ARTICLE III

SANITARY SEWERS

301.00 GENERAL REQUIREMENTS

301.01 Conformance and Interpretation: Authority for discretionary provisions for sewer design shall rest with the Director of Public Works of the City of Manassas Park, who when necessary shall request and obtain the advice of the City Engineer.

301.02 Lateral Connections to Trunk Lines: Sewer laterals shall not be directly connected to a trunk line unless specifically approved by the Director of Public Works.

301.03 Easements: When deemed necessary by the Director of Public Works, and in order to assume maximum utilization of the sanitary sewer system, it will be required that appropriate easements shall be obtained for access to or extension of the sanitary sewer system.

301.04 Pipe Material Changes Between Manholes: There shall be no change in pipe materials from manhole to manhole, unless specifically approved in advance by the Director of Public Works.

301.05 Service Connections Outside of Rights-of-Way or Easements: All sewer service connections or portions of sewer service connections located outside of public road rights-of-way or sanitary sewer easements shall be privately owned and maintained.

301.06 Connections Between Water and Sewer Lines: There shall be no physical connection between a drinking water supply and a sewer, or appurtenance thereto.

302.00 DESIGN STANDARDS

302.01 Tributary Population Consideration: Sewer systems shall be designed for the estimated future population contributing at the point under consideration. Consideration shall be given to domestic, commercial, institutional, and industrial wastes plus ground water infiltration in determining the capacity of the sewer system. The design shall be based on estimates of anticipated population and tributary sewage flow for a period of fifty years hence, or the entire watershed shall be assumed to be completely developed according to present or proposed zoning categories, whichever required the

greater capacity. As a minimum and in the absence of any of the above, sewer systems shall be designed on a density of at least ten (10) persons per acre and a design analysis shall be submitted for all sewerage systems

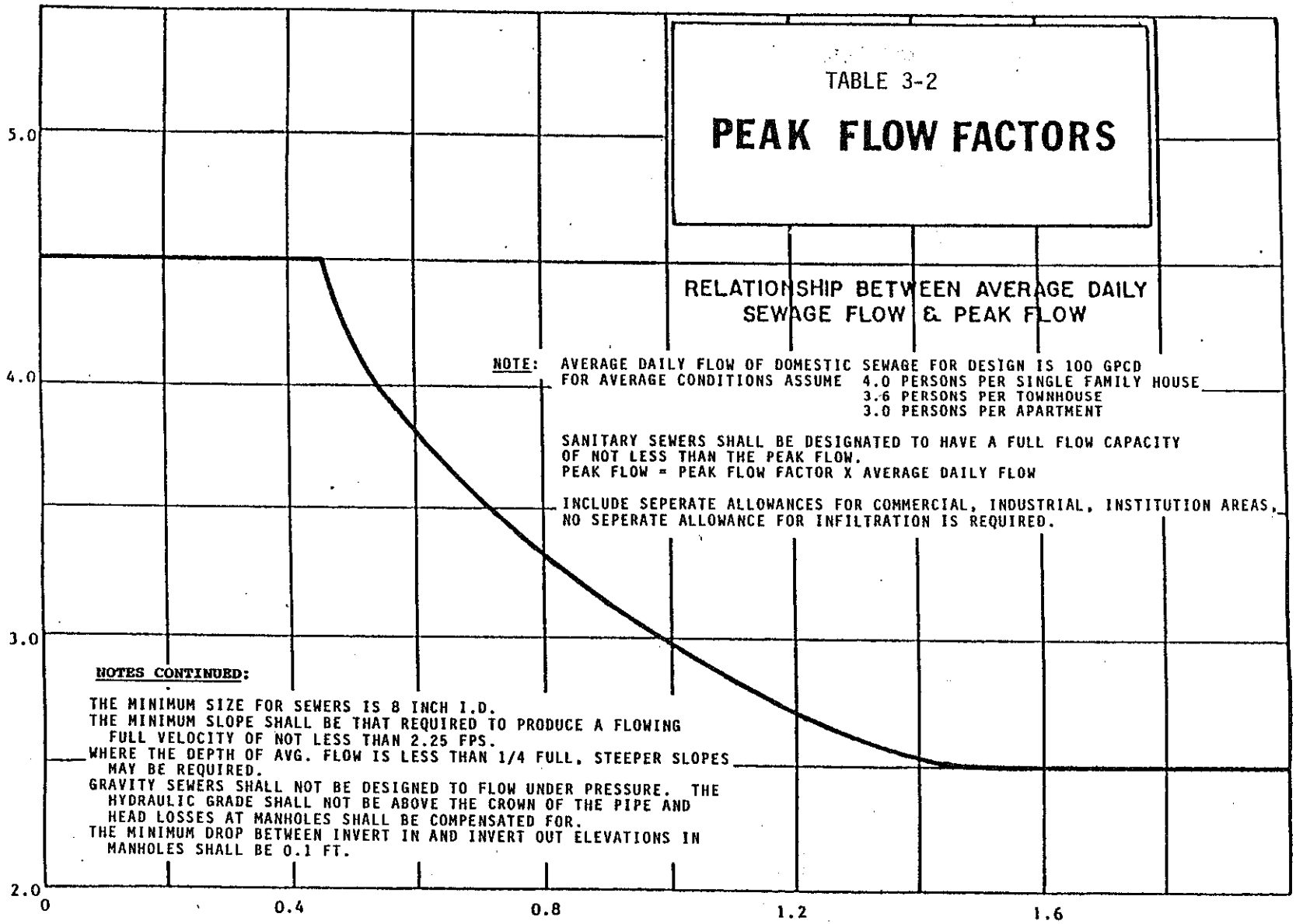
302.02 Design Quantities: New sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than that set forth hereinafter (See Table 3-1). These figures are assumed to cover standard infiltration/inflow. When deviations from the foregoing per capita rates are proposed, a description of the procedure used for sewer design shall be included with the submission.

