

DESIGN AND SPECIFICATION GUIDELINES  
FOR LOW PRESSURE SEWER SYSTEMS

PREPARED BY  
A TECHNICAL ADVISORY COMMITTEE FOR  
THE STATE OF FLORIDA DEPARTMENT  
OF ENVIRONMENTAL REGULATION

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DESIGN AND SPECIFICATION GUIDELINES  
FOR LOW PRESSURE SEWER SYSTEMS

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## FOREWORD

In April 1980, Mr. Jake Varn, Secretary of the State of Florida Department of Environmental Regulation authorized the formation of a Technical Advisory Committee to prepare Departmental Design and Specifications Guidelines for Low Pressure Sewer Systems. This document was prepared with the sponsorship of the General Development Corporation with review and staff assistance provided by Dr. G. J. Thabaraj and Mr. James E. Santarone of the State of Florida Department of Environmental Regulation. The contents of this document are supplemental to and made a part of the Rules of the State of Florida Department of Environmental Regulation, Chapter 17-6, Florida Administrative Code.

Throughout this document, references are made to recognized product and installation standards. Where a conflict may exist between the cited standard and this document, the requirements set forth in this document shall prevail unless otherwise authorized in writing from the Department of Environmental Regulation.

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# CHAPTER I

## DESIGN

### Section A. GENERAL CONSIDERATIONS

#### Part 1. Introduction

In order to properly choose and design any wastewater collection facility it is necessary to define the service area in geographical, topographical, geological, climatological, sociological, and economic terms. The complexity of required definition may vary with circumstances from a relative minimum with a planned development to a maximum for an existing community. Likewise, the difficulty of the design process varies in the same manner. The planned community usually can be characterized as a situation where optimum solutions are possible, the lines of communication simple and direct, and constraints and their sources fewer and more technologically based. Existing communities generally present situations and solutions which are often based on less technical aspects and increased public relations. The considerations of this document are based primarily on the technological problems of pressure sewer systems.

#### Part 2. Facility Planning Information

The initial step in any planning effort is to define the service area. Information which is potentially useful for facilities planning includes:

- a. service area growth and development;
- b. natural and physical features;
- c. existing wastewater and residuals disposal practices; and
- d. regulations and institutions.

For an existing community Table I-1 offers an example of growth and development factors and potential information sources. For a planned community, the design should be based on the projected population growth and those socioeconomic factors which would provide some basis for determining reasonable user charges for the wastewater collection and treatment system

TABLE I-1  
GROWTH AND DEVELOPMENT FACTORS

Factor \ Source	U.S. Census	State Planning Agency	State Office of Employment Security	Regional Planning Agency/208 Agency	Local Planning Agency	Local Administrator	Local Tax Assessor	Business and Institutional Survey	Local Chamber Of Commerce
Existing Population		0		0	*				
Historical Population	*	*							
Population Characteristics for Last Two Federal Census Periods-Age, Cohorts, Median Family Income	*								
Population Projections - Local and Regional During Service Design Period		*		*	*				
Existing Employment For Individual Business and Institutions			0					*	*
Economic Base/Employment Projections				*				0	0
Existing Property Assessment Valuation							*		
Property Tax Rate							*		
Equalized Tax Rate							*		
Annual Revenues by Major Source						*			
Annual Expenditures by Major Service Categories						*			

\* Indicates Preferred Data Source  
0 Indicates Alternative Data Sources

during the planning period. Anticipated growth patterns can affect pressure sewer designs in several ways.

Table I-2 presents a list of typical natural and physical features and potential information sources. These features can affect the design and construction of pressure sewers.

For existing communities relatively complete information on existing wastewater and residuals disposal systems must be obtained. Where sewers and central treatment facilities exist, the existing data sources are relatively easy to locate. Where on-site disposal has been widespread the data are generally more diffuse. Table 1-3 lists typical sources of information on on-site systems. In previously sewered communities a new pressure sewer design will be affected by the present condition and capacity of the existing system. For example, an existing sewer with excess capacity may be the logical receptor of the pressure sewer wastewater discharge, while an existing sewer without available capacity would suggest study of alternative approaches such as infiltration/inflow reduction, water conservation programs to create the necessary capacity or separate treatment and disposal sites for the pressure sewer. Where existing on-site systems have a varied performance, e.g., isolated problem areas, pressure sewer designs should consider the historical performance in determining pressure sewer main location, phasing, construction, and terminal treatment system location and design.

Local regulations and institutions represent major determinants of pressure sewer designs. Table 1-4 indicates the preliminary regulatory constraints which should be determined prior to design. Institutional arrangements in the service locality must be determined to ascertain available mechanisms for pressure sewer management programs. Existing institutional entities may be easily adaptable to managing these systems in some locations, while establishment of new institutions may be required in others.

TABLE I-2  
NATURAL AND PHYSICAL FEATURES

Data Element \ Data Source		NATIONAL WEATHER SERVICE	LOCAL AIRPORTS	LOCAL UNIVERSITY	U.S.G.S.	HUD	SOIL CONSERVATION SERVICE	208 AGENCY	STATE OF FLA. DEPT. OF ENVIRONMENTAL REGULATION	LOCAL TAX ASSESSOR	LOCAL WATER MANAGEMENT DISTRICT	LOCAL HEALTH DEPT.
		CLIMATE	Annual Precipitation	•	0	0						
	Mean Temperature	•	0	0								
	Temperature Ranges	•	0	0								
	Humidity	•	0	0								
	Prevailing Winds	•	0	0								
	Evaporation Potential	•										
Topography					•							
SOILS	Kit Limitation Maps						•					
	Interpretive Reports						•					
	Frost Depth			0			•					
Wetlands					•		•					
Flood Hazard Areas				0	•	•		•				
SURFACE WATER -- STREAMS/RIVERS	Drainage Areas				•							
	Flow Characteristics				•						•	
	Water Quality Data				•			•			•	•
	Existing Water Quality Classification							•				
	Existing Uses of Water							•	•		•	0
SURFACE WATER -- PONDS/LAKES	Drainage Area				•							
	Stream Sources				•							
	Elevation				•							
	Acreage				•							
	Mean Depth						0	•	•		0	
	Ownership							•		•		
	Water Quality Data			0				•	•		•	0
	Existing Water Quality Classification							•	•			
	Existing Uses of Water							•	•		•	0
GROUNDWATER	Areal Extent of Aquifers			0	•						0	
	Seasonal Groundwater Levels				•						0	
	Saturated Thickness of Aquifers			0	•						0	
	Transmissivity				•						•	
	Existing Public Wells										•	
	Average Daily Drawdown for Wells										•	
	Water Quality Data			0	•			0	0		•	0

- Indicated Preferred Data Source
- 0 Indicates Alternative Data Sources

### TABLE I-3

#### TYPICAL SOURCES OF INFORMATION ON ON-SITE SYSTEMS

- \* Local Health Department: Interview staff members including local sanitarian(s).
  
- \* Installation and Repair Records: If available the following information about on-site systems can be useful in evaluating performance.
  - \* installation data (from local Health Department records)
  - \* sizing (from individual installation records)
  - \* test results made before installation
  - \* historical changes in standards (combined with the age of the system to give an indication of size and type)
  - \* records of system repair
  
- \* Septage Disposal:
  - \* septic waste haulers in the area
  - \* local health department and State of Florida Department of Environmental Regulation
  - \* disposal sites and records kept of the number of pumpings per week
  
- \* State of Florida Department of Environmental Regulation
  - \* The Department has jurisdiction over large on-site systems serving schools, hospitals, and apartment complexes (flows exceeding 7.5 M<sup>3</sup>/day (2,000 gpd))
  
- \* Water Quality Data: It may be possible from water quality data to verify septic tank effluent leaching.

TABLE I-4  
PRELIMINARY REGULATORY CONSTRAINTS

GOVERNMENT LEVEL ISSUE	FEDERAL	STATE OF FLORIDA	LOCAL
Solid Waste Disposal – Sludge and Septage	Regulations under Section 1008 (a)(3) and 4004(a) of the Resource Conservation and Recovery Act (PL 94-580) and Section 405(d) of the Clean Water Act (PL 92-217) relate to the disposal of sewage sludge on or into land. If the sludge is classified as a hazardous waste, then hazardous wastes regulations under 40 CFR Parts 260-265 apply.	State regulations regarding sludge and septage disposal are contained in the proposed amendments to the Department of Environmental Regulations rule Chapter 17-6 FAC, <u>Wastewater Facilities</u> and proposed Part IV, Chapter 17-7 FAC, <u>Pollution Control Residuals (Sludges and Septage)</u> .	Local zoning may prohibit certain nuisance uses, such as solids disposal, in certain areas of the community. Also, Local Pollution Control or Environmental Protection Departments should be consulted.
Effluent Disposal – Surface Water Discharge	Under 40 CFR 133, EPA requires a minimum of secondary treatment for sanitary discharges to surface waters. Additional treatment may be required to meet water quality standards in receiving stream.	The State of Florida Department of Environmental Regulation has established minimum treatment requirements for effluents and water quality standards for receiving streams. The rules are found in Chapter 17-3, 4 and 6, Florida Administrative Code.	Local zoning may prohibit certain nuisance facilities such as treatment facilities. This may be a real constraint for package plants in certain neighborhoods. Also, Local Pollution Control or Environmental Protection Departments should be consulted.
Effluent Disposal – Land Application	1974 Safe Drinking Water Act sole source aquifer classification may limit use of land application techniques. At a minimum, land application technologies must meet best practicable waste treatment technology (BPWTT).	The Department of Environmental Regulation is developing minimum land application criteria in its proposed amendment to Chapter 17-6, FAC.	Local zoning again may prohibit land application sites. Also, Local Pollution Control or Environmental Protection Departments should be consulted.
Effluent Disposal – Subsurface Disposal	Under the 1977 Clean Water Act individual systems funded by EPA must meet BPWTT. 1971 Safe Drinking Water Act may regulate community subsurface systems in “sole source aquifers.”	Florida Department of Environmental Regulation Chapter 17-6, FAC. These regulations apply to facilities with design flows of more than 2000 gpd.	Local Health Departments often have complete responsibility for regulation. Local agencies frequently operate under the guidance of State codes. Also, Local Pollution Control or Environmental Protection Departments should be consulted.

### Part 3. System Layout and Alignment

One of the first tasks in the design of a pressure sewer is the preparation of a schematic of the system. The principal purpose is to minimize the length of the lines in the system just as with conventional gravity sewers. However, the relatively unconstrained alignment requirement and lower construction cost per lineal foot of the pressure sewer provides an opportunity to exercise imagination and demonstrate good judgement.

#### a) Pressure sewer main

Several factors to be considered in developing a preliminary layout of a pressure sewer main include:

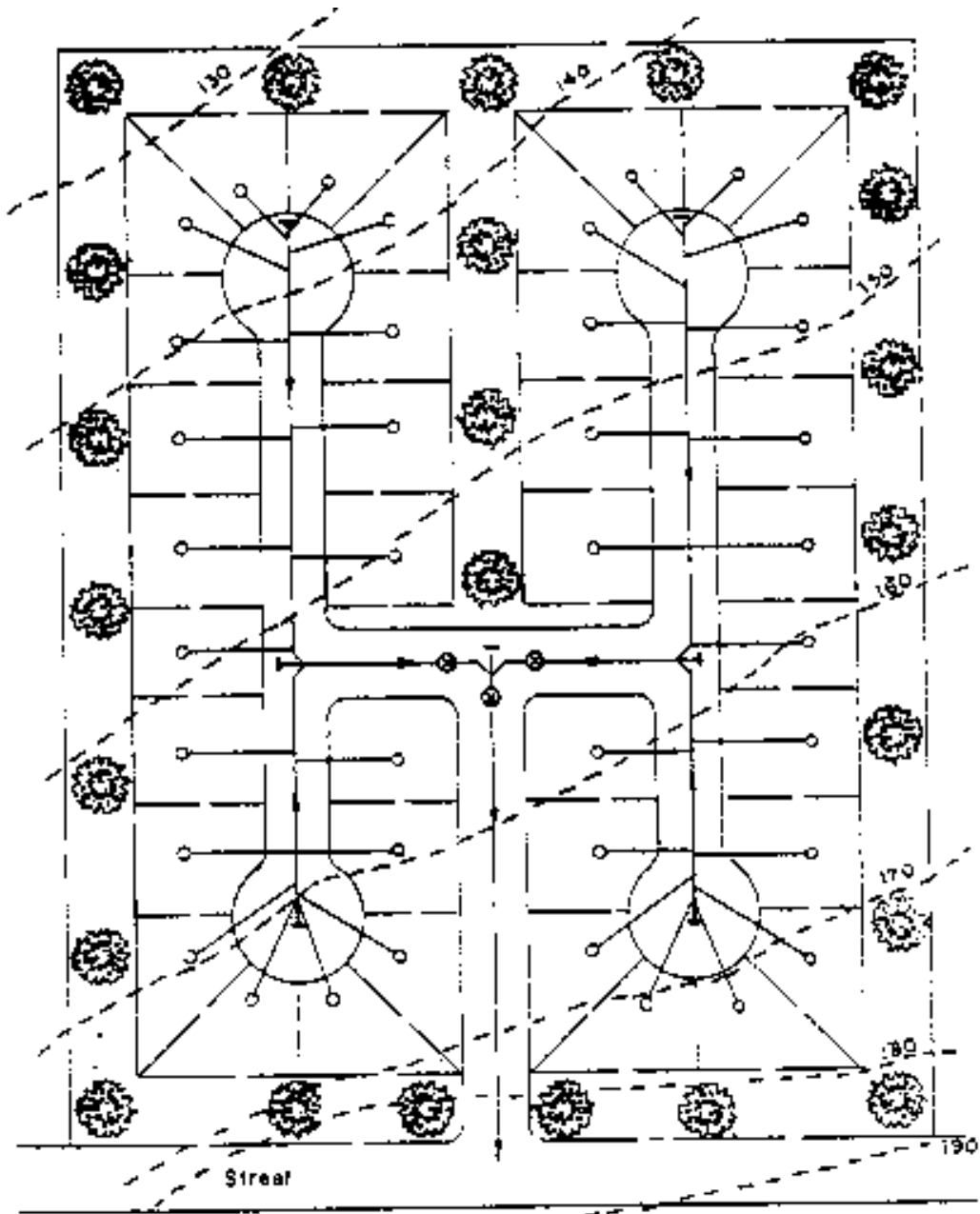
- 1) right of way, access and easements
- 2) resident and traffic disruption
- 3) dendriform vs. grid horizontal layout
- 4) potential main breakage, repair time, and users affected
- 5) pressure sustaining
- 6) air entrainment

Presently both dendriform and grid horizontal layouts are used. Dendriform layouts theoretically require the least amount of pressure sewer main construction. However, where each unit feeds the main sewer, any damage to the main sewer would interrupt service to all upstream connections. The grid layouts, as employed in water supply systems, overcome the loss of service problems, but would result in the uneven flow patterns which are a particularly difficult problem in systems where scouring velocities are integral to their proper functioning.

