



Stormwater Management Studies

PDS

Engineering Services Division

ES Policy # 3-01

Revised: 04/01/2019

INTRODUCTION

The City of Overland Park requires submission of a stormwater management study as part of the development plan application. This study is required for new development, and may also be required on redevelopment of existing property.

The goal of these studies is to identify existing and potential drainage problems and delineate required stormwater treatment facilities early in the development process so that positive steps can be taken to address the problems and to document the final decisions made.

The process for stormwater management studies includes the following steps:

1. ***At Initial Rezoning, Preliminary Development Plan, or Preliminary Plat:*** Submit a preliminary stormwater management study. A flood study may also be required when a development is near a large drainage course.
2. ***At Final Development Plan or Final Plat:*** If significant changes to the plan have been made, staff may require an updated and/or more detailed preliminary stormwater management study of the final development plan/plat area.
3. ***During development of construction documents:*** A final stormwater management study will be required. The final study will document the actual proposed construction and stormwater design elements.

RELATED DOCUMENTS AND ADOPTED REFERENCES

Engineering Services Division Policy # 3-07 – Stream Corridor Development Plan Requirements.

Engineering Services Division Policy 3-09 - Stormwater Treatment Facility Drawing Requirements

City of Overland Park Design and Construction Standards – Volume 1: Design Criteria
APWA Section 5600 - Storm Drainage Systems and Facilities (2006 version)

MARC APWA BMP Manual of Best Management Practices for Stormwater Quality
(2012)

CITY CODE REFERENCES

OPMC 15.10 – Stormwater Management Program – Standards and Permitting

OPMC 18.360 – Floodplain Management

OPMC 18.365 – Stream Corridor Requirements

OPMC 16.210 – Stormwater Treatment

ATTACHMENTS

Attachment A - Stormwater Treatment Facility Requirements for Development Projects

Attachment B - Flood Control Detention Requirements for Development Projects

REQUIREMENTS FOR ALL STUDIES:

Submittals:

- A. Two (2) paper copies and one digital (pdf) of all stormwater management studies will be required. Studies must be bound and include a cover sheet indicating the project name, location, and City assigned project number (when available).
- B. All studies, both preliminary and final, shall be sealed by a Professional Engineer registered in the State of Kansas.
- C. The study shall include a narrative section and engineering calculations as outlined under specific study requirements.
- D. Printouts from various computer programs used in preparation of the study shall be included as an appendix.
- E. All mapping required shall be bound in the study, or placed in bound pockets within the study. Mapping shall not be submitted separate from the study.

- F. Determinations from other regulatory agencies, including the Corps of Engineers, Division of Water Resources, FEMA, etc, shall be incorporated as an appendix to the study.
- G. Data files (digital) – The submitted stormwater management study shall include all input and output files in a digital format for all computer programs used in preparing the stormwater management study/report.
- H. Related Studies, (e.g. wetlands determinations, stream bank stability studies, etc.) shall either be included as an appendix or separately bound. In either case, the narrative shall refer to these studies and their location.

Computational Methods:

Engineering calculations for stormwater management studies must conform to the following acceptable methods:

A. *Storm Sewer Design*

- Design Runoff Computations: Rational Method, TR-55, or other approved methods as provided in the City's Design and Construction Standards.
- Capacity – Manning's equation, inlet and outlet control.
- Head water elevations – Bernoulli equation.
- Design storm for enclosed storm sewers – 10-year (10%) for storm sewers with overflow path for 100-year (1%) storm. Cross road pipes and culverts may require additional capacity. See APWA 5601.8B for additional requirements.

B. *Detention Design* – When it is determined that stormwater detention is required, the applicant should consult with City staff and obtain approval for software packages prior to starting calculations. Software must utilize Modified Puls (aka storage indication method) for reservoir routing. Approximate methods are allowed for preliminary design only.

C. *Open Channel Flow* – All computations should show both Energy Grade Line (EGL) and Water Surface Elevation (WSEL).

- Manning's equation, broad crested weir formula, HEC-RAS computer model, as appropriate.

