

Report

**Erosion Control
and
Stormwater
Management
Requirements**

Village of
Hartland, WI

July 2005

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Hartland

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SECTION 1
TECHNICAL STANDARDS

1.01 TECHNICAL STANDARDS AND REFERENCES

A. Erosion Control and Stormwater Management Technical Standards

All drainage facilities and practices required to comply with the Erosion Control and Stormwater Management Ordinances shall incorporate technical standards and design methods specified in this document, maintained and periodically updated by the Director of Public Works/Village Engineer. Where not superceded by stricter requirements in this document, the following standards are also incorporated by reference:

1. Applicable design criteria, standards, and specifications identified in the Wisconsin Construction Site Best Management Practice Handbook, Wisconsin Department of Natural Resources (DNR) Pub. WR-222, November 1993 Revision.
2. Other design guidance and technical standards identified or developed by the DNR under subchapter V of chapter NR 151, Wisconsin. Administrative Code.
3. DNR is required by recent rule revisions to develop technical standards to provide guidance for measurement and evaluation of this performance standard. Measurement and evaluation of this performance standard shall be based on guidance published by the Department of Natural Resources. Until such guidance is published, total suspended solids removal shall be achieved to the maximum extent practical through implementation of approved BMP's.

1.02 PRECIPITATION DEPTH, DISTRIBUTION AND AVERAGES

A. Precipitation Depths

Precipitation depths specified in the document *Rainfall Frequency in the Southeastern Wisconsin Region*, SEWRPC Technical Report No. 40, April 2000 shall be used as a source for design rainfall depths:

Note that the SEWRPC 90th percentile temporal distribution is recommended to be applied with the SEWRPC 2000 rainfall depths for design and planning purposes.

B. Precipitation Distribution

1. Rainfall depths referenced above may be used in conjunction with either the SCS Type II rainfall distribution for a 24-hour storm duration or the SEWRPC 90th Percentile temporal distribution.
2. Where SEWRPC 90th Percental distribution is used, the storm duration producing the highest peak discharge shall be calculated and used for design.

C. Average Annual Rainfall

1. For applications requiring use of average annual rainfall, recorded City of Milwaukee depths for March 28 through December 6, 1969, shall be used.

1.03 DESIGN METHODS

A. Stormwater Runoff Calculations

1. For design of volume-dependent practices (detention basins, retention basins, infiltration systems, etc.), a hydrograph-producing method hydrologic model shall be developed. The following computer programs shall be allowed:
 - a. TR-55
 - b. TR-20
 - c. HEC-1
 - d. HEC-HMS
 - e. Other computer programs as allowed by the Director of Public Works
2. The Rational Method may be used to calculate peak discharges for tributary areas less than 20 acres for purposes of conveyance system design.
3. Estimation of Required Storage Volume
 - a. Final detention basin sizing shall be based on hydrograph routing through the basin with the proposed outlet structure.

- b. The Soil Conservation Service TR-55 Approximate Method may be utilized to calculate the required storage volume. This may be used for developments with watershed areas of less than 25 acres which do not involve significant off-site drainage that must be passed through the detention basin or routing of stormwater runoff through a series of detention basins. Soil Conservation Service Type II rainfall shall be utilized to estimate storage volume and peak inflow requirements.
4. Stormwater Conveyance System Design
 - a. Storm Sewers shall be designed in accordance with procedures described in Procedures 13-25-35 through 13-25-45 of the Wisconsin Department of Transportation (WisDOT) Facilities Design Manual (FDM).
 - b. Ditches shall be designed in accordance with procedures described in Procedures 13-30-5 through 13-30-10 of the WisDOT FDM.
 - c. Cross Culverts shall be designed in accordance with procedures described in Procedure 13-15-10 of the WisDOT FDM.

1.04 DESIGN CRITERIA

A. Wet Detention Basins

Design in accordance with the Wet Detention Basin Conservation Practice Standard (DNR), Section V.A.1, 2, 4-11 (Appendix D).

B. Dry Detention Basins

The following standards apply to dry detention basins. Dry detention basins designed in accordance with these standards will typically provide only peak discharge reduction benefits. Additional measures such as wet pools and infiltration basins will likely be necessary to address infiltration and water quality requirements of the Village Stormwater Management Ordinance.

Where dry detention basins are proposed to address peak discharge reduction requirements, the following standards shall apply

1. Minimum grades for the bottom of the basin shall be 2 percent unless underdrain is installed. If underdrains are installed, the minimum grade shall be 0.5 percent.

2. Basin side slopes shall not be steeper than 4:1 or flatter than 10:1.
3. Dry detention basins shall be designed to drain completely within 24 hours after the storm event.
4. Forebays shall be used to the maximum extent practical to prevent concentrated flow from entering the basin and allow sediment to settle prior to entering the basin.
 - a. Forebay area should be 10 to 25 percent of the basin's surface area.
 - b. Length to width ratio shall be at least 2:1.
 - c. The forebay shall be located opposite of the basin's outlet to increase detention time.
5. The basin shall be designed with an emergency spillway designed to convey the 100-year peak discharge entering the basin.
6. The basin shall have a ponding depth of less than 10 feet, with at least 1 foot of freeboard above the 100-year flood elevation or emergency spillway elevation, whichever is higher.
7. The basin shape should be designed with a length to width ratio of 3:1 in either a long narrow shape or a teardrop shape, to the maximum extent practical.
8. The basin shall be seeded with vegetation that is tolerant of inundation.
9. The basin outlet structure shall discharge to a stable outlet.

C. Infiltration Practices

The need for, applicability of and design of infiltration practices shall be in conformance with Technical Standards and supporting guidelines published by the DNR. The Infiltration Basin Conservation Practice Standard (DNR), and associated supporting documents are included in Appendix E.

D. Storm Sewers

1. Unless otherwise approved by the Director of Public Works/Village Engineer, all storm sewer in the public right-of-way (R/W) shall be constructed of reinforced concrete pipe of appropriate class for the expected loading. Storm

sewer materials outside of the R/W shall be subject to approval of the Building Inspector. Storm sewer shall be constructed in conformance with the latest edition of the “Standard Specifications for Sewer and Water Construction in Wisconsin” (with addenda) and other Village of Hartland and State of Wisconsin Regulations. Village of Hartland Storm Sewer Specifications are included in Appendix F.

2. The minimum allowable pipe diameter shall be 12 inches.
3. Sewer grades shall be designed so that, in general, a minimum of 2-foot cover is maintained over the top of the pipe. Pipe cover less than the minimum may be used upon site-specific approval by the Director of Public Works/Village Engineer. Uniform slopes shall be maintained between inlets, manholes and inlet to manhole. Minimum and maximum allowable slopes shall be those capable of producing velocities between 2 and 12 feet per second, respectively, when the sewer is flowing full. Velocities lower than the minimum or higher than the maximum may be used upon site-specific approval by the Director of Public Works/Village Engineer.
4. The maximum distance for overland flow of stormwater runoff to an underground storm sewer system shall be 600 feet unless a longer distance is approved by the Director of Public Works/Village Engineer.
5. Inlets and catch basins shall be constructed with a minimum 2-foot sump in areas not served by detention basins or other approved BMPs. ‘
6. All inlets and catch basins shall be poured-in-place or precast concrete. All adjusting rings shall be precast concrete. Brick and block will not be allowed.

E. Ditches

1. Ditch side slopes shall be no steeper than 4:1.
2. Underdrains may be required for ditch grades of 0.75 percent or less.
3. Ditches and open channels shall be protected with erosion mat as necessary to prevent erosion. The erosion mat shall be of an approved type and application specified in the “Erosion Control Product Acceptability List”, most current revision, by the Wisconsin Department of Transportation.

F. Culverts

1. Culverts and similar structures shall have a capacity that meets or exceeds the capacity of the surface drainageway and shall be a minimum of 12 inches in diameter. The flowline of a culvert shall match the flowline of the surface drainage way.
2. Culvert pipe materials and cover requirements shall be the same as pipe materials for storm sewers located within Village right-of-way. Corrugated metal pipe shall be allowed under private driveways and roadways.
3. Culverts shall not create backwater that adversely impacts upstream properties. Design of new culverts shall consider impacts of future upstream development. Backwater impacts shall be estimated in accordance with procedures described in Procedure 13-15-10 of the WisDOT FDM.
4. End sections shall be provided for all culverts. Grates shall be required on end sections for all culverts greater than 18 inches in diameter.
5. All end sections shall be protected by riprap. Riprap shall be installed over geotextile fabric and such that riprap is below the culvert outlet elevation and does not restrict flow.

SECTION 2
PERFORMANCE STANDARDS

2.01 EROSION AND SEDIMENT CONTROL PERFORMANCE STANDARDS

A. Total Suspended Solids Removal Goals (Ref. NR 151.11 & 12)

1. The Erosion and Sediment Control Plan shall include best management practices (BMPs) that, by design, achieve to the maximum extent practicable, a reduction of 80 percent of the sediment load carried in runoff based on an average annual rainfall, as compared with no sediment or erosion controls until the construction site has undergone final stabilization. An 80 percent sediment reduction shall meet the requirement of this paragraph. Erosion and sediment control BMPs may be used alone or in combination to meet the requirements of this paragraph. Credit toward meeting the sediment reduction may be given for limiting the duration or area, or both, of land-disturbing construction activity.
2. If BMPs cannot be designed and implemented to reduce the sediment load by 80 percent, based on an average annual rainfall, the plan shall include a written and site-specific explanation as to why the 80 percent reduction goal is not attainable, and the sediment load shall be reduced to the maximum extent practicable.
3. DNR is developing technical standards to provide guidance for measurement and evaluation of this performance standard. Measurement and evaluation of this performance standard shall be based on guidance published by the Department of Natural Resources. Until such guidance is published, total suspended solids removal shall be achieved to the maximum extent practical through implementation of approved BMP's.

B. Required Best Management Practices

Where appropriate, the plan shall include sediment controls to do all of the following to the maximum extent practicable:

1. BMP's shall be installed prior to other land disturbing activities in upgradient areas.
2. Each site shall provide an access drive and parking area of sufficient dimensions and design, surfaced with a material that will prevent erosion and minimize tracking or washing of soil onto public or private roadways. All nonpaved access drives shall be designed so that stormwater runoff from adjacent areas does not flow down the drive surface.

3. Any significant amount of runoff from upslope land area, rooftops, or other surfaces that drain across the proposed land disturbance shall be diverted around the disturbed area, if practical. Any diversion of upslope runoff shall be done in a manner that prevents erosion of the flow path and the outlet.
4. Any cuts and fills shall be planned and constructed to minimize the length and steepness of slope and stabilized in accordance with the approved erosion control plan timelines and standards of this document.
5. Open channels shall be stabilized as required to prevent erosion.
6. Inlets to storm drains, culverts, and other stormwater conveyance systems shall be protected from siltation using approved BMP's until final site stabilization.
7. Water pumped from the site shall be treated by temporary sedimentation basins or other appropriate controls designed for the highest dewatering pumping rate. Water may not be discharged in a manner that causes erosion of the site or receiving channels.
8. All waste and unused building materials shall be properly disposed of and not allowed to be carried by runoff into a receiving channel or storm sewer system.
9. All off-site sediment deposits occurring as a result of a storm event shall be cleaned up by the end of the next workday. All other off-site sediment deposits occurring as a result of land-disturbing activities shall be cleaned up by the end of the workday. Flushing may not be used unless the sediment will be controlled by a filter fabric barrier, sediment trap, sediment basin, or equivalent.
10. All activities on the site shall be conducted in a logical sequence to minimize the area of bare soil exposed at one time. Existing vegetation shall be maintained as long as possible.
11. Soil stockpiles shall be located no closer than 25 feet from lakes, streams, wetlands, ditches, drainageways, or roadway drainage systems. Stockpiles shall be stabilized by mulching, vegetative cover, tarps, or other means if remaining 20 days or more. BMP's shall be installed downstream of all soil stockpiles.

12. For any disturbed area that remains inactive for greater than 7 working days, or where grading work extends beyond annual permanent seeding deadlines, the Village of Hartland will require the site to be treated with temporary stabilization measures.
13. When the disturbed area has been stabilized by permanent vegetation or other means, temporary BMPs such as silt fences, straw bales, and sediment traps shall be removed and these areas stabilized.

C. Maintenance and Inspection

The landowner, or the landowner's representative, shall inspect erosion and sediment control practices weekly, and within 24 hours following a rainfall of 0.5 inches or greater. Written documentation of each inspection shall be maintained at the construction site and shall include the time, date and location of inspection, the phase of land disturbance at the construction site, person conducting the inspection, assessment of control practices, and a description of any erosion or sediment control measure installation or maintenance performed in response to the inspection. A copy of the inspection results shall be provided to the Village, upon request.

2.02 STORMWATER MANAGEMENT PERFORMANCE STANDARDS

A. Total Suspended Solids (Ref. NR151.12)

1. BMPs shall be designed, installed, and maintained to control total suspended solids carried in runoff from the postconstruction site as follows:
 - a. For new development, by design, reduce to the maximum extent practicable, the total suspended solids load by 80 percent, based on the average annual rainfall, as compared to no runoff management controls. An 80 percent total suspended solids reduction shall meet the requirements of this subdivision.
 - b. For redevelopment sites one acre or larger, by design, reduce to the maximum extent practicable, the total suspended solids load by 40 percent, based on the average annual rainfall, as compared to no runoff management controls. A 40 percent total suspended solids reduction shall meet the requirements of this subdivision.
 - c. Notwithstanding items a. and b. if the design cannot achieve the applicable total suspended solids reduction specified, the stormwater management plan shall include a written and site-specific explanation why that level of reduction is not attained, and the total suspended solids load shall be reduced to the maximum extent practicable.
 - d. Measurement and evaluation of this standard shall be based on guidance published by the DNR. In the absence of such guidance, total suspended solids removal shall be achieved to the maximum extent practical through implementation of approved BMPs.

B. Peak Discharge

1. By design, BMPs shall be employed to reduce the peak runoff discharge rates, to the maximum extent practicable, as compared to pre-development conditions for the 2- through 100-year design storm applicable to the development site. The following peak discharge reductions will be required:
 - a. The 10-year post-developed conditions peak flow rate will be reduced to the 2-year pre-developed peak flow rate.

- b. The 100-year post-developed peak flow rate will be reduced to the 10-year pre-development peak flow rate.
- 2. Predevelopment conditions shall assume “good hydrologic conditions” for appropriate land covers as identified in TR-55 or an equivalent methodology. The meaning of “hydrologic soil group” and “runoff curve number” are as determined in TR-55. However, when predevelopment land cover is cropland, rather than using TR-55 values for cropland, the runoff curve numbers in Table 2.02-1 shall be used.

Hydrologic Soil Group	A	B	C	D
Runoff Curve Number	56	70	79	83

Table 2.02-1 Maximum predevelopment Runoff Curve Numbers for Cropland Areas

C. Infiltration and Runoff Volume (Ref. NR 151.12(5)(c))

At locations where site conditions permit and where technically feasible, infiltration of stormwater to reduce the volume of runoff may be required. Where applicable, evaluation of the need for, appropriateness of, and required volume of infiltration shall be based on the most current DNR rules and technical standards. Infiltration shall not be permitted at locations specifically excluded in the DNR rules. BMPs shall be designed, installed, and maintained to infiltrate runoff to the maximum extent practicable in accordance with the following, except at locations where infiltration is excluded or exempted.

1. Residential Development

Infiltration shall be provided for residential development in accordance with one of the following criteria:

- a. Infiltrate sufficient runoff volume so that the post-development infiltration volume shall be at least 90% of the pre-development infiltration volume, based on an average annual rainfall. However, when designing appropriate infiltration systems to meet this requirement, no more than 1% of the project site is required as an effective infiltration area. Guidance for estimating the required infiltration volume is included in Appendix E.
- b. Infiltrate 25% of the post-development runoff from the 2 year -24 hour design storm with a type II distribution. Separate curve numbers for pervious and impervious surfaces shall be used to calculate runoff volumes and not

composite curve numbers as defined in TR-55. However, when designing appropriate infiltration systems to meet this requirement, no more than 1% of the project site is required as an effective infiltration area.

2. Non-residential Development, including commercial, industrial and institutional development,

Infiltration shall be provided for non-residential development in accordance with one of the following criteria:

- a. Infiltrate sufficient runoff volume so that the post-development infiltration volume shall be at least 60% of the pre-development infiltration volume, based on an average annual rainfall. However, when designing appropriate infiltration systems to meet this requirement, no more than 2% of the project site is required as an effective infiltration area. Guidance for estimating the required infiltration volume is included in Appendix E.
 - b. Infiltrate 10% of the runoff from the 2 year - 24 hour design storm with an NRCS Type II Rainfall Distribution. Separate curve numbers for pervious and impervious surfaces shall be used to calculate runoff volumes, and not composite curve numbers as defined in TR-55. However, when designing appropriate infiltration systems to meet this requirement, no more than 2% of the project site is required as an effective infiltration area.
3. Predevelopment conditions shall assume “good hydrologic conditions” for appropriate land covers as identified in TR-55 or an equivalent methodology. The meaning of “hydrologic soil group” and “runoff curve number” are as determined in TR-55. However, when predevelopment land cover is cropland, rather than using TR-55 values for cropland, the runoff curve numbers in Table 2.02-1 shall be used.
 4. Pretreatment of stormwater runoff from parking lots and new roads in commercial, industrial and institutional areas that will enter an infiltration system is required. The pretreatment shall be designed to protect the infiltration system from clogging prior to scheduled maintenance and to protect groundwater quality in accordance with Section 2.02©(8). Pretreatment options may include, but are not limited to, oil/grease separation, sedimentation, biofiltration, filtration, swales or filter strips.

5. Exclusions

Stormwater runoff from the following areas is prohibited from meeting the requirements of this paragraph due to the potential for groundwater contamination:

- a. Areas associated with tier 1 industrial facilities identified in s. NR 216.21(2)(a), Wis. Adm. Code, including storage, loading, rooftop and parking.
- b. Storage and loading areas of tier 2 industrial facilities identified in s. NR 216.21(2)(b), Wis. Adm. Code.

Note: Runoff from tier 2 parking and rooftop areas may be infiltrated but may require pretreatment.

- c. Fueling and vehicle maintenance areas.
- d. Areas within 1000 feet upgradient or within 100 feet downgradient of karst features.
- e. Areas with less than 3 feet separation distance from the bottom of the infiltration system to the elevation of seasonal high groundwater or the top of bedrock. This requirement does not prohibit infiltration of roof runoff.
- f. Areas with runoff from industrial, commercial and institutional parking lots and roads and residential arterial roads with less than 5 feet separation distance from the bottom of the infiltration system to the elevation of seasonal high groundwater or the top of bedrock.
- g. Areas within 400 feet of a community water system well as specified in s. NR 811.16(4), Wis. Adm. Code, or within 100 feet of a private well as specified in s. NR 812.08(4), Wis. Adm. Code, for runoff infiltrated from commercial, industrial and institutional land uses or regional devices for residential development.
- h. Areas where contaminants of concern, as defined in s. NR 720.03(2), Wis. Adm. Code are present in the soil through which infiltration will occur.
- i. Any area where the soil does not exhibit one of the following soil characteristics between the bottom of the infiltration system and the seasonal

high groundwater and top of bedrock: at least a 3-foot soil layer with 20% fines or greater; or at least a 5-foot soil layer with 10% fines or greater. This does not apply where the soil medium within the infiltration system provides an equivalent level of protection. This requirement does not prohibit infiltration of roof runoff.

6. Exemptions

The following are not required to meet the requirements of this paragraph:

- a. Areas where the infiltration rate of the soil is less than 0.6 inches/hour measured at the site.
 - b. Parking areas and access roads less than 5,000 square feet for commercial and industrial development.
 - c. Redevelopment post-construction sites.
 - d. In-fill development areas less than 5 acres.
 - e. Infiltration areas during periods when the soil on the site is frozen.
 - f. Roads in commercial, industrial and institutional land uses, and arterial residential roads.
7. Where alternate uses of runoff are employed, such as for toilet flushing, laundry or irrigation, such alternate use shall be given equal credit toward the infiltration volume required by this paragraph.
8. Infiltration systems shall, to the extent technically and economically feasible, minimize the level of pollutants infiltrating to groundwater and shall maintain compliance with the preventive action limit at a point of standards application in accordance with ch. NR 140, Wis. Adm. Code. However, if site specific information indicates that compliance with a preventive action limit is not achievable, the infiltration BMP may not be installed or shall be modified to prevent infiltration to the maximum extent practicable. Notwithstanding, the discharge from BMPs shall remain below the enforcement standard at the point of standards application.

D. Oil and Grease

Fueling and vehicle maintenance areas shall have BMPs designed, installed, and maintained to reduce petroleum within runoff so that the runoff that leaves the site contains no visible petroleum sheen.

E. Protective Areas (Ref: NR 151.12 (5) (d))

1. A “Protective area” is an area of land that commences at the top of the channel of lakes, streams and rivers, or at the delineated boundary of wetlands, and that is the greatest of the widths specified in Table 2.02, as measured horizontally from the top of the channel or delineated wetland boundary to the closest impervious surface. A protective area does not include any area of land adjacent to any stream enclosed within a pipe or culvert, such that runoff cannot enter the enclosure at this location.

Type of Resource	Protective Area
Outstanding and Exceptional Resource Waters	75 feet
Perennial/Intermittent Streams per USGS Map	50 feet
Lakes and Highly Susceptible Wetlands (1)	50 feet
Less Susceptible Wetlands	(2)
Other Waterways with Drainage Areas > 130 ac	10 feet
<p>(1) Highly susceptible wetlands include fens, sedge meadows, bogs, low prairies, conifer swamps, shrub swamps, other forested wetlands, fresh wet meadows, shallow marshes, deep marshes and seasonally flooded basins. Wetland boundary delineations shall be made in accordance with s. NR 103.08(1m). This paragraph does not apply to wetlands that have been completely filled in accordance with all applicable state and federal regulations. The protective area for wetlands that have been partially filled in accordance with all applicable state and federal regulations shall be measured from the wetland boundary delineation after fill has been placed.</p>	
<p>(2) For less susceptible wetlands, 10 percent of the average wetland width, but no less than 10 feet nor more than 30 feet. Less susceptible wetlands include degraded wetlands dominated by invasive species such as reed canary grass.</p>	

Table 2.02-2 Types of Resources and Protective areas

2. Impervious surfaces shall be kept out of the protective area unless impractical, with consideration of the planned use. The stormwater management plan shall contain a written site-specific explanation for any parts of the protective area that are disturbed during construction.
3. Where land-disturbing construction activity occurs within a protective area, and where no impervious surface is present, adequate sod or self-sustaining vegetative cover of 70 percent or greater shall be established and maintained. The adequate sod or self-sustaining vegetative cover shall be sufficient to provide for bank stability, maintenance of fish habitat, and filtering of pollutants from upslope overland flow areas under sheet flow conditions. Nonvegetative materials, such as rock riprap, may be employed on the bank as necessary to prevent erosion, such as on steep slopes or where high velocity flows occur.

In selecting the vegetative cover for the protective area, existing natural vegetative cover shall be left undisturbed, to the maximum extent practical. Where existing vegetative cover must be disturbed, consider revegetating the protective area with native plantings, where feasible.

4. Best management practices such as filter strips, swales, or wet detention basins that are designed to control pollutants from nonpoint sources may be located in the protective area.
5. The protective area requirement does not apply to:
 - a. Redevelopment sites.
 - b. In-fill development areas less than 5 acres.
 - c. Structures that cross or access surface waters such as boat landings, bridges, and culverts.
 - d. Structures constructed in accordance with s. 59.692(1v), Wis. Stats.
 - e. Postconstruction sites from which runoff does not enter the surface water, except to the extent that vegetative ground cover is necessary to maintain bank stability.

F. Stormwater Conveyance Systems

1. Storm Sewers shall be designed to convey the peak discharge for a 10-year frequency storm event.
2. Cross culverts shall be designed to convey the peak discharge for a 25-year frequency storm event.
3. Ditches shall be designed to convey the peak discharge for a 25-year frequency storm event.
4. All conveyance systems shall be designed to safely pass the 100-year storm flow without damage to adjacent structures. Unless waived by the Village of Hartland, all new structures shall be constructed at least 2 feet higher than the estimated 100-year overflow elevation.

SECTION 3
GENERAL REQUIREMENTS

3.01 STORMWATER MANAGEMENT CONSIDERATIONS

- A. New development and redevelopment activities shall meet requirements of Village Stormwater Management and Erosion Control Ordinances.
- B. These requirements do not pre-empt more stringent stormwater management requirements that may be imposed by any of the following:
 - (a) Wisconsin Department of Natural Resources administrative rules, permits or approvals including those authorized under ss. 281.16 and 283.33, Wis. Stats.
 - (b) Targeted non-agricultural performance standards promulgated in rules by the Wisconsin Department of Natural Resources under s. NR 151.004, Wis. Adm. Code.
- C. All concentrated stormwater discharges leaving a site must be conveyed into an existing channel, storm sewer, or overland flow path with adequate downstream stormwater capacity and shall not result in increased flood hazard, erosion, or other adverse impacts.
- D. Natural topography and land cover features such as natural swales, natural depressions, native soil infiltrating capacity, and natural groundwater recharge areas shall be preserved and used, to the extent possible, to meet the requirements of this section.
- E. Emergency overland flow for all stormwater facilities shall be provided to prevent exceeding the safe capacity of downstream drainage facilities and prevent endangerment of downstream property or public safety.
- F. Stormwater drainage easements of sufficient width to accommodate future maintenance activities shall be provided for all stormwater management facilities to be located outside of Village right-of-way. Stormwater drainage easements shall also be required to protect critical overland flow routes.
- G. Where discharge of urban stormwater runoff to natural wetlands is proposed, demonstration that the discharge does not adversely impact wetland functional values shall be required. Impacts of the discharge on wetland functional values shall be assessed using a method acceptable to the Village and DNR. Significant degradation to wetland functional values shall be avoided.

**SECTION 4
SUBMITTAL REQUIREMENTS**

4.01 EROSION AND SEDIMENT CONTROL PLAN REQUIREMENTS

Submittal requirements for Erosion and Sediment Control Plans are summarized below. The Director of Public Works/Village Engineer may waive a portion of these submittal requirements where such information is not necessary to demonstrate compliance with the ordinance.

A. Responsible Party and Legal Description

1. Name, address, telephone number, and e-mail address for the following or their designees: landowner; developer; project engineer for practice design and certification; person(s) responsible for installation of stormwater management practices; and person(s) responsible for maintenance of stormwater management practices prior to the transfer, if any, of maintenance responsibility to another party.
2. A site location map and proper legal description of the property proposed to be developed, referenced to the US Public Land Survey system or to block and lot numbers within a recorded land subdivision plat.

B. Predevelopment Site Conditions Mapping

1. A USGS Quadrangle or other appropriate map showing the project location and nearby regional water resources potentially impacted by the project.
2. A copy of the applicable Soils Survey Map showing predominant soil types and hydrologic soil groups.
3. Mapping or description of existing cover type and condition.
4. A predeveloped conditions site map including the following information described below. Mapping shall include enough of the contiguous properties to show runoff patterns onto, through, and from the site.
 - a. Existing topographic contours of the site at a contour interval not to exceed 2 feet.
 - b. Property lines.
 - c. Existing flow paths and direction across the site.
 - d. Outlet locations identifying where stormwater drainage leaves the property.

- e. Drainage basin divides and subdivides to all outlet locations where stormwater drainage leaves the property.
- f. Existing drainage structures on and adjacent to the site.
- g. Watercourses that may affect or be affected by runoff from the site.
- h. Lakes, streams, wetlands, channels, ditches, and other watercourses on and immediately adjacent to the site.
- i. Limits of the 100-year floodplain.

C. Proposed Site Grading and Erosion Control Plan

A Site Grading and Erosion Control Plan shall be provided that includes the following items. The plan shall be at an appropriate scale for the size of the development.

- 1. Boundaries of the construction site.
- 2. Drainage patterns and approximate slopes anticipated after major grading activities.
- 3. Areas of soil disturbance.
- 4. Location of major structural and nonstructural controls identified in the plan.
 - a. Location of areas where stabilization practices will be employed.
 - b. Areas which will be vegetated following construction.
- 5. Extent of wetland acreage on the site and locations where stormwater is discharged to a surface water or wetland.

D. Calculations

Calculations shall be provided including computer modeling input and output files, as needed, to demonstrate compliance with ordinance performance standards. All major assumptions used in developing input parameters shall be clearly stated. The drainage basin areas used in making the calculations shall be clearly cross-referenced to the required map(s).

E. Narrative

A narrative description of the proposed Erosion and Sediment Control Plan shall be provided, including the following:

1. Name of the immediate named receiving water from the United States Geological Service 7.5 minute series topographic maps, as well as locations of all surface waters and wetlands within one mile of the construction site.
2. A description of the site and the nature of the construction activity.
3. A sequence of construction of the development site, including stripping and clearing; rough grading; construction of utilities, infrastructure, and buildings; and final grading and landscaping. Sequencing shall identify the expected date on which clearing will begin, the estimated duration of exposure of cleared areas, areas of clearing, installation of temporary erosion and sediment control measures, and establishment of permanent vegetation.
4. Estimates of the total area of the site and the total area of the site that is expected to be disturbed by construction activities.
5. Estimates, including calculations, if any, of the runoff coefficient of the site before and after construction activities are completed.
6. A description of appropriate controls and measures that will be performed at the site to prevent pollutants from reaching waters of the state. The plan shall clearly describe the appropriate control measures for each major activity and the timing during the construction process that the measures will be implemented. The description of erosion controls shall include, when appropriate, the following minimum requirements:
 - a. Description of interim and permanent stabilization practices, including a practice implementation schedule. Site plans shall ensure that existing vegetation is preserved where attainable and that disturbed portions of the site are stabilized.
 - b. Description of structural practices to divert flow away from exposed soils, store flows, or otherwise limit runoff and the discharge of pollutants from the site. Unless otherwise specifically approved in writing by the Village of Hartland, structural measures shall be installed on upland soils.

- c. Descriptions of any other practices proposed to meet requirements of the ordinance and prevent erosion from the site.

4.02 STORMWATER MANAGEMENT PLAN SUBMITTAL REQUIREMENTS

Submittal requirements for Stormwater Management Plans are summarized below. The Director of Public Works/Village Engineer may waive a portion of these submittal requirements where such information is not necessary to demonstrate compliance with the ordinance.

A. Responsible Party and Legal Description

The stormwater management plan required under S.08 (1) should contain, at a minimum, the following information:

1. Name, address, telephone number, and e-mail address for the following or their designees: landowner; developer; project engineer for practice design and certification; person(s) responsible for installation of stormwater management practices; and person(s) responsible for maintenance of stormwater management practices prior to the transfer, if any, of maintenance responsibility to another party.
2. A proper legal description of the property proposed to be developed, referenced to the U.S. Public Land Survey system or to block and lot numbers within a recorded land subdivision plat.

B. Predevelopment Site Conditions Mapping

1. A USGS Quadrangle or other appropriate map showing the project location and nearby regional water resources potentially impacted by the project.
2. A copy of the applicable Soils Survey Map showing predominant soil types and hydrologic soil groups.
3. Mapping or description of existing cover type and condition.
4. A predeveloped conditions site map including the following information described below. Mapping shall include enough of the contiguous properties to show runoff patterns onto, through, and from the site:
 - a. Existing topographic contours of the site at a contour interval not to exceed 2 feet.

- b. Property lines.
- c. Existing flow paths and direction across the site.
- d. Outlet locations identifying where stormwater drainage leaves the property.
- e. Drainage basin divides and subdivides to all outlet locations where stormwater drainage leaves the property.
- f. Existing drainage structures on and adjacent to the site.
- g. Watercourses that may affect or be affected by runoff from the site.
- h. Lakes, streams, wetlands, channels, ditches, and other watercourses on and immediately adjacent to the site.
- i. Limits of the 100-year floodplain.
- j. Location of wells and wellhead protection areas covering the project area and delineated pursuant to s. NR 811.16, Wis. Adm. Code.

C. Postdevelopment Site Conditions Mapping

- 1. Proposed pervious areas including vegetative cover type and condition.
- 2. Proposed impervious surfaces including all buildings, structures, and pavement.
- 3. Proposed topographic contours of the site at a scale not to exceed one foot.
- 4. Proposed drainage network including enough of the contiguous properties to show runoff patterns onto, through, and from the site; locations and dimensions of drainage easements.
- 5. Locations of maintenance easements specified in the maintenance agreement.
- 6. Flow path and direction for all stormwater conveyance sections.
- 7. Location and type of all stormwater management conveyance and treatment practices, including the on-site and off-site tributary drainage area.

8. Location and type of conveyance system that will carry runoff from the drainage and treatment practices to the nearest adequate outlet such as a curbed street, storm drain, or natural drainageway.
9. Proposed drainage divides and subdivides identified to each outlet location where stormwater will discharge from the proposed development site.

D. Detailed Drawings

Detailed drawings including cross sections and profiles of all permanent stormwater conveyance and treatment practices.

E. Calculations

Calculations, including computer modeling input and output files, as needed to demonstrate compliance with ordinance performance standards. All major assumptions used in developing input parameters shall be clearly stated. The drainage basin areas used in making the calculations shall be clearly cross-referenced to the required map(s).

F. Narrative

A narrative including, at a minimum, the following:

1. A description of methodologies and major assumptions used in developing hydrologic and hydraulic analyses.
2. A summary of analysis results and conclusions that shall include the following:
 - a. Tables summarizing predeveloped and postdeveloped hydrologic parameters for each drainage basin. Tables shall include subbasin areas, runoff curve numbers, impervious areas, and times of concentration for predeveloped and postdeveloped conditions.
 - b. Tables summarizing peak discharge rates for the 2-year, 10-year, 25-year, and 100-year storm events for predeveloped, post-developed without practices, and postdeveloped with practices conditions.
3. Explanation of the provisions to preserve and use natural topography and land cover features to minimize changes in peak flow runoff rates and volumes to surface waters and wetlands.

4. Explanation of any restrictions on stormwater management measures in the development area imposed by wellhead protection plans and ordinances.
5. Results of investigations of soils and groundwater required for the placement and design of stormwater management measures.
6. A description and installation schedule for the stormwater management practices needed to meet the performance standards in S.07.
7. A maintenance plan developed for the life of each stormwater management practice including the required maintenance activities and maintenance activity schedule.
8. Cost estimates for the construction, operation, and maintenance of each stormwater management practice.
9. Other information requested in writing by the Village of Hartland to determine compliance of the proposed stormwater management measures with the provisions of this ordinance.

G. Certification of Site Investigations, Plans, Designs, Computations, and Drawings

All site investigations, plans, designs, computations, and drawings shall be certified by a Wisconsin-licensed professional engineer to be prepared in accordance with accepted engineering practice and requirements of the ordinance.