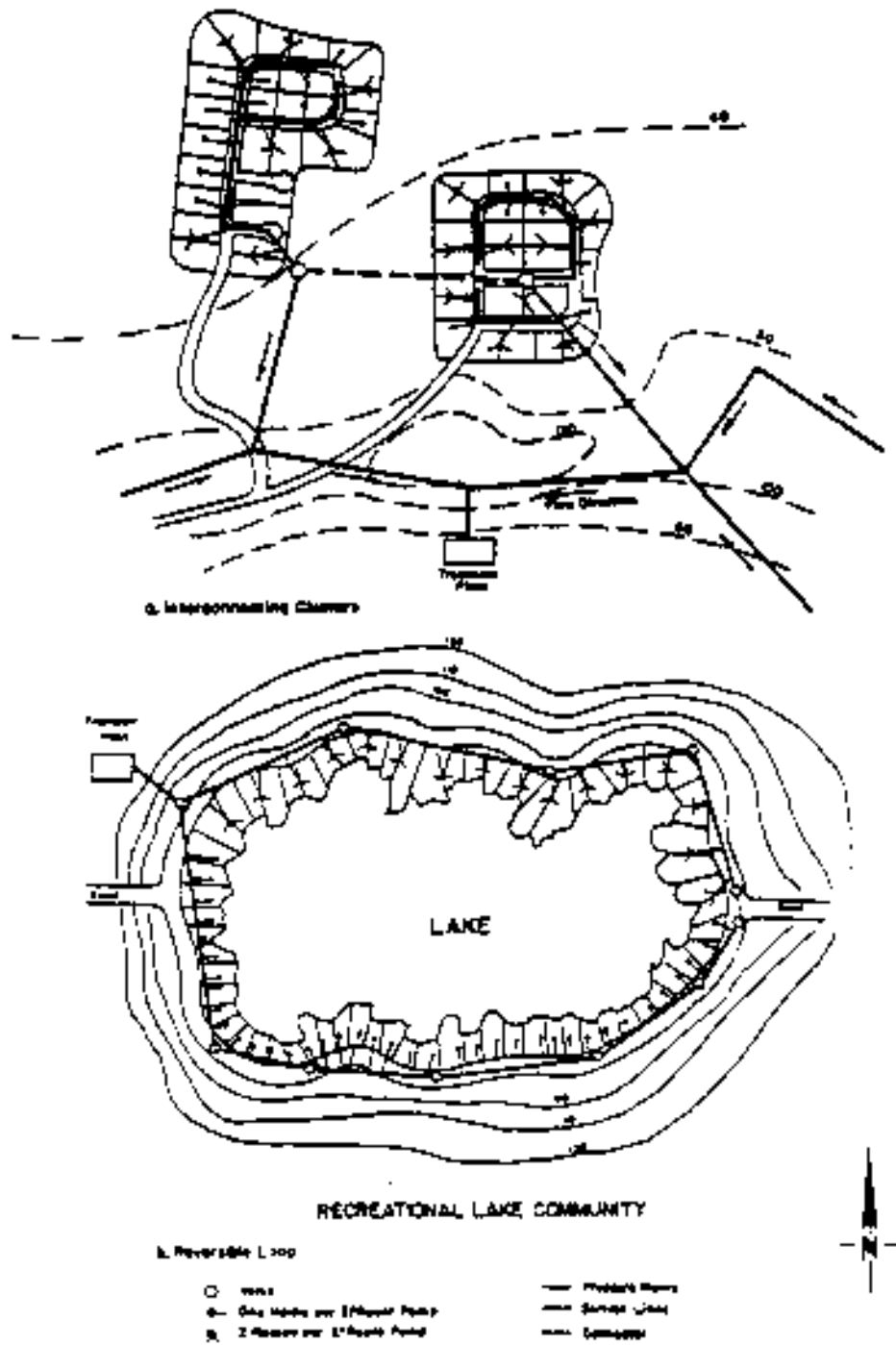
A popular compromise to either the dendriform or grid layout has been the clustered feeder approach as depicted in Figure I-1, wherein smaller branched systems service multiple connections and feed into the main sewer. This main sewer may be either a pressure or gravity sewer with the clustered feeder layout, where service or mainline breakage is more likely only



**FIGURE I-1. Typical pressure sewer layout**



- Pressurization Unit
- └ Cleanout
- Pressure sewer
- - - Contour line
- Flow direction
- ⊗ Valve



**FIGURE I-2. Pressure Sewer Schematics**

to affect the particular cluster in which breakage occurs and flows would remain more predictable as in the dendriform layout. Additionally, a reduction of service interruption could be accomplished by the installation of a connector line between clusters as shown in Figure I-2. The connector line would normally be valved from service and could be opened to service otherwise isolated dwellings.

Vertical alignment considerations will also impact the horizontal layout. Ideally, a pressure sewer would be optimal if it were provided a nearly constant upward grade from its farthest point to its terminus and thereby eliminate the need for air release valves, pressure sustaining valves or similar appurtenances. These concerns should be considered during the design stage although the final pipe location will often be determined in the field at the -time of construction.

The pressure sewer systems shall be able to handle the wastewater generated by the design population of the service area. In the example where there are several underdeveloped lots within the service area, the designer must consider if system capacity will be sufficient to handle the design discharge. The designer shall analyze the capacity of the system to determine the Units of development beyond the design population which the system can handle through special approaches.

b) On-lot facilities

The major capital and operation and maintenance (O/M) costs of pressure sewers have historically related to the on-lot or pressurization facilities. Several considerations must be factored into on-lot pressure sewer system design, and include:

- 1) type of pressurization system
- 2) single vs. multiple service
- 3) location of pressurization system
- 4) alarms and controls
- 5) aesthetics and safety problems
- 6) serviceability of components

- 7) materials of construction
- 8) electrical problems
- 9) contingency problems

The first on-lot facility design decision is the specification of the generic type of pressurization unit (PU). This will have specific effects on the remainder of the system design. However, unless local circumstances preclude one of the two primary alternatives, both the grinder pump (GP) and septic tank effluent pump (STEP) system should be considered. A comparison table of the two alternatives is shown below:

<u>Item of Comparison</u>	<u>GP</u>	<u>STEP</u>
*Capital cost: on-lot pressurization unit	more	less
appurtenances	less	more
*Capital cost: main	similar	similar
*O/M cost on-lot pressurization unit	more	less
residuals handling	less	more
*O/M cost: main $\frac{\text{present population}}{\text{design population}} \approx 1$	similar	similar
$\frac{\text{present population}}{\text{design population}} \ll 1$	more	less
*Treatment Plant capital cost	more	less
O/M cost	more	less
*H <sub>2</sub> S Corrosion and Odor Potential	less	more

Economics tend to favor multiple service per PU if they are within reasonable proximity. The cost-effective separation distance is a function of local construction costs and system design. However, the problems resulting from one homeowner receiving credits for power usage and inherent tendencies of people to blame others for malfunction of the PU or service line components should be expected. These types of problems can be overcome through

management, arrangements which utilize direct power transmission through a separate power meter and inclusion of service calls within the user charges. Such systems usually result in the placement of the PU where there is a high degree of accessibility for service labor, but possibly at a cost of excessive lengths of piping. With small lots or building sites and favorable terrain this latter problem may be minimized.

Serviceability of the on-lot components is important to both minimize the time lost due to a malfunction and keep the cost of inspection and maintenance to a minimum. Quick-disconnect features are recommended both for the piping and the electrical connections, so that the service person can quickly remove the unit for inspection and repair or replacement. With very shallow, less than 1 m (3.3 ft), wetwells a simple union arrangement is often acceptable. With deeper wetwells, slide-away coupling arrangements with slide-rail and lifting chains are more common. With GP units complete manufacturer packages are generally employed which incorporate simplified GP unit removal arrangements.

In residential developments safety problems are generally related to protection of the homeowner and their neighbors. One of the most frequent concerns relates to the PU wetwell cover. In the interest of providing a safe PU the wetwell covers shall incorporate locking mechanisms which provide relief under emergency conditions. By proper venting of STEP units through the septic tank and house roof vents accumulation of hazardous and potentially odorous gases can be minimized.

Materials of construction must be capable of withstanding the environmental conditions of service. GP systems are generally packaged in such a manner that these considerations have been incorporated at the factory. STEP systems which are often designed and assembled locally require a cognizance of the highly corrosive nature of septic tank effluent. All components of the STEP system exposed to the atmosphere (not always submerged) must be highly resistant to corrosion. Materials which have been acceptable for different components are listed below:

Septic tank and wetwell - concrete, plastic, coated steel

Valves - bronze, plastic

- Ancillary items - plastic, 316 stainless steel
- Pump housing - cast iron, plastic, bronze, coated cast iron
- Pump impellers - plastic, bronze, cast iron
- Tank and wetwell cover - concrete, plastic, coated steel

Electrical connections to the main panel must be in accordance with local construction codes. Approved underground wiring is recommended for both pump and control circuits and should be provided with separate fuses or circuit breakers. The controls shall be located outside the house in full view of the PU and contained in a lockable or tamper free and weatherproof circuit breaker box. For single service units, PU power sources should not be metered separately since minimum local billing charges will greatly exceed actual usage. The pump panel should have a smaller fuse or breaker than the service panel. Finally, the pump motor connections must be water-tight.

Due to potential power outages in rural areas both STEP and GP installations should have reserve holding- capacity. Single service GP installations generally provide a reserve storage capacity of about 0.19 m<sup>3</sup> (50 gallons). Septic tanks usually have about 0.38 to 0.76 m<sup>3</sup> (100 to 200 gallons) or residual capacity due to the freeboard inherent to the construction. Additional storage capacity may be required based on local conditions. The loss of power in rural areas that are served by individual wells and cisterns essentially eliminates the possibility for wastewater generation because water supplies become unavailable. The minimum storage capacity required is .19 m<sup>3</sup> (50 gal) unless local authorities require additional storage based on local conditions.

On-lot facility considerations should include the use of hydraulically similar PU equipment in order to simplify design and O/M tasks. Spare parts and equipment inventories shall be maintained as a minimum:

<u>PU's Installed</u>	<u>Spares Required</u>
1-10	1
10-20	2
20-40	3
40-60	4
60-100	5
100-200	6
200	3%

In addition, a complete supply of spare units of all system components must be maintained in similar quantities to the above scale for complete PU's.

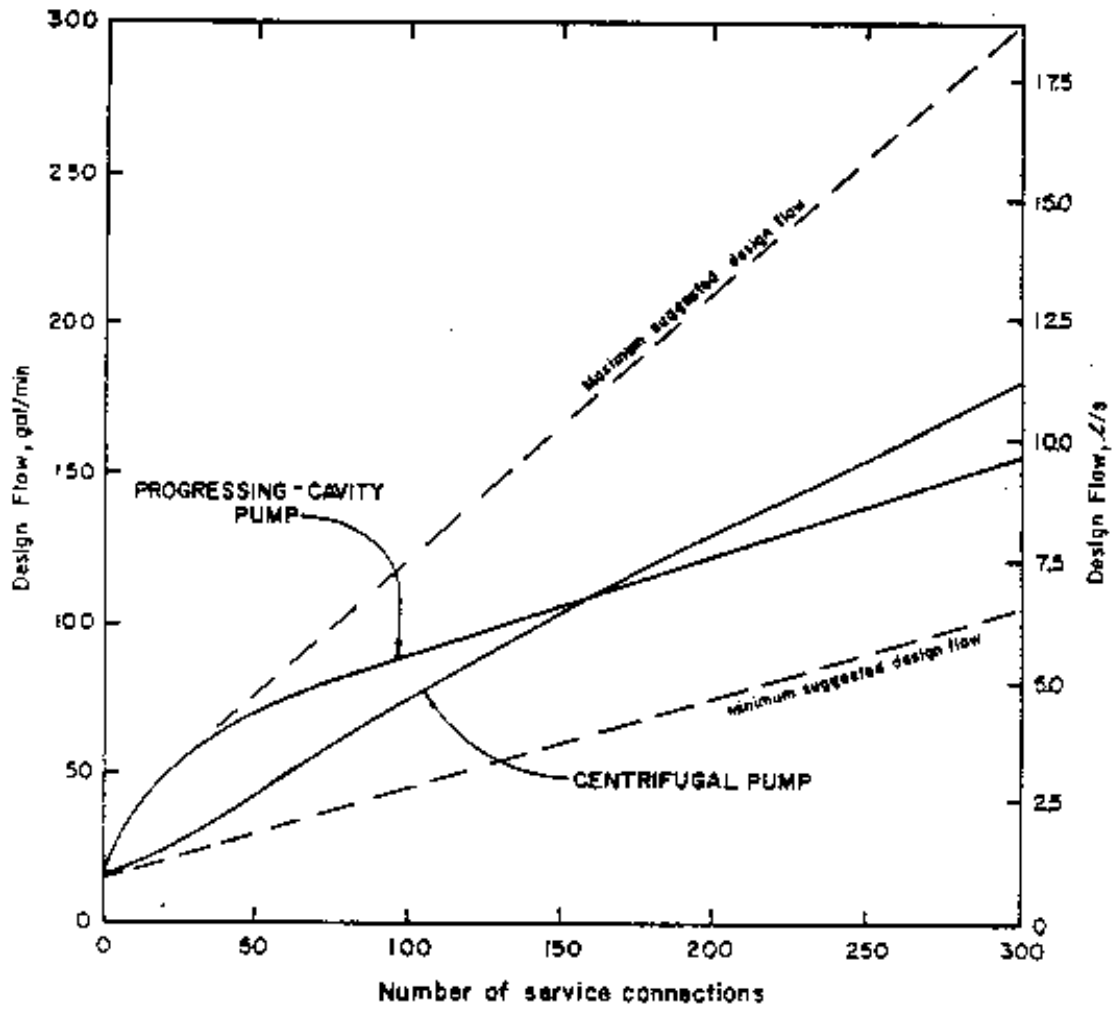
Part 4. Design Flows

Systems must be designed on the basis of the type of PU employed and peak flows from the number of people to be served by the system. Figure I-3 indicates the recommended design flow for the anticipated number of service connections. For the more predictable progressing-cavity units, the design curve is based on the probability of simultaneous operations determined from the operating experience of previous PU system developments. If a progressing-cavity unit is to be installed and exhibits dynamic head-discharge (H-Q) significantly different from 0.7 l/s (11 gal/min) at high head, the curve should be adjusted accordingly. For centrifugal units in systems of less than 30 total separate services the pump and system characteristics are the primary determinants of the design flows to be used. In the range of 1 to 30 units the design flow should always be more than a single pump operating against the minimum system head possible and no more than 1.9 l/s (30 gal/min). The design must utilize the facility planning data on this subject to determine water use or average persons per dwelling. If either information source or other mitigating information, e.g., excessive lawn watering due to climatic conditions, indicates that flows differ significantly from the average use, the engineer should adjust the design flows from those listed below, and shown in Figure I-3 (centrifugal), accordingly.

No. Dwelling Units	Design (Peak) Flow in m <sup>3</sup> /s x 10 <sup>-3</sup>	(gal/min)
1	.9	(15)
10	1.9	(30)
50	2.7	(43)
100	4.7	(75)
200	8.2	(130)
300	11.4	(180)

A pressure sewer is normally designed to flow full at all times. In smaller installations there may be relatively long periods of time where no flow will occur. During these periods an opportunity exists for deposition of grease or solids and gas accumulation. The results of these no-flow periods can pose serious problems if subsequent hydraulic conditions are unable to scour the depositions and transport those materials and gas accumulations out of the system.

FIGURE I-3. Recommended Design Flow





GP system designers have employed peak design velocities of 0.6 m/s to 1.6 m/s (2 to 5 ft/s). The minimum required peak design velocity for GP systems shall be 0.8 m/s (2.5 ft/s). For septic tank effluents with greatly reduced solids and grease concentrations no peak velocity requirements have been determined, but shall be at least 0.3 m/s (1 ft/s) to insure the scouring of any suspended material. Use of other design velocities for either type of system is subject to the approval of the Department of Environmental Regulation.

## Part 5. Hydraulics

Plastic pipe has been shown to exhibit a Hazen-Williams roughness coefficient C in English units of 155 to 160 with clean water. However, due to the nature of wastewater and the potential for grease deposition and microbiological growth on the walls of pressure sewers, a reduced value of 130 to 150 is recommended. By multiplying the Hazen-Williams C by 1.318 one can obtain the Chezy C in English units.

Although polyvinyl chloride (PVC) pipe has been most widely used for pressure sewers, high density polyethylene pipe (PE) has recently been employed in some installations. Roughness coefficients for straight sections of both pipes are essentially identical. Although some use of polybutylene for service lines has been reported, there is no present basis for its evaluation as a mainline system.

PVC pipe with a pressure rating of 1,100 kPa (160 psi) will usually suffice for normal pressure sewer systems utilizing PU equipment with centrifugal or progressing-cavity pumps having a maximum dynamic head of less than 1,100 kPa (160 psi). However, due to potential imperfections in manufacture and installation of pressure pipeline components, the ratio of pressure pipe rating to the maximum pressure developed by the PU should not be less than 2:1. The standard pressure sewer PVC pipes and their characteristics are shown in Table I-5. Both rubber ring and solvent weld joints can be used if properly jointed per ASTM requirements.

High density polyethylene pipe (HDPE) has been used in lieu of PVC in at least three locations. This material has certain advantages and disadvantages when compared to PVC. Longer pipe length with fewer joints are available but special joining techniques (butt-fusion) are required. HDPE is similar to PVC in working pressure and roughness coefficient.

TABLE I-5

PVC PIPE CHARACTERISTICS

PVC PIPE DESIGNATION DATA	SDR 26	SDR 21	SCHEDULE 40	SCHEDULE 80
SDR (O.D./wall thickness)	26	21	VARIES WITH SIZE	
WORKING PRESSURE	1,100 kPa (160 psi)	1,400 kPa (200 psi)	VARIES WITH SIZE	
NORMALLY USED JOINTS	RUBBER RING		SOLVENT WELD	
STANDARD LENGTH	6.1 meters (20 feet)			
THERMAL EXPANSION	0.08 mm/m/°C (0.33 in./100ft/°F)			

The hydraulic design of a pressure sewer must take into account several factors. The most noteworthy being the head-discharge characteristics of the PU. The simplest case is that of a centrifugal STEP system. Pipe sizes should be selected which display the best combination of low frictional headloss and reasonable velocity at the design flow. Most pressure sewer systems will employ pipe sizes of increasing diameter when progressing from the origin toward the terminus of the system. It is recommended that a centrifugal pump should not be specified under conditions requiring greater than 85% of the available head when operating alone.