- D. ***Water Quality Event Peak Runoff and Volume Calculations*** – Utilize the methods outlined in MARC/APWA BMP Manual with modifications shown in the City of Overland Park Design and Construction Standards Manual.

Waivers:

Engineering Services may waive submission of a study/report, or any part of the study/report, where site conditions warrant. However, it is the applicant's responsibility to provide written documentation as to why a waiver is appropriate.

PRELIMINARY STORMWATER MANAGEMENT STUDY

The goal of the preliminary stormwater management study is to ensure that stormwater runoff from the development will not have an adverse impact on existing development, to ensure that all existing and proposed structures shall be protected from flooding, and to ensure that there is adequate space on the site for required stormwater conveyance and treatment facilities.

Scope:

The preliminary stormwater management study must include the following minimum items. For critical areas, staff may modify the scope as necessary to address individual site needs.

- A. ***Identification of Downstream Drainage Issues:*** Analyze the drainage system downstream from the development and determine system deficiencies. In most cases, the downstream analysis must extend to a point where the contributing drainage area from the project site is less than 10% of the total downstream drainage area. The City maintains records of previously identified flooding problems; however, this does not relieve the design engineer from performing their own analysis.
- B. ***Preliminary Onsite Drainage System:*** Prepare a plan showing the preliminary stormwater drainage system. The preliminary drainage system should show:
- Pipe system alignment (sizing not required).
 - Delineation of public vs private storm sewers.
 - Overflow system path (sizing may be required for large overflows). Include an evaluation of building/parking site layout with relation to overflow drainage. Overflow drainage must allow for 1-foot freeboard

from Energy Grade Line (EGL) to structure low opening. Maximum flow depth in parking/driving areas shall be 7-inches.

- How stormwater treatment facilities are integrated into the stormwater conveyance system.

C. ***Drainage Computations:*** At a minimum, the following drainage computations will be required. In critical areas, staff may require additional drainage computations to help ensure that a project is viable as designed. In ALL cases, full upstream development should be assumed using the City's land use map for determining estimated impervious areas. Upstream stormwater detention should be assumed to not be present for design flow purposes.

- Design flows (10 and 100-year) entering the site from all upstream tributary areas.
- Design flow (10 and 100-year) leaving the site at each downstream outfall.
- Water quality volumes and approximate surface area required for each proposed stormwater treatment facility. See Chapter 6 of the MARC/APWA BMP Manual.

D. ***Flood Control Detention:*** The preliminary stormwater management study must investigate the need for detention on the proposed development site. Stormwater detention may be required when habitable buildings are flooded based on existing or future conditions or when streets are flooded in excess of the City Standards. See OPMC 15.10.400 for specific conditions that warrant the need to provide stormwater detention*.

Although Attachment B can be used as a tool to determine if a site is required to provide detention, it is ultimately the design engineer's responsibility to determine that detention is required and to verify the associated downstream flooding issue regardless of whether City staff has previously determined that there is a flooding issue located downstream from a property. Simply stating that detention is required because City staff has indicated that detention is required is not acceptable.

* For application of OPMC 15.400, flooding of an unimproved thoroughfare, street flooding warrants detention only when all of the following are true: 1) The street flooding will exceed 12-inches at the crown during the 1% storm event, 2) The overtopping flow exceeds 250

cfs during the 1% storm at full development, and 3) The downstream receiving system is an open channel.

E. **Flood Control Detention Requirements:** If it is determined that stormwater detention is required for a site, the following information must be submitted:

- Preliminary detention volume and surface area computations**. Stormwater detention volume shall be computed in accordance with APWA Section 5600 (2006 version) with modifications as provided in the City's Design and Construction Standards manual. Those requirements include:
 - Routing shall be computed by the Modified Puls (storage indication) method.
 - The SCS Type-II 24 hour storm distribution shall be utilized for hydrograph development.
 - The basin shall be sized to control runoff to the 2 (50%), 10 (10%), and 100-year (1%) storm to the pre-developed condition.
- Site plan showing how the required detention area will be incorporated into the overall development.

