City of Topeka, KS
Stormwater BMP Record Drawing Checklist

*This list presents the required elements of a Stormwater BMP Record Drawing. Elements included in this list are required if applicable to the project. Applicants **are not required** to submit this checklist with the Record Drawing.*

General Information: Submittal of the Stormwater BMP Record Drawing signifies to the City of Topeka that construction of the applicable development is substantially complete[2] and the project's stormwater BMPs and conveyance system is fully and permanently constructed and functional. The Utilities Director may wish to perform an inspection as part of their review of the Record Drawing. See Section 2.6 of the *Stormwater BMP Design Handbook* for more information.

Provide all maps at a scale of 1" = 50' unless otherwise noted.

1. STORMWATER BMP LOCATION MAPS

REQUIREMENTS: The map shall clearly and accurately indicate the location, extent, and identity (by proper name as provided in this Handbook) of each stormwater quality and quantity BMP constructed on the project, and all easements related to stormwater BMPs, conveyance system, and stream buffers. Locate each labeled BMP by depicting their location relative to easily identifiable, permanent, labeled landmarks, such as roads, buildings, sidewalks, parking areas and waterbodies. A single map is sufficient for BMP location map if it can clearly depict all required information and can easily be read.

*GUIDANCE: The BMP location map will be used by future property owners, many of whom will not have professional or specialized knowledge in engineering or construction drawings. Therefore, it must be accurate and easily readable, and free of unnecessary or overly technical detail such as grade lines, geographical data, survey points, etc. **See example BMP Location map in Handbook Section 2.5.***

____ a. Project/development name and street address
____ b. North arrow
____ c. Location, extent, and type of stormwater BMPs located on the property -- denote BMP type using the proper name as used in the City of Topeka Stormwater BMP Design Handbook
____ d. Easement boundaries, labeled by easement type, including stormwater management easements (SMEs), public and private drainage easements, stream buffer easements, utility easements, and SME access easements
____ e. Water bodies and the stream buffer boundaries (label inner and outer buffers)
____ f. Building and pavement footprints, cross-roads, adjacent properties, and other information (all labeled) to orient the reader and facilitate map understanding by non-technical readers

[2] Substantially complete means the construction of outdoor areas is finished, the stormwater conveyance system and permanent post-construction BMPs are fully installed and functional, 100% of all pervious areas have been permanently stabilized from sediment erosion, and any remaining construction materials stockpiles and waste storage areas are not exposed to rainfall or stormwater. Construction in the building interior may still be ongoing.

2. CERTIFICATIONS, LEGAL DOCUMENTS, AND AGREEMENTS

____ a. Signed original Engineers and Landscape Architects Certification Statement (see Appendix D)

____ b. If applicable, signed originals of any other legal agreements or certifications pertaining to the stormwater BMPs or stormwater conveyance system (e.g., agreement with downstream property owner for use of offsite BMPs or drainage easements, etc.)

____ c. Copy of recorded plat with accurate description of constructed stormwater BMPs, their stormwater management easements, and all other easements. Plats must include statement: "***Stormwater BMPs shall be maintained in accordance with TMC Chapter 13.40.***"

3. AS-BUILT PLAN

A. General Information

____ a. Name and contact information of developer

____ b. Name and contact information of person preparing the Stormwater BMP Record Drawing

____ c. Name and contact information of responsible State of Kansas professional engineer or landscape architect

____ d. Common address and parcel/lot number of the applicable development

____ e. Vicinity map showing parcel boundaries, adjacent properties, and cross streets, appropriately labeled to locate the applicable development

____ f. List, describe, and explain all elements of the constructed site that differ from what is shown in the approved SWMP

B. Topographical Maps

____ g. Title block with project name, address, and contact person(s) *(all pages)*

____ h. Seals and signatures for the certifying Kansas Professional Engineer or Landscape Architect and the certifying Kansas Registered Land Surveyor *(all pages)*

____ i. Survey benchmarks or other reference points *(all pages)*

____ j. North arrow, bar scale, and coordinates *(all pages)*

____ k. Topographical map clearly indicating the property boundaries, cross-streets, and bounding roadways with names, building and pavement footprints of the applicable development, waterbodies, stormwater BMP locations, stream buffers, and general extents and boundaries

____ l. Stormwater and grading map indicating as-constructed grading of the property using maximum 2-foot contours, drainage basin boundaries, waterbodies, stream buffers, stormwater BMPs, stormwater conveyance system (inlets, connections, outlets, and flow directions) and stormwater outfalls to adjacent properties or waterbodies, and easement boundaries (labeled by easement type)

____ m. Stormwater, stream buffer, and landcover map indicating drainage basin boundaries, waterbodies, stormwater BMPs, pavement and rooftop footprints, and general types of pervious land covers (e.g., woods, unmaintained meadow, crop, grazing area, managed turf, landscaped area, etc.)

C. Stormwater BMP Information/Diagram (one for each BMP)

(Provide BMP schematics at a scale of 1" = 50' or smaller.)

