POST-DEVELOPMENT STORMWATER RISK ASSESSMENT

This document provides the rationale and sequential procedures for assessing risk of impacts from post-development stormwater discharge.

Pursuant to the GFO 3-73, and working within the constraints of the project, designers must provide features and practices that cause post-development hydrology to mimic pre-development baseline hydrology of the site to the maximum extent practicable for small, frequent rain events up to and including a 95th percentile rain event at all locations of discharge. The risk assessment for post-development changes in stormwater discharges will focus on two categories of possible impacts: impacts to structures near or downstream from the site, and impacts to any streams, ponds or lakes that may receive the stormwater discharges. Although the risk assessment analysis is focused on impacts from the small, frequent rainfall events up to and including a 95th percentile rainfall, these small storm events can predict possible impacts of larger storm events from a 2-year storm up to a 100-year storm. Stormwater discharges may affect downstream structures such as a building, culvert, bridge, levee, dam, etc. by flooding. Such damage could occur as a result of the direct flow of stormwater or by increasing the flow of downstream receiving waters. Evidence of pre-development flood damage and/or evidence of potential post-development damage after small rain events will provide guidance for selection and installation of appropriate stormwater controls that can reduce risk of more significant damage from larger storm events.

Post-development increase in stormwater discharge may also affect the stability and function of existing streams that receive the stormwater discharge. Increased stream flow above baseline caused by stormwater discharge could incise the streambed and/or banks of receiving waters, resulting in post-development changes such as widening or deepening of the streambed, downstream deposition of sediment, impacts to aquatic biological organisms, or other problems. Thus, the potential damage or impairment of the streambeds of receiving waters from increased stormwater discharges should be assessed.

The following procedure serves as guidance for assessing post-development impacts, including scour and erosion, associated with site topographic modification, installation of facilities and related infrastructure, including increased impervious areas, which could result in increased volume and force of stormwater discharges and potential flooding. A flow chart illustrating the procedure is included as Table 1.

Perform Hydrologic Analysis for the 95th Percentile Event

- Run hydrologic models for all discharge points leaving the right-of-way to determine if there will be increases in discharge for the 95th percentile storm event. If increased discharges are predicted, provide BMPs to mimic pre-condition hydrology to the maximum extent practicable and perform hydrologic analysis for larger storm events.

Perform Hydrologic Analysis for Larger Storm Events

- Run hydrologic models for all discharge points leaving the right-of-way to determine if larger events will increase discharge. If a possible increase in discharge is indicated, perform storage routing using the proposed culvert. If increased discharge will be present after storage routing, begin risk assessment.

Perform Risk Assessment

Desktop Review

- Complete Section A of Form HYD-100
  - Determine drainage area to outlet location
  - Review current aerials with drainage areas located
  - Note if there are buildings, ponds, or other structures downstream within the drainage area
  - If ponds exist, determine date of construction if possible.
- Complete Section B of Form HYD-100
  - Review current flood studies
  - View floodplain and/or floodway boundary on the most current aerials
  - Identify other structures downstream that may be located in or near the floodplain or floodway.
  - Identify and interview National Floodplain Insurance Program (NFIP) coordinator regarding community policies
  - Consult city engineer, county engineer, NFIP coordinator, or other public or knowledgeable private personnel regarding information including previous studies, surveys, or other available materials that may identify sensitive features or areas that would require additional attention to avoid or minimize future claims and impacts.
- Complete Section C of Form HYD-100
  - Determine environmental impacts that could affect hydraulic design
  - Determine if the receiving waters are ephemeral, intermittent, or perennial
  - Using soil survey or core borings, identify the types of soil and/or other geological features in or near the site (sand, silt, or clay)
- Complete Section D of Form HYD-100
  - Determine average daily traffic for present year and design year
  - Determine what routes may be affected (school, mail, emergency etc.)