***For approval of rezonings, preliminary development plans, and preliminary plats, reserving an effective detention volume of 10,000 cubic feet per acre is acceptable in lieu of providing actual computations. If this method is used for determining rough area requirements for detention, a revised preliminary stormwater study including actual detention modeling must be completed and submitted prior to approval of a final development plan or final plat. For detention facilities that will provide both flood control and extended detention of the water quality volume (WQv), the WQv shall be added to the reserved effective detention volume to determine the total volume and surface area requirement for the facility.*

F. **Stream Corridors:** OPMC requires the preservation of most natural streams and reservation of a stream corridor on each side of the existing stream channels in accordance with OPMC Chapter 18.365.

Land disturbances in a stream corridor during construction is highly restricted. There are also use limitations. See OPMC 18.365.080 and ES Policy 3-07 for additional information.

For purposes of the Preliminary Stormwater Management Study, the following information must be included on the maps included in the study:

- Proposed limits of disturbance adjacent to the stream corridor.
- Tributary area of the stream(s) entering and leaving the site and all significant confluences with side channels within the site.
- Location of the OHWM on both sides of the stream and limits of the stream corridor based upon required offsets. For any stream with a drainage area less than 100 acres, showing the stream centerline in lieu of the OHWM is acceptable.
- Locations for any existing or proposed utility crossings or encroachments into the stream corridor.
- Identification of proposed uses and locations within the stream corridor.
- Location of significant stands of trees and native vegetation within the stream corridor.

G. *Stormwater Treatment Requirements:*

The Preliminary Stormwater Management Study shall indicate whether stormwater treatment is required for a site based upon applicability requirements set forth in OPMC 16.210.030. Attachment A can be used as a tool to help determine if a site is required to provide stormwater treatment. If a deviation to those requirements is requested, the applicant must submit information supporting the request as set forth in OPMC 16.210.060.

The Preliminary Stormwater Management Study must determine the required footprint for all stormwater treatment facilities proposed for the site. Adequate documentation shall be included to verify the required size, type, and location of all stormwater treatment facilities.

In order to meet the above three goals, the Preliminary Stormwater Management Study shall, at a minimum, include documentation of the following steps:

1. Written or graphic inventory of the natural resources on the site, including soil conditions, existing vegetative cover, and topography on the site.
2. Identification of and a preliminary plan for control of any stormwater “hot spots” as indicated in the MARC/APWA BMP Manual Section 4.4.

3. Inventory map of existing soil types and land usage for determining a Curve Number (CN) for the existing site.
4. Summary of proposed or assumed site uses and impervious cover percentage.
5. Description of development impacts and Level of Service calculations on MARC/APWA Manual Section 4 Worksheet 1 for an undeveloped site or on Worksheet 1A with Tables 3 and 4 for a developed site that is to be redeveloped. For infill or redevelopment projects, the City of Overland Park Design and Construction Standards provide a modified method for computing Level of Service.
6. Proposed stormwater treatment facility types and locations in plan.
7. Maps and/or plans indicating the tributary drainage areas for each stormwater treatment facility proposed for the site and how the 100-year storm peak flow will be routed through each facility.
8. Mitigation Package Calculations, including completed Worksheet 2 from the MARC/APWA BMP Manual. For infill or redevelopment sites, utilize Worksheet 1A and Tables 3 and 4 in lieu of Worksheet 1 or the method shown in the City's Design and Construction Standards for infill/redevelopment sites.
9. Proposed stormwater facility types and locations in plan.
10. Infiltration Facilities. Note that a percolation test in conformance with methods shown in the City's Design and Construction Standards is required to be submitted with the Preliminary Stormwater Management Study for any facility that relies on soil infiltration to function. Additionally, infiltration type facilities are not permitted in HSG "D" classified soils.
11. Water Quality Control Volume (WQv) utilized in sizing design of the stormwater treatment facilities (see next item).
12. Summary of required surface area for each stormwater treatment facility, including the WQv and maximum ponded depth. In general, preliminary sizing for stormwater treatment facilities can be determined