SECTION 5
DEFINITIONS

5.01 DEFINITIONS

- 1) “**Average annual rainfall**” means a calendar year of precipitation, excluding snow, which is considered typical.
- 2) “**Best management practice**” or “**BMP**” means structural or non-structural measures, practices, techniques or devices employed to avoid or minimize sediment or pollutants carried in runoff to waters of the state.
- 3) “**Business day**” means a day the office of the Director of Public Works is routinely and customarily open for business.
- 4) “**Building Inspector**” means the Village of Hartland Building Inspector or designee.
- 5) “**Connected imperviousness**” means an impervious surface that is directly connected to a separate storm sewer or water of the state via an impervious flow path.
- 6) “**Construction Site**” means an area upon which one or more land disturbing construction activities occur, including areas that are part of a larger common plan of development or sale where multiple separate and distinct land disturbing construction activities may be taking place at different times on different schedules but under one plan.
- 7) “**Design storm**” means a hypothetical discrete rainstorm characterized by a specific duration, temporal distribution, rainfall intensity, return frequency, and total depth of rainfall.
- 8) “**Development**” means residential, commercial, industrial or institutional land uses and associated roads.
- 9) “**Director of Public Works**” means the Village of Hartland Director of Public Works or designee.
- 10) “**Effective infiltration area**” means the area of the infiltration system that is used to infiltrate runoff and does not include the area used for site access, berms or pretreatment.
- 11) “**Erosion**” means the process by which the land’s surface is worn away by the action of wind, water, ice or gravity.
- 12) “**Exceptional resource waters**” means waters listed in s. NR 102.11, Wis. Adm. Code.
- 13) “**Final stabilization**” means that all land disturbing construction activities at the construction site have been completed and that a uniform, perennial, vegetative cover has been established, with a density of at least 70% of the cover, for the unpaved areas and areas not covered by permanent structures, or employment of equivalent permanent stabilization measures.
- 14) “**Impervious surface**” means an area that releases as runoff all or a large portion of the precipitation that falls on it, except for frozen soil. Rooftops, sidewalks, driveways, parking lots and streets are examples of areas that typically are impervious.
- 15) “**In-fill area**” means an undeveloped area of land located within existing development.
- 16) “**Infiltration**” means the entry of precipitation or runoff into or through the soil.
- 17) “**Infiltration system**” means a device or practice such as a basin, trench, rain garden or swale designed specifically to encourage infiltration, but does not include natural infiltration in pervious surfaces such as lawns, redirecting of rooftop downspouts onto lawns or minimal infiltration from practices, such as swales or road side channels designed for conveyance and pollutant removal only.
- 18) “**Karst feature**” means an area or geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater, and may include caves,

- enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps or swallets.
- 19) **“Land Development Activity”** means any construction related activity that results in the addition or replacement of impervious surfaces such as rooftops, roads, parking lots, and other structures. Measurement of areas impacted by land development activity includes areas that are part of a larger common plan of development or sale where multiple separate and distinct land disturbing construction activities may be taking place at different times on different schedules but under one plan.
 - 20) **“Land disturbing construction activity”** means any man-made alteration of the land surface resulting in a change in the topography or existing vegetative or non-vegetative soil cover, that may result in runoff and lead to an increase in soil erosion and movement of sediment into waters of the state. Land disturbing construction activity includes clearing and grubbing, demolition, excavating, pit trench dewatering, filling and grading activities.
 - 21) **“MEP” or “maximum extent practicable”** means a level of implementing best management practices in order to achieve a performance standard specified in this ordinance which takes into account the best available technology, cost effectiveness and other competing issues such as human safety and welfare, endangered and threatened resources, historic properties and geographic features. MEP allows flexibility in the way to meet the performance standards and may vary based on the performance standard and site conditions.
 - 22) **“New development”** means development resulting from the conversion of previously undeveloped land or agricultural land uses.
 - 23) **“Off-site”** means located outside the property boundary described in the permit application.
 - 24) **“On-site”** means located within the property boundary described in the permit application.
 - 25) **“Ordinary high-water mark”** has the meaning given in s. NR 115.03(6), Wis. Adm. Code.
 - 26) **“Outstanding resource waters”** means waters listed in s. NR 102.10, Wis. Adm. Code.
 - 27) **“Percent fines”** means the percentage of a given sample of soil, which passes through a # 200 sieve.
 - 28) **“Performance standard”** means a narrative or measurable number specifying the minimum acceptable outcome for a facility or practice.
 - 29) **“Permit”** means a written authorization made by the Director of Public Works to the applicant to conduct land disturbing construction activity or to discharge post-construction runoff to waters of the state.
 - 30) **“Pervious surface”** means an area that releases as runoff a small portion of the precipitation that falls on it. Lawns, gardens, parks, forests or other similar vegetated areas are examples of surfaces that typically are pervious.
 - 31) **“Pollutant”** has the meaning given in s. 283.01(13), Wis. Stats.
 - 32) **“Post-construction site”** means a construction site following the completion of land disturbing construction activity and final site stabilization.
 - 33) **“Pre-development condition”** means the extent and distribution of land cover types present before the initiation of land disturbing construction activity, assuming that all land uses prior to development activity are managed in an environmentally sound manner.
 - 34) **“Preventive action limit”** has the meaning given in s. NR 140.05(17), Wis. Adm. Code.
 - 35) **“Redevelopment”** means areas where development is replacing older development.

- 36) “**Responsible party**” means any entity holding fee title to the property.
- 37) “**Runoff**” means stormwater or precipitation including rain, snow or ice melt or similar water that moves on the land surface via sheet or channelized flow.
- 38) “**Sediment**” means settleable solid material that is transported by runoff, suspended within runoff or deposited by runoff away from its original location.
- 39) “**Separate storm sewer**” means a conveyance or system of conveyances including roads with drainage systems, streets, catch basins, curbs, gutters, ditches, constructed channels or storm drains, which meets all of the following criteria:
 - a. Is designed or used for collecting water or conveying runoff.
 - b. Is not part of a combined sewer system.
 - c. Is not draining to a stormwater treatment device or system.
 - d. Discharges directly or indirectly to waters of the state.
- 40) “**Site**” means the entire area included in the legal description of the land on which the land disturbing construction activity occurred.
- 41) “**Stormwater management plan**” means a comprehensive plan designed to reduce the discharge of pollutants from stormwater after the site has undergone final stabilization following completion of the construction activity.
- 42) “**Stormwater management system plan**” is a comprehensive plan designed to reduce the discharge of runoff and pollutants from hydrologic units on a regional or municipal scale.
- 43) “**Technical standard**” means a document that specifies design, predicted performance and operation and maintenance specifications for a material, device or method.
- 44) “**Top of the channel**” means an edge, or point on the landscape, landward from the ordinary high water mark of a surface water of the state, where the slope of the land begins to be less than 12% continually for at least 50 feet. If the slope of the land is 12% or less continually for the initial 50 feet, landward from the ordinary high water mark, the top of the channel is the ordinary high water mark.
- 45) “**TR-55**” means the United States Department of Agriculture, Natural Resources Conservation Service (previously Soil Conservation Service), Urban Hydrology for Small Watersheds, Second Edition, Technical Release 55, June 1986.
- 46) “**Type II distribution**” means a rainfall type curve as established in the “United States Department of Agriculture, Soil Conservation Service, Technical Paper 149, published 1973”. The Type II curve is applicable to all of Wisconsin and represents the most intense storm pattern.
- 47) “**Village Engineer**” means the Village of Hartland Village Engineer or designee.
- 48) “**Waters of the state**” has the meaning given in s. 281.01 (18), Wis. Stats.

**SECTION 6
FORMS**

**VILLAGE OF HARTLAND
GENERAL INFORMATION
CONSTRUCTION SITE EROSION CONTROL PERMIT APPLICATION**

Send Application to:

Village of Hartland
210 Cottonwood Avenue
Hartland, WI 53209

Official Use Only

Date Received	_____
Number	_____
Fee Received	_____
Reviewer	_____

Instructions: Please type or print. Read all instructions before completing application.

Name of Project: _____

Applicant/Entity Receiving Permit

Name of Applicant: _____
First Name of Contact: _____ Last Name: _____
Name: _____
Street (1): _____
Street (2): _____
City: _____ State: _____ Zip Code: _____
Telephone Number: (____) _____
Fax Number: (____) _____
E-mail Address _____

Property Owner

First Name: _____ Last Name: _____
Street (1): _____
Street (2): _____
City: _____ State: _____ Zip Code: _____
Telephone Number: (____) _____
Parcel Identification Number(s): _____
E-mail Address _____

Engineer (Where Applicable)

Name of Firm: _____
First Name of Contact: _____ Last Name: _____
Name: _____
Street (1): _____
Street (2): _____
City: _____ State: _____ Zip Code: _____
Telephone Number: (____) _____
Fax Number: (____) _____
E-mail Address _____

Village of Hartland Construction Site Erosion Control Plan Application Checklist

Project Name: _____

Permit #: _____

Date: _____

Please check the appropriate box: I = Included; NA = Non-Applicable

(If "NA" is checked, an explanation must be entered.)

Plan Requirement	I	NA	Explanation/Location in Plan
A. Submittal Requirements			
1. Permit Application Form			
B. Predevelopment Site Conditions Mapping			
1. Location Map			
2. Soils Survey Map			
3. Existing Land Use Mapping			
4. Predeveloped Site Conditions			
a. Existing Contours			
b. Property lines			
c. Existing flow paths and direction			
d. Outlet locations			
e. Drainage basin divides and subdivides			
f. Existing drainage structures on and adjacent to the site.			
g. Nearby Watercourses			
h. Lakes, streams, wetlands, channels, ditches, etc.			
i. Limits of the 100-year floodplain;			
C. Proposed Site Grading and Erosion Control Plan			
1. Boundaries of the construction site.			
2. Drainage Patterns/slopes after grading activities			
3. Areas of land disturbance			
4. Locations of structural and nonstructural controls			
5. Drainage basin delineations and outfall locations			
D. Drawings/Details			
1. Practice Location/Layout/Cross Sections			
2. Construction Details			
E. Calculations, as required to demonstrate ordinance compliance			
F. Narrative			
1. Name of receiving waters			
2. Site Description/Nature of construction activity			
3. Sequence of Construction			
4. Estimate of site area and disturbance area			
5. Pre- and postdeveloped runoff coefficients			
6. Description of proposed controls, including			
a. Interim and permanent stabilization practices			
b. Practices to divert flow from exposed soils			
c. Practices to store flows or trap sediment			
d. Any other practices proposed to meet ordinance			

Village of Hartland

CONSTRUCTION SITE EROSION CONTROL PERMIT NO. _____

Date of Application _____
Site Address _____
Plat Name _____
Certified Survey Map _____
Lots No. (s) _____

Permit Conditions:

- (a) Permittee shall notify the Director of Public Works 48 hours prior to commencing any land disturbing construction activity.
- (b) Permittee shall notify the Director of Public Works of practice installation within 5 days of installation.
- (c) Permittee shall obtain permission in writing from the Director of Public Works prior to any modification pursuant to S.08(2) of the erosion and sediment control ordinance.
- (d) Permittee shall install all practices as identified in the approved erosion and sediment control plan.
- (e) Permittee shall maintain all road drainage systems, stormwater drainage systems, BMPs and other facilities identified in the erosion and sediment control plan.
- (f) Permittee shall repair any siltation or erosion damage to adjoining surfaces and drainage ways resulting from land disturbing construction activities and document repairs in a site erosion control log. Remove accumulated sediment from downstream culverts, storm sewers, and other drainage facilities.
- (g) Permittee shall inspect the practices within 24 hours after each rain of 0.5 inches or more which results in runoff during active construction periods, and at least once each week, make needed repairs and document the findings of the inspections in a site erosion control log with the date of inspection, the name of the person conducting the inspection, and a description of the present phase of the construction at the site.
- (h) Permittee shall allow the Director of Public Works to enter the site for the purpose of inspecting compliance with the erosion and sediment control plan or for performing any work necessary to bring the site into compliance with the control plan. Permittee shall keep a copy of the erosion and sediment control plan at the construction site.

**APPLICANT
MUST FILL
IN BOXED
AREA**

Owner _____

(please print or type full name)

Address _____

Signature or Owner or Authorized Representative

Area of Land Disturbance (Square Feet) _____

SPECIAL CONDITIONS: _____

CONDITIONAL APPROVAL: _____

Administrative Authority

Title

Date

Permits issued under this section shall be valid for a period of 180 days, or the length of the building permit or other construction authorizations, whichever is longer, from the date of issuance. The Director of Public Works may extend the period one or more times for up to an additional 180 days. The Director of Public Works may require additional BMPs as a condition of the extension if they are necessary to meet the requirements of this ordinance.

**VILLAGE OF HARTLAND
GENERAL INFORMATION
STORMWATER MANAGEMENT PERMIT APPLICATION**

Send Application to:

Village of Hartland
210 Cottonwood Avenue
Hartland, WI 53209

Official Use Only

Date Received	_____
Number	_____
Fee Received	_____
Reviewer	_____

Instructions: Please type or print. Read all instructions before completing application.

Name of Project: _____

Applicant/Entity Receiving Permit

Name of Applicant: _____
First Name of Contact: _____ Last Name: _____
Name: _____
Street (1): _____
Street (2): _____
City: _____ State: _____ Zip Code: _____
Telephone Number: (____) _____
Fax Number: (____) _____
E-mail Address _____

Property Owner

First Name: _____ Last Name: _____
Street (1): _____
Street (2): _____
City: _____ State: _____ Zip Code: _____
Telephone Number: (____) _____
Parcel Identification Number(s): _____
E-mail Address _____

Engineer

Name of Firm: _____
First Name of Contact: _____ Last Name: _____
Name: _____
Street (1): _____
Street (2): _____
City: _____ State: _____ Zip Code: _____
Telephone Number: (____) _____
Fax Number: (____) _____
E-mail Address _____

Village of Hartland Stormwater Management Plan Application Checklist

Project Name: _____

Permit #: _____

Date: _____

Please check the appropriate box: I = Included; NA = Non-Applicable

(If "NA" is checked, an explanation must be entered.)

Plan Requirement	I	NA	Explanation/Location in Plan
A. Submittal Requirements			
1. Permit Application Form			
2. Maintenance Agreement			
3. Financial Guarantee			
4. Certification/Stamp by Wisconsin Prof. Engineer			
B. Predevelopment Site Conditions Mapping			
1. Location Map			
2. Soils Survey Map			
3. Existing Land Use Mapping			
4. Predeveloped Site Conditions			
a. Existing Contours			
b. Property lines			
c. Existing flow paths and direction			
d. Outlet locations			
e. Drainage basin divides and subdivides			
f. Existing drainage structures on and adjacent to the site.			
g. Nearby Watercourses			
h. Lakes, streams, wetlands, channels, ditches, etc.			
i. Limits of the 100-year floodplain;			
j. Wells/Wellhead Protection Areas			
C. Post-Development Site Conditions Mapping			
1. Pervious Surfaces			
2. Impervious Surfaces			
3. One Foot Topographic Contours			
4. Proposed Drainage System (including applicable off-site)			
5. Proposed Easement Locations			
6. Proposed Flow Paths, Overland Flow Routes			
7. Proposed Outlets/Drainage Divides			
D. Drawings/Details			
1. Practice Location/Layout/Cross Sections			
2. Outlet Structure Details			
3. Ditch/Storm Sewer Plan/Profile			
4. Other			
E. Calculations, including computer modeling input and output files.			
1. Hydrograph Parameter Calculations			
2. Computer Modeling Input/Output (Pre- and Postdeveloped)			
3. Detention Pond Routing			
4. Conveyance System Design			
5. Other			

Village of Hartland Stormwater Management Plan Application Checklist

Project Name: _____

Permit #: _____

Date: _____

Please check the appropriate box: I = Included; NA = Non-Applicable

(If "NA" is checked, an explanation must be entered.)

Plan Requirement	I	NA	Explanation/Location in Plan
F. Narrative			
1. Methodologies and Assumptions			
2. Results/Conclusions			
a. Pre-, and Post-developed parameter summary			
b. Pre-, and Post-developed peak discharge Summary			
3. Provisions to preserve natural topography/cover features			
4. Limitations from wellhead protection plans and ordinances.			
5. Results of investigations of soils and groundwater			
6. Practice Installation Schedule			
7. Maintenance Plan			
8. Cost Estimates			
9. Other Information			

Village of Hartland Application Checklist Summary Tables

Peak Discharge Summary

Outfall No. _____

Storm Frequency	Peak Discharge (cfs)		
	Predev.	Postdev.	Postdev. w/Detention
2-Year			
5-Year			
10-Year			
25-Year			
50-Year			
100-Year			

Note: Provide 1 table for each outfall location.

Detention Basin Summary

Detention Basin _____

Storm Frequency	Storage Volume (ac-ft)	Peak Discharge (cfs)		
		Inflow	Discharge	Pond Elevation
2-Year				
5-Year				
10-Year				
25-Year				
50-Year				
100-Year				

Note: Provide 1 table for each detention basin.

Village of Hartland
STORMWATER MANAGEMENT PERMIT NO. _____

Date of Application _____
Site Address _____
Plat Name _____
Certified Survey Map _____
Lots No. (s) _____

General Conditions:

- (a) All storm water management measures shall be installed in accordance with the approved storm water management plan and this permit.
- (b) The Director of Public Works shall be notified at least 3 business days before commencing any work in conjunction with the storm water management plan, and within 3 business days upon completion of the storm water management practices.
- (c) Practice installations shall be certified "as built" by a licensed professional engineer. Completed storm water management practices must pass a final inspection by the Director of Public Works or its designee to determine if they are in accordance with the approved storm water management plan and ordinance.
- (d) The Director of Public Works shall be notified of any significant proposed modifications to an approved storm water management plan.
- (e) All storm water management practices shall be maintained in accordance with the storm water management plan until the practices either become the responsibility of the Village of Hartland, or are transferred to subsequent private owners as specified in the approved maintenance agreement.
- (f) The Village of Hartland is authorized to perform any work or operations necessary to bring storm water management measures into conformance with the approved storm water management plan, and consent to a special assessment or charge against the property as authorized under subch. VII of ch. 66, Wis. Stats., or to charging such costs against the financial guarantee posted under S.10.
- (g) If so directed by the Director of Public Works, all damage to adjoining facilities and drainage ways caused by runoff, where such damage is caused by activities that are not in compliance with the approved storm water management plan shall be repaired at the permittee's expense.
- (h) Access is permitted to the Director of Public Works or its designee for the purpose of inspecting the property for compliance with the approved storm water management plan and this permit.

**APPLICANT
MUST FILL
IN BOXED
AREA**

Owner _____

(please print or type full name)

Address _____

Signature or Owner or Authorized Representative

Gross Aggregate Area (Square Feet) _____

SPECIAL CONDITIONS: _____

CONDITIONAL APPROVAL: _____
Administrative Authority Title Date

Permit VALID for a period of twelve (12) months from date of issuance by Director of Public Works and all work must be completed prior to the expiration unless authorized in writing from the Director of Public Works.

AGREEMENT TO MAINTAIN
STORMWATER FACILITIES
BY AND BETWEEN
THE VILLAGE OF HARTLAND AND
_____, AND
ITS HEIRS, SUCCESSORS, OR ASSIGNS

The upkeep and maintenance of stormwater facilities and the implementation of pollution source control best management practices (BMPs) is essential to the protection of water resources in the Village of Hartland. All property owners are expected to conduct business in a manner that minimizes impacts of stormwater runoff. This Agreement contains specific provisions with respect to maintenance of stormwater facilities. The authority to require maintenance and pollution source control is provided in the Village of Hartland Stormwater Management Zoning Ordinance.

FACILITY LOCATION AND AREA SERVED (Attach Map if Necessary):

This space reserved for recording data
Return To:
Parcel Identification No./Tax Key No.

Whereas, Owner has constructed improvements, including but not limited to, buildings, pavement, and stormwater facilities on the property described above. In order to further the goals of the stormwater management goals of the Village of Hartland, the City and Owner hereby enter into this Agreement. The responsibilities of each party to this Agreement are identified below.

OWNER SHALL:

- (1) Implement the stormwater facility maintenance plan included herein as Attachment A.
- (2) Implement the stormwater management plan included herein as Attachment B.
- (3) Allow the Director of Public Works or designee to access the property to conduct inspections of storm water management practices as necessary to ascertain that the practices are being maintained and operated in accordance with the agreement.

- (4) Undertake corrective actions required by Village within a reasonable time frame as set by the Director of Public Works.
- (5) Maintain a record of steps taken to implement the programs referenced in (1) and (2) above. Record shall be available for inspection by Village staff at Owners business during normal business hours. The record shall catalog the action taken, who took it, when it was done, how it was done, and any problems encountered or follow-on actions recommended.

THE VILLAGE OF HARTLAND SHALL:

- (1) Provide technical assistance to Owner in support of its operation and maintenance activities conducted pursuant to its maintenance and source control programs. Said assistance shall be provided upon request, and as Village time and resources permit.
- (2) Maintain public records of the results of the site inspections, inform the party responsible for maintenance of the inspection results, and specifically indicate any corrective actions required to bring the storm water management practice into proper working condition.
- (3) Notify the Owner of maintenance problems that require correction.

REMEDIES:

- (1) If corrective actions required by the Village are not completed within the time set by the Director of Public Works, written notice will be sent to the persons who were given notice stating the Village intention to perform such maintenance and bill the owner for all incurred expenses.
- (2) If at any time the Village determines that the existing system creates any imminent threat to public health or welfare, the Director of Public Works may take immediate measures to remedy said threat. No notice to the persons listed in (1), above, shall be required under such circumstances.
- (3) The owner grants unrestricted authority to the Village for access to any and all stormwater system features for the purpose of performing maintenance or repair as may become necessary under Remedies (1) and/or (2).
- (4) The persons listed in (1), above, shall assume all responsibility for the cost of any maintenance and for repairs to the stormwater facility. Such responsibility shall include reimbursement to the Village within 30 days of the receipt of the invoice for any such work performed. Overdue payments will require payment of interest at the current legal rate for liquidated judgments. If legal action ensues, any costs or fees incurred by the Village will be borne by the parties responsible for said reimbursements.
- (5) The owner hereby grants to the Village a lien against the above-described property in an amount equal to the cost incurred by the Village to perform the maintenance or repair work described herein.

This Agreement is intended to protect the value and desirability of the real property described

**Village of Hartland
Stormwater Management Plan**

Financial Guarantee

To: [permit holders name]
Date:
Subject: **Financial Guarantee** in the Amount of \$ _____
Check # _____ Received by (staff initials): _____

Project Name: _____

Location: Section [no.], Town of [public land survey township name]

This memo shall serve as a receipt for the above noted Financial Guarantee and as an agreement of the purpose and conditions for release by the Village of Hartland (herein referred to as the "Village").

Authority.

The authority of the Village to collect and hold this Financial Guarantee is stated in Chapter ____, Section ____ of the Village of Hartland Code of Ordinances – Stormwater Management Zoning Ordinance (herein referred to as the "Ordinance").

Purpose.

The purpose of this Financial Guarantee is to ensure compliance with the Ordinance and the terms and conditions of a Stormwater Management Permit issued for the above noted project and location.

Conditions For Release.

Terms for release of the Financial Guarantee shall include all of the following:

1. Construction Certification. A professional engineer licensed in Wisconsin shall certify that construction of all stormwater management practices comply with the approved plans and the technical standards of the Village. "As-built" plans shall be submitted for stormwater management practices showing actual location, elevations, materials, construction methods and other items as deemed necessary by the Village to determine compliance.
2. Maintenance Agreement. A copy of an approved maintenance agreement for all stormwater management practices associated with this project must be provided to the Village. The agreement shall be stamped by the Register of Deeds, showing that it has been recorded for all applicable properties.
3. Final Inspection. The Village shall complete a final inspection of the property and certify compliance with the permit and the Ordinance.

If the Village should use any portion of the Financial Guarantee to complete permit activities, due to default or improper action by the permit holder, the Village shall withhold any amounts owed for this work, in accordance with the Ordinance.

APPENDIX A
CONSTRUCTION SITE EROSION CONTROL ORDINANCE

**VILLAGE OF HARTLAND
CONSTRUCTION SITE EROSION CONTROL ORDINANCE**

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**VILLAGE OF HARTLAND
CONSTRUCTION SITE EROSION CONTROL ZONING ORDINANCE**

[CHAPTER]
CONSTRUCTION SITE EROSION

S.01 AUTHORITY

- (1) This ordinance is adopted under the authority granted by s. 61.354, Wis. Stats. This ordinance supersedes all provisions of any ordinance previously enacted Wis. Stats. that relate to construction site erosion control. Except as otherwise specified in s. 61.35 Wis. Stats. s. 61.354, Wis. Stats., applies to this ordinance and to any amendments to this ordinance.
- (2) The provisions of this ordinance are deemed not to limit any other lawful regulatory powers of the same governing body.
- (3) The Village of Hartland hereby designates the Director of Public Works/Village Engineer to administer and enforce the provisions of this ordinance.
- (4) The requirements of this ordinance do not pre-empt more stringent erosion and sediment control requirements that may be imposed by any of the following:
 - (a) Wisconsin Department of Natural Resources administrative rules, permits or approvals including those authorized under ss. 281.16 and 283.33, Wis. Stats.
 - (b) Targeted non-agricultural performance standards promulgated in rules by the Wisconsin Department of Natural Resources under s. NR 151.004, Wis. Adm. Code.

S.02 FINDINGS OF FACT

The Village of Hartland finds that runoff from land disturbing construction activity may carry a significant amount of sediment and other pollutants to the waters of the state in the Village of Hartland.

S.03 PURPOSE.

It is the purpose of this ordinance to further the maintenance of safe and healthful conditions; prevent and control water pollution; prevent and control soil erosion; protect spawning grounds, fish and aquatic life; control building sites, placement of structures and land uses; preserve ground cover and scenic beauty; and promote sound economic growth, by minimizing the amount of sediment and other pollutants carried by runoff or discharged from land disturbing construction activity to waters of the state in Village of Hartland.

S.04 APPLICABILITY AND JURISDICTION.

- (1) APPLICABILITY.
 - (a) Any land disturbing activity shall be subject to erosion and sediment control provisions of this article, if:
 - (1) A subdivision plat, requiring review and approval by the village would result, or if construction of buildings on platted lots results;
 - (2) A certified map, requiring review and approval by the village would result, or if construction of buildings on certified survey map lots results;
 - (3) An area of 4,000 square feet or greater will be disturbed by excavation, grading, filling or other earth moving activities, resulting in a loss or removal of protective ground cover, vegetations;

- (4) Excavation, fill, or any combination thereof, will exceed 400 cubic yards; or more than 15 cu. yds. within areas specified by the Waukesha County Shoreland and Floodland Protection Ordinance;
 - (5) Any public (federal, state or local) street, road or highway is to be constructed, enlarged, relocated, or substantially reconstructed;
 - (6) Any watercourse is to be changed, enlarged or materials are removed from a stream or lake bed; or
 - (7) Any utility work in which underground conduits, piping, wiring, water lines, sanitary sewers, storm sewers or similar structures will be laid, repaired, replaced or enlarged, if such work involves more than 300 linear feet of each disturbance.
 - (8) Grading, removal of protective ground cover or vegetation, excavation, landfilling or land disturbing activity within 200 feet of a lake, stream, or wetland when work affects more than 10 cubic yards of material.
- (b) This ordinance does not apply to the following:
1. Land disturbing construction activity that includes the construction of a building and is otherwise regulated by the Wisconsin Department of Commerce under s. Comm 21.125 or 50.115, Wis. Adm. Code.
 2. A construction project that is exempted by federal statutes or regulations from the requirement to have a national pollutant discharge elimination system permit issued under Chapter 40, Code of Federal Regulations, part 122, for land disturbing construction activity.
 3. Nonpoint discharges from agricultural facilities and practices.
 4. Nonpoint discharges from silviculture activities.
 5. Routine maintenance for project sites under one acre of land disturbance if performed to maintain the original line and grade, hydraulic capacity or original purpose of the facility.
- (c) Notwithstanding the applicability requirements in paragraph (a), this ordinance applies to construction sites of any size that, in the opinion of the Village staff, are likely to result in runoff that exceeds the safe capacity of the existing drainage facilities or receiving body of water, that causes undue channel erosion, that increases water pollution by scouring or the transportation of particulate matter or that endangers property or public safety.

(2) JURISDICTION

This ordinance applies to land disturbing construction activities on lands within the boundaries and jurisdiction of the Village of Hartland,

(3) EXCLUSIONS

This ordinance is not applicable to activities conducted by a state agency, as defined under s. 227.01 (1), Wis. Stats., but also including the office of district attorney, which is subject to the state plan promulgated or a memorandum of understanding entered into under s. 281.33 (2), Wis. Stats.

S.05 TECHNICAL STANDARDS

(1) DESIGN CRITERIA, STANDARDS AND SPECIFICATIONS

All drainage facilities and practices required to comply with this ordinance shall incorporate technical standards and design methods specified in the document Village of Hartland Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works/Village Engineer. Where not superceded by stricter requirements in Village of Hartland Erosion Control and Stormwater Management Requirements, the following standards are also incorporated by reference:

- (a) Applicable design criteria, standards and specifications identified in the *Wisconsin Construction Site Best Management Practice Handbook*, WDNR Pub. WR-222 November 1993 Revision.
- (b) Other design guidance and technical standards identified or developed by the Wisconsin Department of Natural Resources under subchapter V of chapter NR 151, Wis. Adm. Code.

(2) OTHER STANDARDS

Other technical standards not identified or developed in sub. (1), may be used provided that the methods have been approved by the Director of Public Works/Village Engineer/Village Engineer.

S.06 PERFORMANCE STANDARDS

- (1) **RESPONSIBLE PARTY.** The entity holding fee title to the property shall be responsible for either developing and implementing an erosion and sediment control plan, or causing such plan to be developed and implemented through contract or other agreement. This plan shall be developed in accordance with S. 09, that incorporates the requirements of this section.
- (2) **PLAN.** A written plan shall be developed in accordance with S.08 and implemented for applicable land development activities.
- (3) **EROSION AND SEDIMENT CONTROL PERFORMANCE STANDARDS.** All drainage facilities and practices required to comply with this ordinance shall meet performance standards specified in the document Village of Hartland Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works/Village Engineer.
- (4) **LOCATION.** The BMPs used to comply with this section shall be located prior to runoff entering waters of the state.
- (5) **ALTERNATE REQUIREMENTS.** The Director of Public Works/Village Engineer may establish alternative erosion and sediment control requirements to those set forth in Village of Hartland Erosion Control and Stormwater Management Requirements, if the Director of Public Works determines that an added level of protection is needed or that extraordinary hardships or practical difficulties may result from strict compliance with these regulations. Exceptions or waivers to requirements set forth in this ordinance and Village of Hartland Erosion Control and Stormwater Management Requirements shall be considered in accordance with S. 12.

S.07 PERMITTING REQUIREMENTS, PROCEDURES AND FEES.

- (1) **PERMIT REQUIRED.** No responsible party may commence a land disturbing construction activity subject to this ordinance without receiving prior approval of an erosion and sediment control plan for the site and a permit from the Director of Public Works/Village Engineer.
- (2) **PERMIT APPLICATION AND FEES.** The responsible party desiring to undertake a land disturbing construction activity subject to this ordinance shall submit an application for a permit and an erosion and sediment control plan that meets the requirements of S.08. The applicant

shall pay an application fee consistent with the fee schedule maintained by the Village clerk. By submitting an application, the applicant is authorizing the Village staff to enter the site to obtain information required for the review of the erosion and sediment control plan.

- (3) REVIEW AND APPROVAL OF PERMIT APPLICATION. The Director of Public Works/Village Engineer shall review any permit application that is submitted with an erosion and sediment control plan, and the required fee. The following approval procedure shall be used:
 - (a) The Director of Public Works/Village Engineer may request additional information if required for a complete application within 15 business days of receipt of any permit application. Within 30 business days of the receipt of a complete permit application, including all items as required by sub. (2), the Director of Public Works/Village Engineer shall inform the applicant whether the application, plan and maintenance agreement are approved or disapproved based on the requirements of this ordinance.
 - (b) If the permit application and plan are approved, the Director of Public Works/Village Engineer shall issue the permit.
 - (c) If the permit application or plan is disapproved, the Director of Public Works/Village Engineer shall state in writing the reasons for disapproval.
- (4) FINANCIAL GUARANTEE. As a condition of approval and issuance of the permit, the Director of Public Works/Village Engineer may require the applicant to deposit a surety bond or irrevocable letter of credit to guarantee a good faith execution of the approved erosion control plan and any permit conditions.
- (5) PERMIT REQUIREMENTS. All permits shall require the responsible party to:
 - (a) Notify the Director of Public Works/Village Engineer 2 full business days prior to commencing any land disturbing construction activity.
 - (b) Notify the Director of Public Works/Village Engineer of completion of any BMPs within 3 full business days after their installation.
 - (c) Obtain permission in writing from the Director of Public Works/Village Engineer prior to any modification pursuant to S.08(2) of the erosion and sediment control plan.
 - (d) Install all BMPs as identified in the approved erosion and sediment control plan.
 - (e) Maintain all road drainage systems, stormwater drainage systems, BMPs and other facilities identified in the erosion and sediment control plan.
 - (f) Repair any siltation or erosion damage to adjoining surfaces and drainage ways resulting from land disturbing construction activities and document repairs in a site erosion control log. Remove accumulated sediment from downstream culverts, storm sewers, and other drainage facilities.
 - (g) Inspect the BMPs within 24 hours after each rain of 0.5 inches or more which results in runoff during active construction periods, and at least once each week, make needed repairs and document the findings of the inspections in a site erosion control log with the date of inspection, the name of the person conducting the inspection, and a description of the present phase of the construction at the site.
 - (h) Allow the Village staff to enter the site for the purpose of inspecting compliance with the erosion and sediment control plan or for performing any work necessary to bring the site into compliance with the control plan. Keep a copy of the erosion and sediment control plan at the construction site.
- (6) PERMIT CONDITIONS. Permits issued under this section may include conditions established by Director of Public Works/Village Engineer in addition to the requirements set forth in sub. (5), where needed to assure compliance with the performance standards in S.06.
- (7) PERMIT DURATION. Permits issued under this section shall be valid for a period of 180 days, or the length of the building permit or other construction authorizations, whichever is longer, from the date of issuance. The permit duration may be extended one or more times for up to an

additional 180 days. The Director of Public Works/Village Engineer may require additional BMPs as a condition of the extension if they are necessary to meet the requirements of this ordinance.

- (8) MAINTENANCE. The responsible party throughout the duration of the construction activities shall maintain all BMPs necessary to meet the requirements of this ordinance until the site has undergone final stabilization.

S.08 EROSION AND SEDIMENT CONTROL PLAN AND AMENDMENTS.

- (1) PLAN REQUIREMENTS. An Erosion and Sediment Control Plan shall be prepared and submitted to the Director of Public Works/Village Engineer. The Erosion and Sediment Control Plan shall include, at a minimum, information required in the Village of Hartland Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works/Village Engineer.
- (2) AMENDMENTS. The applicant shall amend the plan if any of the following occur:
- (a) There is a change in design, construction, operation or maintenance at the site which has the reasonable potential for the discharge of pollutants to waters of the state and which has not otherwise been addressed in the plan.
 - (b) The actions required by the plan fail to reduce the impacts of pollutants carried by construction site runoff.
 - (c) The Director of Public Works/Village Engineer notifies the applicant of changes needed in the plan to comply with this ordinance or the Village of Hartland Erosion Control and Stormwater Management Requirements.

S.09 FEE SCHEDULE.

The fees referred to in other sections of this ordinance shall be established by the Village Board and may from time to time be modified by resolution. A schedule of the fees established by the Village Board shall be available at the Village Clerk's office

S.10 INSPECTION.

The Director of Public Works/Village Engineer, Building Inspector, or designee may access the site for the purpose of inspecting installation and construction of best management practices at any time between initiation of construction activities and final inspection/release of the project guarantee.