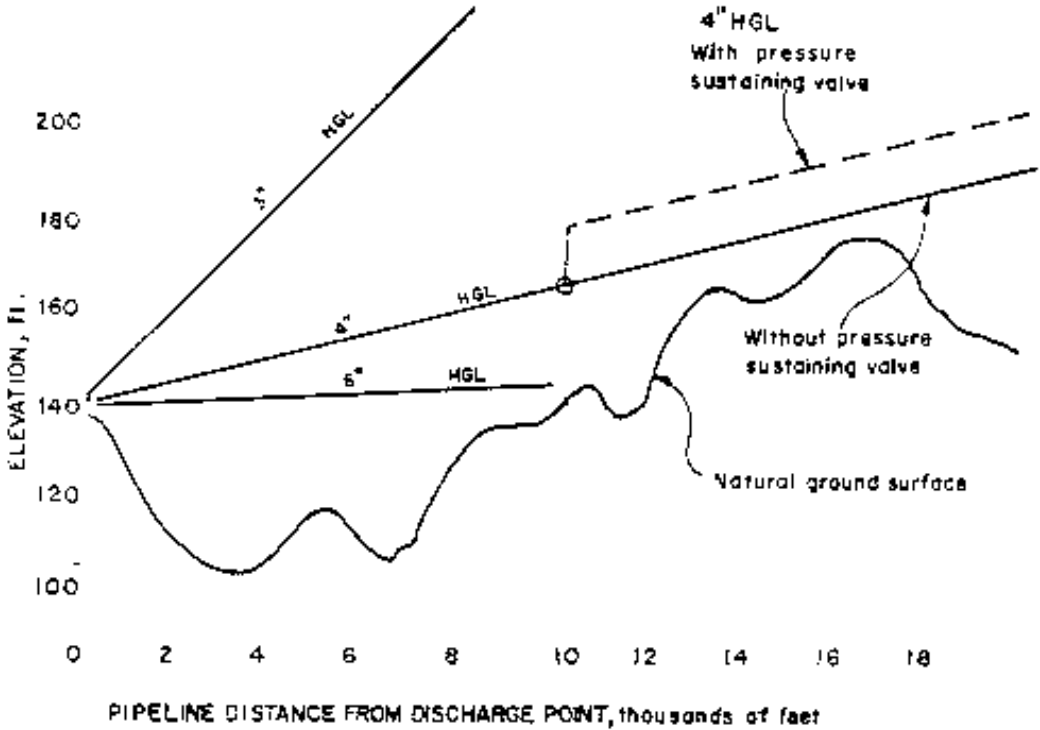
The following procedure is typically used to approximate the initial hydraulic design:

1. Determine the ultimate number of facilities to be served by the system.
2. Choose a design peak flow value using Figure I-3.
3. Prepare a condensed plan and profile of proposed system.
4. Evaluate the need for air release and pressure sustaining valves.
5. Plot hydraulic grade lines (HGL) corresponding to various pipe sizes. Any pipe size which indicates an excessive total dynamic head (TDH) is sequentially discarded until a proper one is found based on economics pressure limitations, and reasonable approximation of pump characteristics. Pressure sustaining valves maintain positive pressure, increase the TDH against which the pumps operate and prevent drainage of the line (see Figure I-4).
6. Prepare dynamic hydraulic grade line (HGL) based on previous determinations. Individual pump units can then be selected based on site-specific head conditions and desired flow rate. Individual pump characteristics can be tested for sufficiency by checking the elevation difference between pump and dynamic HGL where the pump lateral intersects the mainline.

Test:

- a. Plot system-head curve of pump (including losses in service lines and fittings).
- b. Locate head requirements at design flow and determine adequacy of pump and suitable pipe size.

**FIGURE I- 4  
PIPE SIZING PROCEDURE**



The PU selection will depend upon the hydraulic profile of the system and the characteristic pump curves chosen for the system. Thus, an analysis of the manifolded pump and pipe networks should be determined for the proposed system. An analysis of the time dependent alternations in the manifold system's characteristics as pumps turn on and off should be included to determine the proposed system capabilities. Water hammer and surge analyses may be necessary on large systems with higher pressures but are not normally a concern. Factors to be taken into consideration in performing the analysis include:

- operating capacity of pump chamber or wetwell
- pump characteristics
- distribution piping, materials and appurtenances.

Pressure sewer equipment manufacturers frequently have computer simulations available to simplify the system analysis.

## Part 6. Contingency Planning

As previously discussed in Chapter 1, Section A, Part 3 the contingency needs of GP units are greater than for STEP units. Greater on-site storage capacity lessens O/M personnel requirements by permitting repairs to be made during normal working hours and minimizing the need for extra working shifts and the associated additional manpower. Connection to abandoned soil-absorption systems where groundwater conditions are favorable, enlarged pump chambers or wetwells with quick-disconnect arrangements, and adjoining overflow tanks with gravity drainage back to the pumping chamber during normal operation are possible contingency solutions which are simple and, therefore, practical. The requirements for an average day's flow storage is subject to local conditions. Most analyses of these requirements based on nationwide electrical outage data, bare little relation to local conditions of electrical outages and anticipated or experienced repair times for pressure sewer mains.

The problems of pressure sewer main breakage must be anticipated. Location of pressure sewer mains in areas where damage is less likely, provision of detailed and accurate as-built contractors plans, warning signs along route with offset markings, inductive wire burial with pipe, and a stringent permit requirement for excavation work in proximity to pressure sewers have been shown to be effective in eliminating pressure sewer main breakage. Management

arrangements shall incorporate regulations which clarify the financial and repair responsibilities for pressure sewer damages.

Contingency plans are subject to the review and approval of the Department of Environmental Regulation.

#### Part 7. Mainline Appurtenances

The need for terminal and in-line cleanouts is a function of the design of the system. For example, a pure dendriform design would require only one terminal cleanout arrangement, while a multiple-cluster feeder design would require a terminal cleanout for each cluster. Cleanouts and/or shutoff valves should be provided at all pipe junctions and at locations where pipe sizes change. Subject to the approval of the Department, this requirement may be fulfilled in phases for new developments. Consideration should also be given to angle points in the pressure sewer and major pressure sewer main junctions. Beyond these specialized considerations the needs for cleanouts and/or shutoff valves may be related to the available cleaning methods, contingencies required for the system and the projected use or growth rate of the service population.

The previous discussion of in-line cleanouts is pertinent to shut-off valves and bypassing arrangements. Pressure sewer main segment isolation for repair is necessary and the longer distance between valve stations makes isolation more difficult. However, the use of an arbitrary rule of maximum separation distance is often unnecessarily restrictive, e.g., a 120 to 150 m (400 to 500 ft.) requirement in a relatively rural area may service 4 or 5 connections, while in a more dense development it may service 15 to 20 connections.

Therefore, in the absence of special needs for mechanical cleaning, pipe size changes, abrupt changes in direction, or major main confluences, the spacing of inline shut-off valves need not be less than every 183 m (600 ft) in high density areas and not more than 307 m (1000 ft) in low-density areas. By utilizing simple meter box designs such as those shown in Chapter III with a cleanout and valves, these mainline arrangements can be economical and simple to operate.

Gas accumulations in pressure mains can increase the dynamic head resisting the PU. As noted in Chapter I, Section A, Part 3 above the design should provide a continuous upward slope on the pressure sewer main to maintain a positive pressure at all times, to avoid siphoning, air accumulation and solids accumulation. In some areas, high points in the system cannot practically be eliminated, and air release valves must be employed at the more pronounced locations. With higher flow rates, minimum downstream slopes and short travel distances to subsequent low points, the need for air release valves is marginal. The need for air release valves should be closely examined for any downslopes in excess of ten percent (10%). Locations with lesser slopes, where long downstream pipe volume is in excess of that which would be expected to be pumped during one continuous pumping interval, may also require air release valves.

Adequate preventive measures should be taken to avoid the accumulation of gases and air in pressure sewer mains. These include:

1. Sufficient purging after pressure sewer main filling and testing.
2. Submersion of PU pump intake to prevent siphoning or vortexing after shut-off.
3. Proper design to prevent undue retention time of wastes in pressure sewer where biological and chemical activity may produce gases.

In areas where topographical considerations preclude elimination of high and low points in the vertical alignment, pressure-sustaining or pressure-control valves are required. Constant pressure valves impose a constant control point to maintain all or part of the system under pressure during no flow periods, while flow-responsive valves accomplish this same task and also provide a reduced control pressure during active pumping periods. With relatively low head PU's the flow-responsive type valve is more commonly employed.

#### Part 8: Treatment And Characteristics Of Low Pressure Sewer System Wastewaters

Effluent wastewater characteristics of GP and STEP systems are dependent upon the initial wastewater characteristics entering the system from the service user. In consideration of the pressure sewer systems presently in operation, both GP and STEP effluents have demonstrated a high degree of treatability. Available data suggests that GP effluent wastewater characteristics are of greater concentrations than commonly found in domestic wastewater. This is entirely due

to absence of infiltration or inflow to the pressure sewer system.

Wastewater treatment facilities must be provided which are designed for the specific wastewater expected from the pressure sewer if it discharges into a treatment facility exclusively for these wastes. Consideration of the unique characteristics of the GP and STEP effluents becomes less critical if these effluents are combined with gravity sewer wastewaters and do not constitute a significant proportion of the total wastewater received for treatment.

Generally, treatment facilities which are constructed to treat GP or STEP wastewaters only should be designed to anticipate influent wastewater characteristics as follows:

#### Treatment Facility Influent Characteristics

<u>Parameter</u>	<u>GP Systems</u>		<u>STEP Systems</u>	
	<u>Average</u>	<u>Range</u>	<u>Average</u>	<u>Range</u>
BOD <sub>5</sub> mg/l	350	300-400	143	110-170
TSS, mg/l	350	300-400	75	50-100
FLOWS, gpcd	70		70	

The only special concern during the treatment processes has been the need to minimize liberation of hydrogen sulfide, H<sub>2</sub>S, if present by excess turbulence at the inlet to the treatment plant. With conventional mechanical treatment facilities, the elimination of grit chambers, comminutors and primary treatment processes may be offset by the need for preaeration or chemical oxidation of H<sub>2</sub>S for STEP system wastewaters.

When a STEP system is designed to discharge into a conventional gravity sewer system, the liberation of H<sub>2</sub>S at the junction structure and corrosion of unprotected concrete sewer pipe immediately downstream of the junction must be considered. Consideration to H<sub>2</sub>S liberation may also need to be given at GP discharges. The adverse effects should not be a great concern unless the dissolved sulfide content of the STEP or GP wastewater attains a level of 0.1 mg/l or greater concentrations at the outlet. In situations where the dissolved sulfide content of the STEP



or GP wastewater exceeds 0.1 mg/l, a sulfide control system must be incorporated into the pressure sewer system. Approximations of the dissolved sulfide content should be determined by the methods published in the U.S. EPA Technology Transfer Process Design Manual for Sulfide Control in Sanitary Sewerage Systems.

Standard pretreatment methods can be utilized to prevent corrosion and control odors in both the collection system and the treatment plant. Several measures of pretreatment are presented in the cited references. The design of the wastewater treatment facility being utilized should follow standard procedures as outlined in Manual of Practice of the Water Pollution Control Federation “Wastewater Treatment Plant Design”, U.S. EPA Technology Transfer Design Seminar Manual – “Alternatives for Small Wastewater Treatment Systems” as well as the U.S. EPA Sulfide Control Manual and any other treatment plant design guidelines recommended by the State of Florida Department of Environmental Regulation.

#### Part 9. Management Implications

Several management arrangements have been employed with pressure sewer systems. In order to minimize the responsibility of the service users the Department of Environmental Regulation requires that the operation and maintenance of the pressure sewer system be the responsibility of a central management entity, be it public or private, having indicated prior acceptance. Outside of discovery and reporting of system malfunctions, homeowners cannot generally be relied upon to take a responsible role in management. Ordinances prohibiting disposal of particularly troublesome articles, such as plastics, to the system are not universally effective without strict enforcement by a strong central management entity.

The overall staffing of the management entity is a function of system size and the type of entity. The actual field crews required for on-lot inspection and emergency repairs, pressure sewer main inspection and preventive maintenance are usually comprised of two people with a fully equipped truck. Some STEP systems have been operated and maintained by a one-person crew, but normally two would be more desirable, especially for emergency repairs. These crews shall be fully trained as to the equipment characteristics and functions by the manufacturers

involved and supplied with O/M manuals. For systems with less than 100 services contractual arrangements for O/M may be more economical because of insufficient demand to justify a trained full-time operator.

Some suggested management characteristics already discussed within this chapter are:

1. A single telephone number, for service calls.
2. Pumpout and disposal of septic tank residuals for STEP systems and GP wetwell accumulations.
3. Periodic inspection of PU and septic tank residual accumulation.
4. Emergency repairs facilities for system malfunctions.
5. Pressure sewer valve inspection, testing and periodic cleaning.
6. Maintenance of a sufficient spare part inventory.

In addition to specific training the persons responsible for the overall maintenance and operation of a pressure sewer system should have some knowledge of:

1. Pump mechanics and operation.
2. Pipe handling and repair.
3. Mechanics of fittings, valves, etc. and other components that comprise the on-site unit and system as a whole.
4. Customer relations.
5. General operation of the pressure sewer system.
6. Installation of the system including on-lot facilities.

Routine annual inspections of on-lot facilities include removal and/or visual inspection of the PU, controls, warning system and other ancillary items, including the electrical connections. For STEP systems a visual check of sludge and scum accumulations in the septic tank should be made at the same time. Routine inspection of pressure sewer main appurtenances should be made a requirement. Shut-off, air-release, and pressure-sustaining valves should be inspected at least once per month and exercised. Maintenance of air release valve assemblies should be performed as dictated by these inspections. Pressure sewer main flushing should be performed as required and with the necessary precautions for preventing cross-connections.

Pressure sewer systems shall be administrated in the same manner as gravity sewers or treatment facilities. A central authority shall maintain ownership and responsibility for all components of the pressure sewer system.

The same central authority shall be responsible for collection, treatment and disposal of septage and other residual solids in accordance with all applicable state and local agency rules and regulations.

## Section B. BASIC DESIGN

### Part 1. Summary

There are basic procedures for the design of pressure sewer systems which are common to all situations. The example provided in Part 2 is presented to indicate a basic design sequence for existing and new developments.

### Part 2. Design Sequence

The design sequence may typically be as follows:

- a. Determine required data where possible for the planning area including the location of dwellings, population (present and design), water use, soils profiles, groundwater and surface water characteristics, present wastewater disposal facilities and problem locations, climate, and topography.
- b. Determine State and local regulations and available management entities.
- c. Determine location and condition of existing septic tank systems, where applicable.
- d. Evaluate alternative treatment plant designs and locations and choose the most cost-effective.
- e. Prepare a preliminary layout of pressure sewer mains based on minimized pipe lengths to sewer design population, the cost-effectiveness of serving fringe units (where applicable) which require long piping reaches vs. continued or modified on-site system service, potential for phasing construction of feeder mains and the potential for multiple service PU's.

- f. Locate and determine minimum quantity of air-release and pressure-sustaining valves, in-line and terminal cleanouts and mainline shut-off valves.
- g. Analyze alternative on-lot systems with respect to PU, control and alarm equipment, contingency systems, residuals disposal plan, and capital and operating costs. Determine most cost-effective generic type system and potential for phasing.
- h. Where available determine design flows based on present local data, theoretical flow patterns and type of equipment chosen.
- i. Perform hydraulic analysis to finally determine pipe sizes, transition points, valve and cleanout locations and anticipated needs.
- j. Analyze alternative management systems.
- k. Review plan with Department of Environmental Regulation.

