

1.0 **GENERAL**

1.1 **UBC Energy & Water Services Jurisdiction**

- .1 UBC Energy & Water Services (EWS) is responsible for design, operation, maintenance, and overall stewardship for each of the following underground utility services:
 - .1 Section 33 10 00 Water Utilities
 - .2 Section 33 51 00 Natural Gas Distribution
 - .3 Section 33 63 00 Steam Energy Distribution
 - .4 Section 33 49 00 Storm Drainage
 - .5 Section 33 30 00 Sanitary Sewerage Utilities
 - .6 Section 33 71 00 Electrical Utility Transmission and Distribution
 - .7 Section 33 61 00 District Hot Water Energy Distribution
- .2 The demarcation point of service defining UBC Energy & Water Services' responsibility is included in the respective sections as listed above.

1.2 **UBC Energy & Water Services Contact Information**

- .1 Engineering & Utilities:

6130 Agronomy Rd,
Vancouver, BC V6T 1Z3
Phone: (604) 822-9445
Fax: (604) 822-8833

Energy Conservation & Innovation:
2260 West Mall
Vancouver, BC V6T 1Z4
Phone: (604) 822-5301

- .2 Key Positions in Utilities include:
 - .1 Director, Engineering and Utilities
 - .2 Senior Manager, Electrical Utilities
 - .3 Senior Manager, Mechanical Utilities
 - .4 Mechanical Utilities Engineer
 - .5 Lead Trades: Head Electrician, Head Plumber, Head Steamfitter, Head Utilities Maintenance Engineer.

1.3 **Designer and Contractor Responsibility**

- .1 UBC Technical Guidelines establishes the minimum acceptable standards for the supply and installation of the underground utility services to the buildings on the campus. This is not a design manual. The designer is responsible to ensure that the standards stipulated herein are consistent with the project requirements and are adequate for the project design criteria. The designer shall define the project requirements in the project specification as part of the project tender document.
- .2 Where comments in UBC Technical Guidelines is interpreted to conflict with the industry Standards, Acts and Codes, the compliance with the Standards, Acts and Codes shall prevail and the designer shall bring these conflicts in writing to the attention of the responsible manager at UBC Energy & Water Services.

- .3 The consultant and/or contractor shall provide drawings in accordance with the Technical Guidelines. Within 60 days from backfill, the consultant and/or contractor shall provide a set of Red Line drawings to UBC Energy & Water Services. Upon completion of installation of any new or modified underground utility services and prior to a final walkthrough before hand over to owner, Record drawings of underground utility services shall be provided to *Infrastructure Development, Records*. Record drawings shall show utility service and/or infrastructure details as constructed including, for example, pipe or infrastructure facility size, material, invert and rim elevations, etc. Service profiles shall be provided in congested areas indicating location of all services. See Section 01 78 39 Project Record Documents for details. Upon completion, CCTV inspections must also be provided to UBC Energy & Water Services (see specifications 33 82 01 and 33 01 30.41 at <https://energy.ubc.ca/community-services/contractors-developers/>).
- .4 UBC Energy & Water Services has created checklists intended to guide projects through the steps and procedures required to successfully coordinate with UBC EWS and obtain approval for various construction activities/stages. The forms should be completed and submitted to UBC EWS prior to final completion and acceptance of the project. Note that these forms ONLY addresses coordination with mechanical utilities (water, sanitary, storm and gas) and District Energy. Coordination required for electrical utilities is not outlined in these forms and should be addressed separately. The forms (UBC Mech Construction Checklist and UBC DES Construction Checklist), along with other required connection and activation application forms for contractors and consultants can be downloaded here: <https://energy.ubc.ca/community-services/contractors-developers/>.

2.0 UBC ENERGY & WATER SERVICES (EWS) DEVELOPMENT SUPPORT SERVICES

2.1 General

- .1 Table 2.1.1 outlines the utility requirements assessment in the project approval process for core UBC buildings. Support services and development requirements are defined in terms of UBC Board of Governors approval status.

Table 2.1.1
Utility Requirements Assessment
in the Project Approval Process for Core UBC Buildings

Timing	Utility Planning and Design Work	Product	Lead Responsibility
Prior to Exec 2	As part of the siting process complete an engineering requirements assessment <ul style="list-style-type: none"> - Run the master servicing model - Complete GIS overlay analysis to identify all utilities requiring move or protection 	Engineering and Services Requirement Document (based on general floorspace)	Campus & Community Planning - May refer to EWS for comment, but always provided for information

Timing	Utility Planning and Design Work	Product	Lead Responsibility
Prior to Exec 3/ Board 1	Utilities Concept Design	Engineering Sketch and Costing* (to be included in project design brief) * to include site plan and possible services connection locations *Project Manager / applicant to provide costing	Campus & Community Planning - Include EWS and project managers in working session to prepare concept design - Variances from Engineering and Services Requirements document must be approved by Managing Director, Building Operations & Associate VP, Campus & Community Planning.
Prior to Board 2	Utilities Schematic Design No later than halfway through the development of schematic design, an integrated design discussion should be held with Campus & Community Planning, EWS and Building Operations representatives	Engineering design drawings* * prepared by applicant team * must be part of Development Permit (DP) Application submission Preliminary service connection application information to be provided	Campus & Community Planning - Design drawings submitted through DP application circulated to EWS and Campus & Community Planning UA/Eng Services for comment in 10 working days - Campus & Community Planning to verify model analysis
Post Board 2	Drawing Review against Technical Guidelines	Service Connection Application with drawings and variance requests from either Engineering Services Requirements document or Technical Guidelines	Technical Guidelines variances approved by Managing Director, Building Operations and Managing Director, Infrastructure Development
Prior to Development Permit Issuance		Development Permit with Engineering Requirements Document attached	Campus & Community Planning for Development Permit

Timing	Utility Planning and Design Work	Product	Lead Responsibility
<p>Engineering Clearance for Building and Streets and Landscape Permits*</p> <p>*Building permits address all onsite engineering works and services; Streets and Landscape permits address all offsite engineering works and services</p>	<p>Vancouver Coastal Health (VCH) Water Connection Permit</p> <p>Review of service connection design for Building Permit and / or Streets and Landscape Permit Applications</p>	<p>Permit from VCH</p> <p>Final Service Connection clearance for either:</p> <p>Staged Building Permit – Excavation / Shoring, Foundation and/ or Full (addresses onsite works and services)</p> <p>or</p> <p>Streets and Landscape Permits (addresses offsite works and services and public realm projects)</p>	<p>Applicants secure permit (or EWS for UBC utility infrastructure projects)</p> <p>EWS to provide Service Connection clearance to Campus & Community Planning</p> <p>EWS to provide Service Connection clearance to Campus & Community Planning</p>
<p>As part of Building Permit process</p>	<p>Site visit prior to backfill of below-grade works and services</p>	<p>Record drawings based on digitized red-line construction drawings, submitted to Infrastructure Development, Records by project manager (set of red line drawings to be provided within 60 days of backfill)</p> <p>Survey of inverts to check compliance with design (completed prior to walk-through)</p> <p>Photos of installation and sewer CCTV inspection reports submitted to Infrastructure Development, Records by project manager</p>	<p>EWS for walk-through of installation and review of red line construction drawings</p> <p>Working Group and Steering Committee for problem solving</p> <p>Final loading data for utilities to be provided by applicant (to Campus & Community Planning and EWS)</p>

2.2 Underground Utility Record Drawings

- .1 Record drawings for all underground utility services must be obtained from Infrastructure Development, Records (Telephone: 604-822-9570).

2.3 Field Inspections

- .1 To verify or complement record drawing information, UBC Energy & Water Services will provide trades staff support to assist in verifying locations, condition, and features of existing underground utility services. Trades staff will be supported by UBC Energy & Water Services engineering and technical professionals.

- .2 Written requests (facsimile or email) shall be submitted as follows:
 - .1 For electrical service contact Senior Manager, Electrical Utilities.
 - .2 For gas, district hot water, water, sanitary, or storm contact Senior Manager, Mechanical Utilities.
- .3 UBC Energy & Water Services charges a \$300 fixed fee per utility service per site. For example, field inspections for water, electrical, sanitary sewer, and storm sewer underground utility services for a new development would cost \$1,200.