If land disturbing construction activities are being carried out without a permit required by this ordinance, the Director of Public Works/Village Engineer may enter the land pursuant to the provisions of ss. 66.0119(1), (2), and (3), Wis. Stats.

S.11 EXCEPTIONS AND WAIVERS

- (1) GENERAL. Where the Director of Public Works/Village Engineer finds that extraordinary hardships or practical difficulties may result from strict compliance with these regulations and/or the purposes of these regulations may be served to a greater extent by an alternative proposal, they may approve exceptions and waivers to these regulations so that substantial justice may be done and the public interest secured, provided the exception or waiver shall not have the effect of nullifying the intent and purpose of these regulations; and further provided the Director of Public Works/Village Engineer shall not approve exceptions and waivers unless they shall make findings based upon the evidence presented to it that all of the following conditions are met by the petitioner.
- (a) The granting of the exception or waiver will not be detrimental to the public safety, health, or welfare or injurious to other property;

- (b) The conditions upon which the request is based are unique to the property for which the relief is sought and are not applicable generally to other property;
 - (c) Because of the location or conditions affecting the specific property involved, a particular hardship to the owner would result, as distinguished from a mere inconvenience, if the strict letter of these regulations is carried out;
 - (d) The relief sought will not materially alter the provisions of any existing regional stormwater management plan except that this document may be amended in the manner prescribed by law.
 - (e) The granting of the exception or waiver will not result in a violation of State or Federal laws or permits.
- (2) **CONDITIONS.** In approving exceptions or waivers, the Director of Public Works/Village Engineer may require such conditions as will in their judgment secure substantially the purposes described in this ordinance and accompanying written stormwater management and erosion control requirements.
- (3) **PROCEDURES.** A petition for an exception or waiver shall be submitted in writing by the responsible party at the time when the development is filed for the consideration of the Director of Public Works/Village Engineer. The petition shall state fully the grounds for the application and all of the facts relied upon by the petitioner.

S.12 ENFORCEMENT.

- (1) The Director of Public Works/Village Engineer may post a stop-work order if any of the following occurs:
- (a) Any land disturbing construction activity regulated under this ordinance is being undertaken without a permit.
 - (b) The erosion and sediment control plan is not being implemented in a good faith manner.
 - (c) The conditions of the permit are not being met.
- (2) If the responsible party does not cease activity as required in a stop-work order posted under this section or fails to comply with the erosion and sediment control plan or permit conditions, the Director of Public Works/Village Engineer may revoke the permit.
- (3) If the responsible party, where no permit has been issued, does not cease the activity after being notified by the Director of Public Works/Village Engineer, or if a responsible party violates a stop-work order posted under sub. (1), the Director of Public Works/Village Engineer may request the Village attorney to obtain a cease and desist order in any court with jurisdiction.
- (4) The board of zoning appeals may retract the stop-work order issued under sub. (1) or the permit revocation under sub. (2).
- (5) After posting a stop-work order under sub. (1), the Director of Public Works/Village Engineer may issue a notice of intent to the responsible party of its intent to perform work necessary to comply with this ordinance. Village staff or contractors may go on the land and commence the work after issuing the notice of intent. The costs of the work performed under this subsection by the Village Board, plus interest at the rate authorized by the Village Board shall be billed to the responsible party. In the event a responsible party fails to pay the amount due, the clerk shall enter the amount due on the tax rolls and collect as a special assessment against the property pursuant to subch. VII of ch. 66, Wis. Stats.

- (6) Any person violating any of the provisions of this ordinance shall be subject to a forfeiture of not less than \$100 nor more than \$500 and the costs of prosecution for each violation. Each day a violation exists shall constitute a separate offense.
- (7) Compliance with the provisions of this ordinance may also be enforced by injunction in any court with jurisdiction. It shall not be necessary to prosecute for forfeiture or a cease and desist order before resorting to injunctive proceedings.

S.13 APPEALS.

- (1) BOARD OF ZONING APPEALS. The board of zoning appeals created pursuant to Chapter 46, Division 5 of the Village's ordinance pursuant to 61.35(7)(e), Wis. Stats.:
 - (a) Shall hear and decide appeals where it is alleged that there is error in any order, decision or determination made by the Director of Public Works in administering this ordinance except for cease and desist orders obtained under S.12 (3).
 - (a) Upon appeal, may authorize variances from the provisions of this ordinance which are not contrary to the public interest and where owing to special conditions a literal enforcement of the provisions of the ordinance will result in unnecessary hardship; and
 - (b) Shall use the rules, procedures, duties and powers authorized by statute in hearing and deciding appeals and authorizing variances.
- (2) WHO MAY APPEAL. Appeals to the board of appeals may be taken by any aggrieved person or by any office, department, board, or the Village of Hartland affected by any decision of the Director of Public Works/Village Engineer.

S.14 SEVERABILITY.

If a court of competent jurisdiction judges any section, clause, provision or portion of this ordinance unconstitutional or invalid, the remainder of the ordinance shall remain in force and not be affected by such judgment.

S.15 DEFINITIONS.

- (1) **“Administering authority”** means a governmental employee, or a regional planning commission empowered under s. 62.234 Wis. Stats., that is designated by the Village of Hartland to administer this ordinance.
- (2) **“Agricultural facilities and practices ”** has the meaning in s. 281.16(1), Wis. Stats.
- (3) **“Average annual rainfall”** means a calendar year of precipitation, excluding snow, which is considered typical.
- (4) **“Best management practice” or “BMP”** means structural or non-structural measures, practices, techniques or devices employed to avoid or minimize soil, sediment or pollutants carried in runoff to waters of the state.
- (5) **“Business day”** means a day the office of the Director of Public Works/Village Engineer is routinely and customarily open for business.
- (6) **“Cease and desist order”** means a court-issued order to halt land disturbing construction activity that is being conducted without the required permit.
- (7) **“Construction site”** means an area upon which one or more land disturbing construction activities occur, including areas that are part of a larger common plan of development or sale where multiple separate and distinct land disturbing construction activities may be taking place at different times on different schedules but under one plan.
- (8) **“Division of land”** means the creation from one parcel of [number] or more parcels or building sites of [number] or fewer acres each in area where such creation occurs at one time or through the successive partition within a 5 year period.
- (9) **“Director of Public Works”** means the Village of Hartland Director of Public Works or designee.
- (10) **“Erosion”** means the process by which the land’s surface is worn away by the action of wind, water, ice or gravity.
- (11) **“Erosion and sediment control plan”** means a comprehensive plan developed to address pollution caused by erosion and sedimentation of soil particles or rock fragments during construction.
- (12) **“Final stabilization”** means that all land disturbing construction activities at the construction site have been completed and that a uniform perennial vegetative cover has been established, with a density of at least 70 percent of the cover, for the unpaved areas and areas not covered by permanent structures, or that employ equivalent permanent stabilization measures.
- (13) **“Governing body”** means town board of supervisors, county board of supervisors, city council, village board of trustees or village council.
- (14) **“Land disturbing construction activity”** means any man-made alteration of the land surface resulting in a change in the topography or existing vegetative or non-vegetative soil cover, that may result in runoff and lead to an increase in soil erosion and movement of sediment into waters of the state. Land disturbing construction activity includes clearing and grubbing, demolition, excavating, pit trench dewatering, filling and grading activities.
- (15) **“MEP” or “maximum extent practicable”** means a level of implementing best management practices in order to achieve a performance standard specified in this chapter which takes into account the best available technology, cost effectiveness and other competing issues such as human safety and welfare, endangered and threatened resources, historic properties and geographic features. MEP allows flexibility in the way to meet the performance standards and may vary based on the performance standard and site conditions.
- (16) **“Performance standard”** means a narrative or measurable number specifying the minimum acceptable outcome for a facility or practice.
- (17) **“Permit”** means a written authorization made by the Director of Public Works/Village Engineer to the applicant to conduct land disturbing construction activity or to discharge post-construction runoff to waters of the state.
- (18) **“Pollutant”** has the meaning given in s. 283.01 (13), Wis. Stats.
- (19) **“Pollution”** has the meaning given in s. 281.01 (10), Wis. Stats.
- (20) **“Responsible party”** means the entity holding fee title to the property.

- (21) **“Runoff”** means stormwater or precipitation including rain, snow or ice melt or similar water that moves on the land surface via sheet or channelized flow.
- (22) **“Sediment”** means settleable solid material that is transported by runoff, suspended within runoff or deposited by runoff away from its original location.
- (23) **“Separate storm sewer”** means a conveyance or system of conveyances including roads with drainage systems, streets, catch basins, curbs, gutters, ditches, constructed channels or storm drains, which is designed or used for collecting and conveying stormwater runoff.
- (24) **“Site”** means the entire area included in the legal description of the land on which the land disturbing construction activity is proposed in the permit application.
- (25) **“Stop work order”** means an order issued by the Director of Public Works/Village Engineer which requires that all construction activity on the site be stopped.
- (26) **“Technical standard”** means a document that specifies design, predicted performance and operation and maintenance specifications for a material, device or method.
- (27) **“Waters of the state”** has the meaning given in s. 281.01 (18), Wis. Stats.

S.16 EFFECTIVE DATE.

This ordinance shall be in force and effect from and after its adoption and publication. The above and foregoing ordinance was duly adopted by the Village Board of Village of Hartland on the [number] day of [month], [year].

Adopted this _____ day of _____, _____

Village of Hartland

David C. Lamerand, Village President

Attest:

Connie Casper, CMC, Village Clerk

Adopted: _____

Published: _____

APPENDIX B
STORMWATER MANAGEMENT ORDINANCE

**VILLAGE OF HARTLAND
STORMWATER MANAGEMENT ORDINANCE**

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07/12/05
DRAFT #3

S.17 Effective Date

AN ORDINANCE TO CREATE CHAPTER [NUMBER] OF THE [CODE OR ORDINANCE] OF THE VILLAGE OF HARTLAND RELATING TO THE CONTROL OF POST-CONSTRUCTION RUNOFF

S.01 AUTHORITY.

This ordinance is adopted by the Village of Hartland under the authority granted by s 61.354, Wis. Stats. This ordinance supersedes all provisions of an ordinance previously enacted under s. 61.35, Wis. Stats., that relate to stormwater management regulations. Except as otherwise specified in s. 61.354, Wis. Stats., s. 61.35, Wis. Stats., applies to this ordinance and to any amendments to this ordinance.

The provisions of this ordinance are deemed not to limit any other lawful regulatory powers of the same governing body.

The Village of Hartland hereby designates the Director of Public Works/Village Engineer or his or her designee to administer and enforce the provisions of this ordinance.

The requirements of this ordinance do not pre-empt more stringent stormwater management requirements that may be imposed by any of the following:

- (a) Wisconsin Department of Natural Resources administrative rules, permits or approvals including those authorized under ss. 281.16 and 283.33, Wis. Stats.
- (b) Targeted non-agricultural performance standards promulgated in rules by the Wisconsin Department of Natural Resources under s. NR 151.004, Wis. Adm. Code.

S.02 FINDINGS OF FACT.

The Village of Hartland finds that uncontrolled, post-construction runoff has a significant impact upon water resources and the health, safety and general welfare of the community and diminishes the public enjoyment and use of natural resources. Specifically, uncontrolled post-construction runoff can:

- (1) Degrade physical stream habitat by increasing stream bank erosion, increasing streambed scour, diminishing groundwater recharge, diminishing stream base flows and increasing stream temperature.
- (2) Diminish the capacity of lakes and streams to support fish, aquatic life, recreational and water supply uses by increasing pollutant loading of sediment, suspended solids, nutrients, heavy metals, bacteria, pathogens and other urban pollutants.
- (3) Alter wetland communities by changing wetland hydrology and by increasing pollutant loads.
- (4) Reduce the quality of groundwater by increasing pollutant loading.
- (5) Threaten public health, safety, property and general welfare by overtaxing storm sewers, drainage ways, and other minor drainage facilities.
- (6) Threaten public health, safety, property and general welfare by increasing major flood peaks and volumes.
- (7) Undermine floodplain management efforts by increasing the incidence and levels of flooding.

S.03 PURPOSE AND INTENT.

- (1) **PURPOSE.** The general purpose of this ordinance is to establish long-term, post-construction runoff management requirements that will diminish the threats to public health, safety, welfare and the aquatic environment. Specific purposes are to:
 - (a) Further the maintenance of safe and healthful conditions.
 - (b) Prevent and control the adverse effects of stormwater; prevent and control soil erosion; prevent and control water pollution; protect spawning grounds, fish and aquatic life; control building sites, placement of structures and land uses; preserve ground cover and scenic beauty; and promote sound economic growth.
 - (c) Control exceedance of the safe capacity of existing drainage facilities and receiving water bodies; prevent undue channel erosion; control increases in the scouring and

transportation of particulate matter; and prevent conditions that endanger downstream property.

- (2) INTENT. It is the intent of the Village of Hartland that this ordinance regulates post-construction stormwater discharges to waters of the state. This ordinance may be applied on a site-by-site basis. The Village of Hartland recognizes, however, that the preferred method of achieving the stormwater performance standards set forth in this ordinance is through the preparation and implementation of comprehensive, systems-level stormwater management plans that cover hydrologic units, such as watersheds, on a municipal and regional scale. Such plans may prescribe regional stormwater devices, practices or systems, any of which may be designed to treat runoff from more than one site prior to discharge to waters of the state. Where such plans are in conformance with the performance standards developed under s. 281.16, Wis. Stats., for regional stormwater management measures and have been approved by the Village of Hartland, it is the intent of this ordinance that the approved plan be used to identify post-construction management measures acceptable for the community.

S.04 APPLICABILITY AND JURISDICTION.

(1) APPLICABILITY.

- (a) Where not otherwise limited by law, this ordinance applies to land development activity that results in one or more acres of land disturbing construction activity.
- (b) A site that meets any of the criteria in this paragraph is exempt from the requirements of this ordinance.
- A redevelopment site with no net increase in exposed parking lots, roads, rooftops, or other impervious areas.
 - A site with less than 10% connected imperviousness based on complete development of the post-construction site, provided the cumulative area of all parking lots and rooftops is less than one acre.
 - Nonpoint discharges from agricultural facilities and practices.
 - Nonpoint discharges from silviculture activities.
 - Routine maintenance for project sites under 5 acres of land disturbance if performed to maintain the original line and grade, hydraulic capacity or original purpose of the facility.
 - Underground utility construction such as but not limited to water, sewer and fiberoptic lines. This exemption does not apply to the construction of any above ground structures associated with utility construction.
- (c) Notwithstanding the applicability requirements in paragraph (a), this ordinance applies to land development activity of any size that, in the opinion of the Director of Public Works, Village Engineer, or Building Inspector, is likely to result in runoff that exceeds the safe capacity of the existing drainage facilities or receiving body of water, that causes undue channel erosion, that increases water pollution by scouring or the transportation of particulate matter or that endangers property or public safety.

(2) JURISDICTION

This ordinance applies to land development activities within the boundaries and jurisdiction of the Village of Hartland, as well as the division of land in the Village's extraterritorial jurisdiction.

(3) EXCLUSIONS.

This ordinance is not applicable to activities conducted by a state agency, as defined under s. 227.01 (1), Wis. Stats., but also including the office of district attorney, which is subject to the

state plan promulgated or a memorandum of understanding entered into under s. 281.33 (2), Wis. Stats.

S.05 TECHNICAL STANDARDS AND DESIGN METHODS

DESIGN CRITERIA, STANDARDS AND SPECIFICATIONS. All drainage facilities and practices required to comply with this ordinance shall incorporate technical standards and design methods specified in the document Village of Hartland Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works/Village Engineer. Where not superceded by stricter requirements in Village of Hartland Erosion Control and Stormwater Management Requirements, the following standards are also incorporated by reference:

- (a) Applicable design criteria, standards and specifications identified in the *Wisconsin Construction Site Best Management Practice Handbook*, WDNR Pub. WR-222 November 1993 Revision or subsequent revision.
- (b) Other design guidance and technical standards identified or developed by the Wisconsin Department of Natural Resources under subchapter V of chapter NR 151, Wis. Adm. Code.
- (c) OTHER STANDARDS. Other technical standards not identified or developed in sub. (1), may be used provided that the methods have been approved by the Director of Public Works/Village Engineer.

S.06 PERFORMANCE STANDARDS

- (1) RESPONSIBLE PARTY. The entity holding fee title to the property shall be responsible for either developing and implementing a stormwater management plan, or causing such plan to be developed and implemented through contract or other agreement. This plan shall be developed in accordance with S. 08, which incorporates the requirements of this section.
- (2) PLAN. A written plan shall be developed in accordance with S. 08 and implemented for applicable land development activities.
- (3) STORMWATER MANAGEMENT PERFORMANCE STANDARDS. All drainage facilities and practices required to comply with this ordinance shall meet performance standards specified in the document Village of Hartland Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works/Village Engineer.
- (4) LOCATION AND REGIONAL TREATMENT OPTION.
 - (a) Stormwater Management Facilities required to meet this ordinance may be located on-site or off-site as part of a regional stormwater device, practice or system.
 - (b) The Director of Public Works/Village Engineer may approve off-site management measures provided that all of the following conditions are met:
 - 1. The Director of Public Works/Village Engineer determines that the post-construction runoff is covered by a stormwater management system plan that is approved by Village of Hartland and that contains management requirements consistent with the purpose and intent of this ordinance.
 - 2. The off-site facility meets all of the following conditions:
 - a. The facility will be in place before the need for the facility arises as a result of on-site construction activities.
 - b. The facility is designed and adequately sized to provide a level of stormwater control equal to or greater than that which would be afforded by on-site practices meeting the performance standards of this ordinance.
 - c. The facility has a legally obligated entity responsible for its long-term operation and maintenance.
 - d. Where a regional treatment option exists such that the Director of Public Works/Village Engineer may exempt the applicant from all or part of the

minimum on-site stormwater management requirements, the applicant shall be required to pay a fee in an amount determined by the Director of Public Works/Village Engineer. In determining the fee for post-construction runoff, the Director of Public Works/Village Engineer shall consider an equitable distribution of the cost for land, engineering design, construction, and maintenance of the regional treatment option.

- (5) **ALTERNATE REQUIREMENTS.** The Director of Public Works/Village Engineer may establish alternative stormwater management requirements to those set forth in Village of Hartland Erosion Control and Stormwater Management Requirements, if the Director of Public Works/Village Engineer determines that an added level of protection is needed for to address downstream stormwater management issues; or that extraordinary hardships or practical difficulties may result from strict compliance with these regulations. Exceptions or waivers to stormwater management requirements set forth in this ordinance and Village of Hartland Erosion Control and Stormwater Management Requirements shall be considered in accordance with S. 12.

S.07 PERMITTING REQUIREMENTS, PROCEDURES, AND FEES

- (1) **PERMIT REQUIRED.** No responsible party may undertake a land disturbing construction activity without receiving a Stormwater Management Permit from the Building Inspector/ Director of Public Works prior to commencing the proposed activity.
- (2) **PERMIT APPLICATION AND FEES.** Unless specifically excluded by this ordinance, any responsible party desiring a permit shall submit to the Building Inspector/Director of Public Works a permit application made on a form provided by Village for that purpose.
- (a) Unless otherwise excepted by this ordinance, a permit application must be accompanied by a stormwater management plan, a maintenance agreement (where required) and, where not otherwise covered by a developer's agreement, a non-refundable permit administration fee. The permit administration fee, where applicable, shall be consistent with a fee schedule maintained by the Village.
- (b) The stormwater management plan shall be prepared to meet the requirements of S.06 and 08, the maintenance agreement shall be prepared to meet the requirements of S.09, the financial guarantee shall meet the requirements of S.10, and fees shall be those established by the Village of Hartland as set forth in the schedule fees.
- (3) **REVIEW AND APPROVAL OF PERMIT APPLICATION.** The Building Inspector/ Director of Public Works shall review any permit application that is submitted with a stormwater management plan, maintenance agreement, and the required fee. The following approval procedure shall be used:
- (a) The Village Staff may request additional information if required for a complete application within 15 business days of receipt of any permit application.
- (b) If the stormwater permit application, plan and maintenance agreement are approved, or if an agreed upon payment of fees in lieu of stormwater management practices is made, the Village Staff shall issue the permit.
- (c) If the stormwater permit application, plan or maintenance agreement is disapproved, the Village Staff shall detail in writing the reasons for disapproval.
- (d) Prior to commencing the land development activity, the project may be subject to additional approvals under other portions of the Villages's municipal code.
- (4) **PERMIT REQUIREMENTS.** All permits issued under this ordinance shall be subject to the following conditions, and holders of permits issued under this ordinance shall be deemed to have accepted these conditions. The Building Inspector/Director of Public Works may suspend or revoke a permit for violation of a permit condition, following written notification of the responsible party. An action to suspend or revoke this permit may be appealed in accordance with S.14.
- (a) Compliance with this permit does not relieve the responsible party of the responsibility to comply with other applicable federal, state, and local laws and regulations.

- (b) The responsible party shall design and install all structural and non-structural stormwater management measures in accordance with the approved stormwater management plan and this permit.
 - (c) The responsible party shall notify the Director of Public Works/Village Engineer at least 2 business days before commencing any work in conjunction with the stormwater management plan, and within 3 business days upon completion of the stormwater management practices.
 - (d) Practice installations required as part of this ordinance shall be certified "as built" by a licensed professional engineer. Completed stormwater management practices must pass a final inspection by the Director of Public Works/Village Engineer or its designee to determine if they are in accordance with the approved stormwater management plan and ordinance. The Director of Public Works/Village Engineer or its designee shall notify the responsible party in writing of any changes required in such practices to bring them into compliance with the conditions of this permit.
 - (e) The responsible party shall notify the Village of any significant proposed modifications to an approved stormwater management plan. The Director of Public Works/Village Engineer may require that the proposed modifications be submitted to it for approval prior to incorporation into the stormwater management plan and execution by the responsible party.
 - (f) The responsible party shall maintain all stormwater management practices in accordance with the stormwater management plan until the practices either become the responsibility of the Village of Hartland, or are transferred to subsequent private owners as specified in the approved maintenance agreement.
 - (g) The responsible party authorizes the Village to perform any work or operations necessary to bring stormwater management measures into conformance with the approved stormwater management plan, and consents to a special assessment or charge against the property as authorized under subch. VII of ch. 66, Wis. Stats., or to charging such costs against the financial guarantee posted under S.10.
 - (h) If so directed by the Village, the responsible party shall repair at the responsible party's own expense all damage to adjoining facilities and drainage ways caused by runoff, where such damage is caused by activities that are not in compliance with the approved stormwater management plan.
 - (i) The responsible party shall permit property access to the Director of Public Works/Village Engineer or its designee for the purpose of inspecting the property for compliance with the approved stormwater management plan and this permit.
 - (j) Where site development or redevelopment involves changes in direction, increases in peak rate and/or total volume of runoff from a site, the Director of Public Works/Village Engineer may require the responsible party to make appropriate legal arrangements with affected property owners.
 - (k) The responsible party is subject to the enforcement actions and penalties detailed in S.13, if the responsible party fails to comply with the terms of this permit.
- (5) PERMIT CONDITIONS. Permits issued under this subsection may include conditions established by the Village related to the requirements needed to meet the performance standards in S.06 or a financial guarantee as provided for in S.10.
- (6) PERMIT DURATION. Permits issued under this section shall be valid from the date of issuance through the date the Village notifies the responsible party that all stormwater management practices have passed the final inspection required under sub. (4)(d). The permit shall be invalid if work is not commenced within 1 year of permit issuance.

S.08 STORMWATER MANAGEMENT PLAN

- (1) PLAN REQUIREMENTS. A Stormwater Management Plan shall be prepared and submitted to the Village. The Stormwater Management Plan shall include, at a minimum, information required in the Village of Hartland Erosion Control and Stormwater Management Requirements, maintained and periodically updated by the Director of Public Works/Village Engineer. The

Director of Public Works may waive certain submittal requirements if determined by the Director of Public Works/Village Engineer to be unnecessary to demonstrate compliance with ordinance standards.

- (2) ALTERNATE REQUIREMENTS. The Director of Public Works/Village Engineer may prescribe alternative submittal requirements for applicants seeking an exemption to on-site stormwater management performance standards under S.06 (5) or S.12.

S.09 MAINTENANCE AGREEMENT

- (1) MAINTENANCE AGREEMENT REQUIRED. The maintenance agreement required under S.07 (2) for stormwater management practices shall be an agreement between the Village and the responsible party to provide for maintenance of stormwater practices beyond the duration period of this permit. The maintenance agreement shall be filed with the County Register of Deeds as a property deed restriction so that it is binding upon all subsequent owners of the land served by the stormwater management practices.
- (2) AGREEMENT PROVISIONS. The maintenance agreement shall contain the following information and provisions and be consistent with the maintenance plan required by S.07(2).
 - (a) Identification of the stormwater facilities and designation of the drainage area served by the facilities.
 - (b) A schedule for regular maintenance of each aspect of the stormwater management system consistent with the stormwater management plan required under S.06(2).
 - (c) Identification of the property or easement owner, organization or county, or village responsible for long term maintenance of the stormwater management practices identified in the stormwater management plan required under S.06 (2).
 - (d) Requirement that the responsible party(s), organization, or city, county, town or village shall maintain stormwater management practices in accordance with the schedule included in par. (b).
 - (e) Authorization for the Village staff or contractors to access the property to conduct inspections of stormwater management practices as necessary to ascertain that the practices are being maintained and operated in accordance with the agreement.
 - (f) A requirement on the Village to maintain public records of the results of the site inspections, to inform the responsible party responsible for maintenance of the inspection results, and to specifically indicate any corrective actions required to bring the stormwater management practice into proper working condition.
 - (g) Agreement that the party designated under par. (c), as responsible for long term maintenance of the stormwater management practices, shall be notified by the Village of maintenance problems which require correction. The specified corrective actions shall be undertaken within a reasonable time frame as set by the Village.
 - (h) Authorization for the Village to perform the corrected actions identified in the inspection report if the responsible party designated under par. (c) does not make the required corrections in the specified time period. The Village finance director shall enter the amount due on the tax rolls and collect the money as a special charge against the property pursuant to subch. VII of ch. 66, Wis. Stats.

S.10 FINANCIAL GUARANTEE

- (1) ESTABLISHMENT OF THE GUARANTEE. The Director of Public Works/Village Engineer may require the submittal of a financial guarantee, the form and type of which shall be acceptable to the Village attorney. The financial guarantee shall be in an amount determined by the Director of Public Works/Village Engineer to be the estimated cost of construction and the estimated cost of maintenance of the stormwater management practices during the period that the designated party in the maintenance agreement has maintenance responsibility. The financial guarantee shall give the Village the authorization to use the funds to complete the stormwater management practices if the responsible party defaults or does not properly implement the approved stormwater

management plan, upon written notice to the responsible party by the administering authority that the requirements of this ordinance have not been met.

- (2) **CONDITIONS FOR RELEASE.** Conditions for the release of the financial guarantee are as follows:
- (a) The Director of Public Works/Village Engineer shall release the portion of the financial guarantee established under this section, less any costs incurred by the Village to complete installation of practices, upon submission of "as built plans" by a Wisconsin licensed professional engineer. The Director of Public Works may make provisions for a partial pro-rata release of the financial guarantee based on the completion of various development stages.
 - (b) The Director of Public Works shall release the portion of the financial guarantee established under this section to assure maintenance of stormwater practices and facilities, less any costs incurred by the Village, at such time that the responsibility for practice or facility maintenance is passed on to another entity via an approved maintenance agreement.

S.11 FEE SCHEDULE

The fees referred to in other sections of this ordinance shall be established by the Village of Hartland and may from time to time be modified by resolution. A schedule of fees shall be available at the Village Clerk's office.

S.12 EXCEPTIONS AND WAIVERS

- (1) **GENERAL.** Where the Village finds that extraordinary hardships or practical difficulties may result from strict compliance with these regulations and/or the purposes of these regulations may be served to a greater extent by an alternative proposal, it may approve exceptions and waivers to these regulations so that substantial justice may be done and the public interest secured, provided the exception or waiver shall not have the effect of nullifying the intent and purpose of these regulations; and further provided the Director of Public Works/Village Engineer shall not approve exceptions and waivers unless they shall make findings based upon the evidence presented to them that all of the following conditions are met by the petitioner.
- (a) The granting of the exception or waiver will not be detrimental to the public safety, health, or welfare or injurious to other property;
 - (b) The conditions upon which the request is based are unique to the property for which the relief is sought and are not applicable generally to other property;
 - (c) Because of the location or conditions affecting the specific property involved, a particular hardship to the owner would result, as distinguished from a mere inconvenience, if the strict letter of these regulations is carried out;
 - (d) The relief sought will not materially alter the provisions of any existing regional stormwater management plan except that this document may be amended in the manner prescribed by law.
 - (e) The granting of the exception or waiver will not result in a violation of State or Federal laws or permits.
- (2) **CONDITIONS.** In approving exceptions or waivers, the Director of Public Works/Village Engineer may require such conditions as will in their judgement secure substantially the purposes described in this ordinance and accompanying written stormwater management and erosion control requirements.

- (3) PROCEDURES. A petition for an exception or waiver shall be submitted in writing by the responsible party at the time when the development is filed for the consideration of the Director of Public Works/Village Engineer. The petition shall state fully the grounds for the application and all of the facts relied upon by the petitioner.

S.13 INSPECTION AND ENFORCEMENT

- (1) The Director of Public Works/Village Engineer, Building Inspector, or designee may access the site periodically to inspect stormwater management practices and facilities to evaluate compliance with the approved stormwater management plan.
- (2) Any land disturbing construction activity or post-construction runoff initiated after the effective date of this ordinance by any person, firm, association, or corporation subject to the ordinance provisions shall be deemed a violation unless conducted in accordance with the requirements of this ordinance.
- (3) The Director of Public Works/Building Inspector shall notify the responsible party by certified mail of any non-complying land disturbing construction activity or post-construction runoff. The notice shall describe the nature of the violation, remedial actions needed, a schedule for remedial action, and additional enforcement action which may be taken.
- (4) Upon receipt of written notification from the Director of Public Works under sub. (2), the responsible party shall correct work that does not comply with the stormwater management plan or other provisions of this permit. The responsible party shall make corrections as necessary to meet the specifications and schedule set forth by the Director of Public Works/Village Engineer in the notice.
- (5) If the violations to a permit issued pursuant to this ordinance are likely to result in damage to properties, public facilities, or waters of the state, the Director of Public Works/Village Engineer may enter the land and take emergency actions necessary to prevent such damage. The costs incurred by the Village plus interest and legal costs shall be billed to the responsible party.
- (6) The Director of Public Works/Village Engineer is authorized to post a stop work order on all land disturbing construction activity that is in violation of this ordinance, or to request the Village Attorney to obtain a cease and desist order in any court with jurisdiction.
- (7) The Director of Public Works/Building Inspector may revoke a permit issued under this ordinance for non-compliance with ordinance provisions.
- (8) Any permit revocation, stop work order, or cease and desist order shall remain in effect unless retracted by the Director of Public Works, Building Inspector, Village Attorney, or by a court with jurisdiction.
- (9) The Director of Public Works is authorized to refer any violation of this ordinance, or of a stop work order, or of a cease and desist order issued pursuant to this ordinance, to the Village Attorney for the commencement of further legal proceedings in any court with jurisdiction.
- (10) Any person, firm, association, or corporation who does not comply with the provisions of this ordinance shall be subject to a forfeiture of not less than 100 dollars or more than 500 dollars per offense, together with the costs of prosecution. Each day that the violation exists shall constitute a separate offense.
- (11) Compliance with the provisions of this ordinance may also be enforced by injunction in any court with jurisdiction. It shall not be necessary to prosecute for forfeiture or a cease and desist order before resorting to injunctive proceedings.

- (12) When the Director of Public Works determines that the holder of a permit issued pursuant to this ordinance has failed to follow practices set forth in the stormwater management plan, or has failed to comply with schedules set forth in said stormwater management plan, the Director of Public Works or a party designated by the Director of Public Works may enter upon the land and perform the work or other operations necessary to bring the condition of said lands into conformance with requirements of the approved plan. The Director of Public Works shall keep a detailed accounting of the costs and expenses of performing this work. These costs and expenses shall be deducted from any financial security posted pursuant to S.10 of this ordinance. Where such a security has not been established, or where such a security is insufficient to cover these costs, the costs and expenses shall be entered on the tax roll as a special charge against the property and collected with any other taxes levied thereon for the year in which the work is completed.

S.14 APPEALS

- (1) **BOARD OF ZONING APPEALS.** The board of zoning appeals, created pursuant to **Section 19.72 of the Village of Hartland ordinances** pursuant to s. 61.35(7)e Wis. Stats, shall hear and decide appeals where it is alleged that there is error in any order, decision or determination made by the Director of Public Works in administering this ordinance. The Board shall also use the rules, procedures, duties, and powers authorized by statute in hearing and deciding appeals. Upon appeal, the Board may authorize variances from the provisions of this ordinance that are not contrary to the public interest, and where owing to special conditions a literal enforcement of the ordinance will result in unnecessary hardship.
- (2) **WHO MAY APPEAL.** Appeals to the board of appeals may be taken by any aggrieved person or by an officer, department, or board of the Village of Hartland affected by any decision of the Director of Public Works.

S.15 SEVERABILITY

If any section, clause, provision or portion of this ordinance is judged unconstitutional or invalid by a court of competent jurisdiction, the remainder of the ordinance shall remain in force and not be affected by such judgment.

S.16 DEFINITIONS

- (1) **“Agricultural facilities and practices”** has the meaning given in s. 281.16, Wis. Stats.
- (2) **“Average annual rainfall”** means a calendar year of precipitation, excluding snow, which is considered typical.
- (3) **“Best management practice” or “BMP”** means structural or non-structural measures, practices, techniques or devices employed to avoid or minimize sediment or pollutants carried in runoff to waters of the state.
- (4) **“Business day”** means a day the office of the Director of Public Works is routinely and customarily open for business.
- (5) **“Cease and desist order”** means a court-issued order to halt land disturbing construction activity that is being conducted without the required permit.
- (6) **“Connected imperviousness”** means an impervious surface that is directly connected to a separate storm sewer or water of the state via an impervious flow path.
- (7) **“Design storm”** means a hypothetical discrete rainstorm characterized by a specific duration, temporal distribution, rainfall intensity, return frequency, and total depth of rainfall.
- (8) **“Development”** means residential, commercial, industrial or institutional land uses and associated roads.
- (9) **“Director of Public Works”** means the Village of Hartland Director of Public Works or designee.
- (10) **“Division of land”** means either a major subdivision or minor subdivision, as defined by Chapter 20, Land Division and Subdivision.
- (11) **“Effective infiltration area”** means the area of the infiltration system that is used to infiltrate runoff and does not include the area used for site access, berms or pretreatment.
- (12) **“Erosion”** means the process by which the land’s surface is worn away by the action of wind, water, ice or gravity.
- (13) **“Exceptional resource waters”** means waters listed in s. NR 102.11, Wis. Adm. Code.
- (14) **“Extraterritorial Jurisdiction”** means Extraterritorial Jurisdiction as defined by Section of the Village of Hartland Subdivision Ordinance.
- (15) **“Final stabilization”** means that all land disturbing construction activities at the construction site have been completed and that a uniform, perennial, vegetative cover has been established, with a density of at least 70% of the cover, for the unpaved areas and areas not covered by permanent structures, or employment of equivalent permanent stabilization measures.
- (16) **“Financial guarantee”** means a performance bond, maintenance bond, surety bond, irrevocable letter of credit, or similar guarantees submitted to the Director of Public Works by the responsible party to assure that requirements of the ordinance are carried out in compliance with the stormwater management plan.
- (17) **“Governing body”** means village board of trustees.
- (18) **“Impervious surface”** means an area that releases as runoff all or a large portion of the precipitation that falls on it, except for frozen soil. Rooftops, sidewalks, driveways, parking lots and streets are examples of areas that typically are impervious
- (19) **“In-fill area”** means an undeveloped area of land located within existing development.
- (20) **“Infiltration”** means the entry of precipitation or runoff into or through the soil.
- (21) **“Infiltration system”** means a device or practice such as a basin, trench, rain garden or swale designed specifically to encourage infiltration, but does not include natural infiltration in pervious surfaces such as lawns, redirecting of rooftop downspouts onto lawns or minimal infiltration from practices, such as swales or road side channels designed for conveyance and pollutant removal only.
- (22) **“Karst feature”** means an area or geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater, and may include caves, enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps or swallets.
- (23) **“Land Development Activity”** means any construction related activity that results in the addition or replacement of impervious surfaces such as rooftops, roads, parking lots, and other structures. Measurement of areas impacted by land development activity includes areas that are part of a larger common plan of development or sale where multiple separate and distinct land disturbing

- construction activities may be taking place at different times on different schedules but under one plan.
- (24) **“Land disturbing construction activity”** means any man-made alteration of the land surface resulting in a change in the topography or existing vegetative or non-vegetative soil cover, that may result in runoff and lead to an increase in soil erosion and movement of sediment into waters of the state. Land disturbing construction activity includes clearing and grubbing, demolition, excavating, pit trench dewatering, filling and grading activities.
- (25) **“Maintenance agreement”** means a legal document that provides for long-term maintenance of stormwater management practices.
- (26) **“MEP” or “maximum extent practicable”** means a level of implementing best management practices in order to achieve a performance standard specified in this ordinance which takes into account the best available technology, cost effectiveness and other competing issues such as human safety and welfare, endangered and threatened resources, historic properties and geographic features. MEP allows flexibility in the way to meet the performance standards and may vary based on the performance standard and site conditions.
- (27) **“New development”** means development resulting from the conversion of previously undeveloped land or agricultural land uses.
- (28) **“Off-site”** means located outside the property boundary described in the permit application.
- (29) **“On-site”** means located within the property boundary described in the permit application.
- (30) **“Ordinary high-water mark”** has the meaning given in s. NR 115.03(6), Wis. Adm. Code.
- (31) **“Outstanding resource waters”** means waters listed in s. NR 102.10, Wis. Adm. Code.
- (32) **“Percent fines”** means the percentage of a given sample of soil, which passes through a # 200 sieve.
- (33) **“Performance standard”** means a narrative or measurable number specifying the minimum acceptable outcome for a facility or practice.
- (34) **“Permit”** means a written authorization made by the Director of Public Works/Village Engineer to the applicant to conduct land disturbing construction activity or to discharge post-construction runoff to waters of the state.
- (35) **“Permit administration fee”** means a sum of money paid to the [administering authority] by the permit applicant for the purpose of recouping the expenses incurred by the authority in administering the permit.
- (36) **“Pervious surface”** means an area that releases as runoff a small portion of the precipitation that falls on it. Lawns, gardens, parks, forests or other similar vegetated areas are examples of surfaces that typically are pervious.
- (37) **“Pollutant”** has the meaning given in s. 283.01(13), Wis. Stats.
- (38) **“Pollution”** has the meaning given in s. 281.01(10), Wis. Stats.
- (39) **“Post-construction site”** means a construction site following the completion of land disturbing construction activity and final site stabilization.
- (40) **“Pre-development condition”** means the extent and distribution of land cover types present before the initiation of land disturbing construction activity, assuming that all land uses prior to development activity are managed in an environmentally sound manner.
- (41) **“Preventive action limit”** has the meaning given in s. NR 140.05(17), Wis. Adm. Code.
- (42) **“Redevelopment”** means areas where development is replacing older development.
- (43) **“Responsible party”** means any entity holding fee title to the property.
- (44) **“Runoff”** means stormwater or precipitation including rain, snow or ice melt or similar water that moves on the land surface via sheet or channelized flow.
- (45) **“Separate storm sewer”** means a conveyance or system of conveyances including roads with drainage systems, streets, catch basins, curbs, gutters, ditches, constructed channels or storm drains, which meets all of the following criteria:
- (a) Is designed or used for collecting water or conveying runoff.
 - (b) Is not part of a combined sewer system.
 - (c) Is not draining to a stormwater treatment device or system.
 - (d) Discharges directly or indirectly to waters of the state.
- (46) **“Site”** means the entire area included in the legal description of the land on which the land disturbing construction activity occurred.
- (47) **“Stop work order”** means an order issued by the Director of Public Works/Village Engineer which requires that all construction activity on the site be stopped.

- (48) **“Stormwater management plan”** means a comprehensive plan designed to reduce the discharge of pollutants from stormwater after the site has undergone final stabilization following completion of the construction activity.
- (49) **“Stormwater management system plan”** is a comprehensive plan designed to reduce the discharge of runoff and pollutants from hydrologic units on a regional or municipal scale.
- (50) **“Technical standard”** means a document that specifies design, predicted performance and operation and maintenance specifications for a material, device or method.
- (51) **“Top of the channel”** means an edge, or point on the landscape, landward from the ordinary high water mark of a surface water of the state, where the slope of the land begins to be less than 12% continually for at least 50 feet. If the slope of the land is 12% or less continually for the initial 50 feet, landward from the ordinary high water mark, the top of the channel is the ordinary high water mark.
- (52) **“TR-55”** means the United States Department of Agriculture, Natural Resources Conservation Service (previously Soil Conservation Service), Urban Hydrology for Small Watersheds, Second Edition, Technical Release 55, June 1986.
- (53) **“Type II distribution”** means a rainfall type curve as established in the “United States Department of Agriculture, Soil Conservation Service, Technical Paper 149, published 1973”. The Type II curve is applicable to all of Wisconsin and represents the most intense storm pattern.
- (54) **“Waters of the state”** has the meaning given in s. 281.01 (18), Wis. Stats.

S.17 EFFECTIVE DATE.

This ordinance shall be in force and effect from and after its adoption and publication. The above and foregoing ordinance was duly adopted by the Village Board of the Village of Hartland on the [number] day of [month], [year].

Adopted this _____ day of _____, _____

Village of Hartland

David C. Lamerand, Village President

Attest:

Connie Casper, CMC, Village Clerk

Adopted: _____

Published: _____

ILLCIT DISCHARGES AND CONNECTIONS

(a) DEFINITIONS. The following definitions shall be applicable in this Section:

- (1) Illicit Connection: Any drain or conveyance, whether on the surface or subsurface, which allows an illegal discharge to enter the storm drain system including, but not limited to any conveyances which allow any non-storm water discharge including sewage, process wastewater, and wash water to enter the storm drain system and any connections to the storm drain system from indoor drains and sinks, regardless of whether said drain or connection had been allowed, permitted, or approved by a government agency, prior to the adoption of this ordinance.
- (2) Person: Means any individual, association, organization, partnership, firm, corporation or other entity recognized by law and acting as either the owner or as the owner's agent.
- (3) Storm Drain System: Publicly-owned facilities by which storm water is collected and/or conveyed, including but not limited to any roads with drainage systems, municipal streets, gutters, curbs, inlets, piped storm drains, pumping facilities, retention and detention basins, natural and human-made or altered drainage channels, reservoirs, and other drainage structures.

(b) DISCHARGES PROHIBITED. No person shall discharge, spill or dump substances or materials which are not entirely composed storm water into receiving bodies of water or onto driveways, sidewalks, parking lots or other areas that drain into the storm drainage system. Unless otherwise approved by the Director of Public Works/Village Engineer, no person shall discharge roof drains, yard drains or sump pumps onto streets, sidewalks, or other areas within Village right-of-way that drain into the storm drainage system. Roof drains, yard drains, and sump pumps shall discharge onto pervious areas at grade on private property.

(c) CONNECTIONS PROHIBITED. The construction, use, maintenance or continued existence of illicit connections to the storm drainage system is prohibited. This prohibition expressly includes, without limitation, illicit connections made prior to the adoption of this ordinance, regardless of whether the connections was permissible under law or practice applicable or prevailing at the time of connection. Unless otherwise approved by the Director of Public Works/Village Engineer, roof drain and sump pump discharge connections to the Storm Drainage System shall be prohibited.

(d) EXEMPTIONS. The following activities are exempt from the provisions of this section unless found to have an adverse impact on the storm water:

- (1) Discharges authorized by a permit issued by the Wisconsin Department of Natural Resources.
- (2) Discharges resulting from fire fighting activities.
- (3) Discharges from uncontaminated ground water, potable water source, air conditioning condensation, springs, lawn watering, individual residential car washing, water main and hydrant flushing and swimming pools if the water has been dechlorinated.

(e) ENFORCEMENT. Whenever the Village of Hartland finds a person has violated a prohibition or failed to meet a requirement of this section, the Village of Hartland may order compliance by written notice of violation to the responsible person. Such notice may require without limitation:

- (1) The elimination of illicit connections or discharges;
- (2) That violating discharges, practices, or operations shall cease and desist;
- (3) The abatement or remediation of storm water pollution or contaminated hazards and the restoration of any affected property;
- (4) In the event the person fails to eliminate the illicit connects or discharge, fails to cease and desist in discharge, practices or operations in violation of this Section or fails to abate or remediate the storm water pollution or contamination hazards, that person may be subject to a forfeiture of not less than \$50.00 nor more than \$500.00 for each offense, together with the costs of prosecution. Each day that the violation exists shall constitute a separate offense.

This ordinance shall be in force and effect from and after its adoption and publication. The above and foregoing ordinance was duly adopted by the Village Board of Village of Hartland on the [number] day of [month], [year].

Adopted this _____ day of _____, _____

Village of Hartland

David C. Lamerand, Village President

Attest:

Connie Casper, CMC, Village Clerk

Adopted: _____

Published: _____

APPENDIX D
WET DETENTION BASIN TECHNICAL STANDARD

Wet Detention Basin (No.) Code 1001

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A permanent pool of water with designed dimensions, inlets, outlets and storage capacity, constructed to collect, detain, treat and release stormwater runoff.

II. Purposes - Primary reasons for which the practice is applied. Each purpose identifies a resource problem the practice can be specifically designed to treat.

The primary purposes of this practice are to control water pollution and peak flow.

III. Conditions Where Practice Applies - Land uses and site conditions that affect the suitability or function of the practice.

This practice applies to urban, construction, and agricultural sites where runoff pollution due to suspended solids loading and attached pollutants is a concern. It also applies where increased runoff from urbanization or land use change is a concern. Site conditions must allow for runoff to be directed into the basin and a permanent pool of water to be maintained.

This practice does not apply to wetland restorations, animal lot runoff control, infiltration basins, or dry detention basins. It also does not apply to sites with high concentrations of toxic materials, or other regulated materials contained in the runoff.

This practice may not apply to all flood control, floodplain management and other flooding issues. Modifications to the peak flow criteria or additional analysis of the potential flooding issues may be needed.

IV. Federal, State and Local Laws

The design, construction, and maintenance of wet detention basins shall comply with all federal, state and local laws, rules or regulations. The owner/operator is responsible for securing required permits. This standard

does not contain the text of any federal, state or local laws governing wet detention basins.

The location and use of wet detention basins may be limited by regulations relating to navigable waters (Ch. 30, Stats.), floodplains, wetlands, buildings, wells and other structures, or land uses, such as waste disposal sites and airports. The basin embankment may also be regulated as a dam under Ch. 31 Stats. and further restricted under NR 333, Wis. Adm. Code which includes regulations for embankment heights and storage capacities.

V. Criteria - Allowable limits for design parameters, acceptable installation processes, or performance requirements to accomplish one or more identified purposes.

A. General The following minimum criteria shall apply to all wet detention basin designs used for the purposes stated in section II of this standard. Use more restrictive criteria as needed to fit the conditions found in the site assessment.

1. **Site Assessment** - A site assessment shall be conducted and documented to determine the physical site characteristics that will affect the placement, design, construction, and maintenance of the basin. The site assessment shall identify characteristics such as ground slopes, soil types, soil conditions, *bedrock*¹, sinkholes, drainage patterns, runoff constituents, proximity to regulated structures, natural resources, and specific land uses. The site assessment shall include the following:
 - a. A 2 foot contour map drawn to scale showing location and elevations for the basin area, soil borings and test pits, buildings and other structures, property lines, wells, wetlands, 100 yr.

¹ Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used in the text.

- floodplains, surface drains, navigable streams, known drain tile, roads and overhead or buried utilities.
- b. Soil logging of the site shall be to a depth at least 3 ft. below the proposed design bottom of the basin and include information on the texture, color, odor, structure, water table indicators, and distance to and type of bedrock, if encountered.
2. **Water Pollution Control** - A minimum of 80% of the total suspended solids load shall be removed from the runoff volume generated by the drainage area on an average annual basis. The following criteria meet this requirement:
- a. **Permanent Pool** - All basins shall be designed to include a permanent pool of water consisting of a sediment forebay and main pool. (See fig. 1 and fig. 2)
 - (1) The minimum surface area of the permanent pool shall be based on the total drainage area to the basin or it shall be 10,000 sq. ft., whichever is greater. Table 1 or an *approved model* shall be used. Values shall be prorated for mixed land uses.
 - (2) A sediment forebay shall be located at the inlet to trap large particles such as road sand. The storage volume of the sediment forebay shall be consistent with the maintenance plan, with a goal of 5-15% of the permanent pool surface area. The sediment forebay shall be a minimum depth of 3 ft. plus the depth for sediment storage.
 - (3) The length to width ratio of the flow path shall be maximized with a goal of 3:1 or greater. The flow path is considered the general direction of water flow within the basin including the permanent pool and forebay.
 - (4) A safety shelf shall extend a minimum of 8 ft. from the edge of the permanent pool, with a slope of 10h:1v or flatter. The maximum depth of water over the shelf shall be 1.5 ft.
 - (5) Excluding the safety shelf and sediment storage, the average water depth of the permanent pool shall be a minimum of 3 ft.
 - (6) A minimum of 2 ft. shall be added for sediment storage.
 - (7) For basins greater than 20,000 sq. ft., 50% of the total surface area of the permanent pool shall be a minimum of 5 ft. deep. For basins less than 20,000 sq. ft., maximize the area of 5 ft. depth.
 - (8) All side slopes below the safety shelf shall be 2h:1v or flatter as required to maintain soil stability.

Table 1 - Calculation of Minimum Permanent Pool Surface Area.¹

Land Use/Description/Management ²	Total Impervious (%) ³	Minimum Surface Area of the Permanent Pool (% of Watershed Area)	
Residential <ul style="list-style-type: none"> • < 2.0 units/acre (>1/2 acre lots) • 2.0 - 6.0 units/acre • > 6.0 units/acre (high density) 	8 - 28 >28 -41 >41 - 68	0.7 0.8 1.0	
Office Park/Institutional/Warehouse⁴ (Non-retail related business, multi-storied buildings, usually more lawn/landscaping not heavily traveled, no outdoor storage/manufacturing)	<60 60-80 >80	1.6 1.8 2.0	
Commercial/Manufacturing/Storage⁵ (Large heavily used outdoor parking areas, material storage or manufacturing operations)	<60 60-80 >80	1.8 2.1 2.4	
Parks/Open Space/Woodland/Cemeteries	0-12	0.6	
Highways/Freeways (Includes right-of-way area) <ul style="list-style-type: none"> • Typically grass banks/conveyance • Mixture of grass and curb/gutter • Typically curb/gutter conveyance 	<60 60-90 >90	1.4 2.1 2.8	
Cropland (Cropland that is draining to the basin)			
Dominant Surface Soil Texture ⁶ - S, LS - SC, SCL, SL, L, SiL, Si - C, CL, SiCL, SiC		Erosion < <i>Tolerable</i> 0.6 1.6 2.0	Erosion > <i>Tolerable</i> 0.9 2.4 3.0
¹ Multiply the value listed by the watershed area within the category to determine the minimum pond surface area. Prorate for drainage areas with multiple categories due to different land use, management, percent impervious, soil texture, or erosion rates. For example, a 50 acre (residential, 50% imperviousness) x 0.01 (1% of watershed from table) = 0.5 acre + 50 acres (office park, 85% imperviousness) x 0.02 (2% of watershed) = 1.0 acre. Therefore 0.5 acre + 1.0 acre = 1.5 acres for the minimum surface area of the permanent pool.			
² For offsite areas draining to the proposed land use, refer to local municipalities for planned land use and possible institutional arrangements as a regional stormwater plan.			
³ Impervious surfaces include rooftops, parking lots, roads, and similar hard surfaces, including gravel driveways/parking areas. Roofs are assumed to be pitched and half connected (or draining directly) to the storm sewer system. The other half is assumed to drain onto a vegetated area. Paved parking and storage areas are assumed to be all connected. Sidewalks and driveways are only half connected.			
⁴ Category includes insurance offices, government buildings, company headquarters, schools, hospitals, and churches.			
⁵ Category includes shopping centers, strip malls, power plants, steel mills, cement plants, lumber yards, auto salvage yards, grain elevators, oil tank farms, coal and salt storage areas, slaughter houses, and other outdoor storage or parking areas.			
⁶ S=Sand, Si=Silt, C=Clay, L=Loam (USDA Textural Soil Classification System)			

- b. **Extended Detention Volume** - Volume above permanent pool that is released slowly. (see fig. 1 and 2)
 - (1) Extended detention volume shall be the runoff volume produced by a 1-yr., 24-hr. design storm or as computed by an approved model. The 1-yr., 24-hr rainfall data for Wisconsin is shown in Table 4. The relationship of runoff to precipitation is shown in Table 5. For curve number determination see Chapter 2, Natural Resources Conservation Service, Technical Release 55 (TR-55). Use the post development curve number.
 - (2) Outlet design shall allow for the release of the extended detention volume over a period of 24 hr. or greater.
- 3. **Peak Flow Control** - Peak flow control shall be designed to maintain stable downstream conveyance systems and comply with local ordinances or conform with regional stormwater plans where they are more restrictive than this standard. At a minimum:
 - a. Outflow shall not exceed pre-development peak flows for both the 2-yr. and 10-yr., 24-hr design storms.
 - b. All runoff and flow calculations required for peak flow design of this practice shall use a hydrograph-producing method such as TR-55.
 - c. When pre-development land cover is cropland, use the runoff curve numbers in Table 2. For all other pre-development land covers, use runoff curve numbers from TR - 55 assuming “good hydrologic conditions.” For post-development calculations use runoff curve numbers based on actual conditions.

Hydrologic Soil Group	A	B	C	D
Runoff Curve Number	55	68	77	80

- 4. **Inflow Points** – All inlets shall be designed to prevent erosion during peak flows produced by the 10-yr., 24-hr. design storm. Any rock rip-rap or other channel liners shall extend a

- minimum of 1.5 vertical ft. below the permanent pool elevation.
- 5. **Outlets** –All outlet designs shall incorporate preventive measures for ice damage, trash accumulation, and erosion at the outfall.
- 6. **Emergency Spillway** – All basins shall have an emergency spillway. The spillway shall be designed to safely pass peak flows produced by a 100-yr., 24-hour design storm routed through the basin without damage to the structure. The flow routing calculations shall start at the permanent pool elevation.
- 7. **Freeboard** – The basin design shall ensure the top of embankment, after settling, is a minimum of 1 vertical foot above the flow depth in the emergency spillway required to safely pass the routed 100-yr., 24-hr. storm.
- 8. **Side Slopes** – All interior side slopes above the safety shelf shall be 4h:1v or flatter.
- 9. **Bedrock** – If bedrock is encountered within 2 ft. of the bottom of the pond, special precautions shall be taken, as needed, to minimize movement of pollutants to groundwater.
- 10. **Earthen Embankments** - Earthen embankments (see fig. 2) shall be designed to address potential risk and structural integrity issues such as seepage and saturation. All constructed earthen embankments shall meet the following criteria.
 - a. The base of the embankment shall be stripped of all vegetation, stumps, topsoil and other matter. Stripping shall be a minimum of 6 in.
 - b. For embankments where the permanent pool is ponded 3 ft. or more against the embankment, there shall be a core trench or key-way along the centerline of the embankment up to the permanent pool elevation. The core trench or key-way shall be a minimum of 2 ft. deep and 8 ft. wide with a side slope of 1:1 or flatter.
 - c. All embankments shall be constructed with non-organic soils and compacted to 90% standard proctor according to the procedures outlined in ASTM D-698 or by using compaction requirements of USDA Natural Resource Conservation Service, Wisconsin Construction Specification 3. No tree stumps, or other organic material shall be buried in the embankment. The constructed embankment height shall be increased by a minimum of 5% to account for settling.

- d. Any pipes extending through the embankment shall be bedded and backfilled with embankment or equivalent soils. The bedding and backfill shall be compacted in lifts and to the same standard as the original embankment. Excavation through a completed embankment shall have a minimum side slope of 1:1 or flatter.
- e. Measures shall be taken to minimize seepage along any conduit buried in the embankment. Measures such as anti-seep collars or sand diaphragms are acceptable.
- f. Downstream side slopes shall be 3h:1v or flatter.
- g. Minimum embankment top width shall be 10 ft.

11. **Topsoil and Seeding** - Topsoil shall be spread on all disturbed areas, except for elevations below the safety shelf, as areas are completed. Minimum depth of topsoil spread shall be 4 in. Seed all areas above safety shelf.
12. **Operation and Maintenance** - An operation and maintenance plan shall be developed that is consistent with the purposes of this practice, its intended life, safety requirements and the criteria for its design.

The plan shall address the responsible party for operation, maintenance, and documentation of the plan. At a minimum, the plan shall also include details on inspecting sediment depths, frequency of sediment removal, disposal locations for sediment, inlet and outlet maintenance, keeping embankments clear of woody vegetation, and providing access to perform the operation and maintenance activities.

- B. **Construction Site.** A wet detention basin, designed to meet the minimum criteria in section V. A. will also meet the criteria for construction sites if the following criteria are followed.

1. The minimum permanent pool area shall be the larger of 1.5% of the disturbed area, or the permanent pool size as specified in Table 1.
2. If a minimum of 2 vertical feet of sediment storage is not available after construction and site stabilization, all excess sediment must be removed and disposed in accordance with the operation and maintenance plan. After the site is stabilized, the minimum permanent pool depth must meet the requirements of V. A. 2. a.

- C. **Agricultural.** A wet detention basin, designed to meet the minimum criteria in V. A. will also meet the criteria for the control of pollution from agricultural watersheds if the following additional criteria and exceptions are followed.

1. A permanently vegetated buffer extending a minimum of 75 ft. beyond the designed permanent pool elevation is required around the entire basin.
2. The peak outflow for the 10-yr., 24-hr. design storm shall not exceed the peak inflow for the 2-yr., 24-hr. design storm.
3. If the permanent pool is ponded 3 ft. or more against the basin embankment, the embankment and spillway design shall meet the criteria in Engineering Standard 378 - Pond, NRCS Field Office Technical Guide (FOTG) Section IV.
4. The sediment forebay (V. A. 2. a. (2)) is not required.
5. Livestock shall be excluded from the pool, embankment, outlet, and buffer areas.

- VI. **Considerations.** Additional recommendations relating to design which may enhance the use of, or avoid problems with, this practice.

- A. **General.** Consider the following items for all applications of this standard:

1. Additional conservation practices should be considered if the receiving water body is sensitive to temperature fluctuations, oxygen depletion, excess toxins or nutrients.
2. Consider providing additional length to the safety shelf, above or below the wet pool elevation, to enhance safety.
3. The use of liners should be evaluated for maintaining permanent pool levels and reducing potential groundwater contamination.
4. To prevent damage or failure due to ice, all risers extending above the pond surface should be incorporated into the basin embankment.
5. The use of underwater outlets should be considered to minimize ice damage, accumulation of floating trash or vortex control.

6. When designing basins in series (along same flow path), consider the impacts on sediment removal efficiency, flow routing, and safety.
 7. Minimum watershed size and land cover should be considered to ensure adequate runoff volumes to maintain a permanent pool. For supplementing low runoff periods, consider the installation of a well to maintain the permanent pool level.
 8. Aesthetics of the pond should be considered in designing the shape and specifying landscape practices.
 9. If downstream flood management or bank erosion is a concern, a watershed study should be conducted to determine the most appropriate location and design of stormwater management structures.
 10. For elongated pools in the direction of prevailing winds, consider reinforcing banks, extending the safety shelf, or other measures to prevent erosion of embankment due to wave action.
 11. Consider the potential impacts on downstream channels, farming practices, or other land uses if the wet detention basin may create or alter base flows.
 12. To prevent failure, earthen emergency spillways should not be constructed over fill material.
 13. All flow channels draining to the basin should be stable to minimize sediment delivery to the basin.
 14. The use of baffles may be used to artificially lengthen the flow path in the basin.
 15. Consider aerators to maintain aerobic conditions.
- B. Urban Applications.** Consider the following items when applying this standard to urban areas:
1. Consider including volume reduction practices in the design to reduce the potential downstream impacts of larger runoff volumes with increased development.
 2. Consider using flow splitters before the basin inlet to provide treatment of the first flush from urban areas.
3. Consider safety issues such as signage, flotation devices and special landscaping to deter entry by people.
 4. Consider the effects of construction site compaction and the use of deep tilling to increase soil infiltration. Consider raising the hydrologic soil group used in calculating post-development runoff to calculate a more representative runoff volume due to compaction.
 5. Consider vegetative buffer strips along drainage ways leading to the detention basin to help filter pollutants in urban runoff.
- C. Construction Site Applications.** Consider the following items when applying this standard to construction sites:
1. Consider providing extra sediment storage depth for structures that will serve as permanent stormwater management practices. This could eliminate the need for sediment removal after site stabilization.
 2. The entire drainage area, and all of the basin side slopes, should be thoroughly stabilized with a vegetative cover prior to conversion to a permanent pond.
 3. Consider construction sequencing to minimize the amount of land opening during construction.
- D. Agricultural Applications.** Consider the following items when applying this standard to an agricultural setting:
1. Consider installing a sediment forebay to minimize maintenance needs for the entire basin, especially if coarse surface soils are present in the watershed.
 2. Consider vegetative buffer strips between cropland and drainage ways leading to the detention basin to help filter agricultural pollutants. See Standard 393 - Riparian Vegetative Buffer, NRCS FOTG Section IV.
 3. To enhance use by wildlife, consider enlarging the pond surface area, flattening slopes below the water surface, creating irregular edges and planting native species in and around the pond. See Chapter 11 - Ponds and Reservoirs, NRCS Engineering Field Manual.

4. Consider using the basin as an outfall for subsurface drains from upstream agricultural lands.
5. All concentrated flow channels entering the basin from drainage areas as large or larger than those listed in the middle column of Table 3 should be vegetated adequately to carry the 10 yr. storm. See Standard 412 - Grassed Waterway, NRCS FOTG Section IV and to Chapter 7 - Grassed Waterways, USDA-NRCS Engineering Field Manual.
6. All concentrated flow channels entering the basin from drainage areas in the range shown in the right hand column of Table 3 should be vegetated 200 ft. up the channel from the permanent pool. Vegetation should be adequate to carry the 10 yr. storm.
7. Consider measures to minimize sheet and rill erosion in the entire drainage area.

Hydrologic Soil Group	Drainage Area for vegetated channels, ac	Drainage Area for 200 ft. of vegetation up the channels, ac
A	100	20 to 99
A/B	40	15 to 39
B	25	10 to 24
B/C	15	7 to 14
C, D	10	5 to 9

E. Operation and Maintenance Considerations for All Applications -The maintenance plan should address weed or algae growth and removal, insect and wildlife control and any landscaping practices. Outlet designs should consider having the ability to dewater the pond to ease future maintenance. To prevent nuisance from geese, consider not mowing around the pond perimeter. To maximize safety and pollutant removal, allow plant growth along the safety shelf.

VII. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall specify the materials, construction processes, location, size and elevations of

all components of the practice to allow for certification of construction upon completion.

VIII. References

Center for Watershed Protection, *Stormwater BMP Design Supplement for Cold Climates*, Draft Review Document, August 1997.

United States Department of Agriculture, Natural Resources Conservation Service, *Ponds – planning, Design, Construction*, Agriculture Handbook 590, Revised September 1997.

United States Department of Agriculture - Natural Resources Conservation Service, *Wisconsin Field Office Technical Guide, Section IV*.

United States Department of Agriculture - Natural Resources Conservation Service, *Engineering Field Handbook*.

United States Department of Agriculture - Natural Resources Conservation Service, *Technical Release 55*.

United States Department of Commerce - Weather Bureau, *Rainfall Frequency Atlas of the United States, Technical Paper 40*.

Wisconsin Department of Natural Resources - Bureau of Water Resources Management, *Wisconsin Construction Site Best Management Practice Handbook*, Publication WP-222 93 REV, April 1994.

Wisconsin Department of Natural Resources - Bureau of Water Resources Management, *The Wisconsin Stormwater Manual Part One: Overview*, Publication WR-349-94.

IX. Definitions

Approved Model(V. A. 2. b. (1), V. A. 2. c. (1)) - A computer model that is used to predict pollutant loads from urban lands and has been approved by the applicable regulatory authorities. SLAMM and P8 are examples of models which may be used to verify that a detention pond design meets the minimum criterion of 80% reduction of suspended solids.

Bedrock (V. A. 1., V. A. 1. b., V. A. 2. a.) - Consolidated rock material and weathered in-place material with > 50%, by volume, larger than 2 mm in size.

Tolerable (Table 1) - The tolerable level (“T”) of erosion that could occur without losing long term productivity as farmland. T values are assigned for each soil type and are found in Section 1 of the NRCS FOTG. Erosion

rates are estimated using industry standard formulas such as the Revised Universal Soil Loss Equation.

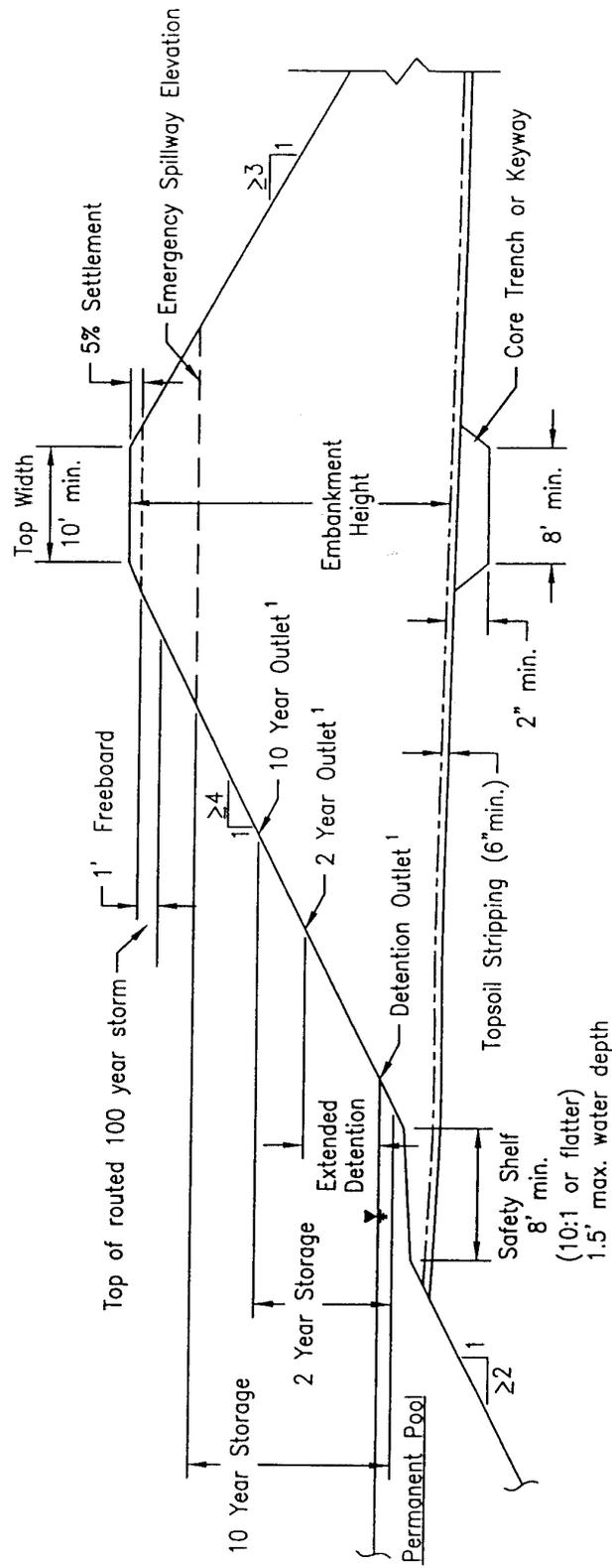
Inches of Rainfall	County
2.1 in.	Door, Florence, Forest, Kewaunee, Marinette, Oconto, Vilas
2.2 in.	Ashland, Bayfield, Brown, Calumet, Douglas, Iron, Langlade, Lincoln, Manitowoc, Menominee, Oneida, Outagamie, Price, Shawano, Sheboygan
2.3 in.	Barron, Burnett, Dodge, Fond du Lac, Green Lake, Marathon, Milwaukee, Ozaukee, Portage, Racine, Rusk, Sawyer, Taylor, Washburn, Washington, Waukesha, Waupaca, Waushara, Winnebago, Wood
2.4 in.	Adams, Chippewa, Clark, Columbia, Dane, Dunn, Eau Claire, Jackson, Jefferson, Juneau, Kenosha, Marquette, Pepin, Pierce, Polk, Rock, St. Croix, Walworth
2.5 in.	Buffalo, Green, Iowa, La Crosse, Monroe, Richland, Sauk, Trempealeau, Vernon
2.6 in.	Crawford, Grant, Lafayette

¹TP - 40 - Rainfall Frequency Atlas of the United States, U.S. Department of Commerce Weather Bureau.