- using the guidelines provided in Chapter 8 of the MARC/APWA BMP Manual for each category of stormwater treatment facilities.
13. Required easements, tracts, setbacks, and access routes for each proposed stormwater treatment facility, in accordance with the Stormwater Treatment Standards and Chapter 8 of the MARC/APWA BMP Manual (if dedicated by applicant/owner). Easements shall be sized to include the total area required for construction and ongoing maintenance of each stormwater treatment facility. This shall be shown graphically on a site plan and summarized in the text.
 14. Preliminary grading plan, including retaining walls, to ensure required storage volumes and depths can be achieved within the constraints of the site.
 15. The party responsible for long-term maintenance of the stormwater treatment facility.
- H. **Corps of Engineers Requirements:** Determine the Corps of Engineers requirements and indicate whether a permit is required. Any required 404 permits must be submitted with the Final Stormwater Management Study and prior to issuing construction permits.
- I. **FEMA/DWR Requirements:** In the event a developer wants to alter floodplain boundaries, a professional engineer must prepare a flood study as detailed below under FLOOD STUDY. A flood study may be required with submission of the preliminary development plan.
- J. **Maps:** The submitted preliminary stormwater management study shall include, at a minimum, the following maps:
1. **Site Map:** A site map at a scale of 1" = 50 feet or greater, and a maximum contour interval of 2-feet. The site map must include existing topographical information of the site to be developed and adjoining land whose topography may affect the proposed layout or drainage patterns for the development. The source of the topographic information should be indicated on the map. The map shall show all existing streams, waterways, channels, the extent of both FEMA and non-FEMA floodplains, waters of the U.S. and jurisdictional wetlands.
 2. **Drainage Maps:** Existing and proposed drainage area maps at a scale of 1" = 200 feet or greater, and a maximum contour interval of 2-feet. In cases where there are large off-site areas draining to a site making

2-foot contours impractical, a larger contour interval may be allowed. The drainage area maps should include all off-site drainage, including pipe network information, that drains to the site and all on-site drainage that leaves the site (to the next downstream storm drainage conveyance).

FLOOD STUDY

In addition to the above information required for the Preliminary Stormwater Management Study, if the development plan includes a significant natural stream, drainageway, or open channel, a flood study may be required. The goal of the flood study may include any one or more of the following:

- Verification that any fill placed in the floodplain will result in no adverse impacts, including no rise in flood elevations (or Energy Grade Line) beyond the limits of the property, or in the case of grading within the floodway, that a “no-rise” condition is maintained.
- To provide supporting documentation for submission of a Federal Emergency Management Agency (FEMA) Letter of Map Change (LOMC).
- Determination of the location of the FEMA Special Flood Hazard Area (SFHA) and/or floodway.
- Establishing minimum floor and/or low opening elevations for adjacent structures.
- Determining depth of flow in parking lots and streets.

If the plan proposes fill in a federally regulated floodplain, refer to OPMC Chapter 18.360 for the City’s floodplain management criteria. Depending on the scope of the work in the floodplain, the work may be completed with a local floodplain permit, or may require a pre-project Conditional Letter of Map Revision (CLOMR), and/or a post project Letter of Map Revision (LOMR) or Letter of Map Revision based on Fill (LOMR-F).

In addition to the local and FEMA approvals, other state and federal permits may be required prior to the issuance of City permits, including but not limited to a Section 404 Permit from the Corps of Engineers, and a Stream Obstruction Permit from the Kansas Department of Agriculture, Division of Water Resources.

Scope:

The scope of a flood study must include the following minimum items. For critical areas, staff may modify the scope as necessary to address individual site needs.

A. **Modeled Conditions:**

Flood studies must include the following modeled conditions under both Existing and Ultimate flow conditions:

- Duplicate Effective
- Corrected Effective
- Post Project

B. ***Input and Output Data:***

Include HEC-RAS tabular output at each cross section showing the following data fields:

- Reach
- River Station
- Profile (Modeled Flow – i.e. 1% existing, 1% planning, 0.2% planning, etc)
- Total Flow
- Minimum Channel Elevation (Flowline)
- Water Surface Elevation
- Critical Water Surface Elevation
- Energy Grade Line Elevation
- Energy Grade Slope
- Channel Velocity

Include cross section printout data (graphical) including water surface elevations for each modeled condition.

Include stream profile printouts (graphical) including water surface and energy grade line elevations for each modeled condition.

