SEWER SYSTEM DESIGN GUIDELINES

PART 1 GENERAL

1.1 GENERAL GUIDELINES

A. The following sewer system design guidelines are based on Federal, State and Local health requirements, and the Berkeley County Water & Sanitation engineering design criteria.

B. Design criteria not indicated herein shall comply with “Ten States Standards” where applicable.

C. All installations are to meet the standards of the South Carolina Department of Health and Environmental Control (SCDHEC) Standards for Wastewater Facility Construction: R. 61-67, and in particular: Section 67.300 Construction Permits.

D. No line extension shall be made from an existing line when the existing line does not meet the minimum requirements outlined in this section.

E. Sewer services and plumbing connections thereto must conform to relevant local plumbing codes or the National Plumbing Code.

F. No pressurized discharge to the gravity sewer system shall be allowed unless specifically approved in writing by the BCWS.

G. These design guidelines are applicable to all developments including but not limited to residential, commercial and industrial developments, subdivisions, and/or parks requiring sanitary sewer service from BCWS.

H. The BCWS will approve plans for new systems, extensions, or replacement sewers only where rain water from roofs, streets, and other areas, and ground water from foundation drains are excluded.

I. Sewers shall not be constructed under street paving except for crossings.

J. Sewer systems should be designed for the estimated ultimate tributary population, except in considering parts of the system that can be readily increased in capacity. Similarly, consideration should be given to the maximum anticipated capacity of institutions, industrial parks, etc.

1.2 BCWS MASTER PLAN

A. Sewer system design shall comply and be compatible with BCWS Wastewater System Master Plan.

1.3 GENERAL DESIGN CRITERIA

A. In determining the required capacities of sanitary sewers the following factors shall be considered:

1. Maximum hourly sewage flow.
2. Additional maximum sewage or waste flow from industrial plants.
3. Ground water infiltration.
4. Topography of area.
5. Location of the waste treatment plant.
6. Depth of excavation.
7. Pumping requirements.
8. Design flows shall accommodate the BCDCOG 20 year projected population figures.
9. Additionally, where at least 30 percent of a drainage area is already developed, a population density at least equal to that of the existing development must be used for the entire drainage area.

1.4 SIZING OF SEWER FACILITIES

A. Average flow projections for all domestic wastewater facilities shall be based on the type of facility to be served, as stated in R 61-67, Appendix A, unless otherwise justified by the applicant and approved by the BCWS.

B. Peak hourly flow projections shall be at least two and one half (2.5) times the average daily flow projection, unless otherwise justified by the applicant and approved by the BCWS. Where actual data are available, the BCWS may require its use in determining a peaking factor.

C. Sewer system components shall be designed to accommodate the maximum anticipated tributary flow.

1.5 LOCATION OF SEWER LINES

A. All sewers shall be constructed with a minimum of three (3) feet of cover, unless justified by the applicant and approved by the BCWS (e.g., use of ductile iron pipe may have cover less than three (3) feet).

B. Sewer lines, manholes, pump stations, force mains, and wastewater treatment facilities shall be located more than one hundred (100) feet from a public water supply well. Sewer lines, manholes, pump stations, and force mains shall be located at least twenty (20) feet from any other potable well, as defined in Regulation 61-71. Wastewater treatment facilities shall be located at least one hundred (100) feet from any other potable well, as defined in Regulation 61-71.

Special designs may be considered which shall provide equivalent protection to the well when this requirement is not achievable.

C. When sewers are proposed adjacent to any existing or proposed potable water supply facilities, the following requirements apply:

1. Potable Water Supply Interconnections. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or come into contact with any part of a sewer manhole.

2. Horizontal and Vertical Separation from Potable Water Mains. Sewers shall be laid at least ten (10) feet horizontally from any existing or proposed potable water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten (10) foot separation, the BCWS may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to a potable water main, provided that the potable water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the potable water main is at least eighteen (18) inches above the top of the sewer.