Rainfall (inches)	Runoff Depth in Inches for Curve Number of:										
	50	55	60	65	70	75	80	85	90	95	98
2.1 in.	.00	.02	.08	.17	.28	.43	.63	.88	1.18	1.58	1.87
2.2 in.	.01	.04	.10	.20	.33	.49	.69	.95	1.27	1.67	1.97
2.3 in.	.01	.06	.13	.24	.37	.54	.76	1.03	1.35	1.77	2.07
2.4 in.	.02	.07	.15	.27	.42	.60	.82	1.10	1.44	1.86	2.17
2.5 in.	.02	.08	.17	.30	.46	.65	.89	1.18	1.53	1.96	2.27
2.6 in.	.03	.10	.20	.34	.51	.71	.96	1.26	1.62	2.06	2.37

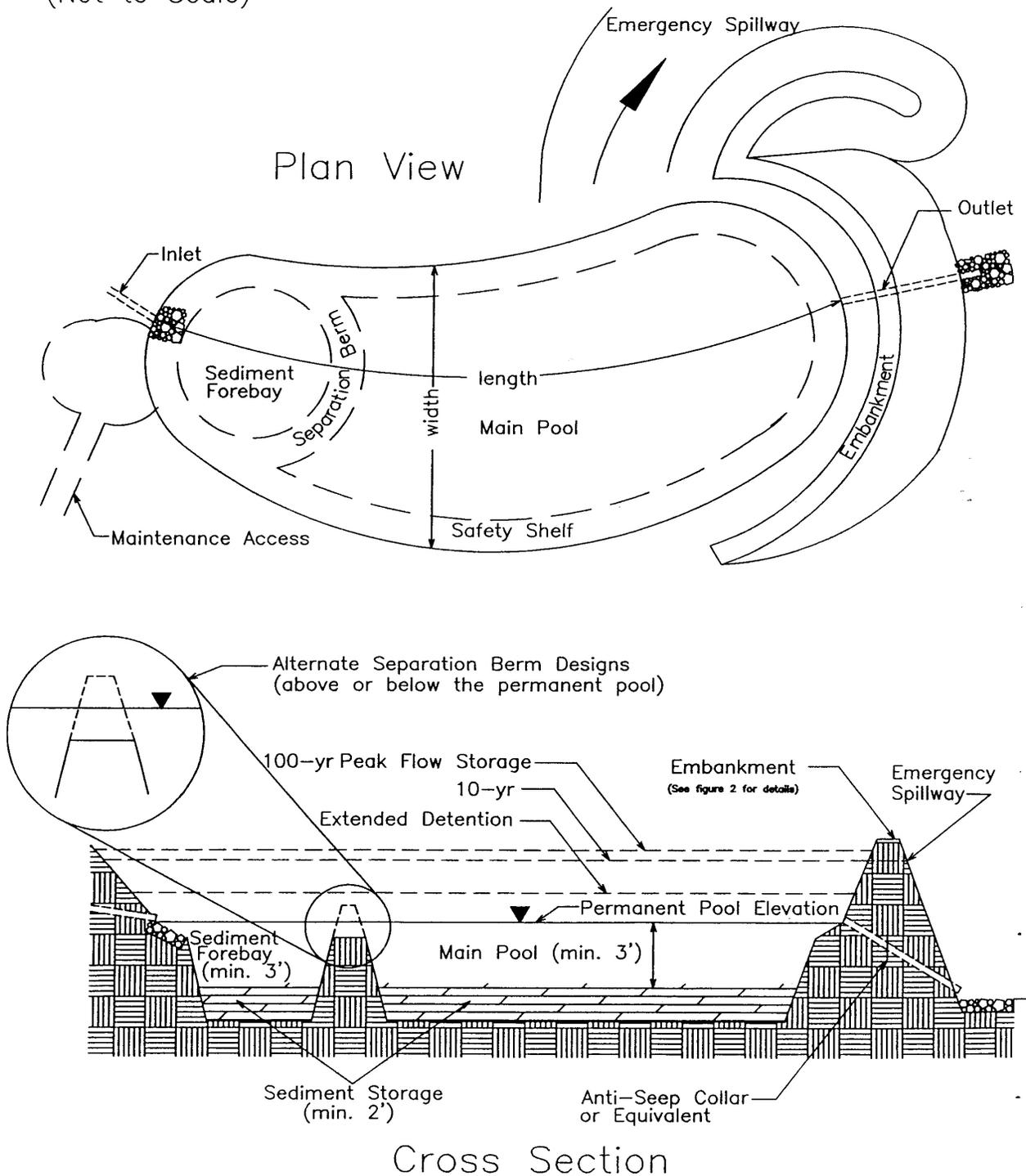
¹NRCS TR-55

Figure 2: Typical Embankment Cross Section for Wet Detention Basin
(Not to Scale)



1. These are conceptual outlet locations to indicate the need to have different outlets for different purposes. Numerous outlet designs will meet the criteria of the standard.

Figure 1: Conceptual Wet Detention Basin
(Not to Scale)



Site Evaluation for Stormwater Infiltration (1002)

Wisconsin Department of Natural Resources
Conservation Practice Standards

I. Definition

This standard defines site evaluation procedures to:

1. Perform an initial screening of a *development site*¹ to determine its suitability for infiltration.
2. Evaluate each area within a development site that is selected for infiltration.
3. Prepare a site evaluation report.

II. Purpose

1. Establish methodologies to characterize the site and screen for exclusions and exemptions under Chapter NR 151 Wis. Adm. code.
2. Establish requirements for siting an *infiltration device* and the selection of design infiltration rates.
3. Define requirements for a site evaluation report that insures appropriate areas are selected for infiltration and an appropriate *design infiltration rate* is used.

III. Conditions where Practice Applies

This standard is intended for development sites being considered for stormwater infiltration devices. Additional site location requirements may be imposed by other stormwater infiltration device technical standards.

IV. Federal, State and Local Laws

Users of this standard shall be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing infiltration devices. This standard does not contain the text of federal, state or local laws.

V. Criteria

The site evaluation consists of four steps for locating the optimal areas for infiltration, and properly sizing infiltration devices.

- Step A. Initial Screening.
- Step B. Field Verification of information collected in Step A.
- Step C. Evaluation of Specific *Infiltration Areas*.
- Step D. Soil and Site Evaluation Reporting.

The steps shall coincide, as much as possible, for when the information is needed to determine the following: 1) the potential for infiltration on the site, 2) the optimal locations for infiltration devices, and 3) the design of the infiltration device(s). Steps A and B shall be completed as soon as possible in the approval process. See Consideration VI.M for an example.

Step A. Initial Screening

The initial screening identifies potential locations for infiltration devices. The purpose of the initial screening is to determine if installation is limited by ss. NR 151.12(5)(c)5. or NR 151.12(5)(c)6., and to determine where field work is needed for Step B. Optimal locations for infiltration are verified in Step B.

Information collected in Step A will be used to explore the potential for multiple infiltration areas versus relying on a regional infiltration device. Smaller infiltration devices dispersed around a development are usually more sustainable than a single *regional device* that is more likely to have maintenance and groundwater mounding problems.

The initial screening shall determine the following:
Note: Useful references for the existing resource maps and information are listed in Considerations VI.I and J.

1. Site topography and slopes greater than 20%.
2. Site soil infiltration capacity characteristics as defined in NRCS County soil surveys.
3. *Soil parent material*.
4. Regional or local depth to groundwater and bedrock. Use seasonally *high groundwater* information where available.

¹ Words in the standard that are shown in italics are described in VIII. Definitions. The words are italicized the first time they are used in the text.

5. Distance to sites listed on the GIS Registry of Closed Remediation sites within 500 feet from the perimeter of the development site.
6. Distance to sites listed on the Bureau of Remediation and *Redevelopment* Tracking System within 500 feet from the perimeter of the development site.
7. Presence of endangered species habitat.
8. Presence of flood plains and flood fringes.
9. Location of hydric soils based on the USDA County Soil Survey and wetlands from the WDNR Wisconsin Wetland Inventory map.
10. Sites where the installation of stormwater infiltration devices is excluded, due to the potential for groundwater contamination, by chapter NR 151 Wis. Adm. Code.
11. Sites exempted by chapter NR 151 Wis. Adm. Code from the requirement to install infiltration devices.
12. Potential impact to adjacent property.

Step B. Field Verification of the Initial Screening

- A. Field verification is required for areas of the development site considered suitable for infiltration. This includes verification of Step A.1, 2, 3, 4, 9, 10 and 11.
- B. Sites shall be tested for depth to groundwater, depth to bedrock and *percent fines* information to verify any exemption and exclusion found in Step A.10 and 11. The following is a description of the percent fines expected for each type of soil textural classification.
 1. Several textural classes are assumed to meet the percent fines limitations of Ch. NR 151.12(5)(c)5.i. for both 3 and 5 foot soil layers. These classifications include the sandy loams, loams, silt loams and all the clay textural classifications. *Coarse sand* is the only soil texture that by definition will not meet NR 151.12(5)(c)5.i. limitations for a 3 foot soil layer consisting of 20% fines. Other sand textures and loamy sands may need the percent fines level verified with a laboratory analysis.
 2. Borings and pits shall be dug to verify soil infiltration capacity characteristics and to determine depth to groundwater and bedrock.
- C. The following information shall be recorded for Step B:
 1. The date or dates the data was collected.

2. A legible site plan/map that is presented on paper that is no less than 8 ½ X 11 inches in size and:
 - a. Is drawn to scale or fully dimensional.
 - b. Illustrates the entire development site.
 - c. Shows all areas of planned filling and/or cutting.
 - d. Includes a permanent vertical and horizontal reference point.
 - e. Shows the percent and direction of land slope for the site or contour lines. Highlight areas with slopes over 20%.
 - f. Shows all flood plain information that is pertinent to the site.
 - g. Shows the location of all pits/borings included in the report.
 - h. Location of wetlands as field delineated and surveyed.
 - i. Location of karst features, private wells within 100 feet of the development site, and public wells within 400 feet of the development site.
3. Soil profile descriptions must be written in accordance with the descriptive procedures, terminology and interpretations found in the Field Book for Describing and Sampling Soils, USDA, NRCS, 1998. Frozen soil material must be thawed prior to conducting evaluations for soil color, texture, structure and consistency. In addition to the data determined in Step B, soil profiles must include the following information for each soil horizon or layer:
 - a. Thickness, in inches or decimal feet.
 - b. Munsell soil color notation.
 - c. Soil mottle or redoximorphic feature color, abundance, size and contrast.
 - d. USDA soil textural class with rock fragment modifiers.
 - e. Soil structure, grade size and shape.
 - f. Soil consistence, root abundance and size.
 - g. Soil boundary.
 - h. Occurrence of saturated soil, groundwater, bedrock or disturbed soil.

Step C. Evaluation of Specific Infiltration Areas

This step is to determine if locations identified for infiltration devices are suitable for infiltration, and to provide the required information to design the device.

A minimum number of borings or pits shall be constructed for each infiltration device (Table 1). The following information shall be recorded for Step C:

1. All the information under Step B.C.3.
2. A legible site plan/map that is presented on paper no less than 8 1/2 X 11 inches in size and:
 - a. Is drawn to scale or fully dimensional.
 - b. Illustrates the location of the infiltration devices.
 - c. Shows the location of all pits and borings.
 - d. Shows distance from device to wetlands.
3. An analysis of groundwater mounding potential is required as per Table 1. The altered groundwater level, based on mounding calculations, must be considered in determining the vertical separation distance from the infiltration surface to the *highest anticipated groundwater elevation* as specified in NR 151. References include but are not limited to Finnemore 1993 and 1995, and Hantush 1967.
4. One of the following methods shall be used to determine the design infiltration rate:
 - a. Infiltration Rate Not Measured - Table 2 shall be used if the infiltration rate is not measured. Select the design infiltration rate from Table 2 based on the least permeable soil horizon five feet below the bottom elevation of the infiltration system.
 - b. Measured Infiltration Rate - The tests shall be conducted at the proposed bottom elevation of the infiltration device. If the infiltration rate is measured with a *Double-Ring Infiltrometer* the requirements of ASTM D3385 shall be used for the field test.

The measured infiltration rate shall be divided by a correction factor selected from Table 3. The correction factor adjusts the measured infiltration rates for the occurrence of less permeable soil horizons below the surface and the potential variability in the subsurface soil horizons throughout the infiltration site.

A less permeable soil horizon below the location of the measurement increases the

level of uncertainty in the measured value. Also, the uncertainty in a measurement is increased by the variability in the subsurface soil horizons throughout the proposed infiltration site.

To select the correction factor from Table 3, the ratio of design infiltration rates must be determined for each place an infiltration measurement is taken. The design infiltration rates from Table 2 are used to calculate the ratio. To determine the ratio, the design infiltration rate for the surface textural classification is divided by the design infiltration rate for the least permeable soil horizon. For example, a device with a loamy sand at the surface and a least permeable layer of loam will have a design infiltration rate ratio of about 6.8 and a correction factor of 4.5. The depth of the least permeable soil horizon should be within five feet of the proposed bottom of the device or to the depth of a limiting layer.

5. To determine if infiltration is not required under NR 151.12(5)(c)6.a., a scientifically credible field test method is required unless the least permeable soil horizon five feet below the bottom of infiltration system is one of the following: sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, or clay. The infiltration rate used to claim the exemption shall be the actual field measurement and shall be used without the correction factors found in Table 3.

Step D. Soil and Site Evaluation Report Contents

The site's legal description and all information required in Steps B and C shall be included in the Soil and Site Evaluation Report. These reports shall be completed prior to the *construction plan* submittal.

Table 1: Evaluation Requirements Specific to Proposed Infiltration Devices

Infiltration Device	Tests Required¹	Minimum Number of Borings/Pits Required	Minimum Drill/Test Depth Required Below the Bottom of the Infiltration System
<i>Irrigation Systems²</i>	Pits or borings	NA ²	5 feet or depth to <i>limiting layer</i> , whichever is less.
<i>Rain Garden²</i>	Pits or Borings	NA ²	5 feet or depth to limiting layer, whichever is less.
<i>Infiltration Trenches</i> (≤ 2000 sq feet impervious drainage area)	Pits or borings	1 test/100 linear feet of trench with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer, whichever is less.
<i>Infiltration Trenches</i> (> 2000 sq ft of impervious drainage area)	<ul style="list-style-type: none"> • Pits or borings • Mounding potential 	1 pit required and an additional 1 pit or boring/100 linear feet of trench, and sufficient to determine variability	Pits to 5 feet or depth to limiting layer Borings to 15 feet or depth to limiting layer
<i>Bioretention Systems</i>	<ul style="list-style-type: none"> • Pits or borings • Mounding potential 	1 test/50 linear feet of device with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer
<i>Infiltration Grassed Swales</i>	Pits or borings	1 test/1000 linear feet of swale with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer
<i>Surface Infiltration Basins</i>	<ul style="list-style-type: none"> • Pits or borings • Mounding potential 	2 pits required per infiltration area with an additional 1 pit or boring for every 10,000 square feet of infiltration area, and sufficient to determine variability	Pits to 10 feet or depth to limiting layer Borings to 20 feet or depth to limiting layer
<i>Subsurface Dispersal Systems</i> greater than 15 feet in width.	<ul style="list-style-type: none"> • Pits or borings • Mounding potential 	2 pits required per infiltration area with an additional 1 pit or boring for every 10,000 square feet of infiltration area, and sufficient to determine variability	Pits to 10 feet or depth to limiting layer Borings to 20 feet or depth to limiting layer

¹Continuous soil borings shall be taken using a bucket auger, probe, split-spoon sampler, or shelly tube. Samples shall have a minimum 2-inch diameter. Soil pits must be of adequate size, depth and construction to allow a person to enter and exit the pit and complete a morphological soil profile description.

²Information from Step B is adequate to design rain gardens and irrigation systems.

Table 2: Design Infiltration Rates for Soil Textures Receiving Stormwater

Soil Texture ¹	Design Infiltration Rate Without Measurement inches/hour ²
Coarse sand or coarser	3.60
Loamy coarse sand	3.60
Sand	3.60
Loamy sand	1.63
Sandy loam	0.50
Loam	0.24
Silt loam	0.13
Sandy clay loam	0.11
Clay loam	0.03
Silty Clay loam	0.04 ³
Sandy clay	0.04
Silty clay	0.07
Clay	0.07

¹Use sandy loam design infiltration rates for fine sand, loamy fine sand, very fine sand, and loamy fine sand soil textures.

² Infiltration rates represent the lowest value for each textural class presented in Table 2 of Rawls, 1998.

³ Infiltration rate is an average based on Rawls, 1982 and Clapp & Hornberger, 1978.

Table 3: Total Correction Factors Divided into Measured Infiltration Rates

Ratio of Design Infiltration Rates ¹	Correction Factor
1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16.0	6.5
16.1 or greater	8.5

¹Ratio is determined by dividing the design infiltration rate (Table 2) for the textural classification at the bottom of the infiltration device by the design infiltration rate (Table 2) for the textural classification of the least permeable soil horizon. The least permeable soil horizon used for the ratio should be within five feet of the bottom of the device or to the depth of the limiting layer.

Required Qualifications

- A. Site Evaluations - Individuals completing site evaluations shall be a licensed professional acceptable to the authority having jurisdiction and have experience in soil investigation, interpretation and classification.
- B. Soil Evaluations - Individuals completing the soils evaluation shall be a Soil Scientist licensed by the Department of Regulation and Licensing or other licensed professional acceptable to the authority having jurisdiction.

VI. Considerations

Additional recommendations relating to design that may enhance the use of, or avoid problems with this practice but are not required to insure its function are as follows:

- A. Groundwater monitoring wells, constructed as per chapter NR 141, Wis. Adm. Code, can be used to determine the seasonal *high groundwater level*. Large sites considered for infiltration basins may need to be evaluated for the direction of groundwater flow.

- B. Karst Inventory Forms on file with the Wisconsin Geological and Natural History Survey should be filled out if a karst feature is located within the site.
- C. Cation Exchange Capacity (CEC) of the soil can indicate the number of available adsorption sites. Sandy soils have limited adsorption capacity and a CEC ranging from 1-10 meq/100g. Clay and organic soils have a CEC greater than 20 and have a high adsorption rate.
- D. Soil organic matter and pH can be used to determine adsorption of stormwater contaminants. A pH of 6.5 or greater is optimal. A soil organic content greater than 1 percent will enhance adsorption.
- E. NR 151 provides for a maximum area to be dedicated for infiltration depending upon land use. This cap can be voluntarily exceeded.
- F. One or more areas within a development site may be selected for infiltration. A development site with many areas suitable for infiltration is a good candidate for a dispersed approach to infiltration. It may be beneficial to contrast regional devices with onsite devices that receive runoff from one lot or a single source area within a lot, such as rooftop or parking lot.
- G. Stormwater infiltration devices may fail prematurely if there is:
 - 1. An inaccurate estimation of the Design Infiltration Rate;
 - 2. An inaccurate estimation of the seasonal high water table;
 - 3. Excessive compacting or sediment loading during construction;
 - 4. No pretreatment for post-development and lack of maintenance.
- H. No construction erosion should enter the infiltration device. This includes erosion from site grading as well as home building and construction. If possible, rope off areas selected for infiltration during grading and construction. This will preserve the infiltration rate and extend the life of the device.
- I. Resources available for completing Step A. Initial screening:
 - 1. Sites listed on the GIS Registry of Closed Remediation sites.
<http://gomapout.dnr.state.wi.us/org/at/et/geo/gwur/index.htm>
- 2. Sites listed in the Bureau of Remediation and Redevelopment Tracking System.
<http://dnr.wi.gov/org/aw/rr/brrts/index.htm>
- 3. Flood plain areas as regulated under s. 87.30, Wis. Stats. and NR 116, NR 30 and NR 31, Wis. Adm. Code.
- 4. Wetlands as defined in Ch. NR 103, Wis. Adm. Code.
- 5. Endangered species habitat as shown on National Heritage Inventory County maps
- 6. Access points and road setbacks as determined by county or municipal zoning plans.
- 7. Existing reports concerning the groundwater and bedrock. Examples include: Publications from USGS, NRCS, Regional Planning Commissions, DNR, DATCP, DOT, UW system or WGNHS.
- 8. The Drinking Water and Groundwater pages of the DNR
<http://dnr.wi.gov/org/water/dwg/>
- 9. The Wisconsin Grain Size Database
<http://www.geology.wisc.edu/~qlab/>
- J. The development site should be checked to determine the potential for archeological sites. This search may be conducted by state staff for projects required or funded by the state.
- K. Slopes 20% or greater are inappropriate for some infiltration devices.
- L. Expect to complete the preliminary design work (Criteria Step A through Step C) before the approval process (platting). Once required information is compiled, the initial design work for an infiltration device can begin.
- M. The approval process requirements for development sites vary across the state and may also vary within a municipality depending on the number of lots being developed. The timing of Steps A, B, and C might have to be adjusted for the type of approval process. The following is an example of when the steps might be completed for a typical development site requiring a plat. The sequence in the example would comply with the criteria for timing of Steps A, B, and C.

Step A should be completed before the preliminary plat and Step B should be completed before the final plat, or CSM is approved. For regional infiltration devices, and for devices constructed on public right-of-ways, public land or jointly owned land, Step C should be completed before the final plat or final CSM approval.

It can be difficult to select the final location and drainage area for an infiltration device before the use of the lot is known. Sometimes it is more desirable to design an infiltration device for an individual lot after the lot is purchased. For this situation Step C would be completed after the final plat is approved. The information for Step C would be collected when the lot is purchased. To give future devices credit towards achieving the infiltration performance standard, the final plat would contain approximate sizing information for each device. Information from Step A and B would be used to determine the approximate sizing information.

- N. The inner ring of the Double-Ring Infiltrometer should be at least 12 inches in diameter.
- O. Section NR 151.12(5)(c)5., is included in the administrative code as a means to discourage infiltration of runoff from or into the listed areas, due to potential concerns of groundwater contamination. Although it is not illegal to infiltrate storm water in areas with the listed limitations, DNR will not give credit for this infiltration towards meeting the infiltration requirements of ss. NR 151.12(5)(c)1. or NR 151.12(5)(c)2. Runoff that is infiltrated must be in compliance with s. NR 151.12(5)(c)8., which requires minimizing infiltration of pollutants so that groundwater quality standards are maintained.

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VIII. Definitions

Bioretention systems (Table 1): Bioretention is an infiltration device consisting of an excavated area that is back-filled with an engineered soil, covered with a mulch layer and planted with a diversity of woody and herbaceous vegetation. Storm water directed to the device percolates through the mulch and engineered soil, where it is treated by a variety of physical, chemical and biological processes before infiltrating into the native soil.

Construction Plan (V.Step D): A map and/or plan describing the built-out features of an individual lot.

Coarse sand (V.Step B.B.1): Soil material that contains 25% or more very coarse and coarse sand, and <50% any other one grade of sand.

Design infiltration rate (II.3): A velocity, based on soil structure and texture, at which precipitation or runoff enters and moves into or through soil. The design rate is used to size an infiltration device or system. Rates are selected to be minimal rates for the different types of soils. Selection of minimal rates will provide a robust design and maximize the longevity of the device.

Development site (I.1): The entire area planned for development, irrespective of how much of the site is disturbed at any one time or intended land use. It can be one lot or multiple lots.

Double-ring infiltrometer (V.Step C.4.b): A device that directly measures infiltration rates into a soil surface. The double-ring infiltrometer requires a fairly large pit excavated to depth of the proposed infiltration device and preparation of a soil surface representative of the bottom of the infiltration area.

High groundwater level (V.Step A.4): The higher of either the elevation to which the soil is saturated as observed as a free water surface in an unlined hole, or the elevation to which the soil has been seasonally or periodically saturated as indicated by soil color patterns throughout the soil profile.

Highest anticipated groundwater elevation (V.Step C.3): The sum of the calculated mounding effects of the discharge and the seasonal high groundwater level.

Infiltration areas (V): Areas within a development site that are suitable for installation of an infiltration device.

Infiltration basin (Table 1): An open impoundment created either by excavation or embankment with a flat densely vegetated floor. It is situated on permeable soils and temporarily stores and allows a designed runoff volume to infiltrate the soil.

Infiltration device (II.2): A structure or mechanism engineered to facilitate the entry and movement of precipitation or runoff into or through the soil. Examples of infiltration devices include irrigation systems, rain gardens, infiltration trenches, bioretention systems, infiltration grassed swales, infiltration basins, subsurface dispersal systems and infiltration trenches.

Infiltration trench (Table 1): An excavated trench that is usually filled with coarse, granular material in which stormwater runoff is collected for temporary storage and infiltration. Other materials such as metal pipes and plastic domes are used to maintain the integrity of the trench.

Irrigation system (Table 1): A system designed to disperse stored stormwater to lawns or other pervious areas.

Limiting layer (Table 1): A limiting layer can be bedrock, an aquatard, aquaclude or the seasonal high groundwater table.

Percent fines (V. Step B.B): the percentage of a given sample of soil, which passes through a # 200 sieve.

Rain garden (Table 1): A shallow, vegetated depression that captures stormwater runoff and allows it to infiltrate.

Regional device (V.Step A): An infiltration system that receives and stores stormwater runoff from a large area. Infiltration basins are the most commonly used regional infiltration devices.

Redevelopment (V.Step A.6): Areas where new development is replacing older development.

Soil parent material (V.Step A.3): The unconsolidated material, mineral or organic, from which the solum develops.

Subsurface dispersal systems (Table 1): An exfiltration system that is designed to discharge stormwater through piping below the ground surface, but above the seasonal high groundwater table.

**Technical Note for Sizing
Infiltration Basins and Bioretention Devices
To Meet State of Wisconsin Stormwater Infiltration Performance Standards**

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PART 1. INTRODUCTION

This technical note includes several tools approved by the Wisconsin Department of Natural Resources to design infiltration basins and bioretention devices capable of meeting the state of Wisconsin stormwater infiltration performance standards contained in ss. NR 151.12(5)(c) and NR 151.24(5), Wis. Adm. Code. The purpose of this technical note is to describe where these tools can be found and how they are used. The Department of Natural Resources recognizes the existence of other models that estimate stormwater infiltration. These other models and tools may also be used to meet the state of Wisconsin infiltration performance standards if approved by the Department of Natural Resources.

The tools included in this technical note are:

- a chart for determining target stay-on depth;
- RECARGA, an infiltration model that can be used to determine the required effective infiltration area for infiltration basins and bioretention devices;
- a set of design charts, developed using RECARGA, which can be used to determine the required effective infiltration area for infiltration basins.

The University of Wisconsin-Madison Department of Civil Engineering developed the RECARGA model. The University of Wisconsin and Department of Natural Resources staff developed the other design charts included in this technical note.

To design an infiltration basin or bioretention device, one or more conservation practice standards must be used in conjunction with this technical note. These conservation practice standards include other important requirements relating to siting, dimensions, construction, operation and maintenance of infiltration practices. The applicable conservation practice standards include:

- DNR Conservation Practice Standard 1002, Site Evaluation for Stormwater Infiltration;
- DNR Conservation Practice Standard 1003, Infiltration Basin;
- DNR Conservation Practice Standard 1004, Bioretention for Infiltration;
- Wisconsin Department of Natural Resources Specification S100, Compost.

These conservation practice standards are posted on the following DNR Internet site:

<http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm#Post>

The designer will use Parts 2 and 3 of this technical note and the DNR Conservation Practice Standard 1003 to determine the required effective infiltration area for an infiltration basin. Part 5 of this technical note may also be used. To determine the effective infiltration area for a bioretention device, the designer will use Parts 2, 4 and 5 of this technical note in conjunction with DNR Conservation Practice Standard 1004. In addition, DNR Conservation Practice Standards 1002 and S100 apply to both devices.

This technical note also cross-references several digital files that can be used to size infiltration basins and bioretention devices. A list of these digital files is shown in Table 1. Note that some of the digital files will be used in designing both infiltration basins and bioretention devices while others are specific to only one of these practices. These digital files can be downloaded from the following DNR Internet site:

<http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm#Post>

Table 1. Directory of digital files referenced in this technical note.

File Content	Applicability	File Name
Technical note text	Infiltration Basins, Bioretention Devices	<i>Technical Note for Sizing Infiltration Devices.doc</i>
Target Stay-on Depth	Infiltration Basins, Bioretention Devices	<i>Target stay-on requirements.xls</i>
Silt loam soils, 3" pond depth	Infiltration Basins	<i>Chart1madsiltloam3.xls</i>
Loam soils, 6" pond depth	Infiltration Basins	<i>Chart2madloam6.xls</i>
Sand loam soils, 6" pond depth	Infiltration Basins	<i>Chart3madsandyloam6.xls</i>
Sand loam soils, 12" pond depth	Infiltration Basins	<i>Chart4madsandyloam12.xls</i>
Loamy sand soil, 6" pond depth	Infiltration Basins	<i>Chart5madloamysand6.xls</i>
Loamy sand soil, 12" pond depth	Infiltration Basins	<i>Chart6madloamysand12.xls</i>
Loamy sand soil, 18" pond depth	Infiltration Basins	<i>Chart7madloamysand18.xls</i>
Loamy sand soil, 24" pond depth	Infiltration Basins	<i>Chart8madloamysand24.xls</i>
Sand, 6" pond depth	Infiltration Basins	<i>Chart9madsand6.xls</i>
Sand, 12" pond depth	Infiltration Basins	<i>Chart10madsand12.xls</i>
Sand, 18" pond depth	Infiltration Basins	<i>Chart11madsand18.xls</i>
Sand, 24" pond depth	Infiltration Basins	<i>Chart12madsand24.xls</i>
RECARGA v. 2.3	Infiltration Basins, Bioretention Devices	<i>RECARGA_2_3.exe</i> <i>(In Recarga Folder)</i>
RECARGA User's Manual v. 2.3	Infiltration Basins, Bioretention Devices	<i>RECARGA 2p3 User's Guide.doc</i>

PART 2. DETERMINING THE TARGET STAY-ON DEPTH FOR INFILTRATION BASINS AND BIORETENTION DEVICES

Instructions. DNR Conservation Practice Standard 1003 (Infiltration Basin) and 1004 (Bioretention for Infiltration) define target stay-on as follows:

"The amount of infiltration required on an average annual basis. It is the portion of the annual rainfall (inches) on the development site that must be infiltrated on an annual basis to meet the infiltration goal."

The target stay-on depth is a required input for the RECARGA model and the infiltration basin design charts included in this technical note. Consequently, the target stay-on depth must be known in order to use these tools to determine the effective infiltration area of either an infiltration basin or a bioretention device.

The target stay-on depth for a development site is a function of the pre-development infiltration for the site and that portion of the pre-development infiltration that must be retained on the site to meet the state requirement. This technical note includes a simple design chart incorporating these factors. The chart can be used to determine the target stay-on needed to meet the state infiltration goal. The chart is found in the file "*Target stay-on requirements.xls*" (See Table 1). This Microsoft Excel file contains two worksheet tabs: "Target Chart" and "Target Data". Open the worksheet tab entitled "Target Chart". The chart itself is titled "Chart 1. Target Stay-on Requirement". You do not need, and should not attempt to open or modify, the underlying target data.

Note: State infiltration requirements are established in chapter NR 151, Wis. Adm. Code. Pursuant to NR 151.12(5)(c)1.a., the goal for residential development is to maintain 90% of the annual pre-development infiltration. Pursuant to NR 151.12(5)(c)2.b., the goal for non-residential sites is to retain 60% of the annual pre-development infiltration.

Other parts of NR 151 (NR 151.12(5)(c)1. and NR 151.12(5)(c)2.) include alternative infiltration requirements based on infiltrating runoff from the 2-year, 24-hour design storm. Although the design storm approach can be used to fulfill the state requirement, this technical note does not address that method.

“Chart 1, Target Stay-on Requirement” is used to determine the annual infiltration requirement for any site, regardless of the management practice to be applied. This means it is applicable to both infiltration basins and bioretention devices.

The x-axis of Chart 1 is the pre-development curve number. The appropriate pre-development curve number should be taken from TR-55 unless the pre-developed land use is cropland. If the pre-developed land use is cropland, s. NR 151.12(5)(b) 1., Wis. Adm. Code identifies maximum pre-development curve numbers that can be used. These are reproduced in the following table.

Table 2. Maximum pre-development runoff curve numbers for cropland areas				
Hydrologic Soil Group	A	B	C	D
Runoff Curve Number	56	70	79	83

Note: The curve numbers in this table represent mid-range values for soils under a good hydrologic condition where conservation practices are used.

The y-axis of Chart 1 is the target stay-on depth (annual infiltration requirement), in inches/year, for the development area. There are three curves in the chart. One curve is for residential development, a second is for non-residential (including commercial) development and a third is for pre-development conditions. The example below explains how to use this chart to make the required determination.

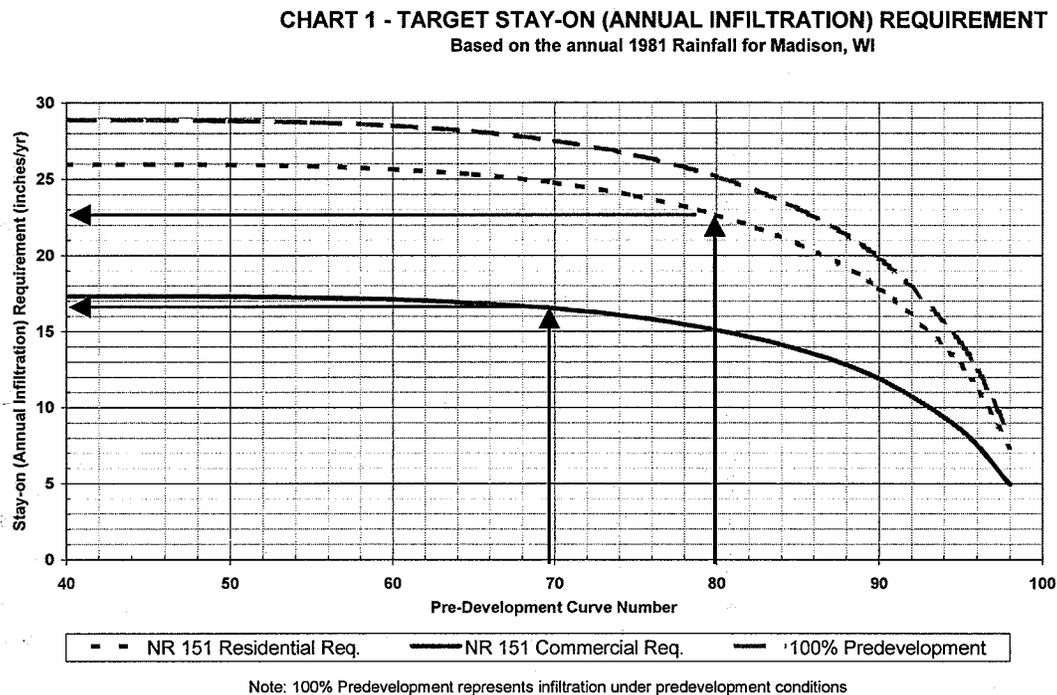
Chart 1 was developed using the annual rainfall sequence file for Madison, Wisconsin, 1981 (March 12 – December 2). This file may be used for statewide application until additional charts are prepared for other regional rainfalls. When additional charts are completed, they will be posted in this technical note.

Example. Figure 1 illustrates how the chart can be used to determine the annual infiltration requirement for a particular development:

- Locate the pre-development curve number on the x-axis.
- Move vertically to intersect the appropriate curve (residential or non-residential (commercial))
- Move horizontally to intersect the y-axis and determine the annual infiltration requirement.

For example, if the predevelopment curve number is 70 and the development site is non-residential (commercial), the annual infiltration requirement is 16.5 inches/year. If the predevelopment curve number is 80 and the development site is residential, the annual requirement is 22.5 inches/year.

Figure 1. Sample use of chart to determine the target stay-on requirement.



PART 3. DETERMINING THE EFFECTIVE INFILTRATION AREA REQUIREMENT FOR INFILTRATION BASINS

Instructions. In addition to target stay-on depth, other important parameters that affect the required effective infiltration area of an infiltration basin include:

- design infiltration rate of the native soil;
- design ponding depth in the basin;
- percent imperviousness of the development in the area tributary to the basin;
- post-development curve number of pervious areas in the area tributary to the basin.

A set of 12 design charts for infiltration basins was prepared using the RECARGA model. These are listed in Table 1 (example: *Chart5madloamysand6.xls*). Each chart represents a combination of design infiltration rate (K_d) and design ponding depth. The design infiltration rate (K_d) for each soil textural class is taken from DNR Conservation Practice Standard 1002, Site Evaluation for Stormwater Infiltration. DNR Conservation Practice Standard 1003 states that the ponding depth must infiltrate within the maximum allowable draw down period of 24 hours. This means that $(\text{Pond depth})/(K_d)$ must be equal to or less than 24 hours. Table 3 shows the combinations of design infiltration rates and ponding depths covered by the charts listed in Table 1. All infiltration basins were modeled using a rooting zone depth of 6 inches.

