

# **PWC DESIGN MANUAL**

## **TABLE OF CONTENTS**

<b><u>Preface</u></b>	<b><u>Page</u></b>
Introduction	i-ii
Acknowledgment	iii
Copies of Manual	iv
Contact List	v
Disclaimer	vi
 <b><u>Chapter One - General Requirements for Water and Sewer Extensions</u></b>	
I      Standard Definitions	1.1-1.6
II     Standard Abbreviations	1.7-1.8
III    General Requirements	1.9-1.10
IV    Submittals and Guidelines	1.11-1.12
V     Conceptual Phase	1.13
VI    Safety	1.14
 <b><u>Chapter Two - Sanitary Sewer Design Guidelines</u></b>	
I      General Guidelines	2.1
II     Required Permits for Construction	2.2
III    Design Capacity and Design Flow	2.2-2.6
IV    Details of Design and Construction of Sanitary Sewer Collection Mains	2.6-2.8
V     Sanitary Sewer Locations	2.8-2.12
VI    Manholes	2.12-2.16

VII	Sewers in Relation to Streams and Other Water Bodies	2.16-2.19
VIII	Protection of Potable Water Supplies, Storm Sewers and Other Utilities	2.19-2.21
IX	Pump Stations and Force Mains	2.21-2.42

### **Chapter Three - Water Distribution Design Guidelines**

I	General	3.1
II	Hydraulic Design and Demand	3.1-3.2
III	Water Distribution System	3.2-3.15
IV	Cross Connection Prevention	3.15-3.21

### **Chapter Four - Survey Requirements**

I	General	4.1
II	Data for Design	4.1
III	Data for Construction	4.1

### **Chapter Five - Drawing Requirements**

I	General	5.1
II	Typical Drawing Set	5.1
III	Plan Sheet Requirements (All Drawings)	5.2-5.3
IV	Title Sheet	5.3
V	Utility Layout Sheet	5.3-5.4
VI	Plan/Profile Sheets	5.4-5.6
VII	Detail Sheets	5.6

VIII	Record Drawings Checklist	5.6-5.7
IX	Standard Checklist	5.7-5.9

### **Chapter Six - Drafting and CADD Standards**

I	General	6.1-6.2
II	Standard Layer List	6.3-6.7
III	Standard Abbreviations	6.8-6.11

### **Chapter Seven - Permits, Encroachments and Easements**

I	Required Permits for Construction	7.1-7.9
II	Water and Sewer System Approval Process	7.9-7.10
III	Required Sets of Plans and Specifications for Approvals	7.11
IV	Examples	7.12
	?? Final Plans and Permit Submittal Checklist	
	?? PWC Specification Checklist	
	?? PWC Property Questionnaire	
	?? PWC Economic Development Incentive Questionnaire	
	?? PWC Application for Approval of Engineering Plans and Specifications for Water Supply Systems	
	?? PWC Application for Gravity Sewers, Pump Stations, and Force Mains	
	?? PWC Water Permit Issuance Letter	
	?? PWC Sewer Permit Issuance Letter	
	?? Engineer's Certification – Water	
	?? Engineer's Certification – Sewer	
	?? Final Approval Letter from PWC	
	?? NCDOT Encroachment Drawing	
	?? Aberdeen and Rockfish Railroad Pipeline Crossing Application	
	?? Easement Submittal Checklist	
	?? Standard Easement Drawing	
	?? Blanket Easement Exhibit	

### **Chapter Eight - Standard Details**

Sewer Details  
 Water Details  
 Miscellaneous Details  
 Erosion Control/Wetland/Drainage Details  
 Miscellaneous Notes

## **Chapter Nine - Technical Specifications**

Definitions of Terms	1-3
General Conditions	1-11
02110 Site Clearing	02110 1-2
02111 Site Clearing (Utility)	02111 1-2
02211 Grading, Utilities	02211 1-4
02222 Excavation, Trenching and Backfilling for Utility Systems	02222 1-6
02272 Erosion Control - General Provisions	02272 1-3
02273 Temporary Silt Fence	02273 1-2
02274 Gravel Construction Entrance/Exit	02274 1-1
02301 Boring and Jacking (Roadways and Railroads)	02301 1-3
02350 Steel "H" Piles	02350 1-2
02505 Adjustment of Existing Structures	02505 1-2
02573 Remove and Replace Pavement (Permanent Patch)	02573 1-2
02660 Water Distribution	02660 1-15
02662 Fire Hydrant Painting	02662 1-2
02730 Sanitary Sewer Systems	02730 1-11
02732 Sewage Force Mains	02732 1-5
02733 Watertight Manhole Insert	02733 1-1
02753 Submersible Pump Lift Station	02753 1-4
02831 Chain Link Fencing	02831 1-3
02930 Lawns and Grasses (Utility)	02930 1-3
02931 Sod	02931 1-5
02933 Lawns and Grasses (Seeding)	02933 1-3
02934 Seeding Wetlands	02934 1-3
03301 Concrete Construction (Utility)	03301 1-4
09800 Special Coatings (Coal Tar Epoxy Lining Manholes)	09800 1-3
09802 Special Coatings - Ceramic Epoxy	09802 1-3
09803 Special Coatings - Cementitious Lining	09803 1-3
16000 Underground Electrical Crossing	16000 1-4
16768 Fiber Optic Conduit	16768 1-2

## LIST OF TABLES

<u>Chapter 1</u>	<u>Page</u>
Table 1 - Required Sets of Plans & Specs for PWC and State Agency Approval	1.12
<u>Chapter 2</u>	
Table 1 - Guidelines for Determining Domestic Waste Quantities	2.3
Table 2 - Minimum Slopes	2.4
Table 3 - Concrete Pipe & Depth of Cover	2.9
Table 4 - SDR26 PVC Pipe Minimum & Maximum Depth of Cover	2.9
Table 5 - Extra Strength Clay Pipe Minimum & Maximum Depth of Cover	2.10
Table 6 - Ductile Iron Pipe Maximum Depth of Cover	2.10
Table 7 - CCFRMP Maximum Depth of Cover	2.11
<u>Chapter 3</u>	
Table 1 - DI Mechanical Joint Allowable Deflection	3.6
Table 2 - DI Restrained Joint Allowable Deflection	3.6
Table 3 - DI Push on Joint Allowable Deflection	3.7
Table 4 - C900 PVC Allowable Deflection	3.7
Table 5 - Min. Length DI Pipe Restraint 16" Diameter and Greater	3.13
Exhibit 1 – Meter Sizing Form	3.22
<u>Chapter 4</u>	
Exhibit 1 – Water Cut Sheet (Sample)	4.4
Exhibit 2 – Sewer Cut Sheet (Sample)	4.5

## Chapter 6

Table 1 – Standard Sheet Sizes	6.2
--------------------------------	-----

## Chapter 7

Table 1 – Minimum Easement Widths	7.7
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## INTRODUCTION

The Public Works Commission (PWC) was created by an act of the North Carolina Legislature to provide utility services to the citizens and industry within the City of Fayetteville, Town of Hope Mills, and surrounding unincorporated areas. The Public Works Commission is owned by the City of Fayetteville and its citizens. The PWC is operated by a four (4) member Board of Commissioners appointed by the Fayetteville City Council. The day-to-day management of the PWC is by a General Manager with a Chief Operating Officer for each Department (Finance, Administration, Electric, and Water Resources).

The PWC Water Resources Engineering Office is located at the following address:

Water Resources Engineering  
PWC Operations and Maintenance Complex  
955 Old Wilmington Road  
Fayetteville, NC 28301

The City of Fayetteville Public Works Commission provides electric, water and sewer service to a major portion of the City of Fayetteville and the surrounding area. The PWC service area is not limited and is considered to be all of Cumberland County excepting Ft. Bragg. Currently PWC serves approximately 58% of the population of Cumberland County and intends to serve 90% of the population by the year 2030.

PWC currently provides 26.6 mgd of water to 184,136 people through 56,000 meters on 1,200 miles of distribution system. PWC has two water treatment plants, the P.O. Hoffer Treatment Plant and the Glenville Lake Treatment Plant. The Hoffer Plant has a treatment capacity of 32 mgd expandable to 96 mgd; the Glenville Lake Plant has a treatment capacity of 18 mgd.

The PWC wastewater collection system is composed of two water reclamation facilities (WRF), the Rockfish Creek WRF and the Cross Creek WRF. The Rockfish Creek WRF is permitted for 21 mgd of wastewater; the Cross Creek WRF is permitted for 25 mgd of wastewater. The collection system contains approximately 1,200 miles of sewer mains conveying wastewater from approximately 55,000 customers.

The purpose of this Manual is to serve as a guide in determining the planning, design standards and methodology, construction materials, details, technical specifications and regulatory requirements for the preparation and submittal of water and wastewater extensions for the Public Works Commission of the City of Fayetteville, NC.

This document and contents are intended to establish the minimum PWC requirements and is not intended to provide an explanation for every design problem nor as a substitute for experience, sound judgment, and engineering knowledge. Likewise, this publication is not intended to replace or supercede adopted codes, ordinances, or statutes. Engineers are encouraged to use this Manual on PWC related projects to facilitate the review process of detailed engineering drawings. These guidelines and requirements shall apply to all utility extensions to be owned and/or operated by PWC.

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Water Resources Engineering Manager



## ACKNOWLEDGMENT

This Manual for the Design and Construction of Water and Wastewater System Extensions for Public Works Commission of the City of Fayetteville, NC was created and assembled by the following:

### P.W.C. Commissioners:

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VANCE NEAL, VICE CHAIRMAN

MILTON R. WOFFORD, TREASURER  
WILSON A. LACY, SECRETARY

STEVEN K. BLANCHARD, PE, GENERAL MANAGER  
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Public Works Commission  
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Billy Bill Grading Company  
Autry Grading Company  
The Rose Group  
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Public Works Commission  
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Public Works Commission  
Broadwell Land Company  
Riddle Properties  
Autry Grading Company  
Billy Bill Grading Company  
The Rose Group  
Moorman, Kizer & Reitzel, Inc.

## COPIES OF MANUAL

This Manual is available on the Public Works Commission website (<http://www.faypwc.com>) for downloading and easy reference. Periodically, updates to this Manual will be posted to the website. The Public Works Commission will send an email notification to those that have previously purchased a manual. It is the individual's responsibility to verify that they are using the most up to date information, requirements, and technical standards, as posted to the website.

If you would like to purchase a hard copy of this manual, please contact the Water Resources Engineering Department at:

Public Works Commission  
955 Old Wilmington Road  
Fayetteville, NC 28301  
(910) 223-4730  
(910) 829-0203 (fax)

Hard copies of the manual are available for a fee of \$100. This fee includes a CD of the standard details, a CD of the technical specifications, covers production costs, and the costs of future revisions. Please note that revisions will not be mailed – they will only be available via the internet.

## **Contact List**

### **PUBLIC WORKS COMMISSION**

#### PWC Water Resources

M.J. Noland, PE, COO  
W - 910-223-4733

Joe Glass, P.E.  
Engineering Manager  
W - 910-223-4740

#### PWC Water/Sewer Construction

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#### PWC Cross Connection Control

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#### PWC Dispatch

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#### PWC Special Projects

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#### PWC Environmental

Chad Ham  
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#### PWC Risk Manager

Ike Copeland  
W - 910-223-4116

#### Glenville Water Treatment Facility

Chris Smith, Chief Operator  
W - 910-223-4708

### **CITY OF FAYETTEVILLE**

Mayor  
Marshal Pitts  
W - 910-433-1992

City Manager  
Roger Stancil  
W - 910-433-1990

Planning Division  
Jimmy Teal  
W - 910-433-1996

Police Department  
Dial 911

Fire Department  
Dial 911

### **COUNTY OF CUMBERLAND**

Emergency Management  
Department  
William Elmore  
W - 910-321-6736

Sheriff's Department  
Earl Butler, Sheriff  
W - 910-323-1500

Joint Planning Board  
Barry Warren  
W - 910-678-7600

### **STATE OF NORTH**

### **CAROLINA**

State Emergency Operations  
Center  
1-800-858-0368

NCDENR - Dam Safety -  
State Dam Safety Engineer  
919-733-4574

NCDENR - Fayetteville  
Regional Office - Regional  
Engineer  
910-486-1541

National Weather Service  
919-515-8209

American Red Cross  
910-867-8151

## **DISCLAIMER**

### **OWNERSHIP OF DOCUMENTS**

This document including design standards, design methodology, construction details, technical specifications, and drafting standards have been compiled based on PWC standards and practices, from various Governmental Agencies Guidelines, North Carolina General Statutes and enabling legislation. This document is intended to be used in the planning, designing and constructing water and sewer utilities to be owned and maintained by PWC. The document or the contents are not intended or represented to be suitable for use on projects that will not be owned and/or operated by PWC. Any reuse without written verification or adaptation by PWC will be at the Engineer's sole risk and without liability to PWC.

### **NONDISCLOSURE OF PROPRIETARY INFORMATION**

Engineers providing services for PWC utility extensions shall consider all information provided herein by PWC and this document to be proprietary, unless such information is available from public sources. Consulting Engineers shall not publish or disclose proprietary information for any purpose without PWC's prior written authorization.

### **COMMENTS**

Any and all comments will be greatly appreciated. Please direct comments to:

Water Resources Engineering  
Public Works Commission  
955 Old Wilmington Road  
Fayetteville, NC 28301  
910-223-4730  
910-829-0203 (fax)  
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# CHAPTER ONE

## GENERAL REQUIREMENTS FOR WATER AND SEWER EXTENSIONS

### I. STANDARD DEFINITIONS

#### A. Definitions

Wherever used in this Manual, the following terms shall have the meanings indicated which shall be applicable to both the singular and plural thereof. There are other terms used in this document, which are defined in the sections to which they apply.

**Applicant** - Person who is financially responsible for the proposed water distribution or sewer collection system construction or modification, and who shall maintain operational responsibility of said system unless fee simple title is granted to PWC. The Applicant becomes the "Permittee" under PWC's Local Permitting Authority when a Permit is issued, gaining new responsibilities and retaining all the same responsibilities as the Applicant has under Article VI, Chapter 31 of the Fayetteville City Code of Ordinances (hereinafter referred to as "Ordinance").

**Application** - Form or forms provided by PWC and completed by the Design Engineer and Applicant providing pertinent information regarding the proposed construction or modification of water distribution or sewer collection facilities. It includes all required associated documents.

**Approving Authority** - General Manager of the Public Works Commission of the City of Fayetteville, or his duly authorized deputy, agent or representative, who shall be responsible for the administration of the delegated local permitting authority as outlined in the Ordinance, and shall be the designated party to receive service of documents pertaining to such programs.

**Approved Plans** - Water and/or sewer system extension plans, which have been reviewed by and received the approval of the Water Resources Department of the Public Works Commission and/or the appropriate state and local agencies.

**Capacity Factor** - The mathematical value, varying inversely with the magnitude of the population, which is applied to the effective-population figure to provide for reasonable increases in population, variations in water demands and uncertainties as to actual water-supply requirements, and for unusual peak demands, the magnitude of which cannot be accurately estimated in advance.

**Chief Financial Officer** - The Chief Financial Officer of the Public Works Commission.

**City** – City of Fayetteville, North Carolina.

**Commission** - The term "Commission" refers to the Water Resources Engineering Department of the Public Works Commission and those persons employed by and authorized by the Public Works

Commission to act on the behalf of the Water Resources Engineering Department in the particular instance cited. Words such as "as required by the Commission" shall also refer to this Manual and the Public Works Commission Utility Regulations.

**Commission's Representative** - An authorized employee or representative of the Public Works Commission.

**Contract Documents** - The term "Contract Documents" shall refer to the project plans and specifications for water and/or sewer system extensions.

**Contract for Service** - Written agreement by and between the PWC and the Applicant stipulating the terms of extending utility service and the value of the improvements. By attachment the Contract shall also stipulate the project duration and the associated costs for PWC construction observation, basic and excess.

**Contractor** - The person, business, or corporation responsible for the performance of water or sewer system construction work.

**Construction/Warranty Bond** - Financial instrument provided by the applicant to PWC at execution of Contract for Services with PWC, with such bond being held to protect PWC during the construction and post acceptance warranty period. Such bond shall carry language satisfactory to PWC relative to Civil Penalties under the Local Permitting Authority Ordinance.

**Department Engineer** - The term "Department Engineer" refers to a Professional Engineer on the staff of the Water Resources Engineering Department of the Public Works Commission.

**Design Engineer** - Professional Engineer, licensed to practice in the state of North Carolina, responsible for performing the design and preparing the drawings and specifications for the proposed water distribution system and/or sewer collection system construction or modification(s), construction administration and certifying the completion of such construction or modification(s) in accordance with the approved plans and permit.

**Design Population** - The population figure obtained by multiplying the effective population figure by the proper capacity factor.

**Developer** - The person(s) or corporations financially responsible for the design and construction of a development for which water or wastewater service by the Public Works Commission will be requested.

**Distribution Mains** - The pipelines that comprise the water distribution system.

**Documents** - Any and all drawings, graphs, charts, calculations, compilations of data, writings, photographs, audio or video tape recordings or other such records from which project pertinent information can be obtained, extracted or translated in a usable form.

**Engineering Manager** - The Engineer Manager of the Water Resources Engineering Department of the Public Works Commission.

**Feeder Mains** - The principal pipelines of the distribution system.

**Fire Demand** - The amount of water in gallons per minute required during specified fire period. The fire demand is determined by the sum of the fire flow, fifty percent (50%) of the average domestic demand rate, and any industrial or other demand that cannot be reduced during a fire period. The residual pressure is specified for either the fire flow, or essential industrial demand, whichever is the higher. Fire demand will include quantities required for automatic sprinkler operation, in addition to direct hydrant fire-flow demand as appropriate, when sprinklers are served directly by the water-supply system.

**Fire Flow** - The amount of water in gallons per minute required at a specific residual pressure at the site of the fire for a specific period of time.

**Fixture Value** - A quantity in terms of which the demand producing effects on the plumbing system of different kinds of plumbing fixtures are expressed in accordance with a table of values representing the flow demand of each fixture when operating without the interference of other units.

**Manual** - The term "Manual" shall refer to all applicable standards, specifications, standard details and policies contained in or referenced by this document.

**NCDENR** - North Carolina Department of Environment and Natural Resources.

**Non-Conformance Notice** - Written notice to the Design Engineer and/or Applicant when construction performed under PWC's Local Permit Authority is found to not substantially conform with either the approved permit design, or the requirements of PWC or NCDENR, whichever is more restrictive.

**Operating Agreement** - Document prepared by the Applicant in accordance with NCDENR requirements to specifically retain operational responsibility for water distribution or sewer collection system features connected to PWC owned facilities, but for which fee simple title ownership has not been granted to PWC. Said agreement shall include language satisfactory to PWC, and a draft thereof shall be filed with the Application when an Application is filed.

**Peak Domestic Demand** - The peak domestic demand is assumed to be 2.5 times the daily average domestic requirements.

**Permit** - Written document which is issued by the City, through PWC and its Approving Authority, in accordance with the Ordinance, describing the specific construction and/or modification activity allowed, and including any and all general, supplemental and special conditions to the Permit, assigning construction responsibility under the Permit and providing operation responsibility (PWC or Private), for the facilities upon completion of the permitted work.

**Permit Period** - Duration during which a Permit is valid, commencing on the date of permit issuance by the Approving Authority, and unless suspended, modified or revoked for cause, shall be valid for the succeeding 24 months, or until work is complete, accepted and certified by the Design Engineer, whichever occurs first.

**Person** - Individuals, sole proprietorships, partnerships, limited liability corporations, corporations, professional associations, firms, joint ventures, businesses, institutions, municipal or other local government subdivisions, governmental agencies or any other body corporate or political, for profit or non-profit.

**Pipe Backfill Zones** - The following terms are used in reference to excavation and backfill for pipe. Refer to the standard detail entitled, "Sewer Bedding" for the Installation of Sanitary Sewer Pipe.

**Bedding** - That portion of the pipe support structure bounded by the Foundation or undisturbed trench bottom, the trench walls and the bottom of the pipe.

**Final Backfill** - That portion of the backfill lying above the Initial Backfill.

**Foundation** - That portion of the pipe support structure bounded by the undisturbed trench bottom, the trench walls, and the pipe Bedding. The construction of a pipe foundation is generally not required unless unstable materials are encountered in the trench bottom.

**Haunching** - That portion of the pipe support structure bounded by the Bedding, the trench walls, the outside of the pipe and a horizontal plane having an elevation equal to that of the spring line or the pipe.

**Initial Backfill** - That portion of the back fill lying above the spring line of the pipe and below a horizontal plane having an elevation which is one (1) foot above the top of the pipe.

**Professional Engineer** - A person who has been duly registered and licensed as a professional engineer by the North Carolina State Board of Examiners for Professional Engineers and Land Surveyors.

**PWC** - The Public Works Commission, of the City of Fayetteville.

**PWC Certificate of Operation** - Document issued by PWC documenting final acceptance of a permitted improvement for projects donated to PWC. Issuance of such is contingent upon specific actions by the Permittee and his Design Engineer.

**PWC sewer collection system** - Part or portion of the facilities owned by the City, through the PWC, which are used to collect and carry wastewater to the treatment works and ending at the sewer service lateral cleanout or other Contract for Service designated connection.

**PWC water distribution system** - Part or portion of the facilities owned by the City, through PWC, which are used to distribute potable water to its customers, excluding any supply, pumping, storage or treatment works, and ending at the water service metering point or other Contract for Service designated connection.

**Rated Capacity** - The rated capacity of a filter or pumping unit is the amount of water, which can be passed through the unit when operating under design conditions.

**Record Drawing** - Complete set of drawings composed of one (1) reproducible, one (1) bond



copy, and one (1) electronic copy of the original approved plans showing actual installed conditions tied to NAD 83 in accordance with PWC standard methods and reflecting finished locations sufficiently dimensioned to fixed objects and elevations tied to NGVD 29 vertical datum. Record Drawings shall be delivered to PWC concurrent with request for final inspection of permitted work, and prior to acceptance of the work by PWC.

**"Red Line" Review** - Plans and specifications reviewed by PWC staff indicating desired comments and changes. The Design Engineer must address the "red line" comments, to the satisfaction of PWC staff in order to receive approval to construct. PWC's original "red line" review plans and specifications must be furnished to PWC with the corrected resubmission.

**Required Daily Demand** - The total daily water-supply requirement is obtained by multiplying the design population by the per capita domestic water allowances, and adding to this quantity any special industrial, aircraft-wash, irrigation, air-conditioning, or other demands. Other demands include the amount necessary to replenish, in 48 hours, the storage required for fire protection and normal operation. Where the supply is from wells, the quantity available in 48 hours of continuous operation of the wells will be used in calculating the total supply available for replenishing storage and maintaining fire and domestic demands and industrial requirements that cannot be curtailed.

**Required Fee** - Fees levied by the City through the PWC, as established in adoption of the PWC User Charge System for construction observation, permit application, modification or renewal, as well as administrative review.

**Service Lines** - Small pipelines connecting buildings to distribution mains.

**Sewer Collection System** - The meaning as stated in North Carolina General Statute 143-213 (15) in its most current amended form.

**Standards** - Where this Manual makes a reference to published standards such as ASTM, ANSI, AWWA, etc., the latest revisions of such standard shall apply.

**Stop Work Order** - Order issued by the Approving Authority to the Permittee to cease and desist any further construction and/or modification of the work being performed under a Permit issued pursuant to the Ordinance, because of failure to correct construction deficiencies identified in a Non-Conformance Notice. In the case of imminent danger to persons, property and/or the environment, a Stop Work Order may be issued without being preceded by a Non-Conformance Notice. Ability to issue and/or actual issuance of a Stop Work Order shall in no way transfer any responsibility from the Permittee, his representatives, agents or assignees to PWC or the City of Fayetteville.

**Supply Line** - The pipeline from the source of supply to the treatment works or to the distribution system.

**Supply Works** - Dams, impounding reservoirs, intake structures, pumping stations, wells, and all other construction for the development of a source of water supply.

**Terms and Conditions** - The latest revision of the Terms and Conditions of Water and/or Sewer Service of the Public Works Commission's Utility Regulations, a copy of which is available upon request.

**Treatment Works** - Filtration plant, reservoirs, and all other construction required for the treatment of a water supply.

**Utility Service Area** - Area described in North Carolina General Statute 143.215.1(f) and North Carolina General Statute 130A-317(d) as the "service area" for a commission.

**Utility Transfer Unit Value** - Basis for establishing the Warranty Bond to be issued prior to acceptance of any utility improvement by PWC. Such bond is intended to be approximately one half (1/2) the installed value of the improvements, with such values established by PWC during the preparation of the Contract for Service.

**Water Distribution System** - The meaning stated in North Carolina Administrative Code Title 15A Subchapter 18C Rule .1801, "the network of pipes valves, hydrants and related appurtenances but does not include pumps, storage tanks, treatment devices, wells or other facilities."

**Water Works** - All construction for the collection, transportation, pumping treatment, storage, and distribution of water.