## CHAPTER II

### ON-LOT FACILITY CONSTRUCTION

#### Section A. SEPTIC TANK AND WETWELL

##### Part 1. General

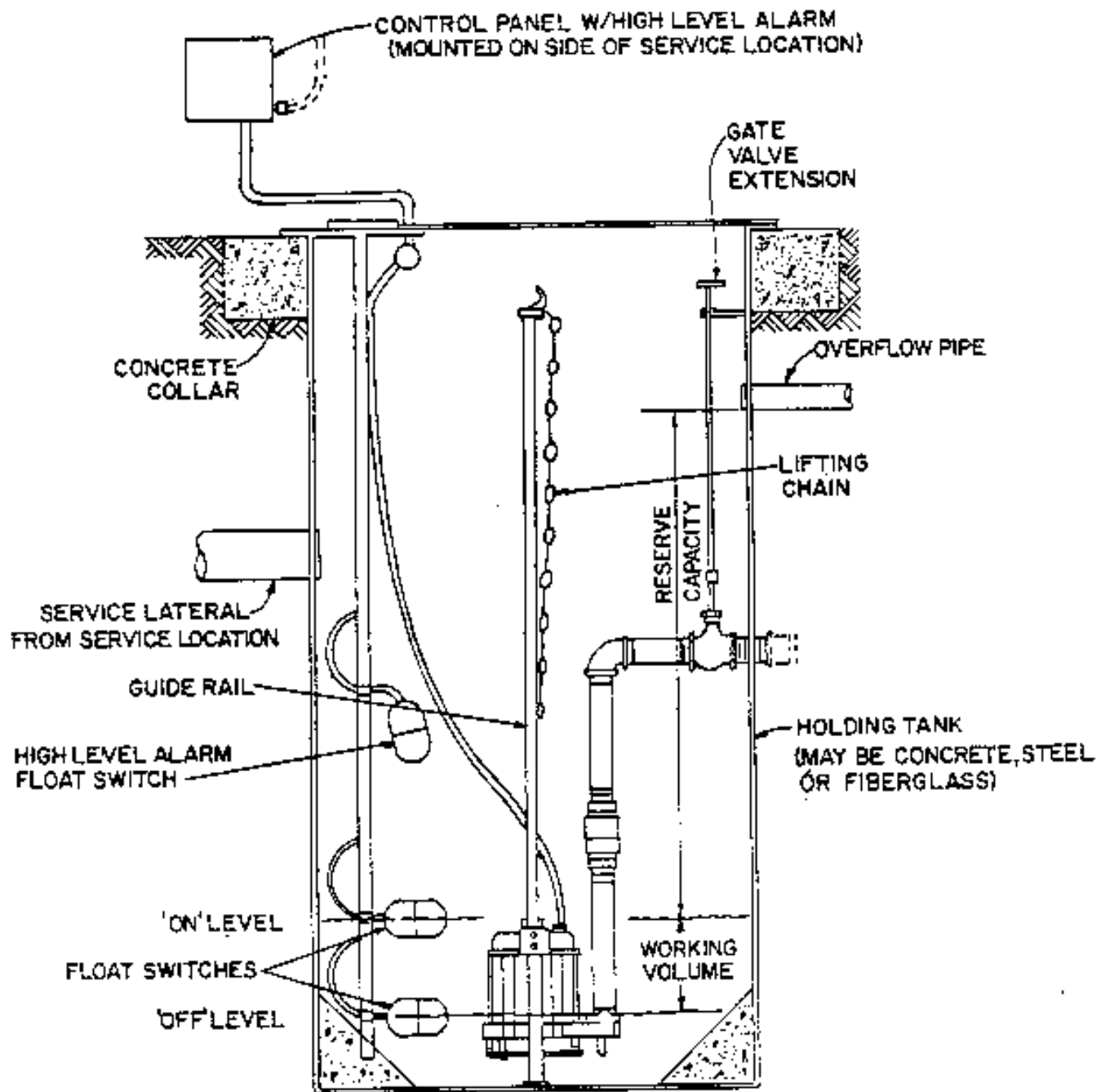
As discussed in Chapter I, Section A, Part 3, both grinder pump (GP) and septic tank effluent pump (STEP) systems should have reserve holding capacities. Individual resident GP installations generally provide a reserve storage capacity of about 0.19m<sup>3</sup> (50 gallons) while septic tanks generally have about 0.38 to 0.76 m<sup>3</sup> (100 to 200 gallons) of residual capacity due to the freeboard inherent in the construction. The pressuration unit (PU) reserve capacity is shown in Figure II-1 as the volume available for storage between the elevations of the high water alarm float switch and the invert of the overflow pipe. Figure II-2 indicates the freeboard within the septic tank generally available for reserve storage for a typical STEP system with the PU located either within or adjoining the septic tank.

##### Part 2. Sizing

Wetwell sizing is normally a function of required reserve capacity and PU hydraulic characteristics. Installations which serve more than two residences per PU often require smaller amounts of reserve capacity per residence than would PU's which serve individual residents. Large installations may consider employment of standby power generation facilities rather than provide large reserve capacity.

##### Part 3. Septic Tank Structural Design

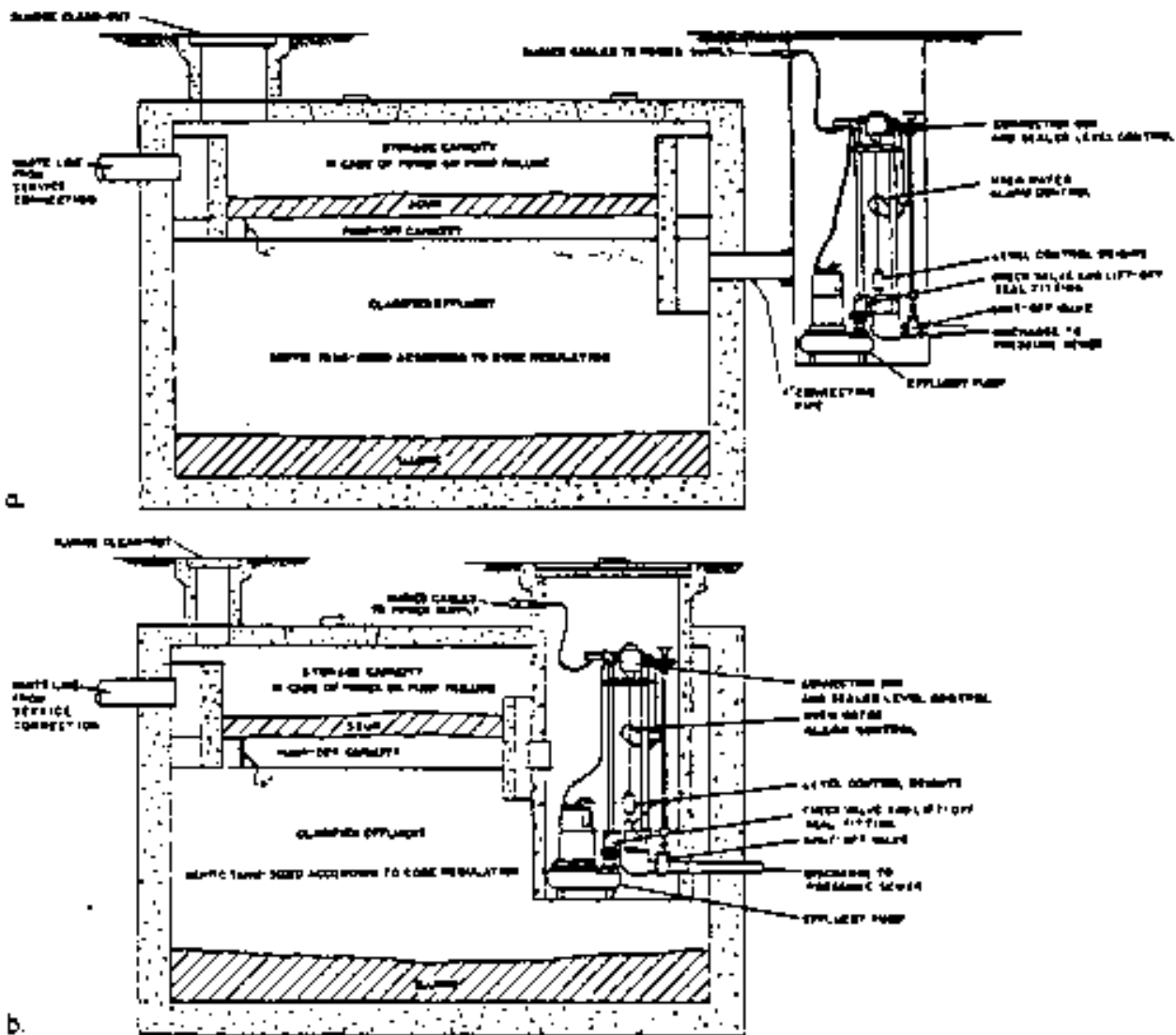
Owing to the presence of a high water table within many areas of the State of Florida, the structural design of septic tanks should include hydrostatic loading in addition to the soil loading upon the septic tank walls, floor and roof. Under most circumstances, septic tanks are located in areas not subject to vehicular traffic, however, occasionally it may be necessary for a vehicle to pass over an existing septic tank and, therefore, the septic tank roof should be of strength to resist collapse. Septic tanks shall be provided which have an approved structural design.



**FIGURE II-1**  
**TYPICAL PRESSURIZATION UNIT (PU)**  
**INSTALLATION**

# FIGURE II-2

## TYPICAL SEPTIC TANK EFFLUENT PUMPSYSTEMS



#### Part 4. Corrosion of Materials Used in Septic Tank and Wetwell Construction

Septic tank and wetwell interior wall surfaces, whether partly submerged or covered with condensation, are subject to corrosion from several sources. Corrosive agents may be present in the water supply itself, such as chlorides, as well as the polluting material within the wastewater. As sewage is detained in the septic tank for long periods of time, oxygen is depleted from the wastewater and anaerobic conditions develop. Hydrogen sulfide, H<sub>2</sub>S, reacts biologically with bacterial organisms on moist interior surfaces to form sulfuric acid, H<sub>2</sub>SO<sub>4</sub>. Materials used in septic tank construction should be shown suitable by test, experience, or analysis acceptable to the reviewing agency.

#### Part 5. Testing

To insure water tightness, septic tanks shall be tested by filling with water to the soffit, left standing for twenty-four hours and examined for leakage. This is most important when installed in an area of high groundwater. Some types of tanks will require only testing of a representative sample, while with other types, each tank should be tested. Concrete and fiberglass septic tanks are normally of the second category.

#### Part 6. Installation of Septic Tanks

Septic tanks shall be installed in accordance with the sound engineering practice. The excavation backfill adjacent to the installed septic tank should be placed in 150 mm (6 inch) lifts watered to optimum and compacted to 90% of relative density. Stones or debris having a diameter of 102 mm (four inches) or larger should not be included in the backfill material. Backfill in the vicinity of the septic tank inlet and outlet piping should be manually placed and consist of crushed rock to a depth of 150 mm (6 inches) over the inlet or outlet pipes with the remaining backfill placed in the same manner as adjacent to the septic tank. Septic tanks installed in soft or yielding soils should be bedded on crushed rock having a thickness of not less than 150 mm (6 inches). When septic tanks are installed in areas where groundwater will be above the septic tank floor the septic tank shall be secured against floatation.



## Section B. SEPTIC TANK CONSTRUCCION

### Part 1. Concrete Septic Tanks

Concrete septic tanks shall be constructed in accordance with recommendations of the American Concrete Institute (ACI) or an approved equal. A study by the U.S. Public Health Service (1) was made on concrete septic tanks ranging in age of field use from one-half to 39 years. Of the 150 tanks inspected, 91% were judged to be in good or excellent condition with respect to the concrete with some showing corrosion at and above the water line. Various coatings have been applied to the interior of the septic tank above the operating water level but have shown little success in reducing corrosion.

### Part 2. Plastic Septic Tanks

Septic tanks are available in fiberglass, polyethylene and Acrylonitrile-butadiene-styrene (ABS) construction materials with fiberglass reinforced plastic being the most common. Fiberglass septic tanks shall be constructed according to ASTM D3299 or International Association of Plumbing and Mechanical Official (IAPMO) IGC3-74 as applicable. Wall and bottom thicknesses will be determined by the specific application to meet the worst structural loading condition. Because of their light weight, plastic septic tank installations should consider antiflotation measures.

Deterioration of fiberglass has been known to occur by wicking along the glass fibers should fiberglass become exposed to moisture. Wicking may be reduced by application of resin rich coating or a gel coat applied to all surfaces.

### Part 3. Metal Septic Tanks

Common carbon steel with a coal tar epoxy coating has been used for GP wetwells and septic tanks. Prior to fabrication, the steel should be sand- or shotblasted to a "white metal" finish as recommended by the steel structurals painting specification SP-5-63 or NACE #2. After cleaning, fabrication, inspection and spot recleaning, the surface must be coated before oxidation can reoccur. Coal tar epoxy or bituminous products are often specified and applied in one or two coats to a dry film thickness of 0.2 mm (8 mils.). Magnesium anodes are normally used in conjunction with steel tanks for cathodic protection.

#### Part 4. Existing Septic Tanks

On STEP systems, some existing septic tanks may be used. A careful inspection of the septic tank is required. As septic tanks often leak infiltration can occur if installed in an area of high ground water. The tanks should be emptied, the inlet and outlet devices inspected, and effects of corrosion examined. While emptied, smoke testing will help determine if structural cracks exist. If the existing septic tank has failed to remain watertight it should be rehabilitated or replaced.

#### Part 5. Inlets and Outlets

Grinder pump and STEP wetwell inlets have been constructed either as a straight pipe or tee entering the tank. Experience has not shown either design to be preferable. Required ventilation of the GP or STEP wetwell internal atmosphere is usually through the roof vent of the service connection. STEP wetwells may be designed as an integral part of the septic tank structure as shown in Figure II-2.

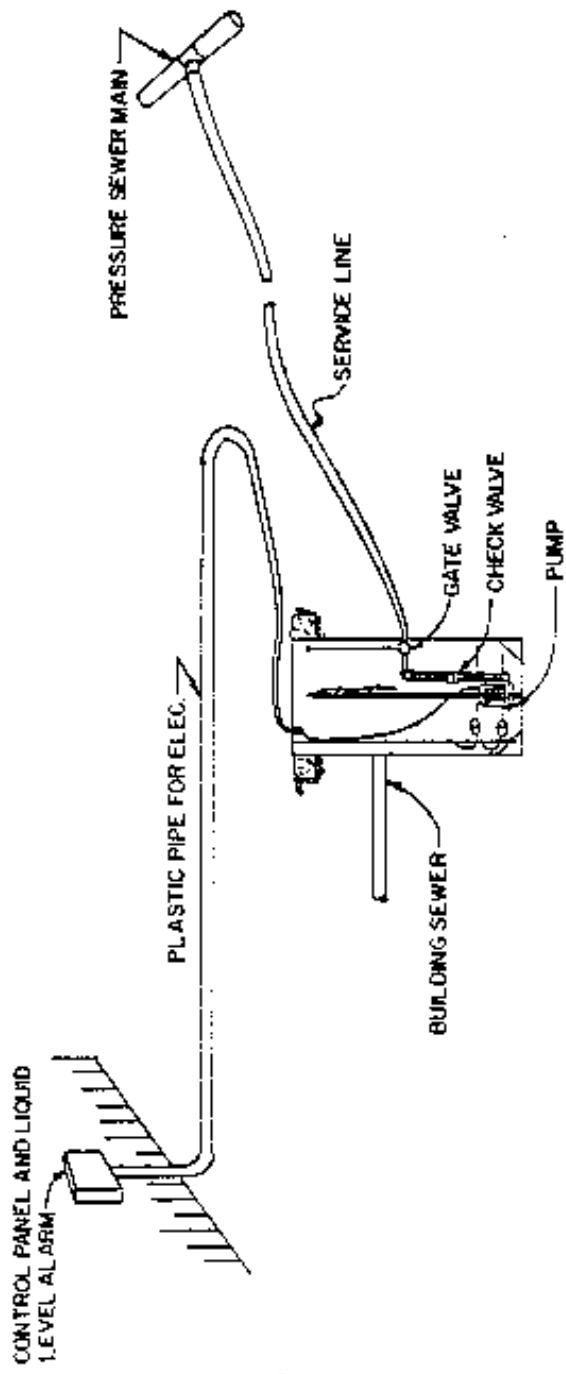
#### Part 6. Septic Tank Risers and Wetwell Covers

Septic tank risers and wetwell covers shall be secured to preclude desired removal, but be provided sufficient clearance to vent hydrostatic pressure should a check valve fail and backflow enter the tank, unless other forms of pressure relief are provided. Unauthorized removal of the septic tank riser or wetwell covers should be discouraged through use of a tamper-resistant construction or locking device.

### Section C. APPURTENANCES

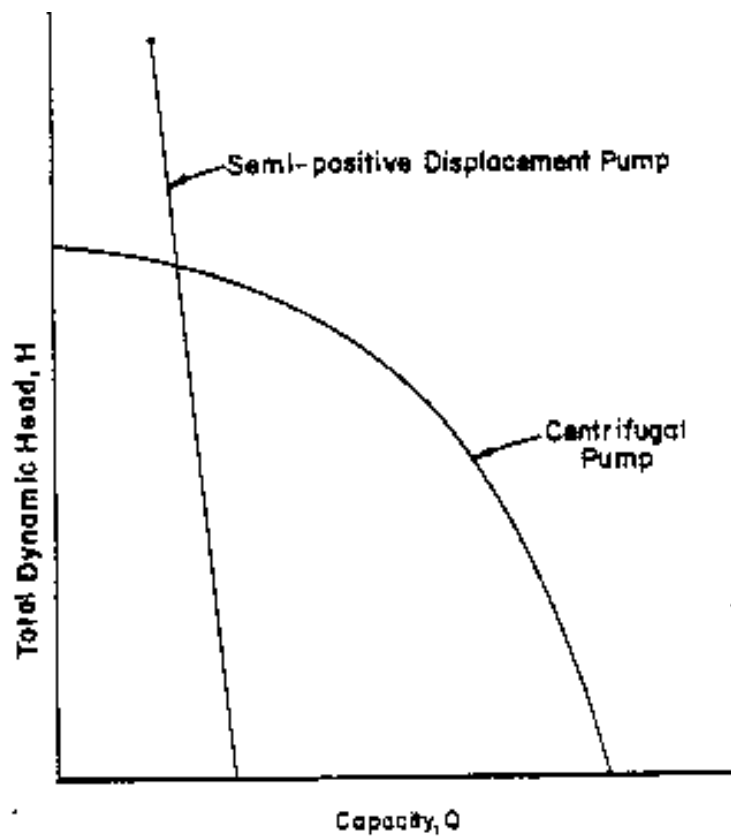
#### Part 1. Grinder Pumps

Submersible centrifugal or semi-positive displacement (SPD) progressing cavity screw-type pumps having ratings within the range of 745 to 1,490 watts (1 to 2 horsepower) are normally specified. The performance for the two types of pumps are different in respect to capacities and shut-off head. The submersible centrifugal pump has generally a higher flow producing capacity at low heads while the SPD pump has the ability to generate higher pressures and more predictable flows at higher heads as shown in Figure II-4. For clustered service connections submersible centrifugal grinder pumps are available with rating between 2,240 and 3,730 watts (3 and 5 horsepower). The SPD pump is not presently available with ratings exceeding 750 watts (1 horsepower).