3. Pipe Crossings. Sewers crossing potable water mains shall be laid to provide a minimum vertical separation of eighteen (18) inches between the outside of the potable water main and the outside of the sewer. This shall be the case where the potable water main is either above or below the sewer. Whenever possible, the potable water main shall be located above the sewer main. Where a new sewer line crosses a new potable water main, a full length of pipe shall be used for both the sewer line and potable water main and the crossing shall be arranged so that the joints of each line shall be as far as possible from the point of crossing and each other. Where a potable water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the potable water main while maintaining line and grade.

4. Force Mains. There shall be at least a ten (10) foot horizontal separation between sanitary sewer force mains and potable water mains. There shall be an eighteen (18) inch vertical separation at crossing as required in subsection 67.300.A.14.b and subsection 67.300.A.14.c.

5. Special Conditions. When it is impossible to obtain the distances specified in subsection 67.300.A.14.b, subsection 67.300.A.14.c, and subsection 67.300.A.14.d the BCWS may allow an alternative design. Any alternative design shall:

a. maximize the distances between the sewer line and the potable water main and the joints of each;

b. use pipe materials which meet the requirements as specified in Regulation 61-58.4(D)(1) for the sewer line; and

c. Allow enough distance to make repairs to one of the lines without damaging the other.

6. Sewer Manholes. No potable water pipe shall pass through or come into contact with any part of a sewer manhole.

1.6 SURFACE WATER AND WETLAND CROSSINGS

A. Surface water and wetland crossing, whether over or under water, present special problems. BCWS should be consulted before plans are prepared. Sewer lines crossing surface waters must be adequately supported and anchored, protected from damage and freezing, and be accessible for repair or replacement [R.61-67]. Any support or anchoring system should be designed to be corrosion resistant using concrete or 316 stainless steel. Sewer mains crossing water courses which are greater than 15 feet in width, the following must be provided.

1. The pipe material and joints shall be designed appropriately.]

2. For force mains, valves must be located so that the section can be isolated for testing or repair; the valves must be easily accessible, and not subject to flooding.

3. For gravity sewer, manholes must be provided on each side of the wetland crossing.

B. Berkeley County, being a designated coastal county, requires that a Coastal Zone consistency review be provided by the SCDHEC's Office of Ocean and Coastal Resource Management (OCRM) as part of the wastewater construction permit process; unless a general certification applicable to the project from OCRM has already been provided. [R61-67.300 A.19.]

1.7 MATERIALS

A. Materials and installation for all gravity sewer lines and force mains shall comply with commonly accepted design standards such as ASTM (American Society for Testing and Materials), ANSI (American National Standard), AWWA (American Water Works Association) or other design standards and as shown in the BCWS Standard Specifications.

PART 2 GRAVITY SEWER LINES / COLLECTION SYSTEMS

1.1 GRAVITY SEWER LINES

A. Gravity sewer lines shall be constructed such that the internal angle of deflection is equal to or greater than ninety (90) degrees, including connections at manholes.

B. No gravity sewer line conveying raw sewage shall be less than eight (8) inches in diameter. Wyes for services lines shall have a minimum branch size of six inches.

C. All gravity sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than two (2) feet per second, based on Manning's formula using an "n" value of thirteen thousandths (0.013). Slopes slightly less than those required for the two (2) feet per second velocity, when flowing full, may be permitted. Such decreased slopes shall only be considered where the depth of flow shall be three tenths (0.3) of the diameter or greater for average flows. Whenever such decreased slopes are selected, the design engineer shall furnish with the report design computations of the anticipated flow velocities of average and peak flows. The report shall indicate the actual velocity in the sewer lines at the proposed slope and the actual velocity at the required slope in order to achieve two (2) feet per second, when flowing full. The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize settling problems. Oversized sewers shall not be approved to justify using flatter slopes. The operating authority of the sewer system shall give written assurance to the BCWS that any additional sewer maintenance required by reduced slopes shall be provided.