## II. STANDARD ABBREVIATIONS

### A

A&R R/R -	Aberdeen and Rockfish Railroad
AASHTO -	American Association of State Highway Transportation Officials
ABC -	Aggregate Base Course
ACI -	American Concrete Institute
ANSI -	American National Standards Institute
API-	American Petroleum Institute
ASTM -	American Society for Testing and Materials
AWWA -	American Water Works Association

### C

CSX -	CSX Transportation (Railroad)
-------	-------------------------------

### D

DI -	Ductile Iron
------	--------------

### E

EA -	Environmental Assessment
EEP -	Environment Enhancement Program
EIS -	Environmental Impact Statement

### F

FEMA -	Federal Emergency Management Agency
FIRM -	Flood Insurance Rate Map
FONSI -	Finding of No Significant Impact

### G

gal/person -	gallons per person
gal/unit -	gallons per unit
gal/acre -	gallons per acre
GPD -	Gallons per Day
GPM -	Gallons per Minute

### H

HDPE -	High Density Polyethylene
--------	---------------------------

### I

I/I -	Inflow and Infiltration
-------	-------------------------

### M

MGD -	Million Gallons per Day
-------	-------------------------

### N

NC -	North Carolina
NCAC -	North Carolina Administrative Code
NCDA -	North Carolina Department of Administration
NCDEH -	North Carolina Division of Environmental Health
NCDENR -	North Carolina Department of Environment and Natural Resources
NCDOT -	North Carolina Department of Transportation
NCDWQ -	North Carolina Division of Water Quality
NEC -	National Electric Code

## **N (cont'd)**

NEMA - National Electric  
Manufacturer's Association

NFPA - National Fire Protection  
Association

NPDES - Non Point Discharge  
Elimination System

NPSH<sub>A</sub> - Net Positive Suction Head  
Available

NPSH<sub>R</sub> - Net Positive Suction Head  
Required

## **O**

OSHA - Occupational Safety and Health  
Administration

## **P**

PPI - Plastic Pipe Institute

psi - pounds per square inch

psig - pounds per square inch guage

PVC - Polyvinylchloride

PWC - City of Fayetteville Public Works Commission

## **S**

SF - Safety Factor

## **T**

TDH - Total Dynamic Head

## **U**

UL - Underwriters Laboratories

USCE - United States Corps of Engineers

### III. GENERAL REQUIREMENTS

- A. Water Permits – For those water systems that have a master meter with PWC, and that system is owned, operated, and maintained by another entity, and that entity does not have its own Public Water Supply Identification number (PWS ID), PWC has the authority to permit any water extensions/expansions for that system. For example, under this scenario, PWC would be the permitting authority for Fayetteville State University, Methodist College, Kelly Springfield, Eastover, etc.

However, if the entity has a PWS ID number, owns, operates, and maintains its system, the water permit is reviewed and issued by the State. Therefore, PWC would not permit any water extensions/expansions by Brookwood-Lagrange, Spring Lake, Fort Bragg, or within the Town of Stedman. However, since PWC has an operation and maintenance agreement with the Town of Stedman, PWC will review all plans for water extensions, prior to being sent to the State for permitting.

For those systems owned, operated, and maintained by PWC, PWC will be the permitting authority.

- B. Sewer Permits – For those areas or intergovernmental agencies that have wastewater collection systems that are tied to the PWC system and have a flow meter to measure the amount of waste being delivered to the PWC system, any extensions within those areas are to be permitted by the State. However, prior to submitting the application to the State, PWC will need to issue a flow acceptance letter for the additional flow. This situation applies to Hoke County, the Town of Stedman, NORCRESS, Eastover, etc. For those systems that PWC has operation and maintenance agreements with, PWC will review all plans for the proposed sewer extensions, prior to being sent to the State for permitting.

For those areas that are within PWC's service area that own, operate, and maintain their sewer system, discharge to the PWC system, and do not have a flow meter, PWC will be the permitting authority. These will be the "private" systems, such as Methodist College, Fayetteville State University, mobile home parks, etc.

For those systems owned, operated, and maintained by PWC, PWC will be the permitting authority.

The following situations must be permitted by the State, regardless of ownership:

- a. Outfalls into a basin where sewer service has not yet been provided;
  - b. Low pressure sewer systems or STEP systems;
  - c. Projects involving Environmental Assessments; and
  - d. Any collection system where a variance from State regulations is required.
- C. All PWC Standard Specifications and Standard Details shall be incorporated and become an integral part of the Plans, Specifications and Contract Documents submitted for review and approval. Deviations must be noted in writing and receive written approval from PWC prior to final Contract Document approval.

- D. The Contract Documents shall insure that all structures, pavements, utilities, and other facilities, which may possibly be damaged as a result of project work, are replaced or repaired in a manner, which meets the approval of PWC or any governing bodies having jurisdiction.
- E. No connection to, or alteration of any existing facilities owned or maintained by the PWC shall be permitted without the express permission of the PWC and, where required, the presence of the PWC's Representative except as directed by the PWC. Where a connection or alteration of any existing facilities is approved, the connection or alteration shall conform to the standards of the Manual for new installations.
- F. All water and sewer extensions to be operated and maintained by PWC shall be designed and built in accordance with this Design Manual, and all applicable State and local regulations.

## **IV. SUBMITTALS AND GUIDELINES**

### **A. REQUIRED COPIES OF CONTRACT DOCUMENTS FOR PWC APPROVAL**

The Engineer should submit to PWC one (1) set of Contract Documents, including pertinent calculations, and shall have made application for applicable permits (see the following table) to PWC, for a preliminary review prior to submission of all Contract Documents necessary. The Department Engineer and his staff shall review such plans and make the appropriate notes and return the redlined drawings to the Engineer marked so that the necessary corrections can be made and the Contract Documents revised. Upon review by the Engineer of the "red lines", the Engineer may request to meet to discuss comments. All comments shall be addressed so as to comply or an explanation of reasons for not complying must be provided and approved by PWC. The corrected plans, applicable permit applications, and other supporting documentation shall be submitted for the approval by PWC and the appropriate state agencies, as appropriate.

### **B. ENGINEERING DESIGN CALCULATIONS & REPORTS**

All Contract Documents submitted to PWC for approval shall be accompanied with the necessary design calculations as specified herein or requested by PWC. The calculations and any reports must be signed and sealed by a Professional Engineer. All design calculations based on data not contained herein shall be referenced to the origin. The calculations shall be submitted in duplicate, clearly referencing the project and presented in a neat, orderly, and logical procedure. All reports shall list the assumptions made in the report preparation.

### **C. WATER DESIGN CALCULATIONS**

PWC will furnish the Design Engineer with information regarding the available flow and pressures near the proposed extension when PWC requires a hydraulic analysis. If requested by PWC, the Engineer shall provide calculations demonstrating that the new extension, to include each future phase of a project, will provide a minimum residual pressure of 20 psi at the minimum required fire flow plus and/or peak, whichever is greater demand (Note: Fire flow = hose stream requirement + sprinkler demand +  $\frac{1}{2}$  domestic demand). The calculations shall be based upon an energy balance accounting for friction and minor losses utilizing software such as Haestad Methods WaterCADD (Cybernet) or other PWC approved modeling software. The "C" factor shall be 120 for new systems and shall be chosen by the Design Engineer and approved by PWC for older system piping.

### **D. SEWER DESIGN CALCULATIONS**

Sanitary sewer, force main and pump station extension calculations shall demonstrate adequate capacity to serve the entire contributing area. The calculations for the gravity mains shall be based on Mannings Formula, using a roughness ("n" factor) of 0.013. (See Chapter 2 for more information)

## E. SUBMITTALS FOR APPROVAL

PWC shall require submission of the following number of sets of Contract Documents for the approval by PWC and/or the appropriate state agencies.

Table 1. REQUIRED SETS OF PLANS AND SPECIFICATIONS FOR PWC AND/OR STATE AGENCY APPROVALS

Type of Project	No. of Copies of Drawings	No. of Copies of Specifications	Permit Originals	Permit Copies	Application Fee	Submit Appl. to	Approving Authority
PWC Sewer Ext. Fast Track Form	1- Original 3 - Bond	1	1	0	\$500	PWC	PWC
PWC Water Ext. FTA 09/03	1 - Original 3 - Bond	1	1	0	\$500	PWC	PWC
NCDOT* Encroachment	1	0	0	0	N/A	PWC	DOT
Erosion Control	1 - Bond/ Blueprint	1	1 Financial Responsibility	1	\$50 per acre or partial disturbed acre	NCDENR	NCDENR
Wetlands 404 Wilmington District	1 - Bond/ Blueprint	1	1	1	1	USCE Wilmington	USCE
Wetlands 401	7 - Bond/ Blueprint 11" x 17" Max	1	0	1	\$0 for non- written confirmation \$200 under 5 acres \$400 over 5 acres	NCDWQ	NCDWQ
Easement Maps	1 - Vellum 8½" x 14" Only	1 Disk Legal Description in WORD format	0	0	0	PWC	PWC
R/R Encroachments	1 - Vellum 8½" x 14" Only	N/A	1	0	Varies by Railroad	PWC	Railroad

***\*NOTE: NCDOT requires approved Erosion Control Certification prior to submittal of encroachment when applicable.***



## **V. CONCEPTUAL PHASE**

### **A. GENERAL**

The Engineer and Developer shall become familiar with the water and sewer extension policies of the PWC prior to making conceptual plans for developments, which will require water and/or sewer service.

The Engineer or Developer should obtain the approval of the appropriate Planning and Zoning Commission or Board for any proposed projects under their respective jurisdiction prior to submission for water and sewer permits.

### **B. INITIAL CONFERENCE**

Prior to finalizing any plans for water or sewer collection system extensions, the Developer or his Engineer shall consult PWC to determine if an initial conference will be necessary prior to the submission of plans for approval. If the scope of the proposed development is such that an initial conference will be beneficial prior to the development of final plans and specifications ("final - not released for construction"), the Developer or his Engineer will request scheduling of an initial conference. The Developer or his Engineer shall present the following:

- a. **Conceptual Plans:** Submit two (2) copies of conceptual subdivision plans or site plans at a scale of 1 inch equals 200 feet (or larger scale) showing the proposed layout of the water, and sewer extensions. The conceptual plans should show all proposed pipelines and sizes, manholes, valves, fire hydrants and pump stations and the nearest existing water and sewer facilities to which the proposed new extensions will connect. All proposed easements shall be shown. Where extension of utility is anticipated, provide sketch of extension and projected inverts with service area for sanitary sewer.
- b. **Design:** Preliminary engineering design calculations used to determine estimated water and wastewater demands use to size line and pump station and fire protection requirements including expected initial and future populations to be served. The nature of the water usage (domestic, commercial, etc.), and the probable character of the wastewater generated should be provided.
- c. **Estimated Time Schedules:** Submit an estimated time schedule identifying the expected dates of completion of the final plans and specifications and expected beginning and completion dates of construction.
- d. **Projected Cost Estimate (PWC Projects):** Submit a cost estimate prepared by an engineer for the proposed water and sewer extensions. The cost estimate shall be as detailed as possible with estimated quantities of specific items work and their projected unit costs.

## **VI. SAFETY**

It is expected that Contractors will comply at all times with all OSHA Regulations. In addition, PWC has developed a Safety Manual that is available to all interested contractors and engineers. Please contact the PWC Safety Office at (910) 223-4117 to request a Safety Manual and for other information regarding safety regulations.

PWC assumes absolutely no responsibility for the safety of the construction personnel or any other persons at the jobsite other than PWC employees. Safety is the sole responsibility of the site employers and their workers.

# CHAPTER TWO

## SEWER DESIGN GUIDELINES

### I. GENERAL GUIDELINES

- A. Public sewer collection system design and construction shall be in accordance with the requirements of Title 15A of the North Carolina Administrative Code, Department of Environment and Natural Resources, Subchapter 2T .0200 “Waste Not Discharged to Surface Waters” (latest revision), and this Manual, including the Master Specifications. Where conflicts occur in the PWC and State design requirements, the more stringent requirement shall apply. The City of Fayetteville Public Works Commission shall review and issue permits for all new construction, extensions into new areas, and replacement sewers. Design submittals shall not include flow from rainwater, storm sewers, streets or groundwater.
- B. Private sewer collection system design and construction shall be in accordance with the standards and requirements of Title 15A of the North Carolina Administrative Code, Department of Environment and Natural Resources, Subchapter 2T .0200 “Waste Not Discharged to Surface Waters” (latest revision) and this Manual. All private sewer mains that connect to the PWC system, for which PWC will **NOT** own, operate or maintain, shall be tested in accordance with PWC requirements. Where conflicts occur in the PWC and State design requirements, the more stringent requirement shall apply. PWC shall review and issue permits for all new sewer construction, sewer extensions into new areas within the service area, and replacement sewers. Design submittals shall not include flow from rainwater, storm sewers, streets or groundwater.
- C. Private collection systems that connect to a subsurface treatment and disposal facility shall be permitted through the County Health Department or NCDEH. Low-pressure sewer systems and projects involving an Environmental Assessment shall be permitted through NCDWR with prior approval from PWC.
- D. Operations that involve routine maintenance or the rehabilitation of existing sewer lines may not require a permit. In situations where existing sewer lines are undergoing routine maintenance, the existing sewer lines are being rehabilitated by constructing or installing replacement sewers, or the existing sewer lines are being refurbished by the installation of some type of sealant or sleeve inside the existing sewer line, a specific non-discharge permit may not be required. These operations will be deemed permitted as long as: 1) all construction and installation conforms to the design criteria in 15A NCAC 2T .0200 and this Manual; 2) new sources of wastewater flow are not being connected to the rehabilitated sewers; 3) all replacements or newly constructed sewers are located in the same proximity (same general horizontal and vertical alignment) and are the same diameter as the existing sewers, and 4) rehabilitation or replacement of public six (6) inch sewers with eight (8) inch sewers provided that the rehabilitation or replacement is to correct deficiencies and bring the sewer up to current minimum standards . If any of the criteria in this paragraph are not being adhered to, the applicant must apply for a permit. If the project is permitted, once the maintenance or rehabilitation activities are completed, a North Carolina Professional Engineer’s certification (form provided by PWC) must be submitted to PWC for the completed work.

## **II. REQUIRED PERMITS FOR CONSTRUCTION**

PWC is delegated by the North Carolina Environmental Management Commission to issue permits for the construction of all public and private sewer extensions involving pump stations, force mains and gravity sewers. Refer to Chapter 1, Section III “General Requirements” for specific information on when permits are required. The appropriate forms to be completed can be found on the PWC website ([www.faypwc.com](http://www.faypwc.com)).

## **III. DESIGN CAPACITY AND DESIGN FLOW**

### **A. GENERAL**

1. Sewer capacities and main sizes shall be designed for the estimated ultimate tributary population in the drainage basin. Consideration shall be given to the maximum anticipated capacity of commercial areas, of institutions, industrial parks, inflow/infiltration, etc. in calculating the service requirements within the area of the natural drainage basin. The capability of downstream sewers to accept future flow, made tributary to the collection system, shall be evaluated by the engineer. Where future relief sewers are planned, analysis of alternatives should accompany initial permit applications. Wastewater flow rates shall be determined in accordance with 15A NCAC 2T .0114, or as indicated in Table 1.
2. Unless otherwise permitted by PWC, all gravity trunk mains and outfall sewers shall be designed to serve the entire natural drainage basin and shall be placed on an adequate grade to allow extension to the natural basin ridgeline to collect all tributary flow.

### **B. HYDRAULIC DESIGN AND ROUTE SELECTION**

The following procedures and criteria are to be used for sizing and hydraulic design of gravity sanitary sewers. Generally, sewer outfalls and trunk mains shall be sized for the future full development of the basin using the following criteria unless more specific data is available. These design and peak flow calculations are not to be used to calculate flows for wastewater permits. Wastewater permits will be issued on the basis of current actual land use and NCDWR guidelines for flow allocation shown in 15A NCAC 2T .0114.

1. Determine Drainage Basin and Population To Be Served
  - a. Outline the major basin on topographic maps. Identify and outline all sub basins and identify any other basins or sub basins that will be pumping into the sewer being designed.
  - b. Using either a planimeter, or computer calculated area or some other acceptable method, determine the area to be served. Include the basins or sub basins that will be pumped into the sewer. If the area is undeveloped, reduce the area by

20% to account for streets. Further reduce the area by any acreage that is not considered developable (i.e. lakes, wetlands, etc.). If the area is developed, reduce the area as necessary to allow for existing streets.

- c. For each basin and sub basin, determine the existing population, land use and zoning. Refer to the appropriate area Land Use Plan to determine trends in land use and zoning and for predictions of population growth rate.

## 2. Estimate the "Build out" Population to be Served

- a. Estimate the "build out" population in the areas to be served when the areas are fully developed according to land use and zoning projections. Table 1 may be used, along with any population projections contained in the Land Use Plan, in estimating this population with supporting hydraulic calculations. Where several pipe diameters are acceptable, i.e. 12 inch and 15 inch, the Design Engineer shall furnish hydraulic calculations for both and a detailed estimate of construction costs for each.
- b. Estimate the percentage of the "build out" population that will exist in the areas in the 50th year. This percentage should be based on growth rate projections contained in the Land Use Plan. The sewer line should be sized to serve this population.

Table 1 is intended only as a minimum design standard for the classification listed. The Design Engineer shall be responsible for insuring that the design discharge utilized in sizing sewer collection facilities are adequate for the area, which the extension is to serve.

Table 1. GUIDELINES FOR DETERMINING DAILY DOMESTIC WASTE QUANTITIES

<u>CLASSIFICATION TYPE</u>	<u>UNITS &amp; MEASUREMENTS</u>	<u>FLOW VALUE</u>
Rural Residential	1.2 units/acre @ 270 gal/unit	324 gal/acre
Low Density Residential	2.5 units/acre @ 270 gal/unit	625 gal/acre
Medium Density Residential	10 units/acre @ 270 gal/unit	2700 gal/acre
High Density Residential	15 units/acre @ 270 gal/unit	4050 gal/acre
Commercial	1000 ft. <sup>2</sup> /acre developed @ 120 gal/100 ft. <sup>2</sup>	1200 gal/acre
Office/Institutional	60 people/acre @ 25 gal/person	1500 gal/acre
Light Industrial	8 employees/acre @ 40 gal/employee	320 gal/acre
Heavy Industrial	4 times light industrial	1280 gal/acre

## C. FLOW DETERMINATION

1. Determine the average daily flow (design flow) for residential areas.
2. Determine average daily flow (design flow) for industrial or commercial areas. Add additional flow based on research of specific zoning and any known large water users.

3. Determine, peak daily flow by multiplying the average daily flow by the appropriate peaking factor. The minimum peaking factor permitted is 2.5 and this factor should be used in the absence of specific design or flow data supporting a higher peaking factor.
4. Determine the allowable infiltration flow based upon 100 gpd/in. dia./mile (for gravity sewers).

#### D. SANITARY SEWER MINIMUM SLOPE

1. From topographic maps and any vertical survey control in the area, determine the average slope of the natural drainage in the area to be serviced. Determine whether any sections are significantly flatter than the average.
2. Determine whether there are obstructions (e.g. existing utilities) or natural terrain features that will limit the pipe slopes such as creek crossings, proper cover under railways, etc.
3. Based on (1) and (2), establish the minimum slope for the pipeline. This should be used as the design slope.
4. All public sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Manning's Formula using an "n" value of 0.013. The following are the minimum slopes, which shall be provided. However, slopes greater than these are recommended, particularly for mains and services serving few residences, to effect flushing solids.

<b>Table 2. Minimum Slopes</b>	
<b>Diameter of Pipe (Inches)</b>	<b>Minimum Slope (Feet per 100 feet)</b>
4 (laterals)	2.00
6 (laterals)	1.00
6 (private)	0.60
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06
36	0.05

#### E. SANITARY SEWER PIPE SIZING:

1. Use the peak daily flow for design calculations with the pipe flowing full.
2. Sewers shall be designed to flow half full at the average daily flow. However, the smallest acceptable line size for private sanitary sewers is 6 inches. The smallest acceptable line size for public sanitary sewers is 8 inches.
3. Using Manning's Equation or Charts, to determine the pipe size:

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2} \quad \text{Note: all units in feet}$$

Where:

Q = cubic feet per second

n = Coefficient of roughness (typically, n = 0.013)

S = energy grade line in. ft/ft

$R_H$  = hydraulic radius =  $\frac{\text{cross sectional area}}{\text{wetted perimeter}}$

A = cross sectional area of pipe in square feet ( $A = \pi r^2$ )

Solve for A and then r to get the design pipe size.

4. Using Manning's equation, check the velocity of the gravity sewer:

$$V = \frac{1.486}{n} (R^{2/3})(S^{1/2}) \quad \text{Note: all units in feet}$$

Where:

V = mean velocity in feet/second

n = coefficient of roughness (typically n = 0.013)

S = Slope of energy grade line, ft/ft

$R_H$  = hydraulic radius, ft  
=  $\frac{\text{cross-sectional area of flow (ft}^2\text{)}}{\text{wetted perimeter}}$

5. Check the pipe size and slope and adjust the pipe size as needed to meet the minimum design slope and velocity as required.

#### F. PRELIMINARY SANITARY SEWER ROUTE SELECTION

1. Overlay property lines onto topographic map. (Where available, overlay existing structures, utilities, streets, etc.)
2. Make a preliminary layout, minimizing the number of parcels involved, and paralleling property lines where possible. Avoid obvious construction problems where possible such as excessive cuts, wetland impacts, etc.
3. Where wetlands are encountered, delineate in accordance with the guidelines published in the *Corps of Engineers - Wetlands Delineation Manual* if they cannot be avoided.

4. Where Environmental Assessment is required, perform as necessary. Projects involving an Environmental Assessment cannot be permitted by PWC, and must be permitted by NCDWR.
5. If the proposed route crosses or parallels a roadway, have all utilities located or as a minimum obtain utility locations from each affected provider. Consider the NCDOT requirements for encroachments in selecting the route.
6. If the proposed route crosses or parallels a utility, such as an overhead transmission line, consider the requirements for encroachments into the utility right-of-way.
7. If the proposed route crosses a railway, consider the requirements for encroachments into the right-of-way of the particular Railroad Corporation involved.
8. Provide the Public Works Commission with the preliminary route selection.
9. Survey the proposed alignment, setting stakes at each manhole centerline. (Prior to survey, Consultant Engineer shall coordinate with PWC notification to property owners that surveyors/consultants will be working in the area.)
10. Walk the project with PWC staff if required by PWC. Modify preliminary routing as necessary based on field observation of terrain features, environmental considerations, and potential property damage. Maintain sufficient distance from creeks to protect the sewer pipe from washout and comply with minimum separation requirements imposed by NCDWR in 15A NCAC 2T.0200 and this Manual.

#### **IV. DETAILS OF DESIGN AND CONSTRUCTION OF SANITARY SEWER COLLECTION MAINS**

##### **A. MINIMUM SIZE**

1. Public sanitary sewer collection system, conveying wastewater, shall be a minimum of eight (8) inches in diameter. Private sanitary sewer collection systems, conveying wastewater, shall be a minimum of six (6) inches in diameter.

##### **B. DEPTH**

1. A minimum of three (3) feet of cover, as measured from the crown of the pipe to the finished grade, shall be provided for all sewers, unless ductile iron pipe is specified and approved by PWC. Proper bedding shall be provided where sewers are subject to traffic bearing loads to develop design-supporting strength. Additional protection shall be provided for sewers that cannot be placed at a depth sufficient to prevent damage. PWC shall determine the acceptability of such installations.
2. Typically, the depth of gravity sewer mains shall be deep enough to serve adjoining property or the first floor of existing homes if possible. Basement service, or service to low lying lots that require extra depth (greater than 10 feet), will be evaluated by PWC on a case-by-case basis. In isolated cases, the lot will be required to lift sewage



to the gravity main.

3. These minimum requirements do not negate the need for the design engineer to evaluate specific trench conditions in the design of a project. Where unstable soil conditions are known to exist in the pipe zone, structural design shall be based on a careful evaluation of the soil conditions and depth of cover. Special structural designs (e.g. pilings with pipe support cradles, etc.) shall be used where appropriate, and shall be detailed by the Design Engineer. A North Carolina Professional Engineer shall design trench excavation, as indicated in the State of North Carolina minimum design criteria.
4. Special structures such as large concrete vaults, pumping stations and all buildings shall have a specific foundation design. This design shall be based on site conditions and be based on the evaluation of actual subsurface boring and/or other pertinent tests required for the design (soil bearing, soil classification, etc.).

#### C. SLOPE PROTECTION

1. The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize settling problems. Designs must include a minimum scouring velocity of 2 feet per second. Sewers shall not be oversized to justify using flatter slopes. If the minimum scouring velocity cannot be maintained during initial operation prior to the design flow capacities being reached, the lines will be designated as high priority in the permit. High priority lines must be checked once every six months and flushed as necessary (15A NCAC 2T .0403).
2. Maximum grade for sanitary sewers is 9% unless otherwise approved by PWC on a case-by-case basis.
3. Where design velocities are projected to be greater than 15 feet per second, the sewers and manholes shall be protected against displacement by erosion and impact. For velocities greater than 20 feet per second, erosion control measures shall be documented on the "Record Drawings" and in the Engineer's Certification.

#### D. STEEP SLOPE PROTECTION

1. If approved by PWC, sewers on 20 percent slopes or greater shall be anchored securely with concrete, or equal, with the anchors spaced as follows:
  - a. Not greater than 36 feet center to center on grades 21% to 35%;
  - b. Not greater than 24 feet center to center on grades 35% to 50%; and
  - c. Not greater than 16 feet center to center on grades 50% and over.

#### E. CHANGES IN PIPE SIZE

1. Where a smaller pipe joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. Generally, aligning the crowns of the different size pipes is acceptable.

2. Sewer extensions shall be designed for projected flows, even when the diameter of the receiving sewer is less than the diameter of the proposed extension at a manhole, with special consideration of an appropriate flow channel to minimize turbulence when there is a change in sewer size. Justification shall be provided with the certification of completion and the construction plans, indicating that the capacity of the downstream sewer will not be overloaded by the proposed upstream installation. The PWC may require a schedule for construction of future downstream sewer relief.
3. Pipe size and material should remain consistent between manholes, and must not change, unless approved by PWC. At drop manholes, the pipe material shall transition to SDR 26 PVC, in accordance with PWC Standard Details.