C. ***Summary Table of Results:*** Include a table of results that includes the following information at pertinent cross sections for all modeled conditions.

- Q – Flow rates
- WSEL - Water surface elevation
- EGL – Energy grade line
- Delta EGL and Delta WSEL – Show the change in the modeled EGL and WSEL during the design storm for all modeled physical conditions

- D. ***Floodplain Boundary Changes:*** The report must include a discussion of proposed changes, if any, to the floodway or floodway fringe boundaries.
- E. ***Effects on Adjoining Property:*** The report must include a discussion of the possible effects that proposed development could have on area adjoining the development.
- F. ***Cross Section Spacing:*** In areas where adjacent lots are, or will be developed, and the flood study is being utilized to establish minimum low opening elevations or minimum property grades, cross section spacing shall be sufficient so that there is a maximum EGL differential of **1 foot** between cross sections. **Greater EGL differentials may be accepted in areas of very steep and uniform grade, where the potential errors introduced by interpolation are less, or where adjacent ground is well elevated and the possible errors less critical.**

Maps:

The submitted Flood Study shall include, at a minimum, the following maps:

- A. ***Site Map:*** The site map should be at a scale of 1" = 50 feet or greater and include the following information:
 - Existing and proposed contours at a maximum 2-foot contour interval
 - Source of the contour information (i.e. AIMS maps, field survey, etc)
 - Plans must be referenced to state-plane coordinate system
 - Benchmark and datum (tied to 1988 NAVD (Johnson County Datum)
 - Stream centerline
 - Existing conditions and post-construction 1% (100-year) floodplain for both existing and ultimate (planning) flows
 - Limits of the floodway (if applicable)
 - Proposed site infrastructure
- B. ***Drainage Area Map:*** A drainage area map at a scale appropriate for the size of the watershed. The drainage area map should include all off-site drainage that drains to the site
- C. ***Cross Section Map:*** An overall plan view map indicating the locations and river stations of modeled cross sections in the vicinity of the project. The cross sections shown should extend upstream and downstream from the project beyond the distance that is affected by proposed fill in the floodplain.

FINAL STORMWATER MANAGEMENT STUDY

The goal of the Final Stormwater Management Study is to document the final design of the proposed stormwater conveyance and treatment facilities.