____ n. For each BMP, provide a plan view map of the BMP as it is constructed, properly labeled in keeping with the BMP names identified in the *MARC/APWA BMP Manual*, and depicting the BMP boundary and extent, topography (if relevant). Use max. of 2-ft contours with 1-ft contours where detail is needed. Locate and label all areas of inflow, pretreatment, outflow, emergency overflow or bypass, and energy dissipation measures

____ o. For each BMP, provide at least one cross-section view of the BMP as it is constructed, properly labeled showing relevant elevations, depths, layers/details of subsurface layers and underdrains (i.e., for infiltration based GI-BMPs), multi-outlet structure(s), spillways, berm, dam, etc.

____ p. For each BMP, as applicable, provide the proper label, structure, and current condition (as constructed) of the following. For each provide elevations, length, width, diameter, depth, material, vendor schedule, or other as appropriate for the construction detail being described.

____ i. Inlet structures, including filtration bed, vegetated or rock aprons, trash racks, baffles, curbs, curb cuts, headwalls, grate inlet, pipe, etc.

____ ii. Outlet structures, including all orifices, weirs and emergency spillways, properly labeled with size, diameter, invert elevation, means of anchoring, underdrain systems, and method(s) of receiving system protection/energy dissipation measures

____ iii. Pretreatment areas, stilling basins, rock, vegetation, or baffle aprons, etc.

____ iv. Subsurface layers, including soil media layers, rock and other layers, fabric/textile wraps/layer, underdrains, outlet drains, and observation wells,

____ v. Surface level stormwater treatment or detention areas

____ vi. Dams and berms, include geotechnical information

____ q. Stormwater calculations (signed & stamped by the engineer or landscape architect) indicating that the as-constructed conditions meet the approved design as indicated by the approved SWMP. Include all inputs and methods

____ r. For each proprietary BMP (i.e., green roofs, cisterns, proprietary filtration media, hydrodynamic devices, baffle box, catch basin inserts, and similar devices), provide the vendor name and contact information, the manufacturer name and contact information (if different from the vendor), the make, model number, and date of manufacture of the BMP, a list of BMP parts that must be removed/replaced as part of normal BMP inspection maintenance (such as filtration cartridges) with each part's make and model number, design-related information provided by the manufacturer or developed by the site designer, and all inspection and maintenance instructions and information supplied by the manufacturer or vendor

D. BMP Planting Plans (one for each vegetated BMP)

____ s. For each vegetated BMP, provide a labeled map with a plant legend depicting the as-constructed vegetation of the BMP (see examples in Handbook Section 2.5)

____ t. Provide the following for each plant species installed:

____ i. The plant type (denote both common name and the genus & species) or turf seed mix, and whether species is native or non-native

____ ii. Planting location(s), spacing, and expected spread upon plant maturation

____ iii. Plant installation or seeding schedule and requirements *(e.g., seeding shall take place in the spring (April 1 to June 1) or in the fall (Sept 1 to Oct 1). Remove unwanted vegetation prior to planting.)*

____ iv. Required growing conditions *(e.g., full sun, partial shade, full shade, loose soil, etc.)*

____ v. Watering and fertilization schedule *(i.e., continuous moisture for 4-6 weeks after seeding is required for proper germination. Water to a full soak of each plants roots at least once per week thereafter.)*

____ vi. Other weed control and general care requirements, as appropriate

____ vii. Plant warranty information *(recommended)* as listed below. Applicants are encouraged to obtain plant warranties (typically through 2 growing seasons)

- A statement of the warranty periods *(e.g., "The warranty period for all plants in BMP #2 is provided by insert name of warrantor and covers two years from purchase date of Sep 7, 2019.")*
- Any warranty information needed to actuate the warranty (e.g., purchase receipts, plant installation contactor warranty statement, etc.)

E. Stormwater Hotspot Maps/Information

____ u. Locate and identify land uses and/or areas which have the potential to cause higher than normal concentrations of hydrocarbons, metals, or other pollutants to stormwater due to the activities that are expected for the project, once constructed *(See Section 4.4 of the APWA/MARC Manual, e.g., litter can be expected around a fast food restaurant)*

____ v. For each hotpot, locate and identify the management practices installed to mitigate pollutant discharges for these areas *(e.g., dumpsters/trash cans installed to reduce litter)*

F. Stormwater Conveyance System Maps/Information

____ w. Map and provide a schedule of all drainage pipes, channels, and other conveyances properly labeled with slope, length, shape, size or diameter, material, invert elevation, and the hydraulic grade line (HGL) for the 25-year storm event in the post-construction condition

____ x. Map and provide a schedule of all drainage structures related to the conveyance system (not stormwater BMPs in Part C above) such as inlets, catch basins, manholes, headwalls, wing walls, and culverts. Provide top and invert elevations, size, material, detail #, and other relevant information

____ y. Locate and identify pumps and provide pump system data, including unique identifier, pump make and model, capacity, switch design, inlet and discharge sizes, maximum and minimum water surface, and head-flow curves

____ z. Provide a narrative describing the stormwater conveyance system and special conditions encountered that changed the approved design

City of Topeka, KS
LID Technique Form

This form should be completed and included with the Stormwater Management Plan for projects that employ LID techniques.