## **V. SANITARY SEWER LOCATIONS**

### **A. OUTFALLS/INTERCEPTORS**

1. Gravity sewer lines serving drainage basins shall follow the natural drainage pattern of the basin as closely as possible. Specific horizontal alignment should be made with due consideration to property lines, topography, environmental damage, and reasonable property owner requests.
2. Where possible, elevations should be set so that the top of the pipeline is at least four feet below the natural grade and at least three (3) feet below stream or drainage channel beds.
3. Where the natural slope will permit, the Design Engineer shall use the available grade (natural fall of land) to increase slope of the gravity sewer rather than designing for the minimum slope with large invert drops.

### **B. COLLECTION MAINS**

1. Sewer lines shall be laid on straight lines between manholes and at a constant grade or uniform slope. Sewer collection mains shall be laid on the minimum slope as identified in Table 2. The straight alignment shall be checked by using a laser, lamping and/or mirrors, and a mandrel.
2. All sewer collection mains shall be installed within the street right-of-way or within a dedicated easement, while maintaining separation distances, as stated in Section VII and VIII.
3. When located in the street, the main shall be located as near as possible to the center of the pavement so that manhole covers are not located in vehicle wheel paths.
4. When located in a dedicated easement, the main shall be centered in a permanent easement of adequate width to allow excavation and maintenance of the line while maintaining separation distances. A temporary easement may be required for installation.

5. Mains extended in the street to serve a property must be extended across the entire length of the property to allow for future extension. Mains, which require extension within a drainage basin, must be extended to the upper most point of the property or to any other point, which can provide reasonable service to adjacent property.
6. To accommodate future extensions in unpaved areas, stub out a section of pipe properly plugged and on proper grade. In paved areas, the sewer main shall be extended beyond the pavement and terminate in the next planned manhole.

### C. SANITARY SEWER PIPE STRENGTH

1. Sanitary sewer pipe strengths and classes, as shown in Table 3 through Table 7, were designed based upon a minimum weight of 120 cubic feet of soil and an H<sub>2</sub>O loading condition. Trench width at the top of the pipe and design calculations are based upon not exceeding two (2) feet for 8-inch and 12-inch pipe, three (3) feet for 15-inch and 18-inch pipe, four (4) feet for 24-inch and 30-inch pipe, and six (6) feet for 36-inch through 48-inch pipe. Greater trench widths shall require the Design Engineer to provide individual design to support the additional load up to the transition width. The Design Engineer shall insure that constructed trench dimensions do not exceed those indicated above, otherwise greater trench widths will require either an increase in pipe class, bedding condition and/or pipe material suitable to provide sufficient structural integrity to withstand the increase in load on the pipe.

<b>Table 3</b>											
<b>D 0.01 Concrete Pipe &amp; Depth of Cover (feet)</b>											
<b>Pipe Dia.</b>	<b>Trench Width (ft.)</b>	<b>6</b>	<b>8</b>	<b>10</b>	<b>12</b>	<b>14</b>	<b>16</b>	<b>18</b>	<b>20</b>	<b>22</b>	<b>24</b>
<b>24"</b>	4	III	III	III	III	III	III	IV	IV	IV	IV
<b>30"</b>	4	III	III	III	III	III	III	III	III	III	III
<b>36"</b>	4	III	III	III	III	IV	IV	IV	IV	IV	IV
<b>42"</b>	6	III	III	III	III	III	III	IV	IV	IV	IV
<b>48"</b>	6	III	III	III	III	III	III	IV	IV	IV	IV

Note: Reinforced concrete pipe only.

<b>Table 4</b>		
Greater Depths may be considered, provided individual Design Calculations are submitted		
<b>SDR 26 PVC Sanitary Sewer Pipe Minimum &amp; Maximum Depth of Cover</b>		
<b>Bedding Class</b>	<b>Minimum Cover</b>	<b>Maximum Cover</b>
B	3'	22'

<b>Table 5</b>					
<b>Extra Strength Clay Pipe Minimum and Maximum Depth of Cover</b>					
<b>Maximum Trench Width</b>	<b>Pipe Diameter</b>	<b>Bedding Class</b>	<b>Minimum Cover</b>	<b>H2O Maximum Cover</b>	<b>H2O @ Transition Width (FIO)</b>
2	8"	B	3'	30'	20'
2	12"	B	3'	30'	14'
3	15"	B	3'	26'	12'
3	18"	B	3'	26'	12'

Safety Factor Extra Strength Clay Pipe = 1.5  
Includes 16,000 lb. Wheel Load.  
Includes Impact Load Factor 1.5 (Highways)

<b>Table 6</b>		
<b>Ductile Iron Pipe Maximum Depth of Cover (feet) Class "B" Bedding</b>		
<b>Pipe Diameter</b>	<b>Pressure Class Pipe (Force Mains Only)</b>	<b>CL50</b>
8"	50	50
12"	44	44
16"	34	44
18"	31	38
20"	30	34
24"	29	30
30"	27	24

Note: Pressure class 350 is for force mains 4 to 12 inches in diameter.  
Pressure class 250 is for force mains greater than 12-inches in diameter.

<b>Table 7</b>		
<b>Direct Bury Application CCFRMP (Centrifugally Cast Fiberglass Reinforced Mortar Pipe)</b>		
<b>Cover Depth</b>	<b>SN Required <sup>*2</sup></b>	<b>Bedding Class <sup>*1</sup></b>
0'-10'	36	B
10'-15'	46	B
15'-20'	72	B
<p>*1 Over 20' depth, improved bedding class required.  *2 SN = Nominal stiffness in PSI  Depth of Cover in Relation to the Specific Pipe Stiffness can increase with improved embedment conditions per manufacturer recommendations.</p>		

## 2. Laying Condition

Class "B" - Pipe bedded in crushed stone to spring line of pipe, 4-inches minimum under pipe, with an initial backfill to 12-inches above top of pipe.

## D. SEWER SERVICE/LATERALS

1. Plans for projects, which propose the creation of lots (subdivision) shall include individual sewer service to each parcel, including any residual parcels reserved for future lots.
2. The sizes and locations of the services shall be based on the anticipated use of the lot, for which, PWC's approval shall be required. The minimum lateral size shall be 4-inch laid on a minimum 2% grade. 6-inch lateral grades shall be a minimum of 1%.
3. Services not terminated at manholes shall be installed at right angles to the gravity sewer main using in-line wyes, or tapping service saddles on existing mains. The wyes, saddles or taps shall be separated horizontally at least five (5) feet, measured along the pipe.
4. The lateral length shall not exceed 75 feet for 4-inch or 100 feet for 6-inch. Up-sizing the lateral size to increase lengths is not acceptable.
5. The service cleanout shall be placed 18-inches inside the right-of-way in the center of the lot unless topography or sanitary sewer main location requires deviation. Cleanouts connecting to terminating manholes may be located 10 feet inside the side property lines.
6. Cleanouts connecting to a sewer main located inside an easement shall be placed at the easement limit or edge of the permanent easement and in no case shall the cleanout be placed within a temporary easement.
7. Lateral service invert elevation and curb elevation, measured at the cleanout stack, shall be shown on the plans to include street centerline station number. Generally, depths (service invert) should provide a minimum of three (3) feet of cover to a maximum depth of six (6) feet. Depth greater than six (6) feet may be approved provided the depth is necessary to gravity serve the lot. The lateral service depth should be designed to provide gravity sanitary sewer services, unless otherwise approved by PWC. The lateral cleanout minimum invert elevation shall be at least 1.4 feet above the invert of the collection main, or as otherwise approved.
8. Services, which convey sewer from car washes and similar facilities, shall include oil and sand separators, designed and installed in accordance with the North Carolina or locally approved plumbing code.
9. Grease interceptors shall be required for food service facilities and dumpster areas containing food debris and in accordance with PWC requirements.

10. PWC sanitary sewer lateral maintenance extends from the sewer main to the cleanout stack located at the edge of a permanently dedicated right of way or permanent easement.

## **VI. MANHOLES**

### **A. LOCATION**

1. The maximum distance between manholes, measured horizontally along the centerline of the gravity sewer, shall be 425 feet. On a case by case basis, and with approval from PWC, manholes may be located further than 425 feet apart
2. Manholes shall be installed:
  - a. At the end of each main
  - b. At all changes in pipe grade
  - c. At all changes in nominal pipe size
  - d. At all horizontal and vertical changes in pipe alignment
  - e. At all intersections, unless otherwise approved by PWC.
3. Manholes shall be located at property lines unless prohibited by topography, ditch stream, etc. in undeveloped areas to facilitate future expansion, or in the lows by natural drainage sub basins.
4. Cleanouts shall be used in lieu of manholes for 4-inch and 6-inch private sewer lines with the maximum distances between cleanouts not to exceed 75 feet for 4-inch and 100 feet for 6-inch.
5. Manholes installed in pavement shall have their cover set flush with finished grade, and shall be located outside of designated parking spaces, where possible. Whenever practical, manholes located in streets shall be located in the center of the street.
6. Manholes installed in yards and landscape areas shall have the top elevation set flush with the existing grade. Manhole tops located along outfalls in natural areas shall be set 18-inches above grade, or 24-inches above the 100 year flood elevation, whichever is greater. Manholes should not be located in ditches or roadside swales.
7. The minimum elevation difference between the centerline "invert in" and the centerline "invert out" of manholes shall be 0.05 feet. Exceptions are: 1) when there is a change in flow direction of greater than 90 degrees, the minimum difference shall be 0.2 feet; 2) when pipes of different sizes converge in a manhole, the inside tops of the pipes shall be set at the same elevation; and 3) when grade is critical. Exceptions must be approved by PWC.

## B. DIAMETER

1. The minimum inside diameter of manholes shall be 4 feet (48 inches). Larger diameters are required for large (24-inch and greater) diameter sewers. A minimum access diameter of 22 inches shall be provided.
2. The minimum interior diameter for manholes containing drop structures shall be 5 feet (60 inches).
3. Where the deflection angle of the influent verses the effluent sewer mains is 45° or greater, or for larger diameter pipes, the manhole shall be up sized to accommodate the pipes' outside diameter with a minimum of 3-inches of separation between the pipes boot openings, measured along the inside manhole wall.

## C. DROP TYPE

1. Vertical elevation drops through manholes should be limited to prevent turbulent conditions. If the vertical elevation difference between the "invert in" and "invert out" is: 1) greater than 12-inches, but less than 2.5 feet, a pipe slide is required to prevent solids deposition; or 2) 2.5 feet and greater, an interior drop structure is required. Invert drops thru manholes shall be accomplished by providing an invert channel of constant slope, which provides a smooth transition from the discharge elevation of the influent pipes to the effluent pipe.
2. Inside Drops: Only inside drops will be permitted for new lines using a 5-foot inside diameter manhole. For existing 4 foot manholes, an inside drop may be permitted, as approved by PWC. Drop manholes shall be constructed with inside drops, secured to the inside of the wall, and shall be positioned, in such a manner, to allow for cleaning.
3. Exterior Drops are not allowed.
4. Sewer lateral taps in manholes:
  - a. If a service is proposed in the manhole at a height of 30 inches or greater above the invert, an inside drop shall be required for the service.
  - b. The sewer lateral invert shall be a minimum of one (1) inch above the shelf, or sufficiently high enough to allow the installation of a flexible connector and core into existing manholes.

## D. FLOW CHANNEL

1. The flow channel straight through a manhole shall be made to conform as closely as possible in shape, and slope to that of the connecting sewers. The channel walls shall be formed or shaped to three quarters ( $\frac{3}{4}$ ) of the height of the crown of the outlet sewer in such a manner so as not to obstruct maintenance, operations, mandrel pulling, inspection or flow in the sewers, etc.

2. When curved flow channels are specified in manholes, including branch inlets, minimum slopes should be increased to maintain acceptable velocities.

#### E. BENCH/SHELF

1. A bench/shelf shall be provided on each side of any manhole channel, when the pipe diameter(s) are less than the manhole diameter. The bench/shelf shall be sloped not less than 1 inch per foot and not greater than 2 inches per foot. The invert elevation of any lateral sewer, service connection, or drop manhole pipe, shall be above the bench/shelf surface elevation. No invert shall be located directly on the surface of the bench/shelf.

#### F. WATERTIGHTNESS

1. Manholes shall be pre-cast concrete. Manhole lift holes and grade adjustment rings shall be sealed with non-shrinking mortar or other material approved by PWC.
2. Inlet and outlet pipes shall be joined to the manhole with a gasketed flexible watertight connection (boot) or any watertight connection arrangement that allows differential settlement of the pipe and manhole wall to take place. Connections of new sewers to existing manhole, shall be accomplished by machine coring and the installation of a flexible connector (boot).
3. Watertight manhole covers are to be used wherever the manhole tops may be flooded by street runoff or high water. Locked manhole covers may be desirable in isolated easement locations or where vandalism may be a potential.
4. Manholes shall be designed for protection from the 100 year flood elevation
  - a. Manhole rims shall be 24 inches (2 feet above the 100 year flood elevation or,
  - b. Manholes shall be watertight and vented by use of vented covers or external vent structures, only as required for proper pipe ventilation and to insure proper hydraulic performance (e.g. inverted siphon manhole). As a general guideline vents are required at intervals of approximately 1,000 feet or every other manhole, whichever is less. All non-vented manholes shall have solid covers, and all frames and covers subject to flooding or inflow from storm water shall be sealed according to current standard specifications. Manholes with external vents shall have sealed frames and covers with vent outlet a minimum of two (2) feet above the 100-year flood protection elevation.
  - c. Manholes that are subject to being pressurized by surcharging or which are likely to be vandalized shall have mechanically restrained covers. Manholes that have restrained watertight covers, which are subject to pressurization by surcharging, shall be designed to withstand the maximum potential surcharge without damage. For design purposes, the maximum potential surcharge shall be that surcharge which would result from a prolonged outage of the nearest downstream pump station.



## G. BUOYANCY

1. Buoyancy shall be considered, and flotation of the manholes and/or pipe shall be prevented, with appropriate construction where high groundwater conditions are anticipated.

## H. INSPECTION AND TESTING

1. The specifications shall include a requirement for inspection and testing for water tightness or damage prior to placing into service. Refer to PWC Technical Specifications for testing requirements.

## I. CORROSION PROTECTION

1. In areas where the potential for release of hydrogen sulfide gas exists, concrete and ductile iron pipe and concrete structures will be protected from hydrogen sulfide induced corrosion. These areas include force main discharges, inside drops, which create turbulence, and areas where septic conditions are likely to occur.
2. Standard concrete pipe and manhole specifications provide for alkalinity control, sacrificial concrete and/or coatings. Wherever significant corrosion potential exists, the interior of concrete pipe and structures shall be fully coated and protected to a minimum distance of 50 feet upstream and downstream of each affected structure.
3. Where corrosive conditions due to septicity or other causes are anticipated, consideration shall be given to providing corrosion protection on the interior of the manholes.
4. For those manholes that have a force main discharging into them, the interior of the manhole shall be fully coated and protected to prevent hydrogen sulfide induced corrosion. In addition, the next four (4) manholes downstream shall also be fully coated and protected against corrosion.
5. Where high flow velocities are anticipated, the manholes shall be protected against displacement by erosion and impact.

# VII. SANITARY SEWERS IN RELATION TO STREAMS AND OTHER WATER BODIES

## A. STREAM CROSSINGS

1. Crossings of streams shall be minimized and as nearly perpendicular to the stream as possible. Streams shall be protected in accordance with erosion control plans and specifications and shall be stabilized immediately after construction is completed on the segment of crossing line. Depending on actual cover, stream width, flow conditions and soil conditions, the sewer pipe may require special anchorage to prevent flotation and/or washout. Each crossing must be evaluated individually. Pipe for aerial or submerged stream crossings shall be mechanical joint ductile iron

only.

a. Cover Depth

- i. Sewer paralleling streams/creeks shall be designed to be below the streambed elevation, such that lateral connections will be protected as described herein.
- ii. The top of all sewers entering or crossing streams shall be at a sufficient depth below the natural bottom of the streambed to protect the sewer line.
  - a. One (1) foot of cover where the sewer is located in rock;
  - b. Three (3) feet of cover in other material unless ductile iron pipe is specified; in which case, a minimum of one (1) foot of cover will be required. In major streams, more than three (3) feet of cover may be required; and
  - c. In paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement.

b. Horizontal Location

- i. Sewers located along streams, lakes or impoundments, shall be located at least 25 feet outside of the stream and/or creek bank (unless subject to Item ii below) or sufficiently removed there from to provide for future possible stream widening and to prevent siltation of the stream during construction.
- ii. A distance of 100 feet shall be maintained between sewers and water, classified as WS-I-PWS; and 50 feet shall be maintained for areas classified as WS-II, WS-III, B, SA, ORW, HQW, or SB from normal high water (or tide elevation) and wetlands. If the separation requirements cannot be met, the materials, testing methods, and acceptability standards meeting water main standards, as outlined in 15A NCAC 18C, shall be specified.
- iii. All pump station wet wells shall be located a minimum of 50 feet from any wetland.
- iv. Sewer systems shall be designed to maintain maximum feasible separations when the 50 foot separation from wetlands cannot be met.
- v. Manholes within wetlands shall be in accordance with the following:
  - a. A water tight ring and cover (with gasket) shall be provided
  - b. All seams shall be externally sealed
  - c. A full waterproof interior coating/lining shall be provided
  - d. Watertight pipe connections shall be provided, consisting of a flexible rubber boot or compression type connector, as approved by PWC
  - e. All manholes shall be vacuum tested in accordance with PWC requirements

- f. The use of “doghouse” manholes are not allowed
  - g. All manholes not included as part of the United States Army Corps of Engineers 404 Permit or DWQ 401 certification shall be located a minimum of 10 feet from the wetlands.
- vi. Sewers shall not be installed under any part of an impoundment and/or earthen dam, without specific PWC approval. Plans may require review, and approval by NCDWR Dam Safety Section, Fayetteville Regional Office.
- vii. Sewers crossing streams shall be perpendicular (90°) as practical to the streambed and in no case at an angle less than 75° or greater than 105° to the stream.
- viii. Edge of the construction corridor shall not be closer than 10 feet to a stream.
- ix. Intermittent or permanent stream crossing shall not have joints connected within the stream channel or within two (2) feet of banks, unless approved by PWC.
- x. Construction corridor limited to 40 feet in width in wetlands and across stream channels. Wetland delineation shall be clearly shown on the plans.
- c. Structures
  - i. The sewer outfalls, headwalls, manholes, gate boxes, or other structures shall be located so they do not interfere with the free discharge of flood flows of the stream.
- d. Materials
  - i. Sewers entering or crossing streams shall be constructed of ductile iron material pipe with mechanical joints, and shall be constructed to remain watertight, free from changes in alignment or grade and tested to 150 psi. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe.
  - ii. Measures shall be taken to prevent fresh concrete from coming in contact with waters of the state.
  - iii. Placement of rip-rap is restricted to the stream bottom, banks directly impacted and only below normal high water level.
  - iv. No fertilizer shall be placed within 10 feet of a stream.

## B. AERIAL CROSSINGS

- 1. Proper joint technology, such as flanged or restrained, adequate supports prevent excessive flexion, or a combination of both, shall be provided for all aerial pipe

crossings. Supports shall be designed to prevent frost heave, overturning, and settlement.

2. Supports shall be designed to withstand the hydrodynamic effects of the stream flow pressure using the following formula:

$$P = 1.5 KV^2$$

Where:

1.5 - safety factor against overturning,

P = pressure, psf

V = velocity of water, fps

K = 4/3 for square ends, 1/2 for angle ends when angle is < 30° or less and 2/3 for circular piers. (Dimensionless)

3. If it is probable that the aerial pipe could be submerged by the stream flow, the effects of the flow pressure on the pipe shall also be taken into account when computing pier-overturning moments. For aerial stream crossings, the impact of flood waters, and debris shall be considered.
4. H-Piles shall be driven to a minimum penetration of 10 feet by an approved hammer developing not less than 7,500 ft-lbs of energy per blow. The load capacity of each pile shall be determined by the following formula:

$$Ra = 2E/(S+0.3)$$

Where:

Ra = Safe load (lbs)

E = Energy per blow (ft-lbs)

S = Final penetration per blow (inches); (average of last 6 blows)

5. Protection against freezing, such as, insulation and increased slope, shall be provided. Expansion jointing shall be provided. Expansion jointing shall be provided between above ground and below ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize heaving.
6. The bottom of the pipe should be placed no lower than the elevation of the 25-year flood. In the event that the 25-year flood elevation cannot be determined, or the proposed gravity sewer must be placed below the 25-year flood elevation, a letter shall be provided by the applicant upon certification stating: "Regular and proper inspection and maintenance of the aerial crossing shall be provided to insure that the creek/stream flow is not impeded and that no damage will be caused to upstream or adjacent properties."
7. Small streams or ditches that can be spanned with a single joint of ductile iron pipe may be anchored with concrete collars provided the collars are below grade.

### C. ANTI-SEEPAGE COLLARS

1. In areas where the sewer trench is located in jurisdictional wetlands and has the potential to drain wetlands, anti-seepage collars shall be installed. A water quality and wetlands (401/404) permit shall be required. An anti-seep collar shall be placed at the downstream wetland boundary and every 150 feet until the utility exits the wetland. Wetland crossings that are open cut and less than 150 feet long do not require anti-seep collars unless specifically required by PWC.

## **VIII. PROTECTION OF POTABLE WATER SUPPLIES, STORM SEWERS AND OTHER UTILITIES**

### A. CROSS CONNECTIONS PROHIBITED

1. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenances thereto which would permit the passage of any wastewater or polluted water into the potable supply. No water pipe shall pass through, or come in contact with, any part of a sewer manhole.

### B. RELATION TO WATER SUPPLY SOURCES

1. A distance of 100 feet shall be maintained between any private or public water supply source, including any WS-1 waters or Class I or Class II impounded reservoirs used as a source of drinking water. If this minimum separation cannot be maintained, ductile iron sewer pipe with joints equivalent to public water supply design standards and pressure tested to 150 psi to assure water tightness shall be used. The minimum separation shall not be less than 25 feet from a private well or 50 feet from a public water supply well.
2. All existing waterworks units, such as basins, wells, or other treatment units, within 200 feet of the proposed sewer, shall be shown on the engineering plans.

### C. RELATION TO WATER MAINS AND SEWERS

1. Sewer mains and laterals shall be laid at least 10 feet laterally from existing or proposed water mains as measured edge of pipe to edge of pipe, unless local conditions or barriers prevent a 10-foot lateral separation. In locations where it is not practical to maintain a 10-foot separation, PWC may allow deviation on a case-by-case basis if supported by the Design Engineer provided:
  - a. The water main is laid in the same trench as the sewer main and/or lateral with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer main and/or lateral, or
  - b. The water main is laid in a separate trench, with the elevation of the bottom of the water mains at least 18 inches above the top of the sewer main and/or lateral, or

- c. If it is impossible to obtain prompt horizontal and vertical separation as described above, or anytime the sewer main and/or lateral is over the water main, both the water main and sewer main and/or lateral must be constructed of ductile iron pipe complying with Public Water Supply design standards and pressure tested to 150 psi to assure water tightness before backfilling.
2. If a minimum of 24-inch vertical separation, between storm sewer and sanitary sewer lines cannot be provided, the sanitary sewer must be constructed of ductile iron pipe.

#### D. CROSSING A WATER MAIN OVER A SEWER

1. Sewer mains and/or laterals crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer main and/or lateral. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
2. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, one of the following methods must be specified:
  - a. The sewer main and/or lateral shall be designed and constructed of ferrous pipe and shall be pressure tested at 150 psi to assure water tightness prior to backfilling, or
  - b. Either the water main or the sewer main and/or lateral may be encased in a watertight carrier pipe that extends 10 feet on both sides of the crossing, measured perpendicular to the water main. The carrier pipe shall be of materials approved by the regulatory agency for use in water main connections.

#### E. RELATION TO OTHER UTILITIES

1. Underground telephone, cable TV, and conduit banks shall be crossed maintaining a minimum of 12-inch separation or clearance and 18-inches for gas utilities.
2. Where possible, electrical crossings shall be performed while the conductor is de-energized and at all times in the presence of the service provider. Electrical primary conductor crossings shall be as follows:
  - a. Crossing over a conductor, maintain a minimum of 12 inches of undisturbed soil encasing the conductor.
  - b. Crossing under a conductor shall be accomplished by boring, maintaining 12 inches of undisturbed soil encasing the conductor.

#### F. RELATIONSHIP OF SANITARY SEWERS TO STRUCTURES

1. Sanitary sewers shall not be installed within 20 feet of any part of permanent buildings or other structures or within a projected 1½:1 (horizontal and vertical) angle of repose as measured from the pipe centerline at bottom of trench, whichever distance is greater, unless a Geotechnical Engineer determines otherwise. Geotechnical Engineering services are encouraged. The minimum width of a

permanent Sanitary Sewer easement is 20 feet.

2. Should a sewer main be installed between two structures, the sewer main, from manhole to manhole, shall be ductile iron pipe.

#### **G. RELATIONSHIP OF UTILITY TO NCDOT RIGHT OF WAY**

1. All collection systems shall be designed, and approved by both PWC and NCDOT in accordance with both PWC "Manual for the Design and Construction of Water and Wastewater System Extensions" and NCDOT Manual "Policies and Procedures for Accommodating Utilities on Highway Rights-of-way", most recent editions.
2. Utilities to be constructed within NCDOT's right-of-way will require a NCDOT encroachment permit.