2.4 Shutdowns

- .1 UBC Energy & Water Services has sole authority and responsibility to perform shutdowns (or cross connections) of the systems within its jurisdiction. The cost for a service shutdown is based on time and materials, paid by the project.

2.5 Utility Service Connection Permits

- .1 A service connection permit is required for any connection to a utility service as defined in the following Sections in Division 33:
 - .1 Section 33 10 00 Water Utilities
 - .2 Section 33 51 00 Natural Gas Distribution
 - .3 Section 33 63 00 Steam Energy Distribution
 - .4 Section 33 49 00 Storm Drainage
 - .5 Section 33 30 00 Sanitary Sewerage Utilities
 - .6 Section 33 71 00 Electrical Utility Transmission and Distribution
 - .7 Section 33 61 00 District Hot Water Energy Distribution
- .2 The Service Connection Application must be completed and submitted to UBC Energy & Water Services per the instructions on the form. Refer to Energy & Water Services Forms at: <https://energy.ubc.ca/community-services/contractors-developers/>.
- .3 The Service Activation Request must also be submitted to UBC Energy & Water Services prior to any energization of systems. Refer to above link for *Activation* Request form.
- .4 Additional permits from the provincial Electric Safety Branch, Gas Safety Branch, Boiler Safety Branch, Plumbing permits (UBC C&CP) and the Construction Permit from Vancouver Coastal Health, are the responsibility of the project team.

2.6 Development Permit Approval by UBC Energy & Water Services

- .1 The Director, Engineering and Utilities, of UBC Energy & Water Services has sole authority to authorize underground utility service aspects of any development. Sign off of development permits by UBC Energy & Water Services is coordinated by Campus and Community Planning.

END OF SECTION

1.0 **GENERAL**

This section refers to the works that are unique to the requirements for cleaning of new and existing sanitary and storm sewer pipe and pipe culverts.

1.1 **Related Sections**

- .1 Section 33 00 10 Underground Utilities Services
- .2 Regulation - Traffic and Highway Bylaw
- .3 Section 33 82 01 CCTV Pipeline Inspection

1.2 **References**

- .1 This section must be referenced to and interpreted simultaneously with all other sections of the Technical Guidelines pertinent to the works described herein.

1.3 **Material Certification**

- .1 All materials to conform to this specification, to the latest edition of the appropriate specifications of the American Society for Testing and Materials (ASTM) or other standards expressly specified. All provisions in ASTM and other specified standards pertaining to materials, workmanship, finish, inspection and rejection form part of these specifications as far as they are applicable and providing that they are not inconsistent with this specification. This specification takes precedence over the ASTM specifications in case of a discrepancy or conflict. Materials incorporated into the Work but not specifically covered in the specifications are to be obtained from the Contract Administrator prior to installation.

1.4 **Work Regulations**

- .1 Work to conform to all applicable regulations of Work Safe BC Confirm training compliance in the following:
 - .1 Confined space entry procedures
 - .2 Atmospheric monitoring and ventilation methods
 - .3 Personal protective equipment
 - .4 Interpretation of Material Safety Data Sheets (MSDS)

1.5 **Terminology**

- .1 Flushing is defined as a maximum of three (3) passes of high pressure jetting equipment to allow for passage of CCTV or other forms of inspection equipment.
- .2 Cleaning is defined as the removal of all debris by means of high pressure jetting equipment including: gravel, sand, rocks (to 300mm in diameter), grease and other deleterious material.

1.6 **Submissions**

- .1 Submit the following information seven (7) days prior to the commencement of work:
 - .1 Provide schedule and sequence of flushing or cleaning activities
 - .2 Provide dates of training completion for all workers to the Engineer and a list of equipment required for confined space entry.

1.7 **Scheduling**

- .1 Schedule work to minimize interruptions to existing services.
- .2 Hours of work to comply with noise restriction bylaw unless granted exemption.

- .3 Maintain existing flow during sewer cleaning and debris removal unless directed otherwise in contract document.

1.8 Measurement for Payment

- .1 All units of measurement for payment will be as specified herein unless shown in the Form of Tender.
- .2 Sewer cleaning and sewer flushing will be measured in lineal metres. Payment will be made at the unit price bid in Form of Tender.
- .3 Measurement for sewer flushing and debris removal to be determined from plan distances and periodically confirmed by surface measured distances with a calibrated measuring devise.
- .4 Measurement for sewer cleaning and debris removal to be determined from plan distances and periodically confirmed by surface measured distances with a calibrated measuring devise.
- .5 Manhole cleaning will be made at a per unit rate as described in the Form of Tender.
- .6 Root cutting will be measured in hours. Payment will be made at the unit price bid in Form of Tender. Measurement will be determined from the difference in time between when the cutting tool is engaged at the face of the manhole to when it exits on completion of the root removal process.
- .7 Grease cutting and removal will be measured in hours. Payment will be made at the unit price bid in Form of Tender. Measurement will be determined from the difference in time between when the cutting tool is engaged at the face of the manhole to when it exits on completion of the grease removal process.
- .8 Debris disposal is considered incidental to associated cleaning and flushing work. No separate payment will be made for debris disposal.

2.0 PRODUCTS

2.1 Equipment

- .1 High velocity cleaning equipment to be capable of providing a minimum flow of 200 litres per minute (60 GPM) at 140 bar (2000 psi). Cleaning nozzle to be hydraulically or hydro-dynamically propelled and capable of producing a scouring action from 15 to 45 degrees. A variety of ancillary equipment and nozzles to be available including; standard flushing nozzles, high efficiency , spinning jet and plough jet to address all anticipated debris conditions. The equipment to include a water tank, pumps and hydraulically driven hose reel. Equipment to include a wash down gun for cleaning manholes and an approved back flow preventing device for water tank filling.
- .2 Debris removal equipment to consist of a vacuum pump complete with positive displacement pumps or fans producing a minimum of 700 l/s air movement. Equipment to be capable of removing debris at a minimum of 4.5 metres vertical head. Suction hose to be a minimum of 150 mm diameter. Debris tank to be water tight and capable of returning the liquid portion of the debris to the sewer.
- .3 Debris cutting equipment to be an accessory or attachment to hydraulic cleaning equipment. Equipment to be capable of removing heavy roots and solid debris such as encrustation and grease.

- .4 Backflow prevention valves for the purpose of drawing water from hydrants to have air gap and must be pre-approved by the Water Utility Operations Department.
- .5 All water used in the flushing or cleaning of storm sewers shall comply with BC Environmental Management Act and corresponding Municipal Sewage Regulation and be subject to de-chlorination with ascorbic acid or similar approved product prior to use.

3.0 EXECUTION

3.1 Clean or Flush

- .1 Clean or flush all pipelines as specified in contract documents. Notify Engineer immediately in the event that roots, grease or unusual quantities of debris is observed after three passes.
- .2 Notify all affected residences connected to the sanitary sewers in writing of proposed sewer cleaning and CCTV inspection process as specified in the contract documents. Notice to be distributed two (2) working days in advance of flushing. Notice to include Contractor's name and contact information.
- .3 Begin cleaning or flushing from the upstream sewer in the system and proceed downstream. Under no circumstances is the sewer cleaning or flushing process to proceed downstream until all contributing upstream sewers have been cleaned. Sewers to be cleaned or flushed in the direction of flow.
- .4 A manhole to be washed down with high pressure wand AFTER manhole inspection has been completed.
- .5 Remove debris by vacuum pumping at each manhole. Do not pass debris from manhole to manhole.
- .6 Dispose of debris at an approved landfill site
- .7 Comply with applicable Provincial and Municipal environmental laws in regard to the decanting of accumulated waste water with respect to spills and discharge of contaminants.
- .8 Decanting of liquid waste accumulated during debris removal is permitted at a controlled release rate of a maximum of 8 litres per second.

3.2 Water Supply

- .1 Water may be obtained from any UBC fire hydrant once permits are issued. Permit applications will be submitted to Permits & Inspection (Phone: 604 822-8228). Application and instructions are available at <https://planning.ubc.ca/planning-development/permits-and-business-licenses/building-and-trades-permits/trades-permits>
- .2 Dechlorinate all water used for cleaning and flushing storm sewers prior to discharge from tanker in accordance with Section 8 (1) of the Municipal Sewage Regulation.