D. The BCWS preference for minimum slopes of various sewer pipe sizes according to "Ten States Standards" is shown below.

SLOPE RECOMMENDED BY TEN STATES STANDARDS

		50 % Full			100 % Full		
Slope	Dia.	V	FLOW		V	FLOW	
	in	fps	gpm	mgd	fps	gpm	mgd
0.85%	4	2.01	39	0.057	2.01	79	0.113
0.50%	6	2.02	89	0.128	2.02	178	0.256
0.40%	8	2.19	171	0.247	2.19	343	0.494
0.28%	10	2.14	262	0.377	2.14	524	0.754
0.22%	12	2.12	374	0.539	2.12	749	1.079
0.15%	15	2.05	565	0.813	2.05	1129	1.626
0.14%	16	2.04	639	0.920	2.04	1277	1.839
0.12%	18	2.06	815	1.174	2.06	1630	2.348
0.10%	21	2.06	1111	1.600	2.06	2222	3.200

SLOPE RECOMMENDED BY TEN STATES STANDARDS

		50 % Full			100 % Full		
Slope	Dia.	V	FLOW		V	FLOW	
	in	fps	gpm	mgd	fps	gpm	mgd
0.08%	24	2.04	1436	2.067	2.04	2871	4.135
0.067%	27	2.01	1795	2.585	2.01	3591	5.171
0.058%	30	2.01	2214	3.189	2.01	4429	6.377
0.052%	33	2.03	2706	3.897	2.03	5412	7.793
0.046%	36	2.02	3205	4.615	2.02	6409	9.229

E. Sewers shall be designed with a uniform slope between manholes.

F. Sewers on twenty (20) percent slopes or greater shall be anchored securely with concrete anchors or equal, spaced as follows:

1. Not over thirty six (36) feet center-to-center on grades twenty (20) percent and up to thirty five (35) percent;

2. Not over twenty four (24) feet center-to-center on grades thirty five (35) percent and up to fifty (50) percent; and

3. Not over sixteen (16) feet center-to-center on grades exceeding fifty (50) percent.

G. Sewers twenty four (24) inches or less in diameter shall be laid with straight alignment between manholes.

H. All gravity sewers shall be designed and specified such that they will pass a low pressure air test in accordance with ASTM F 1417 and UNI B-6-90 as per BCWS Standard Specification 02731 – SANITARY GRAVITY SEWER LINE TESTING.

1.2 MANHOLES

A. Manhole top elevations shall be greater than or equal to the fifty (50) year flood elevation, unless watertight covers are provided.

B. Manholes shall be installed: at the end of each line; at all changes in grade, size, or alignment; at all intersections of piping; and at distances not greater than four hundred (400) feet for sewers fifteen (15) inches or less, and five hundred (500) feet for sewers eighteen (18) inches to thirty (30) inches. Cleanouts may be used only for special conditions and shall not be substituted for manholes except when installed at the end of laterals not greater than one hundred fifty (150) feet in length. An inside drop pipe shall be provided for a sewer entering a manhole at an elevation of eighteen (18) inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than eighteen (18) inches, the

invert shall be filleted to prevent solids deposition. This is where a slide can be installed.

C. The minimum inside diameter of manholes shall be forty eight (48) inches unless using an inside drop connection where a minimum inside diameter of sixty (60) inches shall be required for all new manholes. For modifications to existing manholes, a minimum diameter of forty eight (48) inches, for inside drop connections, may be provided if justified and approved by the BCWS. A minimum manhole access diameter of twenty four (24) inches shall be provided.

D. Location of Manholes in relation to curbing or general roadside within newly designed subdivisions should be at minimum 3' away from back of curb or roadway. This allows some room for maintenance around manhole as well as minimizes conflicts with curb drains within roadway system. Manholes closer than this would require BCWS approval and justification.