### **IX. PUMP STATIONS AND FORCE MAINS**

#### **A. GENERAL**

1. Pump stations and force mains design shall be in accordance with the requirements of this manual and 15A NCAC 2T .0200. Where conflicts occur in PWC and State design requirements, the more stringent requirement shall apply. In accordance with NCGS 143-215.1(a), no person shall construct, alter, extend, change, or operate any sewer system without first obtaining a permit from the Environmental Management Commission or PWC.
2. The application of standard design practices, good engineering judgment and/or more stringent or conservative design criteria than presented in this manual is highly encouraged when and where applicable and as deemed necessary.
3. The following types of projects involving pump stations and force mains shall be submitted to Department of Environment and Natural Resources for permitting:
  - a. Pump station and force main projects that require an environmental assessment in accordance with 15A NCAC 1C .0100 "State Environmental Protection Act."
  - b. Pump station and force main projects that involve a variance from the State's requirements of 15A NCAC 2T .0200.
  - c. Pressure sewer systems utilizing septic tank-effluent pumps (STEPS) or grinder pumps (low pressure sewer systems).
  - d. Flow reduction requests in accordance with 15A NCAC 2T .0114.
4. The following types of projects involving pump stations and force mains shall be considered private and deemed permitted:
  - a. A building sewer, defined in 15A NCAC 2T .0303, and documented by the local

building inspector to be in compliance with the North Carolina State Plumbing Code, that involves a sewage ejector or pump station, which serves a single building with the sole purpose of conveying wastewater from that building into a gravity sewer that runs on or adjacent to the building's property.

- b. A pump station documented by the local building inspector to be in compliance with the North Carolina State Plumbing Code, that serves a single building whose force main crosses property lines or runs along right-of-way and has no other pump station connections. The force main, however, shall require a permit as stipulated in 15A NCAC 2T .0303.
- c. Operations that involve the routine maintenance, replacement, or rehabilitation of existing pump stations and/or force mains in accordance with 15A NCAC 2T.0303.

## B. GRAVITY FLOWS VERSUS PUMP STATIONS

- 1. PWC's policy is to minimize the need for wastewater pump stations and to limit the construction and use within the collection system. Because pump stations are: (1) inherently less reliable, (2) more expensive to operate, and (3) more likely to cause environmental problems than gravity sewers, pump stations shall be incorporated into the design of a project only as a last alternative. Projects utilizing pump stations or creating a future need for pump stations will not be approved unless documentation satisfactory to PWC is submitted, justifying the installation of a pump station provided the area served by gravity sewers has been maximized. The pump station documentation must include:
  - a. A benefit/cost comparison, comparing the cost of constructing and maintaining the station and constructing and maintaining a gravity sewer extension.
  - b. The lift station can be eliminated, by a project or combinations of projects, which are, included in PWC's 6-year Capital Improvement Plan.
  - c. The proposed lift station is at an appropriate location and has adequate capacity or expansion capacity to serve as a permanent or long term facility and gravity service is cost prohibitive or not possible due to other circumstances.
  - d. The construction of the proposed lift station would include elimination of one or more existing lift stations.
  - e. The construction of the proposed lift station would facilitate significant progress toward achievement of land use goals and strategies described by current, officially approved planning documents and no other reasonable options are available for service.
  - f. In all cases, the receiving system must have available capacity to carry the proposed lift station discharge. Any upgrades required will be the responsibility of the customer requesting the lift station.
- 2. The Commission may agree to accept ownership and maintenance of pump stations designed and constructed to the standards set forth in this Manual subject to the



following conditions:

- a. The Commission determines that acceptance of ownership is in its best interest.
  - b. Easement, satisfactory to the Commission, is provided for unrestricted access to, and operation and maintenance of the pump station.
3. In situations where no reasonable alternative exists, PWC may approve the installation of a privately owned and maintained pump station and force main.

**C. PUMP STATION AND FORCE MAIN ENGINEERING/DESIGN CALCULATIONS & DRAWINGS**

1. Engineering calculations must be signed, sealed, and dated by a North Carolina Registered Professional Engineer (PE). Such calculations shall include, at a minimum, the following items:
  - a. Total dynamic head calculations for all applicable pumping situations.
  - b. System curve/pump curve analysis used to determine pump selection and operational point.
  - c. Pump station cycle and pump run times, including an evaluation of any depressed sections of the force main to determine if the pump station is capable of completely flushing the force main section being evaluated in a single pumping cycle.
  - d. Pump station flotation/buoyancy calculations.
  - e. Available emergency storage capacities at average and peak wastewater flows for pump stations that have not been connected to multiple power sources.
  - f. Minimum velocity within the force main.
  - g. Maximum detention times within the pump station and force main.
2. Downstream sewer evaluation demonstrating that the pump station discharge will not overload the receiving sewer line:
  - a. In situations where the pump station discharges into a gravity sewer, the downstream gravity sewer shall be evaluated based on peak flow from the proposed project as well as peak flows already tributary to the downstream gravity sewer.
  - b. In situations where the pump station discharges into another pump station, the downstream pump station shall be evaluated to verify its ability to convey peak flows from the proposed project as well as peak flows already tributary to the downstream pump station.

- c. In situations where the pump station discharges into a force main, the downstream force main shall be evaluated on peak flows from the proposed project as well as peak flows already tributary to the downstream force main. The ability of each pump station tributary to the downstream force main to pump against additional head created by greater flows through the force main shall also be evaluated. An evaluation of the discharge point of the downstream force main as described above shall also be performed.
  - d. TDH of the pumps shall be based on a C-factor of 120 utilizing the Hazen Williams Formula.
3. Construction record drawings that have been signed, sealed, and dated by a North Carolina PE. Such drawings shall include, but shall not be limited to, the following:
    - a. Plan and profile views of the force main as installed as well as its proximity to other utilities and natural resources. The locations of specific force main materials as well as any valves and other force main appurtenances shall be indicated.
    - b. Construction record detail drawings of the pump station.
  4. Documentation that the required quality assurance/control tests were performed.
  5. Proof that operation and maintenance (O&M) manuals have been supplied to the applicant following construction and commissioning of the pump station/force main system.

#### D. PUMP DESIGN

##### 1. General Requirements

- a. Only pumps designed and manufactured for use in conveying raw, unscreened wastewater shall be acceptable.
- b. Pump selection shall consider the duty requirements as well as the physical and chemical characteristics of the wastewater being conveyed. Materials used in pump construction shall also be suitable from the physical and chemical characteristics of the wastewater being conveyed.
- c. Pump stations conveying residential, commercial, institutional, or industrial domestic wastewater shall be provided with pumps that are suitable for continuous duty in conveying raw unscreened wastewater.
- d. Pumps shall be capable of handling a three-inch solid and any trash or stringy material that can pass through a four-inch hose unless a mechanical means of solids reduction is installed at the pump station.
  - i. Pumps shall be made non-clog either by passing solids, trash, and stringy material through a non-clog or vortex-type impeller or by grinding, chopping,

or cutting them prior to passing them through the impeller. Impellers shall have blades that are generally forward rounded or otherwise configured to avoid catching solids, trash, and stringy material.

- ii. Acceptable mechanical means of solids reduction shall include mechanical bar screens, communitors, dimunitors, or other similar devices. The use of a manual bar screen or trash basket at the pump station shall not be sufficient to apply this exception.
- e. Pump suction and discharge openings shall be no less than four inches in diameter unless the pump is capable of grinding, chopping, or cutting solids, or a mechanical means of reducing the size of a three-inch solid and any trash or stringy material that can pass through a four-inch hose is installed at the pump station.
- f. Pumps shall be designed for continuous duty pumping of raw, unscreened wastewater. Pumps shall be adequately protected from damage due to failure conditions specific to the selected pump type and pump station configuration.
- g. The power source, voltage and phasing shall be certified before ordering the pumps.

## 2. Number and Capacity

- a. Multiple pumps shall be used such that the pump station is capable of conveying the peak discharge (a minimum of 2.5 x average design flow) to its desired outfall location with the largest single pump out of service.
  - i. In duplex pump stations; the pumps shall be of the same capacity. If pumps in series are required, each set of pumps in series shall be viewed as a single pumping unit.
  - ii. Priming pumps, and other auxiliary system for pump functionality, shall be provided in multiple numbers.
  - iii. At least one standby pump and motor shall be provided.
- b. Pump capacity shall be based on wastewater flow expected to become tributary to the station for the entire project at build out. For regional stations, capacity shall be based on wastewater flow expected from the entire service area over the life of the pump station.
- c. Interim sizing of pumps and associated pump stations shall be allowable, although not for economic purposes. A statement of initial service capacity shall be on the drawings for projects that are approved for an interim condition. Additional wastewater flow shall not be made tributary to the station until a request for permit modification is submitted, approved, and the pump station upgraded and certified.

- d. The minimum allowable design daily wastewater flow to the station shall be as follows;
  - i. In accordance with 15A NCAC 2T .0114
  - ii. To serve a developed service area, historical potable water use or wastewater flow generation data may be used in accordance with 15A NCAC 2T .0114. If the resulting design daily wastewater flow is less than that stipulated in 15A NCAC 2T .0114 , NCDWR must approve the flow reduction prior to permit issuance.
  - iii. To serve a broad service area when development is not known, design daily wastewater flow may be based on historical data for the area or Table 1 - Guidelines for Determining Domestic Waste Quantities.
- e. The peak hourly wastewater flow to the station shall be appropriate for the service area as well as the associated wastewater generation patterns and population being served by the pump station. The minimum peak hourly waste water flow to the station shall be calculated using the design daily wastewater flow in conjunction with a peaking factor determined from the following equation:

$$PF = \frac{Q_{phf}}{Q_{ddf}} = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Where:

PF = peaking factor

$Q_{phf}$  = peak hourly flow (gallons per day)

$Q_{ddf}$  = design daily flow (gallons per day)

P = service population (thousands)

The above equation yields a peaking factor that is intended to cover normal infiltration and inflow for well-maintained and constructed sewer systems. In no case shall the peaking factor be less than 2.5 for any pump station.

3. Peaking factors for stations conveying industrial or process wastewater shall be based on actual operating conditions, but in no case shall the peaking factor be less than 2.5.
4. Pump capacity shall also be based upon the need to maintain a minimum force main velocity of 2 fps.
5. Selection Methodology
  - a. Pump selection shall be based on a hydraulic analysis of the system. The design operating point(s) of the pump(s) shall be determined using a pump curve-system curve analysis for all TDH requirements for the lifetime of the station.

- b. A system curve, plotting TDH versus capacity, shall be developed for all operating conditions. TDH for the system shall be calculated by summing the following:
  - i. Static head requirements for both the suction and discharge sides of the pumps shall be evaluated including intermediate high points in the force main and the discharge elevation.
  - ii. Friction head requirements for the suction and discharge sides of the pumps shall be evaluated. The friction head shall be calculated using the Hazen-Williams formula:

$$h_f = L \left( \frac{4.73Q^{1.85}}{C^{1.85} D^{4.87}} \right)$$

Where:

$h_f$  = friction head for pipe segment (feet)

L = length of pipe segment evaluated (feet)

Q = pumping rate (ft<sup>3</sup> per second)

C = Hazen-Williams coefficient

D = diameter of pipe segment evaluated (feet)

Conditions shall be evaluated including, multiple pump operation within the subject force main, simultaneous pump station operation for common force main situations and the possibility for gravity flow conditions in force main segments with extreme negative slopes that may not flow full.

- iii. Head derived from minor losses of valves and other fittings shall be evaluated.
  - iv. If applicable, the pressure head at the junction of the existing force main shall also be evaluated, considering the effects of simultaneous pump station operation and multiple pump operation in other pump stations.
- c. System curves shall be evaluated for present day and conditions that may exist over the expected lifetime of the pump station.
  - i. The following maximum values shall be allowable for C:

Pipe type	Initial Service	End-of-Service C
DI	125	100
PVC	140	120
HDPE	140	120

Friction head and minor losses shall be evaluated for initial condition and the end-of-service condition.

- iii. The design operating point(s) shall be the intersection of the pump curve and the calculated system curve(s)

- d. Pumps shall be selected such that all design-operating points are on the pump curve as supplied by the manufacturer. Pumps shall be selected such that the net positive suction head available (NPSH<sub>A</sub>) shall be greater than the net positive suction head required (NPSH<sub>R</sub>) at each of the design operating points.
- e. Pumps shall be selected such that the pumps will not cavitate. Freewheeling (i.e., operating at pump run-out) or deadheading (i.e., operating at pump shut-off) of pumps shall not be allowed.
- f. Pumps shall be selected so operating efficiency is maximized during all hydraulic conditions over the lifetime of the pump station.
  - i. Consider minimizing motor speeds during the pump selection process.
  - ii. The horsepower rating of each pump motor shall be at least 1.15 times that required by the pump when operating at all design operating conditions.
  - iii. The selected pumps and motors shall operate at the most economical efficiency under average daily flow conditions.

#### 6. Cycle and Pump Run Times

- a. Constant speed pumps shall be cycled such that the number of starts are minimized and resting times are maximized to avoid overheating and overstressing of the pump motor.
  - i. Automatic pump alternation shall be provided.
  - ii. Pumps shall be designed to operate between two and eight times per hour at design daily flow (DDF).
  - iii. The following equation shall be used to determine the active storage volume (between pump on and pump off elevations).

$$V = TQ_{ddf} \left( 1 - \frac{Q_{ddf}}{Q} \right)$$

Where:

V = active volume within the pump station (gallons)

T = allowable cycle time between starts (minutes)

Q<sub>ddf</sub> = design daily flow to pump station (gallons)

Q = pumping rate of a single pump (gallons per minute)

- iv. If less than two cycles per hour will occur at DDF, or if the station is to provide equalization of hydraulic surges, measures to control odor and corrosion shall be employed when detention times cause septic conditions.
- b. PWC may allow using variable speed pumps for main pump stations or stations

that discharge into a wastewater treatment facility, only if constant speed pumps are not applicable or practical.

- c. Pump run times shall be such that excessive wear of the pumps does not occur.
- d. At DDF, adequate time shall be provided to allow a constant speed pump to "ramp up" to full speed before the pumping cycle ends and shall not be less than or greater than those recommended by the pump manufacturer.

## E. PUMP STATION DESIGN

### 1. General Requirements

- a. Pump stations shall be designed to contain influent wastewater and minimize I/I.
- b. Pump stations shall ordinarily be the above-ground type, although submersible-type lift stations may be used on a case by case basis, with approval from PWC.

### 2. Location and Access

- a. Pump stations shall be located and designed to minimize the development of nuisance conditions (i.e., noise, odor, etc.) in the surrounding area.
- b. Pump station sites shall be accessible by an all-weather roadway from a hard surface road. Wherever practicable, the roadway shall be located a minimum of two (2) feet above the 100-year flood elevation, as identified on the most recent FEMA FIRM map and shall accommodate the largest vehicle expected to service the station. The road shall be a minimum width of 12 feet and shall be constructed of 6-inches compacted ABC.
- c. A 6-inch compacted ABC turn-around area of located within the site of sufficient size shall be provided to accommodate maintenance vehicles.
- d. Surface water shall be directed away from the pump station in all directions.

### 3. Wet Wells

- a. Wet wells shall have the interior walls painted in accordance with Technical Specifications, Division 09800.
- b. Buoyancy shall be considered and flotation of wet wells shall be prevented with appropriate construction where high groundwater conditions are anticipated.
- c. Surface water shall be directed away from the station pad in all directions.
- d. Wet wells, and the access road to the site, shall be located a minimum of two (2) feet above the 100 year base flood elevation.

#### 4. Security

- a. Access to pump station structures/equipment/appurtenances shall be restricted.
  - i. All entry into pump station shall be locked.
  - ii. Fencing shall be six (6) feet in height and of sufficient material to deter entry. Locked gates, a minimum of 12-feet wide, shall be provided to allow vehicular access.
- b. The pump station shall have outdoor area light with a minimum of 100-watt high pressure sodium bulb mounted a clear height of 15 feet above the ground, and indoor lighting for daylight and non-daylight hours activities for pump station maintenance.
- c. Safety placards, as required by OSHA, shall be provided and be readily visible.
- d. A Pump Station identification sign shall be posted, with the name, emergency number, and instructions to call in the event of an alarm condition or other emergency.

#### 5. Structural Design

- a. Materials of Construction
  - i. Pump station shall be in complete compliance with all Federal, State and local codes and OSHA standards.
  - ii. Materials for station shall be based on installation and operating factors such as:
    - a) Physical, chemical, and biological wastewater characteristics.
    - b) Corrosive gas production.
    - c) Soil characteristics.
    - d) Groundwater presence.
  - iii. Pump station structures shall be separated unless made watertight and gas-tight.
  - iv. Pump station structures shall be protected from vehicular traffic.
    - a) All interior walls located in the wet well or subject to hydrogen sulfide gases shall be protected in accordance with PWC Standard Specifications, Division 09800.



b. Buoyancy Protection

- i. Below-ground pump station structures shall be protected from the buoyant forces of groundwater and shall be demonstrated through the use of flotation calculations.
  - a) Flotation calculations shall assume that the groundwater table is at ground elevation.
  - b) Calculations shall not add the weight of the pumps, piping, appurtenances, or wastewater in the station, in the downward forces used to counteract buoyancy.
  - c) Saturated weight of any soil above the extended footing of the pump station structure shall be allowed in the flotation calculations.
  - d) Flotation calculations shall show pump station structures will be protected from buoyancy with a safety factor greater than 1.0.

c. Flood Resistance

- i. Station structures and equipment/appurtenances shall be protected from the 100-year flood.
  - a) Protection shall ensure that the station shall remain fully functional during a 100-year flood.
  - b) Protect from floodwaters by elevating structures at least two-feet above the 100-year flood elevation.
- ii. The 100-year flood elevation is identified on the most recent FEMA FIRM.

d. Solids Collection

- i. Wet wells shall be designed with fillets and sloped floors such that solids are moved toward pump suction piping. No projections within the wet well which would allow deposition of solids under normal operating conditions shall be allowed.

e. Depth

- i. Pump Submergence Depth
  - a) Sufficient submergence of the pump or pump suction piping shall prevent vortexing within the wet well.
  - b) In no case shall the all pumps-off activation level be less than the minimum level required for successful pump operation, as recommended

by the pump manufacturer. Wet wells shall be provided with the depth required to maintain the active storage volume and the emergency storage volume as defined in PWC Standard Specifications Section 02753.

## 6. Piping and Valves

### a. Suction and Discharge Piping

#### i. Pumps shall be provided with separate suction and discharge piping systems.

a) Suction and discharge piping shall be no less than four inches in diameter unless the pump is capable of grinding, chopping, or cutting solids.

b) Suction and discharge piping shall have a velocity of between two and eight feet per second with sufficient valves to effect proper operation and maintenance of the pump station during both normal and emergency conditions.

c) Valves shall be suitable for use with raw, unscreened wastewater, as well as the normal and maximum operating pressures expected at the pump station.

1) A full closing shut-off valve shall be on the discharge piping of each pump and on the suction piping of each drywell pump.

2) A check valve shall be on the discharge piping of each pump, between the pump and shut-off valve. Check valves shall be equipped with counter weights and/or springs to prevent water hammer and back siphoning. Check valves shall be placed horizontal unless of ball check-type.

3) A plug valve shall be provided on the suction piping between the pump and the wet well if a potential exist for the wet well water level to rise above the pump suction elevation in wet well, dry well applications.

d) All valves shall be readily accessible. Gate valves located greater than six (6) feet above floor elevation shall be furnished as chain operated. If valves are to be installed in a wet well, the shut-off valve shall be provided with an extension handle.

### b. Pipe Connections

i. Flexible pipe joints shall be used on pipes between the pump station structures.

ii. Pipe inlets and outlets shall be made watertight.

iii. Core-drill or saw-cut when connections are made through existing the

structure wall, hammer taps are not allowed.

c. Water Service

- i. Wherever practicable, water service shall be provided to the station.
- ii. Cross-connection control for potable water services shall be provided in accordance with PWC Cross Connection requirements. Cross-connection control for reclaimed water services shall be provided in accordance with the proper regulations.

d. Bypass Pumping

- i. Connections shall be provided to allow emergency bypass pumping to occur. The bypass pumping shall have quick connect couplings, as indicated in the standard detail for above-ground lift stations.

7. Appurtenances

- a. Consideration shall be given to protecting pump station structures and equipment from physical damage or clogging from solid material normally present in wastewater through the use of screening and other solids reducing equipment.

b. Pump Removal Methods/Equipment

- i. Provisions shall be made so that the largest piece of equipment installed at the pump station may be removed, which may include hoisting equipment or designing clearance around the pump station for mobile hoisting equipment access.
- ii. Station structures shall have access hatches, doors, skylights, etc. of sufficient size such that the largest piece of equipment may be removed without damaging the integrity of the structural design.
- iii. If approved by PWC, stations utilizing submersible pumps in wet wells shall provide for the removal and installation of the pumps without requiring entry into the wet well.
  - a) Each pump shall be provided with guide rail and a lift-out cable. Rail system and the lift-out cable shall be capable of withstanding the forces required to disengage the pump from the wet well. Rail system and the lift-out cable shall be stainless steel or other corrosion-resistant material approved by PWC, excluding use of steel or galvanized steel.

c. Access Equipment

- i. Insure access for operation and maintenance is easy, unobstructed, and safe. Each station structure shall have separate means of access. Under no circumstance shall access to the wet well be provided through a drywell. Steps, ladders, stairs, landings, hatches, and other means of access shall

conform to OSHA standards and local and state building codes.

d. Ventilation Equipment

- i. Stations shall be adequately vented in complete compliance with local and state building codes as well as OSHA and NFPA standards. At a minimum, pump station wet wells shall be provided with a gooseneck-type vent. Active ventilation units shall also be acceptable. Vents shall be two (2) above 100-year flood elevation, comprised of sturdy material resistant to ultraviolet light and adequately supported to withstand damage during normal and emergency operation and maintenance. Vents shall be provided with an insect/bird screen of stainless steel, aluminum, and corrosion-resistant material. Under no circumstances shall steel or galvanized steel be used.
- ii. Drywells or other enclosed pump station structures into which routine operator entry is required shall either have a positive-pressure ventilation system that meets, at a minimum, the requirements of NFPA 820 "Standard for Fire Protection in Wastewater Treatment and Collection Facilities." Consideration shall be given to installing sensor and alarm systems to detect the accumulation of dangerous levels of hazardous gases.

e. Other Equipment

- i. Consider controlling station temperature and humidity to a level appropriate for reliable operation of the electrical and instrumentation/control systems.
- ii. Station structures other than the wet well shall be provided with a means to remove accumulated water and wastewater from the structure. All floor and walkway surfaces shall be sloped to an appropriately sized drainage pipe. Drainage pipe shall convey wastewater to the wet well or wastewater collection system and shall be higher than the high-water alarm activation level or the maximum water level expected. The drainage pipe shall be provided with device to prevent backflow of wastewater and gases from the wet well into the structure.

F. ELECTRICAL DESIGN

1. General Requirements

- a. Electrical systems for pump stations shall be designed and installed in strict conformance with NFPA 70 "National Electric Code," ANSI, as well as all applicable federal, state, and local codes. Electrical and instrumentation/control systems and components shall be protected against corrosive conditions.
- b. If located in a wet well or other location where explosive or flammable gases may concentrate, electrical and instrumentation/control systems and components shall meet the requirements for a Class I, Group D, Division 1 location.
- c. Each pump and motor unit shall be provided with a separate electrical supply, motor starter, alarm sensors, as well as electrical and instrumentation/control

systems and components.

- i. Electrical and instrumentation/control systems and components shall be located such that they may be disconnected from outside a wet well.
  - ii. Cables and conduits shall be provided with seals, which are both watertight and gas-tight, and shall be protected from corrosion, and allow separate strain relief.
- d. The main power feed to all pump stations shall be equipped with an above-grade, fused disconnect switch.

## 2. Enclosures

- a. Enclosures for electrical and control components for the pump station shall be located outside of the wet well and in a location such that they are readily accessible, ensure maximum electrical and personnel safety, and are protected from damage due to vehicular traffic and flooding.
- b. Enclosures shall have a NEMA-rating that is appropriate for the installation location at the pump station.
  - i. If not housed, enclosures shall have a minimum NEMA 3R rating. NEMA 4X enclosures shall be used in locations where the potential for flooding and the development and accumulation of corrosive gases exist. However, PWC recommends the use of NEMA 4X enclosures for all outdoor installations.
  - ii. Enclosures shall be protected by a conduit seal or other appropriate sealing method that meets the requirements of NFPA 70 to protect the wet well atmosphere from gaining access to the enclosure. This seal shall be located such that it will not be disturbed during routine operation and maintenance functions at the wet well for a Class I, Division 2 location.
- c. All enclosures as well as all switches and indicator lights, whether mounted on an inner door or face of the enclosure, shall be provided with a label that conforms to UL descriptions and procedures.
  - i. The applicant's lock-out/tag-out procedures shall be considered in the design of all enclosures to be installed at the pump station.

## 3. Instrumentation and Controls

- a. Wastewater Level Sensing Equipment
  - i. Pump station cycles shall be controlled by wastewater level sensing equipment in the wet well.
  - ii. At a minimum, wastewater levels within the wet well shall be detected by sealed mercury-type float switches. In the event that an alternate method of

level detection (i.e., bubble tube, ultrasonic meter, etc.) is used, a float switch at the high-water alarm level shall be installed as a back up.

- iii. Wastewater level sensing equipment shall be unaffected by flows, etc., entering the wet well.

b. Components

- i. The pump station shall be equipped with sufficient instrumentation/control systems and components to monitor and control key operating conditions.

c. Pump Station Function

- i. Each pump installed at the pump station shall be provided with a "Hand-Off-Auto" select or switch.
- ii. Each pump installed at the pump station shall have a cumulative pump run timer for each pump.
- iii. Sufficient indicator lights shall be used to demonstrate the operational status of the pump station. At a minimum, lights shall indicate a pump on condition and a pump alarm/failure condition.
- iv. Weatherproof audible and visual alarms that are external to any structure or enclosure shall be provided at the pump station. In the event of a power loss at the pump station or a failure of the automatically activated stand-by power generation source, the alarm system shall be operated from a battery back-up power source provided with continuous charge. The following minimum conditions shall be monitored, and shall cause activation of the audible and visual alarms:
  - a) Pump Failure.
  - b) Wastewater level sensing failure (if applicable).
  - c) High water in the wet well.
  - d) High-water level in the drywell sump (if applicable).
  - e) Loss of telemetry transmission line (if applicable).
  - f) Loss of power supply.
  - g) Automatically activated stand-by power generation source failure.
- v. It is required that a telemetry system be installed at all pump stations and inspected once a week. The telemetry system shall meet all PWC standards. Stations not connected to a telemetry system (approved PWC variance) shall be inspected everyday including weekends and holidays.