Project Name:

Address:

Date Prepared: **Designer Name:**

Design Firm/Company:

Check (✓) the appropriate boxes to indicate which Low Impact Development (LID) techniques are included in the Stormwater Management Plan. Note the superscript 1 or 2 and the requirement associated with each stated below the list.

EARLY COORDINATION, COLLABORATION, AND COMMUNICATION

- ☐ Multi-disciplinary design team[1]
- ☐ Stormwater pre-design process[1]

CONSERVATION OF NATURAL FEATURES AND RESOURCES

- ☐ Preserve undisturbed natural areas[2]
- ☐ Preserve or restore stream buffers[2]
- ☐ Avoid developing in floodplains[2]
- ☐ Avoid developing on steep slopes (> 15%)[2]
- ☐ Minimize siting on porous or erodible soils[2]
- ☐ Soil management - Preservation[2] *(MARC 7.1)*
- ☐ Soil management - Restoration[2] *(MARC 7.2)*
- ☐ Restoration of Native Vegetation[2] *(MARC 7.3)*

"BUILD WITH THE LAND" DESIGN TECHNIQUES

- ☐ Redevelopment
- ☐ Fit the design to the terrain[1]
- ☐ Reduce limits of clearing and grading[2]
- ☐ Locate development in less sensitive areas[1]
- ☐ Utilize open space development[1]
- ☐ Reduce imperviousness[1]
- ☐ Consider creative development design[1] (describe) ____

[1] – Please provide a short narrative with the SWMP describing how the LID technique was applied for the proposed design.

[2] – Please show LID technique location by hatching LID areas on the SWMP that were preserved, restored, or avoided.

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City of Topeka, KS
Infiltration BMP Feasibility Statement

This form must be included with the SWMP for each Infiltration BMP to be employed onsite without an underdrain.

Project Name: ____________________

Address: ____________________

Date Prepared: ____________________ **Designer Name:** ____________________

Design Firm/Company: ____________________

What is the design infiltration rate determined via infiltration tests? ____________ in/hr

What is the minimum required infiltration rate for the BMP? ____________ in/hr

Note: These questions pertain to the in-situ soil located beneath the BMP. The in situ design infiltration rate must be greater than 1.0 in/hr and less than 11 in/hr, keeping with the required minimum rate in the MARC/APWA BMP Manual.

SITE FEASIBILITY CRITERIA

		YES	NO
1.	Will the in-situ soil (after site preparation) have an infiltration that meets the requirements of the *MARC/APWA BMP Manual*.	☐	☐
2.	Will the BMP be located more than 100 ft from a drinking water supply well in a sensitive aquifer or more than 50 ft from a drinking water well in a non-sensitive aquifer?	☐	☐
3.	Will there be more than three (3) feet of separation distance from the bottom of the BMP to the elevation of the seasonally saturated soils or the top of bedrock?	☐	☐
4.	Will the BMP be located more than 10 feet away from a building or structure? *If no, a groundwater mounding analysis that confirms the building or structure will not be impacted by the BMP must be provided.*	☐	☐
5.	Will the BMP be located more than 35 feet of a septic drainfield? *If no, provide a groundwater mounding analysis that confirms the BMP will not impact the drainfield.*	☐	☐
6.	Does a groundwater mounding analysis confirm that a mound formed beneath the BMP will not extend into the BMP?	☐	☐
7.	Will the BMP be located more than 200 feet from the toe of a slope that is greater than or equal to 20 percent?	☐	☐
8.	The BMP will not receive stormwater discharges from a hotspot land use (e.g. vehicle fueling yard, brownfield, etc.) or area of known soil contamination.	☐	☐

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City of Topeka
Utilities Department
1115 NE Poplar St.
Topeka, KS 66616

APPENDIX D

Stormwater BMP Certification Statement

Date:

ATTN: Utilities Department
Stormwater Engineer

Project Name:	
Project Street Address:	
Project Parcel No:	

I, ____, a licensed *(check one below)*

☐ Civil Engineer ☐ Landscape Architect

in the State of Kansas, certify that, in my professional opinion, the Stormwater BMP Record Drawing, identified by address above:

- includes a complete and accurate representation of all of the stormwater quality and quantity BMPs located on the property; and,
- represents the as-constructed and fully functional condition for said stormwater BMPs in conformance with the project's approved Stormwater Management Plan, including all revisions made necessary by change orders, design modifications, request for information and/or field orders.

I further state that, based on my calculations and analyses performed using the as-constructed conditions shown in the Record Drawing(s), that the stormwater BMPs installed for this project meet the stormwater performance standards required for the project.