TABLE 3-1

Design Unit	Discharge	Flow-gpd
Dwellings	per person	100
Schools with showers & cafeteria	per person	16
Schools without showers & cafeteria	per person	10
Motels at 65 gals/person	per room	130
Restaurants	per seat	50
Service Stations	per vehicle served	10
Factories	per person per 8 hr. shift	15-35
Hospitals	per bed	300
Shopping Centers	per 1000 sq. ft. of ultimate floor space	200-300
Nursing Homes	per bed	200
Homes for the Aged	per bed	100
Doctors Office in Medical Center	per 1000 sq. ft.	500
Laundromats, 9 to 12 # loads	per machine	500
Swimming Pools	per swimmer	10
Theaters, Auditorium Type	per seat	5
Picnic Areas	per person	5
Camps, Day & Night/limited plumbing	per camp site	50
Luxury Camps/flush toilets	per camp site	100

TABLE 3-2

PEAK FLOW FACTORS



NOTE: AVERAGE DAILY FLOW OF DOMESTIC SEWAGE FOR DESIGN IS 100 GPCD
FOR AVERAGE CONDITIONS ASSUME 4.0 PERSONS PER SINGLE FAMILY HOUSE
3.6 PERSONS PER TOWNHOUSE
3.0 PERSONS PER APARTMENT

SANITARY SEWERS SHALL BE DESIGNATED TO HAVE A FULL FLOW CAPACITY OF NOT LESS THAN THE PEAK FLOW.
PEAK FLOW = PEAK FLOW FACTOR X AVERAGE DAILY FLOW

INCLUDE SEPERATE ALLOWANCES FOR COMMERCIAL, INDUSTRIAL, INSTITUTION AREAS, NO SEPERATE ALLOWANCE FOR INFILTRATION IS REQUIRED.

NOTES CONTINUED:

THE MINIMUM SIZE FOR SEWERS IS 8 INCH I.D.
THE MINIMUM SLOPE SHALL BE THAT REQUIRED TO PRODUCE A FLOWING FULL VELOCITY OF NOT LESS THAN 2.25 FPS.
WHERE THE DEPTH OF AVG. FLOW IS LESS THAN 1/4 FULL, STEEPER SLOPES MAY BE REQUIRED.
GRAVITY SEWERS SHALL NOT BE DESIGNED TO FLOW UNDER PRESSURE. THE HYDRAULIC GRADE SHALL NOT BE ABOVE THE CROWN OF THE PIPE AND HEAD LOSSES AT MANHOLES SHALL BE COMPENSATED FOR.
THE MINIMUM DROP BETWEEN INVERT IN AND INVERT OUT ELEVATIONS IN MANHOLES SHALL BE 0.1 FT.