- a) The telemetry system shall contact personnel capable of initiating a response to a pump station alarm condition 24 hours per day, 365 days per year.
- b) In the event of a power supply loss or a failure of the automatically activated stand-by power generation source, the telemetry system shall be operated from a battery back-up power source with continuous charge.
- c) At a minimum, the telemetry system shall be activated for any of the following alarm conditions: high water in the wet well, pump failure, loss of power supply, and automatically activated stand-by power generation source failure.

d. Appurtenances

- i. 110-volt electrical receptacles shall be provided for maintenance. Outdoor receptacles shall be ground fault interruptible type protected from the weather.
- ii. The pump station shall be provided with an automatically activated standby power generation source. All privately maintained pump stations shall meet the criteria set forth in this design manual and the State regulations.

4. Reliability

- a. One of the following reliability options shall be incorporated into the pump station design:
  - i. The pump station shall be connected to multiple power sources (PWC approved variance).
    - a) A multiple power source shall be defined as a completely separate power feeder line(s) connected to the pump station from a substation or transformer that is independent from the primary feeder.
    - b) Each separate substation or transformer and associated transmission lines shall be capable of starting and operating the pump station at its rated capacity.
  - ii. The pump station shall be connected to an automatically activated stand-by power generation source with automatic reset.
    - a) The generation unit shall be capable of powering the pump motors' starting current, electrical systems, instrumentation/controls and alarm systems, and other auxiliary equipment as may be necessary to provide for the safe and effective operation of the pump station.
    - b) The generation unit shall have the appropriate power rating to start and continuously operate under all connected loads.

- c) The generation unit shall be provided with special sequencing controls to delay lead and lag pump starts unless the generating unit has the capacity to start all pumps simultaneously while the auxiliary equipment is operating.
  - d) The generation unit shall be protected from operating conditions that would result in damage.
  - e) The generation unit shall be capable of shutting down and activating the audible and visual alarms and telemetry (if applicable) if a damaging operating condition develops.
  - f) The generation unit shall be protected from damage when restoration of the power supply occurs.
  - g) The generating unit shall be located in a building structure or otherwise protected from the weather elements and shall be adequately ventilated.
  - h) The generation unit shall be provided with on-site fuel storage. In no case shall the fuel storage be less than that needed to operate the generating unit for 12 continuous hours.
  - i) Stations that provide reliability through the use of permanent generation units used in conjunction with manual transfer switches shall meet the telemetry system and wet well storage requirements.
- b. Demonstrate a history of power reliability for the power supply serving the pump station.
- i. This option is available only to those pump stations whose failure would impact surface waters that are classified as C in accordance with 15A NCAC 2B .0100.
  - ii. Three years worth of data from the power supplier shall be obtained and examined to determine the maximum power outage time at the pump station. Storage shall be provided in the wet well above the high-water alarm level to hold the wastewater expected to become tributary to the pump station over that period of time.
  - iii. Utilizing this option to demonstrate pump station reliability shall be at the applicant's own risk, and the applicant shall be aware that selection of this option does not relieve the applicant of liability or future enforcement problems should a discharge of wastewater occur at the pump station. It is very strongly recommended that, at a minimum, a telemetry system be installed at the pump station, if this reliability option is selected.



## G. FORCE MAIN DESIGN

### 1. Material

- a. Pipe material and specifications shall be selected based on the installation and operating conditions of the force main following installation. Such factors shall include, but shall not be limited to:
  - i. Installation depth and overburden pressure.
  - ii. Soil conditions and groundwater presence.
  - iii. Corrosion resistance from both external and internal sources.
  - iv. Strength required to withstand internal pressures expected during normal operation as well as those resulting from hydraulic surges and water hammer.
- b. Force main materials shall be in accordance with PWC Standard Specifications.

### 2. Force Main Diameter

- a. A minimum four-inch force main shall be used unless the force main is served by pumps capable of grinding, chopping, or cutting solids, or a mechanical means of reducing the size of a three-inch solid and any trash or stringy material that can pass through a four-inch hose is installed in the pump station.

### 3. Velocity

- a. Wastewater velocity occurring in a force main shall be calculated using the continuity equation:

$$v = \frac{0.409Q}{D^2}$$

Where:

v = velocity (feet per second)

Q = pumping rate of single pump (gallons per minute)

D = diameter of pipe segment evaluated (inches)

- b. A self-cleansing velocity of at least two feet per second shall be provided.
- c. 90° bends will not be allowed on force mains.

### 4. Accumulation of Solids

- a. Consider preventing or alleviating the accumulation of solids in the force main by providing one or more of the following:
  - i. Velocities of between three and five feet per second. Velocities greater than

eight feet per second are unacceptable.

- ii. Drain or blow-off valves provided at all low points in the force main, designed to prevent discharge during operation.

#### 5. Anchorage

- a. Force mains shall be adequately anchored with thrust blocks or RJ pipe bends, tees, plugs, and at any other location where a change in flow direction occurs.

#### 6. Surge and Water Hammer

- a. Consider analyzing force mains in conjunction with associated pump stations with respect to the development of hydraulic transients.
- b. Force main design shall be such that active devices for control of transient hydraulic conditions are minimized to the greatest extent possible. However, if this is not feasible, the following shall be acceptable control strategies:
  - i. Variable-speed pumps or constant-speed pumps in combination with control valves that open and close slowly.
  - ii. Providing air-scouring velocities in the force main.
  - iii. Construction of the force main using a higher-strength pipe.
  - iv. Vacuum relief valves.
  - v. Specialized control and/or release valves and other devices designed to prevent transient pressures from reaching levels that could damage the pump station and force main systems.

#### 7. Appurtenances

- a. Air Release and Vacuum Relief Valves
  - i. The route of the force main shall be such that the, number of air release and vacuum relief valves are minimized. An air release valve shall be provided at all high points where the distance between the low point and high point in the force main exceeds 10 vertical feet.
    - a) Automatic or manual air release valves shall be acceptable.
    - b) Consider using manual air release valves in lieu of automatic air release valves or providing automatic air release valves with flood protection in areas within the 100-year floodplain or anywhere flooding is anticipated to occur. Automatic air valves shall be of the quick-opening, slow-closing type to prevent the development of hydraulic surge conditions.
    - c) If possible, force mains should be designed without high points and with

the top of the force main below the hydraulic grade line at the minimum-pumping rate so that air release valves will not be needed. If elimination of high points is not feasible, a manual air-release valve should be installed at each significant high point where air could become trapped. A high point may be considered significant if it is two feet or more above the minimum hydraulic grade line or when pumping is intermittent above the static head line.

- d) The maximum interval between air release valves should not exceed 1,500 feet as measured horizontally along the pipe centerline.
  - e) Where the invert elevation of a force main exceeds the hydraulic grade line, the Engineer shall ensure that the force main pipe is of sufficient strength to withstand the internal vacuum, which will exist in the line during maximum service discharge. Upon request, the Engineer shall supply PWC with documentation demonstrating that the deflection of the pipe due to vacuum will not cause leakage.
  - f) Air release valves for wastewater force mains shall be installed as shown in the Standard Details.
- ii. Consider locating vacuum relief valves at locations along the force main where sub-atmospheric pressures or column separation may occur.

#### H. MINIMUM SEPARATIONS BETWEEN FORCE MAINS AND STREAM CROSSINGS/PRIVATE PUBLIC WELLS

- 1. Force mains shall be routed such that the number of stream crossings is minimized. The crossing shall be as nearly perpendicular to the stream flow as possible. Ductile iron pipe with joints equivalent to water main standards shall be used to construct force mains that cross-streams.
- 2. Ductile iron pipe with flanged joints, with adequate supports, shall be used for aerial stream crossing. Supports shall prevent frost heave, overturning, and settlement, freezing, heaving, and the impact of floodwaters and debris shall be considered during the design of aerial crossings. The bottom of the force main pipes shall be placed no lower than the elevation of the 25-year flood stage of the stream.
- 3. Force mains shall not be closer than 25 feet from any private water supply well or 50 feet from a public water supply well.

#### I. QUALITY ASSURANCE AND QUALITY CONTROL

- 1. Six Operations and Maintenance (O&M) Manuals shall be prepared for each pump station and shall be made available to PWC upon start-up of the pump station/force main system.
- 2. A copy of the O&M Manual shall be kept at PWC's main office. The O&M Manual shall be kept on file for the life of the pump station and updated as required.

3. At a minimum, O&M Manuals shall contain the following information:
  - a. Approved shop drawings, including design data for all installed equipment and each major component and a pump curve/system curve analysis showing the design operating point(s).
  - b. Control panel wiring diagrams.
  - c. Warranty information for all installed equipment and each major component.
  - d. Inventory, functional descriptions, and complete operating instructions for all installed equipment and each major component.
4. Instructions for start-up/shut-down as well as for calibration and adjustment of all installed equipment and each major component.
  - a. Recommended maintenance management system, including preventative and predictive maintenance, for all installed equipment and each major component.
  - b. Contingency plan and analysis of critical safety issues.
  - c. Contact information for local service companies as well as instructions for replacement of all installed equipment and each major component.
  - d. Contact information for local contractors capable of performing emergency repairs.
  - e. Contact information for regulatory and other agencies.
5. Testing
  - a. Refer to Master Specifications for sanitary sewers and manholes, force mains, pump stations and electrical.

# CHAPTER THREE

## WATER DISTRIBUTION DESIGN GUIDELINES

### I. GENERAL

#### A. LOCAL PERMITTING AUTHORITY

In December 2003, PWC initiated its delegated Local Permitting program. In accordance with applicable North Carolina State Statutes, PWC has been given the authority to issue permits for the construction of new water lines. This authority extends to those systems that will not be owned, operated, or maintained by PWC.

##### **What Projects can PWC Permit?**

For those water systems that have a master meter with PWC, and that system is owned, operated, and maintained by another entity, and that entity does not have its own Public Water Supply Identification number (PWS ID), PWC has the authority to permit any water extensions/expansions for that system. For example, under this scenario, PWC would be the permitting authority for Fayetteville State University, Methodist University, Goodyear, etc.

However, if the entity has a PWS ID number, owns, operates, and maintains its system; the water permit is reviewed and issued by the State. Therefore, PWC would not permit any water extensions/expansions by Brookwood-Lagrange, Spring Lake, Fort Bragg, the Eastover Sanitary District, or within the Town of Stedman. However, since PWC has an operation and maintenance (O&M) agreement with the Town of Stedman, PWC will review all plans for water extensions, prior to being sent to the State for permitting. In cases where PWC has an O & M Agreement, the water system shall be designed in accordance with the PWC Standards.

For those systems owned, operated, and maintained by PWC, PWC will be the permitting authority.

All other projects not meeting the above criteria need to be permitted through the State of North Carolina. For further information on permits issued by the State, please refer to: <http://www.ncwater.org/pws/>

- B. All public water distribution systems that are to be owned, operated, and maintained by the Public Works Commission shall be constructed in accordance with PWC requirements. All plans and subsequent revisions shall be reviewed and approved by PWC prior to beginning construction. The water distribution system shall adhere to all requirements of PWC's extension policy, unless otherwise approved by PWC. The public water distribution system shall be designed in accordance with the minimum requirements of Title 15A, Subchapter 18C of the North Carolina

Administrative Code, “Rules Governing Public Water Systems” (most recent edition), this Design Manual, PWC Standard Specifications, and PWC Standard Details. Where discrepancies occur, the more stringent shall apply.

- C. For those public water distribution systems that PWC will not own, operate, or maintain, but PWC is the permitting authority, the public water distribution systems shall be in accordance with the minimum requirements of Title 15A, Subchapter 18C of the North Carolina Administrative Code, “Rules Governing Public Water Systems” (most recent edition).
- D. Residential and commercial developments shall connect proposed water extensions to the PWC water system at the Developer’s expense. Construction shall be in accordance with PWC Standards, Details and Specifications and designed to provide adequate flow and pressure for both domestic supply and fire protection.
- E. Private community water supply systems or individual wells shall be in accordance with the minimum requirements of the North Carolina Division of Health Services, Environmental Management, or Department of Environment and Natural Resources, as applicable. Connections to the PWC water supply system, if approved, shall be subject to PWC requirements.
- F. PWC and the City of Fayetteville, North Carolina Cross Connection Control Ordinance (as amended) shall be adhered to and coordinated with the PWC System Protection Department. Please call 910-223-4699 for additional information regarding backflow requirements and cross-connection issues.
- G. All taps on a PWC water main shall be made by a licensed utility contractor. The Public Works Commission shall observe and approve all connections to PWC water mains. All taps shall be made in accordance with PWC requirements.

## **II. HYDRAULIC DESIGN AND DEMAND**

- A. The Design Engineer shall perform an analysis of all proposed extensions, in order to verify the development meets the fire flow requirements. The design data shall include a sketch of the proposed system, pipe roughness coefficient, fixed nodes, elevations, supply, demand, hydrant flow test (usually provided by PWC) and all calculations for fire flow requirements and domestic water demands. Extended period analysis will not be required.
- B. The developer shall be responsible for ensuring that the development meets the minimum fire flow and pressure requirements. A flow test will be provided by PWC at the fire hydrant closest to the proposed development, upon request from the developer or their Design Engineer.
- C. Average daily flow may be estimated at 85 gallons per person per day with 2.77 persons per household. This estimate should be modified as necessary based on specific zoning and land use data. Maximum daily flow and peak hourly flow shall be determined as follows:

Maximum daily flow = Average daily flow times 1.5

Peak hourly flow = Average daily flow times 2.1

- D. Instantaneous demand for residential areas shall be based on the number of 1-inch service connections. Instantaneous demand for business and industrial development shall be based on detailed analysis of water volume and usage patterns for the particular type of development.
- E. The water distribution systems and any extensions shall be designed to supply for the demand of all customers while maintaining the following minimum pressure and velocity.
  - a. 40 psi for maximum daily flow
  - b. 30 psi for peak hourly flow
  - c. 20 psi for instantaneous flow plus fire flow.
  - d. 4 fps for flushing
  - e. 3 to 6 fps for normal working conditions
- F. The water distribution system and any extensions shall be designed to supply for at least the minimum fire flow required in Appendix B (Fire-flow Requirements for Buildings) of the North Carolina Fire Code (most recent edition).
- G. Mains 12 inches in diameter and larger shall be designed to deliver maximum daily design flow with a head loss not to exceed 5 feet per 1,000 feet. Lower head loss criteria may be established based on length of main and available system head. Distribution mains 8 inches in diameter and smaller shall meet the same criteria for maximum daily domestic demand, but head losses up to 10 feet per 1,000 feet are acceptable for fire flow design provided volume and residual pressure requirements are met. Designs shall be based on a Hazen-William "C" value of 120.

### **III. WATER DISTRIBUTION SYSTEM**

#### **A. MATERIALS**

1. **WATER MAINS** - Water mains shall be constructed of polyvinyl chloride (PVC), high-density polyethylene, or ductile iron. Water mains which are 12 inches or less in diameter can be polyvinyl chloride (PVC), while any water mains greater than 12 inches in diameter shall be ductile iron.
2. **WATER LATERALS** - Water laterals shall be constructed of HDPE or copper. Other materials for laterals shall be approved by PWC prior to construction.
3. All materials for mains and laterals shall be in accordance with the technical specifications, details, and other requirements within this Manual.

## B. LOCATION - WATER MAINS

1. Water mains shall be located within dedicated street right-of-ways, except if existing conditions, underground utility conflicts, or requirements of NCDOT do not permit. Location in a dedicated permanent easement may be required by PWC. Water mains located in an easement shall be centered within an adequate easement width to allow excavation, maintenance, and unrestricted access and free of obstruction. The minimum easement width acceptable to PWC is 20 feet.
2. Within streets maintained by the City of Fayetteville, the main shall be located 10 feet from the sewer main and under the proposed pavement or five (5) feet inside the back of the curb or asphalt. Within NCDOT maintained streets, an encroachment must be approved. Generally, along NCDOT roads, water mains are located outside of pavement, a fixed distance from the edge of pavement or back of curb. No water main shall be designed closer than six (6) feet to the edge of pavement of an NCDOT maintained highway. The alignment should be chosen so as to minimize conflicts with utilities and underground structures, and to minimize the need for additional easement outside of the right-of-way. However, PWC does reserve the right to require that new lines be installed in an easement outside of the NCDOT right of way.
3. Water mains shall not be located closer than 20 feet horizontally to buildings or substantial surface structures. Water mains located closer than 20 feet shall be approved by PWC. If it is necessary to have a water main closer than 20 feet, the water main shall be ductile iron. The Design Engineer shall provide adequate precautions and design considerations to protect existing structures from damage/undermining due to pipe failure (break, leakage, etc.).
4. Water mains should be designed to be located on the "higher" side of the right-of-way street cross section. Where one side of roadway has a fill slope the water main should be placed on the other side of the road to allow for protection of the roadway and main should a leak occur.
5. Main extensions in and/or along the street to serve a property or subdivision shall be extended in accordance with the current PWC policy.

## C. LOCATION - WATER SERVICES

1. Plans for projects which propose the creation of lots shall include the provision of water services to each lot, including any residual parcels and areas reserved for future lots. The size of the lateral shall be a minimum of 1 inch. The location of services and the size of the lateral shall be based upon the anticipated use of the lot and require PWC approval. PWC may agree to waive its requirement that water services be installed



to each lot within non-residential subdivisions if there is sufficient information available to permit proper sizing of services and they can be conveniently installed at the time service is requested.

2. PWC requires individual water and sewer services to each building, tenant space or customer. If the building is single use, only one (1) service is required. For those buildings with multiple uses, each tenant/space shall be served with an individual service, unless otherwise approved by PWC.
3. An individual water service shall be provided for each residential lot.
4. Water meter boxes shall be set in accordance with the PWC Standard Detail, located 18 inches inside the street right-of-way at the center of the lot for which service is installed, and located 18 inches away from the sanitary sewer cleanout, unless approved otherwise.
5. Water meter boxes shall not be located within driveways, sidewalks, or other paved areas subject to vehicular traffic unless approved otherwise.
6. Water meter boxes shall not be installed within a ditch slope. Where the right-of-way limit for a street is within a ditch slope, the meter box shall be installed a minimum of 2.5 feet behind the top of the ditch bank.
7. Easements dedicated for PWC maintenance shall be provided for all water meter boxes not located in existing rights-of-way.
8. Water services shall be located perpendicular to the main, unless otherwise approved by PWC.
9. Water services for commercial facilities should be designed in accordance with the following table:

Lateral Size	Meter Size
1-inch	1-inch or 5/8 inch
2-inch	1-1/2 inch or 2-inch
4-inch	3-inch or 4-inch
6-inch	6-inch
8-inch	6-inch or 8-inch
Note: 4-inch and larger laterals require the installation of a meter vault, in accordance with PWC standard detail W.20.	

10. All water meters shall be located outside of the building in accordance with PWC standards. All meters shall be located a minimum of five (5) feet from the building.
11. All existing services that are not to be used in the current development shall be killed out at the main by closing the corporation stop and cutting

the pipe off at the corporation.

#### D. LOCATION OF AIR RELEASE VALVES

1. Mains 12-inches or larger in diameter, which have a change in elevation of ten (10) feet or greater, shall have an air release valve installed at the highest elevation of such change, unless otherwise approved by PWC.
2. PWC may require air release valves in other instances where, in the opinion of the Department Engineer, the possibility of excess quantities of air accumulating in the proposed main exists.
3. Automatic air release valves shall be installed in accordance with PWC Standard Detail.

#### E. LOCATION OF BLOW-OFFS AND DEAD END HYDRANTS

1. Dead ends on mains shall be provided with a two-inch blow-off at the terminal end. Materials and installation shall be in accordance with PWC standards.
2. Banks of meters shall be provided with a one-inch blow-off or irrigation service as shown in the PWC Standard Detail.
3. All water lines shall be terminated with blow-offs located on property corners whenever possible.
4. Provide a hydrant in severe sags as directed by PWC.
5. The blow-off or fire hydrant shall be located as to provide proper drainage and minimize impacts to any adjacent property or structures.
6. Provide a fire hydrant near the end of mains 12-inches and larger to facilitate flushing.

#### F. MAINS

1. In the PWC system the minimum nominal pipe diameter for new installations of water supply distribution system mains providing fire flow shall be eight (8) inches. Two (2) inch diameter lines may be used within residential subdivisions only for a maximum length of 1,000 feet where fire flow requirements and minimum hydrant spacing is provided by eight (8) inch and larger mains. No more than 20 residential customers may be served from a dead end two (2) inch main and no more than 40 residential customers may be served from a looped two (2) inch main.

If in an area that is operated and maintained, but not owned by PWC the lines should be sized according to demand. Materials shall be in

accordance with PWC requirements.

There may be cases in which a line is being replaced, retrofitted, or rehabilitated in which it will be acceptable to replace the line with the same size main if there are no advantages to upsizing the main. PWC will review these scenarios and determine what is allowable on a case by case basis.

2. Parallel mains shall be used anytime a design involves a multilane (defined as four (4) lanes or more) road so that services and hydrant branches are not crossing all lanes of traffic unless otherwise approved by PWC. Parallel mains may be required on streets with less than three (3) lanes, as required by PWC.
3. Water mains shall be designed with a minimum cover of 3.5 feet, as measured to the top of main. If existing conditions warrant greater or lesser depths of cover than allowed, special design measures, such as using ductile iron pipe or using restrained joint ductile iron pipe, for installations or additional easement widths for deeper installations may be required by PWC. For large diameter transmission mains (16-inches and larger), the main shall be deep enough to allow for the gate valves to be installed upright. Placing the valves sideways and utilizing bevel gearing shall only be done with prior approval of PWC.
4. Water mains utilizing ductile iron restrained joint pipe shall be designed in accordance with the applicable AWWA standards and manufacturer's instructions. The use of factory restrained joint ductile iron pipe shall be in accordance with PWC technical specifications.
5. Valves shall be placed in a manner that will allow for future extension without interruptions of current services. The main shall be extended across the last lot which is served and shall have service connections which are perpendicular to the main. No service connections shall be allowed beyond the last valve on the line. Stub outs shall extend a minimum of five (5) feet beyond the pavement and shall be properly restrained. Existing stub-outs shall be shown on plan view with "As-Built" distances.
6. Fittings, including valves, shall be shown on the plan view for all intersecting water mains and at fire hydrants. Bends shall be labeled on the plan and profile views.
7. A method of restraint shall be labeled on the plan for each bend, fitting, plug and valve.
8. For water mains subject to extreme variations in temperature (i.e. attached to bridges, etc.), consideration shall be given to expansion and contraction of the pipe material and the potential freezing of the line's content. Aerial crossings shall incorporate expansion couplings in the

design.

9. Water distribution pipe shall be designed based upon a minimum soil weight of 120 lbs./cubic feet and an H<sub>2</sub>O loading condition with a minimum 3.5 feet of cover.
10. For pipe sizes 12-inches or less, ductile iron pipe shall be pressure class 350. For pipe sizes larger than 12-inches, pressure class 250 ductile iron pipe shall be used.
11. If the main alignment requires deflection in excess of the specified limitations or as determined by the Public Works Commission, bends shall be utilized. Joint deflection shall not exceed the limits recommended by the pipe manufacturer.
12. Ductile Iron River Crossing Pipe or "Ball Joint" pipe shall be a restrained joint. Pipe thickness class shall be as recommended by the manufacturer, and as approved by PWC. Pipe bell deflection per joint shall be as recommended by the manufacturer. Pipe end shall be tapered by manufacturer to ensure pipe end does not block flow when pipe is deflected. The use of ductile iron "River Crossing" or "Ball Joint" pipe shall only be utilized for underground crossings. The use of this pipe on aerial crossings is not allowed.

#### G. VALVES

1. Valves shall be installed at all pipeline intersections, changes in pipe diameter between mains, and on hydrant branches according to the following:  
Crosses (4 intersecting mains) ..... 3 valves  
Tee Intersections (3 intersecting mains) ..... 2 valves  
Hydrant Branch (on branch line) ..... 1 valve
2. A proposed connection of a new water line to an existing water line may include provisions for the addition of sufficient valves to the existing water line to meet the requirement of a tee intersection, as deemed necessary by PWC.
3. Maximum valve spacing (in-line valves) shall be 1,500 feet in the distribution system and 2,500 feet for transmission mains 16 inches in diameter and larger.
4. Size and type of valves shall be shown on plan view. All two (2) inch valves shall be quarter turn ball valves, in accordance with PWC specifications. All other valves shall be resilient wedge gate valves, in accordance with PWC specifications. All valves shall be placed in the vertical position, unless otherwise approved by PWC. The use of bevel gearing is not allowed without prior approval from PWC.

5. Valves located within sections of restrained joint ductile iron pipe shall be restrained to the pipe. For valves on mains 12-inches and smaller, the use of a mechanical restraint system (i.e., mega-lugs) shall be utilized. For valves on mains 16-inch and larger, the use of factory restraint systems (i.e., Harness-Lok, etc.) shall be utilized.
6. All valves on transmission mains, 16-inches in diameter and larger, shall be restrained joint ductile iron gate valves. The restraint system shall be compatible with the factory restraint system utilized on the piping.
7. Valve boxes shall be installed to allow operation of all valves. Valve box protectors shall be installed in unpaved areas.
8. Street intersection valves shall be located at the tee, unless otherwise approved by PWC.
9. Where valves must be located away from street intersections, (such as along transmission main) valves should be located at hydrant branches and/or property lines.
10. Valves shall not be located in curb and gutter or in the flow line of wedge asphalt curb or in ditches and ditch slopes.
11. For one way feeds and dead end mains to be extended, valves shall be located on the dead end side of the hydrant branch with no service connection beyond the mainline valve.
12. When transitioning from a larger main to a smaller main (e.g., 8 inch to 2 inch), locate valve on the smaller diameter pipe.
13. Each fire hydrant shall have a six (6) inch hydrant branch valve. Valves on a hydrant branch shall not be located in curb and gutter or ditch.
14. Post indicator valves (PIV) and Fire Department Connections (FDC) are not regulated by PWC, but shall be installed in accordance with the local governing authority's rules and regulations.