3.3 Root Removal

- .1 Inform Contract Administrator prior to undertaking any root cutting or grease removal where cutting equipment is required.
- .2 Run root cutter through entire section of pipeline from manhole to manhole or end of pipe to end of pipe.
- .3 Select root cutting devise or grease removal nozzle of appropriately size and configuration for the diameter of the pipeline.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 33 82 01s CCTV Pipeline Inspection (see <https://energy.ubc.ca/community-services/contractors-developers/>)
- .2 33 01 30.41s Cleaning of Sewers (link as above)

1.2 **System Description**

- .1 The campus has a dedicated sanitary sewer system which discharges to the Metro Vancouver trunk system; both to the north and to the south. Each discharge to the Metro Vancouver system is equipped with a flow meter. There are currently 3 communal pump stations and approximately 30 individual building pump stations within the campus wide system.

2.0 **MATERIAL AND DESIGN REQUIREMENTS**

2.1 **Responsibilities**

- .1 UBC Energy & Water Services (EWS) is primarily responsible for operation, maintenance, and overall stewardship of the sanitary sewers in cooperation with the following departments/organizations:
 - .1 UBC Health, Safety, & Environment.
 - .2 UBC Sustainability.
 - .3 UBC Properties Trust.
 - .4 UBC Campus Planning & Development.
 - .5 UBC Building Operations.
- .2 The demarcation of UBC Energy & Water Services point of service is defined in the standard drawing found under Division 33 section listings here:
http://www.technicalguidelines.ubc.ca/technical/standard_drawings.html#div33
- .3 The project Designer must incorporate all specific requirements for design and materials and execution of this section into the contract drawings in the form of job-specific notes. Only making reference to UBC Technical Guidelines in the drawings is not sufficient.

2.2 **Sanitary Sewer Standards**

- .1 The latest revisions of the following standards shall apply to sanitary sewers at UBC:
 - .1 BC Master Municipal Construction Documents (MMCD).
 - .2 GVRD Sewer Use Bylaw No. 299 latest edition.
 - .3 UBC Environmental Protection Policy # 6
(<http://universitycounsel.ubc.ca/policies/index/>).
 - .4 UBC Sustainability Development Policy #5
(<http://universitycounsel.ubc.ca/policies/index/>).
 - .5 BC Provincial Health Act.

2.3 Sanitary Sewer Connections

- .1 The first step to install any new or substantially modified connections to the sanitary sewer system at UBC is to complete a Utility Service Connection Application. This and other forms can be found at <https://energy.ubc.ca/community-services/contractors-developers/>.
- .2 Campus Planning and Development's Regulatory Services also require a Plumbing Permit to meet provisions of the B.C. Building Code Plumbing Provisions.
- .3 Any new connections to the sanitary sewer system will be reviewed for consistency with the Sanitary Sewer Master Servicing Plan.
- .4 The Designer shall obtain the sanitary service records by contacting the Records Clerk at the Infrastructure Development, Records (Phone: 604-822-9570) and develop proposed service connection location(s). Service connections may be possible to more than one sanitary sewer main fronting the site.

2.4 Sanitary Sewer Discharge

- .1 As part of the development design submission, the Designer shall provide the following:
 - .1 Estimates on the number and types of plumbing fixtures proposed in the buildings (i.e. low-flow vs. conventional).
 - .2 The waste stream must be fully characterized by type and quantity.
 - .3 The design flows must be identified for all pipe reaches.
 - .4 Any chemical or biological materials must be fully disclosed and addressed in the design.
 - .5 All waste being discharged shall be in compliance with the GVRD Sewer Use Bylaw No.164. A materials handling and disposal management strategy report must also be submitted for all waste which is not in compliance.
 - .6 The sanitary discharge characterization may be included in the drawing notes of the mechanical or civil design drawings for the development.

2.5 Sanitary Sewer Design

- .1 Sanitary sewer systems shall be designed using the Peak Wet Weather Flow (PWWF). The PWWF flow shall be the sum of the Peak Dry Weather Flow (PDWF), infiltration flow, and pumped flow.
- .2 The PDWF shall be the product of the Average Daily Flow (ADF) and the peaking factor. The minimum ADF rates shown in Table 2.5.2 shall be used:

**Table 2.5.2
 Summary of Minimum Average Daily Flows (ADF)**

Flow Category	Description	Category Code	Average Daily Flow
Family Residential	Housing for families, post graduate couples, professional, faculty and staff.	RES-F	325 Lpcd
Student Residential	Housing for students – apartments, dormitories, shared units.	RES-S	230 Lpcd
Office	Administrative and academic offices.	OFF	90 Lpcd
Classrooms	Classrooms, lectures, teaching labs, student and community activities.	CL	90 Lpcd
Research Facilities	Research and processing.	RSH	90 Lpcd
Mixed Building Use	Mixed use of classrooms, lecture halls, labs, research, administration and academic.	M-RCO	90 Lpcd
Library	Libraries.	LIBRY	90 Lpcd
Medical/ Clinical	Clinics, medical sciences research and teaching.	MEDIC	4 L/m ²
Animal Sciences	Livestock holding for research purposes.	ANIMAL	7.5 L/m ²
Assembly	Visitor oriented buildings for conferences, events, and cultural shows.	ASSM	16 L/m ²
Food Services	Dominant floor area designed for preparing and serving food services.	FOOD	100 L/m ² dining area
Hospital	Hospital.	HOSP	680 L/bed or 7 L/m ²
Other Uses	No distinct common use or other than described above.	OTHER	Specifically determined for use.

- .3 The ADF values listed above shall be considered minimum values. The varied building uses and activities at UBC may produce unique sewage flow rates. The Developer is responsible to ensure that flow rates are computed in accordance with the specific size and activities of the proposed facility. All pertinent information shall be provided on the design drawings as described above.
- .4 The PDWF shall be computed using the Harmon Peaking Formula.
- .5 An infiltration rate of 250 litres per pipe diameter (m) per Length (m) per day shall be added to the PDWF to determine the PWWF.
- .6 Sanitary sewer shall flow only by gravity into UBC sanitary system. Only under unique circumstances will pumped sewage be considered, but a request for a permission to do so shall be submitted to UBC Energy & Water Services with an explanation why the sanitary sewer cannot run by gravity, the proposed pump capacity (L/s) at operating head (kPa), a diagram showing pump curve with the superimposed piping system curve at operating flow and head and sump dimensions with elevations at which pump starts and stops. Sump volume between pump start and stop elevations shall be sized so that the maximum number of On/Off cycles does not exceed six per hour.
- .7 Gravity sewers shall be sized using the Manning's Formula using an "n" value of 0.011 for PVC or 0.013 for concrete. New gravity sewers shall be sized such that the PWWF depth will

- not exceed 50% of the full depth of the pipe, with a resulting minimum flow velocity of 0.6 m/s.
- .8 Forcemains shall be sized using the Hazen-Williams formula using a “C” value of 100. Forcemains shall have a minimum pipe size of 100 mm and designed for a minimum velocity of 0.9 m/s.
 - .9 Forcemains grades should be straight lines between defined deflection points and elevations should be recorded. Where possible, the minimum grade of forcemains should be 0.1% and grading should be designed to minimize the number of highpoints. Air release valves are required at high points.
 - .10 When extending the existing trunk lines, sufficient size, depth and slope of the sewer shall be maintained to facilitate the future extension of service in accordance with the Sanitary Sewer Master Servicing Plan.
 - .11 A minimum pipe size of 200 mm shall be used for gravity service mains in residential areas and 250 mm in research / industrial areas. A minimum pipe size of 150 mm shall be used for service connections.
 - .12 Regardless of pipe slope and capacity, the downstream pipe shall be of equal or larger diameter. No downsizing is permitted.
 - .13 Manholes at maximum 100 m spacing shall be installed at each branch connection and each change of direction. Top of manholes shall be 150 mm above the ground in all landscaped areas, otherwise flush with surface. Pipe shall be straight between manholes.
 - .14 Service connections exceeding 20m in length shall connect to sanitary mains with a manhole. Service connections less than 20m length shall connect to sanitary mains as per MMCD Section 33 03 01 or as approved by UBC EWS.
 - .15 The maximum length of any service, from building face to the first manhole or main line connection, shall be 75 m.
 - .16 All services should connect to the mainline distribution system at locations within roadways or utility corridors approved by UBC EWS.
 - .17 MMCD Inspection Chambers are not allowed on the sanitary sewer system under UBC Energy & Water Services jurisdiction.
 - .18 Minimum grades for sanitary services shall meet the requirements of MMCD and BC Building Code.
 - .19 A minimum 750 mm horizontal clearance is required where the sanitary sewer is installed within a common trench with the storm sewer. If the invert of the sanitary sewer varies significantly from the storm sewer, the Designer shall give special consideration to the horizontal spacing. Clearance from building footings shall be approved by EWS and be a minimum of 3 m per MMCD General Design guideline clause 1.3.
 - .20 When crossing electric duct bank, run pipe below electrical duct bank with minimum 150 mm vertical clearance from the bottom of electric duct bank. Crossing angle shall be between 45° degree and 90° degree.
 - .21 Where drop manholes are required, drops shall be outside, with clean-outs.