Each of the 12 charts includes several graphs corresponding to various percentages of imperviousness in the drainage area and the curve number of the pervious portion of the drainage area. In each chart, there are 6 imperviousness categories: 0%, 20%, 40%, 60%, 80%, and 100%. Each of the impervious categories is further refined based on the curve number of the pervious area. Two pervious area curve numbers are graphed: one graph depicts a pervious area curve number (CNp) of 60 and the other depicts a pervious area curve number (CNp) of 80.

To determine the area of an infiltration basin required to meet the annual infiltration requirement, the designer may use one of these prepared charts. If the designer wishes to determine the effective infiltration area for conditions that are not depicted on these charts, RECARGA may be used (See Part 5).

Table 3. Combinations of infiltration rates and ponding depths covered by Charts 1-12 listed in Table 1.

Soil Texture	Design Infiltration Rate (Kd), inches/hour	Basin Design Ponding Depth, inches
Silt loam	.13	3
Loam	.24	6
Sandy loam	.5	6
Sandy loam	.5	12
Loamy sand	1.63	6
Loamy sand	1.63	12
Loamy sand	1.63	18
Loamy sand	1.63	24
Sand	3.6	6
Sand	3.6	12
Sand	3.6	18
Sand	3.6	24

After determining the target stay-on depth (see Part 2) and selecting the appropriate chart from Table 1, determine the preliminary effective infiltration area. This determination is preliminary because it may need to be increased to account for longitudinal slopes and the creation of infiltration cells within the infiltration basin. This correction process is described in DNR Conservation Practice Standard 1003, Infiltration Basin.

To determine the preliminary effective infiltration area required to meet the infiltration requirement, the required target stay-on depth is located on the y-axis of the design chart. Move horizontally to intersect the appropriate line depicting the % imperviousness and pervious area curve number. Drop down to the x-axis to find the infiltration basin area, which is expressed as a percent of the drainage area. Multiply this percentage by the size of the tributary area that will be served by the basin to determine the preliminary value for the effective infiltration area required to meet the state infiltration performance standard. Adjust the preliminary area as needed to account for the longitudinal slope and infiltration cell configuration, as described in DNR Conservation Standard 1003, Infiltration Basin.

In using these charts, it is acceptable to visually extrapolate within the same chart between the percent imperviousness graphs and also between the pervious area curve number graphs. However, it is not acceptable to extrapolate between charts (e.g. between charts 10 and 11).

Example. The site is 20 acres of cropland that will be converted to a mixed commercial & residential development. Assume the native soils in the area to be developed are silt loams and loams in soil hydrologic groups B and C with an average pre-development curve number of 75. Following development, the site will be 15 acres medium density residential and 5 acres commercial. A site investigation using DNR Conservation Practice Standard 1002, Site Evaluation for Stormwater Infiltration, concludes that the soil texture at the infiltration basin site is a sandy loam with a design infiltration rate of 0.5 in/hr. The post-development curve number for the pervious portions of the new urban development is anticipated to be 70, based on TR-55. The designer wants to maximize the pond depth, which would mean a depth of 12 inches could be accommodated based on an infiltration rate of .5 inches/hour and a maximum allowable drawdown time of 24 hours.

Step 1: Determine Overall Approach. The effective infiltration area needed for the runoff from residential areas will be determined and then added to the effective infiltration area needed for commercial areas. The sum of these two areas is the preliminary effective infiltration area. The preliminary effective infiltration area is then adjusted in accordance with DNR Conservation Practice Standard 1003, Infiltration Basin, to account for longitudinal slope and cell configuration.

Step 2: Determine Basin Component to Accommodate Residential Runoff. Two sub-steps are needed.

Sub-step 2A: Determine Target Stay-on Depth for Residential Component. The Target Stay-on Depth for the residential land use is determined using the file *Target stay-on requirements.xls*. The pre-development curve number is 75. The target stay-on depth for the residential portion of the basin is determined to be approximately 24 inches/year. Figure 2 illustrates this determination.

Sub-step 2B: Determine Preliminary Infiltration Area for Residential Component. The chart applicable to this site is *Chart4madsandyloam12".xls* (see list in Table 1.) In this example, assume an impervious area percentage of 40% for medium density residential and assume a curve number for pervious portions of the site to be 70. The target stay-on depth is 24 inches/year as determined in sub-step 2A. Using Chart 4, the facility must be 1.2% of the 15-acre medium density residential area. Figure 3 illustrates this determination. The capacity needed for runoff from the residential area is therefore 7,840 square feet ($43,560 * 15 * .012$).

Step 3: Determine Basin Component to Accommodate Commercial Runoff. Two sub-steps are needed.

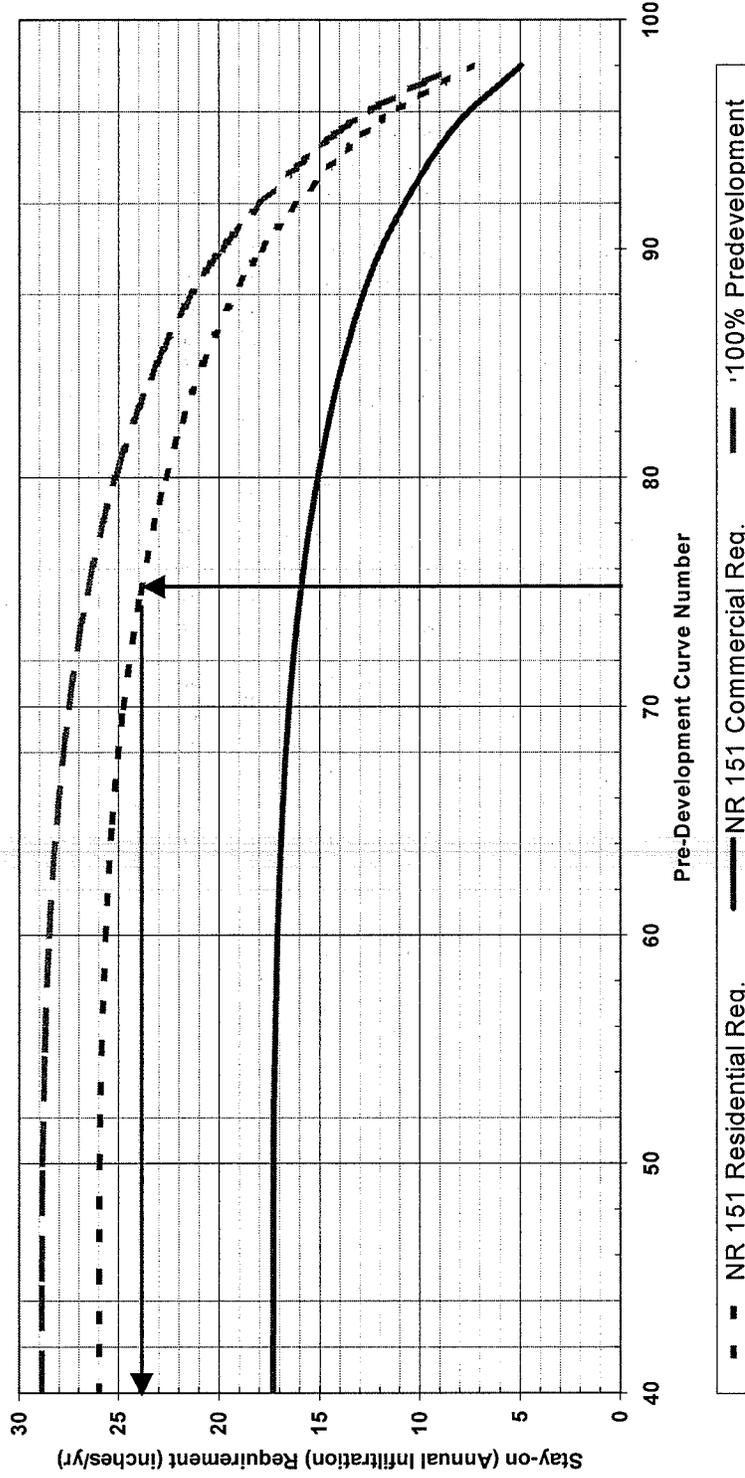
Sub-step 3A: Determine Target Stay-on Depth for Commercial Component. The Target Stay-on Depth for the commercial land use is determined using the file *Target stay-on requirements.xls*. The pre-development curve number is 75. The target stay-on depth for the commercial portion of the basin is approximately 16 inches/year. Figure 4 illustrates this determination.

Sub-step 3B: Determine Preliminary Infiltration Area for Commercial Component. The chart applicable to this site is *Chart4madsandyloam12".xls* (see Table 1.) In using this chart, assume an impervious area percentage of 70% for commercial and assume that the curve number for pervious portions of the site is 70. The target stay-on depth is 16 inches/year as determined in sub-step 3A. Using Chart 4, the facility must be 0.5% of the 5 acres of commercial land use. Figure 5 illustrates this determination. The capacity needed for runoff from the commercial area is 1,089 square feet ($43,560 * 5 * .005$).

Step 4: Add the residential and commercial capacities to determine the preliminary effective infiltration area for a basin 12 inches deep. This area is 8,930 square feet (7,840 square feet for residential capacity + 1,089 square feet for commercial capacity). This area is used in conjunction with DNR Conservation Practice Standard 1003, Infiltration Basin, to determine the final effective infiltration area after needed adjustments are made for longitudinal slope and basin cell configurations.

Figure 2. Using Chart 1 to determine the target stay-on depth (inches/year) for the residential portion of the development area

CHART 1 - TARGET STAY-ON (ANNUAL INFILTRATION) REQUIREMENT
 Based on the annual 1981 Rainfall for Madison, WI



Note: 100% Predevelopment represents infiltration under predevelopment conditions

Figure 3. Using Chart 4 to determine the preliminary effective infiltration area needed to serve runoff from residential portion of drainage area

Chart 4: Infiltration Basin Design Curve
Sandy Loam Soil: $K_d=0.50$ in/hr and 12-inch Ponding Depth

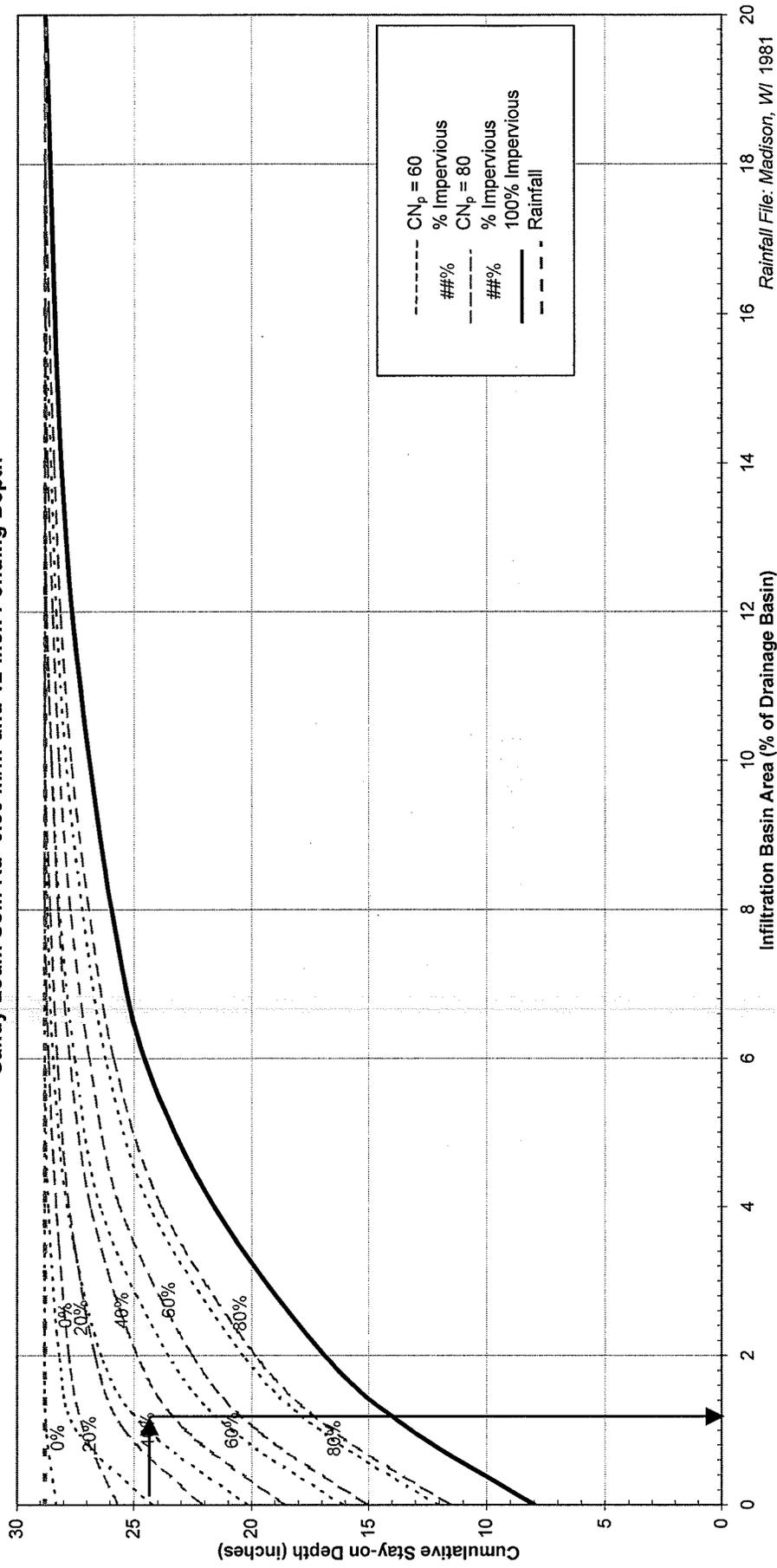
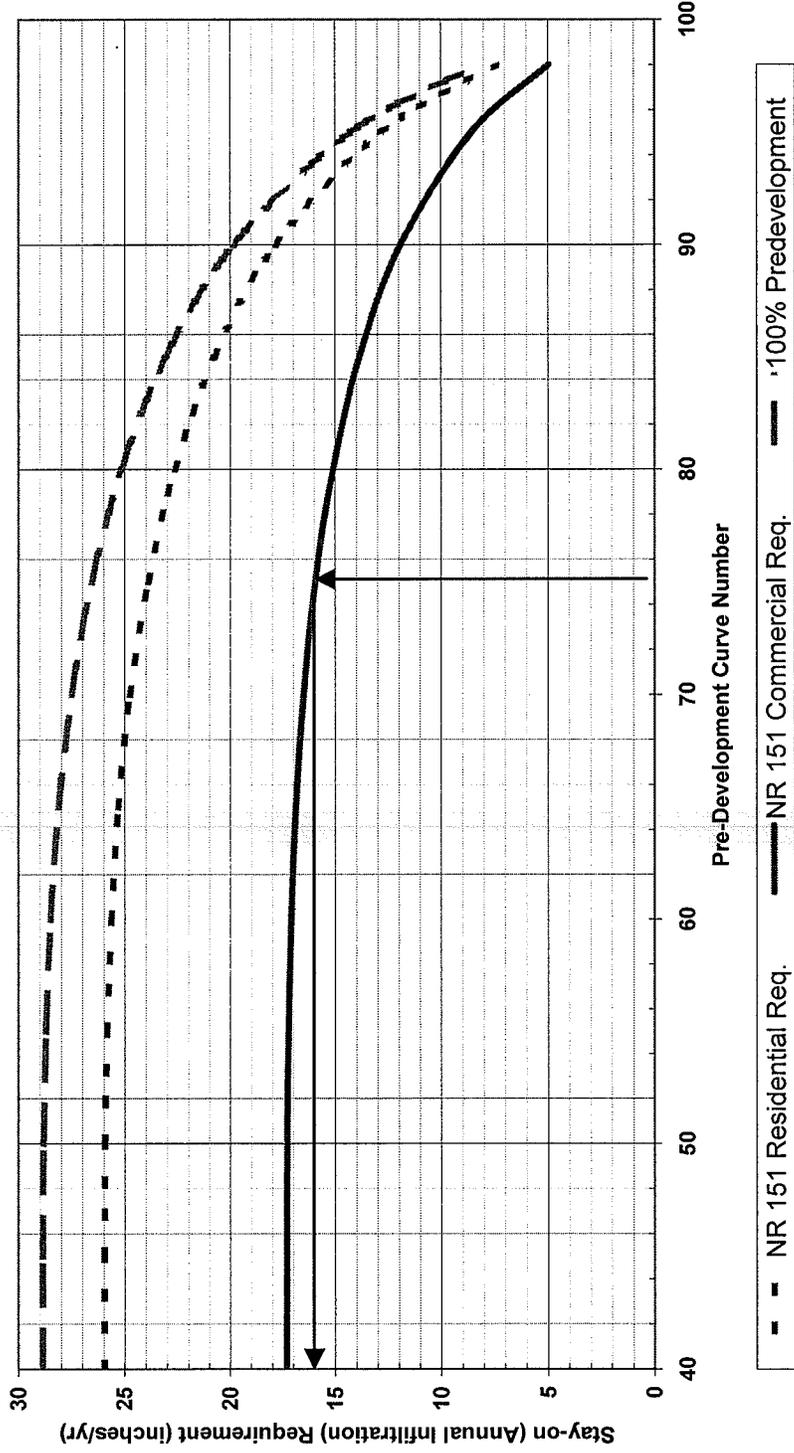


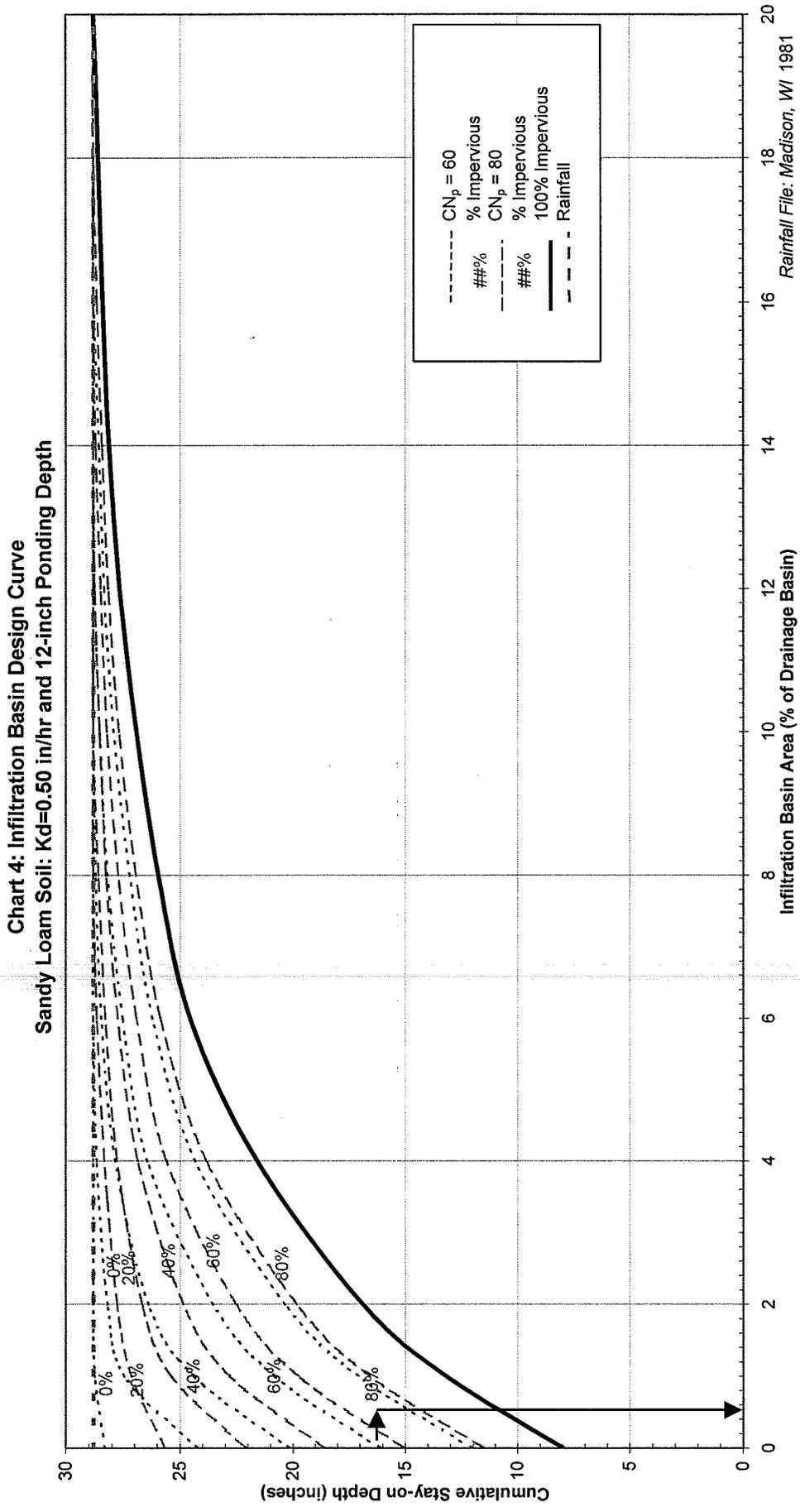
Figure 4. Using Chart 1 to determine the target stay-on depth (inches/year) for the commercial portion of the development area

CHART 1 - TARGET STAY-ON (ANNUAL INFILTRATION) REQUIREMENT
 Based on the annual 1981 Rainfall for Madison, WI



Note: 100% Predevelopment represents infiltration under predevelopment conditions

Figure 5. Using Chart 4 to determine the preliminary effective infiltration area to serve runoff from commercial portion of drainage area.



Part 4.

Determining the Effective Infiltration Area Requirement for Bioretention Devices

Determining the effective infiltration area of a bioretention device is more complicated than determining this area for an infiltration basin. Additional factors that affect infiltration dynamics include variation in the depth of the engineered soil, flow dynamics through the perforated underdrain and a variable sand/gravel storage layer. These additional factors require a more sophisticated modeling tool.

The RECARGA model referenced in Table 1 may be used to determine the required effective infiltration area of a bioretention device. The RECARGA model is discussed in Part 5.

Part 5. The RECARGA Model

The Water Resources Group at the University of Wisconsin Department of Civil and Environmental Engineering developed the RECARGA model. The model provides a design tool for evaluating the performance of bioretention devices, infiltration basins and rain gardens. Individual facilities with surface ponding, up to 3 distinct soil layers and optional underdrains can be modeled under user-specified precipitation and evaporation conditions. The model continuously simulates the movement of water throughout the facility (ponding zone, soil layers and underdrains), records the soil moisture and volume of water in each water budget term (infiltration, recharge, overflow, underdrain flow, evapotranspiration, etc.) at each time step and summarizes the results. The results of this model can be used to size facilities to meet specific performance objectives, such as reducing runoff volume or increasing recharge, and for analyzing the potential impacts of varying the design parameters.

The model uses the Green-Ampt infiltration model for initial infiltration into the soil surface and the van Genuchten relationship for drainage between soil layers. Input to the facility is calculated from user specified land cover data (percent impervious area, pervious area curve numbers and the area of the facility and tributary basin) using an initial abstraction equation (for impervious areas) or the TR-55 methodology for pervious areas. Underdrain flow is calculated using the orifice equation. The model also tracks continuous soil moisture and evapotranspiration between storm events. The user interface is intuitive and simple to use.

The model can be used in two modes: the original RECARGA simulation and the Facility Area Ratio Simulation.

RECARGA Simulation. In this simulation the user enters data for estimated facility area, tributary area, percent imperviousness, pervious area curve number, design pond depth, design engineered soil depth, design engineered soil infiltration rate (default available), design storage layer depth, design storage layer infiltration rate (default available), design infiltration rate of native soil, underdrain flow rate, design rainfall file (default available) and regional evapotranspiration data (default available).

A simulation is run and basic water budget information is provided including the stay-on achieved. If the stay-on achieved is too high or too low, the simulation is run again with a different facility area chosen by the designer. This process is continued until the target stay-on is achieved. This can usually be accomplished in 3-4 model runs. This process should take about 2 minutes per model run (about 10 minutes total) at commonly available computing speeds. Slower processors will take longer.

Facility Area Ratio Simulation. This simulation is a sub-routine run within RECARGA. It uses the same interface as the RECARGA model. Although it does not provide water budget output data, it does not require the user to go through an iterative process to determine the required facility area. This sub-routine performs the iteration for the user. Once the data is entered and the Facility Area Routine (FAR) is run, the program will provide the required facility area ratio. This percentage is then multiplied by the tributary area to calculate the required facility area. The input data is the same except that the user enters the target stay-on instead of the estimated facility area.

This process should take about 10 minutes for the model run at commonly available computing speeds. Slower processors will take longer.

The RECARGA model and the RECARGA User's Manual (Version 2.3) are referenced in Table 1. Both are available for downloading from the DNR Internet site. The User's Manual provides adequate guidance for using this design tool.

Note: The Water Resources Group has also prepared another tool called the Bioretention Nomograph and Worksheet Method. This method is based on RECARGA and as such is an approximation. The Department of Natural Resources does not authorize this tool for final practice design because determinations using the worksheet method may be 10-25% different than estimates produced by the model. However, the Bioretention Nomograph and Worksheet Method is valuable for quickly evaluating the effect that variation in design parameters has on required facility area. Although this worksheet method is not approved for final design and is not part of this technical note, DNR is making the method available as guidance on the DNR Internet site. It is a valuable learning tool and can be used, if desired, for preliminary sizing estimates.

Infiltration Basin

(Acre-Feet)
(1003)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

An infiltration basin is defined as an open impoundment (greater than 15 feet wide in its minimum dimension) created either by excavation or embankment with a flat, densely vegetated floor dedicated to the infiltration of runoff through the ground surface.

II. Purpose

The practice may be applied as part of a structural stormwater management practice system to support one or more of the following purposes:

- Reduce stormwater pollutants
- Increase discharge to groundwater
- Decrease runoff peak flow rates and volumes
- Preserve base flow in streams
- Reduce temperature impacts of runoff.

III. Conditions Where Practice Applies

The infiltration basin practice applies to urban areas where increased pollutant loadings, thermal impacts, or increased runoff volumes are a concern and the area is suitable for infiltration. (See NR 151.12(5) (c) 5 and 6 and WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002).)

IV. Federal, State and Local Laws

Users of this standard shall be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing infiltration basins. This standard does not contain the text of federal, state or local laws.

V. Criteria

A. Screening criteria located in the WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002) shall be followed. In addition, the following site location criteria shall be met.

1. Building location – The basin shall not be *hydraulically connected*¹ to foundations or pavements, or cause negative impacts to structures. These negative impacts could include: water in basements and foundation instability.
2. 20% Slopes - Infiltration shall not cause seepage, contribute to hill slope failure or increase erosion on down gradient slopes. A minimum horizontal setback distance of 200 feet shall be maintained from down gradient slopes greater than 20% unless slope stability calculations demonstrate that the slope is stable under saturated conditions at a shorter distance from the practice. Note: Berms constructed as part of the practice are not included in this separation distance.

B. Design

1. Bypass/Dewatering – The basin shall be designed with a maintenance draw down capability. An example of this device is shown on Figure #3.

When infiltration cells are used, a *draw down device* shall be provided for each cell.

2. Pretreatment Practices – Space must be allotted for pretreatment prior to infiltration to remove the following percentage of total suspended solids, on an average annual basis, based on the following land uses.
 - a. 60% for residential (and associated roads)

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¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

- b. 80% for commercial, industrial, institutional (and associated roads)
- 3. Infiltration Rates - See WDNR Conservation Practice Standard Site Evaluation for Stormwater Infiltration (1002) for design infiltration rates.
- 4. Dimensions
 - a. Depth – Depth is a function of the maximum draw down time of 24 hours (for the infiltration portion of the practice only), using the design infiltration rate, with a not to exceed depth of 24 inches.

The maximum depth of 24 inches applies to all infiltration cells within the practice.
 - b. *Target Stay-on Depth* – The target stay-on depth shall meet the requirements of NR 151. (See Consideration L.)
 - c. Effective Infiltration Area – The maximum depth along with the storage volume of water to be infiltrated can be used to determine the preliminary *effective infiltration area* necessary for the infiltration basin. (See Consideration L.)
 - d. Slopes
 - 1. Longitudinal Slope – If used, the longitudinal slope shall not exceed 1% (0% longitudinal slope is recommended). If any longitudinal slope is specified, “infiltration cells” as described in V.B.4.f. shall be required.
 - 2. Lateral Slopes in the effective infiltration area shall be 0%.

Example: (This example is a continuation of the 20 acre mixed land use example presented in “Technical Note for Sizing Infiltration Basins and Bioretention Devices to Meet State of Wisconsin Stormwater Infiltration Performance Standards.” See Consideration L. for reference.)

This example assumed an average pre-development curve number of 75 for the pre-development soil condition in the drainage basin, sandy loam soils at the infiltration site and a post-development curve number of 70 for the pervious areas in the drainage basin. From that example, the preliminary effective infiltration area is 8,930 square feet or 0.2 acres. Therefore, the storage volume (SV) at a one-foot maximum depth (MD) is 0.2 acre-ft or 8,930 cu. ft.

Calculate the dimensions of the basin. Assume a rectangular basin with a length to width ratio of 3:1
 $SV = MD * L * W$ substitute $L = 3W$
 $SV = MD * 3W^2$
 Solve for W:
 $8,930 \text{ cu. ft.} = 1 * 3W^2$ $2,977 = W^2$
 $W = 55 \text{ ft}$
 $L = 3W$ so $L = 164 \text{ ft}$

If using a longitudinal slope, it is still required that the maximum depth, at any point in the basin, not exceed 24 inches (or in this case 12 inches due to the soil type). This slope results in a 3D triangle of infiltration volume versus the cubic volume created by a basin with a flat floor.

To correct for this and to provide the required infiltration volume, the preliminary effective infiltration area originally calculated must be divided by 0.5. This will correct for the triangle of lost volume created by the sloped floor of the basin, the maximum depth and the water surface.

8,930 sq. ft. / 0.5 = 17,860 sq. ft.
The new W and L are now W = 77ft.
and L = 3W = 231ft.

Note: The surface area calculated is the minimum effective infiltration area and does not include slopes or setbacks. Additional site area will be needed to account for berms and slopes.

- e. Side Slopes – All side slopes for interior and exterior berms shall have a 4:1 slope (horizontal: vertical) or flatter.
- f. Infiltration Cells – To maximize the effective infiltration area utilized and to prevent channelized flow, the effective infiltration area shall be subdivided into multiple smaller “cells” using *level spreaders* (example shown in Figure 1 & 2). These “cells” shall be used if a longitudinal slope is specified or if the length of the flow path exceeds 300 linear feet.

The effective infiltration area shall be divided such that as a downstream cell reaches the depth of its level spreader, the elevation of the water in that cell does not exceed the downstream toe of slope from the next upstream level spreader. The height of any level spreader shall not exceed the maximum ponding depth.

Example (continued)

Given: MD = 12 inches, SA = 17, 860 sq. ft., longitudinal slope = 1%. W = 77 ft. L = 231 ft.

With a length of 231 feet and a slope of 1% we know the basin rises 2.3 feet along its length from the outlet to the toe of the pre-treatment area. Given a 12-inch maximum depth of water in the practice for infiltration, the basin needs to be divided into multiple cells with each cell a maximum 300 feet length or a maximum of 12 inches of depth in each cell.

As this example has a longitudinal slope of 1% the maximum cell is 100 feet in length ($100 * 1\% = 1$ feet which is the maximum depth). Had this basin had no longitudinal slope on the floor, a cell up to 300 feet long could have been utilized.

The first level spreader should be located 100 feet upstream from the outlet structure. This leaves us with 131 feet to the pretreatment area. At 1% slope, the height of the level spreader should be 1.3 feet, which is greater than allowed. So the second level spreader should be 1 foot in height, with the third being 100 more feet upstream with a height of 0.43 feet.

Note: To improve the aesthetics of the basin, the second and third cells may be evened out to two cells of 66 feet each and level spreader heights of 0.66 feet.

- 5. Basin Inlets and Cell Dividers / Level Spreader – The design shall evenly spread the outflow from the pretreatment device or between cells across the width of the basin. The pretreatment discharge pipes and stone trench shown in Figures 1 & 2 (plan and profile view) provide an example of level spreaders.
- 6. Basin Outlets – The infiltration basin outlet shall safely convey stormwater

from the basin through all of the following mechanisms. An example of outlet pipes is shown in Figures 3 & 4 (front and side view)

- a. Draw Down Device – A means shall be provided to quickly remove standing water from the basins for maintenance and winter diversion.
 - b. Emergency Spillway – A means shall be provided to release discharge in excess of the infiltration volume safely into the downstream stormwater conveyance system. The spillway shall be designed for a 100 year 24-hour storm event.
 - c. Freeboard – One foot of freeboard above the flow depth in the spillway shall be provided.
7. Maintenance Access – Provide a 12 foot wide access route, with a 6:1 slope, to the floor of the basin for sediment and debris removal.
8. Embankment Construction – Embankments shall conform with WDNR Conservation Practice Standard Wet Detention Basin (1001). A basin embankment may be regulated as a dam under ch. 31 Stats., and further restricted under ch. NR 333, Wis. Adm. Code, which includes regulations for embankment heights and storage capacities.

C. Construction

1. Construction shall be suspended during periods of rainfall or snowmelt. Construction shall remain suspended if ponded water is present or if residual soil moisture contributes significantly to the potential for soil smearing, clumping or other forms of compaction.
2. An assessment of the active erosion in the drainage area to the infiltration basin shall be performed to determine when to bring the infiltration basin on-line. The basin shall be brought on-line when the area draining to the basin has achieved 90% build out of all lots in any of the first 3 years or 75% build out in any subsequent year. By 5 years

from the start of construction in the drainage area, all infiltration basins shall be brought on-line. Build out means that the lot has been fully developed and stabilized from erosion. If the infiltration basin area is to also provide peak flow control for the fully built out 5-year, 24-hour event or greater, then a bypass device to divert those flows into the practice will be allowed until the infiltration basin is brought fully on-line. Erosion and sediment control practices shall be implemented for the remaining 10-25% of the undeveloped lots with the goal of preventing any sediment from reaching the infiltration basin.

3. During construction one of the following methods shall be used:
 - a. No disturbance – The infiltration area shall be fenced off to prevent heavy equipment access during development.
 - b. Compaction Mitigation – If the active infiltration area is graded the effects of compaction shall be mitigated using the following methods:
 - (1) Incorporate soil additives consisting of two inches of compost mixed into two inches of topsoil.
 - (2) The soil mix (V.C.3.b.1) shall be incorporated into the existing soil using a chisel plow or rotary device with the capability of reaching to 12 inches below the existing surface.
 - (3) The compost component shall meet the following WDNR Specification S100 Compost.
4. The basin shall be constructed to the grades, elevations, and specifications in the plan. After grading and top soiling, the elevation of the basin shall be surveyed for conformance to design specifications.

D. Vegetation Cover

1. Establishment – Cover crops need to be applied in conjunction with the initial seeding of permanent vegetation. When establishing turf type grass, use the criteria contained in the DNR Conservation Practice Standard Seeding for Construction Site Erosion Control (1059). Sod shall not be used.

If turf grass is utilized, the basin cannot be used for recreational purposes due to compaction concerns.