## H. FIRE HYDRANTS

1. Fire hydrants shall be installed on water mains eight (8) inches in diameter or larger and that are designed to provide adequate fire protection flows at the required residual pressure. Fire hydrants may be installed on six (6) inch mains when a larger main is not available; provided that the required fire flow can be met. The design engineer shall provide PWC with a design report, to include calculations, that indicates all hydrants can achieve the required fire protection flows as outlined in Appendix B of the North Carolina Fire Code (most recent edition), as approved by the local governing authority.

2. Fire hydrant spacing and location within the City of Fayetteville shall be in accordance with the most recent edition of the International Fire Code and shall be subject to review and approval of the Fire Marshal of the City of Fayetteville.
3. Fire hydrant spacing and location within the Town of Hope Mills shall be in accordance with Subdivision Ordinance of the Town of Hope Mills and shall be subject to review and approval of the Fire Marshal of the Town of Hope Mills.
4. Fire hydrant spacing and location outside of the City of Fayetteville and the Town of Hope Mills shall be subject to review and approval of the Cumberland County Fire Marshal.
5. For new subdivisions, where structures are not known, fire hydrant spacing shall be measured along street right-of-way and spaced as required by the local governing authority. Radial measurement and/or spacing (i.e. "as a bird flies") are not acceptable. Additionally, measurements across lots, which front different streets, will not be permitted for purposes of satisfying the spacing requirement.
6. In instances where structures front multiple public right-of-ways, fire hydrants shall be provided and spaced as defined above along each public right-of-way, as required by the local governing authority.
7. Structures located on multi-lane (4 lanes or more) roads or highways shall require fire hydrants located on the same side of the roadway as the structure. Staggering fire hydrants in relation to the opposite side of the roadway is recommended, however hydrant branches should not cross multiple lanes of traffic. Parallel mains shall be utilized on multi-lane facilities so that long hydrant branches will not be needed, unless otherwise approved by PWC.
8. Generally, fire hydrants should be located at street intersections and property corners. Intermediate fire hydrant placement shall be located at property corners. Consideration should be given to other utilities such as power, telephone, and cable locations. In all instances, hydrants should be placed to afford protection from vehicle collisions, etc.
9. Fire hydrant spacing along water transmission mains (16 inches and larger) located in undeveloped areas shall be a maximum of 2,500 feet.
10. Fire hydrants shall be installed 18 inches inside the right-of-way measured to the hydrant centerline. Hydrants shall not be located in the back slope of a roadside ditch.
11. Hydrant branches shall have a minimum of three and a half (3.5) feet of

cover unless local conditions dictate otherwise, such as ditch bottoms, but in no case less than two (2) feet of cover with prior approval by PWC. The bury depth of the hydrant shall be in accordance with PWC details and specifications.

12. New fire hydrants should not be located closer than 50 feet to a structure unless approved otherwise.
13. Fire hydrants shall be located on the same side of the roadway as the water main, unless otherwise approved.
14. No fire hydrant older than three (3) years shall be installed, as determined by the manufacture date stamped on the hydrant.
15. Fire hydrants older than 20 years shall be replaced as part of the new construction, retrofit, and/or rehabilitation.

## I. FIRE LINES

### 1. General

- a. Fire lines are required by code to be installed at commercial developments as well as multi-family housing developments, unless otherwise approved by the local governing authority.
- b. Fire lines six (6) inches and larger must be permitted by PWC through the local permitting authority.

### 2. Materials

- a. Fire lines four (4) inches and larger shall be restrained joint ductile iron from the tap of the main to the right-of-way boundary or easement line. All two (2) inch fire lines shall be PVC, SDR-21, from the tap to the right-of-way or easement.
- b. Domestic services and irrigation services may be tapped off of fire lines which are greater than two (2) inches in diameter. Valves shall be placed to allow either the domestic or fire line to remain in service, as indicated on PWC standard details. When a two (2) inch fire line is used the domestic and irrigation services must be tapped off of the main. See PWC Standard Details for further illustration.

### 3. Ownership and Maintenance

- a. PWC will operate and maintain fire lines located at commercial facilities from the tap on the main to the right-of-way/easement line, whichever is applicable. The fire line shall be constructed and tested in accordance with PWC's standards and specifications to the right-of-way/easement line. The remainder of the fire line from the right-of-way/easement line to the building will be overseen by

the local governing authority.

- b. PWC will operate and maintain fire lines located at multifamily developments from the tap on the main to the closest point which is 10 feet from the face of the building, unless otherwise approved by PWC. The fire line shall be constructed and tested in accordance with PWC standards and specifications to the point which is 10 feet from the building. The remainder of the fire line from the above-mentioned point to the building will be overseen by the local governing authority.

#### 4. Fire Department Connections

- a. All Fire Department connections (FDC) shall be located on the customer side (i.e., private) of the backflow preventer.
- b. The FDC shall be located in accordance with, and as approved by, the local governing authority.
- c. Fire lines with FDC shall have a reduced pressure detector assembly (RPDA) for the backflow device. Fire lines without a FDC shall have a double check detector assembly (DCDA) for the backflow device. All backflow devices shall be approved by PWC.

#### 5. Testing and Disinfection

- a. If the fire line has a domestic or irrigation service, both the fire line and service shall be tested and disinfected, regardless of the length.
- b. If the fire line does not have any services connected to it, disinfection is only required if the total length of the fire line is greater than 20 linear feet (i.e., one (1) full joint of pipe).
- c. If the fire line is greater than 20 linear feet, then it shall be pressure tested.
- d. All testing and disinfection shall be done in accordance with PWC requirements.

### J. WATER METER SIZING

#### 1. General

- a. Water laterals greater than 1 inch with meters larger than 1.5 inches shall be sized in accordance with AWWA Manual M22, "Sizing Water Service Lines and Meters", and subject to PWC approval. The size of the proposed water meter shall be determined by the number of gallons per minute required for the facility, and this flow rate provided to PWC to verify the meter size. Documentation of how the flow rate was determined is required for all proposed meters greater than 1.5 inches. The Design Engineer shall be responsible to insure head loss through the meter meets the project requirements.
- b. Irrigation systems shall be metered separately and shall be sized based on the flow demand.



- c. The selection of the type and size of the meter should be based only on the flow requirements and the type of use, not on the pressure loss through the meter.
  - d. If the flow demand is anticipated to increase in the future (i.e. project phasing/expansion), provisions should be made to install a meter box and connections for the future demand, but the meter shall be sized for current demands and changed, as future demands require.
  - e. All improvements on the property side (outlet) of the meter shall be in accordance with the current Plumbing Codes. Properly sizing water service lines, backflow prevention devices, and pressure reducing valves to maintain adequate water flow and pressure from the meter to the structure and/or point of demand shall be the responsibilities of the property owner.
2. Single Family Residential Units
- a. Provide 1-inch copper, type K or polyethylene water lateral for each single-family dwelling unit with a 5/8 inch meter.
3. Residential and Commercial Facilities
- a. For meter sizing use AWWA manual M22 “Sizing Water Service Lines and Meters”.
  - b. Calculations shall be submitted by the Design Engineer to verify meter size selection for meters greater than 1-1/2 inches. The Design Engineer shall provide design calculations in accordance with AWWA M22 “Sizing Water Service Lines and Meters”.
4. Master Meters
- a. Master meters are allowed on a case by case basis on multi family projects if the units are to be rented. There must be a master meter for each building if this form of metering is pursued. It will be the responsibility of the developer to manage each unit and correct any problems which may arise.
  - b. In no case will master meters be allowed on multi family developments in which individual units are sold.
  - c. Manufactured home developments shall be master metered unless otherwise approved by PWC.

## K. STREAM CROSSINGS

- 1. Water mains crossing under streams shall be manufactured restrained joint ductile iron pipe. The pipe shall be buried at sufficient depth to provide a minimum of 42 inches of cover between the top of the pipe and the streambed. The pipe and joints shall be protected against streambed

erosion; unstable subsoil conditions and any other anticipated horizontal or vertical loading. Protection measures may include riprap and driven or drilled piers at each pipe joint or use of ball and socket pipe. For large stream crossings, PWC may require specific designs based on subsurface soil investigations.

2. When installing an aerial crossing it shall be the responsibility of the Developer to obtain all applicable regulatory permits. When the aerial crossing is accomplished by attachment to a bridge or drainage structure, the Developer must meet all the requirements of the agencies that own or have jurisdiction over such structures.
3. Water mains used for aerial crossings shall be designed in accordance with PWC technical specifications and standard details. Mega-lugs, field-lok, and gripper rings are not allowable means of restraint. Each aerial crossing shall have a site-specific design, to include: pile embedment length, geotechnical report, how pile refusal will be determined, lateral loading from wind, flood, ice, etc., pile spacing, and thrust restraint, as applicable.
4. Adequate support shall be provided for all joints of pipe utilized for aerial crossings. A licensed professional engineer must design and seal the supports. Expansion joints shall be incorporated into the design to address expansion and contraction of the pipe. Expansion joints shall be provided between the aerial and buried sections of the main. Calculations and design data shall be submitted by the Design Engineer to PWC for review.
5. On aerial crossings the bottom of the pipe shall not be placed any lower than one foot above the elevation of the bottom of the bridge or two feet above the 25 year flood elevation, whichever is greater.
6. Valves shall be installed at both ends of the aerial crossing on the buried main so that the aerial section may be isolated for testing or repair.
7. The ends of the aerial crossing shall be secured so that the public cannot access the main.
8. Railroad crossings shall be in accordance with the railroad's specifications and approved by PWC.

#### L. HORIZONTAL DIRECTIONAL DRILLING

1. Installation of water mains utilizing horizontal directional drilling is allowed on a case-by-case basis, with prior approval from PWC. Considerations to allow horizontal directional drilling shall include: location of work, future maintenance activities (including cost), traffic control, and environmental impacts. The Design Engineer shall provide supporting documentation to justify the use of horizontal directional

drilling with plan submission.

2. Directional drilling within NCDOT right-of-way shall be done in accordance with NCDOT's "Standard Specifications for Roads and Structures", most recent edition.
3. All horizontal directional drilling shall be completed in accordance with PWC standard technical specifications and the requirements of this Manual.
4. Installation of water mains utilizing horizontal directional drilling shall meet all separation requirements as outlined in this Manual, the NC DENR rules and regulations, and PWC standard specifications. Where the minimum separations cannot be met, installation of ductile iron pipe shall be made to a point 10 feet on either side of the crossing. Upon request, the contractor shall verify that the required separation requirements have been met, through "potholing" or other PWC approved methods.
5. Either high-density polyethylene (HDPE), fusible PVC, or restrained joint ductile iron pipe shall be utilized for horizontal directional drilling. No other materials are acceptable. The Design Engineer shall furnish the proposed pipe material to PWC for review and approval, prior to starting construction.
6. The depth of cover for water mains installed utilizing horizontal directional drilling shall be 3.5 feet, unless variations are required due to separation requirements. Variations shall be clearly noted on the plans submitted to PWC for approval, prior to construction.
7. HDPE shall be ductile iron pipe size (DIPS), unless otherwise approved by PWC. **The interior diameter of the new pipe shall closely match the interior diameter of the existing pipe, unless otherwise approved by PWC.**
8. Subsurface geotechnical investigations are strongly recommended to be completed, prior to selecting horizontal directional drilling as the method of installation. PWC reserves the right to request the geotechnical reports for their review, as part of their approval process.
9. It is the design engineer's responsibility to verify field conditions, including subsurface utilities and geotechnical information, prior to selecting an installation method.
10. PWC reserves the right to reject the installation of the water main utilizing horizontal directional drilling, and require an alternate method of installation.
11. Upon completion of the work, a copy of the drill log shall be furnished to

the Design Engineer and PWC that provides “as-built” information on the line and grade of the installed water main. The drill log shall include horizontal and vertical information on the location of the installed water main, so that the Design Engineer can prepare and submit an “as-built” plan and profile. The drill log shall report horizontal and vertical location a minimum of every 50 feet, or as necessary to accurately determine the location of the installed water main in relation to other utilities and conflicts. The drill log shall clearly provide the recorded information, and shall be submitted to PWC upon completion of the project.

#### M. THRUST RESTRAINTS

1. Thrust restraint for water mains shall be provided by concrete thrust blocks bearing on undisturbed soil or by approved restrained pipe joints for a specified distance. The bearing area for thrust blocks shall be based on the required test pressure of 200 psi, a Type 3 trench condition with a safety factor of 2, and a field determination of the load bearing capacity of the soil. The Design Engineer shall consider the restraint required for valves as a dead-end condition.
2. Acceptable restrained joint types shall be as outlined in the PWC Specifications or as approved by the PWC. Restrained lengths shall be calculated for each application. Calculations shall be based on a test pressure of 200 psi, 3.5 feet of cover and Type ML soil conditions with a safety factor of 2.0.
3. Design of restrained lengths of water distribution systems greater than or equal to 16 inches in diameter shall be performed in accordance with the AWWA standards. Ductile iron mains twelve (12) inches or less in diameter shall be restrained as indicated on PWC’s Standard Detail W.18 “Alternate Restraint Detail”. All water distribution mains twelve (12) inches or less in diameter that are not ductile iron shall be restrained by utilizing thrust blocking as indicated on PWC’s Standard Detail W.17 “Concrete Thrust Block Detail”. The Design Engineer is responsible to evaluate existing conditions, soils, cover requirements, calculate the required restraining lengths, and, upon request from PWC, provide documentation to support the resulting restrained lengths. The Design Engineer shall indicate the locations and lengths of the restrained joint ductile iron pipe on the plans.

#### N. RELATION OF WATER MAINS TO SEWERS

1. Lateral Separation of Sewers and Water Mains: Water mains shall be laid at least 10 feet laterally from existing or proposed sewer main and/or lateral, unless local conditions or barriers prevent a 10-foot lateral separation - in which case:
  - a. The water main is laid in a separate trench, with the elevation of the

bottom of the water main at least 18 inches above the top of the sewer main and/or lateral; or

- b. The water main is laid in the same trench as the sewer main and/or laterals with the water main located at one side on a bench of undisturbed earth and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer main and/or lateral.
2. Crossing a Water Main Over a Sewer Main and/or Lateral: Whenever it is necessary for a water main to cross over a sewer main and/or lateral, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer main and/or lateral, unless local conditions or barriers prevent an 18 inch vertical separation - in which case both the water main and sewer main and/or lateral shall be constructed of ferrous material and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.
3. Crossing Water Main Under a Sewer Main and/or Lateral: Whenever it is necessary for a water main to cross under a sewer main and/or lateral, ***both the water main and the sewer main and/or lateral shall be constructed of ductile iron material*** and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.
4. Crossing Storm Drainage Lines: A minimum of 12-inches of vertical clearance shall be maintained between a water line crossing over a storm drainage line unless ductile iron pipe is used. In addition, three and a half (3.5) feet of cover must be maintained over the water main or it shall be ductile iron. If ductile iron pipe is used then two and a half (2.5) feet of cover must be maintained over the water main and a minimum of four (4) inches of vertical clearance shall be maintained between the water main and the storm drainage line. Where a water main crosses under a storm drainage line a minimum of twelve (12) inches of vertical separation shall be maintained and the water main shall be ductile iron for a distance of 10-feet on each side of the crossing.

## O. CROSSING EXISTING OR PROPOSED UTILITIES

### 1. Relation To Other Utilities

- a. Underground telephone, cable TV, and gas utilities or conduit banks shall be crossed maintaining a minimum of 12-inch separation or clearance.
- b. Where possible, electrical crossings shall be performed while the conductor is de-energized and at all times in the presence of the service provider. Electrical primary conductor crossings shall be as follows:

- i Crossing over a conductor, maintain a minimum of 12 inches of undisturbed soil encasing the conductor.
- ii Crossing under a conductor shall be accomplished by boring maintaining 12 inches of undisturbed soil encasing the conductor.

Refer to PWC's standard specifications, the National Electric Code (NEC), and details on underground electrical crossings for additional requirements and information. In the event that there is a conflict between the PWC standard specifications and the National Electric Code (NEC), then the more stringent shall apply.

#### **IV. CROSS CONNECTION PREVENTION**

##### **A. GENERAL**

1. A copy of the City of Fayetteville's Cross Connection Control Ordinance is available by contacting the PWC System Protection Department at (910) 223-4699.
2. The System Protection Department can provide a list of backflow prevention assemblies, approved by the Public Works Commission for protection of its public water supply.
3. Lawn irrigation systems are required to have a split tap service or a designated lawn irrigation service tap. The connection of a lawn irrigation system to a domestic tap is prohibited.
4. Fire lines with Fire Department connections (FDC) shall have a reduced pressure detector assembly (RPDA) for the backflow device. Fire lines without a FDC shall have a double check detector assembly (DCDA) for the backflow device. All backflow devices shall be approved by PWC

##### **B. LOCATION OF BACKFLOW PREVENTION ASSEMBLIES**

1. All backflow prevention assemblies shall be installed in accordance with the requirements of the Cross Connection Control Program and shall be located before any branch connections to the private system. Backflow prevention assemblies shall also be located between the meter and the facility with not less than five (5) feet of horizontal separation between the meter and backflow enclosure/vault.
2. Backflow assemblies for fire protection systems shall be located within 100 feet of the tap at the water main, unless otherwise approved by PWC. In all cases fire hydrant branches more than 100 feet in length will require a backflow assembly. It is noted that some situations may require a backflow prevention device on fire hydrant branches that are less than 100 feet, as determined by PWC and the Design Engineer.

3. Backflow assemblies shall be required for any application in which possible pollution or contamination of the public water supply system could result from a cross-connection.
4. In accordance with the Terms and Conditions of the City of Fayetteville's Cross Connection Control Ordinances and the Rules Governing Public Water Supply Systems, the severity of the potential effects upon public health shall determine the minimum degree of protection required. PWC will review each case on an individual basis.
5. Backflow prevention assemblies shall be installed on non single family residential meters and on any privately owned and maintained fire lines, distribution systems, domestic services lines, irrigation systems, etc. (For example, an apartment complex that has a master meter will be required to have a BFP, but an apartment complex with individual meters for each unit does not, since these are considered single family residences. In a situation where a meter serves multiple units a BFP is required). The Design Engineer shall determine the type of backflow prevention assembly based on the type of connection to the public water supply, subject to PWC approval.

#### C. BACKFLOW PREVENTION ASSEMBLIES

1. The following should be considered before selecting a particular assembly:
  - a. All plumbing laws and regulations **must** be adhered to.
  - b. All backflow prevention assemblies **shall** be installed in accordance with specifications furnished by the Public Works Commission and the manufacturer's installation instruction. Note: PWC's installation instructions supersede the manufacturer's instructions, due to local requirements.
  - c. Reduced pressure principle assemblies **must** be installed in a horizontal position and in a location in which no portion of the assembly can become submerged under any circumstances (pit/below grade installations are prohibited).
  - d. All double check backflow prevention assemblies 2 ½" and larger shall be installed above ground in accordance with detailed specifications provided by the Public Works Commission unless approved differently by the PWC General Manager or designee.
2. The operations and performance of these assemblies may vary among manufacturers. Because of local pressure conditions, it is suggested that the PWC System Protection Supervisor be contacted at (910) 223-4699 to assist in selecting an assembly.

3. The Public Works Commission of the City of Fayetteville reserves the right to add to or remove any Reduced Pressure Backflow Prevention Assembly, Double Check Valve Assembly, or Pressure Vacuum Breaker Backflow Preventer from the approved list.
4. It is a requirement that backflow prevention assemblies be tested immediately after installation and at least once a year thereafter by a person approved by the Public Works Commission. A copy of the test results **must** be sent to the Public Works Commission System Protection Department immediately (within 10 days) after testing.
5. Any time that repairs to backflow prevention assemblies are deemed necessary, whether through initial, annual testing, or routine inspection by the owner or by the Public Works Commission, these repairs **must** be completed within a specified time in accordance with the degree of hazard. In no case **shall** this time period exceed 30 days. Should you have any questions concerning the above-mentioned testing requirements, contact the PWC System Protection Department at (910) 223-4699.
6. Personnel of the Public Works Commission will conduct testing of backflow prevention assemblies on a random basis to ensure that the assemblies are operating properly. The owner will be given adequate advance notification prior to the test.
7. By-pass piping is not permitted unless the by-pass piping is equipped with an approved backflow prevention assembly of the same type as the main line assembly. In many instances it will be necessary to install two approved backflow prevention assemblies in order that water service will not be interrupted during the testing/repair of the assembly.
8. When cross-connections are found to exist, the owner, his agent, occupant, or tenant will be notified in writing to disconnect the same within the time limit established by the Public Works Commission. The degree of protection required and maximum time allowed for compliance will be based upon the potential degree of hazard to the public water system. The maximum time limits are as follows:
  - a. Cross-connections with private wells or other unapproved auxiliary of water - immediate disconnection of unapproved source.
  - b. Cross-connections requiring correction through 1) elimination; 2) air gap separation; 3) reduced pressure zone backflow prevention assembly, double check valve assembly, or pressure vacuum breaker for sizes  $\frac{3}{4}$ " through 2" - up to thirty (30) days.
  - c. Cross-connections requiring correction through reduced pressure zone backflow prevention assembly or double check valve assembly for sizes 2  $\frac{1}{2}$ " and larger - up to sixty (60) days.



#### D. LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES

**Note:** A list of the approved backflow prevention assemblies is located on the PWC website ([www.faypwc.com](http://www.faypwc.com)). Please contact the PWC System Protection Department for the most up to date list of approved assemblies. There is no implication of preference of assemblies. Assemblies are subject to revision as the devices are evaluated and approved by PWC.

**Note:** All assemblies approved for use in the PWC system must have prior approval by Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California.

**Note:** Backflow Prevention Assemblies two (2) inches and smaller shall have one quarter ( $\frac{1}{4}$ ) turn, full port, resilient seated, bronze ball valve shut-off.

**Note:** Assemblies two and one half ( $2\frac{1}{2}$ ) inches and larger shall have resilient wedge shut-off valves. The backflow preventer and resilient wedge shut-off valves must be fusion bonded epoxy coated.

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# **CHAPTER FOUR**

## **SURVEY REQUIREMENTS**

### **I. GENERAL**

All sanitary sewer and water mains shall be field surveyed under the direct supervision of a Professional Land Surveyor registered in North Carolina. The Developer shall provide all surveys necessary to design the utility extension.

### **II. DATA FOR DESIGN**

- A. All existing underground utilities (water, sewer, gas, storm drains, telephone, electric power, cable TV, etc.) along the route should be located horizontally. Where potential for significant elevation conflicts with the proposed water main exist, the existing utilities shall be exposed and elevations determined. The Developer or Surveyor should contact the individual utilities to determine location policies and procedures.
- B. Vertical control shall be tied to NGS or NCGS vertical control points having a base elevation of NAVD 29 and indicated on the plans.
- C. Horizontal control shall be tied to NC Grid Coordinates NAD 83.
- D. The location of all benchmarks and control points shall be indicated on the plans.
- E. Horizontal alignment shall be chosen in coordination with the Design Engineer and referenced to identifiable features; such as edge of pavement or right-of-way lines.
- F. Profile data shall include centerline shots at manholes and shall include all break points such as culverts, creeks, ditches, etc. When paralleling an adjacent stream, the streambed elevation is required at each manhole. Cross-sections shall be provided at fifty foot intervals in cut and fill slope sections.

### **III. DATA FOR CONSTRUCTION**

#### **A. CUT SHEET**

- 1. Cut Sheets shall be prepared on a form acceptable to PWC, signed and sealed by a Professional Land Surveyor or Professional Engineer registered in North Carolina. Grade shall be calculated from centerline of manhole to centerline of manhole to the nearest .01'

for hub cuts and 0.1' for centerline cuts (reference only). Note: centerline cut is to assist contractor with error determination.

2. Cut sheet shall indicate station number of manholes, fittings, valves, or other structures, lengths of mains, grades, special coatings, different pipe class or other special conditions.
3. Cut sheets (1 original), signed and sealed by an N.C. PE or PLS shall be provided to the PWC Water Resources Engineering Department in advance of construction for water, sewer and/or force main. The approved cut sheet shall also be provided to the Contractor by the Engineer or Surveyor, concurrently with submittal to PWC.
4. Water and sewer main construction cannot begin until the Contractor possesses a signed and sealed cut sheet from the Engineer or Professional Land Surveyor.
5. The following minimum criteria shall be indicated on the cut sheet (an example of a cut sheet is provided at the end of this text):

- Engineer's Name, Address, Phone No. and Fax No.
- Project Name
- Location within Project that cut sheet pertains to i.e., 8" Sanitary Sewer Sta. 0+00 to 12+00 Smith Street.
- Sheet No. of cut sheet i.e., 1 of 2 etc.
- Field Book Number that the field work is in and page number.
- Type of pipe material and Station if material change is designed, i.e. 1-Joint DI centered at Storm Crossing Sta 1+00
- Size of utility, i.e. 8"
- Offset hub distance from centerline
- Station of item
- Hub elev. of perpendicular offset
- Grade elevation of utility (invert)
- Hub cut (vertical distance from offset hub to invert of utility being installed).
- Centerline elevation to nearest 0.1'
- Centerline cut to nearest 0.1'
- A remarks column which indicates the Manhole Station, 20' offset hub, length of pipe and percent slope where applicable. For water, indicate station and location for fire hydrants, valves, etc.  
Station for begin and end of casings, restrained joint pipe, etc.