PART 3 PUMP STATIONS

1.1 PUMPS

A. At least two (2) pumps shall be provided for each pump station. If only two (2) units are provided, they shall have the same capacity and each shall be capable of handling the expected peak flow. Where three (3) or more units are provided, they shall be designed to fit actual flow conditions and shall be of such capacity that with any one unit out of service the remaining units shall have capacity to handle peak sewage flows.

B. For domestic wastewaters and industrial wastewaters with solids which are similar in size and nature to solids in domestic wastewater, pump openings shall be capable of passing spheres of at least four (4) inches in diameter, for raw, unscreened wastewater, and pump suction and discharge piping shall be at least four (4) inches in diameter.

C. For pump stations with duplex pumps each pump shall be designed to operate in a lead lag sequence and be on an alternating cycle. For pump stations with more than two (2) pumps alternate designs may be considered.

1.2 STRUCTURES

A. The pump station wet well shall be ventilated. The vent (e.g., a screened inverted "j" tube) shall be constructed of a weather durable material (e.g., stainless steel).

1.3 VALVES

A. A shutoff valve (e.g., plug valve) and a check valve shall be located on the discharge line from each pump. The check valve shall be located between the shutoff valve and the pump.

B. The shutoff valve(s) for the pump station shall be located outside of the wet well, above grade.

C. The check valves for the pump station shall be located outside the wet well, above grade.

1.4 ELECTRICAL

A. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the Insurance Rating Organization having jurisdiction, the serving electrical utility company, and the latest edition of the National Electrical Code (NEC),

B. Electrical junction boxes shall be located outside of the wet well.

1.5 ALARM SYSTEM

A. Pump stations shall have SCADA communication connected to the BCWS control center.

1.6 FENCING

A. Each pump station shall be fenced to prevent access by unauthorized persons. The type of fencing or other means of controlling access shall be approved by the BCWS.

1.7 EMERGENCY SIGN

A. A weather durable sign, approved by the BCWS, with a twenty four (24) hour emergency telephone number, shall be located at a conspicuous point on the fence.

1.8 FLOOD PROTECTION

A. Pump stations shall be designed to be fully operational during flooding to the twenty five (25) year flood elevation unless the influent flow into the pump station can be stopped. For example, industrial facilities may select to cease operation during these periods in lieu of having the pump station fully operational. Pump station structures and equipment shall be protected from physical damage by flooding to the one hundred (100) year flood elevation. An all-weather access road shall be provided to the pump station.

1.9 EMERGENCY OPERATION

A. An emergency operation plan for the sewer pump station(s) shall be provided.

1. The plan shall include an on-site standby generator with an automatic switching feature.

PART 4 FORCEMAIN

1.1 SIZE, VELOCITY, BLOCKING, LEAKAGE

A. Force mains carrying raw domestic sewage shall be at least four (4) inches in diameter. Force mains crossing paved roadways may require steel casing to meet Berkeley County and SCDOT requirements and will be called out on plans. See SCDOT Utility Accommodations Manual for specific requirements.

B. Velocity in force mains shall be at least two (2) feet per second at design flow. However, lower initial velocities may be permitted by the BCWS if provisions to maintain a flushing velocity can be made, or if the wastewater does not contain suspended solids.

C. Restraint joints shall be provided at all changes in alignment greater than or equal to thirty (30) degrees.

D. Design and construction of force mains shall be such that they satisfy a leakage test in accordance with American Water Works Association (AWWA) Standard C600 (DIP) or AWWA C-605 (PVC) as per BCWS Standard Specification 02734 – SANITARY SEWER FORCE MAIN TESTING.

1.2 AIR RELIEF

A. An automatic air relief valve shall be placed at high points in the force main sewer to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The BCWS may require alternative designs in order to reduce possible odor problems from air relief valves located in highly populated areas.

1.3 CONNECTION TO SEWER SYSTEM

A. Force mains tying onto manholes shall enter the manhole through a cored opening which will allow the invert of the force main pipe to tie in smoothly with the invert channel of the manhole.