**FIGURE II-3**

TYPICAL GRINDER PUMP (GP) SYSTEM



**FIGURE II-4**  
**TYPICAL HEAD-FLOW CHARACTERISTICS FOR**  
**CENTRIFUGAL AND SIMI-POSITIVE DISPLACEMENT PUMPS**

Grinder pump units must be capable of comminuting all material normally found in domestic or commercial wastewater, including reasonable amounts of foreign objects such as glass, eggshells, sanitary napkins and disposable diapers into particles that will pass through the 32mm (1-1/4-inch) standard discharge piping and downstream valves. Stationary and rotating cutter blades on bases should be made of hardened stainless steel.

Single-phase motors are available in 208 or 230 volts and shall be of the capacitor start/capacitor run type for high starting torque. Three-phase motors are available in 208, 230, 460 or 575 volts. A.U GP's shall be standard commercial shop-tested to include visual inspection to confirm construction in accordance with the specifications for correct model, horsepower, cord length, impeller size, voltage, phase and hertz. The pump and seal housing chambers should be tested for moisture and insulation defects. After connection of the discharge piping, the GP should be submerged and amperage readings taken in each electrical lead to check for an imbalanced stator winding.

## Part 2. Effluent Pumps

Effluent pumps shall be of cast iron, bronze, and/or plastic construction of the centrifugal type with submersible motor. The pump shall be mounted in the pump wetwell or septic tank on three integral support feet or base. Effluent pumps ratings range from 185 to 1,490 watts (1/4 to 2 horsepower), depending upon the dynamic head and flow capacity requirements. Effluent pumps with ratings up to 560 watts (3/4 horsepower) can operate on 115 or 230 volt sources while effluent pumps with ratings over 560 watts (3/4 horsepower) require 230 volt service. Effluent pumps are capacitor start with either permanent split capacitor or split phase motors. Effluent pump motor starters and capacitors can be located in the motor or adjacent housing. Either a control box housing or a junction box is required to connect the pump and level controls to the service users power source.

Effluent pumps shall undergo the same testing required for grinder pumps as listed in Chapter H, Section C, Part 1.

### Part 3. Wetwell Appurtenances

#### a) Internal discharge piping

Grinder pump systems may utilize galvanized iron pipe or schedule 80 PVC pipe for internal discharge piping. Due to the severe corrosion potential of septic tank effluent internal discharge piping for STEP system should be schedule 80 PVC or equal. The standard size of internal piping is normally 32 to 38 mm. (1-1/4 inch to 1-1/2 inch) diameter for 1,490 watts (2 horsepower) or less rated pumps. For 2,240 to 3,730 watts (3 to 5 horsepower) rated pumps 51 to 64mm (2 inch to 2 1/2 inch) diameter internal discharge piping is normally required.

#### b) Check valves

Check valves used in both grinder and effluent systems are ball or flapper type with valve bodies constructed of plastic or bronze. Balls and flappers are available in rubber, plastic or metal. Due to possible physical damage to the threaded connections of plastic check valves moderate care must be taken.

#### c) Hose connections

Hose connection may be used in GP or STEP systems as part of the internal discharge piping. Flexible hose connection must be secured to the discharge pipe nipple or hose to iron pipe adapter and sealed with a type 316 stainless steel clamp. Couplings may also be threaded to the pump discharge and connected, to the flexible hose.

#### d) Gate or ball valves

A gate or ball valve will normally be installed inside the pump chamber or may be located outside the pump chamber if required by local codes. Gate or ball valves constructed of bronze or plastic are preferred. If the valve is located more than one foot from the top of the pump chamber, an approved riser should be furnished to open and close the valve.

#### e) Quick disconnect couplings

Rail type mountings of effluent and grinder pumps should be installed with a quick disconnect coupling. This type of coupling is used when the discharge pipe is located 0.9 meter (3 feet) or deeper in the pump chamber. Discharge couplings are made of cast iron with rubber O-rings or diaphragm sealing flanges.

f) Level sensors

There are four basic types of level sensors used with GP and STEP systems. They are:

1. Mercury level control - Mercury level control switches contain a mercury contact switch encased within a polyurethane ball. In the simplex system three separate switches are required with each switch designated to either turn the pump off, on, or activate a high water alarm. Recently, a differential mercury switch has been introduced which has combined the on and off function within the mercury control. A second mercury switch is still required to activate the high water alarm.
2. Magnetic-weight displacement - Magnetic weight displacement switches have been used in both GP and STEP systems. As the water level rises in the wetwell the magnetic weights are moved upward to allow a magnetic contact and start the pump. As the water level in the wetwell recedes, the weight of the plastic weights disengages the switch, turning the pump off. A mercury level control switch is used in conjunction with a weight displacement type for the high water alarm.
3. Pressure sensing switches - Pressure sensing switches have been used in GP systems. This type of switch is operated by hydrostatic pressure as the water level rises and recedes within the wetwell. A similar switch is installed as a high water alarm. Pressure sensing switches must be vented to the atmosphere.
4. Diaphragm switch - Diaphragm switches are used primarily with sump pumps and sewage ejectors but can be used with effluent pumps. Diaphragm switches must be vented to the atmosphere. A second diaphragm switch, mercury level control switch or pressure sensing switch would be required to activate the high water alarm. The diaphragm switch is not recommended for GP systems due to the potential of solids build-up around the diaphragm.

g. Sealing of adaptors passing through chamber

Steel couplings should be butt welded to the sidewall of steel wetwell to provide outlets for the discharge piping and power conduits. For fiberglass wetwells the outlet coupling should be either fiberglass bonded and coated or bolted to the interior wall with type 316 stainless steel bolts. Fittings should then be covered with an approved silicone sealant.

Section D. ELECTRICAL

Part 1. Grinder Pump Control System

Since the single phase submersible centrifugal grinder pump has a capacitor start type motor, the capacitors and start relays must be located in a separate control panel enclosure. This control panel can be located either outside (NEMA 3 enclosure) or inside (NEMA 1 enclosure) the service location. In the interest of safety it is recommended that the control panel enclosure be placed within sight of the pump wetwell. The control panel should include, but not be limited to, a magnetic starter with ambient compensated bimetallic overload relay. The relay should have a test button for simulation of overload trip and manual reset button. Fault protection should be provided via a molded case magnetic circuit breaker with internal common trip or multiple poles. A hand-off-automatic toggle switch for hand operation with a green light to indicate the pump-running mode should be provided for each GP and mounted on a bracket inside the control panel enclosure. The control panel enclosure should be of high quality construction that meets State and local safety codes as well as national electrical codes. Should there be a power failure, GP malfunction, or flooded wetwell, pump controls and wiring must be accessible and comply with all code regulations to insure safety of the service user or operating personnel. As an alternate an explosion-proof combination motor control/junction box may be installed inside the GP wetwell.

Semi-positive displacement pumps having the starter and capacitor located in the pump core require only a standard junction box hook-up to the power source.

Most grinder pumps applications require either 208 or 230 volt single phase power source and the designer must be assured that this power requirement is comparable with the service users power distribution system. The recommendations under this sub-Section D, Part I are also applicable to three phase installations.



## Part 2. Septic Tank Effluent Pump Control Systems

Effluent pump starters and capacitors are located inside the motor housing and do not require a separate control panel containing these components. Depending upon the type of wastewater level control sensors and other components utilized a separate control panel may or may not be required.

## Part 3. Pump and Alarm Systems Wiring

Wiring to connect GP or STEP systems to the power source should be suitable to direct burial and comply with State and local electrical codes. Wiring for the level sensors and control panel (if required) must also comply with these requirements.

It is recommended that an audio and/or visual high water alarm be utilized with both the GP and STEP systems. The purpose of this alarm is to alert the service user of a system malfunction and to call the service authority. The alarm should be designed so that the service user can meet the audio alarm after a malfunction, but not disable it for future malfunctions. The alarm system can be mounted outside or inside the service location. In some cases, one alarm will be installed inside the service location with a backup alarm located outside the service location.

## Section E. EXISTING SEPTIC TANK OVERFLOWS AND DRAINFIELD LINES

### Part 1. Grinder Pumps

Connection of grinder pump installations to an overflow or drainfield system must be approved by the Department of Environmental Regulation. If an overflow to an existing drainfield is not feasible and is required by State or local codes the following methods are recommended.

#### a) Holding tank

A holding tank constructed of coated steel, plastic or concrete may be installed adjacent to the GP installation and connected as an overflow device. The addition of a holding tank will reduce the cost-effectiveness of the entire system and will require the holding tank contents to be removed when the tank has filled. The contents of the holding tank shall be removed by pumping into a tank truck or returned into the inlet of the GP system.

b) Existing on-site septic tank

If an existing on-site septic tank is available -d in a condition as described in Section B, Part 4 it may be emptied, inspected and rehabilitated as necessary for use as a holding tank. This is based on the assumption that GP system service can be restored within a reasonable time period. Emergency storage in the GP wetwell should be at least to 6 to 8 hours depending upon usage.

Part 2. STEP Systems

An advantage of the STEP System concept over the GP system is the additional storage capacity available. In addition to the excess storage in the pump wetwell, there is also the excess storage capacity of the septic tank. These combined capacities equate to about 24 hours of available storage. Since most of the settleable and floatable solids have remained in the septic tank, the clarified effluent can be disposed of if required by State or local codes in the following manner.

a) Existing drainfield

If a previously existing drainfield is in reasonable condition, the overflow may be connected to the drainfield for emergency usage. This can present a potential problem if t-he seasonal water table or flooding conditions in the area were the cause of the original drainfield failure. In these incidences, the ground or surface water could backflow into the pump wetwell, unless a backflow valve were installed, requiring the pump to run for extended periods, decrease the life of the PU and generate excess flows at the wastewater treatment facility.

b) New drainfield

If a previously existing drainfield is unacceptable or unavailable, a new drainage field can be provided if required but it will be susceptible to the same conditions noted for existing drainage fields.

Part 3. Venting

The standard roof venting system will normally be adequate for a STEP or GP system. It is not feasible to include a vent pipe at the ST-EP wetwell due to potentially objectionable odors. Vent piping may be extended to the old drainfield system as a back-up for either STEP or GP systems.

## Section F. BUILDING SEWER

Piping from the wastewater source to the wetwell or septic tank shall be installed by a licensed contractor. The installation is required to comply with State and local codes. Special attention should be given to the inspection of the building sewer to ensure watertight joints and grade that provides gravity flows.

## Section G. SERVICE LINES

### Part 1. General

The service line piping between the PU wetwell discharge coupling and the pressure sewer will usually vary between 32 and 51mm (1-1/4 and 2-inch) in diameter. The 32 mm (1-1/4 inch) pipe is the nominal diameter recognized to offer the best compromise among costs, necessary scouring velocities and minimum head loss considerations for GP systems. If larger horsepower pumps are used to attain higher flow capacities 38 to 51 mm (1-1/2 to 2 inches) may be considered.

Minimum flow velocities for pressure sewer mains are discussed in Chapter 1, Section A, Part 5.

The service lines should be rated to withstand short term operating pressures of 1,100 kPa (160 psi) or twice the calculated operating pressure which ever is the greater. Potential long term high pressures resulting from plugged force mains or closed valves must be identified and remedied within a reasonable period of time. It is recommended that service lines be tested at the maximum PU shut-off head pressure prior to operation.

### Part 2. Service Line Materials

PVC Schedule 40 or Schedule SDR-21 with solvent weld joints are normally used for service lines in conjunction with Schedule 40 fittings. Some polyethylene (PE) pipe service lines have been installed using mechanical fittings. Polyethylene pipe must be installed so as not to kink the pipe and cause a restriction.

It is recommended that the location of the service line be identified to reduce potential damage to the service line by mechanical excavation.

### Part 3. Check Valves

An approved check valve should be installed in the internal piping of the PU on the discharge side of either the GP or STEP system. However, a redundant check valve may be installed

elsewhere between the discharge coupling of the wetwell and the pressure sewer main connection. The check valve may be located on the service line either directly outside the pump wetwell or near the pressure sewer main connection.

It is recommended that check valves be used to prevent siphoning at the pump wetwell where a minimum or negative hydrostatic head is encountered. A check valve will also prevent leakage past the check valve in the event of a water hammer phenomena. This is particularly important if the primary check valve is located in the horizontal position.

#### Part 4. On/Off Valves and Corporation Stops

A gate or ball valve will normally be located in the PU wetwell to prevent backflow when the PU is removed for service. Additionally, a corporation stop or U valve is usually installed near the service line/pressure sewer main connection to isolate the service line. The most common type is a corporation stop.

#### Part 5. Service Line Installations

Service lines must be installed at a depth sufficient to prevent any mechanical damage but not less than 305 mm (1 foot).

In most applications service lines will slope upward to the pressure sewer main connection. In some cases where the service lines may slope downward a spring loaded check valve should be installed in the PU wetwell to minimize potential siphoning problems.

#### Part 6. Separation of Waterlines and Street Crossings

Pressure sewer service lines and potable water supply piping shall be installed with at least 3m (10-foot) horizontal separations and/or pass State and local codes. Pressure sewer service lines and potable supply lines shall be identified by silver markings or color code. Where pressure sewer mains are installed on one side of the street, service line connections from the opposite side of the street should be installed by boring, if the street has been surfaced, or installed within a bored casing in heavily trafficked areas. The potable water supply line and pressure sewer service line may be bored beneath the street surface in the same proximity provided that either line is installed in an approved casing.

## Section H. CONNECTION TO PRESSURE SEWER MAIN

### Part 1. General

The alternatives for installing connections from the service lines to the pressure sewer main are to wet tap the service line as the service connections are required or to provide a plugged connecting wye or tee on the pressure sewer main at the time of construction. If wyes or tees are provided at the time of pressure sewer construction the location of the connection must be identified to avoid excessive excavation to locate connection points for future use. Since the majority of service line and pressure sewer mains are constructed using PVC or PE materials this Section is restricted to a discussion of compatible materials. However, similar connections could be made were other non-plastic materials and compatible fittings utilized.

### Part 2. Connection Methods

#### a) WYE and TEE connections

Wye and tee saddles are available to install 32 to 51 mm (1-1/4 to 2-inch) I.D. service lines to the pressure sewer main. The pressure sewer main in the street or right of way location can vary between 38 and 305 mm (1-1/2-inch and 12-inch) I.D.

#### b) Wet tap connection

A popular method of connection of PVC service lines to a PVC pressure sewer main is by wet tapping and installation of a tee connection. Solvent weld service connections of this type are available in 13 to 51 mm (1/2 to 2- inch) diameters.

#### c) Polyethylene service lines

Polyethylene pipe cannot be solvent welded but must be heat fused to provide installation of connecting service lines. Polyethylene can form a solid joint at high temperatures so that the joint itself is stronger than the pipe wall. A variety of transition fittings for polyethylene pipe is available.

### Part 3. Valves

As previously stated in Chapter II, Section G, Part 4 a corporation stop or “U” valve should be located at the street or property line to isolate the service line from the pressure sewer main. The valve riser and cap should be located out of access of road traffic to prevent damage to the riser

which could, in turn, crush the service line. Some pressure sewers do not provide a riser or valve box to locate or service the check valve located near the street on the assumption that failure would be a rare occurrence and that these components could, if necessary be located, excavated and repaired.

#### Section I. PIPE INSTALLATION SERVICE

Service lines can be jointed on the surface and then placed into the excavated trench. Pipes shall be jointed in accordance with the manufacturer's printed instructions.

The trench should not be excavated for a distance greater than can be backfilled during the same day of excavation.

It is not expected that the service line and valves will require any service under normal operating- conditions. Occasionally, the service line may be broken due to a mechanical excavation in the area or possibly an earth slide. If this happens, the service line can be isolated.

