and alterations to the natural landscape. A site's stormwater storage capacity is lost as vegetation is removed, natural depressions are graded, topsoil is removed, and wetlands are eliminated. If the soil is compacted and resurfaced with impervious materials, rainfall can no longer penetrate into the ground and so runs off of the land, often eroding soil and carrying pollutants that are harmful to waterways. These changes, along with the installation of drainage facilities, such as catch basins and pipes, greatly alter natural drainage patterns. Hydrological impacts will eventually cause changes in the physical condition of receiving waterways.

Changes in Watershed Hydrologic Cycle

- Volume of runoff increases. This raises the magnitude and frequency of severe flood events. In many areas of the county, existing flooding has already reached unacceptable levels requiring no increase in the volume of discharge.
- Frequency of bankfull floods increases. Bankfull floods fill the stream channel to the top of its banks, but do not spill over into the floodplain. Increased bankfull flooding subjects the stream channel to additional disturbance and unnatural aggradation and degradation.
- Flow velocities increase. This is due to the combined effect of increased runoff volume, reduced time of concentration, and smoother hydraulic surfaces.
- Stream flow fluctuations increase dramatically. Runoff rates and volumes are increased, concentrated and stop abruptly at the end of rainfall, leading to wide fluctuations in stream flow. Increased flow fluctuations disrupt habitats and reduce the diversity of aquatic species regardless of water quality.
- Infiltration into the underlying groundwater is reduced. This in turn lowers the level of surface waters that are dependent on groundwater to maintain base flows.

Changes in Stream Morphology

- Channel widening and downcutting are the primary consequences of increased runoff and flow fluctuations.
- Streambank erosion is accelerated as channels are disturbed by undercutting, tree-falls and bank slumping.
- Sediment loads increase due to streambank erosion and construction site runoff. These sediments settle out and form shifting bars that often accelerate the erosion process by deflecting flow into sensitive bank areas.
- Increased sedimentation and channel widening modify aquatic habitats. Pools and riffles are eliminated as the stream adjusts to accommodate frequent floods. Sediment deposition destroys insect and benthic organism habitat as well as fish spawning areas.

Impacts of Human Activity on Water Quality

As described above, changes in land use contribute new or additional pollutants to stormwater runoff. In addition, the accompanying impervious surfaces provide rapid delivery of these pollutants into receiving waterways. Leaves, litter, animal droppings, exposed soil from construction sites, fertilizer and pesticides are all washed off of the land. Vehicles and deteriorating urban surfaces deposit trace metals, oil, and grease onto streets and parking lots. These and other toxic substances are carried by stormwater and conveyed through creeks, swales and storm drains into our rivers and lakes. The major categories of pollutants and their specific impacts are listed in Appendix B.

In short, the ecology of urban streams may be completely reshaped by shifts in hydrology, morphology and water quality that may accompany the development process. The stresses that these changes place on the aquatic community, although gradual and often not immediately visible, are profound: The Michigan Department of Environmental Quality has identified streams in the urban and urbanizing portions of Washtenaw County as requiring special initiatives to restore degraded habitats and improve water quality.

To mitigate stream impacts, it is necessary to reevaluate the way that stormwater and land development are managed. The following discussion provides a framework for this reevaluation, which must encompass the entire development process from land use planning and zoning to site design and construction. A benefit of this site design approach is often a net cost savings to the developer as shown in dozens of case studies.

Framework for the Design of Stormwater Management Systems

Note: The Rules of the Washtenaw County Water Resources Commissioner govern only the design of stormwater management systems within certain new development and redevelopment projects.

The following discussion applies to all aspects of managing land and stormwater. ***This framework will be the basis of discussion at the pre-application meeting.***

Environmentally sensitive site planning can substantially reduce impacts associated with development. To this end, communities, regulatory agencies, and designers must begin to evaluate the impact of each individual development project over the long term, and on a cumulative watershed scale. Such an approach requires consideration of Best Management Practices (BMPs) that function together as a system to ensure that the volume, rate, timing and pollutant load of runoff remain similar to that which occurred under pre-development conditions. This can be achieved through a coordinated network of structural and non-structural methods designed to provide both source and site control. In such a system, each BMP by itself may not provide major benefits, but becomes very effective when combined with others.

Source Controls

Source controls reduce the volume of runoff generated on-site, encourage infiltration, and eliminate initial opportunities for pollutants to enter the drainage system. Source controls are the most effective options for controlling stormwater, and include the following key practices:

- Preservation of existing natural features that perform stormwater management functions. These include depressions, wetlands, woodlands and vegetative buffers along streambanks.
- Minimize impervious surface area using site planning to make efficient use of paved, developed areas and to maximize open space. Flexible street and parking standards and the use of alternative, permeable ground cover materials can also reduce impervious surfaces.
- Direct stormwater runoff from impervious areas to open vegetated areas such as swales and lawns rather than directly into the stormwater conveyance system.
- Design and use erosion control measures on site and include rigorous maintenance throughout the construction period. Effective erosion control measures include minimizing the area of site clearing and grading, and the immediate vegetative stabilization of disturbed areas.
- The soil erosion and sedimentation control (SESC) construction sequence needs to protect infiltration areas from sediment and must include post-construction permeability testing and any necessary remediation prior to approval.

