

Appendix G

Overbank Roughness Selection in Development Areas

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The determination of roughness in the developed areas (commercial and residential) within the overbank/floodplain area is often difficult, since data for floods that greatly exceed bankfull level are not always available for calibration. Roughness values for these types of developed areas are not published. During the 1950 event, flooding extended into developed overbank areas within the City of Winnipeg, such as the “Riverview” neighbourhood. Although small in area during the 1950 flood, these flooded overbank areas did provide valuable information for the calibration of the developed area overbank roughness values. For flood events greater than the 1950 flood however, the level of inundation would extend well into the developed overbank areas.

A technical review was undertaken to ensure that the roughness value for developed overbank areas, as determined from the 1950 calibration, is reasonable. For the developed areas of the model, the structures act as a discontinuous blockage, restricting conveyance. Since the blockage effect is discontinuous, it is not practical to adjust cross section geometry/conveyance for each individual structure. The roughness in the developed areas could best be described as an “effective” roughness value due to these blockages within the natural cross section.

If one considers the Manning equation you will note that the area and roughness are directly proportional as shown below:

$$Q = \frac{I}{n} AR^{2/3} S^{1/2}$$

Where:

- Q is the discharge (m³/s)
- n is the Manning’s roughness coefficient
- A is the conveyance area (m²)
- R is the hydraulic radius (m)
- S is the slope of the channel (m/m).

Based on this relationship, one can assume that a loss in conveyance area can be indirectly accounted for through an increase in the roughness, albeit not a true roughness.

For example in a typical developed residential area within the City of Winnipeg, one can assume that:

- Houses (and other structures e.g. garages) occupy approximately 60% to 75% of a typically lot, depending on the orientation of the house relative to flow. Note that most residential streets and houses within the City of Winnipeg run perpendicular to the Red River flow, and as such offer a higher blockage affect than if the residential streets and houses paralleled the Red River flow.
- Properties have trees, shrubs and fences which would yield higher roughness than cultivated or open floodplains.

With floodplain roughness typically varying from 0.05 to 0.08 depending on ground cover, and assuming a 60% to 75% area blockage, the “effective” roughness in the developed areas could potentially range from a low of 0.13 to a high of 0.32, with an average of approximately 0.2. This average roughness value matches the roughness value estimated during the calibration of the model for 1950 flood conditions.

Note that these assumptions consider that the residential and commercial properties would not be entirely submerged (water level above roofline) or that the structures would become dislodged. If either of these two conditions was to occur, the roughness would change in these areas. Data was not available to calibrate the roughness through commercial areas, therefore the roughness as selected for the residential areas was adopted.