Signature of Licensed Individual ____

Kansas License No. _____________________

Affix stamp or seal here

Date ___________________

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City of Topeka, KS
Design Procedure Form
Infiltration Basin

Designer:	
Checked By:	
Company:	
Date:	
Project:	
Location:	

MARC/APWA BMP Manual Assigned Value Rating: **9.0**

I. Water Quality Runoff Volume, WQ_v

Step 1) Tributary drainage area, A (acres) — A (acres) = ________
(2 acres or less)

Step 2) Percent impervious of tributary area, I (%) — I (%) = ________

Step 3) Volumetric runoff coefficient — R_v = ________

$$R_v = 0.05 + I\,(0.009)$$

Step 4) Rainfall event in inches, P (in) — P (in) = ________
(Water Quality Storm of 1.37 inches)

Step 5) Water quality volume (acre-ft) — WQ_v (acre-ft) = ________

$$WQ_v = \frac{(P)(R_v)(A)}{12}$$

II. Basin Design Depth

Step 1) Soil infiltration rate, f (in/hr) — f (in/hr) = ________
(*See **Section VII** for how to determine infiltration rate*)

Step 2) Design ponding time, t (hours) — t (hrs) = ________
(Maximum ponding time 72 hours)

Step 3) Maximum design depth, d_{max} (inches) — d_{max} (in) = ________

$$d_{max} = (f)(t)$$

III. Design Requirement

Step 1) Length to width ratio — Ratio = ________
(3:1 or greater)

Step 2) Side slopes — Slope = ________
(3:1 or flatter)

Step 3) Ponding depth — Depth = ________
(Maximum ponding depth of 2 feet)

IV. Vegetation

A Stormwater BMP Planting Plan shall be created to meet the policy outlined in Section 2.5.3 of the City of Topeka Stormwater BMP Design Handbook. Select vegetation for the infiltration basin by its ability to withstand wet weather, drought, and short periods of ponding (refer to Appendix A of the *APWA/MARC BMP Manual*).

V. Pretreatment

Describe pretreatment to be used with infiltration basin. Infiltration basins are susceptible to high failure rate due to clogging from sediments. Pretreating stormwater is necessary to remove as many suspended solids from runoff as possible.

VI. Emergency Spillway

Describe emergency spillway design. All basins must have an emergency spillway capable of passing runoff from the 25-year and greater, 24-hour storms without damage to the impounding structure.

VII. Infiltration Rate

Determining the in situ infiltration rate. Site designers have two options when designing the in situ soil infiltration rate(s) used to design the infiltration basin, as follows:

a. **Field infiltration tests** of the in situ soil located beneath the bottom elevation of the infiltration BMP may be used to determine the design infiltration rate for the BMP. *This is the preferred approach to determining the in situ infiltration rate.* Field tests will yield results that reflect actual site conditions and allow the design to be optimized to these conditions. Tests shall be performed using the standard test protocols described in the Topeka Stormwater BMP Design Handbook*.

b. In lieu of field infiltration tests, designers may use infiltration rates provided in the most current *USDA-NRCS Soil Survey for Shawnee County, Kansas*. The survey identifies a range of expected infiltration rates for each soil type. Designers who opt to use the NRCS soil survey must use the most conservative infiltration rate (i.e., the lowest infiltration rate of the range provided for the soil type). A digital copy is available at: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

*See **Section 3.5.4 Design Policies** of the Topeka Stormwater BMP Design Handbook for further information on the infiltration testing requirements.

City of Topeka, KS
Design Procedure Form
Infiltration Trench

Designer:	
Checked By:	
Company:	
Date:	
Project:	
Location:	

MARC/APWA BMP Manual Assigned Value Rating: **9.0**

I. Water Quality Runoff Volume, WQ_v

Step 1) Tributary drainage area, A (acres) — A (acres) = ________
(5 acres or less)

Step 2) Percent impervious of tributary area, I (%) — I (%) = ________

Step 3) Volumetric runoff coefficient — R_v = ________

$$R_v = 0.05 + I\,(0.009)$$

Step 4) Rainfall event in inches, P (in) — P (in) = ________
(Water Quality Storm of 1.37 inches)

Step 5) Water quality volume (acre-ft) — WQ_v (acre-ft) = ________

$$WQ_v = \frac{(P)(R_v)(A)}{12}$$

II. Calculate Minimum Trench Volume, V_{TRMIN}

Step 1) Void space fraction in storage media, — n = ________
(0.4 for clean stone)

Step 2) Minimum infiltration trench volume — V_{TRMIN} (acre-ft) = ________

$$V_{TRMIN} = \frac{WQ_v}{n}$$

III. Area of Trench Bottom

Step 1) Infiltration rate of surrounding native soil, f (in/hr) — f (in/hr) = ________
(*See **Section VI** for determining f*)

Step 2) Design retention time, t — t (hrs) = ________
(Maximum of 72 hours)

Step 3) Bottom area of trench, A (ft^2) — A (ft^2) = ________

$$A = \frac{12(WQ_v)}{(f)(n)(t)}$$

Step 4) Depth of trench, D (ft) D (ft) = ________

(Depth of 3 to 8 feet)

$$D = \frac{(f)(t)}{(n)12}$$

Step 5) Trench width, W (ft) W (ft) = ________

(Width should not exceed 25 ft)

Step 6) Trench length, L (ft) L (ft) = ________

$$L = \frac{A}{W}$$

IV. Pretreatment

Describe pretreatment to be used with infiltration trench. Infiltration trenches are susceptible to high failure rate due to clogging from sediments. Pretreating stormwater is necessary to remove as many suspended solids from runoff as possible.