- Determine if detours are available if route is closed
- Determine if the available detour route(s) is an interstate, freeway, arterial, collector, or local
- Describe the existing roadway including the pavement type, shoulder type, number of lanes, median type, and width of each (N/A for new alignment)

Site Visit

- Complete Section A of Form HYD-101
  - Determine the stream slope and if there are any drops greater than 2 feet
  - Determine the material in the stream bottom
  - Determine the material in the stream banks
  - Determine if the stream material is cohesive or non-cohesive
  - Determine if the stream shows evidence of degradation such as bank scour
  - Determine the material in the floodplain
  - Determine the kind and amount of vegetation in and along the channel
  - Determine the kind and amount of vegetation in the floodplain
  - Estimate Manning's n-values for the stream channel and floodplain
  - Determine other features that might affect water surface elevations
- Complete Section B of Form HYD-101
  - Note if scour is present around or near the structure
  - Describe the alignment and size of structure
  - Provide elevations for elements of structure such as low bridge superstructure, pipe or culvert inverts, low point of road, etc.
  - Provide road width, either shoulder-shoulder or curb-curb
  - Describe the condition of the existing structure
- Complete Section C of Form HYD-101
  - Estimate the flood damage potential
  - Note any buildings in and around the floodplain
  - Determine finished floor elevations of buildings
  - Describe the land use upstream and downstream
- Complete Section D of Form HYD-101
  - Determine if there is any historical highwater information
  - List the source and the location of the information
  - If information exists, note the date and elevation of the highwater

  - Estimate allowable highwater
  - Note any informal or available record(s) of damage from previous floods
- Complete Section E of Form HYD-101
  - Photograph pertinent features such as existing drainage structures, stream channel, floodplain, and any other key features
  - Provide an identification number or description for recording photos
- Complete Section F of Form HYD-101
  - Collect cross-section information and stream slope at any proposed crossing if it cannot be effectively obtained from a digital terrain model (dtm)

Risk Factor Assessment Form

Complete the Risk Factor Assessment form to identify any high risk factors are present. If any questions are answered "Yes," further hydrologic and/or hydraulic analysis should be performed to determine the extent of the possible impact.

Structures / Property

- During the desktop review, identify and note buildings or structures of any kind, including ponds, dams, levees, etc., within the boundaries of the FEMA mapped floodplain or special flood hazard area.
- During the site visit, identify and note houses or structures of any kind, including ponds, dams, levees, etc., built near a stream that does not have a FEMA mapped floodplain.
- Determine if there is personal property, including but not limited to vehicles or other movable property that could be impacted by flooding.
- Determine from the property owner, city engineer, floodplain manager, etc. if there have been previous issues with flooding.

Streams

- Determine if the streambed and stream banks consist mostly of a non-cohesive sand or silt. This can be determined during the site inspection or from soil borings.
- Determine if there is pre-development evidence of scouring or incision of the streambed and/or stream banks, and/or if there is little to no stream bank vegetation.
- Determine if the flood flow would likely break over the stream banks into the floodplain during a 2-year flood event.
- Determine if any endangered or threatened species are present within the stream.
- Determine if there will be outlets without energy dissipation that could accelerate channel degradation.

RISK FACTOR ASSESSMENT FORM

Project Name/No: _____ Date: _____

County: _____ Site No: _____

Stream: _____ By: _____

High Risk Factors - Structures and Property

		Yes*	No
1	Is there a structure in the mapped FEMA Special Flood Hazard Area?		
2	Is there a structure built near the stream in an unmapped floodplain area?		
3	Is there a threat of property damage (other than a structure)?		
4	Is there history of previous flooding?		
5	Is there a privately owned pond, levee, etc. that will be impacted?		
6	Other? Describe if Yes.		

* If any of these items were answered Yes, then perform a hydrologic and hydraulic analysis for the 2-year 24-hour event through the 100-year 24-hour storm event

High Risk Factors - Streams

		Yes*	No
1	Does the stream mainly consist of a non-cohesive silt or sand?		
2	Is the stream already degrading and have little to no bank vegetation?		
3	Is the stream unable to utilize the floodplain on a 2-year event?		
4	Are there endangered species that are impacted?		
5	Will proposed outlet flow be concentrated without energy dissipation?		
6	Other? Describe if Yes.		

* If any of these items were answered Yes, then perform a hydrologic and hydraulic analysis for the 2-year 24-hour storm event

Criteria of recurrence intervals for hydrologic and hydraulic analysis

- If any items on the Risk Factor Assessment Form were answered "Yes," further hydrologic and hydraulic analysis shall be performed
- If any items on the 'Structures and Property' Form were answered "Yes," analyze the 2-year 24-hour storm and all other events up to and including the 100-year 24-hour storm event
- If any items on the 'Stream' Form were answered "Yes," analyze the 2-year 24-hour storm only
- Interchanges, support facilities, rest areas shall meet the local stormwater ordinance criteria.

In some instances there may be specific sites that require greater management of stormwater due to the conditions of the location. In these cases, a context sensitive design approach will be used.

Table 1: Risk Assessment Flowchart