61-67, Appendix A. Unit Contributory Loadings to All Domestic Wastewater Treatment Facilities

Unit Contributory Loadings to All Domestic Wastewater Treatment Facilities	
Type of Establishment	**Hydraulic Loading (GPD)**
A. Airport:	
1. Per Employee	8
2. Per Passenger	4
B. Apartments, Condominiums, Patio Homes:	
1. Three (3) Bedrooms (Per Unit)	300
2. Two (2) Bedrooms (Per Unit)	225
3. One (1) Bedroom (Per Unit)	150
C. Assembly Halls: (Per Seat)	4
D. Barber Shop:	
1. Per Employee	8
2. Per Chair	75
E. Bars, Taverns:	
1. Per Employee	8
2. Per Seat, Excluding Restaurant	30
F. Beauty Shop:	
1. Per Employee	8
2. Per Chair	94
G. Boarding House, Dormitory: (Per Resident)	38
H. Bowling Alley:	
1. Per Employee	8
2. Per Lane, No Restaurant, Bar or Lounge	94
I. Camps:	
1. Resort, Luxury (Per Person)	75
2. Summer (Per Person)	38
3. Day, with Central Bathhouse (Per Person)	26
4. Travel Trailer (Per Site)	131
J. Car Wash: (Per Car Washed)	56
K. Churches: (Per Seat)	2
L. Clinics, Doctor's Office:	
1. Per Employee	11
2. Per Patient	4
M. Country Club, Fitness Center, Spa: (Per Member)	38

N. Dentist Office: 1. Per Employee 2. Per Chair 3. Per Suction Unit; Standard Unit 4. Per Suction Unit; Recycling Unit 5. Per Suction Unit; Air Generated Unit	 11 6 278 71 0
O. Factories, Industries: 1. Per Employee 2. Per Employee, with Showers 3. Per Employee, with Kitchen 4. Per Employee, with Showers and Kitchen	 19 26 30 34
P. Fairgrounds: (Average Attendance, Per Person)	4
Q. Grocery Stores: (Per Person, No Restaurant or Food Preparation)	19
R. Hospitals: 1. Per Resident Staff 2. Per Bed	 75 150
S. Hotels: (Per Bedroom, No Restaurant)	75
T. Institutions: (Per Resident)	75
U. Laundries: (Self Service, Per Machine)	300
V. Marinas: (Per Slip)	23
W. Mobile Homes: (Per Unit)	225
X. Motels: (Per Unit, No Restaurant)	75
Y. Nursing Homes: 1. Per Bed 2. Per Bed, with Laundry	 75 113
Z. Offices, Small Stores, Business, Administration Buildings: (Per Person, No Restaurant)	19
AA. Picnic Parks: (Average Attendance, Per Person)	8
BB. Prison/Jail: 1. Per Employee 2. Per Inmate	 11 94
CC. Residences: (Per House, Unit)	300
DD. Rest Areas, Welcome Centers:	

1. Per Person 2. Per Person, with Showers	4 8
EE. Rest Homes: 1. Per Bed 2. Per Bed, with Laundry	 75 113
FF. Restaurants: 1. Fast Food Type, Not Twenty Four (24) Hours (Per Seat) 2. Twenty Four (24) Hour Restaurant (Per Seat) 3. Drive-In (Per Car Service Space) 4. Vending Machine, Walk-up Deli or Food Preparation (Per Person)	 30 53 30 30
GG. Schools, Day Care: 1. Per Person 2. Per Person, with Cafeteria 3. Per Person, with Cafeteria, Gym and Showers	 8 11 15
HH. Service Stations: 1. Per Employee 2. Per Car Served 3. Car Wash (Per Car Washed)	 8 8 56
II. Shopping Centers, Large Department Stores, Malls: (Per Person, No Restaurant)	19
JJ. Stadiums, Coliseums: (Per Seat, No Restaurant)	4
KK. Swimming Pools: (Per Person, with Sewer Facilities and Showers)	8
LL. Theaters: Indoor (Per Seat), Drive In (Per Stall)	4