2. Native Seeding – Native vegetation shall be established in conformance with recommendations from a qualified native nursery in the area. If trees are to be used, species shall be selected that will not interfere with the function of the basin, or cause maintenance problems. Section IX References, lists sources that provide suggested seed mixtures.

Native (prairie) seeding shall be completed in the fall (as dormant seeding prior to first snowfall) or in the spring (between May 1 and June 20), or plugs shall be used.

3. Fertilizer – Soil testing shall be used to determine proper applications for nutrients and liming. Fertilizer application shall conform to the criteria located in NRCS Conservation Practice Technical Standard, Critical Area Planting (342) or WDNR Conservation Practice Standard Seeding for Construction Site Erosion Control (1059).
4. Mulch – Mulch shall conform to the criteria located in WDNR Conservation Practice Standard Mulching for Construction Sites (1058).

VI. Considerations

- A. Pretreatment Options - See WDNR Conservation Practice Technical Standards Wet Detention Basin (1001), Ditch Check (1062), and Vegetated Infiltration Swale (1005) for guidance. Estimates of pollutant reduction by proprietary devices should be based on monitoring using the EPA

Environmental Testing Verification protocol.

- B. Well Locations - If well locations in relation to the basin are a concern, the site should be evaluated for the direction of ground water flow.
- C. Multiple Uses - Basins can be used for both infiltration and peak shaving as shown on Figure 1 and 2. However, another option is to include a *flow splitter* or diversion prior to pretreatment. By limiting the inflow into a BMP, a flow splitter can enhance the longevity of the BMP by reducing the volumetric rate of treatment, erosion or scour, and vegetation damage. Flow splitters need to be designed to address site conditions and flows.
- D. Drainage Area Size – The drainage area should be between 5 and 50 acres. If the drainage area is more than 50 acres, multiple basins should be provided.
- E. Regulatory Caps - Ch. NR 151 provides for a maximum area to be dedicated for infiltration depending upon land use. This cap can be voluntarily exceeded.
- F. Native Vegetation - The use of prairie grass or other deep-rooted plants is encouraged because these plants can increase the infiltration capacity of the basin. Dense vegetation will also reduce soil erosion on the basin floor.
- G. Level Spreader - Since it is often difficult to construct a level spreader, a combination of a berm and stone trench is recommended. Other methods to disperse flows include irrigation practices such as ridge and furrow irrigation systems. Refer to American Society of Agricultural Engineering Standards for guidelines on construction of irrigation dispersal systems.
- H. Tracked vehicles should be used during construction to lessen compaction.
- I. The final grading should be conducted by the landscape contractor so that the drainage area can be stabilized first.
- J. Snow should not be placed in the effective infiltration area. It may be placed on the

pretreatment area or areas draining into the pretreatment area.

- K. Internally Drained Watersheds – There are unique considerations for watersheds that are closed basins which are internally drained. Infiltration basins constructed in internally drained watersheds shall meet the requirements of NR 151 and this standard. Storms with a recurrence interval greater than a 2-year 24-hour storm must also be considered in the design and engineering judgment may determine that criteria such as draw down time and maximum depth may be exceeded for these larger storms. Infiltration basins in internally drained watershed may have different needs for plants, pretreatment, safety, maintenance or other characteristic that must be considered during design and construction.
- L. The DNR has created a technical note that may be used to size infiltration basins. The “Technical Note for Sizing Infiltration Basins and Bioretention Devices To Meet State Of Wisconsin Stormwater Infiltration Performance Standards” contains an approved method to determine the target stay-on depth and 12 design charts that can be used to size these basins for a variety of conditions. In addition, the technical note contains a reference to an approved infiltration model (RECARGA) that can also be used to determine effective infiltration area requirements. Other models may be used if approved. The Technical Note can be accessed at:
<http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm#Post>

VII. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall specify the materials, construction processes, location, size and elevations of all components of the practice to allow for certification of construction upon completion.

VIII. Operations and Maintenance

An operation and maintenance plan shall be developed that is consistent with the purposes of this practice, intended life of the components,

safety requirements, and the criteria for the design. There may be state and local laws that require adequate O&M of public and private facilities and the identification of responsible parties. At a minimum, the plan shall include:

- A. Inspection Intervals – At minimum, quarterly inspections shall occur. Inspection shall include spreader and overflow spillway for indication of failure. Note the condition of vegetation as part of inspection. If standing water is observed over 50% of the basin floor 3 days after rainfall, the basin is clogged and measures should be undertaken to unclog it. (See section VIII.C).
- B. Native Vegetation - Maintenance of Native Vegetation – Mowing (cutting) or burning shall be used to maintain the vegetation.
1. Establishment - The first mowing of newly planted seed shall occur once it reaches a height of 10 to 12 inches.
 2. Mowing
 - a. Mowing shall reduce the height of plants to 5 to 6 inches.
 - b. After establishment, if burning cannot be accommodated, mowing shall occur once in the fall (after November 1). The area shall be mowed to a height of 5 to 6 inches.
 3. Burning
 - a. Routine Maintenance - Beginning the second year, burning shall occur in the early spring (prior to May 1st) or in the late fall (after November 1st)
 - b. Burning shall be done two consecutive years and then up to three years can pass before the next burning.
 - c. Under no circumstances shall burning occur every other year.
- C. Restoration Procedures – these include removing the top 2 to 3 inches, chisel plowing and adding topsoil and compost. If deep tilling is used, the basin shall be drained and the soils dried to a depth of 8 inches. If the basin was planted in turf grass and clogging again occurs after these restoration procedures have been used, the owner /operator shall replant with prairie

style vegetation using the soil preparation method recommended by the native nursery in the area.

- D. Trash shall be removed as quickly as possible once observed.
- E. Pretreatment – If wet detention is used, see WDNR Conservation Practice Technical Standard Wet Detention Basin (1001) for operations and maintenance requirements.
- F. Winter Maintenance – All draw down devices in the pond shall be opened during winter months to discourage infiltration of runoff water containing high levels of chlorides. If this practice is an enclosed basin, the use of chloride deicers shall be limited in the area draining to the basin to reduce the chance of exceeding the limits in ch. NR 140.

IX. References

Metropolitan Council, 2003. Urban Small Sites Best Management Practice Manual, Chapter 3, Vegetative Methods 3-85 – 3-91. Minneapolis.

United States Department of Agriculture – Natural Resources Conservation Service. Engineering Field Handbook, Chapters 16 and 18.

UWEX Publication A3434 Lawn and Establishment & Renovation.

WisDOT, 2003. State of Wisconsin Standard Specifications for Highway and Structure Construction. Section 630, Seeding.

X. Definitions

Draw down device (V.B.1): A draw down device can consist of any device that allows for the dewatering of the infiltration basin or the infiltration cells down to the ground elevation. Examples include removable weir plates (shown in Figure 3), pipes with valves, weirs with removable stop logs.

Effective infiltration area (V.B.4.c.): An effective infiltration area means the area of the infiltration system that is used to infiltrate runoff and does not include the area used for site access, berms or pretreatment.

Flow Splitter (VI.C): A flow splitter is a device used to direct a fraction of runoff into the BMP facility while bypassing excess flows from larger storm events.

Hydraulically connected (V.A.1.): Two entities are said to be hydraulically connected if a surface or subsurface conduit exists between the two such that water is transmitted from one entity to the other.

Level spreader (V.B.4.f): A level spreader is a device used to disperse concentrated flows back over a wide area, dissipating the energy of the runoff and promoting sheet flow. Common types of level spreaders include vegetated, earthen or stone berms, weirs and stone trenches.

Target Stay-on Depth (IV.B.4.b.): The amount of infiltration required on an average annual basis. It is the portion of the annual rainfall (inches) on the development site that must be infiltrated on an annual basis to meet the infiltration goal.

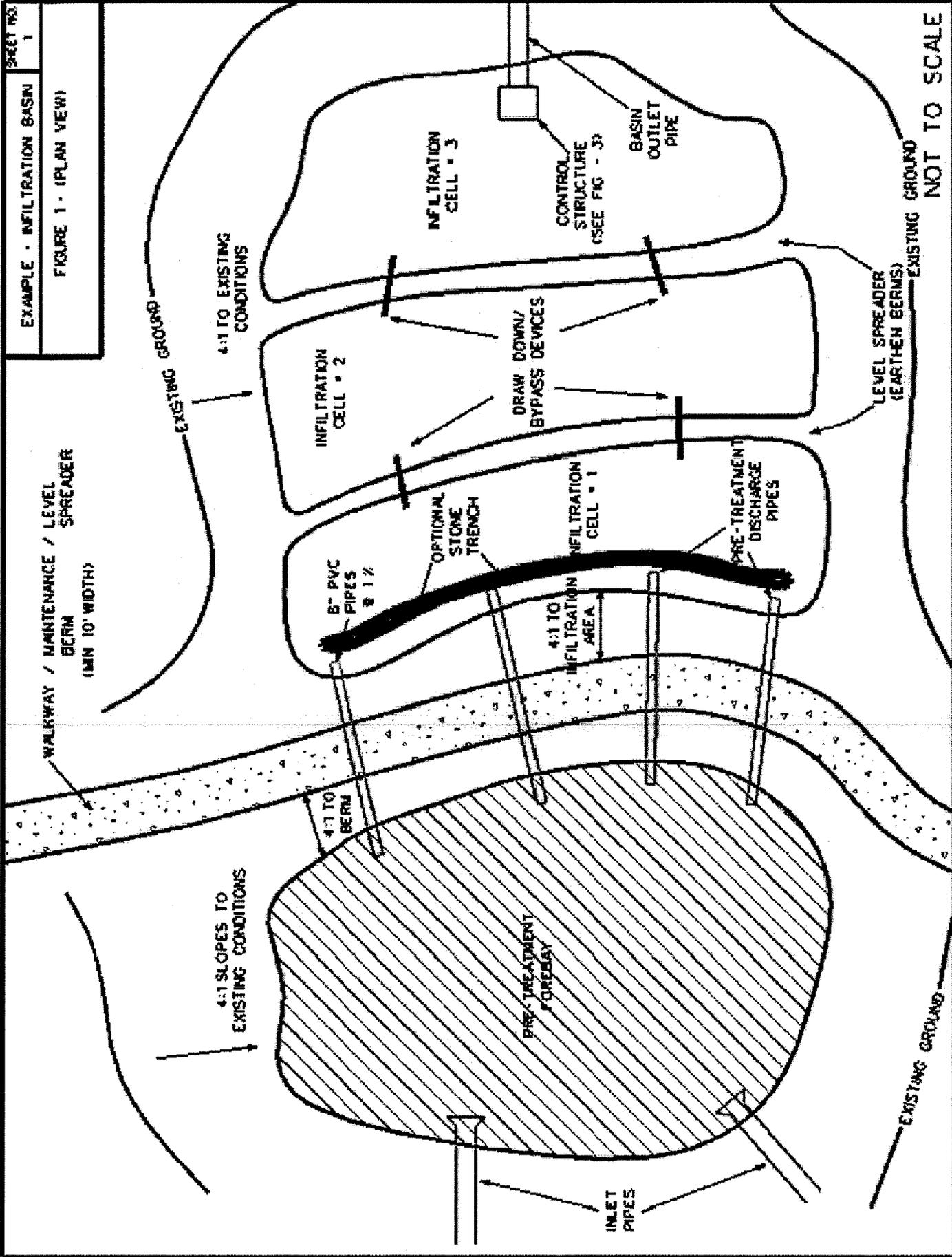


FIGURE 2 - PROFILE

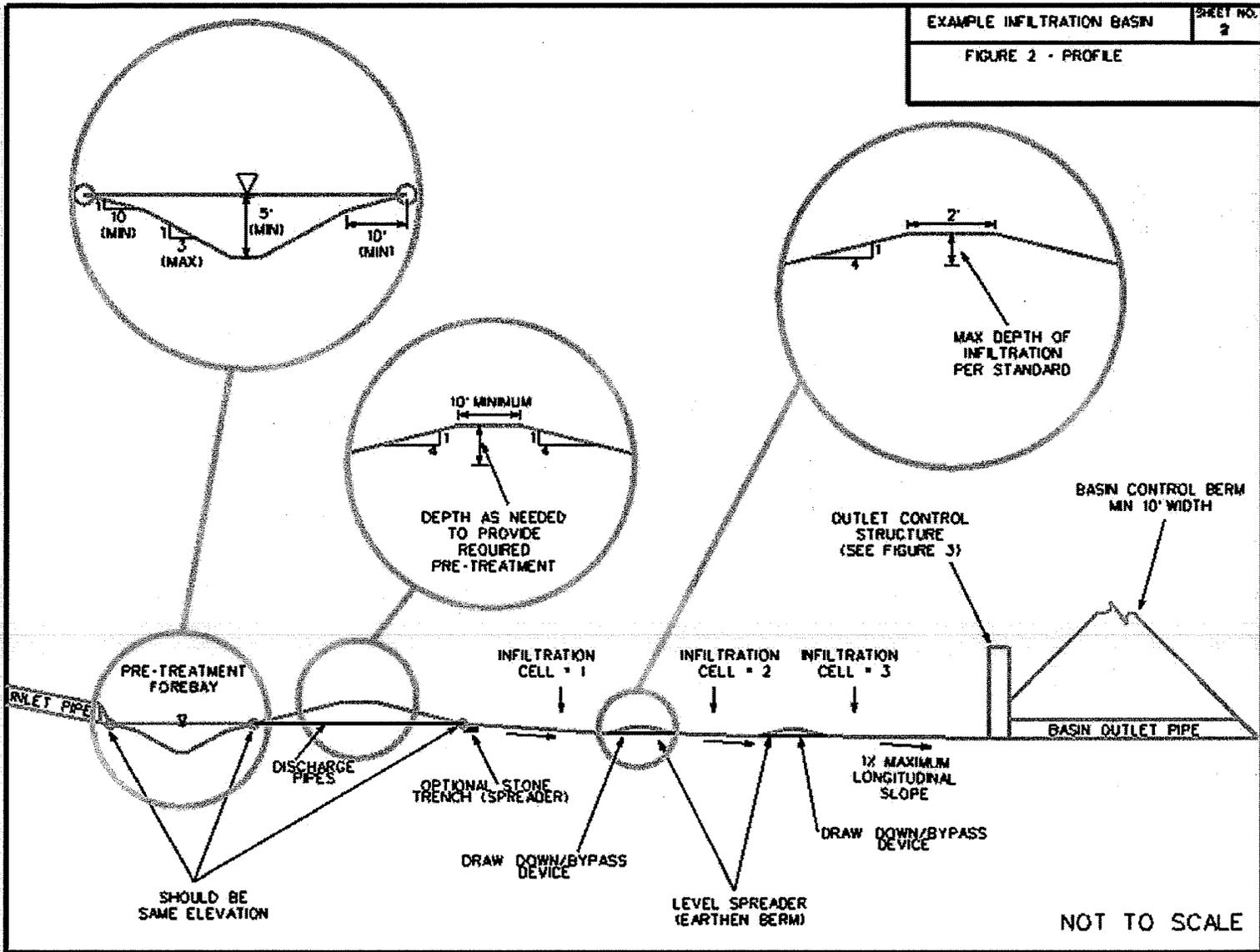
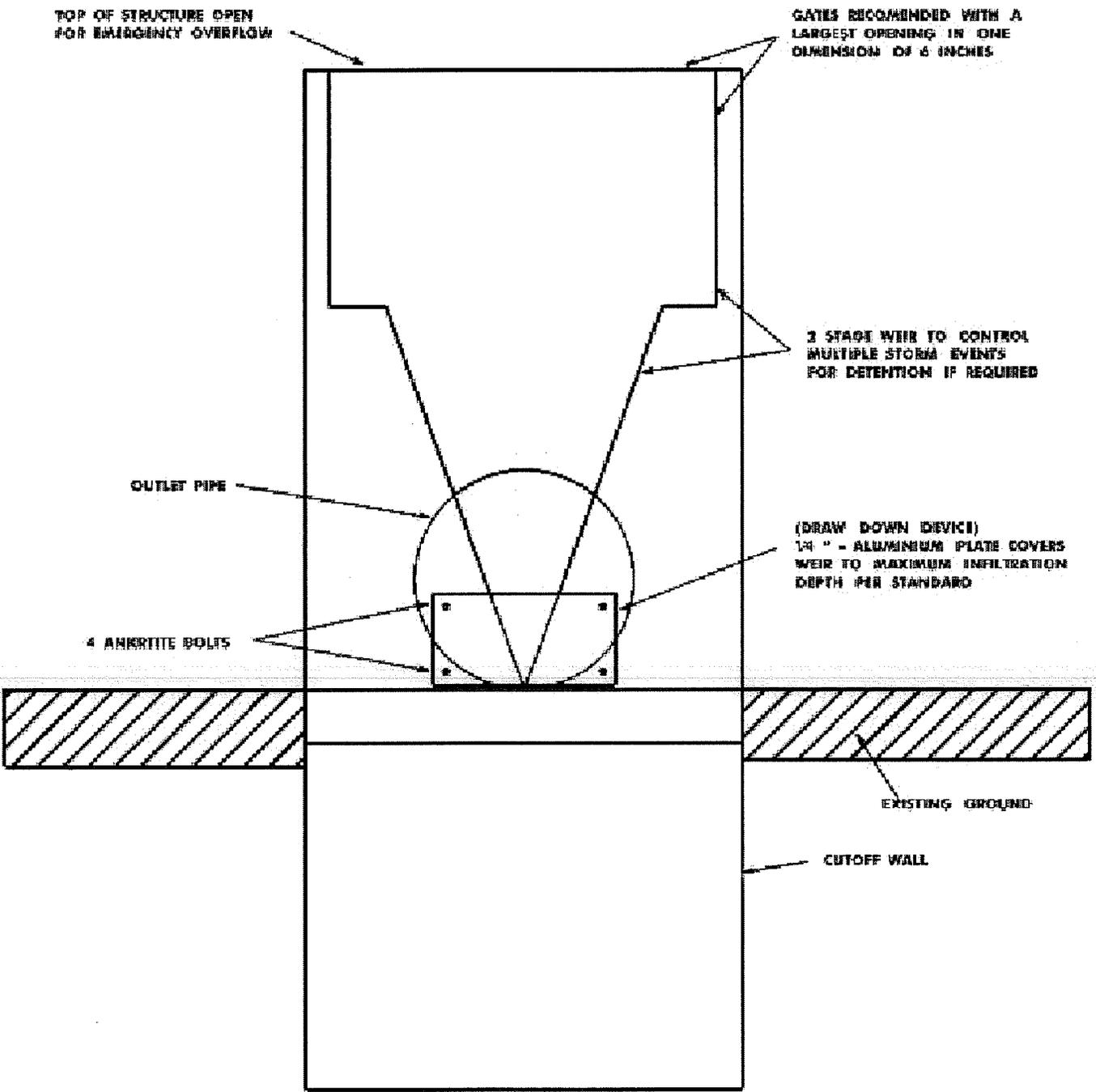


FIGURE 3 - FRONT VIEW



TOP OF STRUCTURE OPEN FOR EMERGENCY OVERFLOW

GATES RECOMMENDED WITH A LARGEST OPENING IN ONE DIMENSION OF 6 INCHES

3 STAGE WEIR TO CONTROL MULTIPLE STORM EVENTS FOR DETENTION IF REQUIRED

OUTLET PIPE

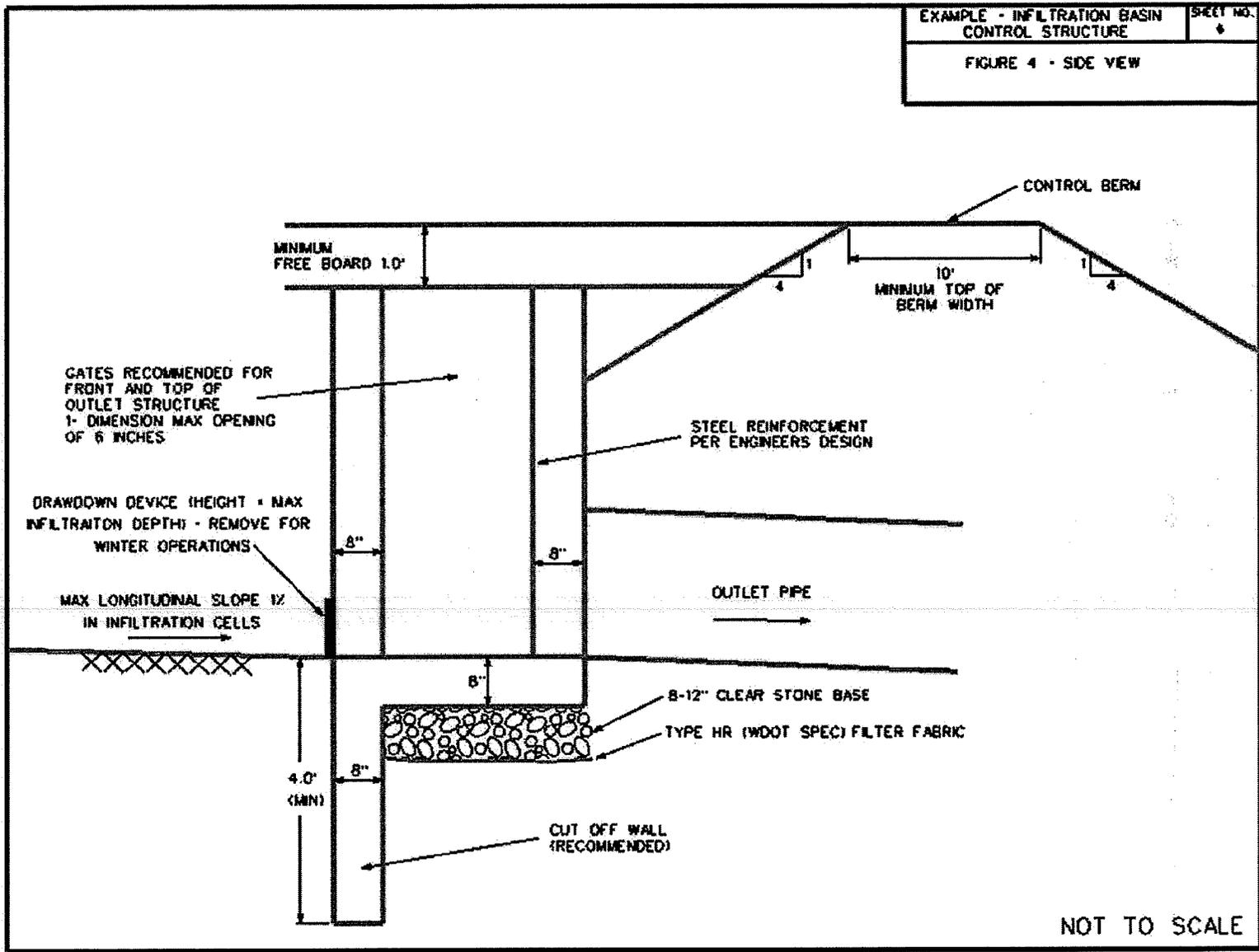
(DRAW DOWN DEVICE)
1/4" - ALUMINIUM PLATE COVERS WEIR TO MAXIMUM INFILTRATION DEPTH PER STANDARD

4 ANCHOR BOLTS

EXISTING GROUND

CUTOFF WALL

NOT TO SCALE



NOT TO SCALE

Bioretention For Infiltration (1004)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A bioretention device is an *infiltration device*¹ consisting of an excavated area that is back-filled with an engineered soil, covered with a mulch layer and planted with a diversity of woody and herbaceous vegetation. Storm water directed to the device percolates through the mulch and engineered soil, where it is treated by a variety of physical, chemical and biological processes before infiltrating into the *native soil*.

II. Purpose

A bioretention device may be applied individually or as part of a system of stormwater management practices to support one or more of the following purposes:

- Enhance storm water *infiltration*
- Reduce discharge of storm water pollutants to surface and ground waters
- Decrease runoff peak flow rates and volumes
- Preserve base flow in streams
- Reduce temperature impacts of storm water runoff

III. Conditions Where Practice Applies

Bioretention devices are suitable for small drainage areas where increased urban storm water pollutant loadings, thermal impacts, runoff volumes and peak flow discharges are a concern and the area is suitable for infiltration. Bioretention devices are best suited to providing on-site stormwater management opportunities adjacent to *source areas* such as landscaped areas, rooftops, parking lots and streets.

Bioretention devices are not suitable for controlling construction site erosion. These devices will not treat chlorides, and will be damaged by heavy loading of salt-based deicers.

IV. Federal, State and Local Laws

Users of this standard shall be aware of applicable federal, state and local laws, rules, regulations or permit requirements governing bioretention devices. This standard does not contain the text of federal, state or local laws.

V. Criteria

A. Site Criteria

1. A site selected for construction of a bioretention device shall be evaluated in accordance with the WDNR Conservation Practice Standard 1002, "Site Evaluation for Stormwater Infiltration" and shall meet the site requirements of that standard.
2. The following site criteria shall also be met:
 - a. Private Onsite Wastewater Treatment System (POWTS) – The bioretention device shall be located a minimum of 50 feet from any POWTS and shall not be *hydraulically connected* to the POWTS dispersal cell or cause negative impacts such as cross contamination.
 - b. Foundations – The bioretention device shall not be hydraulically connected to building or pavement foundations or cause negative impacts to structures.
 - c. Slopes – Sloped areas immediately adjacent to the bioretention device shall be less than 20% but greater than 0.5% for pavement and greater than 1% for vegetated areas to ensure positive flow towards the device.
 - d. Maximum Drainage Area – The area draining to the bioretention device shall not exceed 2 acres. The drainage area shall not contain significant sources of soil erosion.

¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

B. Design – The bioretention device shall be sized using an *approved model*. (See Consideration L.)

1. Configuration - Bioretention components include *pretreatment*, flow regulation, ponding area, planting bed vegetation and surface mulch layer, engineered soil planting bed, storage layer, *underdrain*, sand/native soil interface layer and observation well (See Figures 1 - 3).

2. *Target Stay-on Depth* – The target stay-on depth shall be determined using an approved model. (See Consideration L.)

3. Flow Regulation

a. Inflow – The flow at the inlet to the bioretention device shall be controlled to prevent erosion and achieve uniform distribution across the surface of the soil planting bed.

b. Overflow – The overflow system shall meet the following requirements:

(1) A weir or standpipe shall be used to regulate the maximum ponding depth. The invert of the overflow structure shall be at the elevation of the maximum ponding depth of the bioretention device. This component shall meet the ponding requirements of section V.B.4.

(2) Water discharged from the overflow shall be conveyed to a stable outlet leading to a suitable conveyance such as a swale, storm drain or surface water.

(3) Overflow control structures, such as *curtain drains*, that bypass the soil planting bed and discharge directly to ground water are allowed only if the sole source of stormwater runoff is from rooftops without significant contamination from industrial activity.

c. Underdrain – The underdrain shall meet the requirements of section V.B.8.

4. Ponding Area

a. Maximum *Design Ponding Depth* – The design ponding depth shall not exceed 12 inches.

b. Drawdown Time - In designing the bioretention device, the design ponding depth divided by the *Design Drawdown Rate* shall not exceed 24 hours.

c. Side slopes – The side slopes of the berm that forms the ponding area shall be 2H:1V or flatter.

5. Planting Bed Vegetation and Surface Mulch Layer

a. Vegetation Plan – A vegetation plan and planting specifications shall be prepared. The following apply:

(1) The plan shall identify planting zones based on anticipated depth of water level fluctuations and duration of inundation.

(2) Rootstock and plugs shall be used in establishing trees, shrubs and herbaceous perennials. Seed shall not be used to establish vegetation.

(3) If the bioretention device receives runoff from non-residential source areas or streets, the plant density at maturity must be low enough to accommodate long-term maintenance or replenishment of the surface mulch layer. If the bioretention device receives runoff only from residential land uses other than streets, the mulch layer can be discontinued at maturity provided that a dense vegetation layer is formed.

(4) Plants shall be native to the area and capable of withstanding the environmental conditions of the bioretention device such as insect and disease infestations, drought, water level fluctuations and regional temperature variations. Vegetation shall be salt tolerant when the bioretention device is likely to receive runoff containing salt-based deicers.

- (5) Turf grass shall not be used to vegetate the bioretention device, although it may be used in the pretreatment area. Invasive plants and noxious weeds shall not be used.
- (6) Woody vegetation shall not be specified at inflow locations. Trees and vegetation shall not block flow paths, create traffic or safety issues, or obstruct utilities.
- (7) The planting plan shall cover plant placement, planting sequence, planting time of year, fertilizing, watering and protection from other stresses such as animals, wind and sun to maximize plant growth and survival.
- (8) If the engineered soil will be left to settle prior to planting, the surface shall be mulched.

b. Surface Mulch Layer – Shredded hardwood mulch or chips, aged a minimum of 12 months, shall be placed on the surface of the bioretention area. The mulch shall be 2 to 3 inches in depth. The mulch shall be free of foreign material, including other plant material.

6. Engineered Soil Planting Bed

- a. Surface Area – The surface area shall be determined using an approved model. (See Consideration L.)
- b. Surface Slope – The surface slope of the device shall not exceed 1%.
- c. Engineered Soil Depth – After settling, there shall be sufficient soil to support the rooting depth of the vegetation. If the storage layer (V.B.7.) uses gravel, a lens of pea gravel not to exceed 4 inches shall separate the engineered soil from the storage layer. The soil layer (including the pea gravel lens) shall be at least 3 feet deep.
- d. Engineered Soil Composition– The soil shall be engineered to the following specifications:

- (1) The planting mixture shall consist of a mixture of sand, compost and topsoil.

The mix shall be designed to approximate the percentages in Table 1.

Table 1. Engineered Soil Mix	
Engineered Soil Component	Percentage Composition (by Volume)
Silica Sand	40%
Topsoil	20% if loam texture 30% if sandy loam or loamy sand texture
Compost	30% - 40%

Note: This mixture meets the equivalency requirements of s. NR 151.12(5)(c)5.i., Wis. Adm. Code.

- (2) The silica sand component shall be USDA coarse sand (0.02 to 0.04 inch diameter), pre-washed to remove clay and silt particles, and well-drained or dry prior to mixing. Calcium carbonated, dolomitic sand, and other substitutions are not allowed.
 - (3) The topsoil component shall be a USDA classified sandy loam, loamy sand or loam texture. The topsoil component textural class shall be verified by a laboratory analysis or a professional acceptable to the jurisdiction having authority.
 - (4) The compost component shall meet the requirements of Wisconsin Department of Natural Resources Specification S100, Compost.
 - (5) The engineered soil mix shall be free of rocks, stumps, roots, brush or other material over 1 inch in diameter. No other materials shall be mixed with the planting soil that may be harmful to plant growth or prove a hindrance to planting or maintenance.
 - (6) The engineered soil mix shall have a pH between 5.5 and 6.5.
 - (7) The engineered soil mix shall have adequate nutrient content to meet plant growth requirements.
7. Storage layer – A sand or gravel storage layer situated beneath the underdrain will facilitate groundwater recharge because water in this storage area can not exit via the underdrain. It can only exit the bioretention device by

infiltration into the native soil. The following requirements shall be met in designing the storage layer.

- a. The storage layer is required when the design infiltration rate of the native soil is less than 3.6 inches/hour, as determined using DNR Technical Standard 1002, "Site Evaluation for Stormwater Infiltration."
 - b. The design thickness of the storage layer shall be that which results in a *total device drain time* of 72 hours, but shall not exceed 48 inches. In calculating the total device drain time, assume that event runoff has ended and the bioretention device is *fully saturated* prior to the initiation of drawdown. (Refer to Section VI.U for guidance in determining the storage layer thickness.)
 - c. Gravel Specifications – The gravel shall meet the coarse aggregate #2 and other specifications of Wisconsin Standards and Specifications for Highway and Structure Construction, Section 501.2.5, 2003 edition, or an equivalent as approved by the administering authority. Gravel shall be double-washed.

Note: Inadequate washing of aggregate may lead to clogging at the native soil interface.
 - d. Sand Specifications – A layer of sand may be used in lieu of gravel to form the storage layer. The sand shall be washed quartz or silica. Sand particles shall be 0.02 to 0.04 inches in diameter (USDA Coarse Sand). Calcium carbonated, dolomitic sand, and other substitutions are not allowed.
8. Underdrain – A perforated underdrain pipe is required unless there is no suitable pipe outlet or the risk of infiltration failure at the native soil interface is minimal. The risk of infiltration failure is assumed to be minimal if the design infiltration rate of the native soil is determined to be at least 3.6 inches/hour, as determined using DNR Technical Standard 1002, "Site Evaluation for Stormwater Infiltration."
- a. Pipe Location - The underdrain pipe shall be placed at the top of the gravel or sand storage layer.
 - b. Size and Material – The pipe shall have a minimum diameter of 6 inches and be made

of flexible pipe or other material approved by the administering authority. The pipe shall be capable of withstanding expected traffic loads over portions of the pipe extending beyond the soil planting bed.

- c. Orifice Diameter – The underdrain orifice shall be restricted as necessary so that the *design infiltration rate* plus the *underdrain flow rate* equals the design draw down rate. The restriction shall be achieved by using an adjustable restrictor plate or valve. The restriction device shall be accessible for adjustment.
- d. Perforations – The total opening area of all perforation holes combined shall be sufficient to allow the underdrain pipe to discharge at full capacity, as would occur if there were no orifice restriction. The amount of perforation shall be increased to provide a margin of safety but shall not be so great as to compromise structural integrity of the pipe material.
- e. Pipe Protection – The underdrain pipe shall be protected from clogging by use of filter fabric or a filter sock. If the storage layer is sand, a filter sock shall be used. A cover of pea gravel may also be used.
 - (1) Pea Gravel – If used, the pea gravel layer shall be at least 4 inches thick. Pea gravel shall be washed. Pea gravel shall be large enough to prevent its falling through the perforations of the under-drain pipe.
 - (2) Filter Fabric – Filter fabric shall cover the underdrain pipe and shall not extend laterally from either side of the pipe more than two feet. The fabric shall meet the specifications of Wisconsin Standards and Specifications for Highway and Structure Construction, Section 645.2.4, Schedule Test B, 2003 edition, or an equivalent approved by the administering authority.
 - (3) Filter Sock - The openings in the fabric shall be small enough to prevent sand particles from entering the underdrain pipe. The flow rate of the fabric shall be capable of passing water at a rate equal to or greater than the flow rate capacity of the total combined perforations in the

underdrain pipe. In addition, the fabric shall meet the other requirements of Wisconsin Standards and Specifications for Highway and Structure Construction, Section 612.2.8(1-3), 2003 edition, or an equivalent approved by the administering authority.

