



STORM BULLETIN 19

SEWER FULL FLOW OPERATING VELOCITY

- **The ability of a storm sewer to convey stormwater may** be determined by the available potential energy where:

H = available potential energy in ft
WSE = Water Surface Elevation
H = inlet - outlet WSE

- The junction losses at pipe inlets will consume part of this potential energy where:

JL = Junction Loss in ft
K = junction loss coefficient (for a partially benched structure K = 0.50)
V = pipe operating velocity in ft/sec
 $JL = KV^2/64$

- The friction losses in the pipes will consume the remaining potential energy where:

PF = Pipe Friction loss in ft
L = Length of pipe in ft
Q = Flow rate in ft³/sec
C = pipe conveyance factor

$$PF = L (Q/C)^2$$

A = pipe flow section ft²
Q = VA

$$PF/L = (VA/C)^2$$

- **The available pipe hydraulic grade** is based on pipe length and available pipe friction loss where:

Y = Available pipe hydraulic grade

$$Y = PF/L$$



- The available pipe operating velocity can then be estimated from the available hydraulic grade where:

$$V = Y^{0.5}C/A$$

- The full flow pipe conveyance factor** depends on the pipe size and the friction factor. For the Manning constant $n = 0.012$ these values are:

Pipe dia. inches	12	15	18	24	30	36	42	48
C	38.6	69.9	113.7	244.9	444.1	722.1	1089.3	1555.3
C/A	49.3	57.3	64.8	78.0	91.1	102.8	114.0	124.6

- The slope of the existing terrain** will often determine the available hydraulic grade. Most commercial sites will be located in areas where the existing terrain is relatively flat and poorly drained. Obtaining an available hydraulic grade of 0.30 % may be the best tradeoff between using the existing terrain without incurring excessive earthmoving costs.
- The available full flow operating velocity** must allow for junction losses. The table below assumes the junction losses become excessive when the pipe operating velocity exceeds 6 ft/sec. The pipe grade is 0.30% for all cases in the table.

Pipe dia. inches	12	15	18	24	30	36	42	48
Full flow velocity in ft/sec	2.7	3.1	3.5	4.3	5.0	6.0	6.2	6.8
Operating velocity in ft/sec	2.7	3.1	3.5	4.3	5.0	6.0	6.0	6.0

- The pipe slope is not the basic criteria** for determining full flow operating velocity. If the downstream facilities are flooded the available potential energy is reduced. This could also reduce the available operating velocity to less than 0.50 ft/sec. However increasing the pipe slope will increase the scouring velocity during weak storm events, thereby reducing the deposition of solids in the invert of the pipe. The available pipe operating velocity can then be estimated from the available hydraulic grade: