



WATERMAIN AND SANITARY DESIGN MANUAL

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Transition Policy

The policies and requirements in this Development Manual shall take effect within 90 days of the date of the amendment, noted as a footer on each page. For any current Subdivision Agreements the requirements of those conditions of the Subdivision Agreements shall apply. For any future phases, the requirements of this Development Manual shall apply unless superseded by a new Subdivision Agreement.

This current version of the Development Standards is Version 1.0 amended herein on the ____ day of _____, 2019.

Changes to Version 1.0 from the previous document named V 1.0 include:

PART A

POLICIES, REGULATIONS AND GENERAL SPECIFICATIONS

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FOREWORD

This manual is intended to serve as a guide for engineers during the design process and preparation of plans and specifications for municipal watermains expansion or reposition, installation of new service connections, and new installation of wastewater servicing in the Municipality of Chatham-Kent.

It is not possible to cover recently developed process and equipment in a publication of this type. However, the main idea of this manual is to encourage, rather than obstruct, the development of new processes and equipment.

Chatham-Kent P.U.C. will update this document annually for any sections related with design, constructions, and material for other kind of structures that conform a water and sewer systems.

ACKNOWLEDGEMENTS

As part of the purpose defined by the administration of the Chatham-Kent Public Utilities Commission for 2019, a wide researching process and recompilation of technical information was initiated, and many professionals in environment, water, and sewer issues were involved.

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General inquiries regarding the contents of this document can be directed to the Chatham-Kent Public Utilities Commission Engineering Department.

Credit is extended to the following sources for many of the standards and specification adopted herein:

- Design Guidelines and supplemental specifications for municipal services - DGSSMS, Region of Waterloo and Area Municipal, January 2018
- Standards and Guidelines for municipal waterworks, wastewater and storm drainage systems. Alberta Environment Protection, April 2012
- Designs Standards. City of Lethbridge Alberta Canada, 2016
- Construction Guidelines for Treated Water Distribution, Non-Potable Irrigation and Distribution, City of Greeley Colorado, June 2008
- Temporary Conditions Book 7, Ontario Traffic Manual. March 2014
- OPSS – Ontario Provincial Standards Specification. Ministry of Transportation Ontario and Municipal Engineering Association
- AWWA - American Water Works Association

- The Ministry of the Environment, Conservation and Parks (MOECP) guidelines for water and sewer works and the following publication:
 - Recommended Standard for Water Works, Committee of the Great Lakes-Upper Mississippi River Board State and Provincial Health and Environment Managers, 2012
 - Recommended Standard for Wastewater Facilities, Great Lakes-Upper Mississippi River Board State and Provincial Health and Environment Managers, 2014
 - Design of Water Supply Systems for Small Residential Developments
 - Technical Update for Municipal Drinking Water Systems: Approval Requirements for Drinking Water Systems: Transition from Drinking Water Protection Regulations under SDWA
 - Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines
 - Guidelines for Evaluating Construction Activities Impacting on Water Resources, including the consolidation of former Ministry Guidelines B-6, B-8, B-19 and B-11
 - Sewer and Watermain Installation: Separation Distance Requirements
 - Planning for Sewage and Water Services

A.1 INTRODUCTION

The goal of this manual is to establish, as far as possible, uniformity of practice and standardization among all areas within the Municipality of Chatham-Kent related to water and wastewater. Its content has been developed to provide basic uniform requirements for water and sewer systems during the design process, material selection, and construction procedures.

A.1.1 CURRENT LEGISLATION APPLICABLE TO WATER SECTOR

All efforts have been made to include applicable legislation suitable to the water sector, as well as all municipal By-Laws and standards promulgated for Chatham-Kent P.U.C. to rule the administrative issues. However, it is not possible to cover all regulations in progress or recent developments and procedures. For this reason, the manual shall be considered as general guidelines that may be revised annually to ensure that updated information will command at all times, with the mission of serving people with high quality water at reasonable and sustainable cost.

A.1.1.1 Ontario Ministry of the Environment

It is the aim of Chatham-Kent P.U.C. to be environmentally responsible during phases of design, construction, and operation of all municipal services. However, the users of this manual must be familiar with the environmental protection standards laid out within this document and by the various agencies that govern the Municipality of Chatham-Kent.

A.1.1.2 Ontario Building Code

This manual applies only to municipally owned services. The Ontario Building Code and its associated specifications govern installation of privately held services. The Chatham-Kent P.U.C.'s manual is supplemental to the Ontario Provincial Standards Specifications (OPSS) and thus take precedence over the related specifications (OPSS's) and drawings (OPSD's).

A.1.2 DOCUMENT STRUCTURE

This manual has been structured in the following manner:

- Part A: Policies, Regulations and General Specifications
- Part B: Design Guidelines for Watermains
- Part C: Design Guidelines for Sanitary Sewer
- Part D: Materials Specifications
- Part E: Construction Specifications
- Part F: Standard Drawings

This structure facilitates the referencing and use by multiple users with different needs, such as:

- Project Manager – All Parts
- Consultant – Parts B, C, D, E, and F
- Contract Administrator – Parts A, D, E, and F
- Contractors – Parts D, E, and F
- Municipal Operations – Parts A, C, D and F

The above outline is a general intention only and should not be limiting in any way.

A.1.3 APPLICABILITY AND IMPLEMENTATION

The Chatham-Kent services currently considered in this manual are:

- Watermains and Service Connections
- Sanitary Sewers

For all other municipal services, the user must refer to different specifications. The water and sanitary design guidelines apply to water distribution and service water connections, and wastewater collection only. The user must contact Chatham-Kent P.U.C. for specific guidelines for water supply and treatment. Trunk servicing may use other or additional special specifications.

Chatham-Kent P.U.C.'s manual is a detached document that will be referenced in Engineering Agreements and Contract Documents. Chatham-Kent P.U.C. however, may issue specific instructions or modifications to the specifications as part of a Special Conditions or Special Provisions Section within Construction Contracts. This manual will be used on all municipal service additions and alterations including:

- Subdivisions
- Reconstruction
- Improvements and augmentations
- Waterline projects
- Sanitary sewer projects

This manual is available free of charge via internet at www.chatham-kent.ca. Hard copies will be available at the Chatham-Kent P.U.C.'s office for a fee established or adjusted by the Chatham-Kent P.U.C.

A.1.4 UPDATES

On an annual basis, Chatham-Kent P.U.C. will review the specifications in light of comments received and the introduction of new materials and procedures.

A.2 PURPOSE

The primary purpose of creating a manual containing a common set of design guidelines and contract specifications is to unify the design process and construction specification of municipal services by consultants and contractors that work in more than one locality. Although this document is often referred to as specifications, the design portion (Part B and C) should be considered as guidelines. This manual provides the Chatham-Kent P.U.C.'s design preferences under normal circumstances. The consultant however, should use their best judgement to find innovative solutions when abnormal design conditions are encountered. Chatham-Kent P.U.C. reserves the right to apply discretion in the interpretation of these guidelines, and require the use of other applicable guidelines and good engineering judgement when reviewing each project.

Subdivider/Developers, Consultants, and Contractors interrelated with new projects shall follow this manual. It is their responsibility to obtain and make use of the latest version available at the time of engineering design. The Chatham-Kent P.U.C. will periodically review, update and maintain the most current version of this Manual and make it available through the Chatham-Kent municipal website.

A.3 POLICIES AND BYLAWS

"Ontarians deserve access to clean, safe water*." This means keeping water free of pollutants and contaminants that could harm the environment and human health. The Government of Ontario maintains a series of initiatives to preserve water quality, including new legislation, regulations, standards, and requirements.

Working in that direction, Chatham-Kent P.U.C. has included in this manual all government policies and regulations as well as local By-Laws and regulations. For reference, the applied Regulation and Policies in this manual are:

- Environmental Protection Act
- Ontario Water Resources Act
- Safe Drinking Water Act
- Drinking Water Systems Regulation
- Occupational Health and Safety Act and Regulations for Construction Projects
- Municipality of Chatham-Kent's By-Laws and other applicable regulations
- Chatham-Kent P.U.C. Policies and Procedures

* Extracted from the Environmental Protection Act.

A.4 GENERAL CONDITIONS OF SUPPLY WATER**A.4.1 OVERSIZING**

In those areas designated as Development Charge Areas, the Chatham-Kent P.U.C. will pay for the cost of oversizing watermains in residential subdivisions. Based on the difference in cost of constructing watermains over 200 mm (8 inches) diameter where the oversizing is required by the Chatham-Kent P.U.C. to service areas beyond the subdivisions/areas.

A.4.2 WATER CHARGES AND DEPOSITS**A.4.2.1 P.U.C. WATER PERMITS**

For every service on the water distribution system, the Chatham-Kent P.U.C. requires a water permit.

Water Permits are obtained by the builder of a home[†] and are required by the Municipality of Chatham-Kent in order to obtain a Building Permit. The Chatham-Kent P.U.C. does not charge a fee for the Water Permit itself, but does require that all applicable charges associated with the service be paid for at the time of obtaining a permit. The charges due at the time of obtaining a water permit may include a service flat rate, or a deposit in the amount of the estimated cost to construct a service to the road limit as determined by the Chatham-Kent P.U.C. and a meter charge. Both the service flat rate and the estimate deposit will include a meter charge.

A.5 DESIGNS AND DRAWING REQUIREMENTS

In Parts B, C, and E of this manual, references have been made to Part F: Standard Drawings to ensure the consistency of drawing information for new water and sanitary systems in Chatham-Kent. [The minimum requirements for drawings made during all stages of a project; preliminary and final approval, “as built” approval, and final acceptance is established in Part F.] Standard drawings taken from the Ontario Provincial Standard Drawings (OPSD) have been included with the Chatham-Kent P.U.C. specific requirements. However, in cases in which the drawing to be developed is not included in Part F of this manual, shall be prepared using OPSS and OPSD standards and presented to Chatham-Kent P.U.C. for approval.

[†] Home defined as that place in which people live in a permanent scheme and for which a property title exist.

A.6 WATER PLAN AND DESIGNS REQUIREMENTS

Sufficient design, calculations, and pre-planning are required for a water or sewer design. The consultant shall carry out this pre-planning and detailing based upon part B or C of this manual, and develop the required Subdivider/Developer's engineering drawings.

The Subdivider/Developer, sufficiently in advance to the anticipated start of the work, shall provide acceptable engineering plans, profiles and construction drawings at their own expense, prior to any work being carried out, as outlined in this section for Chatham-Kent P.U.C. review and approval. The required nature and quantity of drawings is [established in Part F:] Standard Drawings.

A.6.1 FINAL ACCEPTANCE

The acceptance of a water distribution or sanitary sewer systems in subdivision(s) is usually tied into the completion, testing, and approval for use of the watermain and services, or sewer in accordance with the subdivision agreement. The Subdivider/Developer shall extend the maintenance or guarantee period given for them one (1) year from the date of acceptance of the system by Chatham-Kent P.U.C.

In accordance with the subdivision agreement, the Subdivider/Developer is responsible for rectifying damages to water or sanitary facilities, which occur prior to the completion of the one- year maintenance period. A damage deposit collected for the protection of a specific water or sanitary service may supersede this responsibility.

Watermain Commissioning shall be carried out as per Section 5. 2. 1 and Sanitary Sewer Commissioning shall be carried out as per Section 5. 2. 2.

A final inspection of the water distribution or sanitary sewer system in the subdivision shall precede final acceptance by the Chatham-Kent P.U.C. The Subdivider/Developer, prior to final acceptance by the Chatham-Kent P.U.C. shall correct all deficiencies.

The Subdivider/Developer shall provide preliminary information for "As Constructed" drawings, card reports, and/or sewer systems in the development before final acceptance by the Chatham-Kent P.U.C. Final "As Constructed" drawings will not be submitted until draft "As Constructed" drawings have been reviewed.

A.6.1.1 Watermain Commissioning

The Subdivider/Developer or their representative is required to comply with Chatham-Kent P.U.C. New Watermains Disinfection Procedure (Control No. 2000677) and complete a Watermain Commissioning Checklist (Control No. 2001837) provided by the Chatham-Kent P.U.C. for all water distribution systems. The Checklist provides detailed instruction on water distribution testing and commissioning requirements, final inspections and communication requirements. The Chatham-Kent P.U.C. will not approve any water plant for connection to the existing distribution system unless a signed and approved Watermain Commissioning Checklist has been received and distributed to all relevant parties.

A.6.1.2 Sanitary Sewer Commissioning

The Subdivider/Developer or their representative is required to conduct a CCTV investigation of all new gravity sanitary sewer systems and provide a report to the Chatham-Kent P.U.C. detailing the results of the investigation. The Chatham-Kent P.U.C. will not accept ownership of any sanitary sewer system unless the CCTV investigation has been reviewed and approved by the Chatham-Kent P.U.C.

A.7 OTHER SPECIFICATIONS**A.7.1 LOCATES**

No person or firm shall dig, bore, grade, excavate, or break ground with mechanical equipment or explosives without first determining the location of any underground watermain or water service line that may be interfered with.

The Chatham-Kent P.U.C. maintains a location service, free of charge, during regular hours. (8:30 am to 4:30 pm) to assist in locating the Chatham-Kent P.U.C.'s underground water and sanitary installations. Any inquiries related to locates performed by Chatham-Kent P.U.C. shall be directed through Ontario One Call.

Parties requesting locates of a non-emergency nature that are to be performed outside regular hours will be charged the actual cost of the location.

The detecting instruments are not infallible, particularly in congested areas. All locates are subject to instrument errors. It is the responsibility of the person or persons digging, boring, trenching, grading, excavating, or breaking ground to verify the location of the underground facilities and to abide by instructions on the location sheet.

The Chatham-Kent P.U.C. shall not be responsible for any damage or additional cost resulting from a failure to follow location instructions.

The party requesting the locate will be responsible for moving excavated material or other construction debris that may have been placed over Chatham-Kent P.U.C. facilities, specifically water service shut-off, hydrants and valve boxes. The Chatham-Kent P.U.C. will insist that this material be moved before completing the locate. This may necessitate a second call to the site, which will have to be pre-arranged in the same manner as the initial request.

A.7.1.1 Notice Requested for Locates

Except in the case of emergency, request for individual water locates (i. e. specific location of the underground watermain and water service shut-off) should be made a minimum [7 days] in advance of the actual need for locate. Where locates are required for entire urban blocks or for a group of lots, additional lead-time for locates may be required.

A.7.1.2 Locates During the Winter Months

Requests for locates during the winter will be accommodated within reason. The party requesting the locate will be responsible for moving frozen materials such as snow, ice and/or construction materials in order that the locate may be accomplished. Any repairs to or replacements of damaged water service boxes will be charged to the appropriate party responsible for the protection of Chatham-Kent P.U.C. facilities (Subdivider/ Developer, Builder or Customer).

A.7.2 INSPECTION REQUIREMENTS

The Chatham-Kent P.U.C. requires an inspection of all water distribution and sanitary systems installed. The Chatham-Kent P.U.C. or representative will carry out periodic spot inspections during the installation of a water distribution or sanitary systems to ensure conformance with the Chatham-Kent P.U.C standards and specifications detailed in this document.

The Subdivider/Developer or their representation is required to provide continuous resident inspection during all stages of installation and testing and shall follow all instructions given by the Chatham-Kent P.U.C. representative relating to the quality or type of material, installation or construction practices. The Chatham-Kent P.U.C. representative has the right to suspend the work immediately if the work practices being employed, the materials being used or the proposed layout is insufficient.

A.7.2.1 Locates in Subdivisions Prior to Final Acceptance

Prior to final acceptance, utility locates shall be requested through Ontario One Call.

A.7.3 LOCATION OF WATERMAINS

Location of watermains shall be according to all specifications included in Part B and Part E of this manual. The consultant shall include related information about location of watermains in plans as it is recommended in Part F: Standard Drawings. The accuracy of this information shall be taken in consideration due to the importance of this information for future utilization.

A.7.4 HYDRANTS

Consistent with the Ontario regulations, the following facts shall be taken in account during the water system's planning:

- All water used for public fire protection must be delivered through hydrants; therefore, a sufficient number of hydrants shall be provided on a distribution system.
- No more than two fire hydrants in the water system shall be taken out of service by a watermain shutdown.
- The number of hydrants needed in any area depends upon the fire flow required. The consultant shall be careful to follow all provincial and local recommendations about the fire flow and minimum number of hydrants on a new or extended portion of the system.

- Relevant aspects about pressure and normal conditions of operation has been included in Part B and E to guide the consultant into the minimum parameters of fire flow and hydrants issues.

A.7.5 WATER SERVICE CONNECTIONS

Chatham-Kent P.U.C. shall provide the required permit to provide water service connections. The developer/owner's contractor or owner shall fill all requirements and follow all procedures to fulfill the process of obtaining a water service permit from Chatham-Kent P.U.C. In all cases, the water permit shall be obtained in accordance with the latest Chatham-Kent P.U.C. By-Law.

Applicable water services rates shall be calculated in accordance with the latest Chatham-Kent By-Law. Exception of permits has not been included in this manual.

Before the service is on, the Chatham-Kent Building Department shall inspect the connection in accordance with the applicable Chatham-Kent P.U.C. standards. Applicable procedures and fees for buying and installing meters shall be as established by Chatham-Kent. In accordance with the latest Chatham-Kent P.U.C. Bylaw, Chatham-Kent P.U.C. has the right to remove and/or test any meter, at any time or times or to substitute with another meter any defective meter in the opinion of the General Manager, and the cost shall be the responsibility of Chatham-Kent P.U.C.

A.7.6 WATERMAIN VALVE OPERATIONS

Where the Chatham-Kent P.U.C. allows the Subdivider/Developer or their Contractor to have the water turned off in existing charged mains, in order to make connections, they shall notify the Chatham-Kent Fire Department and the water users in the affected area of the time of, and the anticipated duration of the shut-off at least 72 hours in advance.

The Chatham-Kent P.U.C. or Chatham-Kent Public Works shall, in all instances, carry out the actual operation of the existing in-service valves to be shut off; and charge or load watermains.

Once the water system has been installed, pressure tested, disinfected, flushed and put into active service, but prior to acceptance by the Chatham-Kent P.U.C. the Subdivider/Developer or their contractor shall:

1. NOT operate any valve that will change the status of the watermains or hydrants that are charged. If the Subdivider/ Developer requires a valve shut-off or turned on, which will affect the status of the watermains or hydrants that are charged, they shall request the Chatham-Kent P.U.C. or Chatham-Kent Public Works to turn the valve on or off.
2. Provide notifications of shut-offs to the existing water users. Notification of the water users shall be 72 hours in advance for pre-planned work.

In case of emergencies, the nature and extent of the emergency will govern the notification to water users. In all cases, the water users should be informed of the situation and given some information as to when they can expect service to be restored.

The Subdivider/Developer or their contractor shall arrange 72 hours in advance with the Chatham-Kent P.U.C. regarding the opening and closing of existing or newly activated watermain valves, hydrants and services. Presently, there is no charge for this service during Chatham-Kent P.U.C. regular working hours.

The Subdivider/Developer or their contractor shall flush the new watermains in a satisfactory manner. The Subdivider/Developer or their contractor will be responsible for satisfactory disposal of all water used in flushing and/or disinfecting in accordance with the requirements of the Ministry of Environment, Conservation and Parks.

End of Part A

PART B

DESIGN GUIDELINES FOR WATERMAINS

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B.1 GENERAL**B.1.1 SCOPE**

The purpose of these design guidelines for water is to present the minimum design and technical criteria for the analysis and design of watermains and water services. This document is to be used by developers, design architects, and design engineers in the design of both public and private watermains for which the Chatham-Kent P.U.C. acceptance is required. The design engineer shall be responsible for compliance with these design guidelines as well as other applicable design and construction guidelines in the preparation of engineering studies, construction drawings, and specifications for Chatham-Kent P.U.C. review.

B.1.2 DEFINITIONS, ABBREVIATIONS, AND UNIT SYSTEM**B.1.2.1 Definitions and Abbreviations**

Wherever the following words, phrases, or abbreviations appear in these specifications they shall have the following meanings.

APPROVED PLAN. The latest revised construction plan stamped by the professional engineer and approved by the Chatham-Kent P.U.C.

AS-CONSTRUCTED RECORD. Documents -duly certified by professional engineer-reflecting actual conditions and information from the project after construction is completed.

ASTM. American Society for Testing Materials.

AVERAGE DAY. The total amount of water demanded within a certain time period, usually one year, divided by the number of days within that time period.

AWWA. American Water Works Association.

CHATHAM-KENT P.U.C. The Public Utilities Commission for the Municipality of Chatham-Kent, which have responsibility for the specification of design, construction, and materials.

CONSTRUCTION DRAWINGS. Detailed and working drawings including plan view, profile, and detail sheets of proposed utility improvements stamped by professional engineer and approved by Chatham-Kent P.U.C.

CONSULTANT/DESIGN ENGINEER. The partnership, corporation, or individual who is registered as a professional engineer, according to Chatham-Kent P.U.C. statutes, and who is hired by the Developer/Owner, and is empowered to act as his agent for the project. This reference may also include municipal staff.

CONTRACT ADMINISTRATOR. The individual or firm responsible for overseeing the construction of the works and representing the municipality's interests.

CRITERIA. Chatham-Kent P.U.C.'s design Criteria for water distribution and sewer systems.

DEVELOPER. The owner, corporation, association, partnership, or individual who has entered into an agreement with the Municipality and has entered into an agreement with the Design Engineer and Contractor to perform the work.

DOMESTIC. Any non-fire potable water use.

INITIAL ACCEPTANCE. This can be either the Initiation of the Maintenance Guarantee Period for subdivision servicing or the Substantial Completion of the Contract for other work. This is typically when the Municipality assumes ownership of the works subject to the Warranty Period.

MAXIMUM DAY. The largest volume of flow anticipated to occur during a one-day period, expressed as a daily average.

MAY. A permissive condition. No requirement for design or application is intended.

OPSD. Ontario Provincial Standard Drawings

OPSS. Ontario Provincial Standard Specifications

OWNER. The developer, corporation, association, partnership, or individual who has entered into an agreement with Chatham-Kent P.U.C. and has entered into an agreement with a Design Engineer and Contractor to perform the work.

PEAK HOUR. The highest short-term (1 hour) demand within a system not including fire flow. The peak hour is normally the highest hourly demand on the maximum day.

PLANS. Detailed working drawings including plan view, profile, and detail sheets of proposed utility improvements, reviewed and stamped by a professional Engineer.

PROFESSIONAL ENGINEER. An engineer currently licensed by the Ontario Statute.

QUALIFIED. Acquired abilities; skill, knowledge, experience, that fits a person for a position, office, or profession.

SHALL. A mandatory condition. Where certain requirements in the design of application are described with the "shall" stipulation, it is mandatory that these requirements be met.

SHOULD. An advisory condition. Where the word "should" is used, it is considered to be advisable usage, but not mandatory. Deviations may be allowed when reasons are given which show that the intent of the standard is met.

UTILITIES. Shall mean all utilities on site prior to the time of any design; such as but not limited to water lines, sanitary sewer lines, drainage lines, electric lines, gas lines, telephone lines, fibre optics lines, or cable television lines.

WARRANTY PERIOD. During this period, the Contractor is responsible for all costs related to repairing any defects in materials or workmanship. The Municipality will specify the length of the warranty period.

WATER AND WASTEWATER GENERAL MANAGER. Shall mean the General Manager of the Chatham-Kent P.U.C. or his designated representative.

WATER DISTRIBUTION MAIN. It is defined as a water pipe that primarily serves as a delivery conduit to transport potable water directly to individual water services.

WATER DISTRIBUTION REPORT. This report is prepared by the designer to document the analysis completed to determine the layout and sizing of a watermain or water distribution system.

WATER TRANSMISSION MAINS. Those are defined as watermains that are 450 mm (18 inches) and larger in diameter. They shall have air and vacuum release valves installed at all high points on the line, blow off assemblies constructed at each low point. Transmission line taps shall be greater than or equal to 203 mm (8 inches) with the exception of fire hydrant taps.

B.1.2.2 Unit System

The following units and abbreviations shall be used in any of the calculations contained in this part of the manual.

Y	=	year	kW	=	Kilowatt
cm ²	=	Square centimetre	lt	=	litre
cm ³	=	Cubic centimetre	m	=	Metre
Day	=	Day	m ²	=	Square metre
ft	=	Feet	m ³	=	Cubic metre
g	=	Gram	mg	=	Milligram
gpm	=	Gallons per minute	Min	=	Minute
gpcd	=	Gallons per day per capita	mm	=	Millimetre
gpd	=	Gallons per day	MPa	=	Mega Pascal
h	=	Hour	N	=	Newton
Ha	=	Hectare	°	=	Degree
Kg	=	kilogram	Pa	=	Pascal
Km	=	Kilometre	psi	=	Pound per square inch
Km ²	=	Square kilometre	s	=	second
KN	=	Kilo Newton	T	=	Ton
kPa	=	Kilopascal	W	=	Watt
kV	=	Kilovolt	In	=	Inch

B.1.3 MINIMUM STANDARDS

B.1.3.1 Precaution

Whenever the provisions of these Standards are found to be inconsistent with any other criteria, standards, regulations, or codes, the design engineer shall determine the current applicable standard. The provisions of these criteria and standards contained in this manual are minimum requirements that do not preclude imposition of more restrictive standards by agreement or by law.

B.1.3.2 Scope

Chatham-Kent P.U.C.'s review and acceptance will only be to determine if the plans, specifications, and construction generally conform to the Municipal requirements. Chatham-Kent P.U.C.'s review and acceptance will not relieve the design engineer and/or Contractor/Owner from responsibility for any variation from the Chatham-Kent P.U.C. requirements or adequate design standards. The Chatham-Kent P.U.C.'s review and acceptance shall not constitute any assumption of responsibility or liability for the design or construction. It is the intent and purpose of these standards and specifications of this manual to obtain high quality construction throughout, with the completed work complying with the standards and specifications.

B.1.4 RELATIONSHIP TO OTHER STANDARDS**B.1.4.1 Restrictions**

Whenever a condition of this manual, and any other condition in any law, ordinance, resolution, rule, or regulation of any kind, contains any restrictions covering any of the same subject matter, the most restrictive standard shall apply. Adherence to the criteria contained in this manual does not remove the design engineer's responsibility to investigate and obtain any other regulatory permits or approvals, from local, provincial, or federal agencies, that may be required for a particular project.

B.1.5 IMPACT OF WORKS ON EXISTING SYSTEM**B.1.5.1 Study of impact**

The design engineer is responsible to determine and ensure the ways to mitigate the impact of the new works on the existing system and its users both inside and outside of the project limits. To do this, the design engineer is responsible to formulate a study of impact to cover operational, physical, and environmental effects during the construction stage.

B.1.5.2 Scope

The study of impact shall include all recommendations required to prevent all possible damage to existing facilities, trees, monuments, natural resources, roadways, etc. At the same time, the study of impact shall provide recommendations about controlling air and water pollution during the construction stage.

B.1.5.3 Standard

The impact study shall be according to OPSS 180, 182, 517, 539, local, provincial, federal and all other MECP applicable considerations related with the environment and resources protection.

B.1.6 ENGINEERING REPORT**B.1.6.1 Project Description**

The consultant shall prepare an engineering report to present all result obtained as part of the design process. Among other technical aspects, the engineering report shall contain the project description in terms of its location, an evaluation of the conditions and situations needing correction, its relation with the water master plan, estimate of the construction and financial possibilities, analysis of phasing, etc.

B.1.6.2 Technical information

The consultant shall include all technical information obtained during the design process like tables, graphics, spreadsheets, plans, and diagrams.

B.1.6.3 Appendices

The engineering report shall include the geotechnical report, impact study, and any other information or report required during the design process.

B.1.7 GEOTECHNICAL INVESTIGATION**B.1.7.1 Objective**

A geotechnical investigation shall be conducted to determine the subsurface soil conditions, associated geotechnical, and geophysical parameters required to prepare recommendations for geotechnical aspects of the design. The number of boreholes and its maximum depth shall be defined according to the size of the project, the geological background of the site project and the kind of structures required.

B.1.7.2 Standard

Geotechnical and geophysical investigations shall be according to ASTM standard D-1586.

B.1.7.3 Referencing

All ground borehole elevations shall be referenced to the geodetic datum.

B.1.7.4 Geotechnical Report

A geotechnical report shall be attached to the engineering report. As a minimum, recommendations shall be made regarding the watermain bedding, thrust restraints, corrosion protection, trench dewatering, and constructability. The resistivity of the soil shall also be provided.

B.1.7.5 Miscellaneous

In cases defined by Chatham-Kent P.U.C. upon the size of the project, the geotechnical investigation shall be limited to a certain number of boreholes located at places approved by Chatham-Kent P.U.C.

B.1.8 SPECIFIC DRAWING REQUIREMENTS**B.1.8.1 General**

Drawings prepared by the design engineer have to comply with all details and procedures described in PART F: Standard Drawings of this manual.

B.1.9 CONSTRUCTABILITY**B.1.9.1 Phasing**

The consultant shall consider the constructability and phasing of the proposed works in order that the works can be constructed in a cost effective manner and that the impact to the adjacent property's owners and residents is minimized. If watermain phasing is proposed, it shall meet the following conditions for acceptance:

- Identified in the Chatham-Kent Water and Wastewater Master Plan.
- Maintain looping integrity within the system.
- Locate line valves and blow-offs, preferably using a permanent or temporary fire hydrant as the blow-off, at the main ends for each phase allowing for testing, disinfection, and connection to future mains.
- Design for adequate valve restraint to allow the valve to be shut off for main extension. Valving shall be such that no service shall be without water service when the line is extended in the future.

B.1.9.2 Precaution

The consultant shall contact the Chatham-Kent P.U.C. to determine if there are possible adverse ramifications within the existing systems, within or outside of the construction limits, due to the construction of the works. The consultant shall take reasonable measures to minimize any adverse effects outside of the construction limits.

B.1.10 WATER QUALITY**B.1.10.1 Minimum chlorine**

The minimum chlorine residual as mandated by the Ministry of the Environment, Conservation and Parks is under the Safe Drinking Water Act.

B.1.10.2 Watermain Looping

Although the Chatham-Kent P.U.C. has primary responsibility to ensure that the minimum chlorine residuals are maintained in the distribution system, the distribution system must be designed to mitigate the degradation of chlorine residuals. Chatham-Kent P.U.C. reserves the right to require watermain looping and/or automatic flushing devices to facilitate the maintenance of chlorine residuals.

B.2 HYDRAULIC ANALYSIS

Standard. The consultant shall develop the design according to the principles and sound engineering practices applicable to water supply and distribution operations.

To support any special hydraulic consideration, the design engineer shall use the latest version of the AWWA manual for Water Transmission and Distribution, or any other sufficiently recognized technical source. In all cases, the design engineer shall obtain approval from Chatham-Kent P.U.C. to use any other documented material if an innovative procedure is being proposed.

B.2.1 PARAMETERS

B.2.1.1 General parameters

The consultant shall develop the design based upon the general parameters established in the latest version of the Chatham-Kent Water and Wastewater Master Plan Study.

B.2.1.2 Minimum Parameters

Parameters including in Table B.1 shall be considered.

Table B.1 Minimum Parameters for Water Systems

PARAMETER	VALUE		Unit
	Rural	Urban	
Minimum watermain size	100	150	mm
Maximum size at any dead end	100	200	mm
Maximum size at Industrial/Commercial dead ends	N/A	300	mm
Minimum class pipe	DR 25	DR18	//
Maximum flow velocity	1.5	1.5	m/s
Maximum length without looping	N/A	50	m
Minimum pipe slope for pipe under 400 mm diameter	0	0	%
Minimum pipe slope for pipe 400 mm diameter and up	0.5	0.5	%
Minimum depth of cover if pipe diameter up to 350 mm	1.5	1.5	m
Minimum depth of cover for diameters over 350 mm	1.5	1.5	m
Minimum vertical clearance to sewer	0.5	0.5	m
Minimum horizontal clearance to sewer	2.5	2.5	m
Maximum spacing between hydrants if residential	N/A	150	m
Maximum spacing between hydrants if Industrial	N/A	100	m
Maximum spacing between hydrants if not fronting lots	N/A	300	m

B.2.2 DESIGN CRITERIA

B.2.2.1 Methodology

Methodology used to obtain the water system's characteristics shall be described in the engineering report including if applicable, an explanation of the software or mathematic model used, year of the version, inputs and outputs handled, and the software's effectiveness and accuracy. The network analysis shall be based in the Hazen William's formula and all other factors like flow velocity, pressure, pipe size, etc.

B.2.2.2 Criteria inputs

The information and values of the design criteria to be used during the modeling process shall be based on (but not limited to) the initial design criteria contained in the Table B.2.

Table B.2 Initial Design Criteria for Water Systems.

PARAMETER	REMARKS OR VALUES		
Design period	20 years*		
Population density (Minimum)	2.5 persons per household		
Population growth rate	Urban	1.0 % per year	
	Rural	0.5% per year	
Average day flow	350 l/Cap/day		
Max. day flow peak factor	2 x average day flow		For small areas, peak factors shall be found by using Table B.3
Hour flow peak factor	3 x average day flow		
“C” factors	“C”	Material	Diameter
	120	PVC	Up to 600 mm
	130	PVC/D.I.	600 mm or more
	140	P.E.	Any
Fire flow†	Urban	See MOE recommendations	
	Rural	Not Applicable	
Pressure	PSI	KPa	Condition‡
	20	140	2, 4, 5, 6

* In all cases, the design period shall be checked with Chatham-Kent P.U.C. to meet the Water Master Plan requirements.

† Fire flow may be from more than one fire hydrant providing that the additional hydrants are accessible to any possible fire location. Refer to the Municipality's current adopted fire code for applicable fire flow requirements. In all cases, the fire flow requirements shall be reduced to that required under the Ontario Building Code. It must be demonstrated even though the ultimate design will satisfy the requirements of the Fire Department and Chatham-Kent P.U.C. At no time shall the available fire flow be less than that required under the Ontario Building Code.

‡ Refer to subsection B.2.4 to find the meaning of the condition number.

PARAMETER	REMARKS OR VALUES		
	40	275	3, 7, 10
	80	550	11
	120	825	1
Other Parameters	To suit conditions and in consultation with Chatham-Kent P.U.C.		

B.2.3 PEAK FACTORS CONSIDERATION

B.2.3.1 Small Areas

For service areas consisting of 60 residential service connections or less, peak design consumption per capita shall be obtained by applying the peaking factors in Table B.3 to the average flow day (excluding fire flow). Linearly interpolate the peaking factor for the exact number of taps in the project site.

Table B.3 Small Area Design Peaking Factors

No. residential service connections	Average Day Flow	Maximum Day Flow	Peak Hour Flow
60	1	2.7	4.2
50	1	3.1	4.8
40	1	3.7	5.7
30	1	4.5	7.0
20	1	6.1	9.5
10	1	10.2	15.6
5	1	16.3	25.0
3	1	20.3	31.3
1	1	27.1	41.7

B.2.4 PRESSURE REQUIREMENTS

B.2.4.1 General Considerations

Watermains and looping must be designed to provide minimum and maximum system pressures. Water system pressure information for the Chatham-Kent P.U.C.'s existing system must be verified by Chatham-Kent P.U.C. During the design process, the following consideration shall be taken into account. For design purposes, the pressure is measured at the centreline road elevation. Under fire flow conditions, the pressure is considered located at the centreline road elevation at the hydrant tee.

1. The distribution system in all areas shall be designed for a maximum static head of 825 kPa (278 ft) (120 psi)
2. The distribution system in all areas and for any emergency conditions shall be designed for a minimum static head of 46 feet (20 psi) (140 kPa).
3. The distribution system in all area and for a non-fire demand scenario shall be designed for a minimum static head of 93 feet (40 psi) (275kPa).

4. The range between maximum static pressure and peak hour demand pressure shall not exceed (20 psi) (140 kPa).
5. Twenty (20) psi residual pressure (140 kPa) shall be taken into account during any required fire flows greater than or equal to 1,000 gpm (63 L/s) at any one hydrant with maximum day demand.
6. Twenty (20) psi (140 kPa) residual pressure is obligatory during any required fire flow greater than or equal to 1,500 gpm (95 L/s) at any two hydrants with maximum day demand.
7. Forty (40) psi (280 kPa) minimum residual pressure is required during peak hour flows.
8. Pressure zones shall conform to existing Chatham-Kent zones as established in the Water Master Plan, latest revision. For all new or extended watermains, the boundary conditions of pressure may be obtained by field testing and/or from the Chatham-Kent P.U.C. field testing.
9. Pressure Regulating Valve (PRV) installation controls pressures between distribution pressure zones. The need for a pressure regulating valve installation shall be based on existing pressure zones and the existing distribution system.
10. In those areas where the pressure at the centreline road elevation will be lower than 280 kPa (40 psi), in-line booster pumping systems may be utilized. This could take the form of a system booster pumping station or individual booster pumps with pressure tanks. The design engineer shall obtain approval from Chatham-Kent P.U.C. to use booster pumps. If the booster pumping station is designed to supply fire flow, the station shall be equipped with standby power. The design of booster pumping stations is outside of the scope of this document.
11. Where the topography is such that pressures at the centreline road elevation will be greater than 550 kPa (80 psi), an individual pressure-reducing device will be required on each water service. In lieu of individual pressure reducing devices, the creation of a new sub-pressure zone should be required. The Chatham-Kent P.U.C. only under exceptional circumstances will consider Creation of a new sub-pressure zone.

B.2.5 MAXIMUM VELOCITY

B.2.6 General

The maximum velocity in the watermain under all normal flow conditions shall not exceed 1.5 m/s. All pipes shall be sized for a maximum flow velocity of no greater than 3.5 m/s at peak hour demands plus fire flow. The nominal diameter shall be used for general water distribution system design. The inside diameter shall be used if High Density Polyethylene (HDPE) pipe is planned to be used.

B.3 WATERMAINS**B.3.1 GENERAL****B.3.1.1 Scope**

The purpose of this section is to provide complementary information for the design of watermains and water services connections acceptable to the Chatham-Kent P.U.C. All watermains design shall be in accordance with the requirements of this section and the materials recommended in Part D: Material Specifications.

B.3.1.2 Limitations

This section is not intended to be inclusive of all situations and the consultant may be required to use sound engineering judgement to meet the overall objective of proper design for constructability and long term operations and maintenance. Chatham-Kent P.U.C. reserves the right to make final determination of the system design based on the best interest of the Chatham-Kent's water system.

B.3.1.3 General Considerations

Watermains connecting to transmission watermains must utilize a suitable tee, cross fitting or anchor tee. An isolation valve must be installed as near as practical to the transmission watermain to minimize the likelihood that damage to the connecting main will interrupt the water supply in the transmission watermain. Multiple connections to transmission watermains shall be reviewed by the Chatham-Kent P.U.C. on a case-by-case basis.

B.3.2 EASEMENTS**B.3.2.1 Minimum Easement**

The minimum easement width shall be the greater of the following considerations:

- 3 meters (10 ft) minimum;
- 2 x depths where the depth is from the proposed final grade to the invert rounded up to the nearest half metre;
- The consultant shall also consider the soil conditions and constructability when selecting the easement width. In addition, if more than one utility is installed in the easement, the easement width should be increased by the separation distance of the utilities;
- The maximum easement width is 15 m.

B.3.2.2 Exclusive Easement

When the Chatham-Kent P.U.C. determines it is not feasible for watermain installation to be in a dedicated street right-of-way, the installation shall be made within a dedicated easement. The conditions for allowance of such an exception shall be determined for each individual case. The minimum easement width acceptable by the Chatham-Kent P.U.C. shall be as per B.3.2.1 and shall be for the exclusive use of Chatham-Kent P.U.C. These easements shall be labelled on the construction and plans documents as "EXCLUSIVE WATER LINE EASEMENT".

B.3.2.3 Combined Easements

For a combined water and sanitary sewer easement, the total width shall be twice the maximum depth to the invert of the water line plus twice the maximum depth to the invert of the sanitary sewer pipe, or 9.0 m (30 feet) whichever is greater. These easements shall be labelled on the construction and plans as “EXCLUSIVE WATER AND SANITARY SEWER EASEMENT”. The easement width will be required to be wider than the minimum widths previously stated if the line depth would require additional width to be able to safely excavate around the pipe without the use of a trench box.

B.3.2.4 Exclusivity

Chatham-Kent P.U.C. shall have the exclusive utility use of water and/or water and sanitary sewer easements except for angled utility crossings. Chatham-Kent P.U.C. will review for acceptance all utility crossing methods prior to construction.

B.3.3 LOCATION OF WATERMAINS**B.3.3.1 General Considerations**

All watermains shall be located as per the Municipal standard utility cross-section, and:

- In all instances, the watermains shall extend to the extremities of the property or the subdivision served. The watermains shall be extended further when required to tie into existing mains for water source looping integrity or system reliability reasons.
- A main serving one lot shall extend all the way across the frontage for that lot, unless approval otherwise by the Chatham-Kent P.U.C.
- Mains serving a subdivision shall extend to the center of adjacent streets (non-internal streets) when paving is not proposed at the time of development. If paving is planned, the mains shall be extended completely to the far edge of the right-of-way prior to paving.
- All piping shall be looped, wherever possible, and extended to the closest existing mains as necessary.
- A hydraulic analysis may be required by the Chatham-Kent P.U.C. to verify that the looping proposed will provide an adequate volume of water and at an acceptable pressure.
- Temporary dead-end mains on any line shall have a fire hydrant or blow off.

B.3.4 WATERMAIN SIZE**B.3.4.1 General considerations**

All watermain distribution systems must be able to transfer the larger of maximum day flow plus fire flow or peak hour flow. The following consideration shall be taken into account during the design process:

- The minimum watermain diameter shall be 150 mm (6 inch)
- 150 mm (6 inches) diameter pipe may be installed on permanent dead-ends less than 50 m long with a permanent blow-off or a fire hydrant.

- Permanent dead-ends longer than 50 m (160 ft) shall not be permitted.
- The minimum watermain diameter shall be 200 mm (8 inch) diameter in Industrial, Commercial and high-density residential areas and in areas specified by the Chatham-Kent P.U.C. The consultant shall contact the Chatham-Kent P.U.C. for clarification if necessary.
- The maximum watermain diameter for cul-de-sacs and other permanent dead-end watermain shall be 300mm (12 inch) diameter for industrial, commercial, and high-density residential areas unless it can be demonstrated and approved by the Chatham-Kent P.U.C. that a unique demand condition exists that necessitates a larger watermain.
- All pipes shall be sized for a maximum water velocity of no greater than 3.5 m/s at peak hour demands plus fire flow.
- The nominal diameter can be used for general water distribution system design. The inside diameter shall be used for the design of regional watermain and watermain of HDPE material.

B.3.5 MATERIAL

B.3.5.1 General

All watermain shall be constructed by using polyvinyl chloride (PVC) pressure pipe or High Density Polyethylene (HDPE) in accordance with Part D: Material Specifications. Chatham-Kent P.U.C. shall authorize any other material if special circumstances apply.

B.3.6 DEPTH OF COVER

B.3.6.1 General

The depth of cover from finished grade to the top of pipe shall not be less than 1.5 m.

B.3.6.2 Freezing Considerations

Where the minimum frost protective covers can not be achieved, Chatham-Kent P.U.C. may allow an exemption if the design engineer can demonstrate incorporation of appropriate special precautions in the selection of pipe, bedding and insulation material.

B.3.7 VERTICAL TRANSITION TO EXISTING SYSTEM

In the event that the existing watermain has less than 1.5 m of cover, maximum 45° bends shall be utilized as necessary at the construction limits to connect the new watermain (at proper depth) to the existing system. This method of connection facilitates the future lowering of the remainder of the existing watermain. Sweeping vertical pipe joint deflections shall not be used.

B.3.8 HIGH POINTS

High points shall be avoided unless an escape route for trapped air is provided. For local watermains, services will generally provide an escape route for trapped air but it is preferred to locate fire hydrants at high points. Air release valves shall not be installed on local watermains without the approval of Chatham-Kent P.U.C. For Transmission Watermains, the preferred method is by a combination air and vacuum release valve.

B.3.9 DEAD-END MAINS

Dead-end watermains are to be avoided wherever possible. Where dead-end watermains cannot be avoided, the maximum length of a permanent dead-end watermain is 50 m. A fire hydrant must be located at the end of cul-de-sacs and other permanent dead-ends. A temporary fire hydrant must be installed in-line at temporary dead-ends. An acceptable alternative is to provide a plug on the main line leg of the hydrant tee and install a fire hydrant in its permanent location.

B.3.10 MINIMUM CLEARANCE TO SEWERS**B.3.10.1 Minimum Clearance**

Water services and distribution mains shall be located horizontally a minimum 2.5 m from existing or proposed water and sewer lines. The distance shall be measured from the nearest edges.

B.3.10.2 Precaution

Where sanitary sewer lines cross watermains, the watermain pipe shall have a minimum 500 mm (20 inch) clear distance vertically above the sanitary sewer pipe. If this clear distance is not feasible or the sanitary sewer line is above the water line, the crossing must be designed and constructed using pipe encasement on the sanitary sewer main, to protect the watermain.

B.3.10.3 Pipe Encasement

Where the sanitary sewer main is already constructed, the pipe encasement shall be placed on the watermain.

B.3.11 OTHER UTILITY CROSSINGS

The minimum horizontal separation to other utilities shall be as per the Municipal Typical Road Cross Sections when parallel in the public right-of-way. Parallel installations shall not be allowed in exclusive water and sanitary sewer easements.

A crossing approval will be required from Chatham-Kent P.U.C. if the crossing is not shown in detail on project construction drawings. In that case, all related information shall be provided in accordance with these documents.

Right angle crossings are permitted under the water pipe with a 0.6 m (2 ft) vertical clearance.

Tunnelling or boring is preferable but if open cut is the only feasible solution, the trench shall be as narrow as possible and backfill shall be flow fill from the top of the lower pipe up to the spring line of the watermain pipe.

Watermain crossings of open drainage ditches shall be detailed, have 3 m (10 ft) minimum cover, and be approved by Chatham-Kent P.U.C. If this situation applies, the consultant shall develop a detail drawing for typical pipe crossing requirements.

B.3.12 TRACER WIRE

Tracer wire shall be installed on all watermains, hydrant laterals, and water services except where such water service pipe is of copper material. The wire shall be installed in such a manner as to be able to properly trace all watermains, hydrant laterals, and water services without loss or deterioration of signal using industry standard locating equipment (RF technology).

When non-metallic mains are connected to metallic mains, tracer wire must be bonded via clad weld to the metallic main. All tracer wire welds onto existing metallic mains shall be completely sealed with use of an approved mastic type sealant, specifically manufactured for underground use. The mastic shall be applied in a coat of 12 mm minimum, and shall be protected from contamination by backfill material with a plastic membrane

B.3.13 THRUST RESTRAINT

Mechanical joint restraints or cast in place concrete thrust blocks shall be designed to be installed to restrain movement of the watermain. The limits for which mechanical joint restraints must be installed shall be clearly indicated on the construction drawings. The restraining joint and pipe design shall be based on transferring thrust through the pipe to the surrounding material.

A safety factor of 1.5 must be used to calculate restraint length for PVC watermain material. A safety factor of 1.5 must be used to calculate restraint length for Concrete Pressure Pipe using methods outlined in AWWA Manual M9-Concrete Pressure Pipe. In areas where there is little “undisturbed” soil, particularly reconstruction projects or congested works, mechanical joint restraints shall be installed and specified on the construction drawings. Chatham-Kent P.U.C. reserves the right to specify the use of mechanical restraints and/or concrete thrust blocks. Pre-cast thrust blocks must be approved by Chatham-Kent P.U.C.

B.3.14 CATHODIC PROTECTION

Refer to Part D: Material Specifications for Cathodic Protection Standards.

B.3.15 SETTLEMENT AREAS

On areas subject to possible future settlement, the bedding design must minimize pipe movement and mechanical joint restraints must be installed to the limits of the possible settlement area. This requirement may be waived if it can be demonstrated that future settlement will not occur. Non-shrink concrete may be used with approval by Chatham-Kent P.U.C.

B.4 APPURTENANCES**B.4.1 HYDRANTS****B.4.1.1 Type**

All hydrants installed in the Municipality of Chatham-Kent shall be dry-barrel fire hydrants. The standards to apply shall be AWWA C502 for manufacturing, and AWWA manual M17 for installation.

B.4.1.2 Fire Flow

In the design process, the fire flow for hydrants shall satisfy the requirements established by the Chatham-Kent Fire Service and Chatham-Kent P.U.C. by-laws in terms of minimum distance between buildings two stories and less. In all cases, the needed fire flow shall meet the minimum requirements under the Ontario Building Code.

B.4.1.3 Pressure

For design purpose, all fire hydrants shall be those designed for a working pressure of 1034 kPa (150 psi) as established in AWWA C-502 Standard for Dry-Barrel Fire Hydrants.

B.4.1.4 Cul-de-sac

A flushing point shall be included in the design where a watermain in the cul-de-sac is a dead end. In cul-de-sac 50 m or less in length, a fire hydrant shall be installed on the intersecting street at or near the intersection of the cul-de-sac.

B.4.1.5 Leakage

No leakage shall be allowed through the castings, main valve, joints, or stem packing.

B.4.1.6 Location

Fire hydrants shall be installed at the end of cul-de-sacs and other permanent dead end watermain. The preferred locations for the fire hydrants are:

- At a space not exceeding 300 m (1000 ft) radius.
- In rural areas, minimum 1100 mm from property line.
- In urban areas, fire hydrants shall be in the boulevard as shown on the Municipal Typical Road Cross Sections.
- On the same side of the road as the watermain.
- At the dividing property line between adjacent properties.
- At high points.

- Where a fire hydrant is installed at a corner of an intersection, it shall be installed at the beginning of the curve of the curb return. Where possible, hydrant shall be placed near street intersections. At street intersections, hydrants shall be installed at least 3.5 metres (12 ft) back from the corner formed by the intersecting street lines and preferably on the short side of the lot, rather than the long side of the lot.
- A temporary hydrant may be required for blow-off purposes at the end of the watermain, which will be continued into a future phase of a subdivision. This temporary hydrant may be required where the end of the watermain is more than approximately 90 metres (300 ft) from the last permanent hydrant. This temporary hydrant may be located on the end of the watermain, providing it does not conflict with the other facilities.
- A permanent hydrant is required at the end of all permanent dead-end watermains in cul-de-sacs, etc. where looping is not possible.
- Private fire hydrants shall not be connected to transmission watermains. A parallel watermain, connection to other watermains, individual supply wells, etc. must be installed to service properties adjacent to transmission watermains.

If the adjacent property is developed (i.e. re-construction projects), new fire hydrants must be placed within 45 m of existing siamese, or similar, fire connections on buildings in accordance with the latest edition of the Ontario Building Code.

B.4.1.7 Spacing

The maximum spacing between fire hydrants as measured along the roadway centreline and for urban areas is as follows:

- Residential: 150 m
- Industrial and commercial: 100 m
- High Density Residence: 100 m
- Watermains not fronting lots: 300 m

The maximum allowable spacing between the back of homes in a cul-de-sac and a hydrant outside of the cul-de-sac shall be 150 m.

B.4.1.8 Lead Size

The minimum hydrant lead size to be 150 mm. On a site specific basis, Chatham-Kent P.U.C. may require a larger hydrant lead size. The valve and boot must be the same size as the lead. A reducer shall not be utilized at the hydrant boot.

B.4.1.9 Signs

The consultant shall include in drawings a marker note accordingly to Part F: Standard Drawings. The hydrant marker sign – black hydrant on yellow reflective backing – shall be fastened to a galvanized “U” channel as supplied by Canada Valve. Rural hydrants shall all have signs. Urban hydrants shall have hydrant signs if requested by Chatham-Kent P.U.C.

B.4.2 VALVES**B.4.2.1 General****B.4.2.1.1 Standards**

For design purposes, all valves shall be according to the latest revision of the following standards.

- AWWA C115, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray- Iron Threaded Flanges.
- AWWA C500, Metal-Seated Gate Valves for Water Supply Service.
- AWWA C509, Resilient-Seated Gate Valves for Water Supply Service.
- AWWA C512, Air Release, Air/Vacuum, and Combination Air Valves for Water Service.
- AWWA C550, Protective Epoxy Interior Coatings for Valves and Hydrants.
- AWWA C800, Underground Service Line Valves and Fittings.

B.4.2.1.2 Spacing

The maximum spacing for isolation valves shall be as listed for the following watermain diameters:

- 300 mm and smaller: 300 m.
- Larger than 300 mm: as directed by Chatham-Kent P.U.C.

B.4.2.1.3 Location

Valves shall be located in accordance with the requirements contained in Table B.4. Any other location not describe in the Table B.4 shall be approved by Chatham-Kent P.U.C.

Table B.4 Location§ of Valves

TYPE	LOCATION**
GATE††	Two valves at tee intersections shall be located in line with the extension of the property line of the intersection through street. However, care is needed to ensure that the valve does not conflict with the curb and gutter.
	Two valves at cross intersections separating hydrants such that no two adjacent hydrants will be out of service at one time, unless otherwise directed by Chatham-Kent P.U.C.
AIR RELIEF/ VACUUM	At high points in the watermain or low points along the watermain or places where Chatham-Kent P.U.C. shall made direct recommendation.
PRESSURE REGULATING	At points where it will be required to reduce an existing high pressure to a pre-adjusted lower downstream pressure for varying rates of flow within causing shock of water hammer on the system.

Valves are generally required on the extension of all street lines. Valves shall be required at each normal four way street intersection. In cases where intersections create short blocks, or when three intersecting watermains meet, two valves will be required at the intersection.

B.4.2.2 Valve Boxes

B.4.2.2.1 Material

Valve boxes shall be cast or ductile iron, buffalo type, two boxes with round bases.

- Valve boxes shall have a 130 mm (5 1/4 inches) screw type shaft suitable for depth of covers as required.
- Valve boxes shall be capable of future adjustment for street overlays

B.4.2.2.2 Valve Box

If a requirement of a maximum 300 mm (12 inches) valve is identified by the consultant, a cast iron inside screw type box shall be calculated. The valve box shall be calculated of a size appropriate for the valve and depth of cover over the watermain. In any case in which a 450 mm (18 inches) and large valve is required, especial consideration shall be given to calculate the force needed to operate them under a 450 kPa (65 psi) pressure differential.

§ Valves required in water services installation are described in Parts B, section B.4.3; Part D and section D.03.03.

** Any other location not contained in this table shall receive approval from Chatham-Kent P.U.C.

†† Water distribution and transmission line isolation valves shall be double disk gate valves.

B.4.2.3 Gate Valves**B.4.2.3.1 Manufacture**

Double disk gate valves shall be manufactured in accordance with AWWA Standard C500. Resilient seat gate valves shall be manufactured in accordance with AWWA Standard C509.

B.4.2.3.2 Valve stems

Valve stems shall be non-rising.

B.4.2.4 Air Relief and Vacuum Valves**B.4.2.4.1 Pressure**

Air relief and vacuum valves shall be rated at working pressure of 1030 kPa (150psi) minimum and a minimum hydrostatic pressure of 1718 kPa (250 psi).

B.4.2.4.2 Air and Vacuum Relief Valve

In the design process, the design engineer shall incorporate into the design the required air relief valve when high points in the watermain are identified. A vacuum relief valves may be required if the configuration and head conditions of the watermain shows the necessity to relieve negative pressures. The Design Engineer, through a cost-benefit analysis, shall consider reducing the number of air and vacuum release valves by altering the profile of the watermain.

B.4.2.4.3 Distribution of Valves

In the design stage, valves shall be distributed so that operating no more than four valves can isolate any section of watermain serving approximately 50 dwelling units.

B.4.2.4.4 Valve Chambers

Valves that require more than 270 Newtons per meter [N/M] (200 ft/lbs) of torque to operate must be placed in valve chambers with a by-pass valve. The by-pass valve must be of sufficient size to bring the operating torque of the main valve below 270 N/M (200ft/lbs). For design purpose, a valve chamber shall be installed for valves larger than 400 mm diameter and larger complete with an integral valved bypass.

B.4.2.4.5 Pressure

For design purpose and in accordance with AWWA Standard, the manufacturer shall guarantee that all valves have been designed for a minimum working pressure of 1034 kPa (150 psi), tested at 2060 kPa (300 psi).

B.4.2.4.6 Valve Bodies

Air Release and Vacuum Release valve bodies shall be 25 mm for watermains up to and including 300 mm diameter and 50 mm for watermains larger than 300 mm diameter. If the design engineer determines that a larger valve body is required, Chatham-Kent P.U.C. must approve the larger sizing. In those cases, the orifice sizing shall be determined in conjunction with a transient analysis of the watermain and consultation with the manufacturer.

B.4.2.4.7 Signs

For rural projects, the consultant shall include in drawings a marker note according to Part F Standard Drawings. The sign shall be a 300 mm by 300 mm engineer grade reflective surface, with text with blue background, on aluminium backing, mounted on a 3.66 m “U” channel steel post. Text shall be “AIR RELIEF VALVE.”

B.4.2.5 Pressure Regulation Valves**B.4.2.5.1 Function**

The function of this valve is to reduce an existing high pressure to a pre-adjusted lower downstream pressure for varying rates of flow without causing shock of water hammer on the system.

B.4.2.5.2 Pressure

The pressure regulating valve shall be hydraulically operated with a free floating guided piston having a seat diameter equal to the size of the valve. All pressure regulating valves shall be rated at a working pressure of 1030 kPa (150 psi) minimum and a minimum hydrostatic pressure of 1718 kPa (250psi).

B.4.2.5.3 Controlling

The pilot valve for controlling operation of the main valve shall be a single seated, diaphragm operated and spring loaded type. The pilot valve shall be attached to the main valve with piping and isolation valves arranged for easy access to make adjustment and for its removal from the main valve while the main valve is under pressure.

B.4.3 SERVICE CONNECTIONS**B.4.3.1 Description**

For design purpose, a water service is described as a connection from the watermain to the proper line. The property owner's responsibility is from the property line to the facility. Water service connections up to 50 mm (2inches) are generally used for residential and business applications. Water service connections 75 mm (3 inches) and larger are considered for commercial and industrial purposes.

B.4.3.2 Drawings

In accordance with Part F: Standard Drawings, the design engineer shall include in drawings all details and specifications related with installation of water services.

B.4.3.3 Sizing

For design purpose, the service pipe shall be a polyethylene pipe of 19 mm or 25 mm in diameter. However, if the design process required a different consideration, the allowable service component sizes shall be as show in Table B.5 or as established by Chatham-Kent P.U.C.

Table B.5 Water Service Component Sizes

COMPONENT	SIZE (mm)	REMARKS	MATERIAL
Tap	/ 100	In existing mains require authorization from Chatham-Kent P.U.C.	D.I
	19 to 50	In new mains shall use tees	Bronze
Corporation Stop	< 50	Shall be use in each tap	Copper
	/ 50	Not considered in this manual	
Service Pipe	[50	Copper for copper service shall be type K according to ASTM Specification B88	Copper PVC Polyethylene
	/ 75	Shall use a 100 mm tap/tee and reduce to 75 mm immediately after Tap\tee	Copper PVC Polyethylene
Coupling	Shall be as required by the installation		
Curb Stop	< 50	Shall be in accordance to AWWA C800	Copper
	/ 50	Shall be gate valve in accordance to section B6 and D.03.02	D.I.
Meter	19 to 50	Provided by Chatham-Kent P.U.C.	
	> 50	Provided by Chatham-Kent P.U.C.	

B.4.3.4 Location

The designer shall use the standard drawings established in Part F: Standard Drawings to prepare all drawings for the specific job in which the water service connection shall be located as detailed as possible.

B.4.3.5 Precaution

Service connections shall not be made to watermains designated as a transmission watermain, which means that the watermain may carry non-potable water. In all cases, private services shall not be connected to transmission watermains. A parallel watermain, connection to other watermains, individual supply wells, etc. must be installed to service properties adjacent to transmission watermains.

B.4.3.6 Number of Services per Property

No more than one individual property shall be serviced by the same service regardless of ownership. In situations where a fire service is required due to infilling or site development after the water distribution system has been installed, private hydrants can be supplied by a separate service at the discretion of Chatham-Kent P.U.C.

B.4.3.7 Exception

In the case of multi-unit blocks, on-site servicing can be arranged to the property owner's convenience. However, there shall only be one service from the municipal system. In unique circumstances and with the approval of Chatham-Kent P.U.C., more than one service may be allowed to one property. Moreover, special testable backflow prevention shall be installed on each service to eliminate the possibility of system flow through private property.

B.4.3.8 Bends

Bend fittings shall be avoided wherever possible.

B.4.3.9 Restraints

Services 100 mm (4 inches) and larger, including valves, joints and bends, regardless of size shall be fully restrained from the watermain to the property line.

B.4.3.10 Valving

For services 50 mm (2 inches) and under, all services shall have two isolation valves. One valve shall be installed immediately adjacent to the watermain (Corporation stop or main stop) and buried, and another valve shall be installed at the property line or easement limit (curb stop). A service box shall be provided to finished grade.

B.4.3.11 Valves in large services

For services 100 mm diameter and larger, the design engineer shall contact Chatham-Kent P.U.C. regarding the number, location and need for valves and valve boxes. The main stop or valve, regardless of size, shall be fully restrained to the watermain, preferably by an anchor tee, joint restraint, or bolted connection.

B.4.3.12 Metering

Each individually metered building unit shall have a separate water service. Metering of water use shall be in accordance with the established Chatham-Kent By-laws and regulations.

B.4.3.13 Allowance for Future Connections

If the location of future servicing is in doubt, then the servicing only shall be installed with the written approval of Chatham-Kent P.U.C.

B.4.3.14 Backflow Prevention

The designer shall ensure the inclusion in drawings of all details about the backflow prevention assembly in accordance with the latest Chatham-Kent P.U.C. Backflow Prevention Policy.

B.4.3.15 Cross Connections

Water service lines, inside or outside of any property or building, shall have NO physical connection with any pipes, pumps, hydrants, water wells or tanks that could draw or discharge any unsafe or contaminated water (including steam condensation or cooling water) into the water system.

B.4.3.16 Tracer wire

All service connections shall have a tracer wire.

B.4.3.17 Stainless steel saddles

For service connections, stainless steel saddles shall be used on all PVC pipes.

End of Part B

PART C

DESIGN GUIDELINES FOR SANITARY SEWER

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C.1 GENERAL**C.1.1 GEOTECHNICAL INVESTIGATION****C.1.1.1 Objective**

A geotechnical investigation shall be conducted to determine the subsurface soil conditions and associated geotechnical parameters required to prepare recommendations for geotechnical aspects of the design. The number of boreholes and its maximum depth shall be defined according to the size of the project, the geological background of the site project and the kind of structures required.

C.1.1.2 Standard

Geotechnical investigations shall be according to ASTM standard D-1586.

C.1.1.3 Referencing

All ground borehole elevations shall be referenced to the geodetic datum.

C.1.1.4 Geotechnical Report

A copy of the geotechnical report shall be attached to the engineering report.

C.1.1.5 Miscellaneous

In cases defined by Chatham-Kent P.U.C. upon the size of the project, the geotechnical investigation shall be limited to a certain number of boreholes located at places defined by Chatham-Kent P.U.C.

C.2 DESIGN SPECIFICATIONS**C.2.1 GENERAL CRITERIA****C.2.1.1 Standard**

Sewer design shall be developed according to the latest version of the Ministry of the Environment, Conservation & Parks (MECP) guidelines for water and sewer works.

C.2.1.2 Methodology

The methodology used to obtain the system's characteristics shall be describe in the engineering report including if applicable, an explanation of the software or mathematic model used, year of the version, inputs and outputs handled and the software's effectiveness and accuracy.

C.2.1.3 Initial information

Information related with the Census, area to be served, historical and statistic information of the population characteristics, and any other related information shall be obtained and used during the design process.

C.2.1.4 Minimum Parameters

The minimum parameters defined in the Ministry of the Environment, Conservation & Parks (MECP) guidelines for water and sewer works shall be considered.

C.2.1.5 Design Criteria

Design criteria to determine the flow generation derived from the service area shall be calculated based on (but not limited to) the information contained in the latest version of the Chatham-Kent Water and Wastewater Master Plan. For any other criteria required or not included in the latest version of the Chatham-Kent Water and Wastewater Master Plan, the latest version of the Ministry of the Environment, Conservation & Parks (MECP) guidelines for water and sewer works shall be met. In all cases, the hydraulic considerations at least shall meet minimum requirements of the latest version of the Ministry of the Environment, Conservation & Parks (MECP) guidelines for water and sewer works.

C.2.2 DESIGN CONSIDERATIONS**C.2.2.1 GENERAL****C.2.2.1.1 Standards**

During the sewer design process, the consultant shall follow all stipulations contained in this part of the Chatham-Kent P.U.C. specifications, the MECP recommendations, the OPSS standards for construction and materials, and the AWWA standards for manufacturing characteristics and material specifications. Adherence to the Criteria contained in this part of the Chatham-Kent P.U.C. specifications does not remove the consultant's responsibility to investigate and obtain any other criteria, or regulatory permits or approvals from local, provincial, or federal agencies that may be required for a particular project.

C.2.2.1.2 Definitions and Abbreviations

Reference to Part B, section B.1.2.

C.2.2.1.3 Plans and Calculations

Flow data sheets and plans showing plan view and profile drainage area shall be developed to be included in the engineering report.

C.2.2.1.4 Curvilinear Sewers

Sewer system shall be conformed by straight pipelines connected by maintenance holes. However, in cases defined by Chatham-Kent P.U.C., curvilinear sewers shall be considered for pipe diameter 600 mm and larger.

C.2.2.1.5 Preconstruction Requirements

All special preconstruction requirements shall be established and calculated based upon the characteristics of the project. Those requirements shall be included in the engineering report.

C.2.2.1.6 Relation to Watermains

The consultant shall consider the water system crossing situations and define horizontal and vertical separation of the sewer system to water mains according to the MOE specifications.

C.2.2.1.7 Backfilling Materials

The consultant shall calculate the approximated volume and material type required for the backfilling process. The type shall be defined upon the kind of pipe to be used and the pipe manufacturer's recommendations about bedding and trench width. Backfill shall be approved by the Road Authority.

C.2.2.2 Gravity Sewer Pipe**C.2.2.2.1 Sizing**

The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize solid deposition problems. Only in cases approved directly by Chatham-Kent P.U.C., the consultant shall consider oversizing the sewer pipe.

C.2.2.2.2 Slope Considerations

The minimum and a maximum slopes recommended in the MECP guidelines shall be used as slope limits in all sewer pipe calculations. If the proposed slope is less than the minimum slope of the smallest pipe that can accommodate the peak wastewater design flow, the actual depth, velocities, and peak wastewater design flow for each pipe sections of the sewer shall be calculated and the results shall be submitted to Chatham-Kent P.U.C. for approval.

C.2.2.2.3 Pipe Bedding

Pipe bedding shall conform to current Ontarian Provincial Standards. Bedding and cover shall be Granular "A" or "B" as set forth in OPSS 1010. Rigid sanitary sewer pipe shall be designed to withstand all earth loads, superimpose loads, and hydraulic loads placed on it, in accordance with methods provided by manufacturers and suppliers.

C.2.2.2.4 Selection of Bedding for Flexible Pipe

Flexible sanitary sewer pipe shall be designed so as to accommodate external dead and live loading imposed on it like traffic, soil, ground water changes, frost actions, soil settlements, etc.

C.2.2.2.5 Pipe Depth

The depth of the pipe below the final road grade shall be as per MECP guidelines. The consultant shall obtain approval from Chatham-Kent P.U.C. for depths over those recommended by MECP.

C.2.2.2.6 Minimum Cover

The minimum cover for sanitary mains shall be 2.1 meters measured from the pipe obvert to finished grade.

C.2.2.2.7 Alignment

Sewer pipe up to 600 mm (24 inches) shall be laid using laser to ensure straight alignment between maintenance holes. Chatham-Kent P.U.C. shall consider curvilinear alignment for sewer pipe bigger than 600 mm (24 inches) only if the manufacturer's maximum allowable pipe joint deflection limits have been taken into consideration.

C.2.2.3 Maintenance Holes**C.2.2.3.1 Location**

Maintenance holes shall be located at all junctions, changes in grade, pipe material, pipe size, or pipe alignment. In all cases, a maintenance hole shall be installed if the service line is 200 mm diameter or bigger.

C.2.2.3.2 Size

The minimum size of a maintenance hole shall be 1200 mm, unless otherwise authorized by Chatham-Kent P.U.C.

C.2.2.3.3 Spacing

The minimum spacing between maintenance holes shall be at least 90 meter for maintenance holes up to 450 mm. For maintenance holes up to 900 mm, the minimum spacing shall be 120 meters. For maintenance holes bigger than 900 mm, an approved spacing shall be obtained from Chatham-Kent P.U.C.

C.2.2.3.4 Precast Maintenance Holes

Maintenance holes shall be of precast concrete unless otherwise approved by Chatham-Kent P.U.C.

C.2.2.3.5 Invert Elevations

The minimum difference in invert elevations between inlets and outlets shall be according to MECP guidelines. A drop inlet maintenance hole shall be required as per OPSD standards if a drop in excess of 0.9 m occurs between any invert and the lowest invert in the maintenance hole. Minimum drop pipe size is 200 mm.

C.2.2.3.6 Minimum Invert Drop

Where pipe enters and leaves inline, or at angles 0 degrees to 45 degrees, the minimum drop from invert across the maintenance hole shall be 0.030 meters. Minimum drop from inverts across the maintenance holes shall be 0.060 meters if the pipe enters and leaves inline or at 45 degrees to 90 degrees.

C.2.2.3.7 Benching

Full height benching is required in maintenance holes for pipes 300mm or less. Three quarter height benching can be used for pipes greater than 300mm.

C.2.2.4 Lateral Sanitary Sewer Service Connections**C.2.2.4.1 General Design Precautions**

During the design process, the consultant shall take into account the following precautions:

- The minimum size of lateral sanitary sewer service connections shall be 125 mm (5 inches).
- All lateral sanitary sewer service connections shall be provided with a clean-out at the property line. Clean-outs shall be comprised of a Tee, Riser, and Cap. The clean-out shall be same diameter as the lateral service connection. Top elevation of the cap shall be placed between a minimum of 100 mm below the grade and a maximum 300 mm below the grade.

- Service lines shall be installed perpendicular to the main wherever practical. Individual lateral sanitary sewer service connections for singles and semi-detached dwellings shall be provided unless directed by the Chatham-Kent P.U.C.
- Connections to larger mains may be by tee connection with the side of the tee rotated at between 22.5 degrees and 45 degrees above horizontal.
- Service lines from adjacent properties shall not be connected to each other.
- The minimum cover for lateral sanitary sewer service connections shall be 2.1 m (7 ft) in new developments or new servicing areas measured from the obvert of the pipe to finished grade.
- Lateral sanitary sewer service connections shall not be connected to storm mains.
- All service connections shall be constructed at a preferred minimum slope of 2% up to a maximum slope of 8%.
- A sanitary inspection maintenance hole as per municipal standards located is to be provided at the property line for all commercial, institutional and industrial developments.

C.2.2.5 Forcemain

C.2.2.5.1 Size

If the pipe is to carry wastewater under pressure, a forcemain shall be designed to convey the sewage from a pumping station to a gravity sewer or between pumping stations. In those cases, the size shall be determined to minimize forcemain head losses and overall cost for pump station operation. Forcemains shall be no smaller than 100 mm (4 inches) diameter except special cases approved by Chatham-Kent P.U.C. (e.g. where grinder pumps are provided.)

The following pipe materials are permitted to be used for forcemains:

- Polyvinylchloride
- High Density Polyethylene
- Ductile Iron
- Concrete Pressure Pipe

The pipe material selection is to take into account the design and transient pressures, cyclical loading, soil conditions, and constructability.

C.2.2.5.2 Velocity

Forcemain velocity shall be in range recommended by MECF.

C.2.2.5.3 Transient Analysis

Forcemains shall be designed to the design pressure and must withstand surge pressures. A transient analysis for all forcemains over 150mm diameter will be required and must be included in the Engineering Design Report. The use of surge tanks and surge relief valves or other suitable means of surge relief shall be evaluated on a case-by-case basis.

C.2.2.5.4 Friction Loss

Determination of friction loss shall be based on the Hazen-Williams formula using appropriate “C” factor values as follows:

- C=120, Low water level in the wet well
- C=130, Median water level in the wet well and normal operating condition
- C=140, High water level in the wet well

Selection of Hazen-Williams “C” factors for older existing forcemains shall be verified with Chatham-Kent P.U.C. during design.

C.2.2.5.5 Selection of Pressure Class

Selection of pressure class shall be based on factors such as installation configuration, required fittings, expected superimposed and hydraulic loads, and joint methods to be used. The pressure class when using PVC pipe shall be per AWWA standards. However, for any other pipe material and pressure class the consultant shall verify with Chatham-Kent P.U.C.

C.2.2.5.6 Valves

Automatic air release valves shall be placed at high points in the forcemain to prevent air locking. A blow-off shall be placed at the low points where gritty material could accumulate and restrict flow through the forcemain. Access to air release facilities shall not be located in traffic-ways. In all cases, the forcemain configuration and head conditions should be evaluated as to the need for and placement of vacuum relief valves.

C.2.2.5.7 Termination

Forcemains should enter the gravity sewer system at a point not more than 200 mm above the flow line of the receiving maintenance hole. The design shall be such as to prevent turbulence and deterioration at this point.

C.2.2.5.8 Restraints

Forcemains shall be restrained at bends to prevent movement occurring from maximum operating pressures or surges.

C.2.2.5.9 Strength

Pipe and joints shall be equal to watermain strength materials suitable for design conditions. The forcemain, reaction blocking, and station piping shall be designed to withstand water hammer pressures and associated cyclic reversal of stresses that are expected with the cycling of wastewater lift stations. The need for surge protection chambers shall be evaluated. The Chatham-Kent P.U.C. shall approve forcemain pipe materials.

C.2.2.5.10 Precaution

Aerial crossings shall not be permitted unless otherwise approved by Chatham-Kent P.U.C.

C.2.2.6 Sewage Pumping Stations**C.2.2.6.1 General****C.2.2.6.1.1 Type**

For design purposes, wastewater-pumping stations shall be of the wet well submersible type. For all other types, the consultant shall obtain approval from Chatham-Kent P.U.C. Wet well submersible type pump stations have submersible pumps located in the same below grade wet well into which wastewater flows.

C.2.2.6.1.2 Station Capacity

Sewage pumping stations shall be designed with sufficient capacity to accommodate the maximum design peak instantaneous flow from the ultimate tributary area serviced. Allowances shall be made in the design such that the pumping station capacity may be upgraded to handle future peak flows (e.g. upgrade or addition of pumps, motors, forcemains, etc.).

C.2.2.6.1.3 Hydraulic Design

Pumping station design shall be based on system-head calculations and system curves using appropriate Hazen-Williams “C” factors. System-head curves shall be generated and included in the pre-design report for the pumping station. Pumps shall be selected based on pump efficiency, optimal performance in relation to the system-head curves, capital operating and maintenance cost. Variable speed drive effects on pump performance shall be provided at the request of the Chatham-Kent P.U.C.

C.2.2.6.1.4 Layout

Design pumping station configuration based on the most efficient layout of pumps and equipment for safe and cost effective operation and maintenance of the facility over the entire expected service life.

C.2.2.6.2 Site Considerations**C.2.2.6.2.1 General**

The following site considerations shall be made when selected a location for a sewage pumping station:

- Type of station, station capacity, and the type and number of pumps required.
- Geotechnical Investigation (i.e. bedrock elevation, water table elevation, etc.).
- Flood protection shall be considered when designing sewage pumping stations. Sewage pumping stations shall be designed to be protected from damage and remaining fully operational and accessible during heavy rain events.
- Vehicle access, fire access and parking must be provided for inspection and maintenance.
- Availability of utilities including hydro, gas, potable water, fire protection and telephone service where required.
- Odour control.
- Noise control and backup power.

C.2.2.6.3 Pumps**C.2.2.6.3.1 Number of Pumps**

All pump stations shall have a minimum of two pumps of the same size. Each pump shall have the capacity to handle the design peak instantaneous flow with one unit out of service. When three or more units are provided, they shall be of such capacity that with any one unit out of service, the remaining units will have the capacity to handle the expected peak instantaneous flow.

C.2.2.6.3.2 Minimum Size

Pumps handling raw sewage shall be capable of passing spheres of at least 75 mm in diameter unless a grinder pump is selected. Pump suction and discharge openings shall be at least 100mm diameter.

C.2.2.6.3.3 Suction Head

All pumps under normal operating conditions shall operate under positive suction head, except where suction-lift pumps are selected.

C.2.2.6.3.4 Electrical Motors

Each pump shall be supplied with an electrical motor with adequate capacity to handle the pump requirements in term of time of operation and power. Electrical specifications shall stipulated by an electrical engineer or determined by the pump manufacturer, according to the hydraulic requirements.

C.2.2.6.3.5 Motor Starters

Pumps shall be supplied with variable speed drives unless otherwise approve the Chatham-Kent P.U.C. An analysis of may be requested by the Chatham-Kent P.U.C. to determine variable speed drive effects on pump performance and reliability.

C.2.2.6.3.6 Electrical Supply

All pump stations shall be supplied with 600V, 3-phase power unless otherwise approved by the Chatham-Kent P.U.C.

C.2.2.6.4 Wet Wells**C.2.2.6.4.1 Regulatory Requirements**

Wet wells shall be designed to comply with all Ministry of Labour (MOL) requirements. Wet wells are classified as Class 1, Group D, Division 1 or II Hazardous Locations and shall conform to all requirements under the Canadian Electrical Safety Code.

C.2.2.6.4.2 Size

The volume required for pump cycling shall be based on the pump manufacturer's duty cycle recommendations; appropriate dimensions to minimize turbulence and vortexing; vertical separation between pump control points; sewer inlet elevation; capacity required between alarm levels, basement flooding and overflow elevations; and the number, spacing and size of pumps. The low water level shall be 300 mm minimum or twice the pump suction diameter above the centre line of the pump volute. The wet well floor shall benched with a minimum slope of one to one (1:1) to the hopper bottom to prevent solids deposition and to allow solids to be transported into the zone of influence of the pump.

The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the pump inlet pipe.

C.2.2.6.4.3 Capacity

The volume of the wet well shall be based on the design average flow with a filling time not to exceed 30 minutes unless the pumping station is designed to provide flow equalization. When the wet well is designed for flow equalization, provisions to prevent septicity shall be included.

C.2.2.6.4.4 Hydrostatic Uplift

Wetwell shall be designed to resist hydrostatic uplift pressures.

C.2.2.6.4.5 Access

Suitable and safe means of access shall be provided to wet wells containing bar screens or mechanical equipment requiring inspection or maintenance or for general cleaning and sludge removal purposes. Ladders shall be provided for installations deeper than 4.6 meters (15 ft) and shall be installed with safety landings not to exceed 3.0 meter (10 ft) vertical intervals.

C.2.2.6.4.6 Pump Removal

Provisions shall be made to facilitate the removal of pumps and motors from the wet well or other structures.

C.2.2.6.4.7 Pump Intakes

Each pump shall have individual intake piping. Wet well design shall be such as to avoid turbulence near the intake, and to minimize air entrainment resulting from proximity of the flow entering the wet well and the pump intake.

C.2.2.6.4.8 Material Selection

Due consideration shall be given to the selection of materials because of the presence of hydrogen sulphide and other corrosive gases, greases, oils and other constituents frequently present in sewage. Structure materials may require cathodic and anodic protection.

C.2.2.6.4.9 Interconnection

All pumping stations with a capacity greater than 100 L/s shall have divided wet wells that are properly interconnected. The wet well shall have provisions such as a shear or sluice gate or knife valve to facilitate continuous operation during maintenance and to allow dewatering of one portion of the wet well.

C.2.2.6.4.10 Ventilation

Provision for air displacement in wet wells shall be made by natural means consisting of 0.10% of the well cross-sectional area, or a minimum two 100 mm diameter inverted “j” or gooseneck pipes with insect screens extending 900 mm above finished grade. Material for ventilation, including insect screens shall be stainless steel.

C.2.2.6.4.11 Valve Chambers

Consider separate valve chamber(s) for submersible pumping stations. Valve chamber to have a drain or sump for portable sump pump.

C.2.2.6.5 Screening**C.2.2.6.5.1 General**

No Screening is required for small pumping stations servicing predominantly residential developments. Use of a grinder placed in a channel upstream of the wet well shall be considered on a case-by-case basis. Solids handling requirements for intermediate to large pump stations shall be reviewed with the Chatham-Kent P.U.C. on a case-by-case basis. Where trash bars have been provided a mechanical hoist shall also be provided. The hoist and accessories shall be rated for not less the 1.5 times the heaviest anticipated load.

C.2.2.6.6 System Overflow and Bypass**C.2.2.6.6.1 Emergency Overflow**

Emergency overflow or emergency storage to be considered as part of pumping station design. Design calculations to be provided to the Chatham-Kent P.U.C. detailing total storage time to overflow under average and peak design flow. The lowest connected basement elevation shall be determined when selecting the overflow elevation to prevent basement flooding.

C.2.2.6.6.2 Emergency Bypass

An emergency bypass system shall be provided to allow engine driven pumps to provide uninterrupted operation should station main pumps fail. A cross-section of the proposed bypass shall be included in the drawings.

C.2.2.6.7 Electrical And Controls**C.2.2.6.7.1 Electrical Equipment**

Electrical system and components in raw wastewater wet well, or in enclosed or partially closed spaces where hazardous concentration of flammable gases or vapours may be present, shall comply with the Canadian Electrical Code and National Fire Protection Association requirements.

C.2.2.6.7.2 Level Control and Monitoring

Level control will be a combination of hydrostatic sensor (primary) and floats (secondary). Flow monitoring shall be accomplished with a magnetic flow meter with a bypass. Pressure gauges and/or ports shall be provided on the discharge and suction piping where applicable. All instrumentation shall be installed for ease of maintenance by operations. Level controls shall be installed such that the effect of turbulence from influent flows or pump suctions is minimized.

C.2.2.6.7.3 Emergency Power

Standby automatic diesel generators shall be provided at all sanitary pump stations in case of power failure. Standby generators shall be sized to provide adequate power to start and continuously operate all connected loads including pumps, lighting, ventilation and other auxiliary equipment necessary for the safe and proper operation of the sewage pumping station. The standby generating equipment shall include an automatic transfer switch. If emergency power is deemed unnecessary by Chatham-Kent P.U.C., a connection shall be provided for portable emergency generators.

C.2.2.6.7.4 SCADA and Communications

Supervisory Control and Data Acquisition (SCADA) shall consist of an integrated hardware and software system to provide full control and monitoring of the pumping station. Pump station controls shall include, at a minimum, a programmable logic controller (PLC), human machine interface (HMI), and a cellular modem for communication with the Chatham-Kent P.U.C. SCADA system.

C.2.2.6.7.5 Alarm Systems

Alarm systems should be provided for all pumping stations systems. At a minimum, the following alarms are required:

- Power failure
- High water level
- Low water level
- Pump failure
- Any of case of pump station malfunction

Alarms shall include identification of the alarm condition and shall be to dial out to a Chatham-Kent P.U.C. operator or facility 24 hours a day.

C.3 ENGINEERING REPORT

C.3.1 TECHNICAL INFORMATION

C.3.1.1 Technical Information

Technical Information to be included in the engineering report shall be according to the latest version of the Ministry of the Environment (MECP) guidelines for water and sewer works. In addition, the following technical information shall be included in the engineering report:

- Hydraulic Consideration: A summary of all hydraulic considerations as well as a summary of the initial parameters used in calculating the system components.
- Contributory Area: A description of the extent of the existing and proposed contributory area with reference to a general system map as well as a description of probable future expansion of the contributory area is requested.
- Location: The proposed collection system, pumping station, forcemains, and point of discharge into the existing sewer system shall be shown on a map. In addition, the engineering report shall discuss the capacity available in the existing downstream sewer, its ability to convey the additional flow and the effect it will have on the treatment facility.
- Design Data: The design data for the proposed project should include (but not limited to) the following:
 - Design Period.
 - Population densities per hectares and total population served.
 - Area served in hectares and acres.
 - Per capita sewage contribution expressed as an average daily and as a peak hourly value.

- Infiltration and inflow and method used to establish.
- Design flow rates expressed as design average daily and peak hourly values.
- All other data obtained or calculated during the design process.

C.3.2 GENERAL DRAWINGS REQUIREMENTS

C.3.2.1 Standard Drawings

Drawings shall be according to the Part F: Standard Drawings

C.3.3 GEOTECHNICAL REPORT

C.3.3.1 Attachment

A geotechnical report shall be attached to the engineering report as part of the design of the sewer system unless otherwise waived by Chatham-Kent P.U.C.

End of Part C

PART D

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D.1 GENERAL**D.1.1 QUALITY OF MATERIALS****D.1.1.1 Standard**

Quality of materials shall be according to the OPSS standard [GC 5.0.] All materials necessary for the proper completion of the work shall be new, unless otherwise specified or approved in writing by Chatham-Kent P.U.C. In all cases, materials used in the work shall meet all quality requirements defined, through a contract, by Chatham-Kent P.U.C. Materials shall not be considered as finally accepted if a required inspection or testing has not been carried out.

D.1.1.2 Samples

When required, representative preliminary samples of the character and quality prescribed shall be submitted for examination and testing. The approval of preliminary samples does not obligate the Chatham-Kent P.U.C.'s supervisor to accept materials from the same source delivered later. If, after trial, it is found that sources of supply for previously approved materials do not produce uniform and satisfactory products, or if the product from any source proves unacceptable at any time, materials for other sources shall be furnished.

D.1.2 UNACCEPTABLE MATERIALS**D.1.2.1 Rejecting Materials**

All material not conforming to the requirements of the specifications will be considered as unacceptable. All unacceptable materials, whether in place or not, will be rejected and shall be removed immediately from the work, unless otherwise directed by the Chatham-Kent P.U.C.'s representative or designate.

D.1.3 STORAGE OF MATERIALS**D.1.3.1 Principles**

All material shall be stored according to manufacturer's recommendations, complementary with the OPSS standard GC. 5.0.

D.1.3.2 Right-of-way

Portions of the right-of-way, approved by the Chatham-Kent P.U.C.'s representative, may be used for temporary material storage purposes. Storage in private property shall not be permitted unless otherwise approved by Chatham-Kent P.U.C.

D.1.4 HANDLING MATERIALS**D.1.4.1 Preservations of quality**

All materials shall be handled in such a manner as to preserve their quality and fitness for the job. Aggregates, and mixtures of aggregates with other materials, shall be transported from the storage site to the work site in such a manner to prevent loss or segregation of materials.

D.1.5 SAMPLES TEST**D.1.5.1 Aggregate and Pavement materials**

All aggregate and pavement materials shall be tested according to the established standards and in accordance with sound engineering practice.

WATERMAIN MATERIALS**D.2 PIPE****D.2.1 General****D.2.1.1 General Classification**

The Consultant shall specify the pipe material and class as required for specific project conditions. The 0 shows the acceptable pipe material and class to be used in Chatham-Kent P.U.C.'s watermain projects.

Table D.1 Material Used for Watermains

	PVC	C.P.P.	PE
Diameter (mm)	100 to 600	>400	12 to 600
AWWA Standard to manufacturing	C-900 C-605 & ASTM D1139 for rubber	C-304 C-130	C-901 C-906 and ASTM 3350 & 3261
Material	Polyvinyl Chloride	Concrete	Polyethylene
Joint types	Bell and spigot slip-on joint with rubber rings		Heat fusion or Flanged connections
Standard Length	6.1	//	//
Special Requirements	Tracer wire	Tracer Wire. Requires approval by Chatham-Kent P.U.C.	Tracer wire

D.2.2 PVC PIPE**D.2.2.1 Standard**

Polyvinyl chloride (PVC) pipe shall be manufactured according to the latest versions of the following standards:

- AWWA standard C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe, and Fittings for Water.
- AWWA standard C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. for Water Distribution.
- AWWA standard C907, Injections-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in. through 12 in (100 mm through 300 mm), for water distribution.
- AWWA Manual M43, Manual of Water Supply Practices, PVC Pipe Design, and Installation.

D.2.2.2 Supply

Only one manufacturer shall supply all PVC pipe for a specific project/development.

D.2.2.3 General Specifications

The following specification for PVC pipe shall be taken into account:

- All PVC pipe shall be manufactured according to the applicable AWWA standard.
- Each length of pipe shall be a standard laying length of 6.1 meters (20 feet).
- Pipe joints shall be non-metallic restrained joint designed by utilizing precision-machined grooves on the pipe and the coupling.
- All PVC pipe shall be a Bell and Spigot slip-on joint with rubber rings to ASTM D3139.
- Information related with type, class and manufacturer of the PVC pipe shall be recorded in the "As Constructed" drawings.
- Fittings for 100 mm or 150 mm (4 or 6 inches) PVC pipe shall be injection moulded, colour coded blue, with push on gasketed joints conforming the AWWA standard C907.

D.2.3 HIGH DENSITY POLYETHYLENE PIPE**D.2.3.1 Standard**

High density polyethylene pipe shall be in accordance to OPSS standard 1842.

D.2.3.2 General

Material used for the manufacture of polyethylene pipe and fittings shall be PE3408 high density polyethylene meeting cell classifications 334434C, D, or E as Per ASTM D 3350.

D.2.3.3 Requirement

The manufacturer shall certify that the material used to manufacture pipe and fittings meet requirements in D.2.3.2.

D.2.3.4 Pressure Rating

Pipe to be installed shall have the DR and the pressure rating defined by the consultant as per the approved drawings.

D.2.3.5 Mark

All Polyethylene pipe shall be marked. Each production lot of pipe shall be tested for melt index, density, percent carbon, dimensions and either quick burst or ring tensile strength.

D.2.3.6 Identifications

Permanent identification of any size piping service shall be provided as per manufacture's recommendations.

D.2.3.7 Fittings

Polyethylene Fittings shall be molded or fabricated by the pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe.

D.2.3.8 Molded Specification

Molded fittings shall be manufactured in accordance with ASTM D 3261 and shall be so marked. Each production lot of molded fittings shall be subjected to the tests required under ASTM D 3261.

D.2.3.9 X-Ray Inspection

The manufacturer shall submit samples from each molded fittings production lot to x-ray inspection for voids, and shall certify that voids were not found.

D.2.3.10 Fabricated Fittings

Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full service pressure rating of the mating pipe. Directional fittings 16 inches IPS and larger such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets.

D.2.3.11 Polyethylene Flange Adapters

Flange adapters shall be made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped groves to provide gasketless sealing, or to restrain the gasket against blow-out. For big diameter polyethylene pipe, sleeves for joints shall be used.

D.2.3.12 Back-Up Rings and Flange Bolts

Flange adapters shall be fitted with lap joint flanges pressure rated equal to or greater than the mating pipe. The lap joint flange bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be Grade 2 or higher.

D.2.4 DUCTILE IRON PIPE**D.2.4.1 Scope**

This section is a minimum guideline for ductile iron pipe material required for furnishing valve chambers and inside building installations.

D.2.4.2 Usage

Ductile iron pipe shall be used in the following situations:

- Water Treatment Facilities
- Valve Chambers

D.2.4.3 Standard

Pipe shall be new and shall conform to AWWA C151 up to and including 450 mm diameter. Cement mortar lining shall conform to AWWA C104. Polyethylene encasement shall conform to AWWA C105.

D.2.4.4 Joints

Pipe shall have push-on joints. Joint gaskets and lubricants shall conform to AWWA C111. Push-On Joint Ductile Iron Fittings shall be produced in strict accordance with all applicable terms and provisions of AWWA C153.

D.2.4.5 Thickness

Thickness class shall be class 52 for all diameters up to and including 300 mm (12 inches) diameter and Class 51 for 400 mm and 450 mm (16 and 18 inches) diameter.

D.2.4.6 Chemical Protection

Ductile iron pipe shall be provided with a road salt, sulphate and corrosion resistant protection cover, which shall consist of a polyethylene encasement conforming to the latest version of standard AWWA C105. Any exposed metal surface not wrapped with polyethylene encasement shall be coated with two finishing coats of a suitable corrosion resistant mastic (i.e.: Sterline Varnish No. 1756 Black Mastic) or wrapped with Denso Tape T-1.

D.2.4.7 Fittings

Ductile iron fittings shall have distinctly cast on them the pressure rating, nominal diameters of openings, manufacturer's identification, and have "DI" or "Ductile" cast on them in accordance with ANSI/AWWA C110-87/A21.10.-87.

D.2.5 CONCRETE PRESSURE PIPE**D.2.5.1 Scope**

Concrete pressure pipe shall be used only in specific cases and upon written authorization by Chatham-Kent P.U.C. Only in those cases, complete material specifications will be issued by Chatham-Kent P.U.C.

D.2.5.2 Precaution

Watermain pipe larger than 400 mm (16 inches) diameter may be constructed using Concrete Pressure Pipe (C.P.P.), as approved by the Chatham-Kent P.U.C. Concrete Pressure Pipe shall be new pipe manufactured in accordance with AWWA specification C301 and C304. Water distribution systems that incorporate concrete pressure pipes shall be constructed according to manufacturer's specifications.

D.2.6 STAINLESS STEEL PIPE**D.2.6.1 Standard**

Stainless steel pipe planned to be used in the construction stage shall be according to AWWA standard C220.

D.2.6.2 Precautions

Only in special cases, and upon written authorization from Chatham-Kent P.U.C., stainless steel pipe shall be used in water systems.

D.2.6.3 Usage

Stainless steel pipe shall be used in the following situations:

- Water Treatment Facilities
- Valve Chambers

D.3 VALVES AND APPURTENANCES**D.3.1 HYDRANTS****D.3.1.1 Standard**

All fire hydrants shall be a dry-barrel type manufactured in accordance with AWWA C502.

D.3.1.2 Type

Fire hydrants shall be the three-way type with one (1) pumper nozzle and two (2) hose nozzles all located on the same horizontal plan; 180° between them.

D.3.1.3 Manufacturer

Acceptable fire hydrants and their manufacturers may be:

- Canada Valve, model Century
- Mueller, model Modern Centurian
- Clow, model Brigadier

D.3.1.4 Configuration

All fire hydrants shall have a minimum main valve opening size of 133 mm (5-¼ inches).

D.3.1.5 Pumper Nozzle

The fire hydrant's pumper nozzle shall be 100 mm (4-½ inches) in diameter. In addition, a 125 mm (5 inch) stortz quarter-turn adapter shall be installed on the pumper port outlet.

D.3.1.6 Hose Nozzle

Each fire hydrant shall have two (2) 65 mm (2.5 inches) hose nozzles.

D.3.1.7 Nuts and Shaft

Operating nut and shaft:

- The bronze operating nut shall be tapered, and measure 33 mm (1-5/16 inches) from point to flat base of the nut and 32 mm (1-1/4 inches) at the top. The height of the nut shall not be less than 25 mm (one-inch).
- The hydrant shall open by turning the operating nut to the left in a counter-clockwise direction and shall have an arrow on top of the bonnet to designate the direction of opening.
- All fire hydrants shall be of the dry-barrel design where an oil reservoir provides permanent lubrication of the operating nut threads.
- One (1) or more "O" rings shall protect the operating mechanism from the water way.
- Lower stem end thread shall be sealed from water.

D.3.1.8 Traffic Collision Break

All fire hydrants shall be supplied with a traffic collision break-off feature, designed for a working pressure of 150 psi. The barrel and operating mechanism shall be so designed that in the event of accident, damage, or breaking of the hydrant at or above the grade level, the main valve will remain closed and reasonably tight against leakage.

D.3.1.9 Drain Valves

One (1) or more drain valves and drain openings shall be furnished.

D.3.1.10 Extension Sections

Extension sections must be available to allow the fire hydrant to be raised to a new grade without shutting off the water. The break-away traffic flange must be able to be retained on the fire hydrant.

D.3.1.11 Barrel Components

All barrel component connections shall be the bolted flange type. The ground line connection shall be manufactured to allow positioning of the top section at increments not greater than 15 degrees.

D.3.1.12 Precaution

All ferrous metal exposed to water in the shoe of the hydrant shall be epoxy lined (4 mm minimum). This coating requirement shall include lower valve (plant) and retainer.

D.3.1.13 Shoe Inlets

Shoe inlets shall be provided with a mechanical joint inlet to accommodate 150 mm (6 inches) diameter cast iron pipe. The mechanical joint shall meet the specifications as stated in section D.2.4.

D.3.1.14 Auxiliary Valve

The auxiliary valve on the fire hydrant lateral shall be a 150 mm (6 inches) resilient seat gate valve. The valve shall be provided with a valve box.

D.3.1.15 Tapping Sleeves

Tapping sleeves and valves are acceptable when connecting to an existing watermain. Chatham-Kent P.U.C. acceptance must be obtained in writing to use a tapping sleeve and valve.

D.3.2 VALVES**D.3.2.1 General****D.3.2.1.1 Standards**

For quality assurance purposes, valves shall comply, as applicable, with all specifications contained in the following Standards:

- AWWA C115, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray- Iron Threaded Flanges, latest revision.
- AWWA C500, Metal-Seated Gate Valves for Water Supply Service.
- AWWA C509, Resilient-Seated Gate Valves for Water Supply Service, latest revision.
- AWWA C512, Air Release, Air/Vacuum, and Combination Air Valves for Water Service, latest revision.
- AWWA C550, Protective Epoxy Interior Coatings for Valves and Hydrants, latest revision.
- AWWA C800, Underground Service Line Valves and Fittings.

D.3.2.1.2 Valve opening

All water distribution valves shall open counter clockwise (left).

D.3.2.1.3 Manufacturer

Table D.2 lists acceptable valve manufacturers:

Table D.2 Acceptable Manufacturers for Valves

TYPE	MANUFACTURER
GATE Double Disk	Mueller Clow Or approved equivalent
GATE Resilient Seat	Mueller Clow Or approved equivalent
AIR RELIEF/ VACUUM	Mueller Apco VAL-MATIC Or approved equivalent

TYPE	MANUFACTURER
PRESSURE REGULATING	Cla-Val Singer Or approved equivalent
VALVE BOXES	Tyler Or approved equivalent

D.3.2.2 Gate Valves**D.3.2.2.1 Material Specification**

All included in AWWA C500.

D.3.2.2.2 Furnishings

All below grade gate valves shall be non-rising stem.

D.3.2.3 Pressure Regulating Valves**D.3.2.3.1 Standard**

Flanges and covers shall conform to ASTM Standards

D.3.2.3.2 Casting

Pressure regulating valves shall be epoxy coated cast iron.

D.3.2.3.3 Furnishing

All pressure regulating valves shall be furnished with flanges ends sized and drilled.

D.3.2.4 Air Relief & Vacuum Valves**D.3.2.4.1 Materials**

The working parts and seats for air relief valves shall be brass, stainless steel, or other non-corroding material in accordance with AWWA Standard C512.

D.3.2.4.2 Configuration

Air relief and vacuum valves shall have an integral type assembly with functions both as an air release and vacuum valve.

D.3.3 VALVE CHAMBERS**D.3.3.1 Standard**

Valve chambers shall be constructed according to OPSS standard 1351, Material Specification for Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers.

D.3.4 WATER SERVICE CONNECTIONS**D.3.4.1 General****D.3.4.1.1 Standards**

For Quality assurance purposes, water service connections shall comply, as applicable, with all specifications contained in the latest revision of following Standards.

- ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- ANSI/AWWA C700, Cold Water Meters - Displacement Type, Bronze Main Case.
- ANSI/AWWA C701, Cold Water Meters - Turbine Type, for Customer Service.
- ANSI/AWWA C702, Cold Water Meters - Compound Type.
- ANSI/AWWA C800, Underground Service Line Valves and Fittings.
- ASTM B88-99, Standard for Seamless Copper Water Tube.

D.3.4.1.2 Precautions

For all non-metallic water service connections, a #10 AWG TWH solid copper with plastic coat tracer wire shall be installed.

D.3.4.1.3 Manufacturer

Table D.3 lists acceptable manufacturers:

Table D.3 Acceptable Manufacturers for Water Service Connections

*COMPONENT	*MANUFACTURE	*DESCRIPTION
SERVICE SADDLES	Rockwell	Series 323 & 352
	Ford	Style F202/Band FS303
	Robar	Style F0506/SS 2606 DB
	Mueller	S.S.
	Cambridge Brass	Tech Saddle
CORPORATION STOP	Mueller	Not specified
	Ford	Not specified
SERVICE PIPE	Canada Brass	ASTM B88/k Soft copper
	Ipex	Blue brute
	Royal	C900 High pressure
	Canada/US Pipe	Not specified
COUPLING	Mueller	A-319/312/314
	Ford	Pack C-44/14/84
	EMCO	17080
	Dresser	88
	Canada Brass	Series 118
CURB STOP	Mueller	A-616/A726
	Ford	B44-333/B22-666
CURB STOP BOX	Mueller	A726
	Bibby-Ste-Croix	A753
	Canada Brass	Series 400
METER	Supplied by Chatham-Kent PUC	

* For any other water service component, manufacturer, or description, Chatham-Kent P.U.C. shall be contacted.

D.3.4.1.4 Characteristics**D.3.4.1.4.1 Saddle**

The configuration of the saddle shall provide a full support around the circumference of the pipe, and shall:

- Be specially manufactured if the watermain pipe is PVC to ensure adequate tolerance related with the PVC tightness.
- Be minimum 50 mm (2 inches) width along the watermain pipe's axis if the tap is 25 mm (one inch) in size.
- Be minimum 75 mm (3 inches) width along the watermain pipe's axis if the tap is 32 mm (1-1/4 inches) in size.
- Narrow U-bolt-type saddles shall be prohibited.

D.3.4.1.4.2 Corporation Stop

All corporation stop shall conform to AWWA Standard C800 Standard and be capable of operating at a working pressure of 1034 kPa (150 psi), and:

- All corporation stops shall be full opening plug type and constructed of the material defined by the applicable Standard.
- Corporation stop inlet threads for tapping saddles shall be chamfered.
- All corporation stop outlets shall use a flared connection.

D.3.4.1.4.3 Couplings

Couplings shall not be permitted. However, if Chatham-Kent P.U.C. gives written authorization, couplings shall be compression types, with minimum pressure rating of 1035 kPa (150 psi) manufactured in accordance with AWWA Standard C800.

D.3.4.1.4.4 Service Pipe

Water service pipe up to 50 mm (2 inches) diameter shall be polyethylene series 160 plastic pipe or an approved alternate and shall be in accordance with AWWA Standard C901. Water service pipes over 50 mm (2 inches) diameter shall be PVC pipe meeting the specifications required for watermain pipes and fittings.

D.3.4.1.4.5 Curb Stop

Curb stops 50 mm (2 inches) inclusive, shall conform to AWWA Standard C-800, and comply with:

- All curb stops shall have flared by flared connections at both ends.
- Curb stops shall be plug type, full opening, and Minneapolis pattern. Curb stop 75 mm (3 inches) and larger shall be a gate valve.

D.3.4.1.4.6 Curb Stop Boxes

Service boxes shall be Eclipse type steel boxes, 1500 mm (5 ft) to 1800 mm (6 ft) with an 875 mm (35 inches) operating rod what shall be Stainless Steel with brass cotter pin. Curb boxes shall be of the type and Model described in **Table D.3** or shall be approved by Chatham-Kent P.U.C.

D.3.4.1.4.7 Water Meters

All 19 mm ($\frac{3}{4}$ inches) to 50 mm (2 inches) meter shall be displacement meters and shall be according to AWWA Standard C-700. All meters greater than 50 mm, (2 inches) intended for bulk measurement or any other Chatham-Kent P.U.C.'s purpose shall be a compound meters, and shall be according to AWWA Standard C702.

SANITARY SEWER MATERIALS

D.4 GRAVITY PIPE

D.4.1 PVC PIPE

D.4.1.1 Standard

Polyvinyl chloride (PVC) pipe shall be manufactured according to the latest versions of the following standards:

- CAN/CSA B182.2, Polyvinyl Chloride (PVC) Sewer Pipe and Fittings (PSM Type)
- ASTM D3034, Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
- ASTM F679, Standard Specification for Polyvinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

D.4.1.2 Supply

Only one manufacturer shall supply all PVC pipe for a specific project/development.

D.4.1.3 General Specifications

The following specification for PVC pipe shall be taken into account:

- Each pipe shall be a standard lay length of 4.2 meters (14 feet).
- All PVC pipe shall be a Bell and Spigot slip-on joint with rubber rings to ASTM D3034 and CSA B182.2 and must withstand a minimum hydrostatic pressure of 50 psi (345 kPa) without leakage.
- Information related with type, class and manufacturer of the PVC pipe shall be recorded in the "As Constructed" drawings.

D.4.2 REINFORCED CONCRETE PIPE

D.4.2.1 Standard

Reinforced Concrete Pipe (RCP) shall be manufactured according to the latest versions of the following standards:

- CAN/CSA A257.2M, Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
- ASTM C76M, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

- ASTM C507M, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
- OPSS 1820 – Material Specification for Circular and Elliptical Concrete Pipe

D.4.2.2 Supply

Only one manufacturer shall supply all PVC pipe for a specific project/development.

D.4.2.3 General Specifications

The following specification for PVC pipe shall be taken into account:

- Each pipe shall be a standard lay length of 2.44 meters (8 feet).
- Gaskets shall be self-lubricating rubber and shall withstand a minimum hydrostatic pressure of 15 psi (103 kPa).

D.5 FORCEMAIN PIPE

D.5.1 PVC PIPE

D.5.1.1 Standard

Polyvinyl chloride (PVC) pipe shall be manufactured according to the latest versions of the following standards:

- AWWA standard C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe, and Fittings for Water.
- AWWA standard C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. for Water Distribution.
- AWWA standard C907, Injections-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in. through 12 in (100 mm through 300 mm), for water distribution.
- AWWA Manual M43, Manual of Water Supply Practices, PVC Pipe Design and Installation.

D.5.1.2 Supply

Only one manufacturer shall supply all PVC pipe for a specific project/development.

D.5.1.3 General specifications

The following specification for PVC pipe shall be taken into account:

- All PVC pipe shall be manufactured according to the applicable AWWA standard.
- Each length of pipe shall be a standard lay length of 6.1 meters (20 feet).
- Pipe joints shall be non-metallic restrained joint designed by utilizing precision-machined grooves on the pipe and the coupling.
- All PVC pipe shall be a Bell and Spigot slip-on joint with rubber rings to ASTM D3139.
- Information related with type, class and manufacturer of the PVC pipe shall be recorded in the “As Constructed” drawings.
- Fittings for 100 mm or 150 mm (4 or 8 inches) PVC pipe shall be injections moulded, with push on gasketed joints conforming to the AWWA standard C907.

D.5.2 HIGH DENSITY POLYETHYLENE PIPE**D.5.2.1 Standard**

Polyethylene pipe shall be as per OPSS standard 1842.

D.5.2.2 General

Material used for the manufacture of polyethylene pipe and fittings shall be PE3408 high density polyethylene meeting cell classifications 334434C, D, or E as Per ASTM D 3350.

D.5.2.3 Requirement

The manufacturer shall certify that the material used to manufacture pipe and fittings meet requirements in D.5.2.2.

D.5.2.4 Pressure Rating

Pipe to be installed shall have the DR and the pressure rating defined by the consultant as per the approved drawings.

D.5.2.5 Mark

All Polyethylene pipe shall be marked. Each production lot of pipe shall be tested for melt index, density, percent carbon, dimensions and either quick burst or ring tensile strength.

D.5.2.6 Identifications

Permanent identification of any size piping service shall be provided as per manufacture's recommendations.

D.5.2.7 Fittings

Polyethylene Fittings shall be molded or fabricated by the pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe.

D.5.2.8 Molded Fittings

Molded fittings shall be manufactured in accordance with ASTM D 3261 and shall be so marked. Each production lot of molded fittings shall be subjected to the tests required under ASTM D 3261.

D.5.2.9 X-Ray Inspection

The manufacturer shall submit samples from each molded fittings production lot to x-ray inspection for voids, and shall certify that voids were not found.

D.5.2.10 Fabricated Fittings

Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full service pressure rating of the mating pipe. Directional fittings 16 inches IPS and larger such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets.

D.5.2.11 Polyethylene Flange Adapters

Flange adapters shall be made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves to provide gasketless sealing, or to restrain the gasket against blow-out. For big diameter polyethylene pipe, sleeves for joints shall be used.

D.5.2.12 Back-Up Rings and Flange Bolts

Flange adapters shall be fitted with lap joint flanges pressure rated equal to or greater than the mating pipe. The lap joint flange bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be Grade 2 or higher.

D.5.3 DUCTILE IRON PIPE**D.5.3.1 Scope**

This section is a minimum guideline for ductile iron pipe material required for furnishing sanitary sewer under pressure or acting in connection to pumping stations.

D.5.3.2 Standard

Pipe shall be new and shall conform to AWWA C151 up to and including 450 mm diameter. Cement mortar lining shall conform to AWWA C104. Polyethylene encasement shall conform to AWWA C105.

D.5.3.3 Joints

Pipe shall have push-on joints. Thickness class shall be class 52 for all diameters up to and including 300 mm (12 inches) diameter and Class 51 for 400 mm and 450 mm (16 and 18 inches) diameter. Joint gaskets and lubricants shall conform to AWWA C111.

D.5.3.4 Chemical Protection

Ductile iron pipe shall be provided with a road salt, sulphate and corrosion resistant protection cover, which shall consist of a polyethylene encasement conforming to the latest version of standard AWWA C-105-88. Any exposed metal surface not wrapped with polyethylene encasement shall be coated with two finishing coats of a suitable corrosion resistant mastic (i.e.: Sterline Varnish No. 1756 Black Mastic) or wrapped with Denso Tape T-1.

D.5.3.5 Fittings

Ductile iron fittings shall have distinctly cast on them the pressure rating, nominal diameters of openings, manufacturer's identification, and have "DI" or "Ductile" cast on them in accordance with ANSI/AWWA C110-87/A21.10.-87.

Push-On Joint Ductile Iron Fittings shall be produced in strict accordance with all applicable terms and provisions of AWWA C153.

D.5.4 CONCRETE PRESSURE PIPE**D.5.4.1 Standard**

Concrete Pressure Pipe shall be constructed according to the applicable AWWA standard as following:

- C300, Reinforced Concrete Pressure Pipe, Steel Cylinder Type.
- C301, Prestressed reviewed Concrete Pressure Pipe, Steel-Cylinder Type.
- C302, Reinforced Concrete Pressure Pipe, Noncylinder Type.

D.5.4.2 Precaution

Specifications for Concrete Pressure Pipe fittings shall be established by the consultant according to AWWA Manual M9. OPSS Standard 1820 shall be used to determine material characteristics for non-pressure Concrete Pipe planned to use in gravity sewer mains.

D.5.5 STAINLESS STEEL PIPE**D.5.5.1 Standard**

Stainless steel pipe planned to be used in the construction stage shall be according to AWWA standard C220.

D.5.5.2 Precautions

Only in special cases and upon written authorization from Chatham-Kent P.U.C., stainless steel pipe shall be used in sewer systems.

D.5.5.3 Usage

Stainless steel pipe shall be used in the following situations:

- Sewage Treatment Facilities
- Valve Chambers

D.6 PRECAST MATERIALS**D.6.1 VALVE CHAMBERS****D.6.1.1 Standard**

Valve chambers shall be constructed according to OPSS standard 1351, Material Specification for Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers.

D.6.2 PUMP STATIONS**D.6.2.1 Standard**

Material specification for precast pump station shall be according to OPSS standard 1351.

D.6.3 MAINTENANCE HOLES**D.6.3.1 Standard**

Maintenance holes shall conform to the requirements of OPSS standard 1351 and ASTM Designation C478. In addition, the following considerations shall be taken into consideration:

- The minimum wall thickness shall be 203 mm (8 inches) with the required steel reinforcement.
- The design of the structure shall include a precast base of not less than 203 mm (8 inches) in thickness poured monolithically with the bottom section of the maintenance hole walls.
- Maintenance hole tops shall terminate at such elevations that will permit laying of grade rings under the maintenance hole frame to make allowances for future street grade adjustments.
- Drop connections, where required on precast maintenance holes, shall be manufactured with the maintenance hole elements at the casting yard. Drop maintenance holes shall be constructed per OPSD.

D.6.3.2 Adjustment Rings

Concrete maintenance hole rings shall be as per OPSS 1351 and CSA A257.4.

D.6.3.3 Rubber Adjustment Rings

Rubber adjustment rings shall be according to OPSS 1853.

D.6.3.4 Maintenance Hole Frames and Covers

Castings for maintenance hole frames, covers and other items shall conform to the OPSS standard 1850. Castings shall be true to pattern in form and dimensions and free of pouring faults and other defects in positions which would impair their strength, or otherwise make them unfit for the service intended. The seating surfaces between frames and covers shall be machined to fit true so the frames and covers do not shift under traffic conditions or permit entry of storm water from flooding.

D.6.3.5 Lid Identification

The words SANITARY SEWER shall be cast in all maintenance hole covers. All maintenance hole frames shall be embedded in mortar to the correct finish grade elevation with adjustment concrete grade rings installed in conformance with the standard drawings in Part F.

D.7 CAST IN PLACE MATERIALS**D.7.1 GENERAL****D.7.1.1 Material**

All material used to perform cast-in-place constructions shall comply with all applicable CSA parameters and specifications.

D.8 VALVES**D.8.1 General**

Valves shall be according to section D.3.2

D.9 LATERAL SERVICE CONNECTION MATERIALS**D.9.1 Material**

Materials required for lateral service connection, which include tees or wyes, service pipe, and riser shall be the same material as the service pipe. Service pipe material shall be as established by the consultant. Suitable materials for lateral service connections are PVC and polyethylene.

D.9.2 Cleanout Caps

Cleanout caps shall be made of metallic material or contain metallic material so it can be located with a metal detector.

GENERAL PURPOSE MATERIALS**D.10 BACKFILLING MATERIAL****D.10.1 NATIVE SITE MATERIAL****D.10.1.1 Specification**

Chatham-Kent P.U.C.'s supervisor shall approve the use of native site material. In all cases, native site material shall be tested to establish if its properties meet the quality control required in OPSS.

D.10.2 IMPORTED MATERIAL**D.10.2.1 Standard**

Imported material shall be according to OPSS standard 212.

D.10.2.2 Precautions

Imported material shall be free from organic material. Imported material with more than 50% of the particles smaller than 75 µm, as determined by LS-702*, shall not be used unless the field moisture content in terms of Plasticity Index meets the Optimum Moisture Content. Tests shall be conducted by certified lab/testing company.

* Laboratory Standard for determination of Particle Size Analysis for Soils.

D.10.3 GRANULAR MATERIAL**D.10.3.1 Standard**

Granular Material shall be according to OPSS Standard 1010.

D.10.3.2 Testing Granular Materials

All granular material shall be tested in accordance with the OPSS.

D.10.4 ORGANIC MATERIALS**D.10.4.1 Topsoil**

Topsoil shall be according to OPSS Standard 802. Existing topsoil shall be used in final grading if it is not contaminated with subsoil. In all cases, Chatham-Kent P.U.C.'s representative or designate shall give a written authorization.

D.10.4.2 Sodding

Sodding shall be accordingly to OPSS 803. The quality of the sod to be placed and the guaranty time shall be in accordance with the time required for the sod to consolidate itself to the ground and grow.

D.10.4.3 Seeding

Seeding shall be according to OPSS Standard 804. The consultant shall specify the kind of seed to be used and shall consult with the Chatham Kent P.U.C. for acceptance of the seed proposed.

D.11 MATERIAL FOR PAVEMENTS**D.11.1 GENERAL****D.11.1.1 Standard**

Material for pavements shall be according to OPSS 310.

D.11.1.2 Precaution

If a hot mix will be used, care shall be taken to supply a Granular "B" for the sub-base, granular "A" for the base, and if applicable, Granular "A" for shoulders. In all cases, drawings and specifications for the design shall be followed.

D.12 OTHER MATERIALS**D.12.1 MORTAR****D.12.1.1 Standard**

Mortar components shall be as followed:

- Mortar sand shall conform to the requirements of OPSS 1004.
- Water shall conform to the requirements of OPSS 1302.
- Portland Cement shall conform to the requirements of OPSS 1301.

D.12.1.2 Proportioning

Mortar for parging, brickwork and patching shall be one part cement to three parts sand.
Mortar for mortar joint pipes and non-gasket valve chambers shall be one part cement to two parts sand.

D.12.2 CONCRETE**D.12.2.1 Standard**

Concrete used to fabricate thrust blocks and fittings and appurtenances supports shall be according to OPSS standard 1350 with the compressive strength required as per the design and drawing information.

D.12.3 RESTRAINERS FOR PIPE**D.12.3.1 Utilization**

Restrained joints shall be provided on all PVC pressurized pipe in the following cases:

- Horizontal bends
- Vertical bends
- Reducers
- Plugs and caps
- Dead end valves
- The line side of hydrant valves
- Where explicitly shown on the drawings
- Restraining rings shall meet or exceed all requirements of UNI-BELL B-13 "Recommended Standard Performance Specifications for Joint Restrainers for Use with Poly-Vinyl Chloride Pipe".

D.12.3.2 Note

The Uni-Flange Series 1300 and 1350 or Mega-Lug restrainers are acceptable for use with PVC pipe.

D.12.4 ELECTRICAL**D.12.4.1 Tracer Wire**

Tracer wire for non-metallic pipe and fittings shall be a #10 AWG TWH solid copper with plastic coat.

D.12.4.2 Cathodic Protection**D.12.4.2.1 General**

The requirements for cathodic protection shall be review on a case-by-case basis. In general, the following general specifications shall apply.

D.12.4.2.2 Non-Metallic Watermain

Non-metallic watermain shall have sacrificial caps on all mechanical joint fittings and valves on every bolt. The Contractor shall provide for sufficient bolt length to accommodate the caps. Corrosion Protection for Concrete Pressure Pipe shall be considered on a project-by-project basis.

D.12.4.2.3 Metallic Watermain

As part of the geotechnical report, the resistivity and corrosiveness of the soil must be determined. Where metallic watermain are to be installed, an appraisal must be done to determine if corrosion protection is required. This appraisal shall be performed using the 10-point soil evaluation procedure as described in AWWA C105 Appendix. If the 10-point soil evaluation establishes a need for corrosion protection, the necessary anode spacing shall be clearly shown on the construction drawings.

D.12.4.2.4 Approved Methods

Approved methods for corrosion protection of existing Ductile Iron watermain and fittings are:

- Sacrificial nuts
- Sacrificial anodes
- Petrolatum tape systems (i.e. Denso)

D.12.4.2.5 Denso Materials

Exposed metal at "Cadweld" locations shall be protected using Denso materials. These products shall be applied in strict conformity with the manufacturer's specifications and recommendations.

D.12.4.2.6 Cathodic Protection

The following size of cathodic protections shall be used in each case showed. Nuts and screws used in connections shall be of adequate material to avoid corrosive effects.

Table D.4 Size of Cathodic Protection

ANODE SIZING (Kg)	ITEM TO BE PROTECTED
(19 mm & 25 mm) 5.5 kg to 14.5	Copper service pipe
(38 mm & 50 mm) 11.0	
11.0	Hydrants
(100 mm to 250 mm) 5.5 to 14.5	Valves
(300 mm and over) 11.0	
(100 mm to 250 mm) 5.5 to 14.5	Cast iron & plain ductile iron fittings and specials
(300 mm and over) 11.0	

D.12.4.2.7 Zinc Anodes

Packaged Zinc Anodes shall be 5.5 Kg castings, manufactured using a high purity zinc - 99.99% pure conforming to ASTM B-418-73 Type II. The zinc casting shall have a 3.2 mm (0.125") diameter galvanized steel core wire throughout its length and shall be packaged in a cardboard or cloth container approximately 100 mm in diameter. The depolarizing material surrounding the zinc casting shall be composed of a gypsum/bentonite base material having an electrical resistivity less than 50 ohm cm. wet. An insulated copper (AWG #10/7 strand) wire, 2 metres minimum in length, shall be brazed to the end of the core wire. Duratron Model DZP-550-12 zinc anodes meet those requirements.

D.12.4.2.8 Magnesium Anodes

Packaged Magnesium Anodes shall be 14.5 Kg castings with a 3.2 mm (0.125") diameter stainless steel core wire and shall be packaged in a cardboard or cloth container approximately 200 mm in diameter. The depolarizing material surrounding the magnesium casting shall be composed of a gypsum/sodium sulphate/bentonite mixture having an electrical resistivity less than 50 ohm cm. wet. An insulated copper (AWG #10/7 strand) wire, 2 metres minimum in length shall be brazed to the end of the core wire. Duratron Systems Limited and Corrosion Service Company Limited presently manufacture anodes to the above requirements. The packaged anode shall be placed in the trench a minimum of 1.0 metre from the material to be protected.

D.12.5 FENCES**D.12.5.1 Standard**

Fences shall be according to OPSS standard 772 for components, and standard 772 for design requirements.

D.12.5.2 Fabric

The fabric, posts, fastenings, fittings, and other accessories for chain link fence shall meet the requirements of OPSS with the following changes:

- The weight of coating on wire fabric shall be 1.2 ounces of zinc per square foot (class B).
- The galvanizing of steel materials shall be hot dip galvanized.
- The weight of coating on posts and braces shall be 1.8 ounces of zinc per square foot, both inside and outside to meet the requirements of OPSS.

D.12.5.3 Base Metal

The base metal of the fabric shall be a good commercial quality 9 gauge steel wire. The fabric shall be of uniform quality, and shall be 2.13 meters (7 ft) high with a 50 mm (2 inches) mesh size. All posts and rails shall be in accordance with the following schedule:

- End, corner and pull posts – 3" o.d., schedule 40
- Line posts and gate frames – 3" o.d., schedule 40
- Gate posts – 3" o.d., schedule 40
- Post braces and top rail – 1 5/8" o.d., schedule 20

- Tension wire shall be 0.177 inch coiled spring wire tensioned along the bottom of the fabric and shall be coated similarly to the wire fabric.
- Miscellaneous fittings and hardware shall be zinc coated commercial quality or better steel or zinc coated cast or malleable iron as appropriate for the article.
- Post caps, designed to provide a drive fit over the top of the tubular post to exclude moisture, shall be provided.

D.12.6 MISCELLANEOUS METAL ITEMS

D.12.6.1 Structural Steel

All Structural Steel shall conform to the current standard specifications of the Canadian Standards Association for Structural Steel for Buildings. NSF and AWWA standards shall be consulted.

D.12.6.2 Cast Iron

Cast Iron shall conform to ASTM designation A-48, Class 30B, Standard Specifications for Grey Iron Castings.

D.12.6.3 Aluminium

Aluminium shall conform to Alloy 6061-T4 for extruded sections, Alloy 6351-T6 for structural members.

D.12.6.4 Galvanizing

Metal products to be galvanized shall be galvanized after fabrication. Galvanizing shall conform to the standard specifications for Zinc Coatings on Structural Steel Shapes, ASTM designation A.123.

D.12.6.5 Coatings

Cast iron products to be coated shall be coated with an approved hot-dipped asphalt coating.

D.12.6.6 Straps, Tie-rods, Angles, Nuts and Bolts

Stainless steel straps, tie-rods, angles, nuts and bolts used in concrete thrust blocks shall conform to ASTM A276, Type 316 Stainless Steel.

D.12.7 OTHER MISCELLANEOUS

D.12.7.1 Lubricants

When required, all lubricants for gaskets shall be NSF 61 type.

End of Part D

PART E

CONSTRUCTION

SPECIFICATIONS

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E.1 GENERAL**E.1.1 GENERAL CONSIDERATIONS****E.1.1.1 Scope**

This part of the manual addresses the construction specifications of water distribution and sanitary sewer systems and includes the acceptable construction practices that shall be used in the installation of watermains, sanitary sewers and all appurtenances including all components, materials and construction practices in accordance with all standards and regulations applicable in Ontario.

E.1.2 PRECONSTRUCTION STAGE**E.1.2.1 Approvals and Permits****E.1.2.1.1 Procedure**

Before any construction begins, all approvals and permits required to perform the job shall be obtained from Chatham-Kent P.U.C. and all other companies or local agencies. The procedure to obtain those approvals or permits shall be followed in accordance with the most recent bylaws or regulations applicable.

E.1.2.1.2 Construction Sign

A construction sign shall be prepared according to Part F: Standards Drawings.

E.1.2.2 Construction Drawing**E.1.2.2.1 Standard**

Construction drawings shall be prepared in accordance with the OPSS Standard GC.3 and the following subsections.

E.1.2.2.2 Preparation

For the purpose of this manual, construction drawings have been defined as those copies from the originals approved by Chatham-Kent P.U.C. or its representative. All construction drawings shall be clearly labelled "Issued for Construction", stamped signed and dated by the design engineer. At least one copy of constructions drawings shall be placed in the job site to be consulted at any time by the Chatham-Kent P.U.C.

E.1.2.2.3 Modifications

As the construction progresses, all modifications resulting from the job conditions shall be registered in the construction drawings and in the daily work record and field books. Using the last version of the construction drawing and any other information obtained during the construction stage, the "As Constructed" drawings shall be updated or developed in accordance with **Section E.1.3.1.6**.

E.1.2.3 Survey**E.1.2.3.1 Survey Monuments**

Monuments, iron bars, round iron bars and stakes representing property boundaries and locations encountered on line of work shall not be removed or altered. In the case of accidental damage or burying, the bars shall be replaced by an Ontario Land Surveyor.

E.1.2.3.2 Survey Data

All elevations indicated on contract and drawing specifications and construction specifications shall be referred to datum of Geodetic Survey of Canada.

E.1.2.3.3 Planning

Information on and identification of existing control points and property lines indicated on contract drawings shall be confirmed prior to commencing the work.

E.1.2.3.4 Protection

All permanent reference points shall be protected during the construction stage.

E.1.2.3.5 Other Utilities

During the survey process, information of other utilities shall be obtained as clear as possible referencing all visible aboveground utility plant.

E.1.2.4 Plant Protection Program for Trees**E.1.2.4.1 Standards**

The plan for tree protections developed for a specific job shall be contained within the OPSS Standards 201, 206, 490, or 801, and shall follow all recommendation from the Ministry of the Environment, Conservation & Parks.

E.1.2.4.2 Protection

All trees and plants designated to remain shall be protected during the construction operations. If it is required to stockpile material close to the tree drip lines, prune interfering branches, or tunnelling through the tree roots, the standards OPSS 490 and 801 shall be followed.

E.1.2.4.3 Precaution

Special care shall be taken in cases in which the final grade becomes lower or higher than the tree position. The standard procedure defined in OPSS 201 and 206 shall be followed to ensure the required care of the trees perimeter condition.

E.1.2.5 Plan to Control Dust, Pollution, Erosion**E.1.2.5.1 Standards**

Special provision shall be taken before the job begins to ensure during the work the compliance of standards and specifications outlined by the Ministry of the Environment, Conservation & Parks. Care shall be taken to comply with the OPSS Standard 490. In all cases, Chatham-Kent P.U.C. shall approve the application of the plan to control dust, pollution, and erosion.

E.1.2.6 Schedule of Work**E.1.2.6.1 General**

Before any job begins and within the time stipulated by Chatham-Kent P.U.C, a schedule of work shall be provided.

E.1.2.6.2 Restrictions

All construction operations shall be carried out during the normal working periods as per the Municipality's noise By-Law.

E.1.2.7 Temporary Facilities for Construction**E.1.2.7.1 Facilities**

Prior to starting the construction stage, a temporary facility (e.g. site trailer) required for the construction of work shall be furnished, installed, and maintained.

E.1.2.7.2 Approval

The facility shall include all temporary buildings for staff and for construction purposes. Chatham-Kent P.U.C. shall approve the location of those facilities. Municipal approval shall be required for facilities on the Right-of-Way.

E.1.2.7.3 Sanitary Facilities

Sufficient sanitary facilities shall be provided to all personnel involved in the work. Those facilities shall be hygienically maintained throughout the construction stage.

E.1.2.7.4 Removing Facilities

All facilities erected during the construction of the work shall be removed at the end of the post-construction stage once Chatham-Kent P.U.C.'s supervisor or designate has given authorization.

E.1.2.7.5 Temporary Supply

If applicable, a temporary water and electricity supply shall be provided during the duration of the construction as per the Occupational Health and Safety Act.

E.1.2.8 Temporary Water Connections**E.1.2.8.1 Use of Hydrants**

If temporary water supply is planned to be obtained from a hydrant, a temporary water supply application shall be filled indicating the period of time and purpose for which the water will be used.

E.1.2.8.2 Charges

If the connection is approved and an agreement is signed, a payment shall be made prior to connection, or when billed the applicable charges indicated by Chatham-Kent P.U.C. Prior to signing the agreement, Chatham-Kent P.U.C. shall establish the applicable rates and charges in accordance with the current by-law.

E.1.2.8.3 Cost

The cost of the temporary water connection shall be calculated upon the appropriate rates for the water consumed, the cost of making the necessary connections to the hydrant, and rental of the equipment installed.

E.1.2.8.4 Backflow

The necessary connections shall, at a minimum, include the installation of a backflow prevention device, and a meter which must be used and carefully preserved at all times. The backflow prevention device shall be supplied with an inspection certificate upon installation. If the equipment furnished by Chatham-Kent P.U.C. is damaged through applicant's negligence or abuse, the cost of repairing it shall be charged to the applicant. If any such equipment is removed from the fire hydrant by others and not recovered by Chatham-Kent P.U.C., a monetary charge will be established to the equipment cost.

E.1.2.8.5 Expiration

Chatham-Kent P.U.C. shall discontinue the supply and remove its equipment at the expiration of the period so designated or if the supply is used for any purpose other than designated by the applicant and approved by Chatham-Kent P.U.C.

E.1.2.8.6 Operation

All precautions shall be taken to operate the hydrant accordingly to the Fire Department Standards. The hydrant body shall be covered as soon as possible, indicating to the public and the Fire Department that the hydrant is temporarily not in service.

E.1.2.8.7 Verification

Chatham-Kent P.U.C. will check the complete payment of the bills incurred by the use of water from a hydrant utilized during the construction and post construction stages.

E.1.2.9 Traffic Control and Signing**E.1.2.9.1 Standard**

The procedure contained in the OPSS Standard 706 shall be followed. All local specifications required by the Ministry of Transportation within Chatham-Kent shall be observed.

E.1.2.9.2 Planning

Sufficient flagging, signing, lighting, delineation, and temporary pavement marking shall be supplied and maintained to provide traffic control. All applicable standards defined by the Ministry of Transportation through its Ontario Traffic Manual for Temporary Conditions (Book 7) shall be followed. A plan for traffic control shall be submitted to Chatham-Kent P.U.C.

E.1.2.9.3 Visibility

The traffic displays shall be visible to pedestrians and vehicles at all times. All necessary changes shall be planned and made to ensure proper traffic movement and access to adjacent properties.

E.1.2.9.4 Temporary Road Closures

If a temporary road closure has to be implemented, the Chatham-Kent Engineering and Transportation Department shall approve the proposed road closure. Notices to property owners with copy to Chatham-Kent P.U.C.'s supervisor or designate shall be provided to inform them of the duration of the closure.

E.1.2.9.5 Access

Every effort shall be made to backfill trenches across entrances as soon as possible. Under no circumstances will access be closed for longer than the time approved by Chatham-Kent Engineering and Transportation Department. Access for pedestrians crossing the roadway shall be ensured all the time, especially during school hours.

E.1.2.9.6 Detours

For no reason, will a detour be constructed without the approval of the authority Chatham-Kent Engineering and Transportation Department. In case of approval, the detours shall be constructed by using granular material, procedures, and specifications approved by the road authority. In all cases, Chatham-Kent P.U.C. shall be informed about the kind of detour approved and the terms and condition of the detour approval.

E.1.2.9.7 Flagging

Flagging control shall be made in accordance with the regulations and procedures established by the Ministry of Transportation through its Ontario Traffic Manual for Temporary Conditions (Book 7) and by the recommendations and procedures defined by the Construction Safety Association of Ontario. If a flagman is required, precaution shall be taken to comply with the personal safety equipment as per the Occupational Health and Safety Act.

E.1.2.10 Other Utilities Coordination**E.1.2.10.1 Standard.**

Coordination with other utilities shall be performed according to OPSS Standard 491.

E.1.2.10.2 Location

The location of all other aboveground and underground utilities shall be carefully determined as established in **Section E.1.2.3.5** Coordination shall be established with the engineering department of the companies that are related with any possible task involving location, exposition, protection, installation, reinstallation, and re-location, or temporary shut-off.

E.1.2.10.3 Guard

In all cases, any work that interferes in any way with existing aboveground or underground utilities must be carried out in such a manner as to protect and maintain those services at all time and shall be done in the manner approved by the engineering department of these companies or public utilities.

E.1.2.10.4 Protection

During the process of the work, care shall be taken to sustain and protect from injury any and all water or gas mains, public or private sewers or drains, conduits, subways, steam and pneumatic pipes, sidewalks, service pipes, curbs, utility poles and all other structures or property in the vicinity of the work.

E.1.2.10.5 Fixing Damages

In cases of damage of any other utilities encountered during the trenching or tunnelling process, immediate contingency plan for fixing damages shall be performed. Immediate coordination with other utility companies shall be carried out to ensure the fastest and most adequate solution.

E.1.2.10.6 Miscellaneous

If applicable, a sufficient quantity of timber and plank, chains, etc., on the site, shall be a guaranty to protect all pipes or structures in danger. All water and service pipes shall be protected from freezing.

E.1.3 CONSTRUCTIONS STAGE**E.1.3.1 Layout****E.1.3.1.1 Standard**

Layout shall be performed according to the OPSS MUNI 100 GC 7.02 and the following conditions shall be applied:

E.1.3.1.2 Benchmarks

The layout process shall be developed based upon baselines and benchmarks for general locations, alignments, and elevations provided by Chatham-Kent P.U.C. or design engineer and other utility companies or agencies.

E.1.3.1.3 Location

A project location shall be established by using reference information taken from the approved construction drawings or design specifications.

E.1.3.1.4 Personnel

Qualified personnel shall perform the layout process and establish all lines and grades necessary for construction.

E.1.3.1.5 Accuracy

During the layout process secondary benchmarks and substantial alignment markers shall be installed and maintained. All stakes, marks, secondary benchmarks, and reference points shall be preserved during the construction stage in such a way that information related with elevations or location of any point can be accurately obtained.

E.1.3.1.6 Corrections

If during the layout process, differences are identified between drawings and existing levels, dimensions, or alignments of any part of the project, rectifications shall be made. That information shall be recorded into the field book and construction drawings to be used during the "As Constructed" process. In all cases, Chatham-Kent P.U.C. or designate shall be informed in writing about those errors and corrections made.

E.1.3.1.7 Miscellaneous

Wherever deemed possible and based upon information obtained during the layout process, adjustment in the alignment of watermain to preserve the integrity of existing facilities shall be recommended to Chatham-Kent P.U.C. or designate to avoid the need for the replacement or reconstruction of existing facilities.

E.1.3.2 Excavations**E.1.3.2.1 Standard**

During the excavation process, all recommendations outline in the last version of the OPSS Standards 206, 501, 491, 401, 801, 802, 575, and in the following points shall be observed.

E.1.3.2.2 Trenching**E.1.3.2.2.1 Preliminary**

Any trenching labour shall not be initiated without the layout process described in **Section E.1.3.1**. In all cases, adequate staking shall be provided to establish acceptable horizontal and vertical control. Offsets shall be staked in the way that vertical and horizontal alignment may be checked by Chatham-Kent P.U.C. or designate. All survey notes and construction staking notes shall be entered into bound, hard cover field books that shall be made available to the Chatham-Kent P.U.C.'s supervisor or representative upon request.

E.1.3.2.2.2 Job Conditions

During the trenching process, excavations and trenches shall be maintained free from water in order to provide a firm subgrade. This condition shall facilitate the pipe installation process and avoid water entering into the pipe. The pipe to be installed shall not be used to do dewatering.

E.1.3.2.2.3 Sequencing

The pipe installation shall be done without exceeding the recommended length of installation. Chatham-Kent P.U.C. suggests a 10 m (30 ft) trench excavation length. This distance may change depending on the site specific conditions. In all cases, the backfilling shall be completed at the end of each day.

E.1.3.2.2.4 Precaution

Where excavation is a hazard to automotive or pedestrian traffic, the amount of open excavation and the time duration of that opening shall be minimized. In all conditions, the access to private residences and businesses shall be maintained.

E.1.3.2.2.5 Underground Obstructions

The location of all existing utilities shall be established prior to the trenching process. However, in the case of encountering underground obstructions related with other service connections, the information shall be recorded in the field book and in the construction drawing to be used during the "As Constructed" drawing process. If an underground obstruction is so that continuation of the work is not possible, authorization to modify the design shall be obtained from Chatham-Kent P.U.C.'s supervisor or representative and a temporary suspension shall be obtained until the design is upgraded.

E.1.3.2.2.6 Protective Measures

Adequate protection and support shall be provided to existing utilities, appurtenances, and structures during the construction and the backfilling and compacting process. Trench side slopes shall conform to the requirements of the Occupational Health and Safety Act (OHSA). All personnel involved during the trenching process shall follow the OHSA safety recommendations.

E.1.3.2.2.7 Weather

Pipe bedding or pipe shall not be installed on frozen soil in trenches.

E.1.3.2.2.8 Topsoil

Topsoil shall be stripped from areas which are to be disturbed by construction and stockpiled. Topsoil shall be segregated from non-organic trench material and debris and shall be stockpiled at the location approved by Chatham-Kent P.U.C. or representative.

E.1.3.2.2.9 Method of Trenching.

The trenching process shall be made by open cut methods, except where boring or tunnelling method is specified by Chatham-Kent P.U.C. or representative. Mechanical equipment shall be suitable for the depth, soil type and type of trench required. Mechanical equipment shall not be used in locations where damage can occur to trees, buildings, culverts, or other property utilities or structures. In these situations hand excavation method shall be used.

E.1.3.2.2.10 Rock During Excavation

If an area of rock is identified during the trenching process, a minimum of 150 mm (6 inches) shall be over-excavated below the bottom of the pipe to allow an extra backfilling with granular material. In all cases, when unstable material is encountered on the bottom of the trench, an over excavation shall be made to a depth suitable for construction of a stable subgrade by using granular material, or any other material recommended in the geotechnical investigation. A layer of geotextile fabric shall be placed between the stabilization material and the bedding material.

E.1.3.2.2.11 Preparation of Trench Bottom

The bottom of the trench shall be uniformly graded to provide clearance for each pipe section. Before a firm subgrade for application of bedding material is provided, all loose materials, water and foreign objects shall be removed.

E.1.3.2.2.12 Stockpiling Excavated Materials

Suitable material for backfilling shall be piled in an orderly manner and sufficient distance from banks of trench to avoid overloading and to prevent slides. Excess excavated material not suitable or not required for backfilling shall be adequately disposed of in accordance OPSS 180 and MOECP Excess Soil Management Regulation (effective January 2020). Excavated material shall not be stockpiled against existing structure or appurtenances.

E.1.3.2.2.13 Minimum Cover

For water distribution and transmission lines, the minimum cover shall be 1.5m from grade to the top of pipe. In all cases, the depth of trench shall be as established in construction drawings.

E.1.3.2.2.14 Trench Widths

Trench width shall be maintained to within the tolerance specified on construction drawings or by Chatham-Kent P.U.C. The trench wall shall not be undercut in order to obtain clearance. The minimum clear width of trench measured at the spring line of the pipe is generally specified as at least 300 mm (one foot) greater than the outside diameter of the pipe to enable backfill material to be installed in the haunching area. Where embedment compaction is required, the trench shall be wide enough to accommodate the compaction equipment.

If minimum trench width is exceeded, and embedment compaction is required, pipe zone haunching shall be compacted to a point at least one pipe diameter from the pipe on both sides of the pipe. For clarification, the CKPUCSD titled "Bedding and Backfill Detail" shall be consulted.

E.1.3.2.3 Jacking and Boring

E.1.3.2.3.1 Standard

Jacking and boring method shall be according to OPSS Standard 416.

E.1.3.2.3.2 Submittal

A plan for Chatham-Kent P.U.C. approval shall be submitted before the jacking and boring procedure start. The plan shall show the proposed procedure of handling, including design for the jacking head, jacking support, or backstop; arrangement and position of jacks, pipes, guides etc.

E.1.3.2.3.3 Precautions

Care shall be taken to clearly define in the jacking and boring plan considerations related with protection of roadbed by means of location of pits, tolerances, materials and equipment, and any other important consideration to be taken in account.

E.1.3.2.4 Horizontal Directional Drilling

E.1.3.2.4.1 Standard

Horizontal directional drilling shall be performed according to OPSS.MUNI 450 and all following subsections.

E.1.3.2.4.2 Permits

Before the drilling process, requirements from environment agencies shall be obtained.

E.1.3.2.4.3 Precautions

During the drilling process, the surrounding area of the rig equipment shall be adequately protected from people by using safety signs and light. All personnel working in the vicinity of the rig area shall be wearing the personal protection equipment in accordance with the OHSA regulations.

E.1.3.3 Dewatering

E.1.3.3.1 Standard

Dewatering process shall be performed in accordance with OPSS Standard 517. If the project is expected to encounter an aquifer, or if during the trench process, a site producing more than 50,000 litres per day is encountered, a Permit to Take Water (PTTW) shall be obtained from the Ministry of the Environment, Conservation & Parks.

E.1.3.3.2 Safety Precaution

In all cases, during the dewatering process, regulations of the Occupational Health and Safety Act shall be followed. If PVC pipe will be installed, the AWWA Manual M23 Chapter 7 shall be taken in account. In cases of installing Ductile Iron Pipe, the AWWA Manual 41 Chapter 11 shall be taken in account.

E.1.3.3.3 Pumping

All excavations shall be at all times kept free from water. Dams and other works necessary for this purpose shall be built and kept in operation on the work. If necessary, a pump or pumps of sufficient capacity for the dewatering purpose shall be provided. Under extreme conditions, when excessive water is seeping into the excavation further methods shall be used to control the ground water if authorization has been previously obtained from Chatham-Kent P.U.C.

E.1.3.3.4 Disposal

Disposal of water removed from the excavation shall be provided in such a manner, as shall not be a danger to public health, private property, or to any portions of the work completed or under construction. Special care shall be taken to ensure that all surfaces of streets to be used by the public are free of impediments.

E.1.3.3.5 Leakage

If during the trenching process a leakage from existing sewers, watermains or drains is encountered, it shall be reported immediately to Chatham-Kent P.U.C.

E.1.3.3.6 Flow Control

Gutters shall be kept open at all times for surface drainage and no damming or ponding of water in gutters or other waterways will be allowed. Any flow shall not be directed across or over pavements except through approved pipes or properly constructed troughs.

E.1.3.4 Backfilling and Compacting**E.1.3.4.1 Standard**

The backfilling and compacting process shall be according to the OPSS Standard 401.

E.1.3.4.2 Backfilling**E.1.3.4.2.1 General Considerations**

The following (but not limited to those) general considerations shall be taken in account during the backfilling process.

- Trench shall be promptly backfilled after completion of pipe bedding.
- Deposit backfill material in uniform layers not exceeding 200 mm (8 inches) in uncompacted thickness.
- Use methods and equipment appropriate for the backfill material. Do not use equipment or methods that will transmit damaging shocks to the pipe.
- Do not perform compaction by jetting or water settling.
- Import material for trench backfill if compaction cannot be obtained with job excavated material or if Chatham-Kent P.U.C. does not approve the use of the excavated material.
- Rock and bedrock encountered in the excavation shall be separated from other excavated material and disposed in an appropriated place.
- Replace topsoil after construction and grading to the depth of stripping over all areas disturbed by construction operations and which will not receive other surface treatment.
- Chatham-Kent P.U.C. shall receive a copy of the disposal permit obtained for disposal of excavated rock and bedrock material, excess excavated materials, and material not suitable for backfilling.

E.1.3.4.2.1.1 Precaution

Backfill shall be considered as starting at 225 mm over the pipe. All materials below this point shall be considered as bedding.

E.1.3.4.2.1.2 Backfilling Around Chambers

Backfill for structures such as valve chambers shall start at the subgrade for the structure and shall be brought up simultaneously and equally on all sides of the structure.

E.1.3.4.2.1.3 Interruptions During Backfilling

If the backfilling process has to be interrupted for long periods, (Working day ending, weekends, etc.) care shall be taken to cover the pipe with a minimum of one-meter fill. The last 1.5 metres of pipe shall be uncovered to avoid backfill material entering to the pipe. Care shall be taken to close the open end of the pipe so that no trench water, earth, or other substances will enter the pipe.

E.1.3.4.2.1.4 Stones

Where stones are included in the backfill, they shall be mixed with suitable material so as to eliminate voids.

E.1.3.4.2.1.5 Boulders

Where it has become necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, the voids remaining shall be backfilled with the material specified by the design engineer.

E.1.3.4.2.1.6 Miscellaneous

All backfill shall be approved earth. If suitable backfill material is not available in sufficient quantity on site, Chatham-Kent P.U.C. will order to import backfill material that shall be pit run gravel as specified elsewhere or similarly approved granular material. In all cases, the backfilling material shall comply with Part D, Section D.10.

E.1.3.4.2.2 Compacting and Field Quality

E.1.3.4.2.2.1 Minimum layer height

A 225 mm layer of cover material shall be provided above the pipe before using a mechanical compactor on top of the pipe.

E.1.3.4.2.2.2 Compacting Procedure

Unless otherwise specified or approved by Chatham-Kent P.U.C. all earth fill shall be placed and compacted using the 150 mm Layer Compaction Method. The fill material shall be spread in uniform full width layers not more than 200 mm (8 inches) in depth. All stones over 150 mm shall be removed and disposed of. All materials shall be compacted to appropriate percentage of maximum dry density specified in Part F: Standard Drawings and ASTM Designation D 698.

E.1.3.4.2.2.3 Equipment

Compaction shall be carried out using approved compacting equipment to obtain the required degree of compaction. When field tests indicate that the required degree of compaction is not being obtained with the equipment in use or with the procedure being followed, compaction process shall be halted until the Chatham-Kent P.U.C.'s supervisor or designate is satisfied with changes in the procedure and equipment to produce the required results.

E.1.3.4.2.2.4 Field Compaction / Moisture Control

Field quality control compaction tests shall be conducted to determine compliance of compaction methods with specified density in accordance with ASTM D 2922.

E.1.3.4.2.2.5 Minimum Density

Compaction shall be to the following minimum densities, reference ASTM D698 or AASHTO T99 Method A, unless otherwise indicated by Chatham-Kent P.U.C.

- Ground water barrier material: 95%
- Pipe bedding: Compacted granular material: 100% (ASTM D4253, D4254)
- Under footings, foundations or structures: 100%
- Seeded areas: 95%
- All other locations: 95%

Do not compact topsoil.

E.1.3.4.2.2.6 Moisture Content

The following points shall be taken into consideration.

- If the material moisture content is not high enough to achieve the required density then water shall be applied by means of an approved distributor.
- When the material moisture content is considered too high, dry material shall be incorporated and the resulting materials thoroughly mixed; alternatively, the wet material shall be dried by blading, dicing or other approved methods. Water shall be added to the material, or the material shall be harrowed, diced, bladed, or otherwise worked to insure uniform moisture content, as specified.
- All compacted backfill shall be within 2% (+/-) of the optimum moisture content of the soil as determined by AASHTO T99 or ASTM D698.
- Moisture/density tests shall be performed at a depth of 600 mm (24 inches) above the top of the pipe bedding and in 600 mm (24 inches) increments up to the final grade, or as determined by Chatham-Kent P.U.C.
- Moisture/density tests shall be performed at a minimum of 60.0 metres (200 ft), as measured along the center line of the pipe, or as determined by Chatham-Kent P.U.C.
- Water services shall have a minimum of one density test per service.
- Sanitary sewer services shall have a minimum of two density tests per service or as Chatham-Kent P.U.C. determines.

- Moisture/density tests in the vicinity of vaults, valve boxes, and maintenance holes shall be performed at a minimum of 304 mm (12 inches) away from the vault/maintenance hole sections or valve box. Tests shall be performed in random directions from the vault, maintenance hole, or valve box, on separate lifts. A minimum of one (1) test shall be performed, on opposite sides of the structure, for every 600 mm (2 ft) of backfill material.
- Quality control moisture/density tests are the responsibility of the Contractor and shall be performed by a private Geotechnical Consultant.

E.1.3.4.2.2.7 Precaution.

Backfilling and compacting shall not be permitted if the required information for “As Constructed” drawings has not been taken and registered in the construction drawings, or in the field book and in the daily work record.

E.1.4 POST-CONSTRUCTION STAGE

E.1.4.1 Reconstruction of Existing Facilities

E.1.4.1.1 Scope

This section covers the requirements to reconstruct existing facilities including, but not limited to, culverts, mailboxes, signs, guiderails, catch basins, tile drains, sewers, and any other existing facility, service, or structure damage as a result of construction activity.

E.1.4.1.2 Standard

Reconstructions of existing facilities shall be made according to the OPSS Standards 491, 517, 721, 441, and 1010, as well as the following subsections.

E.1.4.1.3 Material

Material used for reconstruction of any existing facility, service, or structure damage during the construction stage shall be in accordance with Part D: Materials Specifications. If the material comprising the utility is in condition to be reused, it shall be handled with care, cleaned, salvaged in order to be inspected and approved by the Road or Drainage Authority previously to the reconstruction or reinstallation process. In all cases, the material used to reconstruct or reinstall the facility shall match existing.

E.1.4.1.4 Culverts

Culverts shall be reconstructed to match existing, according to OPSS 421. Where pipe extends across alignment of culvert, the portion of culvert disturbed shall be replaced with a suitable sized length and size of material to match. Recommendations by Road or Drainage Authority shall be followed.

E.1.4.1.5 Mailboxes and Signs

Mailboxes and signs shall be replaced or reinstalled in accordance with the OPSS Standard 491. Any existing street signs, or mailboxes removed during the construction process to accommodate construction shall be reinstalled according to the standard of the Road Authority having jurisdiction in the site of work.

E.1.4.1.6 Catch Basins

Reconstruction process of catch basins shall be made according to the OPSS Standard 402. The final elevation and location of the reconstructed catch basins shall be the same as encountered initially unless otherwise directed by the Road Authority having jurisdiction in the site of work.

E.1.4.1.7 Any Other Existing Facility, Service, or Structure

Any other existing facility, service, or structure removed or damage during the construction stage shall be reconstructed according to the OPSS Standard 402. The material used in the reconstruction process shall be in accordance with the OPSS Standard 1010. The appearance, location, and physical configuration shall be the same as encountered initially unless otherwise approved by the Road Authority having jurisdiction in the work site. The reconstruction process shall be initiated once the field-testing procedure is finished and the Chatham-Kent P.U.C. supervisor or designate has given authorization.

E.1.4.2 Reconstruction of Surfaces**E.1.4.2.1 Pavement Surfaces****E.1.4.2.1.1 Standards**

Reconstruction process of any pavement surface shall be according to the OPSS Standard 313, 1003, 310, 314, 360, and 507.

E.1.4.2.1.2 Existing Concrete

Existing concrete pavements, curbs, sidewalks or driveways removed in connections with construction shall be replaced or reconstructed to neatly sawed edges. Dimension and other specifications of curbs, sidewalk, and driveways shall be preserved.

E.1.4.2.1.3 Saw Cuts

Saw cuts shall be a minimum depth of 40 mm (1-1/2 inches) in concrete pavement or driveways and to a minimum of 25 mm (one inch) in concrete sidewalks. If a saw cut in pavement falls within 1.0 meter of a construction joint, cold joint, expansion joint, or edge, the concrete shall be removed and replaced to the joint edge.

E.1.4.2.1.4 Bituminous Pavement

The portion of bituminous pavements disturbed in connection with construction shall be removed to clean vertical faces along straight lines and replaced. Specifications about bituminous pavements shall be as per the Road Authority having jurisdiction in the site of work.

E.1.4.2.1.5 Aggregates

Material required for reconstructing the base, subbase or subgrade shall be in accordance with OPSS Standard 1010.

E.1.4.2.1.6 Specifications

During the reconstruction process, care shall be taken to comply with all specifications concerning to type of granular material, compaction, kind of pavement material, depth of pavement and granular material, joints used between existing and reconstructed pavement, and any other component not included in this subsection.

E.1.4.2.2 Non-Pavement Surfaces**E.1.4.2.2.1 Unpaved Roadways**

All unpaved roadways shall be restored in accordance with the OPSS Standard 313, 1003.

E.1.4.2.2.2 Grassed Areas

All grass restoration shall be made according to OPSS Standards 206 and 804.

E.1.4.2.2.3 Gravel Surfaces

All gravel surfaces disturbed during construction shall be restored to the minimum conditions encountered before the construction. In cases where the width of salvaged road surfaces is less than two meters between surface excavation and edge of road, the existing road base shall be removed and reinstated with new material. Recommendations from the Road Authority are strongly recommended

E.1.4.2.2.4 Topsoil

The topsoil used for restoration shall be free of stones, roots and branches over 32 mm diameter and shall be fertile, friable natural loam containing 2% or more organic matter. In all cases, condition of topsoil in terms of soluble salt content, organic matter content, and the kind of fertilizer required before the restoration process begins shall be obtained from the Road Authority having jurisdiction in the site of work.

E.1.4.2.2.5 Turf Areas

All turf areas shall be restored with Canada Certified No. 1 grade seed in accordance with the Seed Act of Canada unless otherwise recommended by Chatham-Kent P.U.C. Areas to be seeded shall be covered with topsoil evenly spread over subgrade and loosely compacted to 100 mm depth.

E.1.4.2.2.6 General Precautions

In all cases of non pavement surface restorations, care shall be taken to ensure a finishing surface free of depressions and irregularities, and firm against deep footprints.

E.2 WATERMAINS**E.2.1 GENERAL****E.2.1.1 Scope**

This section addresses the installation of PVC or high density polyethylene pipe and fittings up to 900 mm (36 inches) or less according to Chatham-Kent P.U.C. parameters. The OPSS Standard 441 and AWWA Standard C605 shall be applied. For pipe more than 900 mm (36 inches) in diameter and different materials such as Ductile Iron or Concrete Pressure Pipe, the specification to be applied shall be AWWA Standard C600, AWWA Standard C104, C105, or C110.

E.2.1.2 Specifications

The Polyethylene's or PVC pipe's characteristics in terms of diameter, thickness, vertical and horizontal alignments, constructive details, and all required information shall be as recommended in this manual and as defined by the design engineer in plans, specifications, and details.

E.2.1.3 Material Conditions

Precautions shall be taken to protect the interior of pipes, fittings, and valves against contaminants. Plugs shall be installed in unfinished pipeline when pipe laying is stopped at the close of a day's work or for other reasons such as rest breaks or meal periods. Debris, tools, or clothing shall not be placed in the pipe.

E.2.1.4 Trench Conditions

Provide higher class bedding where unexpected trench conditions are encountered. Distribute grade and compact bedding material to provide uniform and continuous support beneath the pipe at all points between bells and pipe joints. In all cases **Section E.1.3.2.2** shall be taken in account.

E.2.2 PVC PIPE AND FITTINGS**E.2.2.1 Standard**

The installation of PVC pipe must be governed by the following standards:

- AWWA Standard C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- AWWA Standard C900 Polyvinyl Chloride (PVC) Pressure pipe and Fabricated Fittings in 4 in. to 12 in. for Water Distributions.
- AWWA Standard C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350 mm through 1200 mm) for Transmission and Distribution.
- OPSS Standard 441 Construction Specification for Watermain Installation in Open Cut.
- OPSS Standard 401 Construction Specification for Pipe Sewer Installation in Open Cut.
- OPSS-General Conditions Standard G.C. 5.0 Material.

E.2.2.2 Product Delivery, Storage, and Handling

Polyvinyl chloride pipes have reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care shall be taken in handling and installing PVC pipe during cold weather. In general:

- Do not drop pipes or fittings including dropping on cushions
- Do not use hooks
- Use wide fabric choker sling
- Do not expose any pipe or fitting to an impact, bending, compression, or abrasion
- Pipe shall be stored according to the manufacturer's specifications
- Pipe shall be stored on a surface which provides even support for pipe barrel and shall not be stored in such way as to be supported by the pipe bell
- Do not use any pipe or fitting that has any damage from inadequate handling or storage
- Store and use lubricants in a manner that will be void of contamination
- Store loose rubber gaskets in a cool, dark location away from grease and oil, or any possible deterioration
- Care must be taken to prevent any possible damage to the pipes, rubber gaskets or lubricant during pre-construction and construction stages

E.2.2.3 Material

PVC pipe, fittings, and accessories shall be made of material and type indicated in drawings, and those shall conform to the quality and type specified in Part B: Design Guidelines for Water, Part C: Design Guidelines for Sewers, and Part D: Materials Specifications. If not designated, the information shall be obtained from Chatham-Kent P.U.C. In all cases, each pipe shall be stamped or indelibly marked with its type and class and the manufacture's name or mark. Gasket to join PVC pipe shall be the push-on type according to the AWWA Standard C900 and C907.

E.2.2.4 Bedding

PVC pipe bedding shall be according to the drawings and specifications in **Section E.1.3.2.2** and **Section E.1.3.4**.

E.2.2.5 Lowering the Pipe

Place the pipe and fittings into the trench using rope and skids if necessary, slings on the backhoe bucket, or by hand.

E.2.2.6 Cutting

PVC pipe shall be cut by using a handsaw for small diameter pipe or power driven abrasive disc for diameters bigger than 600 mm (24 inches). The cut edge shall be made a square cut. The end of the pipe shall be bevelled with a wood rasp for small diameter or with a bevelling tool for bigger diameters. All burrs shall be removed and dust shall be wiped from the jointing surfaces.

E.2.2.7 Assembly

PVC pipe installation, including trenching, bedding, backfill, and compaction, shall be done in accordance with the Drawings and with **Sections E.1.3.2** and **E.1.3.4**. Pipe shall be joined in accordance with manufacturer's recommendations and as specified below:

- Where practicable, begin at lowest point of proposed pipeline; lay with bell end or receiving groove edge upstream in direction of laying.
- Pipe shall be laid immediately following the trench preparation and bedding and of the approved plans.
- Exercise care when handling pipe. Ropes, nylon slings, or other devices shall be used for lowering pipe into trench.
- Only pipe that is suitable for use shall remain on site. Damaged or broken pipe shall be separated from acceptable pipe.
- Lay pipe uniformly to line and grade on a prepared bed providing even support along entire barrel. Excavate bell holes in bedding material so pipe will rest on barrel and not on bell. As work progresses, interior of pipeline shall be cleared of dirt and debris.
- Do not lay pipe where water is above bedding material except where Chatham-Kent P.U.C.'s supervisor determines that foundation is stable, pipe will not be displaced upward, and joint construction will not be affected by water.

- Rubber-type gasket joint shall be made using adequate lubricant. Groove in spigot shall be lubricated before setting gasket. Prior to connecting pipe joints, all surface of the joint shall be clean, dry, and completely free of dirt. When final grade is achieved, the joint shall be carefully pushed home using approved methods of leverage.
- Seating of the gasket shall be checked around the entire circumference of the pipe by visual and feeler gauge inspection.
- At all pipe crossings provide and install watertight external gasket joint sealant a minimum of 3.0 m (10-feet) to each side of the pipe crossing or at two (2) pipe joints, whichever is greater. Follow manufacturer's installation specifications.
- Each pipe shall be bedded by hand or by equally careful means to 300 mm (12 inches) cover before laying subsequent pipes. Space between pipe and trench wall shall be manually filled and compacted in 150 mm (6 inches) layers. Pipe sizes larger than 380 mm (15 inches) diameter may require mechanical compaction of bedding material.
- Pipe shall be laid with straight alignment between adjacent maintenance holes and/or inlets.
- A tracer wire consisting of #10 AWG TWH solid copper with plastic coat shall be laid along with the pipe in the trench and strapped to the top of the pipe with tape at intervals not exceeding 6 meters.
- When work is not in progress, ends of pipe fittings shall be closed so that no trench water, earth, or other substances will enter pipe.

E.2.2.8 Thrust Restraint

In each dead end, valve, bend, T-connector, and unrestrained hydrant a thrust restraint shall be installed in accordance with the AWWA Standard C605. Thrust blocks, where specified, shall be in accordance with OPSD 1103.010.

E.2.2.9 Precautions

Where PVC pressure pipe is to be connected to existing cast iron or ductile iron main, the spigot end of the PVC pipe shall not be inserted directly into the iron push-fit bell. The bell end of the iron pipe shall be neatly cut off and the connection effected by using a mechanical joint sleeve.

- Plugs at the ends of pressurized mains shall be secured by restraining rings, in addition to thrust blocking.

E.2.2.10 Field Quality Control

For quality control purpose, the **Section E.3.5** shall be observed.

E.2.2.11 Backfilling

Reference **Section E.1.3.4** Backfilling and Compacting.

E.2.3 HIGH DENSITY POLYETHYLENE (HDPE)

E.2.3.1 Standard

Standard used for the material shall be ASTM D 3350. Manufacturing process shall be according to AWWA Standard C901 for sizes 12 mm (1/2 inch) through 75 mm (3 inches), and AWWA Standard C906 for sizes 100 mm (4 inches) through 600 mm (24 inches). The following standards shall be applied for installation:

- ASTM D 3350 Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
- ASTM D 3261 Butt Fusion Polyethylene (PE) Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

E.2.3.2 Product Delivery, Storage, and Handling

When lifting with slings, use only wide fabric choker slings capable of safely carrying the load. Wire rope or chains shall not be used.

E.2.3.3 Material

High density polyethylene (HDPE) pipe, fittings, and accessories shall be of material and type indicated in drawings and shall conform to the quality and type specified in Part B: Design Guidelines for Water, Part C: Design Guidelines for Sewer, and Part D: Materials Specifications. If not designated, the information shall be obtained from Chatham-Kent P.U.C.

E.2.3.4 Trenching

Trench excavations shall conform to the plans and drawings and in accordance with applicable codes. Where necessary, trench walls shall be shored or reinforced and all necessary precautions shall be taken to ensure a safe working environment.

E.2.3.5 Trace Wire

A tracer wire consisting of #10 AWG TWH solid copper with plastic coat shall be laid along with the pipe in the trench and strapped to the top of the pipe with tape at intervals not exceeding 6 meters.

E.2.3.6 Bedding

Pipe shall be laid on a stable foundation consisting of 150 mm (6 inches) thick bedding of compacted Class I material. Excess groundwater shall be removed from the trench before bedding the pipe.

E.2.3.7 Heat Fusion Joining

Joints between plain end pipes and fittings shall be made by butt fusion, and joints between the main and saddle branch fittings, if applied, shall be saddle fusion using only procedures that are recommended by the pipe and fitting manufacturer. External and internal beads shall not be removed. Personnel making heat fusion joints shall be trained in the manufacturer's recommended procedure no less than 12 months before commencing construction.

E.2.3.8 Thrust Restraints

Flanged connections shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the flanged connection will cause the pipe to yield. External joint restraints shall not be used.

E.2.3.9 Flanged Connections

Polyethylene pipe and fittings may be joined together or to other materials by means of flanged connections (flange adapters and back-up rings). Flanged connections shall be installed in accordance with the manufacturer's recommended procedures. Flange faces shall be centered and aligned to each other before assembling and tightening bolts. In no case shall the flange bolts be used to draw the flanges into alignment. Bolt threads shall be lubricated, and flat washers shall be fitted under the flange nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the manufacturer. At least one hour after initial assembly, flange connections shall be re-tightened following the tightening pattern and torque step recommendations of the manufacturer.

E.2.3.10 Butt Fusion Testing

Each day that butt fusions are to be made, the first butt fusion joint of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely then fusion test straps shall be cut out. The test strap shall be 300 mm (12 inches) minimum or 30 times the wall thickness in length with the fusion in the center and 25 mm (one inch) minimum or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled, and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.

E.2.3.11 Pressure Testing

Pressure testing shall be conducted in accordance with the manufacturer's recommendations. Pressure testing shall be by hydrostatic method, pneumatic pressure testing will not be allowed.

E.2.3.12 Backfilling

Pipe embedment backfill shall be Class I or II material placed and compacted to at least 90 percent Standard Proctor Density in 150 mm (6 inches) lifts to at least 150 mm (6 inches) above the pipe crown. Final backfill shall be placed and compacted to finished grade in 150 mm (6 inches) lifts. Native soil without debris, stones, boulders, clumps, frozen clods, or the like larger than 200 mm (8 inches) in their largest dimension may be used.

E.2.4 CONCRETE PRESSURE PIPE

Not included in this manual.

E.2.5 DUCTILE IRON PIPE AND FITTINGS**E.2.5.1 General****E.2.5.1.1 Scope.**

This section is a minimum guideline only for furnishing and installation of ductile iron pipe (D.I.) and fittings in valve chambers and inside buildings.

E.2.5.1.2 Use

According to the scope of this section, Chatham-Kent shall approve any other use of ductile iron pipe. Special design considerations shall be taken to ensure compliance with the Chatham-Kent water system and design specifications. Ductile iron pipe characteristics shall be defined according to AWWA Standard C104. Fittings shall be defined and used according to the AWWA Standard C105.

E.2.5.1.3 Materials

Materials and other specifications related with manufacturing of ductile iron pipe and fittings shall be according to Part D Materials Specifications.

E.2.5.1.4 Mechanical Coupling

All mechanical couplings shall be of a gasketed sleeve type. Tolerance on pipe and coupling shall be sufficient to ensure permanent water tight joints under all conditions.

E.2.5.1.5 Fittings

All ductile iron fittings shall be installed according to AWWA Standard C110 or Standard C153. Ductile iron fittings shall be furnished with Push-on or Mechanical type joints according to AWWA Standard C 111.

E.2.5.1.6 Grounding

All ductile iron fittings and appurtenance shall be provided with a ground connection by using the wire specified by the design engineer or by Chatham-Kent P.U.C.

E.2.5.1.7 Inspection

Any pipe section or fitting shall not have cracks, flaws, broken or loose lining, dents, abrasions, or other defect. Any defective section pipe or fitting shall be marked and removed from the site.

E.2.5.1.8 Cutting Pipe

All ductile iron pipe sections shall be cut smoothly, straight and at right angles to the pipe axis. An abrasive wheel for ductile iron pipe shall be used. All debris shall be removed from the pipe edge. Oxyacetylene shall not be used to cut ductile iron pipe. For push-on joints, the cut end shall be bevelled. Push-on joints shall be used for buried pipe except where indicated elsewhere on the drawings.

E.2.5.1.9 General Recommendations for Installation

Installation of any section of ductile iron pipe and fittings shall be made according to AWWA Manual M41. The following general recommendations for installations of ductile iron pipe and fittings shall be complemented with all recommendation for installation and testing contained in the AWWA Standard C600.

- All joints shall be watertight and free from leaks.
- If required, use Mega-Lug, or approved equivalent, retainer glands on all exposed mechanical joints for restraint.
- Block, anchor, or harness all mechanical couplings, push-on or mechanical joints.
- In each dead end, valve, bend, T-connector, and unrestrained hydrant a thrust restraint shall be installed in accordance with the AWWA Standard C600. Thrust blocks, where specified, shall be in accordance with OPSS 1103.010.

E.2.5.1.10 Joint Installation

For joint installation, the following general recommendations shall be followed complementary to the instruction in the Appendix B of the AWWA Standard C111.

E.2.5.1.11 Push-on Joints

- Clean the inside of the bell and the outside of the spigot to remove dirt, oil, excess coating and other foreign matter.
- Insert the gasket.
- Apply a thin film of lubricant to either the inside surface of the gasket, the spigot end of the pipe or both.
- Do not permit the joint surfaces to enter in contact with the ground.

E.2.5.1.12 Mechanical Joints

- Remove all dirt, oil, grit, excess coating and other foreign matter from the inside of the bell and the outside of the spigot.
- Apply a thin film of lubricant to the inside of the bell, the outside of the spigot and the gasket.
- Tighten nuts alternately on opposite sides of the pipe to produce equal pressure on all parts of the gland.
- Use a torque-limiting wrench with torques as shown in the AWWA Standard C600.

E.2.5.1.13 FLANGED JOINTS

- Extend pipe completely through screwed-on flanges.
- Machine finish the pipe end and flange face in a single operation.
- Do not assemble mechanical connections until all flanged joints affected thereby have been tightened.
- Alternately tighten bolts spaced on opposite sides of the pipe to assure uniform gasket compression.
- All bolts in flange joints shall have the specified torque as stated in Standard AWWA C115.

E.2.5.1.14 Cathodic Protection For Ductile Iron Pipe

E.2.5.1.14.1 Standard

Cathodic protection shall be according to OPSS 702.

E.2.5.1.14.2 Scope

This section is a minimum guideline for furnishing ductile iron pipe and fittings in valve chambers or inside buildings. During the installation of ductile iron pipe and fittings in valve chambers or inside buildings, at least the following requirements shall be taken in consideration to ensure adequate cathodic protection.

- Installation of magnesium anodes
- Fabrication and installation of bond straps
- Supply and installation of test leads
- Installation of test stations

E.2.5.1.15 Electrical Bonding

E.2.5.1.15.1 Requirements

During the electrical bonding, the following considerations shall be taken in account:

- All ductile iron pipe, joints, and fittings shall be electrically bonded.
- Ductile iron pipe, joints, and fittings shall not be bonded to the existing system.
- Electrical bonding of pipe, fittings, and joints shall be carried out by using one of the following methods:
 - Conductivity Straps: Where pipe is supplied with bonding straps, tabs shall be connected with a copper strap that shall be 189 mm long and bolted to the tabs with 8 mm x 26 mm silicon bronze bolts tightened to a minimum of 20 kPa.
 - Conductivity Screws: Where pipe is supplied with conductivity screws, each joint shall have two 26 mm long special alloy set screw inserted into tab lugs projecting from the face of the bell. After insertion of the spigot into the bell and after final settlements of the pipe, the setscrews shall be tightened alternately with a minimum of 20 kPa.
 - Conductivity Wedges: Where conductivity wedges are supplied, four wedges shall be installed at each joint. These wedges shall be driven with a hammer and connected to the bell with nails, supplied with wedges.
 - Bonding Cables: Where fittings or pipe is not supplied with the foregoing continuity facilities, the joints and fittings shall be bonded electrically with a bond cable across each joint or fitting.
 - Material of Bond Cables: Bond cables shall be fabricated using recommended product as per #CAS05F from Erico Products Inc. In all cases, the cable shall be #1/0 AWG 19 strand copper TWU insulated. Bond cables after fabrications shall be welded or fitting to the pipe.

E.2.5.1.16 Magnesium Anodes

E.2.5.1.16.1 General

Unless otherwise specified, sacrificial magnesium anodes shall be used. The anodes shall be H-I alloy (AZ-63 or MIC) magnesium anodes of the weight shown on the approved drawings or as specified by the Chatham-Kent P.U.C.