- f. Clean-out Port – The underdrain pipe shall have a vertical, connecting standpipe to serve as a clean-out port for the underdrain pipe. The pipe shall be rigid, non-perforated PVC pipe, a minimum of 6 inches in diameter and covered with a watertight cap that is flush with the ground elevation of the device.
 - g. Outlet – The underdrain pipe shall discharge to an existing drainage system. Examples of drainage systems include swales, storm sewers, subsurface dispersal fields and surface waters.
 - (1) A check valve shall be installed when backflow is possible.
 - (2) Access for maintenance of the check-valve shall be provided.
9. Sand/Native Soil Interface Layer
- a. The interface layer is required when the design infiltration rate of the native soil is less than 3.6 inches/hour, as determined using DNR Technical Standard 1002, "Site Evaluation for Stormwater Infiltration."
 - b. Three inches of sand shall be placed below the gravel or sand storage layer, and vertically mixed with the native soil interface to a depth of 2-4 inches.
 - c. Sand shall be washed quartz or silica 0.02 to 0.04 inches in diameter (USDA Coarse Sand). Calcium carbonated, dolomitic sand, and other substitutions are not allowed.
10. Design Infiltration Rate – The design infiltration rate of the native soil shall not exceed the rate identified in accordance with WDNR Conservation Practice Standard 1002 "Site Evaluation for Stormwater Infiltration".
11. Observation Wells – If there is no underdrain, one or more observation wells shall be installed to monitor drainage from the device. There shall

be a minimum of one well per 1,000 square feet of *effective infiltration area*. The wells shall be:

- a. Located at the center of each section being monitored.
- b. A minimum 6 inch diameter slotted PVC pipe, anchored vertically to a footplate at the bottom of the bioretention device. The top of the pipe shall be high enough to prevent the entry of water ponded within the infiltration device.
- c. Have a secured aboveground cap.

C. Construction Sequencing and Oversight – A person trained and experienced in the construction, operation and maintenance of infiltration devices shall be responsible for construction of the device. The following apply:

- 1. Construction Site Stabilization – Construction site runoff from disturbed areas shall not be allowed to enter the bioretention device. Runoff from pervious areas shall be diverted from the device until the pervious areas have undergone *final stabilization*.
- 2. Suitable Weather – Construction shall be suspended during periods of rainfall or snowmelt. Construction shall remain suspended if ponded water is present or if residual soil moisture contributes significantly to the potential for soil smearing, clumping or other forms of compaction.
- 3. Compaction Avoidance – Compaction and smearing of the soils beneath the floor and side slopes of the bioretention area, and compaction of the soils used for backfill in the soil planting bed, shall be minimized. During site development, the area dedicated to the bioretention device shall be cordoned off to prevent access by *heavy equipment*. Acceptable equipment for constructing the bioretention device includes excavation hoes, light equipment with turf type tires, marsh equipment or wide-track loaders.
- 4. Compaction Remediation – If compaction occurs at the base of the bioretention device, the soil shall be refractured to a depth of at least 12 inches. If smearing occurs, the smeared areas of the interface shall be corrected by raking or roto-tilling.

5. Placement and Settling of Engineered Soil – The following apply:
- Prior to placement in the bioretention device, the engineered soil shall be pre-mixed and the moisture content shall be low enough to prevent clumping and compaction during placement.
 - The engineered soil shall be placed in multiple lifts, each approximately 12 inches in depth.
 - Steps may be taken to induce mild settling of the engineered soil bed as needed to prepare a stable planting medium and to stabilize the ponding depth. Vibrating plate-style compactors shall not be used to induce settling.
6. Planting – The entire soil planting bed shall be mulched prior to planting vegetation to help prevent compaction of the planting soil during the planting process. Mulch shall be pushed aside for the placement of each plant.

VI. Considerations

- This infiltration device is especially suitable where other benefits are desired such as shade, windbreak, noise absorption, reduction in reflected light, microhabitat for plants and wildlife and improved aesthetics.
- Place the infiltration device in a site that is visible to encourage routine up-keep and maintenance. Choose a site that provides ample room for maintenance access to all parts of the device. Consider traffic visibility and other safety issues when siting the infiltration device.
- The bioretention device may be constructed as a filtration and recovery system followed by discharge to a storm sewer or surface outlet. Table 2 shows estimated pollutant removal rates for bioretention when used as a filtration device:

Pollutant	Removal Rate (percent)
Total Suspended Solids	90 ¹
Metals (Cu, Zn, Pb)	> 95 ²
Total Phosphorus	80 ³
Total Kjeldahl Nitrogen	65-75 ³
Ammonium	60-80 ³
Organics	90 ¹
Bacteria	90 ¹

Source: ¹Prince George's County Department of Environmental Resources, 1993

²Davis, et al., 2003.

³Davis, et al., 2001.

- This infiltration device is not suitable for treating chlorides. Chloride use on source areas tributary to the bioretention device can be reduced or eliminated by minimizing the amount of compound used, using alternative de-icers or using clean sand. Aggressive sweeping in these areas, along with pretreatment sumps and filter strips, will reduce the impact of the sand on the bioretention device.
- A maximum drainage area is established to protect the device and reduce risk of failure. Potential problems such as erosion at the inflow points, disruption of the mulch layer, premature clogging of the device and inputs of chlorides and sodium will be reduced. Additionally, numerous smaller bioretention devices are expected to have better long term performance when compared to one large device. For large impervious areas, such as parking lots, dividing the drainage area up into smaller portions (0.5 – 1 acre) is recommended. If the total drainage area to a treatment device must be larger than 2 acres, an alternative practice should be selected.
- Longevity of the engineered soil is decreased by clogging, reduced cation exchange capacity and accumulation of sodium. Clogging problems can be reduced by limiting the input of sediment. Cation exchange capacity can be rejuvenated by the replacement of the engineered soil. Sodium accumulation can be countered by adding gypsum to the soil and/or by allowing about 1" of clean water to percolate through the planting bed 3 to 4 times in the spring
- Erosion at the inlet to the bioretention device can be reduced by using a sump inlet or gravel bed. Level spreading can be enhanced by the use of a level spreader or by using multiple pipe inlets.

- H. Pretreatment - Pretreatment will extend the life of the bioretention device, particularly when runoff is from parking lots and streets. Alternatives include grass channels, grass filter strips, sumps or forebays. Sumps and forebays should be sized to trap coarse sand (.02 - .04 inches). Table 3 provides sizing guidelines for pretreatment grass channels. Table 4 provides guidelines for sizing filter strips. Pretreatment is not considered part of the effective infiltration area for purposes of section NR 151.12(5)(c) or NR 151.24(5)(a), Wis. Adm. Code.
- I. When possible, the dimensions of the planting bed should have a minimum width of 10 feet, a minimum

length of 15 feet and a width to length ratio of about 2:1.

- J. If no vegetated pretreatment area is provided, snow may be piled upgradient of the bioretention device, preferably upgradient of the pretreatment forebay or sump. If a vegetated pretreatment area, such as a filter strip, is provided, it may be used for snow storage but heavy machinery should not be driven onto or across the vegetated area.

Table 3. Pretreatment Grass Channel Guidance	
The grass channel length should be at least 20 feet long. A level spreader should be used between the grass channel and the bioretention device.	
The channel shape should have:	
<ul style="list-style-type: none"> • A parabolic or a trapezoidal cross-section with a bottom width of 2 to 8 feet. • Channel side slopes that are 3 horizontal:1 vertical or flatter. • Flow velocities under 1 fps for the 1-year, 24-hour design storm. • Flow depth 4 inches or less for the 1-year, 24-hour design storm. 	

Table 4. Pretreatment Filter Strip Sizing Guidance									
Parameter	Stormwater Runoff Inflow Approach From Impervious Parking Lots				Stormwater Runoff Inflow Approach From Lawns/Landscaped Areas				Notes
	35		75		75		150		
Maximum inflow approach length (feet)	35		75		75		150		
Filter strip slope	≤2%	>2%	≤2%	>2%	≤2%	>2%	≤2%	>2%	Maximum Slope = 6%
Filter strip Minimum length	10'	15'	20'	25'	10'	12'	15'	18'	

Example: To pretreat runoff that flows 75 feet across a parking lot before reaching the bioretention device, the filter strip should be 20 feet long if the filter strip slope is <2% and 25 feet long if the filter strip slope is over 2%.

- K. Regulatory Sizing “Caps” – If a bioretention device designed in accordance with this standard exceeds the maximum required effective infiltration area established in s. NR 151.12(5)(c), the designer may reduce the effective infiltration area in the final design. Such a reduction is not required, however, and sizing based on an approved model will achieve optimal infiltration and device longevity. If the size of the device is reduced as provided for in NR

151.12(5)(c), then the design should consider maximizing the pond depth and gravel storage thickness to compensate for the decrease in the effective infiltration area.

- L. The DNR has created a technical note that may be used to size bioretention devices. The “Technical Note for Sizing Infiltration Basins and Bioretention Devices To Meet State Of Wisconsin Stormwater

Infiltration Performance Standards” contains an approved method to determine the target stay-on depth and presents an approved infiltration model (RECARGA) that can be used to determine the effective infiltration area requirements. Other models may be used if approved. The Technical Note can be accessed at:
<http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm#Post>

- M. If possible, settling of the planting bed should be accomplished naturally by allowing the filled bed to sit for several months. This will require over-filling the planting area so that after settling the proper ponding depth is achieved. Watering each lift of the planting bed to induce settling is not recommended unless water can be gently applied and the watered lift is allowed sufficient time (at least 24 hours) to thoroughly drain prior to adding the subsequent lift and at least 48 hours prior to adding mulch.
- N. The sidewalls of the planting bed and sand/gravel storage area may be sloped as needed to assure a stable configuration.
- O. To reduce lateral flow of water from the bioretention device towards pavement foundations, a geotextile fabric may be placed along the side-walls of the device.
- P. The optimal design pond depth for overall system function is 6-9 inches.
- Q. Plants can be selected to simulate a variety of plant communities. Forest and forest fringe communities should contain a mix of trees and shrubs. Trees should be planted 11-19 feet apart, shrubs 4-7 feet apart and shrub-tree mixes about 7 feet apart. Ornamental communities should contain a mix of shrubs and perennial herbaceous plants. The foliage canopy of ornamental communities should completely cover the soil planting bed at the end of two growing seasons. Meadows and meadow gardens that employ a mixture of grasses and wildflowers may also be planted.
- R. Use plant materials from a certified nursery that offers a plant warranty. Select plants that can thrive with minimum maintenance in the environment of the bioretention device and that have added wildlife value as food or cover. Section IX includes two references for plant selection (Shaw and Schmidt, 2003; Bannerman and Considine, 2003). It is recommended

that experienced individuals be consulted to assist with vegetation selection and establishment.

- S. The rooting depth of plants and the depth of the soil planting bed should be matched to prevent plant roots from clogging holes in the underdrain.
- T. A reasonable underdrain perforation safety factor is 2 to 4. The underdrain outlet may be fitted with an end wall and rodent shield if allowed by the local jurisdiction.
- U. A 72-hour time limit is established in this standard for draining water from a fully saturated bioretention device. This limit is established to reduce the risk of declining infiltration caused by persistent saturation at the native soil interface.

The maximum allowable thickness of the storage layer will depend on how much time is available to drain water from that layer after time is taken to drain water from the ponding area and engineered soil. The water in the ponding area and the engineered soil exits the bioretention device via the underdrain and the native soil. The water in the storage layer exits only via the native soil. The following equations may be used to determine the allowable storage layer thickness:

$$H_p = D_p / (K_u + K_n)$$

$$H_{ES} = (D_{ES} * P_{ES}) / (K_u + K_n)$$

$$D = (72 \text{ hours} - (H_p + H_{ES})) * K_n$$

$$T_{SL} = D / P_{SL}$$

Where:

- H_p = Time to drain the ponding area (hours)
- D_p = Depth of ponding area (inches)
- K_u = Underdrain flow rate (inches/hour)
- K_n = Native soil infiltration rate (inches/hour)
- H_{ES} = Time to drain the engineered soil (hours)
- D_{ES} = Depth of the engineered soil (inches)
- P_{ES} = Porosity of engineered soil
- D = Maximum depth of water in storage layer (inches)
- T_{SL} = Thickness of storage layer (inches)
- P_{SL} = Porosity of gravel storage layer

Using these equations, Table 5 shows sample storage layer thicknesses for a variety of conditions. Variables include pond depth, drawdown rate (underdrain flow rate (K_u) + design infiltration rate (K_n)) and design infiltration rate (K_n).

Table 5. Sample storage layer thicknesses (inches) that meet the 72-hour total device drain time								
Pond Depth (in)	Ku+Kn (in/hr)	Kn (in/hr)						
		0.07	0.11	0.13	0.24	0.5	1.63	3.6
Storage Layer Thickness (inches)								
6	0.24	1	2	3	6			
6	0.5	9	14	16	29	48		
6	1.63	13	21	25	45	48	48	
6	3.6	14	23	27	48	48	48	48
9	0.5	7	12	14	25	48		
9	1.63	13	20	24	44	48	48	
9	3.6	14	22	26	48	48	48	48
12	1.63	12	20	23	43	48	48	
12	3.6	14	22	26	48	48	48	48

The following assumptions are incorporated into Table 5:

- Maximum pond depth will drain in 24 hours or less,
- The maximum allowable storage layer thickness is 48 inches,
- The engineered soil depth is 36 inches,
- Engineered soil porosity is assumed to be 27%,
- Storage layer porosity is assumed to be 33%.

V. A municipal easement may be acquired to facilitate maintenance.

W. Once the design depth of the storage layer is determined, it can be reduced as long as the total storage volume is maintained. This will require making a corresponding increase in the surface area of the storage layer. This may be necessary at some sites to meet the required groundwater separation.

VII. Plans and Specifications

A. Plans and specifications shall be prepared for each specific field site in accordance with the criteria of this standard and shall describe the requirements for applying the infiltration device to achieve its intended use. Plans shall specify the materials, construction processes and sequence, location, size, and elevations of all components of the infiltration device to allow for certification of construction upon completion.

B. The plans shall include:

1. A vicinity map showing the drainage area, device location and flow paths to and from the device.
2. A plan view of the device showing the shape, dimensions, flow paths to and from the device, vegetation plan (including plant names and planting locations) and pretreatment components.

3. Longitudinal and cross-section views of the device

C. Specifications shall include the following:

1. A description of the contractor's responsibilities.
2. A requirement for the contractor to submit certifications prior to use for all materials that are to be incorporated into the project stating compliance with the standards.
3. Initial maintenance requirements.
4. Additional specifications relating to vegetation, including:
 - a. Site preparation sufficient to establish and grow selected species.
 - b. Planting dates, care, and handling of the plants to ensure that planted materials have an acceptable rate of survival, including weeding and watering responsibilities.
 - c. Vegetation warranty period

VIII. Operation and Maintenance

A. An operation and maintenance plan shall be developed that is consistent with the purposes of this infiltration device, its intended life, safety requirements and the criteria for its design. The plan shall be developed for inspection, operation and maintenance of the device. The plan shall assign responsibility for activities and the qualifications of the personnel performing the work.

- B. At a minimum, the plan shall address operation and maintenance of all vegetative and non-vegetative components identified in this standard.
- C. At a minimum, the plan shall also include details on the following: frequency of inspections; inspecting for sediment buildup and clogging, erosion, trash and debris build-up and plant health; frequency of sediment removal; disposal locations for sediment; pH testing of the soil; frequency of soil, mulch, and plant replacement; inlet and outlet maintenance, and providing access to perform the operation and maintenance activities. The maintenance activities in the plan shall be consistent with Table 6.

Table 6. Typical Maintenance Activities for Bioretention Areas	
ACTIVITY	FREQUENCY
Water Plants	As necessary during first growing season
Water as necessary during dry periods	As needed after first growing season
Re-mulch void areas	As needed
Treat diseased trees and shrubs	As needed
Inspect soil and repair eroded areas	Monthly
Remove liter and debris	Monthly
Add additional mulch	Once per year

- D. Snow shall not be dumped directly onto the conditioned planting bed.

IX. References

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United States Environmental Protection Agency. 2000. Low Impact Development: A Literature Review. Publ. EPA-841-B-00-005. US EPA Low Impact Development Center, Office of Water, Washington, D.C.

X. Definitions

Approved Model (V.B.): A computer model with an infiltration component that has been approved by the applicable regulatory authorities.

Curtain Drain (V.B.3.b.(3)): An overflow system structures consisting of vertical columns of gravel or sand, called curtain drains, that allow the water quality volume to bypass the soil planting bed and discharge untreated to ground water.

Design Drawdown Rate (V.B.4.b.): The rate (inches/hour) at which water drains from the ponding area through a combination of infiltration into the native soil and loss through the underdrain.

Design Infiltration Rate (V.B.8.c.): The infiltration rate of the native soil selected as a basis to size an infiltration device.

Design Ponding Depth (V.B.4.a.): The distance (inches) between the top of the mulch layer and the invert of the overflow structure.

Effective Infiltration Area (V.B.11) The area of the infiltration system that is used to infiltrate runoff, not to include the area used for site access, berms or pretreatment. For bioretention, the effective infiltration area is considered to be the surface area of the bottom of the excavated hole, at the native soil interface.

Final Stabilization (V.C.1) A condition achieved on pervious areas when uniform perennial vegetative cover has been established with a density of at least 70%.

Fully Saturated (V.B.7.b) A bioretention device that has a saturated storage layer, a saturated engineered soil layer and water ponded to the invert of the overflow pipe in the ponding area.

Heavy Equipment (V.C.3): Equipment with narrow tracks or narrow tires, rubber tires with large lugs, or high-pressure tires.

Hydraulically connected (V.A.2.a): Two entities are said to be hydraulically connected if a surface or subsurface conduit exists between the two such that water is transmitted from one entity to the other.

Infiltration (II): Entry and movement of precipitation or runoff into or through the soil. It includes water that may be subsequently evapotranspired. It does not include water discharged through underdrains or overflow devices.

Infiltration Device (I): A structure or mechanism engineered to facilitate the entry and movement of precipitation or runoff into or through the soil.

Native Soil (I): The undisturbed soil, situated below the bioretention device.

NR 151 (V.B.6.d.(1)): Chapter NR 151, Wisconsin Administrative Code (Runoff Management) that includes State of Wisconsin performance standards for infiltration.

Pretreatment (V.B.1): Preliminary reduction of pollutants from storm water prior to discharge of the storm water to the bioretention device.

Source Area (III): A component of urban land use including rooftops, sidewalks, driveways, parking lots, storage areas, streets and lawns from which urban runoff pollutants and volumes are generated during periods of snow melt and rainfall runoff.

Target Stay-on Depth (V.B.2): The amount of infiltration required on an average annual basis. It is the portion of the annual rainfall (inches) on the development site that must be infiltrated on an annual basis to meet the infiltration goal.

Total Device Drain Time (V.B.7.b): The time it takes water to drain from a fully saturated bioretention device. This includes the time it takes to drain water from the ponding area, the engineered soil and the storage layer. Water from the ponding area and engineered soil exit via a combination of the underdrain and native soil. Water from the storage layer exits only via the native soil.

Underdrain (V.B.1.): A perforated drain pipe situated below the engineered soil bed and above the gravel storage layer.

Underdrain Flow Rate (V.B.8.c.): The rate at which water is discharged from the underdrain, as determined by the orifice flow equation.

Figure 1. Example of Bioretention Device – plan view

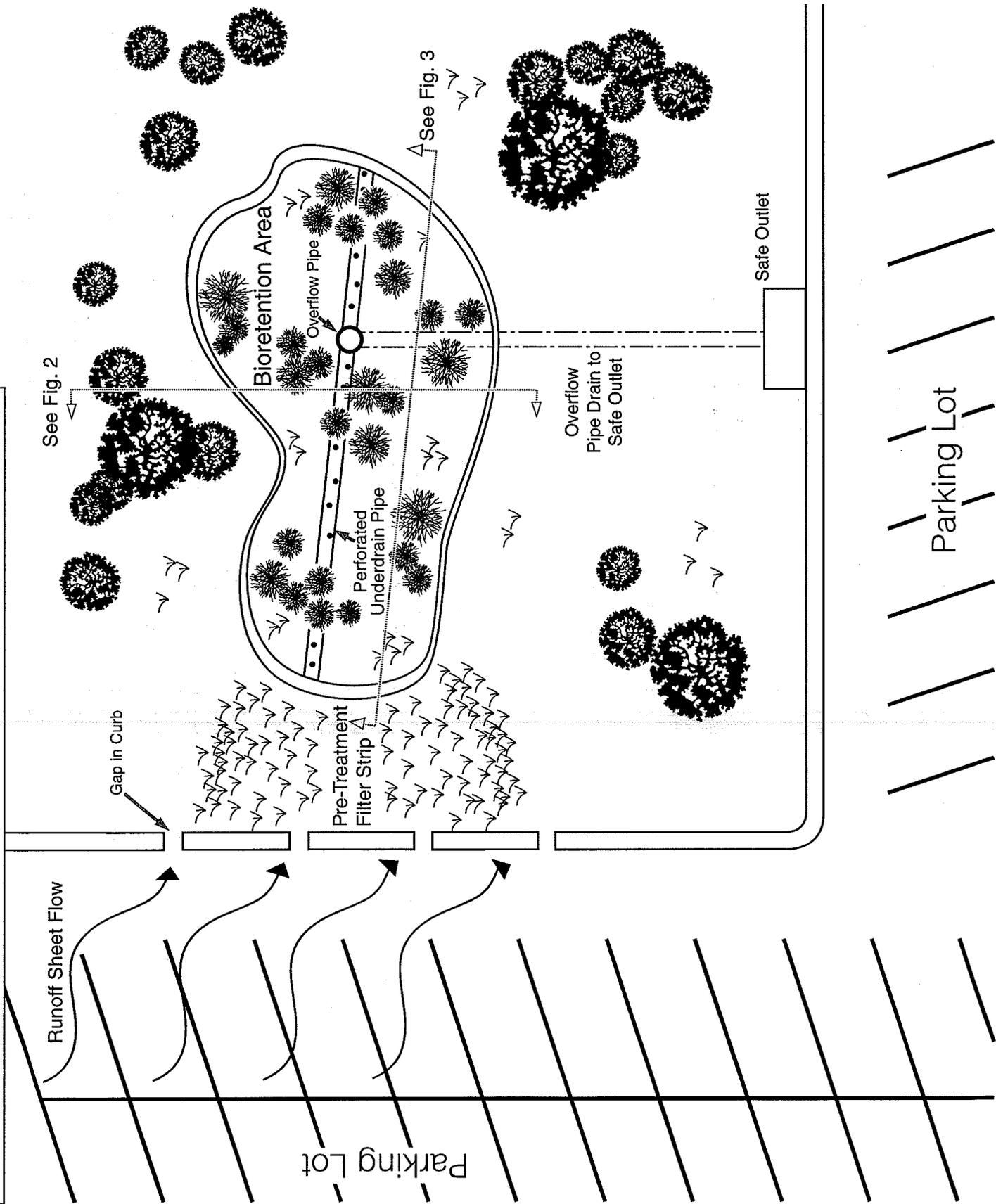


Figure 2. Example of Bioretention Device – cross-section across width of device

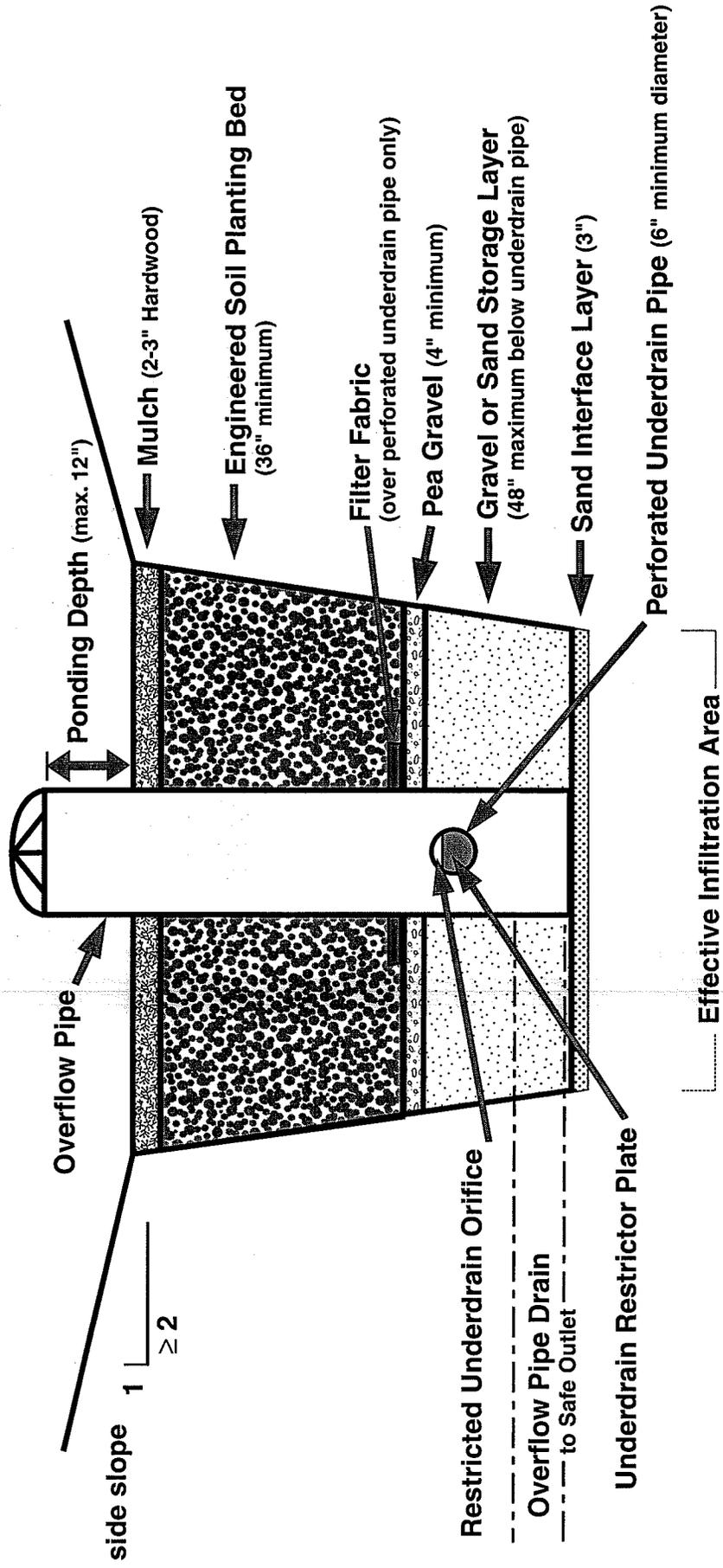
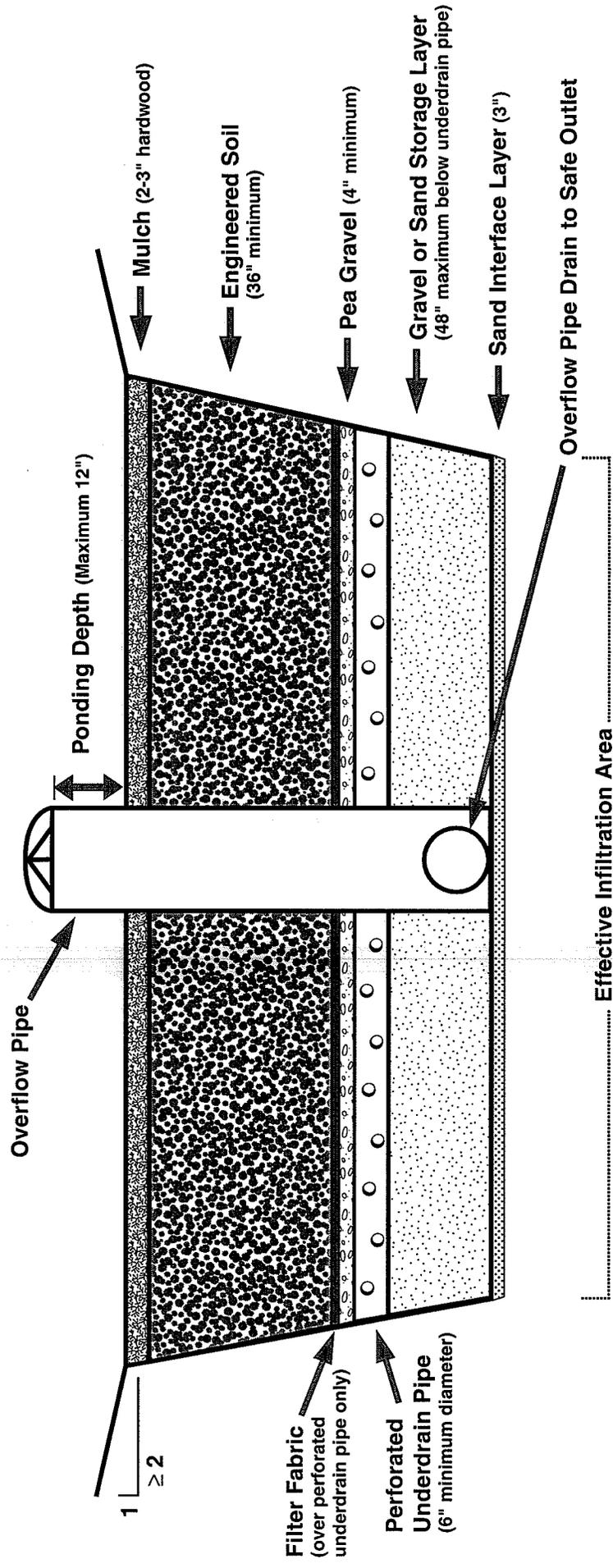


Figure 3. Example of Bioretention Device – cross-section across length of device



Wisconsin Department of Natural Resources Specification S100 Compost

1. SCOPE

Compost is a mixture that consists largely of aerobically decayed organic waste. This specification outlines the minimum material requirements for compost intended to be used in accordance with the criteria of Wisconsin Department of Natural Resources (WDNR) Stormwater Management technical standards. Compost meeting this specification is appropriate to use for compaction mitigation and as the component of an engineered soil mixture.

2. MATERIAL REQUIREMENTS. The following material requirement shall be met:

- a. Particle Size – 98% of the compost shall pass through a 0.75-inch screen.
- b. Physical Contaminants – Less than 1% combined glass, metal and plastic.
- c. Organic Matter/Ash Content – At least 40% organic matter; less than 60% ash content.
- d. Carbon to Nitrogen Ratio – 10-20:1 C:N ratio.
- e. pH – Between 6 and 8.
- f. Soluble Salts – Electrical conductivity below 10 dS m⁻¹ (mmhos cm⁻¹)
- g. Moisture Content – Between 35% and 50% by weight.
- h. Maturity – The compost shall be resistant to further decomposition and free of compounds, such as ammonia and organic acids, in concentrations toxic to plant growth.
- i. Residual Seeds & Pathogens – Pathogens and noxious seeds shall be minimized.
- j. Pathogens – The compost shall meet the Class A requirements for pathogens as specified in s. NR 204.07(6)(a), Wis. Adm. Code.
- k. Other Chemical Contaminants – The compost shall meet the high quality pollutant concentrations as specified in s. NR 204.07(5)(c), Wis. Adm. Code.

3. REFERENCES

Further information regarding compost may be obtained from the US Compost Council website:
www.compostingcouncil.org

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VILLAGE OF HARTLAND STORM SEWER SPECIFICATIONS

CONSTRUCTION SPECIFICATIONS

All construction shall be in compliance with the latest edition of the "Standard Specifications for Sewer and Water Construction in Wisconsin" (with addenda) and other Village of Hartland and State of Wisconsin Regulations.

STORM SEWER MATERIALS

- A. Description: This work shall consist of excavating required trenches or tunnels, laying or constructing therein pipe storm sewers, backfilling the trenches and restoring the site of the work, all as provided by the plans and contract.
- B. Pipe shall be reinforced concrete ASTM C-76 with mortared joints. 12 inch- CL V, 15 inch- CL IV, 18 inch or larger CL III unless otherwise shown on the plans.
- C. Storm manhole and inlet structures shall be constructed out of precast concrete materials, and not brick or block.
- D. Storm inlet frames and covers to be Neenah R-3067L, unless otherwise noted on plan. Where the surface course is placed in subsequent year all low points of the roadway shall have interim inlets and Contractor shall install per detail on plan.
- E. Storm manholes shall be the size as shown, 48 inches in diameter (minimum). Storm manhole frames and lids to be Neenah R-1661 unless otherwise noted, with open grate, Neenah R-2471-D.
- F. Flat slab tops shall have a minimum thickness of 6 inches for risers up to 48 inches in diameter and 8 inches for larger diameters. Slabs shall be reinforced with a layer of steel with a minimum area of 0.12 square inches/lineal feet in both directions. Openings in flat slabs shall be additionally reinforced with a minimum of the equivalent of 0.20 square inches of steel at 90 degrees. Straight rods used to reinforce openings shall have a minimum length equal to the diameter of the opening plus two inches.

BEDDING, BACKFILL, AND COMPACTION

- A. The bedding section to be used for storm sewer pipe shall be the Compacted Section (Class C) as defined in Section 3.2.6(b) of the "Standard Specifications". Use 3/8-inch limestone chips for bedding and cover material.
- B. The bedding and cover material shall be in conformity with Chapter 6.45.2 Paragraph (a), Table 31, of the Standard Specifications.

C. Backfill and Compaction of Backfill Material

Unless otherwise noted in the bid schedule, the base unit bid price for each respective item in the proposal is to include the cost of the backfill material specified for that item as follows:

1. Spoil Backfill: Excavated material to be used as backfill shall consist of loam, clay or other materials, which in the judgment of the Village, are suitable for backfilling. Unstable backfill materials include vegetable or other organic matter, all types of refuse, large pieces or fragments of concrete and such other material as in the judgment of the Village are unsuitable for backfilling. Frozen backfill material shall not be used.
2. Granular Backfill: Granular material for backfilling shall consist of durable particles ranging from fine to coarse in a substantially uniform combination. Sufficient fine material shall be present to fill all the voids of the coarse material. No stones over three (3) inch sieve size shall be present. Some fine clay or loam particles are desirable, but they shall not be present in the form of lumps. Granular backfill shall conform to the gradation requirements of Table 37.

TABLE 37
Gradation Requirements for Granular Backfill

<u>Sieve Sizes</u>	<u>Percentage Passing by Weight</u>
2 Inch	95 - 100%
No. 4	35 - 60 %
Finer than #200	5 - 15 %

3. Aggregate Slurry Backfill: Aggregate slurry backfill consists of No. 1 and No. 2 coarse aggregate Class "C" concrete mix with the cement deleted.

The material shall be mixed with water to inundate the aggregate sufficiently to provide an appropriate three (3) inch slump. The mix shall be deposited in the trench directly from a concrete transit mix truck.

D. Compaction

The backfill shall be mechanically compacted by methods as outlined in Chapter 2.6.14(b) of Standard Specifications. Note: Flushing may be used as a suitable method of compaction if approved by the Village.

INSTALLATION STANDARDS

- A. Storm manholes shall be constructed to binder course grade. Utility contractor will set manholes to this grade after curb and gutter is installed and prior to paving. Costs for returning to site shall be included in unit costs.
- B. Rock rip-rap shall be placed as shown on the plans. Cost of it shall be per the unit prices.
- C. Contractor to install geotextile fabric on inlets as per detail. Also, Contractor to install and maintain silt fencing at all outfalls until the site is stabilized. Cost of same shall be incidental to the cost of the storm sewer.
- D. Adjustments of storm sewer structures shall be made with precast materials, and not bricks or other materials. Contractor shall backplaster and tuckpoint all stormmanholes and inlets.
- E. Interim inlets may be required to allow drainage into low points in the storm sewer system in areas where the surface course of asphalt will be installed in a subsequent year. The contractor shall provide an asphalt drainageway from the binder into the storm inlet and anchor the inlet frame with asphaltic materials. In conjunction with installation of the surface course of asphalt, the contractor shall construct the inlet in its final configuration with precast materials, backplastering, and tuckpointing.
- F. The Village may require sumps in inlets and manholes in areas not currently served by detention basins or other Best Management Practices or in areas where otherwise deemed necessary. Where sumped catch basins are used, the minimum sump depth shall be two feet.