302.03 Hydraulic Design Criteria: Sewers shall have a uniform slope and straight alignment between manholes. Sewers shall be designed to be free flowing with hydraulic grade below the crown of the pipe and with hydraulic slopes sufficient to provide an average velocity when running full of not less than 2.25 feet per second (fps). Velocity computations shall be based on a coefficient of roughness (n) of 0.013 as used in the Kutter or Manning formula. Due to low flows, upper or terminal manhole sections shall have a minimum slope of 0.80 percent unless there is a distinct possibility of the sewer being extended in the near future. Sewers shall be designed such that the maximum velocity is 15 fps. Where velocities must exceed 15 fps, the sewer shall be ductile iron pipe conforming to Section 303.01 of these specifications. Where smaller sewers discharge into larger sewers, the crown of the pipes shall be matched. Minimum size sewer main shall be eight inch (8) diameter.

In general, the following are minimum slopes to be provided for pipes flowing full to one-half (1/2) full:

TABLE 3-3

Sewer Diameter in Inches	Minimum Slope Percent
8	.47
10	.34
12	.26
15	.18
18	.14
21	.113

TABLE 3-4

Depth of Flow	Multiplying Factor
1/3	1.3
1/4	1.7
1.10	4.0

Hydraulic losses at manhole should be accounted for as follows:

A. At manholes on straight runs, a head loss of 0.05 feet shall be allowed.

B. At manholes which have a radius of turn less than two pipe diameters, a head loss of $(0.5\ V^2)/2g$ shall be allowed.

At manholes where the radius of turn is greater than two pipe diameters, a head loss of $(0.25\ V^2)/2g$ shall be allowed.

302.04 Location of Sewers and Appurtenances: In general, sewers shall be placed along the centerline of the street right-of-way. On curved streets, the sewer main shall not vary more than 10 feet on either side of the centerline, except at street intersections. Gas and water mains shall be a minimum horizontal distance of ten feet (10′) horizontal separation, a minimum horizontal separation of six feet (6′) may be allowed, providing the gas and water mains are at least eighteen inches (18") above the crown of the sewer main. All underground utility crossings of the sewer mains shall have a minimum vertical clearance of eighteen inches (18"). Sewer mains may be constructed on private property, with the approval of the Director, if a utility easement of a minimum of ten feet (10) is duly recorded. For trench depths greater than ten feet (10′), five feet (5′) additional easement width shall be required for each five foot (5′) additional depth. Increased easement widths may be required when determined necessary by the Director. All stream crossings shall be ductile iron pipe in conformance with Section 303.01 from manhole to manhole. Concrete encasement shall be required as determined by the Director, and shall extend a minimum of five feet (5′) beyond each bank.

302.05 Manholes: Manholes shall be provided at all junctions with other sewers, at all points in change in alignment or grade and at the terminal point of the main. A manhole shall also be provided at the junction of a private sewer extension and the public sanitary system. The maximum distance between manholes shall be four hundred feet (400′).

At all collector system manholes, the difference between influent and effluent inverts shall not be more than twelve inches (12"). Where this difference occurs, a smooth transition between the pipes, equal in height to 0.80 of the pipe, shall be provided. No

connections shall be made between twelve inches (12") and thirty inches (30") of separation. Where the difference is greater than a 2.5 foot drop, connections conforming to details shown in this Manual shall be constructed. On interceptor system manholes (for pipe larger than eighteen inches (18"), the difference may be twenty-four inches (24").

Four feet (4′) inside diameter manholes shall be provided for sewers up to and including twenty-four inch (24″) diameter pipes. Pipes larger than twenty-four inches (24") in diameter shall have specially designed manhole structures.

Manholes shall extend above the known level of flooding or, if this is not possible or practical, watertight manhole covers shall be used. As a minimum, watertight manhole covers are to be used to the elevation of the 25-year flood. Additional watertight manhole covers may be required as deemed necessary by the Director.

302.06 Service Connections: Service connections installed from the main to the property line or right-of-way shall be a minimum of four inches (4″) inside diameter. A four inch (4″) sewer cleanout shall be installed at the property line for all anticipated service connections at the time of construction of the sewer main. All service connections must be connected by means of a manhole connection or pre-manufactured tee or wye, or with an approved saddle type connection approved by the Director of Public Works. Service connections to terminal manholes shall not exceed 3 in number. Cleanouts shall be installed maximum distance of 50 feet on the service connection.

302.07 Minimum Depth Of Cover: Sewers which will be subjected to vehicular traffic shall generally be installed with six feet (6′) cover below the finished street surface. Sewers at a more shallow depth shall be protected from superimposed loads or effects of traffic on the basis of H-20 highway loading. Special designs must be approved by the Director of Public Works. Minimum depth of cover for sewers in rights-of-way with no highway traffic shall be four feet (4′). The minimum depth of cover may be decreased to three feet (3′) in rights of way with no highway traffic if ductile iron pipe is used.