E.2.5.1.16.2 Dimension

Dimension of magnesium anodes shall be according to the Part D: Materials Specifications.

E.2.5.1.16.3 Installation

During the installation inside of buildings, the packaged magnesium anode shall be installed on the ductile iron pipe at the following spacing:

- On the first joint of pipe installed. Thereafter at the following spacing:

PIPE DIAMETER (mm)	SPACING (metres)	SPACING IF WRAP* (metres)
100	34.5	69
150	22.5	45
200	16.5	33
250	13.5	27
300†	10.0	20
300‡	12.0	36

- The package magnesium anode shall be connected to a copper service using an approved brass-grounding clamp but in no cases shall the anode be moved more than 2.0 metres in order to facilitate the connection of the anode to the copper service piping.
- The anode lead shall be wrapped around the pipe and knotted prior to connecting the copper conductor to the ductile iron watermain.

E.2.5.1.17 Testing Cathodic Protection Systems**E.2.5.1.17.1 Survey**

Upon completion of the watermain installation, a cathodic protection survey of the cathodic protection system shall be undertaken by an N.A.C.E. accredited Corrosion Specialist or Senior Corrosion Technologist or their designated representative.

E.2.5.1.18 Protecting Metallic Fittings On Non-Metallic Pipe**E.2.5.1.18.1 Specifications**

The following anodes shall be installed:

- On all ductile or cast iron fittings such as “T”: “X”, and “Y” etc., one 4.0 kg (9 lb.) magnesium anode shall be installed on each fitting.
- On all hydrants one 7.7 kg (17 lb.) magnesium anode shall be installed on each hydrant and lateral valve. A single 14.5 kg (32 lb.) magnesium anode may be used if the hydrant and lateral valve are electrically connected.
- On all copper services, one 14.5 kg (32 lb.) magnesium anode complete with Thomas & Belts #3888 brass clamps shall be installed on each copper service.

* Wrap by using polyethylene.

† Included in a Residential location.

‡ Included in an Industrial location.

E.2.5.1.18.2 Miscellaneous.

Cathodic protection using magnesium anodes is not required on the metal fittings used on non-metallic service pipes.

E.2.6 HYDRANTS**E.2.6.1 General****E.2.6.1.1 Scope**

This section is a minimum guideline for furnishing a hydrant installation. All hydrants installed in the Municipality of Chatham-Kent must be a dry-barrel fire hydrant.

E.2.6.1.2 Standards

Standards applied in this section are ANSI/AWWA C502, Dry-Barrel Fire Hydrants; AWWA Manual M17; AWWA C-600, Appurtenances for Ductile Iron; OPSS and Ontario Building Code Standards.

E.2.6.1.3 Delivery, Storage, and Handling

Fire hydrants shall be handled, stored, and protected in such a manner as to prevent damage to materials, coatings, and finishes. All fittings and joints shall be kept free from dirt, oil, and grease. Fire hydrants and all appurtenances, including valves and piping, shall be examined for cracks, dents, abrasions, and other flaws prior to installation. Mark and remove defective material from the site.

E.2.6.1.4 Bends

Bends in fire hydrant leads will NOT be allowed unless site conditions warrant and with written approval of Chatham-Kent P.U.C.

E.2.6.1.5 Clearance

The minimum clearance from above ground obstructions to fire hydrants shall be as following:

- Behind 1.0 m
- Each Side 1.0 m
- Front clear to the curb line

E.2.6.1.6 Hydrant Installation

- All hydrants shall be installed in accordance to AWWA C-600, AWWA Manual M17, and the following criteria:
- All fire hydrants shall stand plumbed and be installed in accordance with OPSD 1105.010
- All hydrants shall be field staked for both vertical and horizontal location.
- All fire hydrants shall be connected to the watermain by a minimum 150 mm (6 inch) diameter branch line.
- An independent 150 mm (6 inches) valve shall be installed in the branch line and be restrained back to the main line tee by use of restrained joint pipe and mechanical joint restraints.

- All fire hydrants shall be supported on concrete blocks poured or placed against undisturbed soil.
- A concrete thrust block, with a minimum bearing area of 0.5 m² (4.5 square feet), shall be placed behind the hydrant shoe against undisturbed soil.
 - A sheet of eight (8) mil polyethylene film shall be placed between the hydrant shoe and concrete thrust block.
 - Clear stone shall be placed a minimum 150 mm (6 inches) above the hydrant shoe after the concrete thrust block is poured and has ample time to cure so the clear stone will not penetrate the concrete.
 - Hydrant drain holes shall remain free of obstructions.
- Fire hydrants that are placed in pavement shall maintain 12-inches of horizontal clearance between the concrete and the hydrant barrel. The space between the concrete and the barrel shall be filled with clear stone.

E.2.6.1.7 Colour Coding

In accordance with the Chatham-Kent P.U.C. by-law and Chatham-Kent Fire Service, the colour code of all municipal fire hydrants is as in **Table E.1**.

Table 1: Colour Coding for Hydrants

All yellow hydrant	200 mm (8 inches) main or large
All yellow hydrant with black bonnet and black caps	150 mm (6 inches) main
All yellow hydrant with red bonnet and red caps	100 mm (4 inches) main
Any hydrant with a blue band indicates no drain cocks	Rural and urban
Fluorescent orange	All "Rural Fill Hydrants"
Red	All privately owned hydrants

Hydrants shall be painted prior to shipment to the site with a high gloss exterior paint over a quick dry oxide primer and shall be painted on site at the end of construction before substantial performance is issued. Chatham-Kent P.U.C. must approve the quality of the paint.

E.2.6.1.8 Signs

A marker note shall be installed at the distance from the hydrant as shown Part F: Standard Drawings and according to Section B.4.1.9 in Part B.

E.2.6.1.9 Covering

As soon as possible after the hydrant has been installed and until the water distribution system is in service, the new hydrant shall be covered with a protective bag, suitable to the Chatham-Kent P.U.C. It must be securely fastened to the hydrant, indicating to the public, and the Fire Department, that the hydrant is not in service.

E.2.6.1.10 Use of Hydrants

Use of hydrant is not permitted unless approved by the Chatham-Kent P.U.C. General Manager.

E.2.6.1.11 Hydrants Taken Out of Service

Hydrants taken out of service for any reason must be immediately reported to the Chatham-Kent Fire Department and Chatham-Kent P.U.C. no hydrants, which are put into service, shall be taken out of service without the express written permission of the Chatham-Kent P.U.C.

E.2.6.1.12 Inspections

Chatham-Kent P.U.C. or designate shall schedule hydrant inspections for new and all hydrants directly or by contracting to a specialized inspection company.

E.2.6.1.13 Maintenance

Not included in this manual.

E.2.7 VALVES**E.2.7.1 General****E.2.7.1.1 Scope**

This section cover pressure regulation valves, gate valves, valve operators, valve boxes, air relief & vacuum-relief valves, butterfly valves, and appurtenances used for water distribution and transmission system of Chatham-Kent.

E.2.7.1.2 Standards

Standards applied in this section are as applicable:

- ANSI/AWWA C115, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray- Iron Threaded Flanges, latest revision.
- ANSI/AWWA C500, Metal-Seated Gate Valves for Water Supply Service, latest revision.
- ANSI/AWWA C504, Rubber-Seated Butterfly Valves, latest revision.
- ANSI/AWWA C509, Resilient-Seated Gate Valves for Water Supply Service, latest revision.
- ANSI/AWWA C512, Air - Release, Air/Vacuum, and Combination Air Valves for Waterworks Service, latest revision.
- ANSI/AWWA C550, Protective Epoxy Interior Coatings for Valves and Hydrants, latest revision.
- ANSI/AWWA C800, Underground Service Line Valves and Fittings, latest revision.

E.2.7.1.3 Product Delivery, Storage and Handling

Special precaution shall be taken to avoid material damage during delivery or storage. Store valves off the ground and away from materials that could contaminate the potable water system. Take precautions to keep joints and internal parts clean.

E.2.7.1.4 Size

All valves shall be the same size as the watermain pipe unless Chatham-Kent P.U.C. has given prior approval.

E.2.7.1.5 Flanged

Valves shall be either mechanical or flanged joint as required. Exposed locations shall use flanged joints, and buried locations shall use mechanical joints.

E.2.7.1.6 Installation

With the exception of tapping valves, flanged valves shall not be buried. Valves shall be installed in such a manner that the operation nut is perpendicular to the pipe. The joined valve shall be supported on concrete as shown in Part F: Standard Drawing.

E.2.7.1.7 Operating Nut on Buried Valves

The operating nut on buried valves shall be between 4 and 6 feet below the finished grade. If, in order to achieve the operating nut depth, it is necessary to use a riser stem, the riser shall be double pinned. The riser stem shall be a solid stem, coated to prevent corrosion.

E.2.7.1.8 Valve Boxes

For potable water, the word "WATER" shall be cast into the valve box lid.

E.2.7.1.9 Valve Boxes Installation

All buried valves shall be provided with a valve box, including fire hydrant valves, unless indicated otherwise on the approved drawing. During the installation process, special care shall be taken with:

- Installing the valve box so that no stress is transmitted to valve.
- Setting the valve box plumbed and directly over the valve's operation nut.
- Valve operators which are mounted to one side of the valve shall be located to the south or west of the valve.
- The soil around the valve box, which shall be carefully compacted around the barrel with hand equipment to minimize misalignment and settling of the backfill.

E.2.7.1.10 Cathodic Protection

The following cathodic protection shall be installed according to **Table E.2**.

Table 2: Cathodic Protection for Valves

WATERMAIN	DIAMETER	CATHODIC PROTECTION
Ferrous	300 mm or less	Every valve shall be protected by one packaged 14.5 Kg magnesium anode.
	Greater than 300	
Non ferrous	300 mm or less	5.5 Kg zinc anode in every valve
	Greater than 300	11.0 Kg zinc anode in every valve

E.2.7.1.11 Valve operation.

All valves shall be operated by the contractor in the presence of the Chatham-Kent P.U.C.'s supervisor prior to requesting system acceptance by Chatham-Kent P.U.C. Valves that have been accepted by Chatham-Kent P.U.C. shall be operated by Chatham-Kent P.U.C. or Chatham-Kent Public Works only.

E.2.7.2 Pressure Regulating Valves**E.2.7.2.1 General**

The requirement for Pressure regulation valves shall be reviewed with Chatham-Kent P.U.C. on a case-by-base basis.

E.2.7.3 Double Disk Gate Valves

Construction specification not included in this manual.

E.2.7.4 Resilient Seat Gate Valves**E.2.7.4.1 Stem Seals**

Stem seals shall be provided with two “O”-ring type stem in accordance with section 4.8 of AWWA Standard C509.

E.2.7.5 Butterfly Valves

Construction specification not included in this manual.

E.2.7.6 Air and Vacuum Relief Valves**E.2.7.6.1 Notation in Drawings**

The size of the air relief and vacuum valves shall be as noted in the approved construction drawings.

E.2.7.6.2 Taps

Taps for air relief and vacuum valves shall be made as indicated on the approved construction drawings, unless otherwise established by Chatham-Kent P.U.C.

E.2.7.6.3 Minimum Clearance

The minimum clearance from above ground obstructions to valves is 2.0 meters.

E.2.7.6.4 Utilization

Automatic air relief valves shall not be used in situations where flooding of the maintenance hole or chamber may occur. Air and Vacuum Release valves shall be utilised in watermains in situations where it is possible for air to accumulate or a vacuum to develop and an alternate means for release is not available (i.e. services or fire hydrants) to remove the air. The valves shall be located in accordance with best design practices. This generally includes supply watermains with localized high points, long stretches of flat or gently sloping watermains or at changes in grade. In general, Air and Vacuum Release Valves shall be of the combination configuration. The sole use of either an air release or vacuum release valve must be dictated by the situation and approved by Chatham-Kent P.U.C.

E.2.7.6.5 Restrictions

Watermains servicing adjacent lots generally do not require air and vacuum release valves because air can escape or enter through the services. A blow-off or fire hydrant is an acceptable alternate means of air or vacuum release in temporary situations with the approval of Chatham-Kent P.U.C.

E.2.7.6.6 Location

Air release valves shall be placed at all significant high point in the transmission system, and shall be considered at high points in the water distribution system.

E.2.7.6.7 Air Relief Valve Piping

Automatic valves shall have an air relief pipe with an open end extended at least 300 mm (12 inches) above grade and provided with a 16 mesh screened, downward-facing elbow. A manually operated valve shall have an air relief pipe with an open end extended to the top of the pit.

E.2.7.6.8 Flooding

Automatic air relief valves shall not be used in situations where flooding of the maintenance hole or chamber may occur.

E.2.7.6.9 Ventilation

Air Relief and Vacuum Valves shall be installed in a well ventilated valve chamber. The ventilation pipe shall be stainless steel with a 180° “gooseneck” return elbow plus a #4 screen on the open end and shall be located at adequate distance and elevation measured from the chamber.

E.2.8 THRUST RESTRAINT**E.2.8.1 Mechanical Restraint Systems****E.2.8.1.1 General**

Mechanical thrust restraint systems shall be provided at all joint plugs, wyes, tees, crosses, bends which deflect 11¼ inches or more, reducers and valves and shall be designed to withstand the maximum operating pressure plus the transient pressure to which it will be subjected.

E.2.8.2 Concrete Thrust Blocks**E.2.8.2.1 General Considerations**

Where mechanical restraint systems are inadequate to resist thrust forces, concrete thrust blocks shall be used. The following general considerations shall be taken into account:

- Concrete thrust blocks and anchors for preventing movement shall be provided at all mechanical joint plugs, wyes, tees, crosses, bends which deflect 11¼ inches or more, reducers, and valves.
- The concrete thrust block bearing surface shall be excavated into undisturbed soil.
- All loose soil shall be disposed of, and the location where the thrust block is to be poured shall be carefully shaped to provide a uniform bearing surface of the required size.
- The concrete thrust block bottom shall be flat, and sides shall be vertical.
- If soil is to be disturbed, making a concrete thrust block or thrust anchor unusable, alternate restraining systems shall be considered prior to pipeline installation.
- The concrete thrust block shall be formed to provide access to fittings, valves, and hydrants.
- The concrete thrust block shall be extended from the fitting or valve to be blocked, to solid undisturbed earth.
- Concrete thrust blocks shall be constructed so that joints and drain holes are clear and accessible.
- Concrete shall be separated from fittings, valves, and hydrants by 8 mil polyethylene film.

- The Chatham-Kent P.U.C.'s supervisor shall be notified a minimum 24 hours prior to concrete being placed.

E.2.9 CHAMBERS

E.2.9.1 Drain Chambers

E.2.9.1.1 Utilization

Drain chambers are required where the normal methodology of watermain dewatering is not appropriate due to the watermain size or location. Watermains smaller than 450 mm (18 inches) will generally not require a drain chamber, however, a long downhill gradient without an isolation valve or fire hydrant for bulk draining may necessitate a drain chamber. With the written approval of Chatham-Kent P.U.C., a fire hydrant may be installed with the intention that the watermain will be drained with a hydrant barrel pump.

E.2.9.1.2 Location

Drain chambers must be located at the low points of the watermain profile. Consideration should be given to locating low points adjacent to appropriate discharge locations (i.e. near catch basin).

E.2.9.1.3 Precast Valve Chambers

Precast valve chambers shall be made of precast reinforced concrete, constructed to the dimensions as shown on approved drawings. They shall be supplied with a concrete flat top suitable to carry H20 traffic loading. Maintenance hole frames and covers shall be installed on all chambers. The frames shall be grouted into the top of the chamber to prevent displacement by traffic and to ensure water tightness.

E.2.9.1.4 Precaution

Chambers, pits or maintenance holes containing valves, blow-offs, meters, or other such appurtenances to a distribution system, shall not be connected directly to any storm drain or sanitary sewer. Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water, or to absorption pits underground (if soil conditions are suitable) at sites not subject to a seasonally high groundwater.

E.2.9.2 Swabbing Chambers

E.2.9.2.1 Utilization

Swabbing chambers shall be considered for watermains over 300 mm. Chatham-Kent P.U.C. shall be contacted to determine if a swab launching and/or swab retrieval chamber is required or is available nearby.

E.2.10 SERVICE CONNECTIONS

E.2.10.1 GENERAL

E.2.10.1.1 Scope

This section is a minimum guideline for furnishing and installing water service connections including corporation stops, service pipes, meters, and all appurtenances required.

E.2.10.1.2 Standards

For construction purpose and in accordance with Section D.4.1.1, the Standards applied in this section are:

- ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- ANSI/AWWA C700, Cold Water Meters - Displacement Type, Bronze Main Case.
- ANSI/AWWA C701, Cold Water Meters - Turbine Type, for Customer Service.
- ANSI/AWWA C800, Underground Service Line Valves and Fittings.

E.2.10.1.3 Delivery, Storage and Handling

Products shall be handled, stored, and protected in a manner that will prevent damage to materials, coatings, and finishes. All material shall be kept free from dirt, oil, and grease. All material shall be new.

E.2.10.1.4 Drawings

All specifications, details, and material specifications contained in drawings shall be followed during the construction process. A copy of the working drawings containing service connection details shall be located in an accessible place for supervision purposes.

E.2.10.1.5 Locations

Water services must be installed perpendicular to the road and/or the watermain wherever practical. Water services shall be located in a separate trench at least 2.5 metres from the sewer service, preferably on the uphill side of the sewer service, as referenced from the direction of flow of the sewer. (This location is based on a standard sewer service location in the middle of the lot.) If the sewer service should be located other than in the middle of the lot, the water service location will have to be reviewed and approved by Chatham-Kent P.U.C. If the driveway location of the lots is fixed before the water servicing is carried out, consideration will be given to locating the water service on the non-driveway side of the lot.

Water services shall be installed at least 2.5 metres (98 inches) from any structure (e.g. maintenance holes, catch basins, etc.). In the case where the main is not on the straight standard offset, or is on a bend, the length of the water service pipe from the curb stop to the main shall be noted during construction. On the "As Constructed" drawings, additional dimensional information shall be recorded as appropriate for future location of the service.

All water services shall be at a minimum depth of cover of 1.5 metres (60 inches) measured from the top of the pipe to the finished grade. The depth of the water service shall not exceed 2.0 metres (77 inches).

E.2.10.2 Installation of Water Service**E.2.10.2.1 Scope**

The installation process for service water connections using polyethylene shall be as follows. The installation process of a water service from ductile iron has not been included in this section.

E.2.10.2.2 Service Saddle

Service saddles shall be of the type and model listed in Part D, Table D.3 or shall be approved by Chatham-Kent P.U.C. The installation process shall be followed in accordance with good practices and the proper applicable procedure. The contractor shall ensure the complying of all the safety precaution from the OPSS and AWWA Standards. For PVC installation process, the contractor shall follow the procedure contained in the AWWA Standard 605 Underground Installation of Polyvinyl chloride (PVC) Pressure Pipe and fittings for Water. The drilling process during the saddles installation shall be in accordance with AWWA C605 if the watermain is PVC.

E.2.10.2.3 Corporation Stops

Corporation main stops shall be manufactured in accordance with AWWA Standard C800. Corporation stops shall be of the type and model describes in Part D, Table D.3 or must be approved in written by Chatham-Kent P.U.C. as equal. Corporation stops shall:

- Be placed between 45 and 90 degrees from the top center of the watermain.
- Not be installed on the top one-quarter of the watermain.
- Be located no closer than 600 mm (24 inches) to any other corporation stop, valve, bend, tee, or joint.

E.2.10.2.4 Coupling

Coupling for water service is prohibited. However, if Chatham-Kent P.U.C. approves coupling, unions shall not be installed under the paved portion of roadways.

E.2.10.2.5 Service Pipe

For installation purposes, all service pipe equal or under 50 mm (2 inches) diameter shall be installed in accordance with AWWA Standard C 901, and shall consider:

- Handling, trenching, and backfilling operations that shall be performed with reasonable care to prevent scratches, nicks, and gouges in the conduit.
- Bending to be avoided as much as possible. If Chatham-Kent P.U.C. gives a written approval, bending shall not be permitted closer than 10 diameters from any fitting or valve.
- The minimum ratio of curvature at the horizontal gooseneck point after the corporation stop shall be 30 diameters.
- That the service pipe shall be installed in trench bottom that provide continuous support and are uniform and free from rocks, stones, and debris.
- That the initial backfill from 75 mm below the pipe to maximum 150 mm above the pipe shall be sand or other selected material to prevent freezing in the water line.
- That all service pipes over 50 mm (2 inches) shall be installed in accordance with AWWA Standard C605 or AWWA Standard C153.

E.2.10.2.6 Curb Stops

All curb stops shall be installed with clockwise operation to turn-off service, and:

- The lug must be perpendicular to the property it serves when in the “on” position.
- The curb stop shall be a minimum of 1.52 m (60 inches) deep.
- All curb stops shall be located 300 mm from the property line.

- All curb stops shall be operated by a single quarter-turn.

E.2.10.2.7 Curb Stop Boxes

Curb stop boxes shall be installed plumb. Curb stop boxes shall not be placed in driveways or sidewalks unless otherwise approved by Chatham-Kent P.U.C.

Curb stop boxes shall be operable prior to Chatham-Kent P.U.C. acceptance. The curb box shall be adjusted at least 13 mm (1/2 inch) above the final grade prior to final inspection.

E.2.10.2.8 Meter

For installation purpose, the contractor or authorized plumber may follow the Standard drawing in Part F: Standards Drawings. Where the meter cannot be placed in a practical location, the meter may be located in an approved crawl space or meter chamber. Chatham-Kent P.U.C. will clarify this and all other matters related with a meter installation in accordance with the latest Chatham-Kent P.U.C. Backflow Prevention Policy and By-Law.

E.2.10.2.9 Meter Backflow

All new residential installation and any replacement water tap one-and-a-half inch (1-1/2") or larger shall be fitted with a backflow prevention assembly. All taps must be fitted with a backflow prevention assembly in any case where a potential cross connection exists.

In addition, all commercial taps shall be fitted with an appropriate backflow prevention assembly if a routine annual inspection of the plumbing system is not performed. All backflow prevention assemblies shall be reviewed and accepted by Chatham-Kent P.U.C. in accordance with the latest Chatham-Kent P.U.C. Backflow Prevention Policy and By-Law.

E.2.10.2.10 Marker

Upon completion of the installation of water services a temporary 50mm x 100mm x 2400mm (2 inches x 4 inches x 8 ft) wooden marker, 1.2 metres (4 ft) in the ground, 1.2 metres (4 ft) above ground, and shall be placed behind the water service to indicate its location.

The top 0.6 metre (2 ft) portion of this wooden marker shall be painted blue to indicate the water service. Using indelible marker, a number shall be placed using a 50mm (2 inches) letter on the wooden stake near the top, and facing the street, indicating the municipal address and lot number for each lot or building block being serviced.

E.2.10.2.11 Electrical Grounding

On reconstruction or local improvement projects where existing structures will be serviced by a replacement or new water distribution system, it shall be determined if the electrical grounding systems are connected to the water service. If so, appropriate measures must be taken to ensure that electrical grounding systems are not compromised. Possible solutions include using copper services or installing new grounding rods or plates.

E.2.10.3 Inspection

E.2.10.3.1 Turning On

Chatham-Kent P.U.C. shall turn on the water at the curb stop, only after the service pipe, curb stop, stop box, and meter are installed and inspected. If approval for backfilling is required, Chatham-Kent P.U.C. or designate shall be informed a minimum 48 hours before the tap and service inspection process begins.

E.2.10.3.2 Exposition

The curb stop, corporation stop, and any coupling shall remain exposed until after approval for backfill is given by Chatham-Kent P.U.C or designate.

E.2.10.4 Testing Water Service Connections

All water service connections shall be tested at the same time as the watermains, and as per **Section E.2.11.2**.

E.2.11 WATERMAIN COMMISSIONING**E.2.11.1 Equipment and Material**

All labour, equipment, and material shall be prepared and supplied to carry out pressure and leakage tests, swabbing, sterilization, and flushing of all watermains and appurtenances as specified under this section. All tests shall be carried out under Chatham-Kent P.U.C. supervision.

E.2.11.2 Procedure

The following Chatham-Kent P.U.C. standard procedures shall be followed for the commissioning of all new watermains:

- New Watermains Disinfection Procedure (Control No. 2000677)
- New Watermain Commissioning Checklist (Control No. 2001837)
- New Firelines and New Water Services 100mm Diameter or Greater: Disinfection Procedure (Control No. 2001678)
- New Firelines and New Water Services 100mm Diameter or Greater: Commissioning Checklist (Control No. 2001902)

Each procedure above provides detailed requirements on flushing, swabbing, hydrostatic pressure testing, disinfection, sampling, final acceptance and final connection (tie-in) process to the existing distribution system. The Chatham-Kent P.U.C. will not approve any water plant for connection to the existing distribution system unless the appropriate Chatham-Kent P.U.C. procedure has been adhered to and the accompanying Checklist has been signed and approved by the Chatham-Kent P.U.C.

E.2.11.3 Temporary Connection

In order to fill the main with water for tapping, testing, and disinfection, a temporary connection shall be supplied. The temporary connection may be by using a hydrant or by a 50 mm connection between the distribution system and the new main. The connection in 50 mm diameter copper, polyvinyl chloride, or polyethylene piping shall be assembled together with an appropriately sized dual valve and check valve (backflow prevention device), between the distribution system and the new main. A tee on the temporary line with a smooth, unthreaded sampling faucet shall be supplied so that water entering the main can be tested. This temporary connection shall be removed and replaced with a standard brass plug unless it is to remain as a permanent service connection. The connection suggested in AWWA Standard C651 Disinfecting Watermains may be adopted. If a hydrant is planned to be used, the **Section E.1.2.8** shall be taken into consideration.

E.2.11.4 Temporary Blow-off

A temporary blow-off consisting of a 50 mm diameter piping, a control valve and sampling faucet shall be installed at the discharge end of the main to be tested so that water leaving the main can be tested without disturbing the flow.

E.2.11.5 Miscellaneous

The temporary piping arrangements are recommended for mains 200 mm in diameter and smaller. This will provide flushing velocities of 0.76 m/sec. (2.5 ft/sec.) with a residual pressure in the watermain of 276 kPa (40 psi). Requirements for larger watermain field testing shall be according to the AWWA Standard C651.

E.2.11.6 Final Inspection

After complete installation of all mains and appurtenances under the job, and prior to leaving the site, the Chatham-Kent P.U.C. supervisor or designate shall check all hydrants, valves and valve boxes to verify that valves are fully open, or closed as may be required, and to ensure that the system is operating properly and is fully functional. The Chatham-Kent P.U.C. supervisor shall also ensure continuity through the entire length of tracer wires to the satisfaction of Chatham-Kent P.U.C.

E.3 SANITARY SEWERS**E.3.1 FORCEMAINS****E.3.1.1 Scope**

This section addresses the installation of PVC or high density polyethylene pipes and fittings up to 900 mm (36 inches) for sewer under pressure or acting in connection to pumping stations.

E.3.1.2 Installation Procedure

Installation procedure shall be according to OPSS Standard 410, and **Section E.2.2** or **Section E.2.3**.

E.3.1.3 Precaution

An air relief valve shall be installed at high points in the forcemain to prevent air locking. Vacuum relief valves shall be necessary to relieve negative pressures on forcemains. The forcemain configuration and head conditions shall be evaluated as to the need for and placement of vacuum relief valves.

E.3.1.4 Point of Connection

Forcemains shall enter the gravity sewer system at a point no more than 600 mm (24 inches) above the flow line of the receiving maintenance holes.

E.3.2 GRAVITY SEWER MAINS

E.3.2.1 Scope

This section addresses the installation of sanitary sewer collection mains.

E.3.2.2 Standard

The standard to be applied during the installation process shall be as follows:

- ASTM F1417, Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
- ASTM C1244, Test Method for Concrete Sewer Maintenance holes by the Negative Air Pressure.
- OPSS Standard 410, Construction Specification for Pipe Sewer Installation in Open Cut.

E.3.2.3 Material

Material used in gravity sewer installation shall be according to Part D: Materials Specifications.

E.3.2.4 Alignments

Horizontal alignment shall remain uniform between consecutive maintenance holes. Vertical alignment shall remain uniform between consecutive maintenance holes. However, the following tolerances may be applied during the installation:

- Horizontal: 25 mm
- Vertical for slope less than or equal to 1%: 5 mm
- Vertical for slope greater than 1%: 10 mm

E.3.2.5 Job Conditions

The following conditions shall be observed during the sewer pipe installation;

- Foreign material including trench water, debris, etc., shall not be permitted to enter the pipe under installation.
- All openings in the pipeline shall be closed with watertight plugs when pipe installation is stopped for any reason (i.e. Lunch time, closing the working day, etc).
- Do not place debris, tools, clothing, or other material in the pipe.
- Effective measures shall be used to prevent uplifting or floating of the pipeline prior to completion of backfilling operation.
- Pipe shall not be installed if weather conditions are not suitable or if the bottom of the trench is unstable.
- Pipe shall be protected against dropping and damage. Damaged pipe or appurtenances shall not be used.

E.3.2.6 Inspection

Pipe barrel and maintenance holes shall be free of dirt or other foreign objects prior to installation. Pipe and maintenance holes shall be inspected for cracks, dents abrasions, or other flaws. Defective pipe and/or maintenance holes shall be marked and stored on a separate location away from the work.

E.3.2.7 Installation

The following considerations shall be taken into account during the installation process:

- Pipe installation shall begin at the lowest elevation and proceed upstream to the highest, unless otherwise approved by Chatham-Kent P.U.C.
- Pipe shall be installed so that bells are pointing uphill.
- Effective measure shall be taken to prevent opening of joints during bedding and backfilling operations.
- Joints shall be completed in accordance with the applicable pipe material specification. Pipe position shall be adjusted to the correct line and grade as each length of pipe is placed in the trench.
- Pipe position shall be adjusted by scraping away or filling pipe bedding under the entire length of the pipe, except bells. Wedging, blocking or mounding up the pipe bells shall not be permitted.
- Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints.
- The pipe shall not be disturbed after the joint has been completed.

E.3.2.8 Connections

Connections to maintenance holes shall be made according to **Section E.3.3**. Sanitary sewer service connections shall be made according to **Section E.3.4**.

E.3.3 MAINTENANCE HOLES**E.3.3.1 General****E.3.3.1.1 Scope**

This section addresses the installation of sanitary sewer maintenance holes and its accessories. Maintenance holes considered in this section are the pre-cast type.

E.3.3.1.2 Standard

The applicable standard for installation of maintenance holes is the OPSS Standard 407, Construction Specification for Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber installation.

E.3.3.1.3 Material

Maintenance holes composing material shall be according to Part D. Materials Specifications. Maintenance holes shall be furnished with all accessories, including steps, base, cone sections, and ring and cover.

E.3.3.2 Installation**E.3.3.2.1 Utilization**

Maintenance holes shall be installed wherever there is a change in pipe size, direction, slope, at junctions, and intervals of not more than 120 m (400 ft) for 250 mm (10 inches) and smaller diameter pipe and 150 m (500 ft) for pipe diameters greater than 250 mm (10 inches.)

E.3.3.2.2 Location

Maintenance holes shall be installed at the location of the elevation shown on the approved construction drawing, or as approved by the Chatham-Kent P.U.C. supervisor or designate.

E.3.3.2.3 Transition

Where difference in elevation between the incoming sanitary sewer pipe invert and the outgoing maintenance hole invert is less than 900 mm (36 inches), the channel invert through the maintenance hole shall be benched to make a smooth transition between the incoming and outgoing inverts.

E.3.3.2.4 Inside Drop Pipe

Where the difference in elevation is 600 mm (24 inches) or more, an inside drop pipe shall be provided for the sanitary sewer entering the maintenance hole.

E.3.3.2.5 Maintenance Hole Joints

Maintenance hole sections shall be joined to each other by using preformed flexible gaskets of neoprene or other approved material, on both interior and exterior shiplaps. The maintenance hole section shall be joined to the base by using a double row of preformed flexible gasket of approved material.

E.3.3.2.6 Adjustment Rings

Rubber adjustment units for maintenance holes shall be according to OPSS Standard 1351. Precast concrete adjustment rings shall be provided to bring the ring and cover to grade. The total height measured from the top of the cone section to the finished grade shall not exceed 400 mm (16 inches).

E.3.3.2.7 Precautions

Measurements of the final location and elevation of sanitary sewer inverts and rim shall be made for the "As Constructed" drawings.

E.3.4 SEWER LATERAL SERVICE CONNECTION**E.3.4.1 Scope**

This section addresses the installations of sanitary sewer lateral service connections.

E.3.4.2 Standards

For quality assurance purposes, the applicable standards in this sections is OPSS Standard 410, Construction Specifications for Sewer Installation in Open Cut. All lateral sewer service connections shall be according to the approved drawings.

E.3.4.3 Size and Length

All lateral sewer service connections and its fittings shall be the size and length established by the consultant in the engineering report and approved drawings.

E.3.4.4 Slope

Lateral sewer service connections shall not be allowed to discharge directly into sanitary maintenance holes, except at terminal maintenance holes. A case exception to this requirement may be allowed if lateral discharges at the same elevations as the maintenance hole invert.

Unless otherwise specified by Chatham-Kent P.U.C., all sanitary sewer lateral drain connections to service shall be constructed at a 2% minimum and 8% maximum grade and to a depth 2.5 meters below finished grade at the property line.

E.3.4.5 Installation

During the installation of the lateral sewer service connections and additionally to the specification contained in the OPSS Standard 410, the following considerations shall be taken into account:

- Lateral sewer service connections shall be installed at locations designed on the approved drawings.
- The location of the lateral sewer service connections shall be marked by extending a 38 mm x 89 mm timber marker vertically from the plug to a height of at least one meter above finished ground level. The exposed end of these marker stakes shall be painted green unless otherwise defined by Chatham-Kent P.U.C.
- The low line of the service connection shall be at or above the spring line of the sanitary sewer collection main and no closer than 900 mm (3 ft.) to the bell or spigot of the pipe.
- All lateral sewer service connection lines shall be extended at the constant grade from the tap on the collection main to the property line.
- All lateral sewer service connection lines shall be provided with a clean out at the property line. Clean-out shall be comprised of a Tee, Riser, and metallic Cap. Top elevation of the cap shall be placed between a minimum of 100 mm below the grade and a maximum 300 mm below the grade.

E.3.5 FIELD TESTING AND ACCEPTANCE

E.3.5.1 Standard

All field testing shall be performed according to the OPSS Standards 409 and 410, and the applicable ASTM C1244 and ASTM F1417.

E.3.5.2 General

The testing process shall be conducted when:

- Backfill and compaction has been completed but before street pavement reconstruction are performed.
- Main pipes and maintenance holes have been thoroughly cleaned of all foreign material.
- All required equipment shall be furnished to allow the required maximum pressure test.
- All field testing shall be programmed 48 hours in advance to ensure the Chatham-Kent P.U.C. supervisor or designee's presence during the testing procedure.

E.3.5.3 Pipe Deflection Test

Pipe deflection test shall be carried out on all sewer constructed by using plastic pipe. In all cases, each section of sanitary sewer shall be tested for deflection. The maximum allowed deflection shall be according to the acceptable range[§] defined by Chatham-Kent P.U.C. Sections of the pipe which fail the test shall have the defects repaired and the test repeated.

[§] According to the OPSS Standard 410, the deflection testing of sewer pipe shall be obtained by using the expression (0.15DR) %.

E.3.5.4 Air Testing

The air test, if required, shall be carried out according to ASTM F1417, Time Pressure Drop Method. All preparations required for air test shall be observed including a set relief valve required to handle no less than 35 kPa (5 psi.).

E.3.5.5 Leakage Test

All forcemains shall be pressure tested.

E.3.5.6 Vacuum Testing

Maintenance holes shall be tested before the ring and cover and grade adjustment rings are installed, and after backfill and compaction is complete. The preparation for test and the testing procedure shall be in accordance with the ASTM C1244 standard. The maintenance hole shall pass the test if the time for the vacuum reading to drop from 10-inches mercury to 9-inches mercury meets or exceeds the minimum values dictated by the standard. If the maintenance hole fails the test, the necessary repairs and retests shall be carried out.

E.3.5.7 CCTV Investigation

All sanitary sewer lines shall be CCTV recorded according to the OPSS Standard 409 and the following considerations:

- The recording shall be made within the time recommended in the OPSS Standard 409 unless otherwise defined by the Chatham-Kent P.U.C. supervisor.
- The sanitary line to be televised shall be previously cleaned.
- The recording shall show all joints and the full diameter of the pipe.
- All recording shall have a clear location (e.g. maintenance hole # to maintenance hole #), time, and date of the recording, and footage displayed.

E.3.6 FINAL CONNECTION TO EXISTING SYSTEM**E.3.6.1 Point of Connection**

Connections to the Chatham-Kent's existing sewer collection system shall be made at an existing maintenance hole or by setting a new maintenance hole on the existing line. A watertight plug shall be installed in the new line to prevent any material from entering the existing system until Chatham-Kent P.U.C. accepts the new system.

E.3.6.2 Precaution

Extreme care shall be exercised during the connection operations to ensure that no damage is done to the existing main. Any damage resulting from the main connection shall be immediately repaired.

End of Part E

PART F

STANDARDS DRAWINGS

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F.1 DRAWING REQUIREMENTS**F.1.1 PREPARATION OF PLANS****F.1.1.1 General Information**

The consultant shall develop a set of drawings in accordance with the size and nature of the project to be constructed taking into consideration the following:

- Water and sanitary sewer general conditions shall be appropriately identified on the drawing. These notes are not inclusive as conditions for each project will vary. The notes are in no particular order.
- The size of the plotted drawings shall be 610 mm x 915 mm (24 inch x 36 inch) unless otherwise approved by Chatham-Kent P.U.C.
- In cases where the size of the project is such that it is impossible to fit on one page of the size described above, the consultant shall section the general drawing into smaller sections duly marked. A list of contents shall be prepared in the cover sheet to show the drawing order and all other drawings attached.
- All sheets shall contain the scale used, a north arrow, and a description of the drawing content.
- All sheets, except the cover sheet, are to include a title block which will include: the name of the owner or developer; the name of the subdivision or project; the improvement description and location; and the name of the consultant or design firm. Additionally, all revisions occurring after initial acceptance will be recorded as a revised sheet and will include a description of the revision and date.
- A legend describing all line types, symbols, and abbreviations will be shown either on the cover sheet or individual sheets.
- The cover sheet shall include the minimum following information:
 - o Contract number
 - o Project name and location
 - o Key plan with north arrow and bar scale, and detail to be clear and uncluttered
 - o Sheet index
 - o Name of Owner or Developer
 - o Name of engineering firm responsible for the design and preparation of construction drawings
 - o Project bench marks and basis of horizontal control based upon Canadian Geodetic Datum. (NAD 83)
 - o General project notes (i.e. Reference to geotechnical information, contractor responsible for field locates)
 - o A general overview of the entire project including, but not limited to, streets complete with names, alleys, lot numbers, all proposed utilities on and adjacent to the project site, all existing utilities on and within [30 m (100 ft)] of the project site, and all existing and proposed easements and right-of-ways on and adjacent to the project site.

- o A general overview shall include the highlighted area and which drawing number it can be found in
 - o Proposed point of connection for water and sanitary sewer to the existing system(s). All existing water lines shall be labelled with the pipe's diameter, and type of material. All existing sanitary sewer lines shall show existing manholes, complete with rim and invert elevations, and pipe diameter.
- A plan and profile drawing shall incorporate (but not be limited to) the following details:
 - o Vertical and horizontal scale. Vertical and horizontal scale shall be:

1:500 Horizontal

1:50 Vertical
 - o Existing utilities shall be shown on the drawings.
 - o Horizontal and vertical distances by stationing and elevation.
 - o Diameter, type of material, pipe class, length of pipe between all fittings and manholes for proposed and existing water and/or sanitary sewer lines as well as service connections.
 - o Fittings and valves; top of pipe (T.O.P.) elevation on proposed water lines at all fittings, valves, and points of deflection; depth, elevation, grade, manhole invert, and rim elevations on proposed sanitary sewer lines.
 - o Location of deflections or bends, both horizontal and vertical (point of intersection preferred).
 - o Degree of bends, degree or radius of curves, tangent distances for curves, or external distances if clearance is required.
 - o Points of intersection with pipe centre line for tees, wyes, crosses or other branches, together with direction-right or left hand, up or down-or angle of flow, viewed from inlet end.
 - o Location of all valves, pumps, or other inserted fittings not supplied by the pipe manufacturer.
 - o Location of adjacent or conflicting installations or structures.
 - o Occasional tie-ins with right-of-way/property lines, curb lines, road or street centre lines, and other pertinent features to locate pipe centre-line clearly.
 - o Details and descriptions of all specials, together with data required to supplement AWWA standards.
 - o Any special requirements affecting the manufacturers of the pipe or any installation procedures.

F.1.1.2 Special Details

The following details shall be taken into consideration where a design process related to water projects has taken place:

F.1.1.2.1 Cross Sectional Drawings for Watermains

Drawings shall be developed to show all possible details of the watermain to be installed. The drawing shall have the scale required to ensure a clear view. The format used shall be the plan/cross section type.

The drawings shall include information about elevation and distances between important points, slope of the pipe, diameter to be used, and all other relevant details. Enlargements or schematic views shall be prepared where details cannot be shown on standard scale drawings.

F.1.1.2.2 Dead End Mains

If a dead-end is encountered during the design process, a drawing shall be developed to show all possible details and distances.

F.1.1.2.3 Other Utilities Crossing

Other utilities crossing shall be shown on the drawings and highlighted or noted in box (i.e. GAS MAIN).

F.1.1.2.4 Signs for Air Relief Valves

As per the CKPUCSD attached at the end of this document, drawing of signs for hydrants, pressure regulation valves, and air relief and vacuum valves shall be included showing its dimensions and location in ground.

F.1.1.3 Chatham-Kent P.U.C. Standard Drawings (CKPUCSD)

The CKPUCSD to be included in a project shall be based on (but not limited to) the suggested CKPUCSD contained in the Table F.1. For any other required drawings not contained in the Table F.1, the consultant shall develop a specific drawing based on the correspondent OPSD. The drawing developed shall be incorporated as part of the project's drawings.

Table F1: Chatham-Kent P.U.C. Standard Drawings (CKPUCSD)

FIGURE NO.	DESCRIPTION
W-1	Water Valve Installation
W-2	Connection of New Watermain to Existing Watermain
W-3	Eclipse No. 88 Sampling Station
W-4	Standard Installation of a 19mm (3/4") to 50mm (2") Water Service
W-5	Standard Installation for 19mm (3/4") to 50mm (2") Water Meter Equipped with Remote Reader
W-6	Standard Urban Placement of Main Valves and Hydrants for 20m Road Allowance
W-7	Typical Water Connection for Institutional / Commercial / Industrial
W-8	Pipe Bedding and Backfill Detail (Use of Excavator Method)
W-9	Pipe Bedding and Backfill Detail (Use of Wheel or Chain Trencher Method)
W-10	Watermain Lowering Below Storm Sewer, Culvert or Ditch
W-11	Standard Construction Sign

FIGURE NO.	DESCRIPTION
W-12	Water Valve Sign
W-13	Air Relief Valve (Water) Sign
W-14	Standard Hydrant Marker Sign
W-15	Buried Fibre Optic Cable Sign
W-16	Buried Electrical Cable Sign
W-17	Interconnect Water Valve Sign
W-18	Wastewater Valve Sign
W-19	Air Relief Valve (Wastewater) Sign

F.2 APPROVAL OF PLANS

F.2.1 PRELIMINARY APPROVAL

F.2.1.1 Review and Acceptance

All preliminary contract documents and drawings shall be submitted to Chatham-Kent P.U.C. for review and acceptance prior to the preparation of tender and final construction drawings. At least two weeks will be required for Chatham-Kent P.U.C. to review the drawings before the tendering process. Acceptance of these preliminary submittals shall constitute only a conceptual acceptance and shall not be construed as acceptance of specific design details.

In addition to the general provisions described above, each sheet in the plan set shall be marked "PRELIMINARY" or "NOT FOR CONSTRUCTION" and the date of submittal. This statement will be removed on accepted drawings only. For preliminary approval, plans shall be submitted in digital format. After examination of the preliminary plans, a digital marked up copy of the plans will be returned to Consultant, outlining and showing any revisions, which may be required.

F.2.2 FINAL APPROVAL

F.2.2.1 Submission

The final submission shall be carried, once all requested revisions have been made and shall contain relevant drawings described in **Table F.1**. The final submission to the Chatham-Kent P.U.C. shall be in digital format and each sheet in the plan shall be marked "ISSUED FOR TENDER". Additional marked up revisions may be provided if revisions identified in the preliminary review have not been remedied.

The following approvals shall also be required prior to award of contract for construction:

- New Watermains: MECP Form 1 – Record of Watermains Authorized as a Future Alteration
- New Sanitary Sewers: MECP Environmental Compliance Approval (ECA) Application

Following final approval of plans by the Chatham-Kent P.U.C. and all required regulatory agency, the project can proceed to tendering and contract award for construction.

F.3 CONSTRUCTION INFORMATION**F.3.1 PLANS FOR LAYOUT****F.3.1.1 Discrepancies**

If the construction survey uncovers any discrepancies, the contractor shall notify the consultant prior to construction proceeding. The contractor and consultant are responsible for resolving apparent discrepancies and performing any subsequent modifications. Modifications to the approved plans shall be approved by Chatham-Kent P.U.C.

F.3.2 RECORDING INFORMATION**F.3.2.1 Procedure**

During the construction stage, information about final dimensions, elevations, and details shall be marked in the construction drawings in order to be used during the “As Constructed” preparation. All changes in elevation or location approved by Chatham-Kent P.U.C. shall be recorded. Vertical and horizontal location of underground utilities and appurtenance shall be referenced to a minimum of two permanent surface improvements.

F.3.2.2 Precaution

Do not backfill work until required information is recorded.

F.4 “AS CONSTRUCTED” INFORMATION**F.4.1 PREPARATION OF “AS CONSTRUCTED” PLANS****F.4.1.1 General Information**

The general information contained in the construction drawings shall not be modified unless otherwise approved by Chatham-Kent P.U.C.

F.4.1.2 Accuracy

The “As Constructed” drawings shall be made accurately in order to ensure the future use in repairing existing facilities, replacement, enlargement, or duplication of the existing facilities to accommodate changes to population density or land use patterns.

F.4.1.3 Reference Points

“As Constructed” information shall be recorded using valves, hydrants, and other easily identifiable permanent facilities rather than survey bars. Property lines may be used in conjunction with GIS references. Where water services are installed, on a bend, cul-de-sac, or at locations where it is not possible to locate the water service at right angles to the main, both the location of the main stop and the location of the curb stop shall be shown in the “As Constructed” drawings.

F.4.1.4 Special Details

All special details encountered during the construction stage shall be included into the “As Constructed” drawings. All modification in dimensions, elevation, or configuration occurring to any system components built during the construction stage shall be included in the correspondent drawing. The following special information shall be included in the “As Constructed” drawings:

- 911# and roll number of each property
- Size and material of the service installed
- Stationing, dimensional ties, or elevations that would indicate the location and depth of the casing that was installed for a road crossing
- Stationing reference on each sheet
- At every intersection, a detailed drawing insert shall be provided with measurement. The drawing may be a scaled schematic, indicating locations of fittings and appurtenances. Those locations shall be established by 3 point ties to survey monuments or offset location from property lines. If there is not enough room on the same sheet to label each fitting, it shall be done by numbering each fitting and providing a legend to describe them.
- Watermains shall be tied to property lines and right-of-way limits
- The water/sewer main pipe type, material, and size installed shall be indicated
- A “Bar Scale” shall be included in each reducing drawing. If there is more than one scale in the same drawing, each scale shall be indicated for each one of those drawings. If the drawing has been printed without scale, a note “Not to Scale” shall be included in that drawing.
- All revisions or changes to the construction drawings during the project construction
- Special construction remarks, such as conflicts encountered with other utilities (i.e. gas line, etc), or structures shall be noted in drawings

F.4.1.5 Concrete Pressure Pipe (C.P.P) Information

Shop drawings from C.P.P. supplier shall be included in the “As Constructed” information.

F.4.2 CARD REPORTS**F.4.2.1 General**

As part of the “As Constructed” process, card reports shall be prepared by using the latest version of the official Chatham-Kent P.U.C. card report. Valves, curb box, hydrant, and services (water, sanitary, storm) shall be accurately referenced (stationed) on the card reports to at least 2 known items. Appurtenances tied to trees or any other removable reference shall not be accepted.

Copies of the standard card report can be obtained by request from the Chatham-Kent P.U.C.

The report cards to be completed are:

- Valve Report
- Hydrant Report
- Blow-Off Service Report
- Water Service Report
- Sanitary/Storm Service Report

F.4.2.2 Precaution

Each hydrant, blow-off, valve, and water service shall be noted into an individual card report. Each hydrant, blow-off, valve, and water service shall be copied into an individual digital copy. Only for informative purpose, a copy of those card reports may be obtained from Chatham-Kent P.U.C. Each service location file shall be named by 911# & Road name or Roll# if 911 address doesn't exist.

F.4.3 SUBMISSION OF “AS CONSTRUCTED” INFORMATION

F.4.3.1 Plotted Information

All “As Constructed” drawings and card reports shall be plotted according to the following requirements:

Table F2: “As Constructed” Plotted Information

Description	Number of Copies Required
610mm x 915 mm (24" x 36") set of drawings	1
Set of Card Reports	2
279 mm x 432 mm (11" x 17") set of drawings	1

F.4.3.2 Digital Requirements

Drawing information shall be handled in AutoCAD latest version or minimum AutoCAD 2013. Card reports shall be copied in pdf, tiff, or jpg format for submission via USB. The number or digital copies shall be as following:

Table F3: “As Constructed” Digital Requirements

Description	Number of USB Copies Required
Drawings in AutoCAD format	1
Digital format of report cards in dwg, pdf, tiff, or jpg.	1

F.5 ACCEPTANCE**F.5.1 PRELIMINARY “AS CONSTRUCTED” REVIEW****F.5.1.1 Time Frame**

Within 60 days time of the installation of the watermain, services and hydrants in the subdivision or any phase thereof and before the issuance of permits, the Subdivider/Developer shall provide preliminary “As Constructed” information. This preliminary “As Constructed” information can be in a convenient form such as a marked copy of the overall plan at 1:500 or photocopies of pertinent “As Constructed” field notes. These should show sufficient information so that the valves and services can be readily located from above ground objects, such as hydrants, which are easily found, both summer and winter.

F.5.2 FINAL “AS CONSTRUCTED” APPROVAL

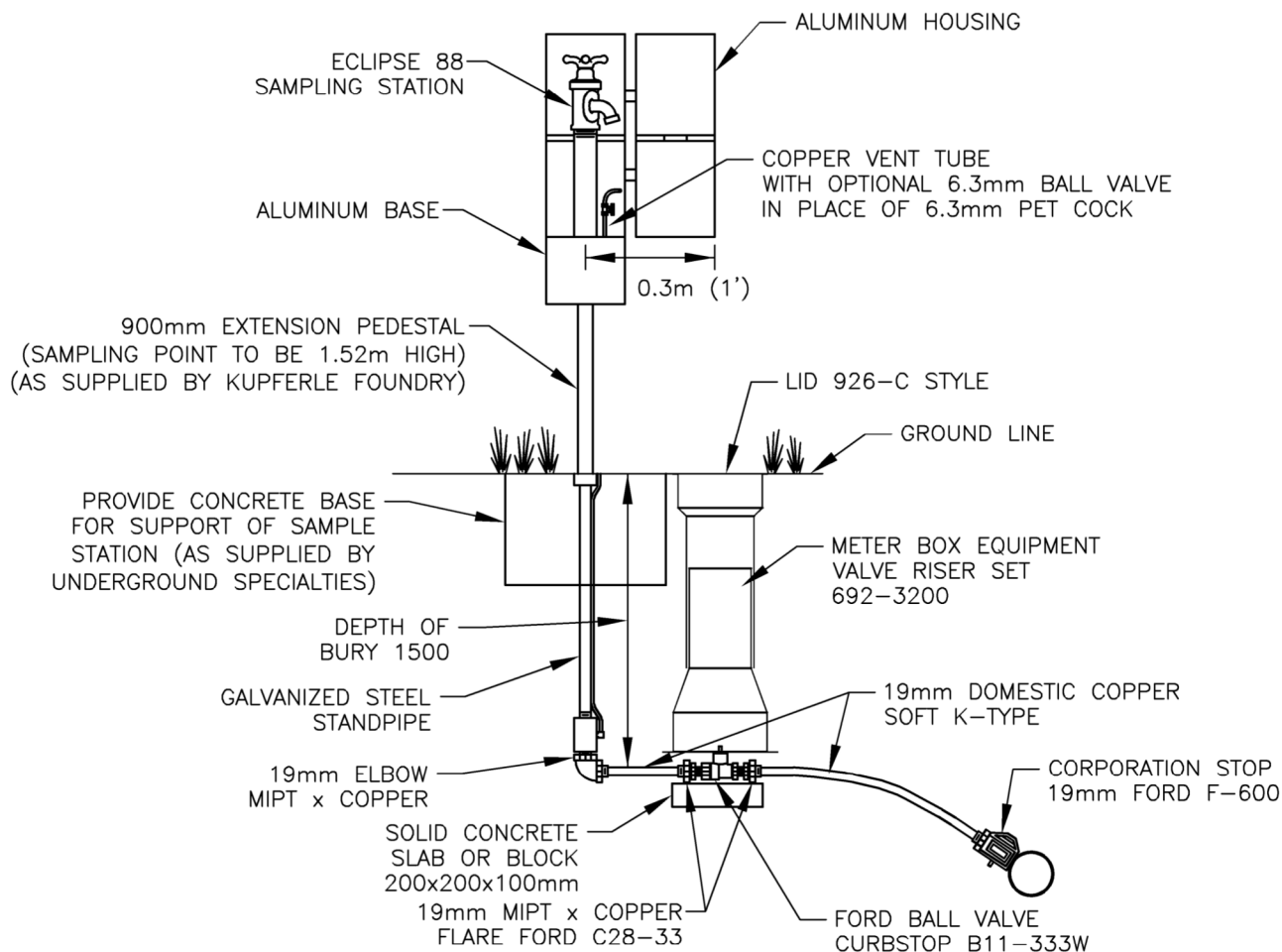
Prior to the final acceptance of the waterworks system in the Subdivision by the Chatham-Kent P.U.C., one (1) complete final set of approved “As Constructed” information shall be provided. The Chatham-Kent P.U.C. should be contacted regarding any questions on the appropriate digital format.

F.5.3 FINAL “AS CONSTRUCTED” ACCEPTANCE

The final “As Constructed” acceptance is tied to the acceptance of a water distribution system in subdivision(s), or water and sewer projects in contracts, which in time are tied into the completion, testing, and approval for use of the system in accordance with the subdivision agreement or contract. In all cases, final acceptance of the system will not be given until the “As Constructed” information have been submitted to and accepted by Chatham-Kent P.U.C.

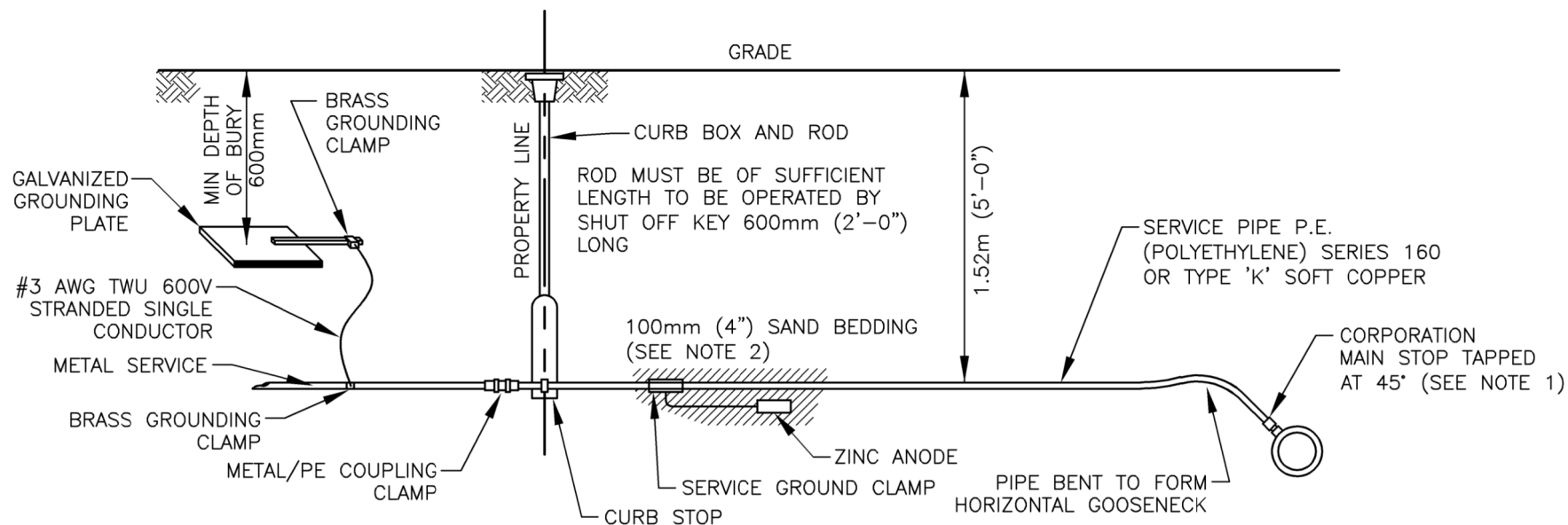
End of Part F





NOTES:

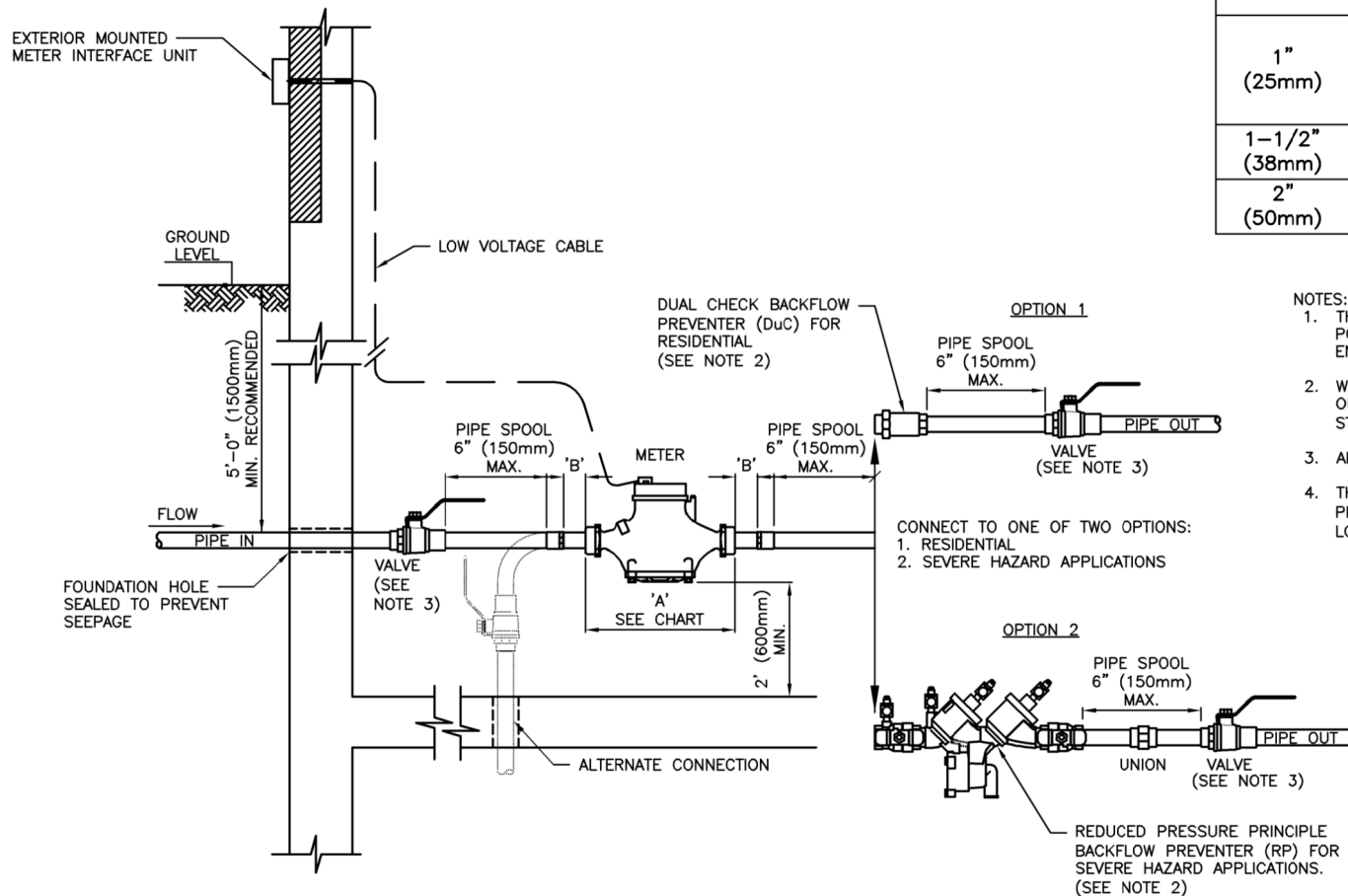
1. SAMPLING STATIONS SHALL BE 1.5m BURY, WITH A 19mm FIP INLET, AND A (19mm HOSE OR UNTHREADED) NOZZLE.
2. ALL STATIONS SHALL BE ENCLOSED IN A LOCKABLE, NONREMOVABLE, ALUMINUM-CAST HOUSING.
3. WHEN OPENED, THE STATION SHALL REQUIRE NO KEY FOR OPERATION, AND THE WATER WILL FLOW IN AN ALL BRASS WATERWAY.
4. ALL WORKING PARTS WILL ALSO BE OF BRASS AND BE REMOVABLE FROM ABOVE GROUND WITH NO DIGGING. EXTERIOR PIPING SHALL BE GALVANIZED STEEL (BRASS PIPE ALSO AVAILABLE).
5. A COPPER VENT TUBE WILL ENABLE EACH STATION TO BE PUMPED FREE OF STANDING WATER TO PREVENT FREEZING AND TO MINIMIZE BACTERIA GROWTH.
6. ECLIPSE NO. 88 SAMPLING STATION SHALL BE MANUFACTURED BY KUPFERLE FOUNDRY, ST. LOUIS, MO 63102.



NOTES:

1. SERVICE SADDLE WILL BE REQUIRED.
2. FOR A PLASTIC SERVICE PIPE AND ANODE IS NOT REQUIRED
3. FOR COPPER SERVICES:
 - A. SERVICES ARE TO BE PROTECTED BY A ZINC ANODE.
 - B. SERVICE GROUND CONNECTOR TO BE COATED WITH T.C. MASTIC OR WRAPPED WITH "SCOTCHFILL" ELECTRICAL PUDDY OR APPROVED EQUAL.
 - C. ANODE TO BE PLACED AT LEAST 3'-4"(1000mm) AWAY FROM WATER SERVICE AND AS DEEP AS THE BOTTOM OF THE SERVICE.

FILENAME: G:\PUC\KVC-MOGEORGE\PUC_SPECS\2018 PUC SPECIFICATIONS\FIGURES\FIG-W-4 TO W-19.DWG PLOTTED BY: DAVID MIDDLETON
 PLOT DATE: 2019-01-30 12:26:52 PM PLOT SCALE: 1:1 PLOT STYLE: CHPK HALF SIZE.CTB

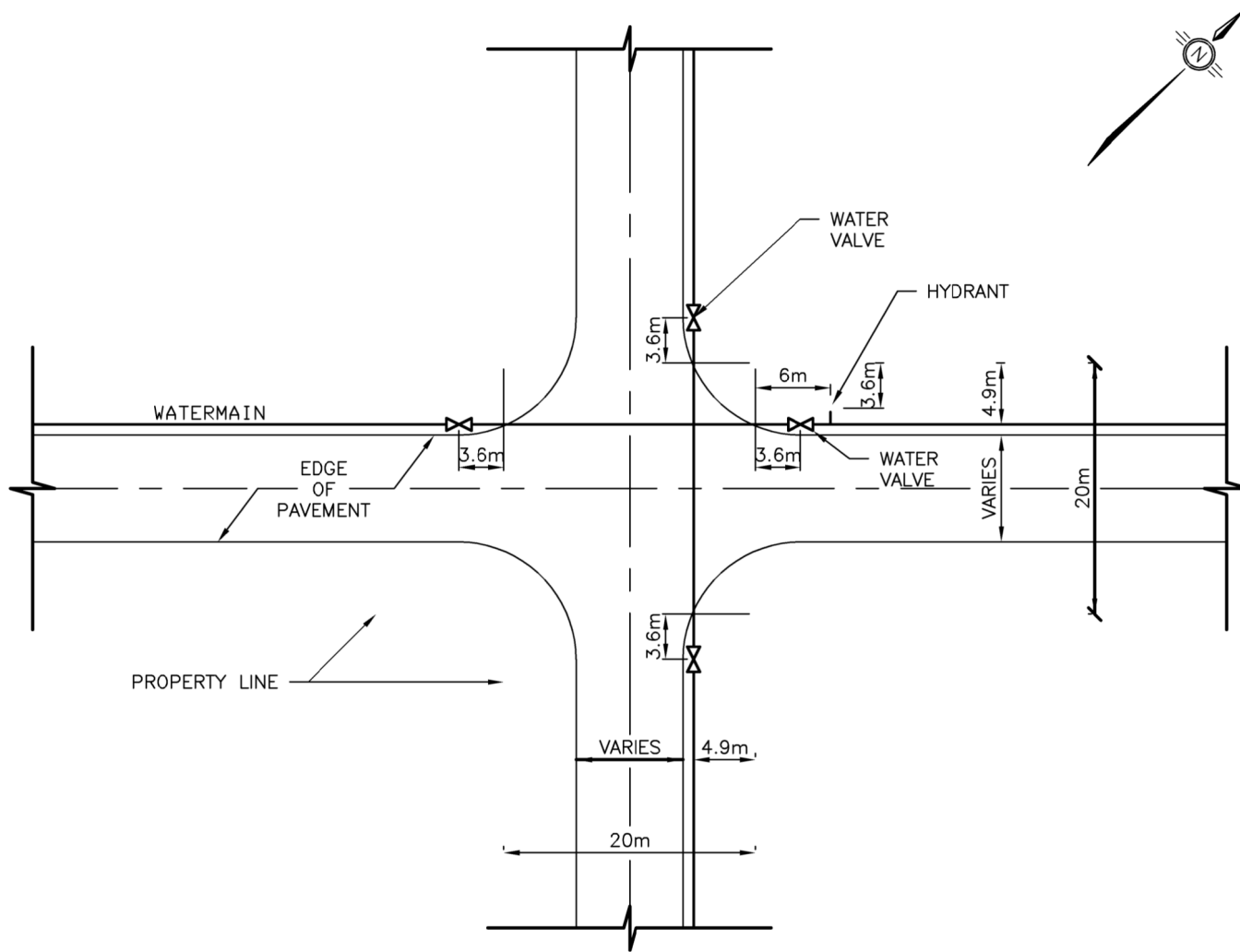


PIPE SIZE (SPOOL IN)	METER SIZE	PIPE SIZE (SPOOL OUT)	A	B
3/4" (19mm)	5/8"x3/4" (16mmx19mm)	3/4" (19mm)	7-1/2" (188mm)	2-1/2" (64mm)
	3/4" (19mm)		9" (225mm)	2-1/2" (64mm)
1" (25mm)	3/4" (19mm)	3/4" (19mm)	9" (225mm)	2-1/2" (64mm)
	1" (25mm)	1" (25mm)	10-3/4" (269mm)	2-1/2" (64mm)
1-1/2" (38mm)	1-1/2" (38mm)	1-1/2" (38mm)	13" (330mm)	2-BOLT FLANGE
2" (50mm)	2" (50mm)	2" (50mm)	17" (432mm)	2-BOLT FLANGE

NOTES:

1. THE METER SHALL BE ACCESSIBLE AND BE INSTALLED AS CLOSELY AS POSSIBLE TO THE POINT AT WHICH THE PRIVATE WATER SERVICE PIPE ENTERS THE BUILDING.
2. WHEN REQUIRED A BACKFLOW PREVENTER WILL BE INSTALLED ON THE OUTGOING SIDE OF THE WATER METER AND IN ACCORDANCE WITH CSA STANDARD B64.10-11/B6410.1-11 AND THE CK PUC BY LAW #???
3. ALL ISOLATION VALVES TO BE THE SAME SIZE AS PIPE SPOOL.
4. THE CHATHAM-KENT FORCES WILL SUPPLY: THE METER, 2-METER TAIL PIECES ('B'), AN EXTERIOR "TOUCH PAD" REMOTE READER UNIT, AND LOW VOLTAGE CABLE AS SHOWN (SINGLE DASHED LINE).

FILENAME: G:\PUC\MOGEORGE\2018 PUC SPECIFICATIONS\FIGURES\FIG-01 TO W19.DWG PLOTTED BY: DAVID MIDDLETON
 PLOT DATE: 2019-01-30 12:26:54 PM PLOT SCALE: 1:1 PLOT STYLE: CPUC HALF SIZE CTB

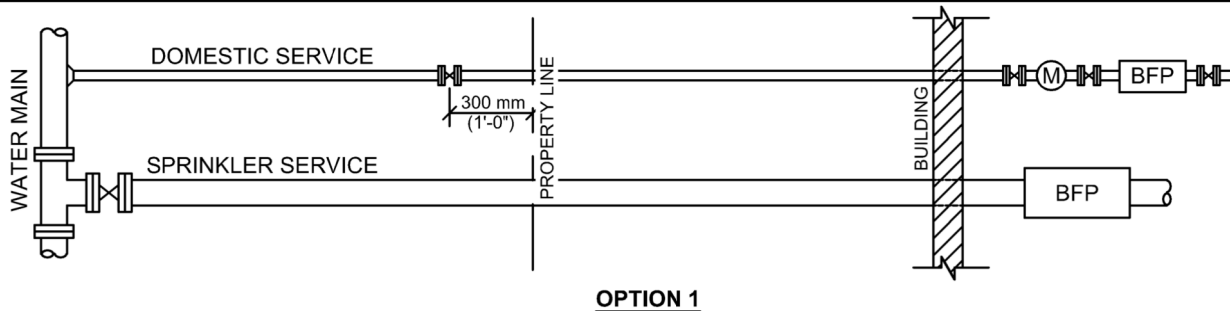


1	January 21, 2019
No.	Revision Date

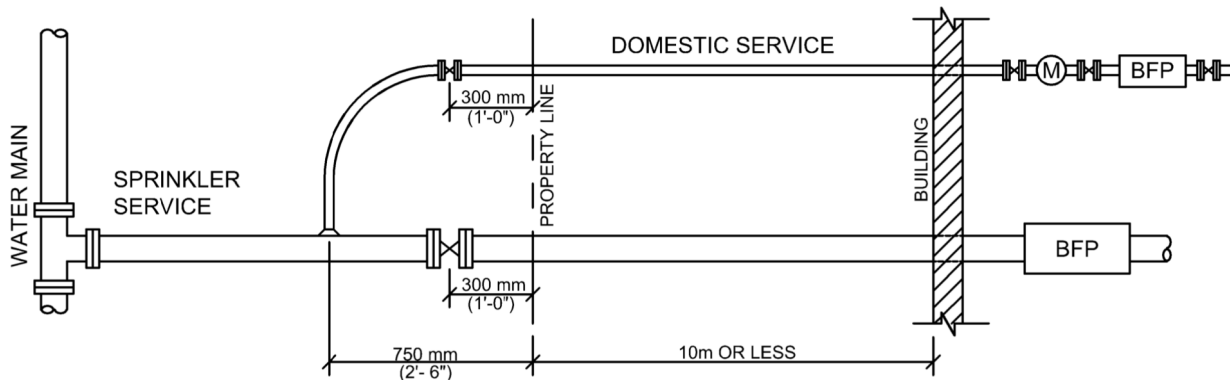
CHATHAM-KENT PUBLIC UTILITIES COMMISSION SPECIFICATIONS

Figure W-6

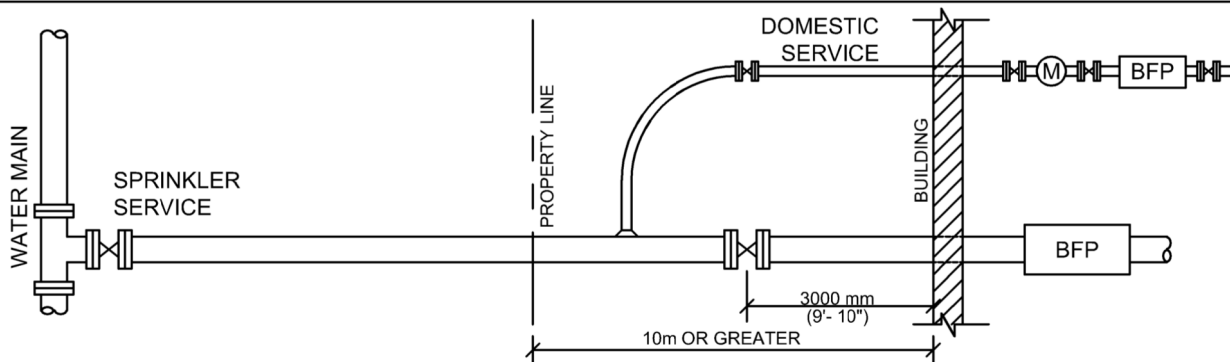
STANDARD URBAN PLACEMENT OF MAIN VALVES AND
HYDRANTS FOR 20m ROAD ALLOWANCE



OPTION 1



OPTION 2



OPTION 3



OPTIONS:

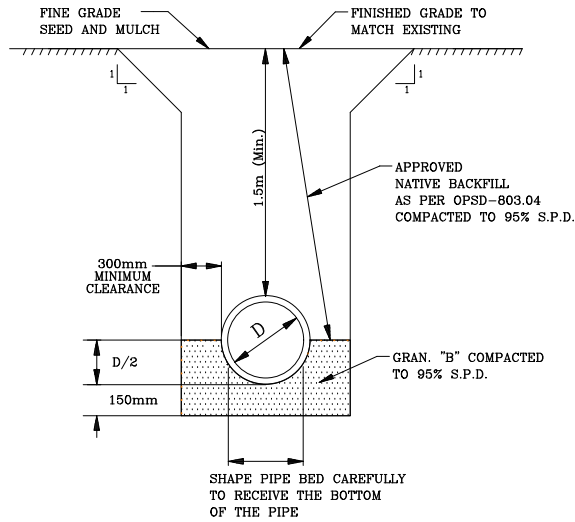
1. WHEN USING A TAPPING SLEEVE AND VALVE THE DOMESTIC SERVICE MUST BE TAPPED DIRECTLY INTO THE WATERMAIN.
2. INSTALLATION 'OPTION 2' MAY ONLY BE USED WITH THE CONSENT OF THE GENERAL MANAGER. MAXIMUM SIZE TAPPING OFF 150 mm (6") SPRINKLER SERVICE IS 50 mm (2") MAXIMUM SIZE TAPPING OFF 200 mm (8") SPRINKLER SERVICE IS 100 mm (4")
3. INSTALLATION 'OPTION 3' MAY ONLY BE USED WITH THE CONSENT OF THE GENERAL MANAGER. MAXIMUM SIZE TAPPING OFF 150 mm (6") SPRINKLER SERVICE IS 50 mm (2") MAXIMUM SIZE TAPPING OFF 200 mm (8") SPRINKLER SERVICE IS 100 mm (4")

NOTES:

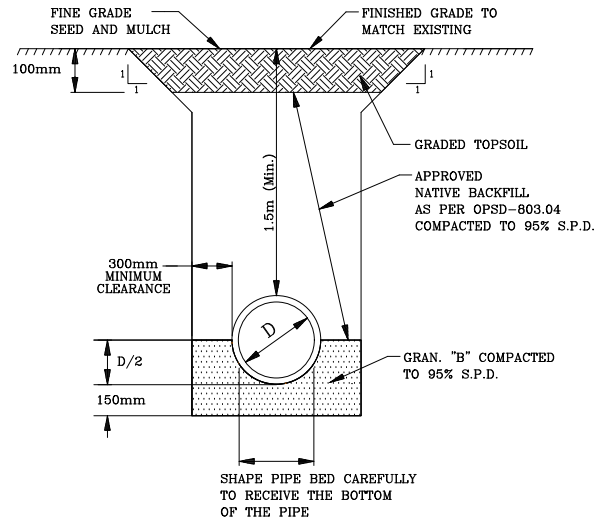
1. REFER AND ADHERE TO CK PUC CURRENT BACKFLOW PREVENTION BY-LAW.
2. ALL BACKFLOW PREVENTION DEVICES MUST BE INSTALLED BY AN APPROVED CONTRACTOR ON THE CK PUC BACKFLOW PREVENTION PROGRAM APPROVED CONTRACTORS LIST.
3. THE APPLICATION OF THE CK PUC BACKFLOW PREVENTION IS IN RESPECT TO PREMISE ISOLATION ONLY.

LEGEND

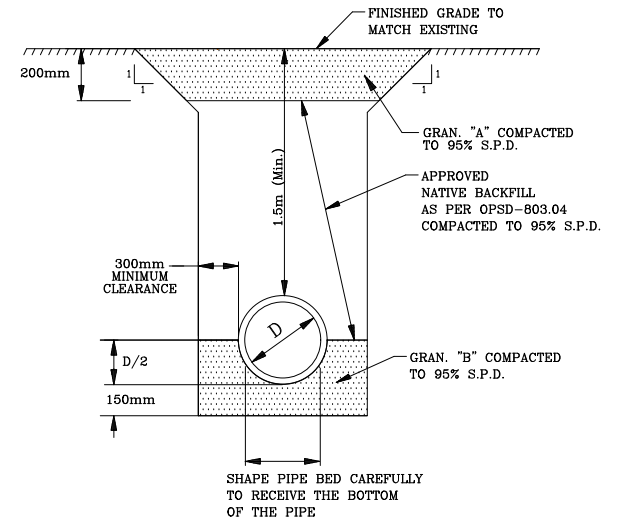
- BFP** BACK FLOW PREVENTER
-  WATER VALVE
-  WATER METER



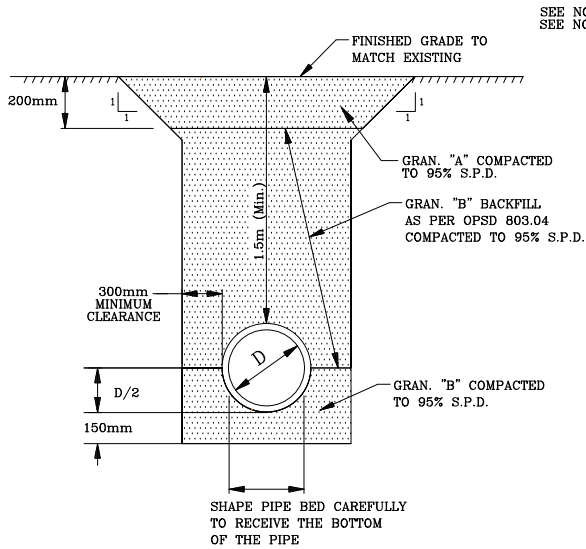
WITHIN GRASSED AREAS



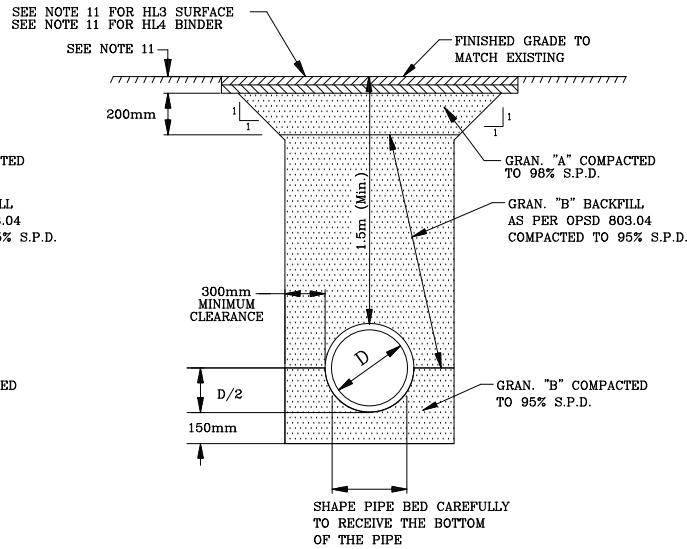
WITHIN DESIGNATED LAWN AREAS



WITHIN GRANULAR ROAD SHOULDER



WITHIN GRANULAR/NATIVE MATERIAL DRIVEWAY CROSSINGS



WITHIN ASPHALT AREAS

NOTES:

1. ALL EXCAVATIONS SHALL MEET REQUIREMENTS OF OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS.
2. CO-ORDINATE ALL UTILITY LOCATES IN FIELD PRIOR TO CONSTRUCTION.
3. ROAD CROSSINGS TO BE BORED OR OPEN CUT AS SPECIFIED.
4. ALL THRUST BLOCKS TO BE CONSTRUCTED AS SHOWN IN OPSD 1103.010
5. STANDARD 25mm DIAMETER WATER SERVICE CONNECTIONS TO BE AS SHOWN IN OPSD 1104.020 AND OPSD 1104.010. FINAL LOCATIONS TO BE CONFIRMED AT TIME OF CONSTRUCTION.
6. HYDRANT INSTALLATION TO BE AS SHOWN IN OPSD 1105.010 OFFSET AS DIRECTED IN FIELD.
7. RESTORE DRIVEWAYS AND ROADWAYS TO MATCH EXISTING. (SEE SPECS.)
8. RESTORE ALL OPEN DRAINS TO MATCH ORIGINAL GRADE AND CONTOUR CONDITIONS.
9. RESTORE ALL GRASSED AREAS AND DESIGNATED LAWN AREAS AS SPECIFIED.
10. ALL CULVERTS, END WALL TREATMENT AND TILE DRAINS REMOVED DURING THE PROCESS OF COMPLETING THE WORK ARE TO BE RESTORED TO MATCH EXISTING CONDITIONS. DAMAGED MATERIALS ARE TO BE REPLACED WITH APPROVED NEW MATERIALS OF SIMILAR SIZE.
11. THICKNESS OF HL3 SURFACE AND HL4 BINDER SHALL BE AT LEAST THE SAME THICKNESS AS ASPHALT ORIGINALLY REMOVED

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No.	Revision Date

FILENAME: G:\PUC\KENT-MOGEORGE\PUC_SPECS\2018 PUC SPECIFICATIONS\FIGURES\KUC-SPEC-FG-W1 TO W19.DWG PLOTTED BY: DAVID MIDDLETON
PLOT DATE: 2019-01-30 12:27:05 PM PLOT SCALE: 1:1 PLOT STYLE: CPUC HALF SIZE.CTB



NOTES:

1. SIGN TO BE PAINTED WHITE WITH BLUE LETTERS AND BORDER.
2. SIGN TO BE SUPPLIED AND INSTALLED BY THE CONTRACTOR.
3. SIGN TO BE MOUNTED ON 100mm X 100mm WOOD POSTS WITH SUITABLE FRAMING SUPPLIED BY THE CONTRACTOR AND PAINTED WHITE.
4. CHATHAM-KENT LOGO TO BE COLOUR.

PROJECT SIGN
2 REQUIRED



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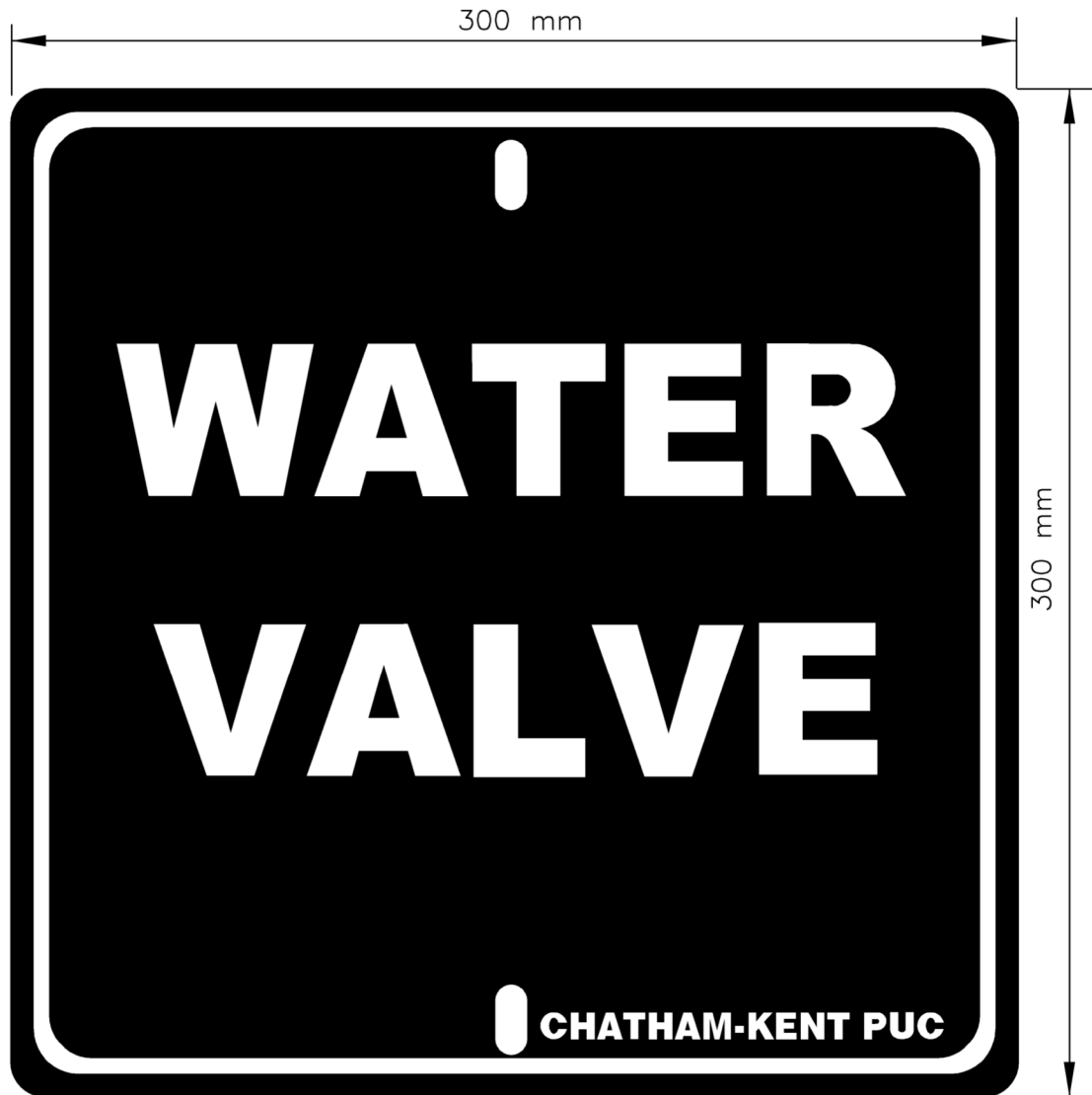
CHATHAM-KENT PUBLIC UTILITIES COMMISSION SPECIFICATIONS

Figure W-11
STANDARD CONSTRUCTION SIGN



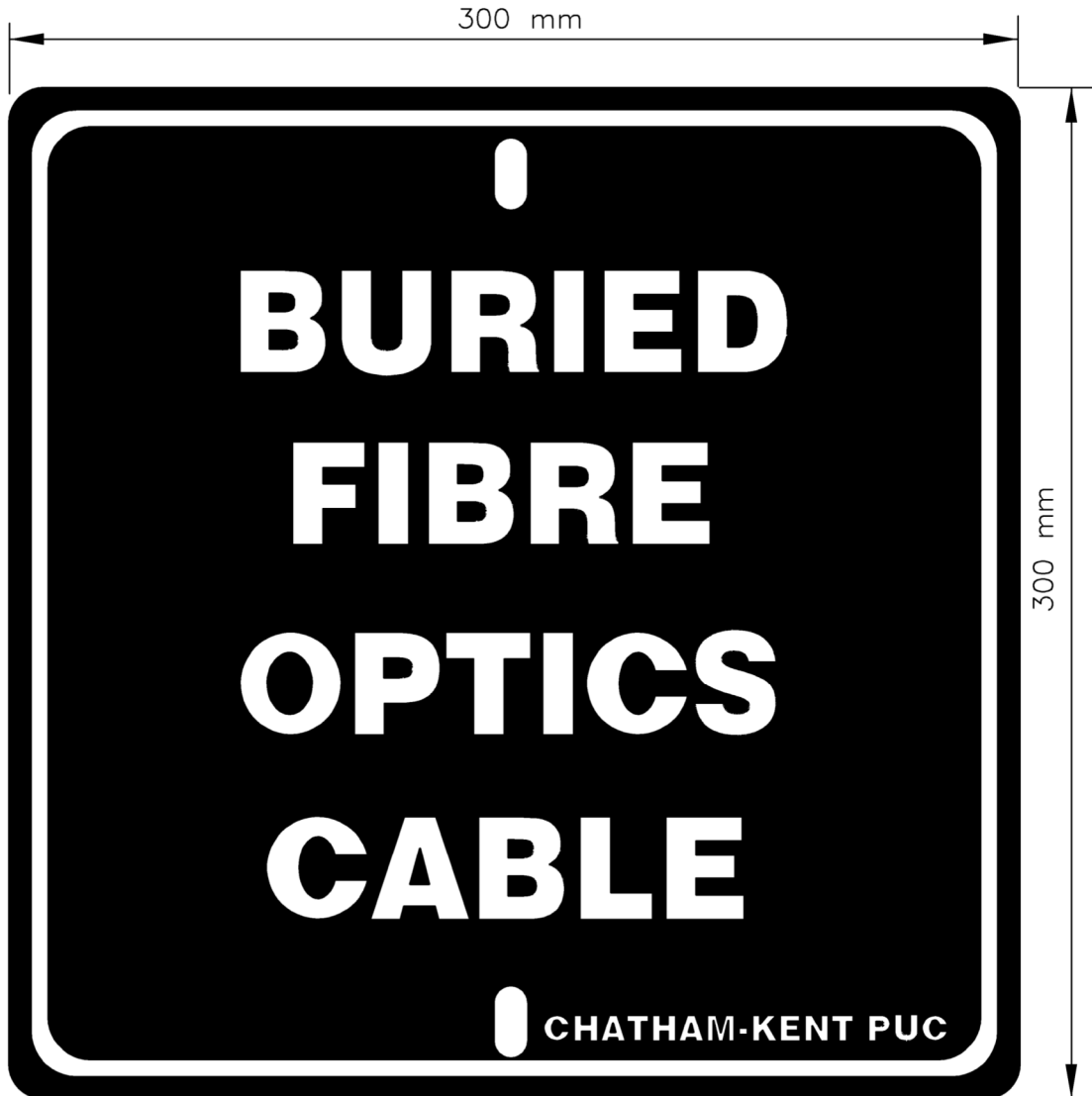
NOTES:

1. SIGN TO BE 300mm x 300mm ENGINEER GRADE REFLECTIVE SURFACE
2. WHITE TEXT FONT AS SHOWN
3. BLUE BACKGROUND WITH WHITE BORDER AS SHOWN
4. MATERIAL SHALL BE ALUMINUM BACKING
5. SIGN SHALL BE MOUNTED ON A 3.66 M "U" CHANNELLED STEEL POST
6. SIGN POST TO BE BUIRED 1.5m DEEP



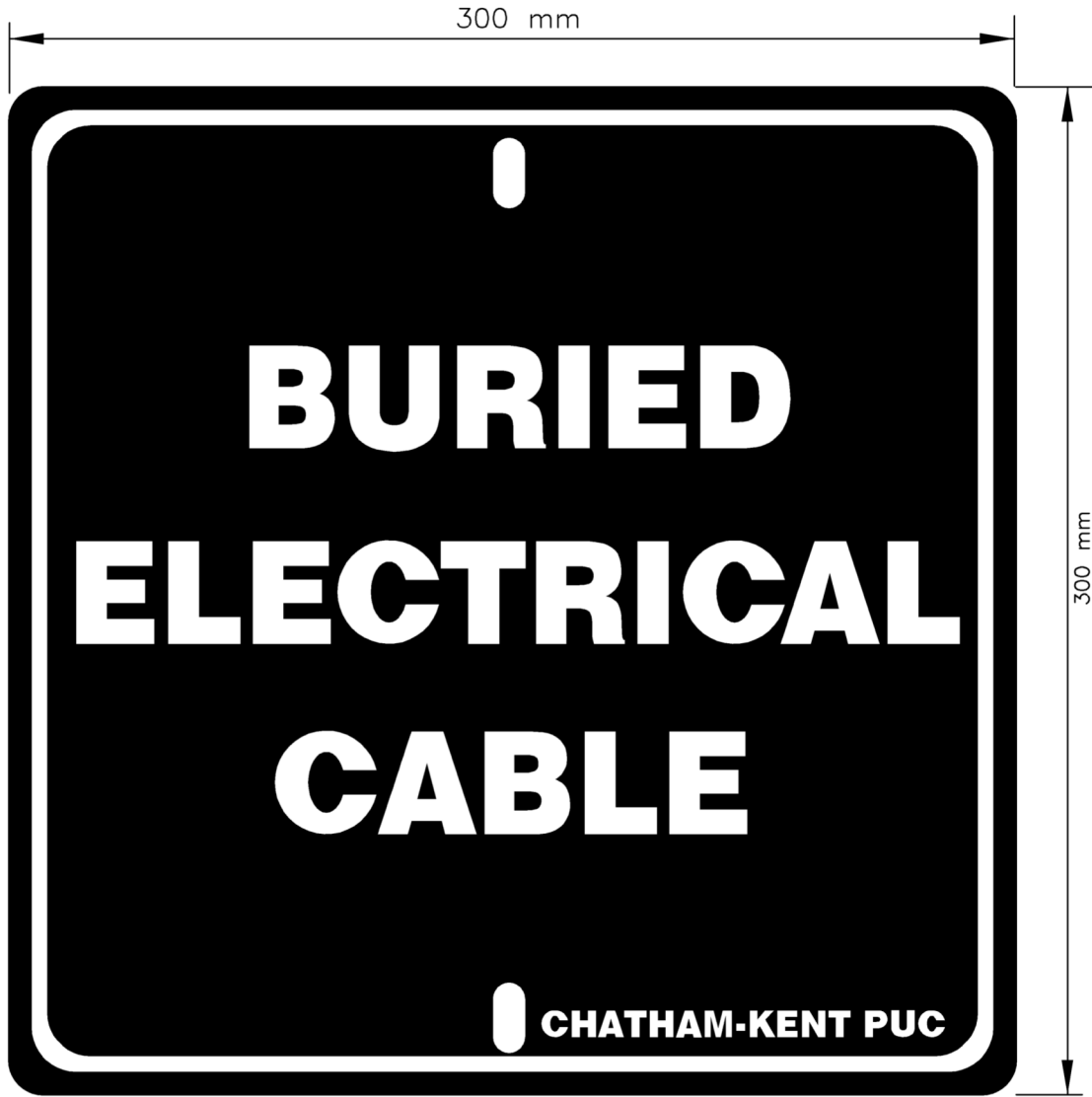
NOTES:

1. SIGN TO BE 300mm x 300mm ENGINEER GRADE REFLECTIVE SURFACE
2. WHITE TEXT FONT AS SHOWN
3. BLUE BACKGROUND WITH WHITE BORDER AS SHOWN
4. MATERIAL SHALL BE ALUMINUM BACKING
5. SIGN SHALL BE MOUNTED ON A 3.66 M "U" CHANNELLED STEEL POST
6. SIGN POST TO BE BUIRED 1.5m DEEP



NOTES:

1. SIGN TO BE 300mm x 300mm ENGINEER GRADE REFLECTIVE SURFACE
2. WHITE TEXT FONT AS SHOWN
3. ORANGE BACKGROUND WITH WHITE BORDER AS SHOWN
4. MATERIAL SHALL BE ALUMINUM BACKING
5. SIGN SHALL BE MOUNTED ON A 3.66 M "U" CHANNELLED STEEL POST
6. SIGN POST TO BE BUIRED 1.5m DEEP



NOTES:

1. SIGN TO BE 300mm x 300mm ENGINEER GRADE REFLECTIVE SURFACE
2. WHITE TEXT FONT AS SHOWN
3. RED BACKGROUND WITH WHITE BORDER AS SHOWN
4. MATERIAL SHALL BE ALUMINUM BACKING
5. SIGN SHALL BE MOUNTED ON A 3.66 M "U" CHANNELLED STEEL POST
6. SIGN POST TO BE BUIRED 1.5m DEEP

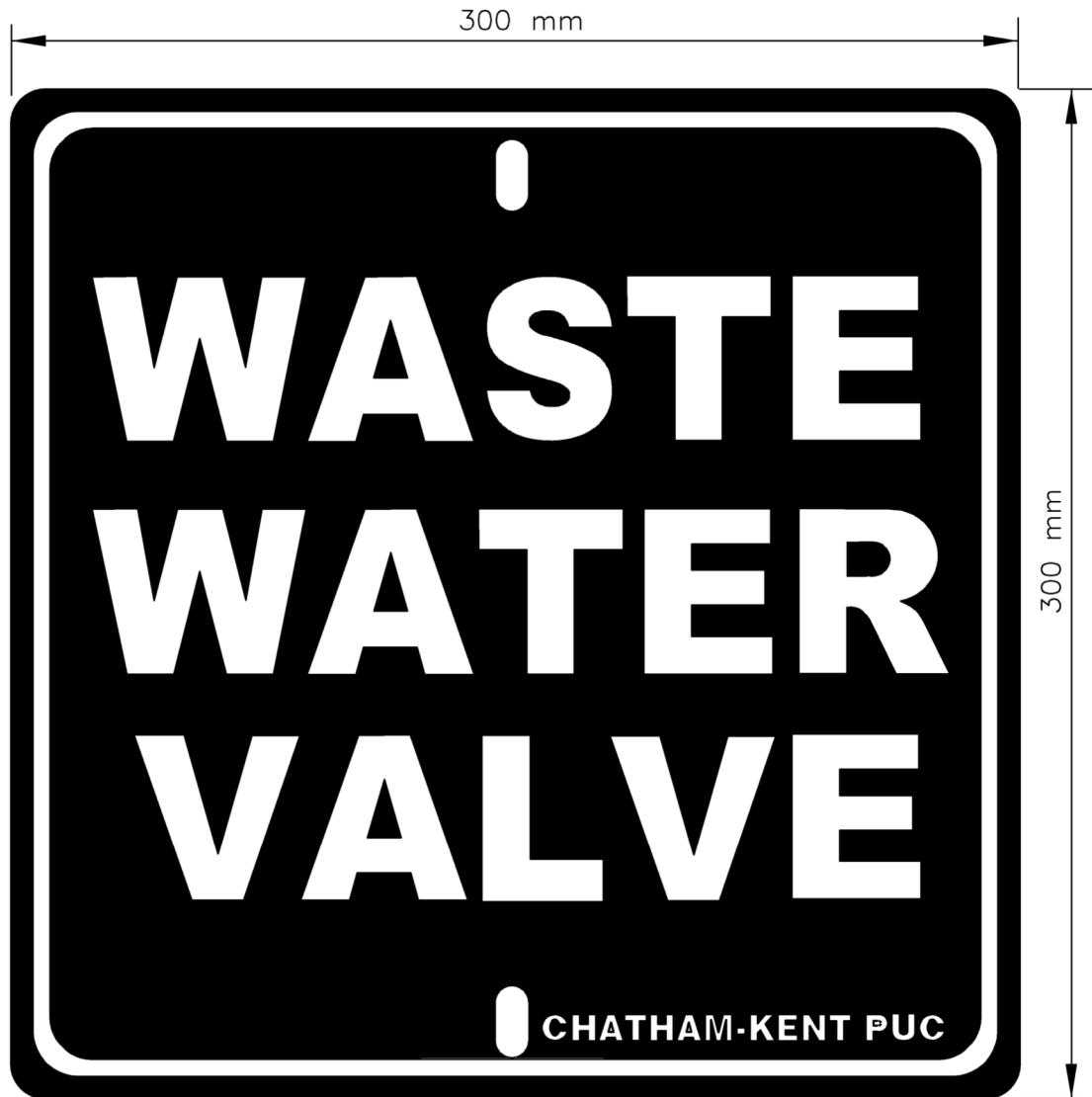
FILENAME: C:\PUC\KENT\MOORE\KENT_PUC_SPECS\FIGURES\KENT-PUC-FIG-W16 TO W19.DWG PLOTTED BY: DAVID MIDDLETON
 PLOT DATE: 2019-01-30 12:27:15 PM PLOT SCALE: 1:1 PLOT STYLE: CHAM_KENT_SIZE.CTB

1	January 21, 2019
No.	Revision Date



NOTES:

1. SIGN TO BE 300mm X 300mm ENGINEER GRADE REFLECTIVE SURFACE
2. WHITE TEXT FONT AS SHOWN
3. BLUE BACKGROUND WITH WHITE BORDER AS SHOWN
4. MATERIAL SHALL BE ALUMINUM BACKING
5. SIGN SHALL BE MOUNTED ON A 3.66 M "U" CHANNELLED STEEL POST
6. SIGN POST TO BE BUIRED 1.5m DEEP



NOTES:

1. SIGN TO BE 300mm x 300mm ENGINEER GRADE REFLECTIVE SURFACE
2. WHITE TEXT FONT AS SHOWN
3. GREEN BACKGROUND WITH WHITE BORDER AS SHOWN
4. MATERIAL SHALL BE ALUMINUM BACKING
5. SIGN SHALL BE MOUNTED ON A 3.66 M "U" CHANNELLED STEEL POST
6. SIGN POST TO BE BUIRED 1.5m DEEP



NOTES:

1. SIGN TO BE 300mm x 300mm ENGINEER GRADE REFLECTIVE SURFACE
2. WHITE TEXT FONT AS SHOWN
3. GREEN BACKGROUND WITH WHITE BORDER AS SHOWN
4. MATERIAL SHALL BE ALUMINUM BACKING
5. SIGN SHALL BE MOUNTED ON A 3.66 M "U" CHANNELLED STEEL POST
6. SIGN POST TO BE BUIRED 1.5m DEEP