V. Emergency Spillway

Describe the emergency spillway design. All trenches must have an emergency spillway capable of passing runoff from the 25-year or greater, 24-hour storms without damage to the impounding structure.

VI. Infiltration Rate

Determining the in situ infiltration rate. Site designers have two options when designing the in situ soil infiltration rate(s) used to design the infiltration trench, as follows:

a. **Field infiltration tests** of the in situ soil located beneath the bottom elevation of the infiltration BMP may be used to determine the design infiltration rate for the BMP. *This is the preferred approach to determining the in situ infiltration rate.* Field tests will yield results that reflect actual site conditions and allow the design to be optimized to these conditions. Tests shall be performed using the standard test protocols described in the Topeka Stormwater BMP Design Handbook*.

b. In lieu of field infiltration tests, designers may use infiltration rates provided in the most current *USDA-NRCS Soil Survey for Shawnee County, Kansas*. The survey identifies a range of expected infiltration rates for each soil type. Designers who opt to use the NRCS soil survey must use the most conservative infiltration rate (i.e., the lowest infiltration rate of the range provided for the soil type). A digital copy is available at: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

*See **Section 3.5.4 Design Policies** of the Topeka Stormwater BMP Design Handbook for further information on the infiltration testing requirements.

City of Topeka, KS
Design Procedure Form
Permeable Pavement

Designer:	
Checked By:	
Company:	
Date:	
Project:	
Location:	

MARC/APWA BMP Manual Assigned Value Rating: **7.5**

I. Water Quality Runoff Volume, WQ_v

Step 1) Tributary drainage area, A (acres) — A (acres) = ________

Step 2) Percent impervious of tributary area, I (%) — I (%) = ________

Step 3) Volumetric runoff coefficient — R_v = ________

$$R_v = 0.05 + I\,(0.009)$$

Step 4) Rainfall event in inches, P (in) — P (in) = ________

(Water Quality Storm of 1.37 inches

Step 5) Water quality volume (acre-ft) — WQ_v (acre-ft) = ________

$$WQ_v = \frac{(P)(R_v)(A)}{12}$$

II. Thickness of Aggregate Base

Step 1) Porosity of aggregate, n — n = ________

(Typical voids 0.36 – 0.42 (36-42%). Use 0.36 if no data available)

Step 2) Permeable pavement area, A_p (acre) — A_p (acres) = ________

(should be **≥ [A/3])**

Step 3) Minimum depth of gravel below overflow pipe system, D_g (in) — D_g (in) = ________

$$D_g = \frac{WQ_v(12)}{(A_P)(n)}$$

Step 4) Overflow pipe system diameter, in — Pipe dia. (in) = ________

(Set bottom of pipe at or above the top of the WQ_v)

Step 5) Cover over overflow pipe system, in — Cover (in) = ________

(Minimum 3-inch cover required between pipe and bottom of pavement)

Step 6) Add results from steps 3, 4 and 5 for total aggregate depth. — Total depth = ________

(Minimum depth of 12 inches is required)

III. Drain Time

Step 1) Soil Permeability, k (in/day) k (in/day) = ______

k can be determined in either of two ways:

A) Field infiltration tests of the soil beneath the bottom elevation of the aggregate using test protocols in the Topeka Stormwater BMP Design Handbook (preferred method) *.

B) Infiltration rates for the soil type published in the most current *USDA-NRCS Soil Survey for Shawnee County, Kansas* or from the USDA Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/). The most conservative (lowest) infiltration rate in the range given for the soil type should be used.

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Step 2) Drawdown time (days) Drawdown time (days) = ________

$$Drawdown\ time = \frac{D_g * n}{k}$$

*See **Section 3.5.4 Design Policies** of the Topeka Stormwater BMP Design Handbook for further information on the infiltration testing requirements

City of Topeka, KS
Design Procedure Form
Sand Filter

Designer: ______
Checked By: ______
Company: ______
Date: ______
Project: ______
Location: ______

MARC/APWA BMP Manual Assigned Value Rating: **6.0**

I. Water Quality Runoff Volume, WQ_v (acre-ft)

Step 1) Tributary drainage area, A (acres) — A (acres) = ______
(5 acres or less)