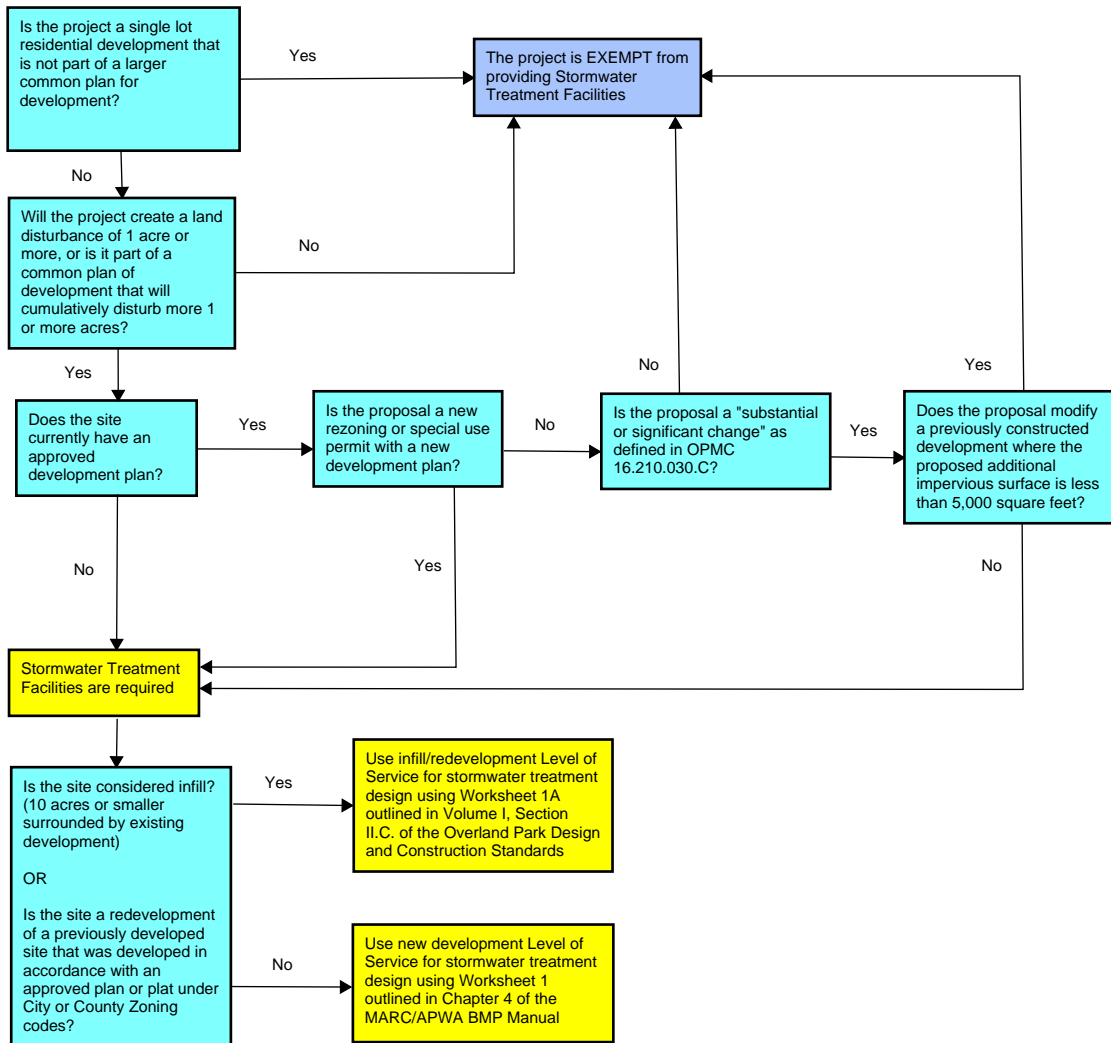
The Final Stormwater Management Study should be a stand-alone document. It must reference and fully document all items addressed in the Preliminary Stormwater Management Study. When the Preliminary Stormwater Management Study covers all items to the level of detail required for the Final Stormwater Management Study, and no significant changes were made during the design of the project, a sealed letter by the design engineer verifying that the final study is in substantial conformance with the preliminary study may be submitted in lieu of a full study.

Scope:

The scope of a Final Stormwater Management Study shall be the same as the preliminary study with the following additional information provided:

- Onsite Stormwater System: Provide final pipe sizing and locations, overflow swale sizing, flow rates and capacity, inlet capacity/bypass
- Final finish floor and building opening elevations with respect to adjacent stormwater facilities
- Stormwater Detention Facilities: Final sizing computations including inflow/outflow hydrographs, control structure sizes/elevations, peak storage volume during all design storms, location and elevation of auxiliary spillways
- Stormwater Treatment Facilities:
 - Design volume and elevations for all volume control type facilities
 - Details of any control structures
 - Planting plans for any native vegetation proposed with any facility
 - Information on any proposed maintenance restrictions such as mowing, establishment requirements, and other vegetation management requirements
 - Restoration plans for any stream corridor restoration proposed
- Floodplain: Copy of final plan for work in the floodplain including any required FEMA submittals
- Other Permits: Copies of all other permits that were required prior to permitting, including but not limited to, Corps of Engineers 404 Permit, and KDWR Permits for work in streams