## B. SANITARY SEWERS

1. Stake and cut centerline, setting hubs at each manhole.

2. Flag both permanent and temporary easements using different color flagging for each.
3. Offset manholes 50' and 100' with hubs installed at right angle points to each manhole, prior to clearing operations.
4. Stake manholes for construction providing minimum 15' offset hub and a 50' offset check station for the sewer main grade.
5. Stake sewer cleanouts for construction providing minimum 5' offset hub.

#### C. WATER MAINS

1. Provide flat stakes with grades every 100' along tangents and every 50' along curves of the water main route and hubs with grades for every bend, valve, hydrant branch, fitting; or where necessary to accommodate a future or proposed utility extension.
2. Provide a hub for each fire hydrant location with an offset for the flange elevation.

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# CHAPTER FIVE

## DRAWING REQUIREMENTS

### I. GENERAL

- A. The Contract drawings shall be prepared under the direct supervision of a Professional Engineer registered in North Carolina. Each drawing sheet shall be signed, sealed and dated.
- B. The drawings shall utilize standard drafting practices and include PWC Standard Symbols and Abbreviations indicated by a legend. The drawings should be produced utilizing an AutoCAD.dwg compatible electronic file using PWC Standard Layering System. Record Drawings shall be provided to PWC in AutoCAD.dwg electronic format, clearly labeled with project name for record keeping purposes.
- C. Since PWC will be scanning all approved plans, blueprints are not acceptable media for reproducible drawings. Blueprint copies are acceptable.

### II. TYPICAL DRAWING SET

The typical drawing set shall be arranged in the following sequence:

Title Sheet

\*Utility Layout Sheet

\*Erosion Control Plan

\*Plan/Profile Sheets

Traffic Control Plan

\*Civil Detail Sheets

?? Erosion Control

?? Water

?? Sewer

Miscellaneous Details

?? Landscaping and Details

?? Structural Plans and Details

?? Electrical Plans and Details

?? Mechanical Plans and Details

?? Plumbing Plans and Details

\* Note: These sheets are required on all projects regardless of size.



### III. PLAN SHEET REQUIREMENTS (ALL DRAWINGS)

- A. Drawings shall be placed on 24"x 36" vellum, mylar or bond media. Other sizes shall be acceptable, as approved by PWC.
- B. The title sheet shall include the following:
  - a. The Project name and/or Subdivision name and Phase;
  - b. Engineer's name, address and phone number;
  - c. Number of sheets;
  - d. revision block;
  - e. sheet description name; and
  - f. date.

A sample title sheet is contained in Chapter 6 of this Manual.

- C. Provide ½" borders along top, bottom and right margin and a 1½" border along the left side of the sheet.
- D. Plan/Profile sheets for PWC projects should be produced with a plan view horizontal scale of 1"=50' and a vertical scale of 1"=5' for profiles. Other scales may be approved by the PWC as necessary. Plan/Profile sheet stationing shall increase left to right or downstream to upstream. The plan view beginning station shall be aligned with the profile view beginning station. Match lines referencing continuation on other sheets shall be used. Profile view should indicate the centerline profile of the proposed route.
- E. The utility layout sheet shall be produced with a horizontal scale of 1"=100' or larger (i.e., 1"=50') to indicate the new layout/extension and the relationship to other proposed or existing utilities, roadways, and other pertinent structures. The utility layout sheet should show contours and an individual sheet index along the route. Large projects may require several sheets with coordinated match lines.
- F. A reference to the horizontal and vertical datum that the project is based on shall be indicated on the utility layout sheet.
- G. Horizontal and vertical (if applicable) bar scale shown in written and graphical format.
- H. North arrow oriented either to the top or to the left of the sheet where practical.

- I. Existing water and/or sewer lines labeled with size and material, if known.
- J. All existing, or proposed rights-of-way and construction easements accurately located and shown on plans. Lot lines and parcel numbers shall be shown with right-of-way and construction easement widths indicated.
- K. All existing and proposed water, sewer, storm drain lines which cross or run parallel to the sewer or water lines shall be shown with exact horizontal alignment. Subsurface exploration should be performed where potential conflicts exist.
- L. Proposed and existing road and drainage shall be shown.
- M. Road names, state route numbers, and right-of-way widths shall be shown.
- N. Proposed future water/sewer projects shall be shown.
- O. Proposed water/sewer lines shall be shown with adequate reference distances from right-of-way, property boundary, buildings, or other utilities, etc., to provide for proper location of the proposed utility.
- P. Show proposed lot layout or subdivision map.
- Q. Location of existing houses, buildings, fences, wells and other structures affected by construction.
- R. Label bores and/or tunnels to show steel casing/tunnel liner beginning and ending stations and length.
- S. Show topography of the area with two (2) foot contour intervals.
- T. Show wetland delineation and locations.

#### **IV. TITLE SHEET** (Sample Included in Chapter Six - Drafting and CADD Standards)

- A. Project name and/or Subdivision name and Phase, if applicable.
- B. Title block information
- C. Sheet Index with sheet numbers.

## **V. UTILITY LAYOUT SHEET**

- A. Legend of sanitary sewer, water, and other utilities, structures; either proposed or existing.
- B. Vicinity/location map with site clearly indicated.
- C. Construction Notes
- D. Overall plan of the water and/or sewer extension layout, indexed to sheet numbers.
- E. Existing utilities to include water and/or sewer labeled with size and material type, if known.
- F. "Composite" of all information contained in the plan view of the individual plan/profile sheets.

## **VI. PLAN/PROFILE SHEETS** (Sample included in Chapter Six - Drafting and CADD Standards)

### **A. WATER PLAN/PROFILE SHEET**

- a. Show all fittings, fire hydrants, and valves including sizes and station number. Label each appurtenance.
- b. Restrained joint pipe beginning and ending station numbers and lengths.
- c. Fire hydrant locations shall comply with design guidelines. Show fire hydrant assembly station, location and flange elevation.
- d. All potential conflicts with storm sewers and other utility lines shall be shown.
- e. Vertical clearance requirements shall be shown at all crossings of other utilities. Horizontal clearance requirements shall be shown (i.e., 10 feet between water and sewer mains).
- f. All water lines shall have a minimum of 3.5 feet of cover, or are otherwise protected as required.
- g. Blow-off stations and locations shall be shown and labeled at the end of all lines.
- h. All water services shall be shown with a station number and finished curb grade.
- i. Show all types of and methods of connection to the existing mains.
- j. Main location relative to back of curb, edge of pavement or right-of-way.

- k. Water line stubs for future extensions are to be installed five (5) feet beyond the edge of proposed pavement. Horizontal alignment and profile, if applicable, are to be shown on the construction plans.
- l. Wetlands shall be shown as delineated by an experienced professional.

#### B. SEWER PLAN/PROFILE SHEET

- a. Proposed manholes and structures shall be labeled with station number, size or diameter, rim elevation, invert elevation of all connecting pipes, coatings, and type of ring and cover. Provide appropriate watertight manhole ring and cover with venting on plan where required. Show existing shelf elevations.
- b. Proposed interior drop structures with invert elevation (5 foot diameter manhole required to 12-inches above drop structure tee).
- c. When connecting to an existing manhole, show invert elevation, top of manhole elevation, alignment of existing line, size existing line, and type of construction of existing manhole (i.e. brick masonry or precast concrete).
- d. Profiles for gravity sewer shall clearly indicate the planned slope of each reach of line given in percent slope. The length between manhole centerlines shall be used to calculate pipe slope.
- e. The length of each reach of gravity sewer shall be clearly indicated on the drawings. This length shall be the manhole centerline-to-centerline length as measured horizontally and shall not exceed 425 feet unless approved by PWC.
- f. Show size of proposed main and type of material for all reaches of sewer, including changes in pipe material for clearance requirements.
- g. Sanitary sewer lateral station number, cleanout invert elevation and finish grade shall be shown. Indicate if the lot requires a grinder pump.
- h. Bearings and distances between manholes or deflection angles for horizontal alignment changes shall be shown unless no deflection is planned (i.e., straight through manholes).
- i. Show proposed and existing sewer main flow directions.
- j. Show 100-year flood elevation and boundary, if applicable.

- k. Show pipe class beginning and ending stations for deeper cuts.
- l. Show all conflicts with water mains with either material changing to ductile iron pipe or show required NCDENR vertical and horizontal clearances.
- m. Indicate where VCP or PVC pipe is replaced with ductile iron where there is less than three (3) feet of cover or where otherwise required.
- n. Provide proper detail for all aerial creek crossings.
- o. Label all easement types, widths, and special conditions where applicable.
- p. Show wetland delineation and location in respect to proposed utility.

## **VII. DETAIL SHEETS**

### **A. GENERAL**

- a. Use PWC Standard Details.
- b. Do not modify PWC Standards without PWC written approval.

## **VIII. RECORD DRAWINGS CHECKLIST**

### **A. GENERAL**

At completion of the project, and all testing has been completed in accordance with PWC requirements, the Water Resources Engineering Department will request, in writing, that the Engineer prepare and submit a set of record drawings for review. For the initial submittal, providing PWC with the contractor's marked up set is acceptable. Once the record drawings are reviewed and approved by PWC, the Engineer will be requested to submit final record drawings. The Engineer shall submit one (1) set of reproducible (bond or vellum) drawings, a digital file (in AutoCAD format), and the Engineer's Certification to PWC. Upon receipt of these items, PWC will activate services for public use.

Samples of the Engineer's Certification are included in Chapter 7 of this Manual.

### **B. DRAWING REQUIREMENTS**

- a. North Carolina registered Professional Engineer seal and signature required on each plan sheet.
- b. Drafter's initials and date of record information is required on each sheet.
- c. Record Drawings completed in ink.
- d. On each sheet, label the type and class of pipe installed.
- e. Label bores and tunnels to show steel casing/tunnel liner type, size, and thickness. Show beginning and ending stations.
- f. Mark through and redraw manholes, valves, fire hydrants, etc., when the as-built location deviates more than 10 feet horizontally from the location indicated on the plans.
- g. Temporary erosion control measures shall not be shown.

#### C. SEWER REQUIREMENTS

- a. Mark through the design information and indicate the actual:
  - i. manhole pipe inverts and rim elevations.
  - ii. distance between manholes on the plan view.
  - iii. distance between manholes on the profile.
  - iv. location of all sewer laterals by station.

#### D. WATER REQUIREMENTS

- a. Mark through the design information and indicate the actual:
  - i. Stationing of all valves, bends, hydrants, fittings, air releases, etc
  - ii. Stationing of fire hydrants – show station for tee, valve, and hydrant.
  - iii. Location of all water services by station along the centerline of the water main or street.
  - iv. Location of concrete blocking where applicable.
  - v. Location by station and type of restrained joint pipe and/or fittings.

### IX. STANDARD CHECKLIST

The following checklist is being provided as a reference to the Design Engineer. This checklist contains items that the PWC Water Resources Engineering Department looks for during plan reviews and failure to include items on the checklist can result in delays to approving the plans.

# WATER RESOURCES ENGINEERING PLAN REVIEW CHECKLIST

## General Requirements

- ✍✍ Plans should be on 24" x 36" paper
- ✍✍ Originals must be reproducible and digital drawing furnished in a DWG format.
- ✍✍ Provide datum reference and elevation.
- ✍✍ A vicinity map needs to be shown on the utility cover sheet.
- ✍✍ Contour lines shall be provided
- ✍✍ Erosion Control Plan to be included in plans and permit obtained if more than 1 acre is disturbed
- ✍✍ Show all, underground utilities paralleling or crossing mains in plan and profile
- ✍✍ Lot Numbers
- ✍✍ Lot Frontage if commercial
- ✍✍ PIN on Lot (if applicable)
- ✍✍ Project name the same on each sheet and match the permit applications?
- ✍✍ Does the project require an annexation petition or agreement and has it been verified with Jimmy Teal?
- ✍✍ Is an off-site easement required? If so, has an easement map been submitted?
- ✍✍ Are all the permit applications and submittal checklists completed properly?
- ✍✍ Is a DOT encroachment required? If so, has an encroachment map been submitted?
- ✍✍ Is a railroad encroachment required? If so, has the appropriate application been submitted?
- ✍✍ Provide wetland delineation (if applicable).
- ✍✍ Can the water and/or sewer be extended across the parcel to serve others? Check GIS for topo and location of existing services.
- ✍✍ If a lift station is proposed, is the lift station located and sized to serve additional developments (i.e., a regional lift station)?
- ✍✍ All manhole data (stations, rims and inverts), all sewer main data (lengths, diameters, materials, direction of flow, and slopes) and all water main data (diameter and materials) must be shown on all plan and profile sheets.
- ✍✍ Are there discrepancies between the plan, profile, and utility sheets (i.e., lengths and/or slopes not matching)?
- ✍✍ All water and sewer laterals, meters and cleanouts (with top and invert elevations) must be shown on all plan views. Unless special circumstances dictate otherwise, meters and cleanouts must be centered on the front property line of a residential lot, and spaced approximately 18-inches apart.
- ✍✍ Indicate stations for all valves, tees, fire hydrants, cleanouts, manholes, catch basins, bends, angles, etc.
- ✍✍ Label material, size, and class of new and existing (if known) water, sewer and storm utilities.
- ✍✍ Water and sewer mains shall include distances and angles or bearings based on NAD 83 or NVGD 88
- ✍✍ If a bore and jack is required on a project, the end of the encasement pipe should extend a minimum of 3 feet past the existing, or known future, edge-of-pavement.
- ✍✍ Are the final (County approved) street names shown on the plans?
- ✍✍ No 90° bends, on water mains or sewer force mains.
- ✍✍ Are all the necessary and up to date details incorporated?
- ✍✍ Are all separation requirements met or ductile iron pipe utilized?

## Sewer Requirements

- ✍✍ Is the sewer ductile iron from MH to MH for those lines between houses?



- ✍✍ Is the sewer ductile iron MH to MH or only 1 transition to PVC in other locations?
- ✍✍ Verify that the easement widths are appropriate – 20 feet for less than 10 feet in depth, 30 feet for greater than 10 feet in depth.
- ✍✍ Is there access to the sewer lines behind houses? If not, request a 20-foot access easement.
- ✍✍ Are the sewer laterals 4 to 6 feet deep?
- ✍✍ Have the pipe lengths, slopes and inverts been checked?
- ✍✍ The angle between the outgoing sewer main and the incoming sewer main shall be a minimum of 90°.
- ✍✍ Manhole rims to be 12-inches above 100-year flood elevation
- ✍✍ Show cleanouts 18-inches inside the easement line where applicable (if a blanket easement applies, is there a note on the plans?).

### Water Requirements

- ✍✍ If a bore and jack is required, the carrier pipe (for water) shall be restrained joint
- ✍✍ Can the water main be looped?
- ✍✍ If there is a bank of meters, is the 2-inch main looped?
- ✍✍ Are there any services past the last gate valve?
- ✍✍ Has justification been requested or provided for those meters greater than 1.5 inches?
- ✍✍ Are the gate valves at street intersections located adjacent to the turning radii?
- ✍✍ Blow-offs at the end of water mains (typically on cul-de-sacs), must be located at a property corner, with the most expeditious conveyance of surface drainage in mind.
- ✍✍ Placement and spacing of in-line valves (valves should be placed to have no more than 20 to 25 customers out of water if a main break occurs).
- ✍✍ Locate a gate valve on the main near a fire hydrant.

### Backflow Requirements

- ✍✍ Are the backflow devices labeled and specific to the type of device needed?
- ✍✍ For commercial projects, lateral and meter sizes, as well as BFP size, type, make and model are required.
- ✍✍ A backflow prevention device will be required on all fire laterals installed, including exterior fire hydrants, if the length of the lateral is greater than 100 feet (measured from the tap to the furthest fire hydrant).
- ✍✍ Approval is required of type, model, installation, and testing by PWC's System Protection Department
- ✍✍ Is the use of the line specified (i.e., fire, domestic, irrigation)?

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# CHAPTER SIX

## DRAFTING AND CADD STANDARDS

### I. GENERAL

Note: As every design firm has their own drafting standards, the following information is meant to be informational, and to provide general guidance in the preparation of electronic drawings for submission to PWC.

Drawings shall be prepared utilizing an AutoCAD compatible system and shall generally be of the size and scale indicated below utilizing the PWC Standard Layer List. The utility layout sheet shall be provided to PWC in an electronic file format with a .DXF or .DWG extension. **PWC may approve other drawing/drafting standards on a case-by-case basis.**

#### A. LETTERING

Text shall be not less than  $0.08 \times \text{Drawing Scale}$  in height. (i.e. 50 scale drawing  $\times .08 = 4'$  text height, 200 scale drawing  $\times .08 = 16'$  text height). Text shall be **Arial** text font and shall be clear and legible in all instances.

#### B. LINE WEIGHTS

All lines shall be depicted to show a marked contrast between new work and existing features. Drawings not readily discernable as to new work and existing will not be accepted for review and comment by the PWC Staff and will be returned. Ultimate responsibility for depicting the work in a clear, concise, uncluttered format rests with the Engineer.

#### C. SHADING

The use of stick-on shadings, user defined line types, etc. is not acceptable.

#### D. REPRODUCTION

All drawings may be reproduced utilizing a full size document copier or a high quality scanner and shall be blue or black on a white background.

#### E. FINISHED FORMAT SHEET SIZES

All drawings shall be produced in accordance with the following sheet sizes as follows in inches, unless indicated otherwise.

Table 1. Standard Sheet Sizes

Drawing Size	Format Width	Format Length	Margin Inches	Intended Use
A	8½"	11" or 14"	5/8"	A, R, E, Enc, W
B	11"	17"	1/2"	R, Enc
C	17"	22"	1/2"	Pl
D	24"	36"	1/2"	D, Pl
E	30"	42"	1/2"	Non-Construction and presentation drawings

INTENDED USE KEY:

E	-	Easement
Enc	-	Encroachment
W	-	Wetland/Water Quality Submittals
Pl	-	Plats for Recordation (See NCGS 47-30 and Requirement of Cumberland County Register Of Deeds)
D	-	Water and Sewer Design Plans
R	-	Revisions
A	-	Addenda Drawings

All drawings for PWC funded projects shall be prepared on the appropriate PWC Standard Title Block as indicated in the following exhibit and are available in AutoCAD.DWG format from the PWC Water Resources Engineering Department. Drawings must be the sizes indicated unless otherwise approved by the PWC Engineer.

## II. STANDARD LAYER LIST

LAYER NO.	DESCRIPTION	LINE TYPE	COLOR	PLOT STYLE
1	DRAWING SHEET INFORMATION - SHT. NO. BAR SCALE/NORTH ARROW, ETC.	CONTINUOUS	7	0.01
2	BREAKLINES	CONTINUOUS	7	0.01
3	X-SECTION DATA	N/A	3	0.01
4	BUILDINGS, SHEDS, ETC. (EXIST STRUCTURES)	CONTINUOUS	4	0.02
5	ANNOTATION OF LAYER 4 ITEMS	N/A	7	0.01
6	TRAVERSE DATA AND TRAVERSE ANNOTATION	CONTINUOUS	2	0.01
7	LOCATION DATA	CONTINUOUS	1	0.01
8	EDGE OF PAV'T. ROADS, PARKING LOTS, ETC. (EXIST)	CONTINUOUS	2	0.01
9	DESIGN "CENTERLINE" PLAN	CENTERLINE	1	0.01
10	SIDEWALKS, CURBS, GUARDRAILS	CONTINUOUS	1	0.01
11	EDGE WATER/CREEK/ ETC.	CONTINUOUS	121	0.01
12	DRIVEWAYS	CONTINUOUS	1.	0.01

LAYER NO.	DESCRIPTION	LINE TYPE	COLOR	PLOT STYLE
13	EXIST. SIGNS AND PAV'T. MARKINGS	CONTINUOUS	1	0.01
14	TIN	CONTINUOUS	1	0.01
15	UNASSIGNED			
16	UNASSIGNED			
17	PAVEMENT HATCH	CONTINUOUS	8	0.002
18	LIGHT LINES IN LEGEND	CONTINUOUS	8	0.002
19	UNASSIGNED			
20	WOODS LINE, SHRUBS, ETC.	CONTINUOUS	3	0.01
21	EXIST. LANDSCAPING	CONTINUOUS	3	0.01
22	EXIST. IRON PIPE, CONC. MON. ETC.	CONTINUOUS	3	0.01
23	EXIST. FENCES	CONT. W/X	1	0.01
24	REMOVALS AND HEAVY LINES IN LEGEND	CONTINUOUS	4	0.02
25	EXIST. GAS W/ANNOTATION	CONT. W/G	2	0.01
26	EXIST. ELECTRIC W/ANNOTATION	CONTINUOUS W/LABEL	1	0.01
27	STREET NAME RIGHT-OF-WAY WIDTH - GREEN	CONTINUOUS	4	0.02
28	SUBDIVISION NAME, PLAT BOOK, PAGE, ETC.	N/A	1	0.01

LAYER NO.	DESCRIPTION	LINE TYPE	COLOR	PLOT STYLE
29	WETLANDS AND ANNOTATION	CONTINUOUS (HATCH AREA)	3	0.01
30	CABLEVISION	CONT W/TV	1	0.01
31	MAJOR CONTOURS	DASHED	4	0.02
32	ANNOTATION MAJOR CONTOURS	N/A	4	0.02
33	MINOR CONTOURS	DASHED	8	0.002
34	ANNOTATION, MINOR CONTOURS, SPOT ELEV. (FINISH FLOOR ELEV.)	N/A	2	0.01
35	TBM DATA	N/A	6	0.01
36	LOT NUMBER (ADDRESS)	N/A	6	0.01
37	PIN NUMBER	N/A	6	0.01
38	UNASSIGNED			
39	UNASSIGNED			
40	UNASSIGNED			
41	UNASSIGNED			
42	CONSTRUCTION LIMITS	CONTINUOUS W/CIRCLE	4	0.02
43	UNASSIGNED			
44	LOT FRONTAGE	N/A	6	0.01
45	NEW FENCE	CONTINUOUS W/X	4	0.02

LAYER NO.	DESCRIPTION	LINE TYPE	COLOR	PLOT STYLE
46	RIGHTS-OF-WAY	CONTINUOUS	4	0.02
47	EASEMENTS (ALL)	HIDDEN	7	0.01
48	PROPERTY LINES	PHANTOM	2	0.01
49	TELEPHONE	CONTINUOUS W/TEL.	2	0.01
50	EROSION CONTROL W/ANNOTATION	CONTINUOUS	4	0.02
51	NEW WALKS	CONTINUOUS	4	0.02
52	EXIST. SANITARY SEWER LATERALS	CONTINUOUS	3	0.01
53	EXIST. SANITARY SEWER MAINS	CONTINUOUS	3	0.01
54	EXIST. SANITARY SEWER SYMBOLS	CONTINUOUS	3	0.01
55	EXIST. SANITARY SEWER ANNOTATION	N/A	3	0.01
56	NEW SANITARY SEWER LATERALS	CONTINUOUS	4	0.02
57	NEW SANITARY SEWER MAINS	CONTINUOUS	4	0.02
58	NEW SANITARY SEWER SYMBOLS	CONTINUOUS	4	0.02
59	NEW SANITARY SEWER MAIN MANHOLE ANNOTATION	CONTINUOUS	4	0.02
60	NEW SANITARY SEWER LATERAL ANNOTATION	CONTINUOUS	4	0.02



LAYER NO.	DESCRIPTION	LINE TYPE	COLOR	PLOT STYLE
61	EXIST. WATER MAINS	PHANTOM W/W	121	0.01
62	EXIST. WATER LATERALS	CONTINUOUS	121	0.01
63	EXIST. WATER SYMBOLS	CONTINUOUS	121	0.01
64	EXIST. WATER ANNOTATION	N/A	121	0.01
65	NEW WATER MAINS	PHANTOM	4	0.02
66	NEW WATER LATERALS	CONTINUOUS	4	0.02
67	NEW WATER SYMBOLS	CONTINUOUS	4	0.02
68	NEW WATER ANNOTATION	N/A	4	0.02
69	EXIST. STORM LINES	HIDDEN CONTINUOUS W/SD	40	0.01
70	EXIST. STORM SYMBOLS	N/A	40	0.01
71	EXIST. STORM ANNOTATION	N/A	40	0.01
72	NEW STORM LINES	CONTINUOUS W/SD	4	0.02
73	NEW STORM SYMBOLS	CONTINUOUS	4	0.02
74	NEW STORM ANNOTATION	N/A	4	0.02

### III. STANDARD ABBREVIATIONS

#### A

ALT.	ALTERNATE
ALUM.	ALUMINUM
AMP., A.	AMPERES
A.O.	ACCESS OPENING
APPROX.	APPROXIMATELY
ARCH.	ARCHITECTURAL
ASSY.	ASSEMBLY
ASTM	AMERICAN SOCIETY TESTING MATERIALS

#### B

BLDG.	BUILDING
BM.	BENCH MARK
BOT.	BOTTOM
BRG.	BEARING

#### C

CAP.	CAPACITY
CB	CATCH BASIN
C/B	CIRCUIT BREAKER
CEM.	CEMENT
CER.	CERAMIC
C.F.M.	CUBIC FEET/MINUTE
CIRC.	CIRCULATING
C.J.	CONTROL JOINT
CKT.	CIRCUIT
C/L	CENTER LINE
CM	CONCRETE MONUMENT
C.M.U.	CONCRETE MASONRY UNIT
C.O.	CLEAN OUT
COL.	COLUMN
CONC.	CONCRETE
COND.	CONDENSATE

CONN. CONST.	CONNECTION CONSTRUCTION
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#### C (cont'd)

