

developing and implementing an erosion and sediment control plan which addresses both temporary and permanent control practices.

B. Quantity: Determinations of stormwater quantity are primarily useful for evaluating and mitigating the impact of a project. Without detention, land development increases peak runoff rates and volumes from storm events, which can lead to higher flood elevations. Appropriate hydrologic and hydraulic calculations presented in various chapters of this manual should be made to determine the required conveyance through the Municipality's project limits, and to aid in mitigating impacts to downstream structures and development.

Procedures contained in Part 2, Section 700, Roadway Drainage Design, should be used to evaluate the ability of a facility to accomplish the following controls for a particular area:

- Provide positive drainage and runoff collection to the minimum criteria for safe passage of traffic on the project roads and parkings.
- Reduce runoff rates when applicable by increasing infiltration, and by storing precipitation and runoff where it falls and releasing it slowly.
- Protect areas subject to flood damages by keeping runoff confined to drainage facilities such as pipes or channels and by building appropriate flood control facilities.
- Maintain offsite flows, through the project area.
- Limit flood plain encroachment to acceptable upstream/downstream flooding impacts.

The following questions should be considered when selecting the plan for disposal of stormwater runoff:

1. Are existing drainage systems large enough to handle runoff?
2. Are runoff estimates consistent with adopted drainage plans and Municipality criteria?

3. Will the project require retention or detention storage areas to mitigate the impacts of increased runoff, or can the increase be handled by other project features?
4. Is there sufficient area to construct a retention or detention storage within the project limits? Are alternative sites available for storage of stormwater?
5. What are the groundwater and soil conditions? Is there a high groundwater table, or are there impermeable soil layers?

C. Flood Plain Encroachment: The primary drainage consideration for facility location in highway planning is the evaluation of the impact of flood plain encroachment for a stream or wadi crossing or where the road embankment longitudinally encroaches into the flood plain area.

The following factors for locating a stream crossing that involves encroachment within a flood plain area:

- Waterway characteristics (stable or unstable)
- Geometry
- Hydrology
- Hydraulics
- Alignment
- Flood plain flow
- Needs of the area
- Economic and environmental concerns

A detailed evaluation of these factors is part of the bridge location and hydraulics study. When a suitable crossing location has been selected, specific crossing components can then be determined. When necessary, these include the geometry and length of the approaches to the crossing, the probable type and approximate location of the abutments, the probable number and approximate location of the piers, the estimated depth to the footing supporting the piers (to protect against local scour), the location of the longitudinal encroachment in the flood plain, the amount of allowable longitudinal encroachment into the main channel, and the required river training works, to ensure that river flows approach the crossing or the encroachment in a