## CHAPTER III

### PRESSURE SEWER MAIN CONSTRUCTION

#### Section A. PRESSURE MAIN PIPE MATERIALS

##### Part 1. Thermoplastic Pressure Pipe Materials

###### a) General

Pressure sewer mains have generally been constructed using polyvinyl chloride (PVC) pressure pipe. Polyethylene (PE) pressure pipe, having had minor pressure sewer usage, and acrylonitrile-butadiene-styrene (ABS) pressure pipe are both suitable for pressure sewer main construction. Thermoplastic pressure pipe should be installed in accordance with written installation directions as provided by the pressure pipe manufacturer. Pressure pipe manufactured from other materials than those described herein may be used for pressure sewer mains if approved by the State of Florida Department of Environmental Regulation for a specified application. Approval of such material for one application should not be considered as approval for any other application.

###### b) Polyvinyl chloride (PVC) pressure pipe

Polyvinyl chloride pressure pipe should be manufactured in accordance with the requirements of American Society of Testing Materials (ASTM) Specifications D1785, D2241 or D2672 or American Water Works Association (AWWA) Standard C900 and be suitable for use in pressure sewer main construction. The ASTA designations are applicable for pressure pipe having nominal diameters between 3 and 305 mm (1/8 and 12 inches). The AWWA C900 Resignation is applicable for pressure pipe having nominal diameters between 102 and 305 mm (4 and 12 inches). The standard pipe length for the above standards is usually 6 meters (20 feet).

The sustained pressure capacity of pressure PVC pipe is a function of its operating temperature. For temperatures higher than the 23<sup>0</sup>C (73.4<sup>0</sup>F) standard rating temperature the pressure sustaining capacity of the PVC pressure pipe decreases significantly. Conversely, higher sustained pressures may be obtained with temperatures less than the standard rating temperatures. Tables or charts are available from PVC pressure Pipe manufacturers to

determine the sustained pressure allowable for the anticipated wastewater temperature and should be considered if the wastewater temperature will be significantly above the standard rating temperature.

The sustained pressure capacity of PVC pressure pipe is also a function of the length -of time the sustained pressure acts upon the pipe and must be considered in the design of the pressure sewer main. Short-term pressure surges considerably higher than the long-term pressure rating of the pipe are easily withstood without damage. For example, Class 150 PVC pressure pipe conforming to AWWA C900 will withstand an internal pressure of 5200 kPa (755 psi) for about one minute but will burst at the same pressure in about five minutes. The same pipe will however normally carry an internal working pressure of 1034 kPa (150 psi) throughout the -design period without failure. The design of PVC pressure pipe must be based on the long-term working pressure of the pipe for pressure sewer main installations. PVC pressure pipe joints may be flexible using elastomeric seals or cemented. Joints should conform to the requirements of ASTNI F477, ASTM D3139, ASTM F545, or ASTM D2564.

c) Polyethylene (PE) pressure pipe

In general PE pressure pipe performs in a manner very similar to PVC pressure pipe. PE pressure pipe should be manufactured in accordance with the requirements of either ASTM D2239, D3035 or AWWA C901. Unlike PVC pressure pipe PE pressure pipe joints cannot be solvent welded but must be fusion-welded together in accordance with the requirements of AST-M D3261.

d) Acrylonitrile-butadiene-styrene (ABS) pressure pipe

ABS pressure pipe has not been installed in pressure sewer systems. However, as a thermoplastic pressure rated pipe having been used in water distribution systems it should be considered as an acceptable alternate pressure pipe material. ABS pressure pipe performs in a manner very similar to either PVC or PE pressure pipe and should be manufactured in accordance with ASTM D2282. ABS pressure pipe may be jointed using either flexible elastomeric seals in accordance with AST.M D3139 and ASTM F477 or cemented joints in accordance with AST.M F545 and ASTM D2235.

e) Thermoplastic pressure pipe fittings

Various fittings manufactured from the same material as the pressure pipe have been developed and are available. However, the fitting must be comparable with pressure pipe and also be able to withstand the normal operating and surge pressures without failure. Steel or iron



pipe fittings may also be utilized if the appropriate ASTM or AWWA specification are met. Acceptable internal and external corrosion protection must also be provided when the ferrous metal fittings are utilized.

f) Pressure sewer pipe identification

In addition to the markings required for pressure pipe manufacture of nominal diameter, manufacturers' name or trademark, pressure pipe type, grade and class in accordance with the designated product standard, the pipe should be marked continuously identifying the pipeline as a pressure sewer. The markings should be safety green, boldface type lettering not less than 25 mm (1.0 inch) in height and should remain legible under normal handling and installation procedures. Alternate methods of identification may be used and are subject to the approval of the Department of Environmental Regulation.

g) Specifications

Pressure sewer pipe is normally specified by either the pressure rating (PR) or required resistance to the hydrostatic stress as determined in accordance with ASTM D1598, DE99 or D2837. Pneumatic and ejector type pumps can develop pressures in excess of the normally sustained operating hydrostatic pressure. The anticipated pressures must be quantified and their frequency of occurrence identified. If this is impractical due to the design of the pressure sewer system, it is normal to accept at least a 100% overage in excess of the normal operating pressure. This should be reflected in the selection of the pipe pressure rating or pipe class.

Part 2. Fiberglass Reinforced Thermosetting Resin (FTR) Pressure Pipe

FTR pipe has been used for the conveyance of water and sewage force main construction, above and below ground, at temperatures up to 52°C (125°F). Though not having yet been utilized for pressure sewer main construction the material would be acceptable as an alternate pressure pipe material if manufactured in accordance with ASTM D2996, D2310 or D3754 with dimensions as specified by ASTM D3567. FTR pressure pipe classifications may be chosen from those provided in ASTM D3754 or D2996 or designed on the hydrostatic basis described in ASTM D2992. FTR pressure pipe should be installed in accordance with written installation directions as provided by the pressure Pipe manufacturer. FTR pressure pipe should also be identified as indicated in Chapter III Section A, Part 1.

### Part 3. Ductile Iron (DI) Pressure Pipe

Ductile iron pressure pipe with various linings or coatings is widely used for the construction of sewage force mains and may have limited application for pressure sewer mains. The product is available in nominal diameters from 75 mm through 1,400 mm (3 inches through 54 inches) for a wide range of pressures. Ductile iron and grey cast iron fittings and other appurtenances are available.

Ductile iron pressure pipe should be manufactured in accordance with “American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water and Other Liquids,” ANSI A21.51 (AWWA C151) and is specified by nominal diameter, class, lining and type of joint. The required thickness (Class) of DI pipe is based on the internal pressure or vertical deflection under trench backflow loading with allowances added for manufacturing tolerance and corrosion. The design procedure is given in “American National Standard for the Thickness Design of Ductile Iron Pipe,” ANSI A21.50 (AWWA C150).

Each length of DI pipe should be continuously marked identifying the pipeline as a pressure sewer main with not less than 25 mm (1.0 inch) in height bold type “Safety Green” color lettering that remains legible under normal handling and installation procedures. Additional marking should give the weight, class or nominal thickness, casting period, manufacturer’s name or trademark and year in which the pipe was produced. The letters DI or DUCTILE should be cast or stamped on the pipe. Markings should be at or near the bell end of the pressure pipe. Alternate methods of identification may be used and are subject to the approval of the Department of Environmental Regulation.

## Section B. PRESSURE SEWER PIPE INSTALLATION

### Part 1. Location and Depth of Cover

Pressure sewer mains and appurtenances should be installed and maintained to lines and grades established by an approved plan signed by an engineer having a valid State of Florida registration, with fittings and valves at the required locations.

All pressure sewer mains should be constructed to a minimum depth of 760 mm (30 inches) or as required and as measured from the final ground surface to the top of the barrel of the pipe.

In areas subject to subsequent excavation or fill, the mains should be laid to grades shown as closely as possible.

Part 2. Excavation and Backfill

a) General

Excavations shall comply with all Federal, State and Local rules, regulations and ordinances applicable to sheeting and bracing of open-cut trenches as required to protect life, property, or the installation. The minimum protection to be provided must conform to the requirements of the Occupational Safety and Health Standards for Construction (OSHA).

b) Trench excavation

The width of trenches must provide adequate space for workmen to place, joint and backfill the pressure sewer pipe properly, but should be kept to a minimum.

If unsuitable pipe bedding material is exposed within the pressure sewer pipe zone of the trench excavation, it should be excavated to such additional depth and width as required and should be replaced with suitable fill materials.

c) Rock excavation

Where rock is encountered in the trench at the level where the pressure pipe is to be installed it should be excavated to a minimum depth of 150mm (6 inches) below the pressure sewer pipe line and the over-excavation refilled with a suitable pipe bedding material. Over-excavations in rock below pipelines and manholes exceeding the depths specified above should be refilled with concrete, crushed stone or other suitable material. Blasting for excavation will be permitted only if the blasting procedures conform to Federal and State laws, municipal ordinances and OSHA rules and regulations.

c) Excavation backfill

This section establishes minimum backfilling requirements. If the pressure pipe manufacturer recommends more stringent backfill conditions, the pipe manufacturer's recommendations should be followed. All excavations should be backfilled to the original surface of the ground or to such other grades as may be required.

Backfilling, unless otherwise specified, should be done with materials free from waste, objectionable organic matter, rubbish, boggy, frozen or other unsuitable materials. Backfill above the pressure pipe bedding zone should not contain rock or debris greater than 100 mm (4 inches) in diameter.

Pressure sewer pipe must be embedded in well graded, compacted, suitable bedding material. If the original soil is unsuitable for bedding material the pressure pipe embedment material should extend a minimum of 100 mm (4 inches) below the bottom of the pipe to 305 mm (1 foot) over the top of the pipe for the full trench width.

Trench backfill extending from 305 mm (1 foot) over the top of the pipe, to the bottom of pavement subgrade, subgrade for lawns or to the top of the existing ground surface or to such other- grades as may be required may be select fill material, suitable job-excavated material or other approved material.

Trench backfill under pavements and in areas where after-settlement is not acceptable should be placed in maximum 228 mm (9 inches), loose thickness lifts and compacted in place. Lifts should be compacted to not less than 75 percent relative density as determined by ASTM D2049 or not less than 90 percent of optimum density as determined by ASTM D1557 as applicable. In other areas where after settlement is of no consequence backfill may be job-excavated material or other approved material placed in 305 mm (12 inch) lifts and consolidated by jetting, tamping, or puddling or alternate means to insure complete filling of the trench. After the trench has been backfilled the top of the trench should then be mounded to allow for natural consolidation of backfill.

### Part 3. Pressure Sewer Main Pipe Laying and Jointing

#### a) General

Pressure sewer main installation shall be in accordance with AWWA C600 for ferrous pressure pipe, D2774 for thermoplastic pressure sewer pipe, ASTM 3839 for thermosetting pressure sewer pipe or approved manufacturers written installation instructions.

Fittings and connections used where grade or alignment changes require offsets greater than those recommended by the pressure sewer pipe manufacturer should be certified by the fitting or connection manufacturer for compatibility with the pressure sewer pipe. Prior to installation pressure sewer pipe and fittings should be cleaned, inspected, and examined for

defects. All imperfections on the face of the spigot, tongue end or the shoulder should be cut away or repaired. Cracked, broken, or defective pressure sewer main pipe, or ancillary items should be rejected or removed from the jobsite.

During the pressure sewer main construction all open pressure sewer main pipelines should be sealed with appropriate plugs when actual construction is not in progress. As the pressure sewer main construction progresses, the interior of the pressure sewer main should be kept free of dirt and debris.

Pressure sewer main installation will be approved only in dry trenches having a stable bottom. Where groundwater is encountered, every effort should be made to secure a trench bottom free of water.

b) Jointing

The requirements for pipe jointing are specified in a) above for thermoplastic, reinforced thermosetting resin and ductile iron pipe. All pipe and jointing for pressure sewers must be subject to tests specified in Part 4 below.

c) Plugs, anchorage and thrust restraint

Plugs for pressure sewer pipe wyes or tees, stubs and valves which are not to be immediately utilized should be made of an approved material and should be secured in place with a joint comparable to the pressure sewer main joint.

Anchorage of pressure sewer mains and appurtenances should be placed at bends greater than 22.5 degrees, tees, stops, valves or changes in pipe sizes. The anchorages consist of thrust blocks, restrained joints or tie rods depending on the pipe material used and trench conditions.

Thrust blocks should be concrete placed on and against undisturbed soil. Thrust blocks must be constructed so that thrust forces are transmitted to the undisturbed soil. The concrete mix used to form the thrust blocks should have a minimum compressive strength of 13.79 MPa (2,000 psi) after 28 days.

Restrained push-on joints, mechanical joints utilizing set screw retainer glands or metal harnesses of the rods or clamps may be used instead of concrete thrust blocking. Tie rods, clamps, or other components of dissimilar metal should be protected against corrosion by hand application of a bituminous coating or by encasement of the entire assembly with 0.2

mm (8mil) thick, loose polyethylene film applied in accordance with AWWA C105.

Part 4. Flushing, Leakage Testing and Repair

a) Flushing

Prior to the commencement of pressure and leakage tests, the sections of pipe to be tested should first be polypigged or flushed to remove any debris that may remain in the pressure sewer main. The flushing procedure should develop a water velocity in the pressure sewer main sections of at least 0.76 m/s (2.5 feet per second) and should result in at least a 100% turnover of the water in the pressure sewer main.

b) Pressure test

After the pressure sewer main has been installed, partly backfilled and fully charged with water it should be subjected to a hydrostatic pressure equal to either 150 percent of the maximum operating pressure or the maximum pressure obtainable during the cleaning operation, whichever is greater, but not to exceed the pressure rating of the type of pressure pipe specified. The duration of this pressure test shall be for a period of not less than one hour. The basic provisions of AWWA C600 and C603 shall be applied.

c) Leakage test

After completion of the pressure test, a leakage test should be conducted to determine the quantity of water lost by leakage under the specified test pressure. The test pressure is defined as the maximum operating pressure of the pressure sewer main. Applicable provisions of AWWA C600 and C603 will apply. Duration of each leakage test should be a minimum of one (1) hour in duration for the pressure test period.

Leakage is defined as the quantity of water to be supplied in the newly constructed pressure sewer or valved section under test, which is necessary to maintain the specified leakage test pressure after the pressure sewer main has been filled with water and the air expelled. The allowable leakage in liters per hour (gallons per hour) for pressure sewer mains should not be greater than that determined by the formula:

$$L = \frac{ND(P)^{1/2}}{130380} \quad (\text{S.I. Units}) \quad \text{or} \quad L = \frac{ND(P)^{1/2}}{7400} \quad (\text{English Units})$$

Where: L = allowable leakage in 1/hr (gallons per hour, gph)  
 N= number of pipe joints in length of pressure sewer main tested  
 D= nominal diameter of the pressure sewer main pipe in mm (inches)  
 P = average test gauge pressure during leakage test in kPa (pounds per square inch)

Allowable leakage rates at various pressures are shown in the Table III-1 based upon nominal pressure pipe sections having a length of 6.1 m (20 ft.).

Table III-1

Allowable Leakage per 304.8 mm (1,000 Ft.) of Pressure Sewer Pipeline (\*) 1/h (gph)

Pipe Size mm(inches)	Test Pressure, kPa (psi)			
	413.7(60)	551.6(80)	689.5(100)	861.8(125)
50.8(2)	1.040(0.10)	.46(0.12)	0.51(0.14)	0.52 (0.15)
76.2(3)	0.59(0.16)	0.69(0.18)	0.79(0.20)	0.86 (0.23)
101.6(4)	0.79(0.21)	0.92(0.24)	1.02(0.27)	1.14 (0.30)
152.4(6)	1.19(0.31)	1.37(0.36)	1.53(0.41)	1.72 (0.45)
203.2(8)	1.58(0.42)	1.93(0.48)	2.05(0.54)	2.29 (0.60)
254.0(10)	1.98(0.82)	2.29(0.60)	2.56(0.68)	2.86 (0.76)

(\*) For pipe with nominal length different than 6.1 mm (20 feet) the recommended allowable leakage may be obtained by multiplying the leakage calculated from the Table III-1 by the ratio of pipe lengths.

Part 5. Special Construction Provisions

a) Roadway crossings

All required permits and construction requirements shall be obtained prior to construction.

b) Railroad crossings

The railroad agency has jurisdiction over all railroad tracks under-crossed by the pressure sewer main. The railroad agency must approve and authorize the under-crossing and must be notified in advance of any construction with the railroad right of way as required by the permitting railroad agency.

The method of installing casing and carrier pipes under railroad tracks, either by open trench excavation, jacking or boring should be approved in writing by the Railroad agency.

c) Bridge crossings

Bridge crossing design and construction must conform to all regulations of the agency having jurisdiction over the work regarding the methods of construction and the protection of the site of the bridge crossing during the construction period. Pressure pipe and fittings installed at bridge crossings must meet the requirements of Chapter III, Section B, Part 3 above for ductile iron pressure pipe. All bolts, pipe hangers, nuts, studs and bolt anchors for pipe hangers, clamps and supports should be series 300 stainless steel or shop coated for corrosion protection. Pipe suspension systems must receive written approval prior to construction of the pressure pipe materials and pipe hanger spacing.