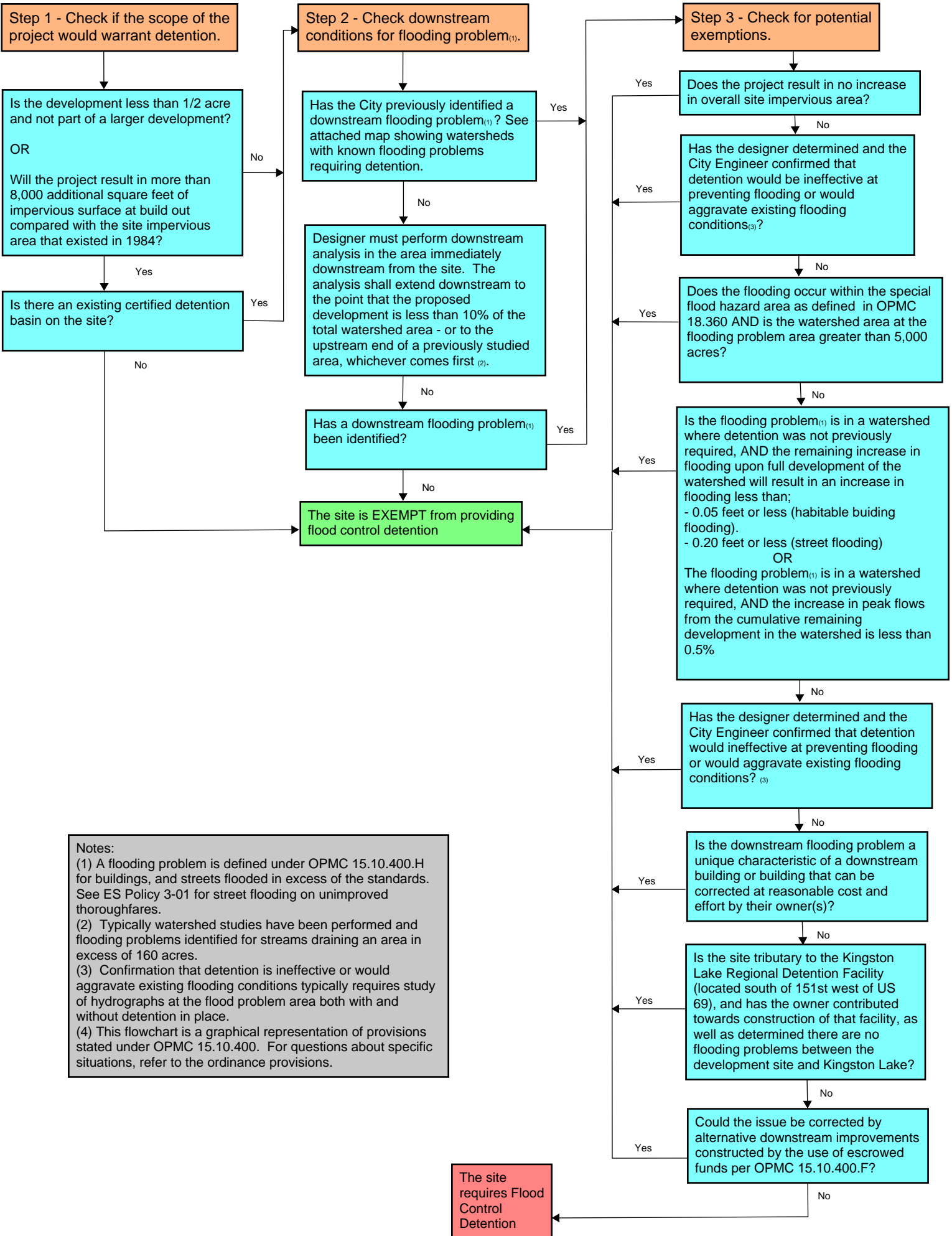
Attachment A - Stormwater Treatment Requirements for Development Projects



Notes:

This matrix is an excerpt from OPMC 16.210.020 and OPMC 16.210.030 and was intended to provide a guide for most development plan applications. See the Overland Park Municipal Code for a listing of all requirements.

Attachment B Flood Control Detention Requirements for Development Projects



Watersheds With Known Flooding Problems Requiring Detention

- ★ 5,000 Acre Drainage Point
- Major Drainageway
- Future Conditions Floodplain
- ◆ Certified Detention Basins
- Watersheds Requiring Detention *
- City Limits

* Disclaimer: This map shows watersheds where previous studies have indicated a downstream flooding issue warranting stormwater detention exists. In most cases, this information is known only for streams with a drainage area exceeding 160 acres. The designer is responsible for verifying downstream conditions and analyzing the area immediately downstream from any proposed development site as required under OPMC Section 15.10 and the City's Design and Construction Standards.