Site Controls

After the implementation of source controls, site controls are then required to infiltrate, convey, pre-treat, and treat the stormwater runoff generated by developed sites. The range of engineering and design techniques available to achieve these objectives is to some degree dictated by site configuration, soil type, and the receiving waterway. For example, flat or extremely steep topography may preclude the use of grassed swales, which are otherwise preferable to curb and gutter systems. Likewise, sites upstream of cold-water fisheries may not be suitable for permanent wet retention/detention facilities that discharge heated surface water. Each site is unique, but some universal guidelines for controlling stormwater quality and quantity can be stated.

Preferred Hierarchy of Stormwater Runoff Controls

1. In general, the most effective stormwater runoff control is infiltration, which reduces both the runoff peak and volume, and prevents many pollutants from entering the surface water. Infiltration is required as part of the stormwater management plan for sites under WCWRC's jurisdiction, whenever feasible. Infiltration best management practices (BMPs) often are most effective when distributed throughout a site close to the sources of runoff and upstream of conveyance systems. Large scale infiltration measures such as basins and trenches receive more concentrated loading and are more likely to fail due to clogging. Therefore, an aggressive maintenance program and extensive upstream pre-treatment measures, such as oil/grit separators, sedimentation basins and vegetative filter strips, must be incorporated into any stormwater management system that employs these practices. Specific site conditions, including soil type and water table elevation, are key considerations.
2. The next most effective stormwater runoff controls

reduce the runoff peak, and involve storage such as retention/detention. In the selection of an appropriate stormwater retention/detention facilities design, wet retention/detention facilities and extended retention/detention facilities are generally preferable to dry retention/detention facilities, as they hold stormwater longer, allowing more particulate matter to settle out. In addition, the aquatic plants and algae within retention/wet detention facilities take up soluble pollutants (nutrients) from the water column. These nutrients are then transformed into plant materials that settle to the retention/detention facility floor, decay, and are consumed by bacteria. As this biological process is dependent upon the presence of water, it does not occur in dry retention/detention facilities.

3. Where site conditions make the use of wet retention/detention infeasible, dry retention/detention facilities should be designed to provide extended detention of stormwater, to provide as much settling of particulate matter as possible. A notable exception to this practice occurs in areas where thermal impacts are of concern. As they hold stormwater longer, retention and extended wet detention facilities tend to increase the exposure of runoff to solar warming before release. Where thermal impacts are of primary concern, a balance must be struck between the goals of pollutant removal and the reduction of thermal impacts. Source controls and infiltration of stormwater, where feasible, are preferable approaches.
4. Once all possible methods of reducing and treating stormwater on-site have been implemented, excess runoff can be discharged into conveyance systems and carried off-site. Discharges must be at rates, velocities and volumes that will not cause adverse downstream impacts to property or waterways. For this purpose, vegetated swales with check dams are generally preferred to curb and gutter systems and enclosed storm drains.

Regardless of the design, any stormwater system will lose effectiveness without regular maintenance. Depending on the specific BMP, maintenance must be performed at regular intervals. This may include inspection, sediment removal, maintenance of vegetation and structures, replacement of filters, and more. A maintenance and budget plan must be developed concurrent with the system design. The design must also include adequate access for maintenance.

The Role of the Washtenaw County Water Resources Commissioner

The preferred hierarchy discussed above and summarized in Table 1 provides a comprehensive framework for evaluating the place and function of individual BMPs within a stormwater management system. While the most important BMPs are source controls that preserve and protect the natural environment, the Washtenaw County Water Resources Commissioner does not have legal authority to mandate all of these. We look to the staff and officials of local governments, as well as to developers and their design engineers and planners, to work together to implement source controls described earlier.

The Washtenaw County Water Resources Commissioner exercises authority over the design and construction of certain facilities that manage, convey and treat stormwater runoff. The Washtenaw County Water Resources Commissioner's Rules govern the design of such management facilities with the following objectives:

- Minimize stormwater runoff and impacts through source control and infiltration
- Incorporate design standards that control both water quantity and quality
- Encourage innovative stormwater management practices that meet the criteria contained within these rules
- Accommodate future maintenance of facilities by planning for it as part of system design
- Establish maintenance plans and procedures to ensure effective long-term operation
- Make safety of facilities a priority
- Protect natural features
- Control soil erosion and sedimentation

Table 1: Hierarchy of Preferred Best Management Practices

Maintenance	**Source Controls**
	Preservation of the natural environment
	Minimization of impervious surfaces
	Use of vegetated swales and natural storage
	Stormwater Runoff Controls
	Infiltration of runoff on-site
	Stormwater retention/detention facilities
	Conveyance off-site