Step 2) Percent impervious of tributary area, I (%) — I (%) = ______

Step 3) Volumetric runoff coefficient — R_v = ______

$$R_v = 0.05 + I\,(0.009)$$

Step 4) Rainfall event in inches, P (in) — P (in) = ______
(Water Quality Storm of 1.37 inches)

Step 5) Water quality volume (acre-ft) — WQ_v (acre-ft) = ______

$$WQ_v = \frac{(P)(R_v)(A)}{12}$$

II. Determine Sand Filter Surface Area

Step 1) Sand filter depth, d_f (ft) — d_f (ft) = ______
(Minimum of 18 inches)

Step 2) Coefficient of permeability for sand bed, k (ft/day) — k (ft/day) = ______

Step 3) Average height of water above the sand bed, h_f (ft) — h_f (ft) = ______
(h_f = ½ $h_{max,}$ not to exceed 6 feet)

Step 4) Time required for the WQ_v to filter through the sand bed, t_f (days) — t_f (days) = ______
(40 hours is recommended)

Step 5) Surface area of filter bed, A_f (ft^2) — A_f (ft^2) = ______

$$A_f = \frac{43560 * (WQ_v)(d_f)}{[k * t_f(h_f + d_f)]}$$

III. Calculate Sand Filter Storage Volume

Step 1) Void space fraction in storage media, n (0.4 for sand and gravel) — n = ________

Step 2) Compute minimum required storage within the sand filter, V_{MIN} (ft^3) — V_{MIN} (ft^3) = ________

$$V_{MIN} = 0.75 * 43560 * WQ_v$$

Step 3) Compute water volume in sand filter bed, V_f (ft^3) — V_f (ft^3) = ________

$$V_f = A_f * d_f * n$$

IV. Pretreatment Method

Describe pretreatment method. The system consists of two or three chambers or basins. The first is the sedimentation chamber, which removes floatable and heavy sediments. The subsequent chamber (or chambers) is the filtration chamber, which removes additional pollutants by filtering the runoff.

V. Settling Basin Sizing

A. Surface Sand Filter

Step 1) Temporary storage volume above the filter bed, $V_{f\text{-}temp}$ (ft^3) — $V_{f\text{-}temp}$ (ft^3) = ________

Step 2) Settling basin volume, V_s (ft^3) — V_s (ft^3) = ________

$$V_s = V_{MIN} - \left(V_f + V_{f-temp}\right)$$

Step 3) Surface area of BMP, A_s (ft^2) — A_s (ft^2) = ________

Step 4) Height in settling basin, h_s (ft) — h_s (ft) = ________
(Verify $h_s > 2 * h_f$, and h_s equals or exceeds 3 feet)

$$h_s = \frac{V_s}{A_s}$$

B. Underground Sand Filter

Step 1) Surface area of BMP, A_s (ft^2) — A_s (ft^2) = ________

Step 2) Minimum wet pool volume in settling basin, V_w (ft^3) — V_w (ft^3) = ________

$$V_w = 3 * A_s$$

Step 3) Temporary storage volume required in both chambers, V_{temp} (ft^3) — V_{temp} (ft^3) = ________

$$V_{temp} = V_{MIN} - \left(V_f + V_w\right)$$

Step 4) Surface area of both chambers, A_t (ft^2) — A_t (ft^2) = ________

$$A_t = A_f + A_s$$

Step 5) Temporary storage height, h_{add} (ft) — h_{add} (ft) = ________
(Verify $h_{add} \geq 2 * h_f$)

$$h_{add} = \frac{V_{temp}}{A_t}$$

C. Perimeter Sand Filter

Step 1) Surface area of BMP, A_s (ft^2) — A_s (ft^2) = ________

Step 2) Minimum wet pool volume in settling basin, V_w (ft^3) — V_w (ft^3) = ________

$$V_w = 2 * A_s$$

Step 3) Temporary storage volume required in both chambers, V_{temp} (ft^3) — V_{temp} (ft^3) = ________

$$V_{temp} = V_{MIN} - \left(V_f + V_w\right)$$

Step 4) Surface area of both chambers, A_t (ft^2) — A_t (ft^2) = ________

$$A_t = A_f + A_s$$

Step 5) Temporary storage height, h_{temp} — h_{temp} (ft) = ________

(Verify $h_{temp} \geq 2 * h_f$)

$$h_{temp} = \frac{V_{temp}}{A_t}$$

D. Pocket Sand Filter

Step 1) Soil layer depth (in) — Depth (in) = ________

(3-4 in)

Step 2) Temporary storage volume required in both chambers, V_{temp} (ft^3) — V_{temp} (ft^3) = ________

$$V_{temp} = V_{MIN} - V_f$$

Step 3) Average area of pocket sand filter, A_{avg} (ft^2) — A_{avg} (ft^2) = ________

Step 4) Temporary storage height, h_{temp} (ft) — h_{temp} (ft) = ________

(Set emergency spillway elevation to h_{temp})

$$h_{temp} = \frac{V_{temp}}{A_{avg}}$$

VI. Vegetation

A Stormwater BMP Planting Plan shall be created to meet the policy outlined in Section 2.5.3 of the City of Topeka Stormwater BMP Design Handbook. Describe vegetation for surface sand filter and pocket sand filter. Vegetation must survive frequent periods of ponding and drought but will not impede infiltration.