CONT.	CONTINUOUS
CONTR. J.T.	CONTRACTION JOINT
CP&L	PROGRESS ENERGY (CAROLINA POWER & LIGHT)
C. TO C.	CENTER TO CENTER

#### D

DCVA	DOUBLE CHECK VALVE ASSEMBLY
DET.	DETAIL
DI	DROP INLET
DIA.	DIAMETER
DIM.	DIMENSION
DISC.	DISCONNECT
D.J.	DUMMY JOINT
DN.	DOWN
DR.	DRAIN
D.S.	DOWN SPOUT
DWG. (S)	DRAWING (S)

#### E

EA.	EACH
E.C.	EMPTY CONDUIT
EL.	ELEVATION
ELEC.	ELECTRIC
EQUIP.	EQUIPMENT
EXP. JT.	EXPANSION JOINT
EXT.	EXTERIOR
EXIST.	EXISTING

**F**

F.D.	FLOOR DRAIN
F.H.	FIRE HYDRANT
FIN.	FINISH
FL.	FLOOR
FM	FORCE MAIN
FT.	FOOT, FEET
FTG.	FOOTING

**G**

GA.	GAGE
GAL.	GALLON
GALV	GALVANIZED
G.P.M.	GALLONS/MINUTE
G.W.B.	GYPSUM WALL BOARD
GYP.	GYPSUM

**H**

H.B.	HOSE BIBB
HT.	HEIGHT
H.P.	HORSE POWER
HR.	HOURLY
H/W	HEADWALL

**I**

I.D.	INSIDE DIAMETER
IN.	INCHES
INV.	INVERT ELEVATION
INCAND.	INCANDESCENT
INSUL.	INSULATION
INT.	INTERIOR
I.P.	IRON PIPE
I.S.	IRON STAKE

**J**

J.B.	JUNCTION BOX
JCT.	JUNCTION
JT.	JOINT

**K**

KVA	KILOVOLT AMPERE
KW	KILOWATT

**L**

LB.	POUND
LG.	LONG

**M**

MAINT.	MAINTENANCE
MAX.	MAXIMUM
M.D.P.	MAIN DISTRIBUTION PANEL
MECH.	MECHANICAL
MTL.	METAL
MIN.	MINIMUM
MISC.	MISCELLANEOUS
M.J.	MECHANICAL JOINT
M.O.	MASONRY OPENING
M.T.	METAL THRESHOLD
MTD.	MOUNTED
MTG.	MOUNTING
MH	MANHOLE

**N**

N.A.	NOT APPLICABLE
NCNG	NORTH CAROLINA NATURAL GAS
N.I.C.	NOT IN CONTRACT
NO.	NUMBER

NPSH            NET POSITIVE SUCTION  
HEAD

**Q**

O.C.            ON CENTER  
O.D.            OUTSIDE DIAMETER

**O (cont'd)**

OH            OVERHEAD  
OPNG.        OPENING  
OPP.           OPPOSITE  
OTCB          OPEN THROAT CATCH  
BASIN

**P**

PAV'T.        PAVEMENT  
PER.           PERIMETER  
PL.            PROPERTY LINE  
PLBG.        PLUMBING  
PNL.          PANEL  
P.P.           POWER POLE  
PRESS.        PRESSURE  
PSF           POUNDS/SQUARE FOOT  
PSI           POUNDS/SQUARE INCH  
PSIG          POUNDS/SQUARE INCH  
GAGE  
PT.            POINT  
PTD.          PAINTED  
PIV           POST INDICATOR VALVE  
PED.          PEDESTAL  
PVC           POLYVINYL CHLORIDE

**Q**

QTR.          QUARTER  
QUAN.        QUANTITY

**R**

RAD.          RADIUS  
RD.           ROUND  
REC'D.        RECESSED  
RECIRC.       RECIRCULATING  
RECP.        RECEPTACLE  
REINF.        REINFORCING  
REQ.          REQUIRED  
RET.          RETURN  
RM.           ROOM

**R (cont'd)**

R.J.           RESTRAINED JOINT  
R.P.M.        REVOLUTION/MINUTE  
R.P.Z         REDUCED PRESSURE  
ZONE

**S**

SCH.          SCHEDULE  
SDR.          STANDARD DIMENSION  
RATIO  
SECT.        SECTION  
SERV.        SERVICE  
SHT.          SHEET  
SPEC.        SPECIFICATIONS  
SQ. FT.       SQUARE FEET  
ST.           STEEL  
STOR.        STORAGE  
STRUC..      STRUCTURAL  
SUSP.        SUSPEND  
SW.           SWITCH

**T**

TB            TOP BANK  
TBM          TEMPORARY BENCH  
MARK  
TC            TOP CURB  
TEL.          TELEPHONE  
TEMP.        TEMPERATURE

THK.	THICKNESS
TYP.	TYPICAL

**U**

UGE	UNDERGROUND ELECTRIC
-----	-------------------------

**V**

VOLT	
VERT.	VERTICAL

**W**

WATT	
W/	WITH
WD.	WOOD
WF	WIDE FLANGE
WM	WATER METER
WP	WEATHERPROOF
WTR.	WATER
W.W.F.	WELDED WIRE FABRIC

**X**

XFMR	TRANSFORMER
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# CHAPTER SEVEN

## PERMITS, ENCROACHMENTS AND EASEMENTS

### I. REQUIRED PERMITS FOR CONSTRUCTION

All water and sewer system extension plans and specifications must be approved by PWC and all necessary permits, encroachment agreements, and/or dedicated easements must be obtained **PRIOR TO CONSTRUCTION**. Several sample application forms are contained in this Manual for informational purposes. The Applicant is responsible to determine the required permits and submit the properly completed application(s) and pay the associated fees to the approving agency or PWC. The PWC General Manager or his designated shall issue the approved water and/or sewer permits.

#### A. SANITARY SEWER AND WATER MAIN EXTENSIONS

1. Non-discharge permits for sanitary sewer collection facilities and permits for water distribution facilities will be required before construction may commence on any project. PWC shall review and issue the water and/or sewer permits.
2. PWC approved plans must accompany the appropriate water and/or sewer applications as indicated in Chapter One - General Requirements for Water and System Extensions.
3. All application fees must be paid with a check (made payable to Public Works Commission) at the time of submission to PWC for review and approval.
4. Construction may not proceed until permits/easements and encroachments are obtained.
5. A copy of the Authorization to Construct, issued by PWC, shall be posted at the project site.
6. The Contractor shall have the approved set of plans, affixed with the PWC permit stamp, on the job site at all times, and shall produce those approved plans upon request from PWC.
7. Upon completion, and before the facilities are activated, the North Carolina Registered Professional Engineer that supervises inspection must certify that the facilities are constructed in accordance with approved plans and specifications and furnish PWC the completed Engineer's Certification and "As Built" drawings.

#### B. NCDOT HIGHWAY ENCROACHMENTS

1. Encroachment agreements with NCDOT are required for any water or sewer facility installed within the limits of NCDOT rights-of-way. Guidelines for design of utility lines within NCDOT rights-of-way are contained in the NCDOT Manual "Policies and Procedures for Accommodating Utilities on Highway Rights-of-Way" and all requirements in that document shall be considered in design of the facilities.

2. Encroachment maps and copies of construction plans shall be provided to PWC for the encroachment application. The PWC shall prepare the encroachment agreement form. A sample of an acceptable encroachment map is included at the end of this chapter.
3. For projects that have cuts deeper than 10 feet within NCDOT rights-of-way, a profile must be included on the encroachment map. In addition, NCDOT may require submission of cut sheets. Approval for these encroachments is completed in the Raleigh Office of NCDOT, and may take up to 90 days for approval.
4. All NCDOT encroachment agreements for facilities to be owned and maintained by PWC will be between the Public Works Commission of the City of Fayetteville (PWC) and NCDOT. The Engineer will be required to make changes as required by NCDOT or PWC, and will provide information as requested during the encroachment negotiations. All contacts with NCDOT personnel regarding encroachments will be through the PWC Water Resources Engineering Department.
5. If the disturbed area exceeds one (1) acre, a letter from the Land Quality Section of the DENR approving the Erosion Control Plan must be submitted to PWC for forwarding to NCDOT prior to their approval of the encroachment agreement.
6. Conditions of an approved encroachment shall be reflected in the project plans and specifications.
7. The Contractor shall be provided and shall display at the project site a copy of the encroachment agreement. Failure to have an approved copy of the encroachment at the jobsite may result in NCDOT closing the job until such documentation is made available.
8. The bottom of the excavation for a parallel installation by open cut shall not be nearer the edge of pavement (measured in a horizontal plane) than the depth of the excavation so that a 1:1 slope from edge of pavement to bottom of excavation can be maintained. If the excavation cannot maintain the 1:1 slope, NCDOT may require active shoring to be in place.
9. Encasements shall be extended from ditch line to ditch line in cut sections and five (5) feet beyond the toe of slope in fill sections.

#### C. CITY OF FAYETTEVILLE EXCAVATION PERMIT

1. All persons who excavate, obstruct and/or occupy the public rights-of-way will obtain the appropriate permit from the City of Fayetteville.
2. Each person shall register and pay all fees for the Excavation Permit at City Hall, and shall provide to the City satisfaction that the person has financial capability to cover any liability arising due to presence in the City rights-of-way.
3. The Excavation Permit Fee shall be established by the City in an amount sufficient to recover the costs



incurred by the City. This fee shall recover costs incurred by the City for each of the following categories as provided herein:

- a. Administrative: The administrative fee shall be the average permit costs for labor plus indirect and other costs.
- b. Repair: Currently, the City does not collect a repair fee.
- c. Degradation: The general formula for computing the degradation fee shall be the cost per square yard for street overlay and sealing, multiplied by the area of the patch. The area of the patch shall be calculated by adding two (2) feet to each side of the actual street cut.

**Total Excavation Permit Fee = Administrative Cost + Degradation Fee (if applicable)**

- d. Extraordinary: Any other cost over and above Items a through c above. These costs may be levied at the end of the project.

**City Exemption:** Notwithstanding Sub d. 26-25.3(a) 3, the City and its contractors shall not pay a degradation fee.

#### D. RAILROAD ENCROACHMENTS

1. Whenever a PWC water or sewer facility enters a railroad right-of-way, an encroachment agreement between the railroad and the PWC is required. The Engineer shall prepare a separate encroachment map and design data form as required by the individual railroad. Railroads operating in Cumberland County are: Aberdeen and Rockfish Railroad, CSX Transportation, and Norfolk Southern.
  - a. A sample application for the Aberdeen and Rockfish Railroad is included at the end of this Chapter.
  - b. Please refer to CSX's website (<http://www.csx.com>) for information and the appropriate forms to complete for an encroachment across CSX facilities.
  - c. Norfolk Southern encroachment applications must be made through the engineering firm DMJM+HARRIS. Please refer to their website (<http://www.dhprojects.com>) or encroachment information and applications.
2. During encroachment negotiations, the Engineer shall make design changes and supply information as required by the railroad.
3. All contacts with railroad personnel will be through the PWC Water Resources Engineering Department.
4. All conditions of the approved encroachment shall be reflected in the project plans and specifications, such as Insurance requirements, construction by approved Contractor, etc.

#### E. PROGRESS ENERGY ENCROACHMENTS

1. Whenever a PWC water and/or sewer facility enters the right-of-way of Progress Energy, an encroachment agreement between PWC and Progress Energy is required. The Engineer shall prepare a separate encroachment map and required documentation and submit to PWC for application to Progress Energy. Please refer to their website (<http://www.prgnprojectsolutions.com>) for further information on Progress Energy's requirements. Alternatively, you can contact the Progress Energy Real Estate Department at 919-546-6205.

#### F. EROSION CONTROL PERMITS

1. All water main or sewer main construction plans, regardless of project size, shall include measures and/or devices to prevent soil erosion and to prevent sedimentation of streams and drainage ways.
2. Each set of plans for a water or sewer project must include appropriate design of erosion and sedimentation control measures as required by NCDENR. If the area disturbed by the construction is one acre or more, a site-specific erosion and sedimentation control plan must be submitted to the NCDENR, Land Quality Section. Borrow and/or spoil areas, staging areas, equipment and material storage either at the project site or at any location used by the Contractor (and approved by the Engineer), shall be subject to all erosion control requirements.
3. An application fee of \$50 for the first acre of disturbed area and \$50 for each additional acre must accompany the application. For developer funded projects, a check made payable to the NCDENR Land Quality Section in the correct amount must be submitted to NCDENR with one set of plans for approval. PWC shall be provided a copy of the NCDENR approved plans and permit. The review time for NCDENR is 30 to 45 calendar days.
4. The Engineer must respond to any questions and make any plan changes necessary to secure approval of the Erosion Control Plan in a timely manner. All construction is subject to inspection by NCDENR Land Quality Section staff for compliance with the approved Erosion Control Plan. A copy of the Permit shall be posted at all times at the project site.
5. Projects that are not under construction three (3) years after the approval are considered expired by NCDENR and will need to be re-submitted as required by NCDENR.

#### G. STORM WATER PERMITS

1. All construction projects, which involve more than five acres of disturbed area, must have an NPDES storm water discharge permit. The permit application, along with the approval for the erosion control plan, must be submitted to NCDENR. Land disturbing activity cannot take place until the permit is issued.
2. For all construction projects located in the City of Fayetteville's Watershed Protection Area, an application shall be submitted to The City of Fayetteville Inspections Department or to the

Cumberland County Engineer for approval. The Watershed Protection Area is generally an area located northeast of Fort Bragg Boulevard to the Cape Fear River and north to Harnett County.

#### H. CITY OF FAYETTEVILLE ANNEXATION AGREEMENTS

1. The City of Fayetteville requires that all Developers wishing to extend PWC utilities, complete either an annexation petition form or an annexation agreement. The Developer shall initiate the appropriate annexation process with the City prior to receiving the water and/or sewer permit.
2. For those projects within three (3) miles of the current City limits, an annexation petition is required. For those projects further than three (3) miles from the current City limits, the Developer is required to sign an annexation agreement.
3. For further information on the annexation requirements, please contact the City of Fayetteville's Planning Department at (910) 433-1996.

#### I. WETLANDS PERMIT

- 1) Any project that involves encroachment on wetland areas must have a wetlands permit issued by the US Army Corps of Engineers in accordance with Section 404 of the Clean Water Act. In addition, a permit may be required from the NC Division of Water Quality, in accordance with Section 401 of the Clean Water Act. The applicant in responsible charge of the project shall secure the required permit(s) and pay all fees.
- 2) Currently, the fees for the NC Division of Water Quality are as follows: \$475 for more than 1 acre of wetland impact or more than 150 l.f. of stream impacts, and \$200.00 for less than 1 acre of wetland impact and less than 150 l.f. of stream impacts.
- 3) Please refer to the NC Division of Water Quality's webpage (<http://h2o.enr.state.nc.us/>) or call 919-733-7015 for requirements, forms, and procedures for obtaining the necessary permits.

The address for the Division of Water Quality is as follows:

NC Division of Water Quality  
1617 Mail Service Center  
Raleigh NC 27699-1617

- 4) Please refer to the U.S. Army Corps of Engineers, Wilmington District's webpage (<http://www.saw.usace.army.mil/>) or call 910-251-4630 for requirements, forms, and procedures for obtaining the necessary permits.

The address for USCE Wilmington is as follows:

Wilmington Regulatory Field Office  
U.S. Army Engineer District, Wilmington  
69 Darlington Ave.  
Wilmington, N.C. 28403

- 5) Close coordination between the Engineer, PWC, USCE Wilmington and NCDWQ will be required to insure all necessary permits are issued in a timely manner.

#### J. ENVIRONMENTAL ASSESSMENTS

1. An Environmental Assessment is required when gravity sewer extensions are greater than three (3) miles of new lines; lines greater than eighteen (18) inches in diameter; and new or expanding individual pump stations and associated force mains with a proposed permitted capacity of more than 1,750 gallons per minute.
2. Procedures for conducting Environmental Assessments and preparing reports are published by the North Carolina Department of Administration. A minimum of nine months should be allowed for review and approval of the Environmental Assessments. Preparation time for the Environmental Assessments may vary from 120 days to a year, depending on project complexity.
3. If any project requires an Environmental Assessment, the project will need to go to NCDENR for permitting.

#### K. ENVIRONMENTAL CONSIDERATIONS

1. Burning Permits: Open burning of materials resulting from any land clearing or of any discarded construction materials or by products is prohibited within the City of Fayetteville. Open burning permits in the County are issued on a case-by-case basis by the Cumberland County Health Department.
2. Noise Control: In populated areas, and/or annexation projects, the Designer may consider limiting, restricting or prohibiting certain construction activities to be performed during specified hours on weekends, holidays, early mornings or evening hours.
3. Dust Control: In populated areas and/or annexation projects, the Designer shall specify frequency and methods for dust control and street sweeping to be performed throughout the life of the project for all areas affected by construction. Dust control should include paved and unpaved roads, haul roads, access roads, disposal sites, borrow pits, material and equipment storage site. Techniques and methods implemented for wetting and brooming streets shall be compatible with the planned erosion control measures.
4. Water Pollution: The Engineer shall specify that the Contractor shall exercise every reasonable precaution throughout the life of the project to prevent pollution of rivers, streams and water impoundments. Pollutants such as chemicals, fuels, lubricants, bitumens, concretes, grouts, raw

sewage or any other harmful waste shall not be discharged into or alongside of any watercourse or impoundment. Containment shall be specified for any stored potential pollutants located in storage or staging areas.

5. **Tree Protection:** The City of Fayetteville Tree Ordinance shall apply to all construction affecting trees located in or upon City of Fayetteville maintained public street or public property. The Ordinance shall not apply to trees located within NCDOT maintained rights-of-way and sanitary sewer or water main construction easements crossing private properties. However, the Engineer shall consider existing trees and shrubs when establishing the main's alignment and location, particularly in landscaped or maintained yards. The Engineer shall specify that selective clearing operations may be required within public rights-of-way and temporary construction easements. Unless otherwise specified, all trees located totally within permanent sewer or water rights-of-way will be cleared. Valuable trees shall be provided with suitable protective devices or barriers placed in such a manner as to prevent mechanical injuries within the drip line. Trees, shrubs, etc. in temporary easements shall be cleared as necessary to facilitate construction. Trees that show distress or die within 12 months of final acceptance of construction within construction corridor shall be removed.

#### L. EASEMENTS AND RIGHTS-OF-WAY

1. **General:** All PWC owned sanitary sewer and water mains shall be located within dedicated street right-of-way or permanent utility easement having unrestricted access and shall be free of obstructions along the entire length of the main. Placement of permanent fencing, signage or other obstructions may be cause for rejection of system acceptance. Easement acquisition shall be the responsibility of the Developer. However, on a case-by-case basis, PWC can provide assistance in the acquisition of easements.
2. **Widths:** Sanitary sewer and water mains shall be centered in a permanent easement of adequate width to allow for excavation and maintenance of the system. The minimum required width of the permanent easement shall be in accordance with the following:

Table 1. MINIMUM EASEMENT WIDTHS			
	Depth of Cut (Ft.)	Min. Permanent Easement (ft.)	Min. Temporary Easement (ft.)
8" Sanitary Sewer in New Developments	0-10	20	0
8" Sanitary Sewer in New Developments	>10 <20	30	0
8" Sanitary Sewer in Existing Developments	0-10	20	10
8" Sanitary Sewer in Existing Developments	>10 <20	30	10
Sanitary Sewers 12" and Larger		30	10
Water Mains and Force Mains	<20	20	0

Combination (i.e. Water and Sewer)	<20	30	10
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Permanent easements of greater width and temporary construction easements may be required by PWC and deemed appropriate as existing conditions warrant such as depth of cut, cuts greater than 20 feet, number of utilities, etc. Permanent easements containing multiple utilities shall locate each utility main a minimum of 10 feet apart and a minimum of five (5) feet (water) or 10 feet (sewer) inside the permanent easement limit and centered within the easement width.

3. Format: All required easement (permanent and temporary) and rights-of-way shall be provided to PWC by one of the following methods:

- i. Record Plat

- 1) The Developer may furnish a record plat of the property to be served with all easements and rights-of-way widths shown. The easement shall be tied to a fixed point, and include bearing and distance for each easement line. The Plat must be recorded at the Cumberland County North Carolina Registry and bear the seal, signature and certification of a Professional Land Surveyor.

- ii. Easement Maps

- 1) For those easements that are off-site and not owned by the Developer, a standard easement map and description is required. All maps shall conform to the requirements of the standards of practice for land surveying in North Carolina, Section 1600 of The Board Rules. A separate map shall be prepared for each parcel where an easement is to be obtained. The map shall contain the following:
      - a) The entire property boundary shall be shown on the map with the proposed right-of-way clearly shown. For large properties, easement details must be shown by separate insets at reduced scale. Not to scale insets may be used when necessary to clearly convey details.
      - b) Every point where the sewer/water centerline or right-of-way crosses a property line must be tied to an identifiable property corner.
      - c) The property owners name, deed book and page where the deed is recorded, and the current PIN must be shown on each map, including adjoining parcels.
      - d) All manhole locations must be shown, whether at angle points or on line. Show bearings between angle points and centerline distances along lines.
      - e) Widths for permanent rights-of-way and temporary construction easements must be shown and labeled.

- f) Show the total parcel area, as well as the permanent and temporary easement areas, separately and clearly in square feet.
  - g) All maps must be on 8½" x 14" vellum or mylar with a standard PWC title block.
  - h) Include a scale, vicinity map and north arrow (show reference datum).
  - i) Submit an original map and one copy with the original signature and original seal of the NC Professional Land Surveyor, as required by G.S. 47-30 to PWC Water Resources Engineering Department.
  - j) Check easement maps against construction plans and make sure they agree. When a revision is made, make sure that both the plans and the affected easement map(s) are changed and that the changes are recorded in the revision blocks on both documents.
  - k) When paralleling property lines, the permanent right-of-way boundary should be contiguous with the property line. If possible, the construction easement should be on the same property. A separate parcel should not be created just for a construction easement unless the site topography requires it (e.g. where the easement would otherwise be within 10 feet of a creek).
- 2) A sample easement map and submittal checklist are included at the end of this Chapter.

### iii. Blanket Easements

- 1) For commercial developments where a plat is not to be recorded, a blanket easement shall be granted to PWC for the operation and maintenance of the utilities within the development. The blanket easement shall be prepared by the PWC, for signature by the Developer. In addition, an easement exhibit map shall be prepared. This exhibit map shall indicate the proposed width of the utility easement, including laterals and meters, as well as the building footprints, and roads. This exhibit map shall be included in the design drawings and submitted to PWC for review and approval.
- 2) A sample easement exhibit map is included at the end of this Chapter.

## II. WATER AND SEWER SYSTEM APPROVAL PROCESS

### A. GENERAL

- 1. The following is the general sequence that is followed by PWC in reviewing and approving plans, and issuing permits:
  - a. The Developer's Engineer prepares the design plans, and completes the appropriate permit

- applications and checklists.
- b. The design package, including appropriate permit fees, is submitted to PWC for review.
  - c. The PWC Water Resource Engineering Department reviews the plans and permit applications.  
Any requested changes are sent to the Engineer, with a copy to the Developer.
  - d. Once the revisions are complete and acceptable to PWC, PWC initiates the contract process.
  - e. Upon completion of the contract, the contract is sent to the Developer for signature.
  - f. Once the Developer signs and returns the contract, the water and/or sewer permits are prepared and issued.
  - g. At such time the permits are issued, construction may commence on the project.
2. In general, permits will not be issued until the following items are completed (as applicable for each project). Exceptions may be granted on a case-by-case basis.
- a. Off-site easements are obtained.
  - b. Encroachments from the appropriate railroad are obtained.
  - c. The annexation petition process has been initiated.
  - d. The annexation agreement process has been initiated.



### III. REQUIRED SETS OF PLANS AND SPECIFICATIONS FOR APPROVALS

Type of Project	No. of Copies of Drawings	No. of Copies of Specifications	Permit Originals	Permit Copies	Application Fee	Submit Appl. to
Sewer Ext. Fast Track Form FTA 02/03	2-Bond/Blueprint	0	1	2	\$400	DWQ
PWC Gravity Sewers, Pump Stations, and Force Mains (rev 1/05)	3-Bond	0*	1	0	\$500	PWC
PWC Water Permit (rev 1-05)	3-Bond	0*	1	0	\$500	PWC
NCDOT Encroachment	1	0	0	0	N/A	PWC
Erosion Control	1 - Bond	1	1 Financial Responsibility	1	\$50 per acre or partial disturbed acre	NCDENR
Wetlands 404 Wilmington District	1 - Bond 11" x 17" Only	1	1	1	\$0 for non-written confirmation \$200 UNDER 5 ACRES \$400 OVER 5 ACRES	USCE Wilmington
Wetlands 401 NCDENR	7 - Bond	7	0	7	0	NCDWQ
Easement Maps	1 - Vellum 8½" x 14"	0	0	0	0	PWC
R/R Encroachment	1 - Vellum 8½" x 11"	0	0	0	Varies by R/R	PWC

\* - Note: PWC Specification Checklist required in lieu of specifications

#### **IV.     EXAMPLES**

The following forms, drawings, and applications are included in this Manual for informational purposes:

- ?? Final Plans and Permit Submittal Checklist
- ?? PWC Specification Checklist
- ?? PWC Property Questionnaire
- ?? PWC Economic Development Incentive Questionnaire
- ?? PWC Application for Approval of Engineering Plans and Specifications for Water Supply Systems
- ?? PWC Application for Gravity Sewers, Pump Stations, and Force Mains
- ?? PWC Water Permit Issuance Letter
- ?? PWC Sewer Permit Issuance Letter
- ?? Engineer's Certification – Water
- ?? Engineer's Certification – Sewer
- ?? Final Approval Letter from PWC
- ?? NCDOT Encroachment Drawing
- ?? Aberdeen and Rockfish Railroad Pipeline Crossing Application
- ?? Easement Submittal Checklist
- ?? Standard Easement Drawing
- ?? Blanket Easement Exhibit