The word "WASTEWATER," in easily discernible letters, should be stenciled or otherwise printed with fade resistant paint at each end and at each midpoint between pipe hangers after installation.

d) Potable water supply crossing

Under normal conditions, pressure sewers crossing under potable water supply mains shall be constructed to provide a separation of at least 457 mm (18 inches) between the bottom of the water main and the top of the pressure sewer.

When local conditions are such that pressure sewer mains crossing under water mains will have less than 457 mm (18 inches) of vertical separation the pressure sewer main shall be concrete encased or installed within a carrier pipe for a distance of about 3 m (10 feet) measured perpendicularly on either side of the potable water supply main.

When pressure sewer mains cross over potable water supply mains, additional protection of the potable water supply shall be achieved by either providing adequate structural support for the pressure sewer main to prevent excessive deflection of joints and settlement and centering the pressure sewer main pipe at the crossing such that the joints will provide about 3 m (10 feet) of clear distance from the potable water supply main.



Under normal conditions all pressure sewer mains shall be located with at least a 3 m (10 foot) horizontal clearance from potable water supply mains or be provided with an approved method of installation.

e) Installation in vicinity of potable water supply well

The installation of pressure sewer systems in the vicinity of potable water supplies shall be governed by the requirements of Chapter 17-22 FAC of the Rules of the Florida Department of Environmental Regulation (formerly IOD-4) and any local ordinance, rule or requirement. Section 17-22.106 (2b) states that any public water supply well “shall be located a minimum of (30 m) 100 feet from any potential source of contamination unless otherwise justified by natural or adequate treatment barriers”.

6. Appurtenances

a) Air release facilities

Air release facilities should be located at the summits of all pressure sewer systems and shall be properly sized to prevent buildup of air or gases that will impede flow of the wastewater.

Facilities for air release may be manually operated or automatic. Automatic systems specifically designed for use with wastewater and well maintained are reliable and widely used. Manually operated valves depend on being opened at frequent intervals by operating personnel for successful performance.

Automatic air release valves must be designed to prevent wastewater solids and grease from reaching the valve operating mechanism. Air and gases are released from the valve by float action. Provisions for cleaning the valve by backflushing should be provided.

Air release valves should be fabricated from materials which are corrosion-resistant.

b) Connections and tapping

Tapping valves should have flanged inlet end connections with a machined Projection on the flanges to mate with a machined recess on the outlet flanges of the tapping sleeves and crosses. The outlet ends shall conform in dimensions to the AWWA Standards for hub or mechanical joint connections, except that the outside of the hub shall have a large flange for attaching a drilling machine. The seat opening of the valves shall be larger than normal size to permit full diameter cuts.

When a lateral pressure sewer connects to a mainline pressure sewer, the lateral pressure sewer shall be valved. If the lateral pressure sewer has greater than 20 service connections, the mainline pressure sewer shall be valved upstream from the lateral connection. When two or more mainline pressure sewers are connected, all branches shall be valved upstream of the junctions. It is not necessary to valve the downstream branch except for looped pressure sewer systems as shown in Figure I-2.

c) Appurtenance boxes and vaults

Boxes and vaults for air release facilities, cleanouts and other appurtenances shall be sized to permit easy removal of the facilities, and to permit operation of the valves. Valves should be capable of being operated from a kneeling or standing position. The word “Sewer” shall be clearly marked or cast on the box or vault cover.

d) Valves and valve boxes

All valves shall be full diameter opening to permit cleaning with a polypig or other devices. Valves in nonmetallic pressure sewer pipelines shall be iron, bronze, PVC, nylon or other approved material and shall have screwed or flanged ends. Valves in metal pressure sewer pipelines shall be iron body, bronze mounted with flanged or mechanical joint ends, except that in the smaller sizes, valves may be all bronze with screwed ends.

All valves shall be hydrostatically shop pressure tested at 1,725 kPa (25.0 psi) first by applying the hydrostatic pressure with the valve in the open position and then with the valve in the closed position. Valves failing to be tight and secure under the test pressure shall be rejected for pressure sewer installations.

Valves installed on pressure sewers constructed with flexible pipe materials shall not have the valve supported by the pipe, but shall be supported by an anchored concrete cradle or concrete block.

Valve boxes shall be constructed of vehicular traffic rated plastic or coated cast iron and set into position during backfilling operations so they will be in a vertical alignment and parallel to the valve operating stem. The lower casing of the unit shall be first installed in such a manner as to be cushioned and to not rest directly upon the body of the valve or upon the pressure sewer main. The upper casing of the unit shall then be placed in proper

alignment and adjusted to final grade. Backfilling shall be placed and compacted uniformly around the structure so as not to disturb the vertical alignment.

d) Cleanouts

Cleanouts should be provided at locations as recommended in Chapter I. Line cleanouts for small diameter force mains may be constructed using meter boxes as shown on Figure III-4. Where more space is required for cleaning equipment, cleanouts may be constructed in vaults or manholes. Where it is considered necessary to isolate a section of the pressure sewer main, a valve may be installed ahead of the wye.

When cleanouts are located in vaults or manholes, It is often convenient to construct a sump in the floor. Groundwater which accumulates in the structure or wastewater which discharges from the opened cleanout can be more readily removed with a portable sump pump.

Typical cleanout arrangements are shown on Figures III-1, III-2, III-3 and III-4.

f) Terminal manhole connections

Pressure sewers should be designed to flow full at all times. If the pressure sewer main terminates at a gravity sewer, the connection can be made with a terminal manhole as illustrated in Figure III-5 with an inlet designed to minimize turbulence. The end of the pressure sewer junction should have a removable plug to facilitate cleaning.

g) Pipe locating marking tape

Underground marking tape for non-metallic pressure sewer pipelines should be installed 102 to 204 mm (4 to 8 inches) below the ground surface or pavement directly over the pipeline. Marker tape should be made of an inert polyethylene material having a minimum thickness of 0.1 mm (4 mils) and should be color-coded "Safety Green" as adopted by the American Public Works Association and the Florida Utilities Coordination Committee. The tape should bear printed identification describing the type of pipeline buried below and should contain a 0.025 mm (1 mil) thick metallic foil core. The imprint should repeat itself for the entire length of the tape. Where ductile iron pipe is installed, a sheet of green plastic having a width of twice the pipe diameter should be laid directly on the top of the pipe before

the pipe is backfilled. The plastic shall be fabricated from inert polyethylene with a minimum thickness of 0.1 mm (4 mils).

Alternate methods of identification may be used given prior approval of the Department of Environmental Regulation.

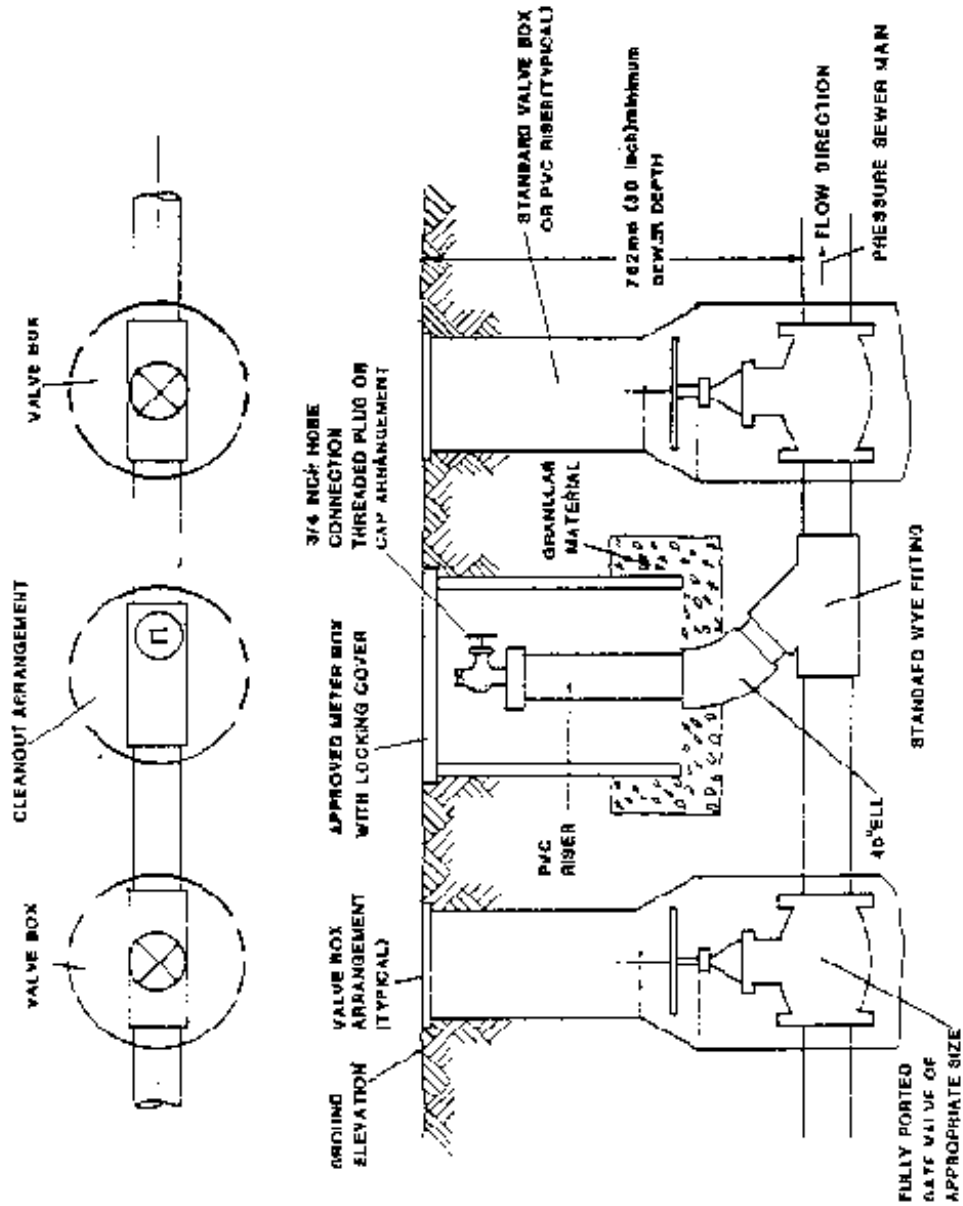
7. Record Drawings

The Contractor shall keep a signed approved record copy of all specifications, plans, addenda, supplementary drawings, working drawings, change orders and similar documents in good order at the construction site and at another convenient location where they are readily available. Specifications, plans and drawings should be annotated to show all changes made during construction. These documents should be delivered to the Owner upon completion of the work.

8. Inspection

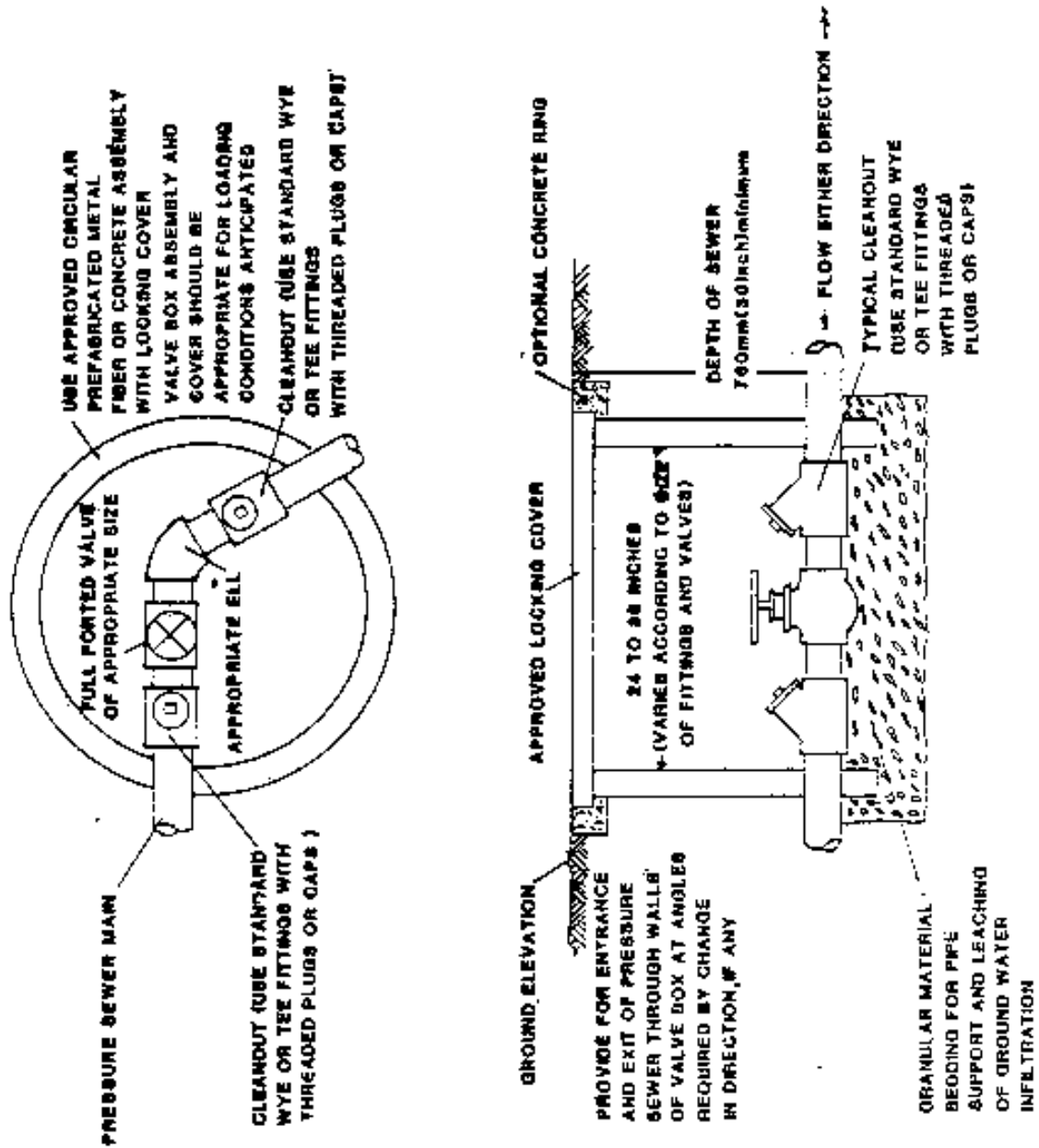
Inspection of construction must be directed by a professional engineer licensed in the State of Florida. The engineer must certify completion in substantial compliance with the approved plans and specifications and the provisos contained therein.