City of Topeka, KS
Design Procedure Form
Vegetated Filter Strip

Designer:	
Checked By:	
Company:	
Date:	
Project:	
Location:	

MARC/APWA BMP Manual Assigned Value Rating: **5.0**

I. Sizing

Step 1) Pervious area flow length, P_L (ft) — P_L (ft) = ________

Step 2) Impervious area flow length, I_L (ft) — I_L (ft) = ________

Step 3) Effective inflow length, L_a (ft) — L_a (ft) = ________

(Maximum effective inflow length for pervious area shall be 130 feet, 65 feet for impervious area)

$$L_a = P_L + 2I_L$$

Step 4) Vegetated filter strip (VFS) length, L_O (ft) — L_O (ft) = ________

(Minimum of 10 feet)

$$L_O = \frac{1}{3}L_a$$

II. Flow Spreader

For runoff from impervious spreaders, flow spreaders (e.g., concrete sills, curb stops, curb cuts, or pea gravel diaphragm) shall be incorporated upstream of the VFS.

III. Grades

Ground slopes across VFS should not be greater than 1% and should be less than 6%.

IV. Vegetation

A Stormwater BMP Planting Plan shall be created to meet the policy outlined in Section 2.5.3 of the City of Topeka Stormwater BMP Design Handbook. Filter strips should not be used on soils that cannot sustain a dense grass cover with high retardance. Grasses in filter strips must be able to withstand relatively high velocity flows at the entrances, and both wet and dry periods. For constructed or enhanced filter strips, designers should reference *MARC/APWA BMP Manual* Section 7.3 and plant species lists provided in Section 8 and Appendix A for a list of acceptable grasses for use in this region. For existing vegetated areas to function as a filter strip as part of the Stormwater Management Plan, the area must contain dense grassy (non-wooded) vegetation with a minimum height of 12" providing complete coverage (no areas of open bare soil) and be able to withstand relatively high flow velocities. Turf grass is not an approved filter strip. Grass and filter strip areas shall be protected from frequent mowing.

City of Topeka, KS
Design Procedure Form
Native Vegetation Swale

Designer:	
Checked By:	
Company:	
Date:	
Project:	
Location:	

MARC/APWA BMP Manual Assigned Value Rating: **4.0**

I. Time of Concentration (T_C)

Step 1) Rational Method Runoff Coefficient, C — C = ________
(2 acres or less)

Step 2) Overland flow distance parallel to slope, D_O (ft) — D_O (ft) = ________
(Maximum distance for overland flow shall be 100 feet)

Step 3) Slope of overland flow path, S (%) — S (%) = ________

Step 4) Overland flow time to most upstream inlet or point of entry, T_I (min) — T_I (min) = ________

$$T_I = 1.8\,(1.1 - C)\frac{D^{1/2}}{S^{1/3}}$$

Step 5) Channelized flow distance, D_C (ft) — D_C (ft) = ________

Step 6) Average channel Slope, S_C (%) — S_C (%) = ________

Step 7) Channelized flow velocity, V (ft/s) — V (ft/s) = ________
(*From MARC/APWA BMP Manual Table 6.4 of Unimproved Channel Velocity using average channel slope)*

Step 8) Travel time in an enclosed system or channel, T_T (min) — T_T (min) = ________

$$T_T = \frac{D_C}{V}$$

Step 9) Time of Concentration, T_C (min) — T_C (min) = ________

$$T_C = T_I + T_T$$

II. Peak Flowrate (Q)

Step 1) Percent impervious of drainage area, I (%) — I (%) = ________

Step 2) Calculate rational method runoff coefficient, C — C = ________

$$C = 0.3 + 0.6I$$

Step 3) Determine rainfall intensity, i (in/hr) — i (in/hr) = ________

(From *MARC/APWA BMP Manual* Table 6.3 Rainfall Intensity for Water Quality Rainfall Event using calculated time of concentration)

Step 4) Drainage area, A (acre) — A (acre) = ________

Step 5) Coefficient for antecedent precipitation, K — K = ________

(1.0 for Water Quality Storm)

Step 4) Calculate peak flow rate for water quality rainfall event, Q (cfs) — Q (cfs) = ________

$$Q = KCiA$$

III. Solve Manning's Equation for Specified Variable

$$Q = \frac{1.49}{n}(A)(R_h^{\frac{2}{3}})(S_L^{\frac{1}{2}})$$

Step 1) Determine Manning's Roughness Coefficient, n — n= ________

Step 2) Side slope, S_S (ft/ft) — S_S (ft/ft) = ________

(Maximum slope 3:1 or flatter)

Step 3) Flow depth, D (ft) — D (ft) = ________

(A maximum of 4 inches for water quality flow is recommended)

Step 4) Width, w (ft) — w (ft) = ________

(Size bottom width between 2 – 8 feet)

Step 5) Area of swale, A_S (ft^2) — A_S (sf) = ________

Step 6) Wetted perimeter, P_w (ft) — P_w (ft) = ________

Step 7) Hydraulic radius, R_h (ft) — R_h (ft) = ________

Step 8) Longitudinal slope, S_L (ft/ft) — S_L (ft/ft) = ________

(Recommended slope 1- 2.5%)

IV. Velocity

Step 1) Calculate swale velocity, V (ft/s) V (ft/s) = ________

(Max permitted velocity 2 ft/s)

$$V = \frac{Q}{A_S}$$

Step 2) Is the maximum velocity 2 ft/s? (Yes or No) ________

(If 'no' adjust variables in Manning's equation)

V. Vegetation

A Stormwater BMP Planting Plan shall be created to meet the policy outlined in Section 2.5.3 of the City of Topeka Stormwater BMP Design Handbook. Native vegetation swales provide optimal function as they greatly improve stormwater infiltration into the soil, remove nutrients and trash from the contributing drainage area, and do not require the fertilizer or herbicides of turf-type plantings. Species selection will depend upon the duration of water inundation, soil type, the amount of sunlight and aesthetic considerations. Specify native plant species resistant to periodic inundation and periodic drought. Use native deep cell plug plants for initial installation.

Appropriate soil stabilization methods, such as mulch, blankets or mats should be used before the establishment of vegetation. Seeding, sodding, and other items related to establishing vegetation should be in accordance with accepted erosion-control and planning practices.

City of Topeka, KS
Design Procedure Form
Cisterns

Designer:	
Checked By:	
Company:	
Date:	
Project:	
Location:	

Cisterns are not assigned a Value Rating as part of the Level of Service calculations. Their benefit in Level of Service calculations is a decreased Curve Number (CN), whereby impervious areas draining to the cistern are assigned a CN of 79 (HSG "C", Turf, Fair). This CN is for Level of Service calculations only (i.e., for purposes of stormwater quality management only). Therefore, the CN of 79 may not be used in detention/retention (i.e., peak flow) design.

I. Water Quality Runoff Volume, WQ_v (ft^3)

Step 1) Roof drainage area to cistern, A (ft^2) — A (ft^2) = ________

Step 2) Rainfall depth, P (in) — I_L (ft) = ________

(Water Quality Storm of 1.37 inches)

Step 3) Water Quality Volume (ft^3) — L_a (ft) = ________

$$WQ_v = \frac{0.95\,(P)(A)}{12}$$

II. Cistern Sizing

Step 4) Selected cistern volume, V_c (ft^3) — V_c (ft^3) = ________

Step 5) Remaining WQ_v not captured by cistern, WQ_{VR} (ft^3) — WQ_{VR} (ft^3) = ________

$$WQ_{VR} = WQ_v - V_C$$

III. Design and Installation

All manufacturer's specifications and guidelines must be followed for all components in design, installation, use, and maintenance of a rain capture and cistern system.

IV. Usage

Cisterns intended to meet the stormwater quality requirements of Topeka Municipal Code Chapter 13.35 shall be designed to drain completely within 72 hours of a storm event, thus providing storage for future storms.

City of Topeka, KS
Design Procedure Form
Green Roofs

Designer:	
Checked By:	
Company:	
Date:	
Project:	
Location:	

The rooftop area is allowed to utilize a CN of **79**

I. Soils

Step 1) Average soil depth (in) — (in) = ________

Step 2) Soil porosity, n — n = ________
(provided by soil testing lab)

Step 3) Soil water retention volume — (in^3/in^2) = ________
(provided by soil testing lab)

II. Drainage System Options

Step 4) Moisture mat volume — (in^3/in^2) = ________

Step 5) Drainage board volume — (in^3/in^2) = ________

Step 6) Other: ____________________________ — (in^3/in^2) = ________

Step 7) Total water volume — n = ________
(Soil water retention + moisture mat volume + drainage board volume + other volume; must be higher than 0.96 in^3/in^2)

III. Describe the Drainage System

Describe the waterproofing and drainage system. Provide a certificate signed by property owner, landscape architect, or contractor stating the system description for approval as follows:

- Calculations documenting average soil depth across roof area
- Porosity of soil
- Product data and moisture retention calculations for moisture mat and drainage panel, if applicable.

IV. Design and Installation

All manufacturer's specifications and guidelines must be followed for all components in design, installation, use, and maintenance of a green roof system.

V. Vegetation

A Stormwater BMP Planting Plan shall be created to meet the policy outlined in Section 2.5.3 of the City of Topeka Stormwater BMP Design Handbook. Describe mix and density of vegetation to be placed in the green roof. Provide a certificate signed by property owner stating, "I certify that the vegetated roof assembly system will achieve a minimum of 90% landscape coverage within 12 months from project substantial completion."