302.08 Anchors: Concrete anchors shall be placed on sanitary sewer lines with grades of twenty (20) percent or greater. Minimum anchorage is as follows:

Not over 36 feet center to center on grades of 20% to 35%. Not over 21 feet center to center on grades of 35% to 50%. Not over 16 feet center to center on grades in excess of 50%.

302.09 Grease Traps, Volatile Liquid Separators: Grease traps, volatile liquid separators, or other devices shall be required for restaurants and may be required by the Director of Public Works on the facilities where, due to the nature of their operation, it is deemed necessary. The grease trap or volatile liquid separator is to be located externally in a manner so that all discharge from the kitchen plumbing pass through the grease trap or volatile liquid separator prior to entering the sanitary sewer; all other domestic waste water shall by-pass the grease trap. The grease trap or volatile liquid separator designs shall be reviewed on an individual basis during the plan review process. A minimum capacity of 500 gallons shall be provided per each grease trap. Adequate access for inspection and maintenance of the grease trap or volatile liquid separator is to be provided. The owner of the facility served by a grease trap or volatile liquid separator shall be responsible for its proper operation and maintenance.

302.10 Sewers In Relation To Streams, Estuaries, Lakes, And Reservoirs:

A. Location of Sewers in Relation to Streams, Estuaries, Lakes, Reservoirs: The tops of all sewers entering or crossing streams shall be at a sufficient depth below the natural bottom of the stream bed to protect the sewer line. In general, one foot (1′) of suitable cover shall be provided where the stream is located in rock and three feet (3′) of suitable cover in other material. Less cover will be considered if the proposed sewer crossing is encased in concrete and will not interfere with future improvements to stream channel. Reasons for requesting less cover shall be given in the application. In paved channels, the top of the sewer lines should be placed below the bottom of channel pavement. Sewers shall remain fully operational during 25-year flood/wave action. Sewers and their appurtenances located along streams shall be protected against the 100-year flood/wave action. Sewers located along streams shall be located outside of the stream bed wherever possible and sufficiently removed therefor to provide for future possible channel widening. Reasons for requesting sewer lines to be located within stream beds shall be given in the application.

B. Sewers Crossing Streams, Estuaries, Lakes Reservoirs: Sewers entering or crossing the streams shall be constructed of watertight

pipe. The pipe and joints shall be tested in place, shall exhibit no infiltration, and shall be designed, constructed and protected against anticipated hydraulic and physical, longitudinal, vertical and horizontal loads and erosion and impact. Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternative exists. Such sewers on piers shall be constructed in accordance with the requirements for sewers entering or crossing under streams. Construction methods and materials of construction shall be such that sewer will remain watertight and free from change in alignment or grade.

302.11 Relationship Of Sanitary Sewers and a Public Water Supply: Sewers shall meet the requirements of the Virginia Waterworks Regulations with respect to minimum distances from water supply wells or potable water supply sources and structures. For all other potable water supply wells or potable water supply sources and structures, sewers should meet the requirements of the Virginia Waterworks Regulations with respect to minimum distances from water supply wells or other water supply sources and structures. No sewer line shall pass within fifty feet (50') of a potable water supply source or structure unless special construction and/or pipe materials are used to obtain adequate protection. The designer is referred to current editions of the Waterworks Regulations and the requirements contained in "Rules and Regulations of the Board of Health, Commonwealth of Virginia, Governing the Disposal of Sewage" as basic design references. The proposed design shall identify and adequately address the protection of all potable water supply structures within one hundred feet (100') of the proposed project.

303.00 MATERIALS AND EQUIPMENT

303.01 Pipe Materials:

A. Structural Requirements: Structural design of sewers shall conform with the methods given in the ASCE Manual Number 37 for the Design and Construction of Sanitary and Storm Sewers. In the use of this manual, backfill weight shall equal 130 pounds per cubic foot and Ku shall be 0.130. The live load for sewers subject to traffic effect shall be determined from a minimum wheel load equivalent to an H-20 loading (16,000 pound wheel load). An allowance of fifty percent (50%) of the design wheel load shall be added for impact. A minimum wheel load of 10,000 pounds per wheel shall be applied to all other sewers not subject to traffic load.