**FIGURE III-1**  
**Recommended Valve Box and Cleanout Arrangements**  
**with Provision for Hose Connections**

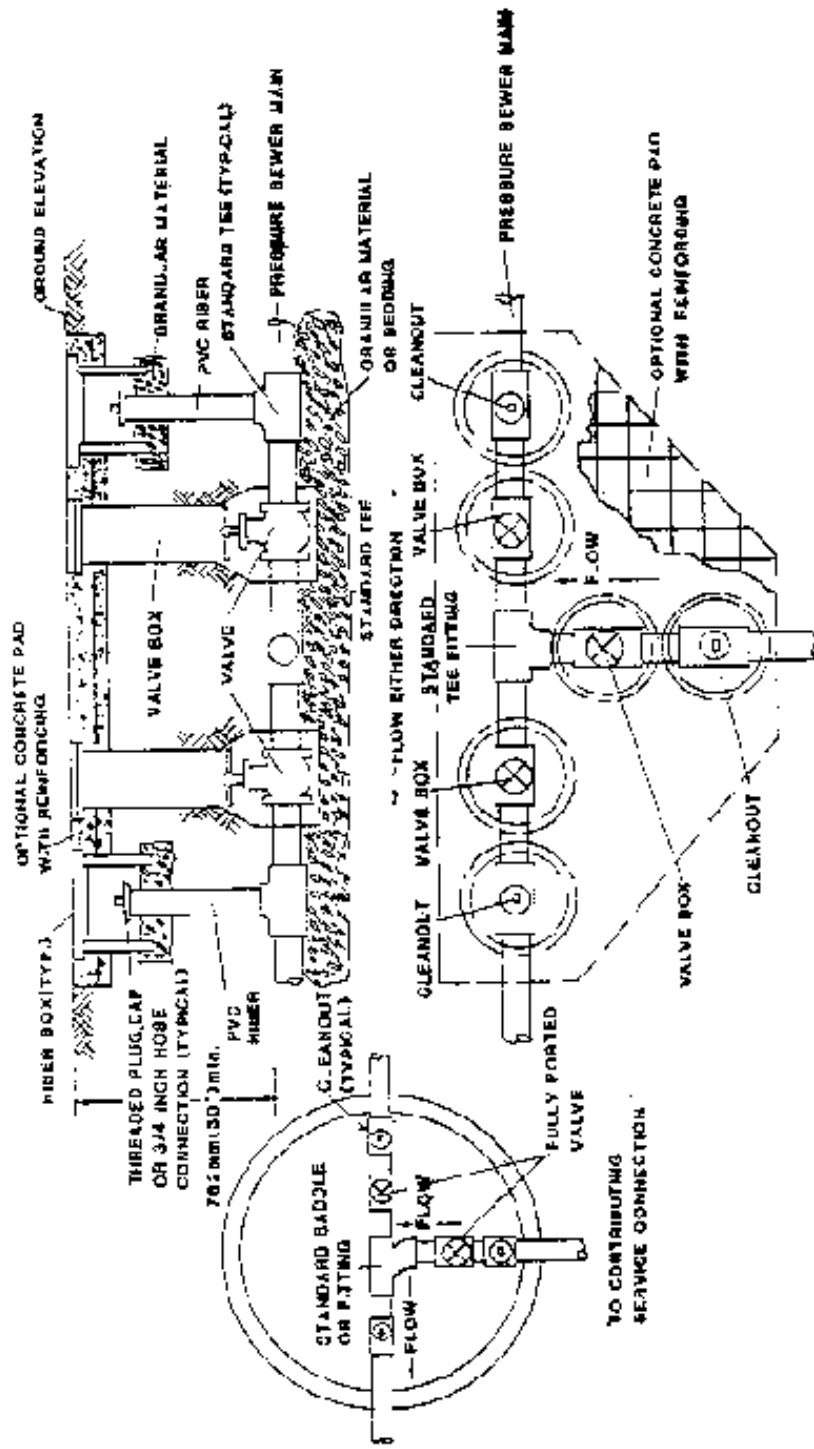


## FIGURE II-2

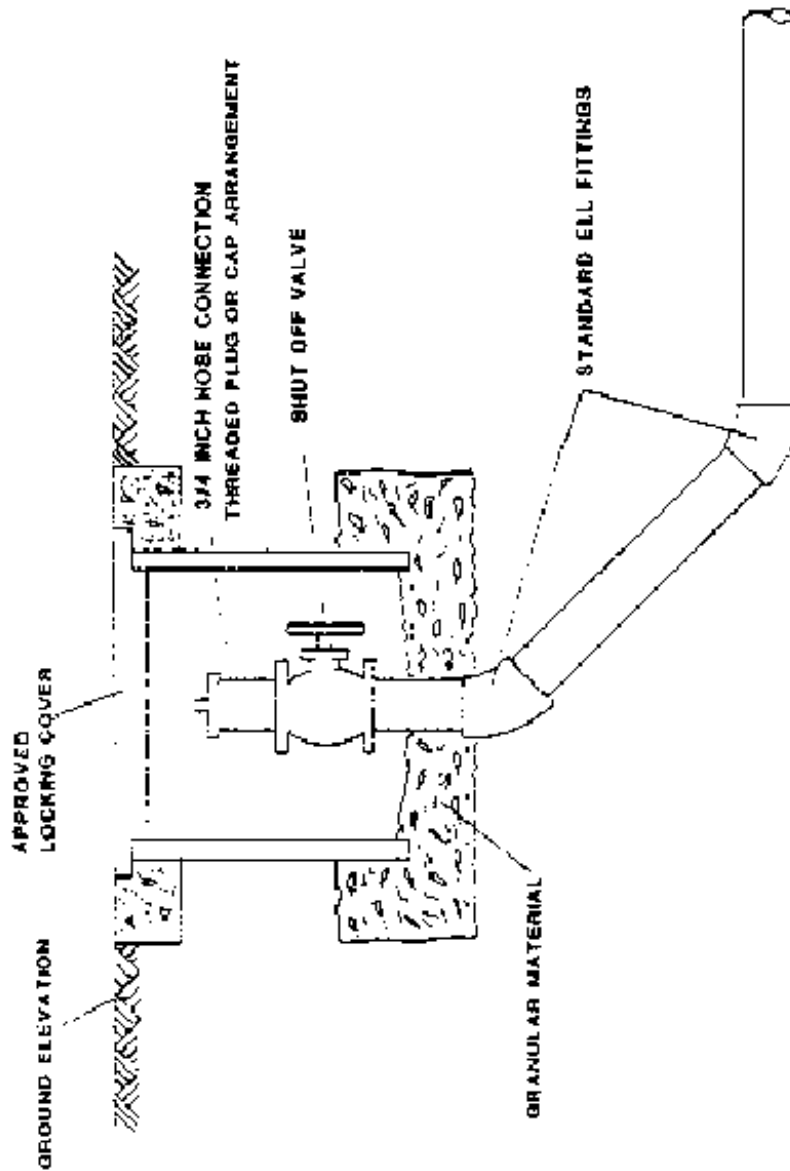
### Recommended Valve Box and Cleanout Arrangements Along Straight Runs and at Changes in Direction



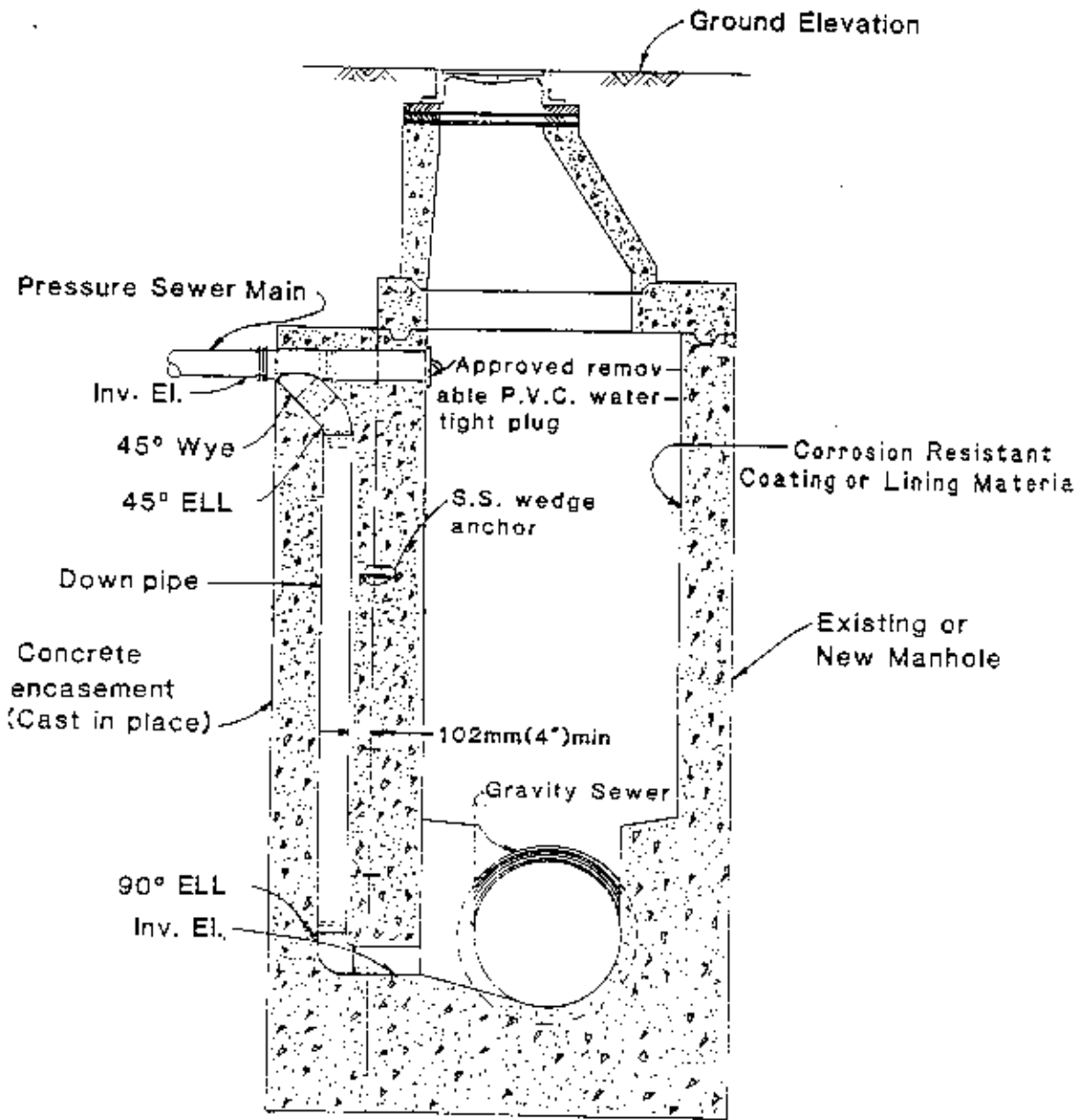
**FIGURE III-3**  
**Suggested Valve Box Cleanout Arrangements at Junction of Pressure Sewer Mains**



**FIGURE III-4**  
**Recommended Cleanout Arrangements**  
**at End of Pressure Sewer Main**

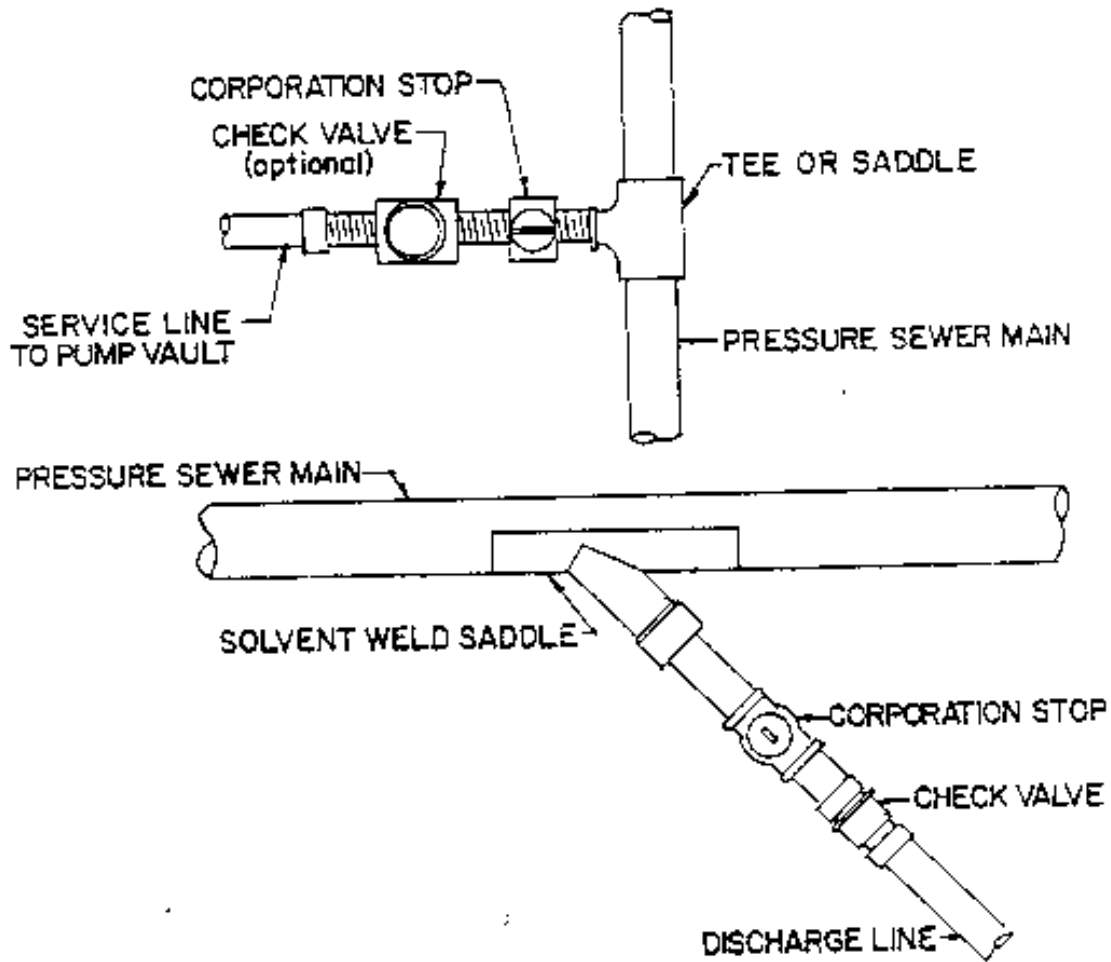






**Terminal Manhole Connection**  
**FIGURE III-5**

**FIGURE III-6**  
**Methods of Providing Service Connections**  
**to Pressure Sewer Mains**



- NOTES: (1) The use of a preplaced wye connection is also an acceptable practice.  
 (2) The use of the corporation stop is recommended and the use of the check valve is optional.

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## GLOSSARY OF TERMS

ANAEROBIC - Organic decomposition occurring in the absence of oxygen.

AS-BUILT PLANS (RECORD DRAWINGS) Plans of the pressure sewer corrected subsequent to construction to show actual installation conditions including final survey elevations of the pressure sewer pipelines.

BUILDING SEWER - The extension from the building drain to the septic tank or grinder pump facility or other place of disposal; also called house connection.

COLLECTION SYSTEM - That system of conveyance lines and discharge mechanisms which act together.

CONVENTIONAL SEWER - A sanitary sewer collection system consisting of a network of pipelines which receive and convey wastewaters from service connections to a point of treatment usually by means of gravity but which may employ occasional lift or pump stations and pressure mains.

DENDRIFORM - Tree-like or branched configuration.

DRAINFIELD - A subsurface irrigation system used -to transport and distribute effluent from septic tanks into the ground for absorption.

EFFLUENT - Material in the form of liquid, solid or gas which is discharged or flows out from a process.

EFFLUENT PUMP - A mechanical device used to force effluent, as from a septic tank, through a suitable conduit for conveyance to another location, also called an ejector.

FORCE MAIN - A pipe line used to convey liquid under pressure from one location to another.

GP - Grinder Pump

GRINDER PUMP (GP) - A pump capable of handling liquids containing certain solid matter because of its ability to reduce particle size of the solid matter by shearing and grinding action.

I/I - Inflow/Infiltration

INFLOW/INFILTRATION - Seepage of groundwater/stormwater into the sanitary sewer system through pipe joints, broken pipe, cracks or openings in manholes of a gravity sewer system.

INFLUENT - A liquid such as wastewater flowing into a particular location or area for the specific purpose of processing or treatment.

INSTITUTIONS - The public or private entity charged with the responsibility for operation and maintenance of the pressure sewer system.

INTERCEPTOR CHAMBER - The part of the septic tank which receives wastes from the building sewer and where partial treatment occurs.

LATERAL - The conveyance line to which service lines are connected.

LIFT STATION - A pumping installation designed to lift wastewater from a lower elevation collection system to a higher one usually within a relatively short distance.

MAINLINE - That primary conveyance line to which both service lines and laterals are connected.

O/M - Operation and Maintenance.

OPERATION AND MAINTENANCE (O/M) - Necessary activities and resources to keep the system in proper operation.

OPERATING POINT (OR DISCHARGE VALUE) - The intersection of the defining pump curve with the defining system head loss curve (or total head loss value).

PRESSURE SEWER SYSTEM - A sanitary sewer collection system consisting of a network of conduits which receive and convey wastewater from residences, businesses and industries to a point of treatment principally by means of pressure.

PRESSURIZATION UNIT (PU) - Any device used initially to impart pressure.

PRIMARY CURVE - Those system head loss and pump curves that are directly imputed and define the most basic components of the system.

PU - Pressurization Unit.

PUMP CURVE - The characteristic relationship between rate of discharge and total head produced by the pump.

SEPTIC TANK - As used throughout this document a holding tank in which the solid matter of sewage is decomposed or digested by bacteria under predominantly anaerobic conditions where no on-site disposal occurs and, therefore, is not under the jurisdiction of the local Health Department.

SERVICE LINE - The conveyance line - from each pressurization unit to its connection with the lateral or mainline.

SEWER - A hydraulically designed, usually subterranean, conduit used to transport wastewater.

STEP - Septic Tank Effluent Pump pressure sewer system combining the operations of a septic tank and an effluent pump.

SUMP PUMP - The submersible pumps in the interceptor chamber that discharge the septic tank effluent into the collection network.

SYSTEM HEAD LOSS CURVE - The relationship between total head loss and the rate of discharge for any conveyance channel.

TOTAL HEAD LOSS (HEAD) - The summation of the velocity and friction losses in the conveyance line plus the static (difference in elevation) losses, expressed in feet of water.

TREATMENT PLANT - Any facility by which the process of sewage treatment is accomplished. The treatment is usually classified as primary, secondary or tertiary, depending on the required degree of effluent purification.

UNIT INFLOW RATES - Average rate of discharge (gpm) from the septic tank to the pump chamber.

WASTEWATER - The liquid and water-carried wastes from residences, businesses, and industries together with any ground or surface water that may be present.

WETWELL - The chamber or tank which houses the pressurization unit, controls and ancillary equipment.