- .22 All manholes shall be benched and have a minimum drop of 30 mm. The drop shall be increased to 50 mm for deflection angles exceeding 45° degree.

2.6 Materials

- .1 Unless otherwise approved in writing by UBC Energy & Water Services, only the following pipe material shall be used for the gravity sanitary sewer system:
 - .1 PVC piping is preferred for all piping 450 mm in diameter or smaller, SDR 28 for 150 mm diameter and smaller and SDR 35 for larger than 200 mm.
 - .2 Concrete for 450 mm diameter and larger (reinforced C76 required for all pipes 600 mm in diameter and larger).
- .2 Unless otherwise approved in writing by *UBC Energy & Water Services*, only the following pipe material shall be used for sanitary sewer forcemains:
 - .1 High-Density Polyethylene (HDPE), designer to specify appropriate dimension ratio
 - .2 PVC, class C900 (300 mm diameter and smaller) and C905.
 - .3 Ductile Iron (DI), class C51.

3.0 EXECUTION REQUIREMENTS

- .1 Sanitary sewer works and appurtenances shall be installed in accordance with the current MMCD standards and specification, unless otherwise noted.
- .2 If temporary bypass pumping is required, the following items are required:
 - .1 Contractor to provide notice of work to residents minimum 1 week prior to commencing (date on letter).
 - .2 Contractor shall install temporary bypass pumping system around the designated sewer sections in accordance with pre-submitted arrangement.
 - .3 Pumps and bypass lines shall be of adequate capacity to accommodate pre-determined flows as specified in the contract documents. A “duplex” pump system is to be used to provide 100% redundancy.
 - .4 Contractor to take all necessary precautions to prevent spills to the environment or backup of sewerage onto private property. In the event of a spill the Contractor shall be responsible for immediate clean-up operation and remediation of damaged property.
 - .5 Contractor shall report any spills and back-ups to UBC Energy & Water Services Mechanical Utilities Engineer immediately.
- .3 Minimum cover on all sanitary sewers shall be 1.0 meters in accordance with the MMCD standards. Where no future main line extension or connection of services is required, and where no traffic road exists or in future will exist, minimum cover may be reduced to 600 mm with special approval.
- .4 All pipe surround material shall consist of clean granular MMCD Type 1 bedding.
- .5 Trench backfill is to be as per MMCD specifications or as approved by UBC EWS.
- .6 For purposes of cleaning and flushing, water may be supplied from UBC fire hydrants upon application for a Hydrant Use Permit. Refer to: <https://planning.ubc.ca/planning-development/permits-and-business-licenses/building-and-trades-permits/trades-permits>

- .7 Completed sanitary sewers shall be video inspected as per UBC supplemental specifications and MMCD prior to final approval by UBC.
- .8 Prior to covering the pipe, Contractor shall notify for inspection UBC Energy & Water Services Head Plumber (604-816-9364). Notification for inspection shall be provided minimum 48 hours in advance.
- .9 Records of pipe sizes and inverts shall be provided to Infrastructure Development, Records; and to *UBC Energy & Water Services*; in accordance with Sections 01 78 39 Project Record Documents and 33 00 10 *Underground Utilities Services* of these guidelines.
- .10 Where notification requirements are not met, services may need to be re-excavated, at the cost of the project, for inspection and/or testing upon request of *UBC Energy & Water Services*.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **System Description**

- .1 The University of British Columbia owns and operates its own natural gas distribution system. All parts of the system are non-interruptible (firm gas) service, except the supply to the steam plant.
- .2 There are three pressure zones within North Campus part of the system (north of 16th Avenue) as follows:
 - .1 1.8 kPa (7" water) low pressure.
 - .2 34 kPa (5 psig) medium pressure.
 - .3 83 kPa (15 psig) high pressure.
 - .4 414 kPa (60 psig) high pressure.
 - .5 The UBC Okanagan campus operates low and medium pressure zones.
- .3 The south campus (south of 16th Avenue) operates at 83 kPa (12 psig).
- .4 Steel gas piping system throughout UBC Campus has a complete cathodic protection system.

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Responsibilities**

- .1 UBC Energy & Water Services (EWS) is primarily responsible for operation, maintenance, and overall stewardship of the natural gas distribution system. The demarcation of UBC Energy & Water Services point of service is as shown on Gas Meter standard drawing found under Division 33 section listings here:
http://www.technicalguidelines.ubc.ca/technical/divisional_specs.html.
- .2 Where there is no gas meter for a given building, UBC Energy & Water Services demarcation point is the last valve outside the building wall.
- .3 UBC Energy & Water Services is not responsible for any part of the gas piping or equipment inside buildings.
- .4 For all natural gas pipeline and service projects, the Project Designer must incorporate all specific requirements for metering, design and materials and execution of this section into the contract drawings in the form of job-specific notes. Only making reference to UBC Technical Guidelines in the drawings is not sufficient.

2.2 **Natural Gas Distribution Standards**

- .1 The latest revisions of the following standards shall apply to natural gas distribution at UBC:
 - .1 UBC Sustainability Development Policy #5
(<http://universitycounsel.ubc.ca/policies/index/>).
 - .2 B.C. Gas Safety Act.
 - .3 Canadian National Gas Code.
 - .4 National Association of Corrosion Engineers (NACE)
 - .5 CGA Standard (as applicable).
 - .6 CSA Standard (as applicable).

2.3 Natural Gas Service Connections

- .1 The first step to install any new or substantially modified connections to the natural gas distribution system at UBC is to complete a Utility Service Connection Application. This and other forms can be found at <https://energy.ubc.ca/community-services/contractors-developers/>.
- .2 Any new connections to the gas distribution system will be reviewed for consistency with UBC Energy & Water Services standards.
- .3 Project design drawings shall provide building load (list of appliances with nameplate capacities in m³/hour) and required pressure.
- .4 The Designer shall obtain the gas service records by contacting the Records Clerk at Infrastructure Development, Records, and develop proposed service connection location(s). Service connections may be possible to more than one gas main fronting the site.

2.4 Metering

- .1 Natural gas meters are required for all buildings. All meters shall be temperature compensated. Gas meter design requirements are as shown in Standard Documents - GasMeterStd.dwg, the location of which is referenced in section 2.1.1 above. Revenue gas meters shall have reading in m³, shall be provided with PFM regulator, ISO 9001 (smaller meters) or with electronically compensated pressure and temperature (larger meters).
- .2 The mean atmospheric pressure for PFM (Pressure Factor Measurement) is 100.71 kPa for all revenue natural gas meters on UBC Campus.
- .3 As indicated on the drawing standard, the meter assembly is to be procured and supplied by UBC Energy & Water Services at the project's expense. The project will provide a purchase order for Energy & Water Services to purchase the meter hardware. There will be no additional markup or procurement fees.
- .4 The project is responsible for providing any required protection, such as installing a lockable enclosure and/or bollards as per UBC Energy & Water Services approval.

2.5 Seismic Protection

- .1 The decision whether to install seismic shutoff valves is the responsibility of the project consultants. Buildings which meet the following criteria may not benefit significantly by installing a seismic shutoff valve:
 - .1 Building is structurally designed for current seismic codes.
 - .2 Restraints installed on all gas equipment (e.g. water heaters, air heating units) and piping.
 - .3 Flexible connections installed on all gas equipment.
- .2 Buildings which use natural gas for emergency power or other emergency needs are recommended not to install seismic valves.
- .3 When installed, the following valves are required: California Seismic™ (formerly Koso™) valves for horizontal orientation: Safe-T-Quake valves for vertical orientation. Seismic gas valve shall be supported with two (2) brackets secured to a building wall or equivalent.
- .4 Regardless, UBC Energy & Water Services requires that seismic restraints be used on all gas equipment (i.e. water heaters) and main gas piping in the building.

- .5 UBC Energy & Water Services requires that flexible gas connections be used on all gas equipment in the building.

2.6 Design and Materials

- .1 Design piping pressure: 415 kPa (60 psig).
- .2 Connections shall be to the highest available pressure.
- .3 New underground piping shall be SDR11 Series 125 Polyethylene, manufactured to CAN 3-B137.4M86. New underground valves shall be PSV polyethylene shut off valves with butt fusion outlet ends, to accommodate SDR 11 pipe, conforming to ASTM D-2513. Pipe fittings shall be butt heat fusion polyethylene manufactured to ASTM D-3261-85.
- .4 New aboveground piping up to shall be minimum Schedule 40, ASTM A53 steel piping. Up to, but not including the gas meter assembly, all piping shall be painted yellow. All piping up to 2" size shall be socket welded, manufactured to ASTM A182. New piping over 2" may be butt welded. All aboveground valves shall be bronze plug-type shutoff valves with threaded outlet ends to accommodate A53 steel pipe, and conforming to ASTM B62.

2.7 Permits

- .1 Permits by B.C. Gas Safety Branch and inspections/witness by B.C. Gas Safety Inspector of pressure testing and purging are the sole responsibility of the project.

2.8 Notification

- .1 The Mechanical Utilities Engineer (Telephone: 604-822-3274) and Utilities Head Plumber (Telephone: 604-822-5986) shall be notified in writing 24 hours in advance of any planned pressure testing of a new gas service pipe. Failure to provide notice may result in installed services to be re-excavated for inspection.

3.0 EXECUTION REQUIREMENTS

- .1 Minimum soil cover shall be 600 mm.
- .2 Warning tape at 300 mm below grade level shall be provided.
- .3 Minimum 1.0 m wall to wall horizontal clearance is required from all other services. Clearance from building footings shall be approved by EWS and be a minimum of 3 m per MMCD General Design guideline clause 1.3.
- .4 When crossing electric ductbank, run pipe above electrical ductbank with minimum vertical clearance 150 mm from the top of electric ductbank. Crossing angle shall be 90° degree. If crossing of electric ductbank cannot be done in this manner, then encase natural gas pipe in one larger plastic pipe projecting minimum 500 mm from either side of the electric ductbank.
- .5 Contractor shall provide and install a top tracer wire attached to underground polyethylene pipe.
- .6 Continuity of the existing cathodic protection system shall be maintained when any additions or replacements are undertaken.

- .7 Hot tapping may be done only with written permission from the Mechanical Utilities Engineer, UBC Energy & Water Services. Phone: 604-822-3274.
- .8 Purge pipe with nitrogen after new service pipe is installed.
- .9 For pipe bedding use clean granular pipe bedding, graded gravel, 10 mm (minus), MMCD type:
 - .1 Bottom bedding shall be a quarter of pipe diameter or 100 mm thick, whichever is larger. Top bedding shall be minimum 300 mm thick. Side bedding shall be a minimum 225 mm to maximum 300 mm thick
 - .2 Trench backfill is to be as per MMCD specifications or as approved by UBC EWS.
- .10 No trees shall be planted within 1,200 mm of underground gas piping.
- .11 Shutdowns must be requested in writing adhering to UBC's campus- wide standard procedures. Refer to <http://www.buildingoperations.ubc.ca/resources/policies-procedures-forms/>.
- .12 Connections to existing gas distribution system may be made by a qualified and EWS approved Contractor with a UBC EWS approved design.
- .13 See also Energy & Water Services' Natural Gas Service Installation work procedure, at <https://energy.ubc.ca/community-services/contractors-developers/>.
- .14 Gas distribution valves and meter stations on the UBC Energy & Water Services system may only be operated by UBC Energy & Water Services.
- .15 Records of pipe sizes and inverts shall be provided to Infrastructure Development, Records; and to UBC Energy & Water Services; in accordance with Sections 01 78 39 Project Record Documents and 33 00 10 Underground Utilities Services of these guidelines.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 This Section refers to those portions of work related to supply and installation of geothermal and LDES mains, valves and valve boxes, fittings, service connections and related appurtenances. Where a supply/return facility is part of the contract, this section refers to those areas outside the facility from the connection point outside the facility walls.

1.2 All and any references made to MMCD will be considered applicable to the latest versions available. Any discrepancies between MMCD specifications referenced within this document and what is currently available will be reviewed and decided upon by the Consultant.

1.3 **Aggregate Samples**

- .1 Samples may be required. Submit samples in accordance with MMCD 35 05 17 1.3 Approvals.
- .2 Inform Consultant of proposed source of bedding materials and provide access for sampling at least 2 weeks prior to commencing work. Time is required for sieve analysis and Proctor Density calibration.

1.4 **Material Certification**

- .1 Products having CSA certification to be used where readily available. Certification by Standards Council of Canada approved independent third body that products conform to CSA standards is acceptable in lieu of CSA certification.
- .2 Submit manufacturer's test data and certification to consultant that pipe materials meet requirements of this section at least two (2) weeks prior to commencing work. Include manufacturer's drawings, information and shop drawings where pertinent.

2.0 **PRODUCTS**

2.1 **General**

- .1 Only one type of pipe material will be allowed throughout the contract unless specified otherwise or shown otherwise on Contract Drawings.
- .2 All products are specified by reference to approved specifications and/or standards. Refer to Supplementary Specifications and/or Contract Drawings for specified or approved manufacturers or trade names.
- .3 Contractor is to supply itemized list of all installed products including make, model #, size and class.
- .4 Refer to Contract Drawings for pipe material and pressure class.

2.2 Pipe, Joints, and Fittings

.1 Polyvinyl Chloride (PVC) Pressure Pipe:

.1 Pipe:

- .1 Pipe to be manufactured to specifications for pipe size ranges as follows:
 - Pipes 100 to 300mm dia. - AWWA C900 SDR 25 or Series 160 DR 26
 - Pipes 350 to 1200mm dia. - AWWA C905 SDR 25 or Series 160 DR 26

AWWA C900 pipe to Pressure Class or AWWA C905 pipe to pressuring rating of DR26 pipe. Pipes to be certified by Canadian Standards Association for pipe size ranges below:

- Pipes 100 to 1200mm dia. – CSA B137.3.

- .2 ULC listed.
- .3 Cast iron pipe to be equivalent outside diameter.
- .4 To be compatible with specified mechanical joint and push-on joint fittings and valves without the use of special adapters.
- .5 Joints: Push-on integrally thickened bell and spigot type to ASTM D3139 with single elastomeric gasket to ASTM F477.
- .6 All Pipes to be white, not blue to distinguish from potable water pipes.

.2 Steel Pipe:

- .1 Steel pipe diameter bigger than 100mm to ANSI/AWWA C200, Grade steel seamless.

- .1 Exterior finish: to ANSI/AWWA C203, hot applied coal tar enamel (Only for outside of building-in ground applications).
- .2 Interior finish: to ANSI/AWWA C210 standard, liquid epoxy coating systems for all pipe applications.
- .3 Pipe joints: to be flanged, hardware to be stainless steel for buried application. Flanges: to ANSI/AWWA C207, class B ring type.
- .4 Pipe fittings: to ANSI/AWWA C210 epoxy coated and exterior protected with hot applied coal tar enamel to ANSI/AWWA C203.

.3 Fittings:

- .1 Ductile iron fittings to AWWA C110 suitable for pressure rating of 2415 kPa, cement mortar lined to AWWA C104.
- .2 Compact ductile iron fittings to ANSI/AWWA C153/A21.53-94, suitable for pressure rating of 2415 kPa, cement mortar lined to AWWA C104.
- .3 Flanged Joints:
 - .1 Flat faced conforming to the face dimension and drilling of ANSI B16.1, Class 125.
 - .2 On AWWA C110 fittings to AWWA C110 with minimum pressure rating 1035 kPa or higher as specified in Contract Documents.
 - .3 On AWWA C153 fittings to AWWA C153 with minimum pressure rating of 1723 kPa or higher as specified in Contract Documents.

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- .4 Flange gaskets to be manufactured from black natural rubber 3.175mm thick with layer of cotton on both sides.
 - .5 Bolts and nuts:
 - .1 Bolts to be carbon steel, Grade B to ASTM A307, heavy hex style, zinc plated to ASTM B633 or cadmium plated to ASTM B766. Bolt sizes to AWWA C110.
 - .2 Nuts and washers: Nuts to be carbon steel, Grade A to ASTM A563. Washers to be flat hardened steel to ASTM F436. Nuts and washers to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.
 - .6 Tie Rods and nuts:
 - .1 Tie rods to be continuous threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC. To be zinc plated to ASTM B633 or cadmium plated to ASTM B766. Rod sizes are to be minimum 19mm diameter or greater as shown on the Contract Drawings.
 - .2 Nuts and internally threaded couplings to be zinc plated to ASTM B633 or cadmium plated to ASTM B766. Rod sizes are to be minimum 19mm diameter or greater as shown on the Contract Drawings.
 - .7 Fabricated steel pipe fittings: to AWWA C208 and AWWA C207 if flanged, interior and exterior protected with hot applied coal tar enamel to AWWA C203 or liquid epoxy coating to AWWA C210.
 - .8 Couplings and Flanged Coupling Adapters:
 - .1 General Requirements:
 - .1 Suitable for Pressure Class 160.
 - .2 Flanges and full face flange gaskets where applicable to Clauses of this Section.
 - .3 Anti-corrosion coating of interior and exterior centre sleeve and end rings to AWWA C219, AWWA C213, AWWA C210, or AWWA C550 as specified in Contract Documents.
 - .4 Compression gaskets to AWWA C219.
 - .5 Bolts and nuts high strength low alloy steel to be AWWA C111, stainless steel to be ASTM F593 or F738 for bolts and ASTM F594 or F836M for heavy hex nuts, as specified in Contract Documents. Rolled threads, fit and dimensions to AWWA C111.
 - .6 Ductile Iron castings to be ASTM A536, Grade 65-45-12.
 - .2 Plain end or transition coupling adapters as specified in Contract Documents.
 - .3 Flanged coupling adapters as specified in Contract Documents.
 - .9 Joint Restraint Devices: General Requirements:
 - .1 Ductile iron castings to ASTM A536.
 - .2 Anti-corrosion coating of ductile iron castings as specified in Contract Documents.

- .3 Bolts and nuts high strength low alloy steel to AWWA C111 or as specified in Contract Documents, stainless steel to ASTM F593 or F738 for bolts and ASTM F594 or F836 for heavy hex nuts. Rolled threads, fit and dimensions to AWWA C111.
 - .4 Restrainers for mechanical joints or push-on joints in ductile iron pipe as specified in Contract Documents.
 - .5 Joint restraint devices for PVC watermain to be Underwriter Laboratories of Canada (UL) or Factory Mutual (FM) approved.
- .10 Tapping Sleeves for branch connections 75mm and larger:
- .1 General Requirements:
 - .1 Location, type and Pressure Class as specified in Contract Documents. Exterior condition of existing water mains as found in the field may alter type and/or materials.
 - .2 To AWWA C219 for sleeve and gasket materials and generally for design, manufacture and performance.
 - .3 Flanges and flange gaskets to Clauses 2.2.4.7 and 2.2.4.8 of this Section and AWWA C207 and AWWA C208 for fabricated steel sleeves. Flange gaskets for use with epoxy coated flanges to be annular ribbed type.
 - .4 Anti-corrosion coating of fabricated carbon steel and ductile iron sleeve assemblies to AWWA C213 (Fusion bonded epoxy) or shop coated to AWWA C219 in field applied dressings are specified in the Contract Documents.
 - .5 Bolts and nuts high strength low alloy steel to AWWA C111 or as specified in Contract Documents, stainless steel to ASTM F593 or F738 for bolts and ASTM F594 or F836 for heavy hex nuts. Rolled threads, fit and dimensions to AWWA C111.
 - .6 Ductile iron castings to ASTM A536, grade 65-5-12.
 - .7 Flanged branches for welding to steel pipe mains to AWWA C207 and AWWA C208.
 - .8 Branches shall include a threaded test plug 19mm NPS minimum if tapping machine to be used does not have provision for pressure testing.
 - .2 Tapping sleeve for cast iron, ductile iron, asbestos cement, PVC to AWWA C900, prestressed concrete pressure pipe or steel mains for taps other than size-on-size:
 - .1 Split assembly to incorporate an annular gasket cemented or mechanically held in place on the branch end or split assembly incorporating ring seal and wrap around sleeve length gasket liner.
 - .2 Acceptable models: as specified in the Contract documents.
 - .3 Tapping sleeves for size-on-size taps on cast iron, ductile iron, and asbestos cement, PVC to AWWA C900, pre-stressed concrete pressure pipe or steel:
 - .1 Split assembly incorporating ring seal and wrap around sleeve length gasket/liner.
 - .2 Acceptable models: as specified in Contract Documents.
 - .4 Tapping sleeves for size-on-size tap on ductile iron pipe and PVC to AWWA C900 only:

.1 Acceptable models: as specified in Contract Documents.

.11 Repair clamps shall be constructed of 18-8 stainless steel passivated for corrosion resistance. Stainless steel components shall be Type 304 or 304L. All surfaces including weld areas shall be thoroughly cleaned of scale, grease or other contaminants. Welding must be performed in a controlled environment to prevent sensitization. Nuts and bolts shall be Type 304 18-8 stainless steel 5/8 x 11 NC rolled thread lubricated to prevent galling. Gasket shall be SBR (Buna) rubber per ASTM D2000.

2.3 Valves and Valve Boxes

.1 Mainline Valves - General Requirements:

.1 Valves to open counter clockwise.

.2 All valves to have manufacturers name, year of manufacture, size and working pressure on the bonnet or valve body.

.2 Mainline Gate Valves:

.1 Locations of valves shown on the Contract Drawings.

.2 To AWWA C500, for 75mm to 300mm to working pressure of 1380kPa; 400mm and larger to working pressure of 1035 kPa, gray cast iron or cast ductile iron body, bronze mounted solid wedge, or double disc, non-rising stem hub or flanged ends.

.3 To AWWA C509: 75mm to 300mm to working pressure 1380 kPa; Gray cast iron or ductile iron body, resilient seated, non-rising stem, hub or flanged ends.

.4 Stem seal to be O-ring type.

.5 Valves to be complete with 50mm square operating nut for underground service.

.6 Acceptable manufacturers are as specified in Contract Documents.

.3 Mainline Butterfly Valves:

.1 All butterfly valves shall be manufactured in accordance with the latest revision of AWWA C504 for Class 150B service.

All valves shall be either Henry Pratt Groundhog® as manufactured by the Henry Pratt Company or engineer approved equal and be approved for direct bury. Valves in sizes 3-24" shall have 304 stainless steel trim as standard.

.2 Valves to be complete with 50mm square operating nut for underground service.

.4 Plug valve:

.1 Flanged valve, cast iron body, class 125, to ANSI B16.1, valve seat to be pure nickel to machined smooth finish, tested in accordance with AWWA C504 suitable for vertical installation, complete with eccentric gear actuator.

.2 Valves to be complete with 50mm square operating nut for underground service.

.5 Blow-down or Blow-off Valves: 100mm to AWWA C800 for working pressure of 1035 kPa.

.6 Air Release, Air /Vacuum, and Combination Air Valves:

.1 Gray cast iron or ductile iron body.

- .2 Threaded or flanged connections.
- .3 Maximum working pressure 2070 kPa.
- .4 To AWWA C512

- .7 Mainline Valve Boxes:
 - .1 To be as specified in the Contract Documents: cast iron, top flange type service box, caps to read supply/return:
 - .1 Circular type to be as specified in Contract Documents.
 - .2 Valve box riser pipe to be 150mm diameter PRV DR 35 or better.

- .8 Check Valves
 - .1 To AWWA C508: 50 to 300mm to working pressure 1200 kPa: 400 to 500 mm to working pressure of 1035 kPa; gray cast iron or ductile iron cast iron body, clear waterway type, metal to metal seat, mechanical joint ends to AWWA C111 or flanged ends to AWWA C110.

2.4 Pipe Bedding and Surround Material

- .1 Granular material to Aggregates: General and following requirements:
 - .1 Crushed or screened stone, gravel or sand.
 - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

Sieve Designation	% Passing	
	Stone/Gravel	Gravel/Sand
25 mm	100	-
12.5 mm	65-90	100
4.75 mm	35-55	80-100
2.00 mm	-	50-90
0.425 mm	10-25	10-50
0.075 mm	0-8	0-10

- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to (MMCD) Section 03300 - Cast-in-Place Concrete.
- .3 Backfill Material.
- .4 As indicated.
- .5 Type 3, in accordance with Excavating, Trenching and Backfilling (MMCD).

3.0 EXECUTION

3.1 Preparation

- .1 Clean pipes, fittings, valves, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects to approval of Consultant. Remove defective materials from site as directed by Consultant.

3.2 Trenching

- .1 Do trenching work in accordance with MMCD 2009 Section 31 23 01 - Excavating, Trenching and Backfilling.
- .2 Trench depth to provide cover over pipe of not less than 1.5m from finished grade or as indicated.
- .3 Trench alignment and depth require Consultant's approval prior to placing bedding material and pipe.

3.3 Granular Bedding

- .1 Place granular bedding material in uniform layers to a thickness of depth of 150mm below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% modified proctor density.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with MMCD 31 23 01 - Excavating, Trenching and Backfilling with compacted bedding material.

3.4 Pipe Installation

- .1 Lay pipes to ANSI/AWWA Manual of Practice and manufacturer's standard instructions and specifications. Do not use blocks except as permitted in 3.3.2.
- .2 Join pipes in accordance with AWWA Manual of Practice and manufacturer's recommendations.
- .3 Bevel or taper ends of PVC pipe to match fittings and manufacturers recommendations.
- .4 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .5 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10mm in 3m.
- .6 Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends up-grade.
- .7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

- .9 Position and join pipes with equipment and methods approved by Consultant.
- .10 Cut pipes in an approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .11 Align pipes carefully before jointing.
- .12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .13 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated and replaced before jointing is attempted again.
- .14 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Engineer.
- .15 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations. Ensure insertion line is visible and positioned according to manufacturer installation instructions.
- .16 Complete each joint before laying next length of pipe.
- .17 Minimize deflection after joint has been made.
- .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .20 Do not lay pipe on frozen bedding.
- .21 Backfill remainder of trench.
- .22 Supply Pipes to be installed on the right looking at entrance to building. All pipes to be labelled LDES at regular intervals (3m).Landscape to be remediated.

3.5 Valve Installation

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of concrete blocks, located between valve and solid ground. Bedding same as adjacent pipe. Maximum length of pipe on each end of valve shall be 1m. Valves not to be supported by pipe.
- .3 Install underground post-type indicator valves as indicated.
- .4 Valve caps are to designate DES supply or return

3.6 Hydrostatic and Leakage Testing

- .1 Tests apply to all watermains that will operate under pressure created by pumping system.

- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Consultant and UBCO operations at least 24 h in advance of all proposed tests. Perform tests in presence of Consultant.
- .4 Where any section of system is provided with concrete thrust blocks, conduct tests at least five days after placing concrete or two days if high early strength concrete is used.
- .5 Test pipeline in sections not exceeding 365m in length, unless otherwise authorized by Consultant.
- .6 Upon completion of pipe laying and after Consultant has inspected work in place, surround and cover pipes with approved granular material placed to dimensions indicated or directed by Consultant.
- .7 When testing is done during freezing weather, protect all unprotected and above ground valves, joints, gauges and fittings from freezing.
- .8 Strut and brace end caps, and blow off assemblies to prevent movement when test pressure is applied.
- .9 Fully open all valves pertaining to the tested section.
- .10 Expel air from main by slowly filling main with potable water. Install corporation stops at high points in main where no air-vacuum release valves are installed. Remove stops after satisfactory completion of test and seal holes with plugs.
- .11 Thoroughly examine exposed parts and correct for leakage as necessary.
- .12 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .13 Apply a leakage test pressure of 1034 kPa or 1.5 times working pressure (whichever is greater) after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 h.
- .14 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2 h.
- .15 Do not exceed allowable leakage of 0.016 L/mm diameter per 300m of pipe, including lateral connections, per hour.
- .16 Locate and repair defects if leakage is greater than amount specified.
- .17 Repeat test until leakage is within specified allowance for full length of watermain.

3.7 Surround Pipe

- .1 Upon completion of pipe laying and after Consultant has inspected work in place, surround and cover pipes as indicated.
- .2 Place surround material in uniform layers not exceeding 300mm of compacted thickness as indicated. Do not dump material within 2m of pipe.

- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Hand tamp bedding from pipe invert to mid height of pipe to ensure no voids exist under pipe. Installer must ensure compaction effort does not alter designed pipe grading.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 95% modified proctor density.

3.8 Backfill

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 300mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact approved backfill to at least 95% modified proctor density and confirm results are verified and recorded by a Certified Geotechnical Consultant.
- .4 In other areas ensure compaction effort of approved to at least 90% modified proctor density and confirm results are verified and recorded by a Certified Geotechnical Consultant.

3.9 Flushing

- .1 Flushing shall be witnessed by the Consultant. Notify Consultant at least 4 days in advance of proposed date when operations will commence.
- .2 Flush water mains through available outlets with a sufficient flow of water until foreign materials have been removed and flushed water is clear, prior to connecting to existing system.
- .3 Flushing flows shall be as follows:

<u>Pipe Size NPS</u>	<u>Min. Flow (L/s)</u>
50mm	6
75mm	14
100mm	20
150mm	38
200mm	75
250mm	115
300mm	150

- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves and service connections to ensure thorough flushing.

3.10 Surface Restoration

- .1 After installing and backfilling over watermains, restore surface to original condition or as directed by Consultant.

END OF SECTION

1.0 **GENERAL**

1.1 **System Description**

- .1 There are few buildings left serviced by steam and those are serviced by steam from the Bio Energy Research and Demonstration Facility. Saturated steam is generated at 827 kPa (120 psig) for distribution to the remaining steam line running north lower mall and east up University Blvd.
- .2 There is a condensate return as part of UBC's steam distribution system. Wherever the term "steam distribution" is used, it applies to both steam supply and condensate return piping and appurtenances unless otherwise specified.
- .3 Most of the steam/condensate system is gradually being replaced by a District Energy Hot Water system. Also see Division 23, Section 23 21 05 District Hot Water Heating System.

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Responsibilities**

- .1 UBC Energy & Water Services (EWS) is primarily responsible for operation, maintenance, and overall stewardship of the steam distribution system. The demarcation of UBC Energy & Water Services point of service is normally up to and including the PRV at each consumer. Energy & Water Services also maintain the condensate tank and pumps, whereas the steam distribution with the consumer's premises is outside EWS jurisdiction. Also refer to Condensate Pump and Tank Standard Drawing located on web page (https://technicalguidelines.ubc.ca/technical/divisional_specs.html) under Division 33's section listings.
- .2 Key positions in UBC Energy & Water Services are described in Division 33, Section 33 00 10 Underground Utilities Services of UBC Technical Guidelines.
- .3 Unless otherwise agreed in writing, the project Designer is responsible for all design, permit, and inspection requirements of Technical Safety BC (TSBC).
- .4 The project Designer must incorporate all specific requirements for metering, design and materials and execution of this section into the contract drawings in the form of job-specific notes. Only making reference to UBC Technical Guidelines in the drawings is not sufficient.

2.2 **Steam Distribution Standards and Policies**

- .1 The latest revisions of the following standards and policies shall apply to steam distribution at UBC:
 - .1 B.C. Boiler and Pressure Vessel Act and ASME B31.1 Power Piping Code; TSBC.
 - .2 UBC Sustainability Development Policy #5 (<https://universitycounsel.ubc.ca/board-of-governors-policies-procedures-rules-and-guidelines/policies/>).
 - .3 CSA standards as applicable.

2.3 Steam Distribution Service Connections

- .1 The first step to install any new or substantially modified connections to the steam distribution system at UBC is complete a Utility Service Connection Application. This and other forms can be found at <https://energy.ubc.ca/community-services/contractors-developers/>.
- .2 Any new connections to the steam distribution system will be reviewed for consistency with UBC Energy & Water Services standards as defined in the UBC Technical Guidelines. If necessary the steam distribution engineering/flow model will be updated and run by UBC Energy & Water Services at no cost to the project.
- .3 The Designer shall obtain the Steam service records by contacting the Records Clerk at Infrastructure Development, Records Section (Telephone: 604-822-9570) and develop proposed service connection location(s).

2.4 Steam Distribution Design and Materials

- .1 Steam Piping
 - .1 Maximum operating pressure shall be 1,030 kPa (150 psig), A106 Grade B seamless.
 - .2 Schedule 40 is required for pipe sizes over 2", and Schedule 80 is required for pipe sizes 2" and smaller.
 - .3 Fittings shall be A234 WPB, Schedule 40 for pipe sizes over 2", and #3000 forged-steel, socket welded for pipes 2" and smaller.
 - .4 Flanges shall be #150 raised-face, weld neck (bore to suit pipe), A105, Grade 1.
 - .5 Pressure bolting shall be A194, Grade B7.
 - .6 Support lugs shall be carbon steel.
 - .7 No cast iron or copper based metal fittings or valves are acceptable.
 - .8 All valves upstream of PRV's, including PRV bypass valve, shall be at least #150 rated and socket welded for pipe sizes 2" and smaller. Greater than 2" shall be flanged or butt welded.
 - .9 Attachment to condensate main piping shall be a tee. Optionally a Sockolet™ shall be used for pipes 2" or smaller, or Weldolet™ if greater than 2".
- .2 Condensate Piping
 - .1 Maximum operating pressure shall be 1,030 kPa (150 psig), A106 Grade B seamless. Design temperature must be a minimum of 200C (400° F).
 - .2 Schedule 80 is required for all pipe sizes in consideration of corrosion.
 - .3 Fittings shall be A234, WPB and #3000 F/S socket welded for pipes 2" and smaller.
 - .4 Flanges shall be #150 raised-face, weld neck, extra heavy (XH) A105, Grade 1.
 - .5 Pressure bolting shall be A194, Grade B7.
 - .6 Support lugs shall be carbon steel.
 - .7 No cast iron or copper based metal fittings or valves are acceptable.
 - .8 Beginning with the last condensate return valve leaving a building, all valves shall be at least #150 rated and socket welded for pipe sizes 2" and smaller. Greater than 2" shall be flanged or butt welded.
 - .9 Attachment to condensate main piping shall be a tee. Optionally a Sockolet™ shall be used for pipes 2" or smaller, or Weldolet™ if greater than 2".
- .3 Isolating valves are required in all mains and branches (incoming and outgoing) for steam and condensate.
- .4 Double block and bleed is mandatory inside steam manholes on all main steam, main condensate, and small bore piping (including steam traps).

- .5 Steam meters are required for all newly construction or substantially modified buildings at UBC. Steam meters shall be installed inside buildings, and located upstream of the pressure reducing valves (PRV). For core buildings use Endress & Hauser and for billable buildings use Foxboro. Refer to Standard Documents – 1130-UT-05-SteamMeterStd-Foxboro.dwg and 1130-UT-SteamMeterStd-Endress.dwg, the locations of which are referenced in section 2.1.1 above. As indicated on the drawing standard, the meter, computer, and transmitter are to be procured and supplied by UBC Energy & Water Services. The project will provide a purchase order for Energy & Water Services to purchase the meter hardware. There will be no additional markup or procurement fees.
- .6 Condensate return shall be a pumped, open system and shall conform to UBC's condensate pump system standard - refer to Standard Documents - CondPumpStd.pdf.
- .7 A copy of design approval by TSBC shall be provided to UBC Energy & Water Services Manager, Mechanical Utilities (Senior Mechanical Engineer) and Campus Chief Engineer.
- .8 A copy of hydrostatic tests required by TSBC shall be provided to UBC Energy & Water Services Manager, Mechanical Utilities and Campus Chief Engineer.
- .9 Manholes shall be constructed with one or two side openable tops.
- .10 Insulation of piping, valves and expansion joints shall conform to UBC Energy & Water Services requirements (available upon request submitted to UBC Energy & Water Services).
- .11 All underground steam and condensate piping shall be installed in inverted concrete channel with removable lid, all joints sealed with tar. Perforated cast iron drainpipe, connected to the storm sewer shall be installed under all steam distribution trenches.
- .12 Steam trap assemblies inside steam manholes shall conform to UBC Energy & Water Services Standard. Refer to Standard Documents - SteamTrapStd.pdf.
- .13 Welding: procedures and welder certification as per ASME B31.1 applies to all steam and condensate piping, equipment, and pipe supports. There shall be no splatter, arc strikes, or center punch marks on piping.
- .14 Zinc coated components shall not be in contact (welded, bolted, or loose) with any part of the piping.
- .15 Substances containing chlorine or which will decompose to hydrogen chloride (i.e. coating to prevent adhesion of weld splatter) shall not be applied to any part of the piping.

3.0 EXECUTION REQUIREMENTS

- .1 Minimum soil cover to be 700 mm.
- .2 Minimum 750 mm horizontal clearance required from all other services, except for condensate.
- .3 Cross electrical duct-bank above and leave vertical space for any future expansion. Crossing angle shall be 90° degree. If future expansion is not required, leave minimum 200 mm vertical clearance from the top of electrical duct-bank and place minimum 50 mm Temperlite overlapping minimum 250 mm on each side.
- .4 The insulation of piping, valves and expansion joints shall conform to these requirements:

- .1 Steam pipes to be insulated with 2" thick "Temperlite"* , c/w minimum 0.016" thick corrugated aluminum jacketing.
- .2 Condensate pipes to be insulated with 1-1/2" thick "Temperlite", c/w minimum 0.016" thick corrugated aluminum jacketing.
- .3 "Temperlite" insulation should stop minimum 2" before any flange joint to allow easy removal of bolts/nuts. Where the insulation stops, it should be tapered at 45° angle and clad with smooth aluminum end caps.
- .4 All valves and expansion joints should be insulated with removable heat jackets fabricated from 1" thick "Fibrox" mat on stainless steel mesh, covered with #1702 silicone cloth. Each heat jacket should cover at least 2" of adjacent "Temperlite" insulation on both sides of the valves or the expansion joint.
- .5 Pipe-covering protection saddles shall be used for high temperature service ($\geq 50^{\circ}\text{C}$), Model Grinnell Fig. 161 or equal.
- .6 On completion of the job, the surface temperature is to be inspected in six locations with a heat gun and records provided to Mechanical Utilities Engineer.

* UBC Energy & Water Services may consider alternative insulating material with similar or better properties.

- .5 When steam pipes are not installed in concrete channel, use pipe bedding and backfilling as follows:
 - .1 For pipe bedding use clean granular pipe bedding, graded gravel, 19 mm(-), MMS type 1:
 - .1 Bottom thickness shall be a quarter of pipe diameter but minimum 100 mm.
 - .2 Top shall be minimum 300 mm.
 - .3 Sides shall be minimum 225 mm to maximum 300 mm.
 - .2 For trench backfill, native backfill may be used if free of rock greater than 100 mm.
- .6 Shutdowns must be requested in writing adhering to UBC's campus-wide shutdowns procedures. Refer to Service Shutdown Request at <https://buildingoperations.ubc.ca/resources/policies-procedures-forms/>.
- .7 Operating valves on the steam-condensate distribution system shall only be performed by UBC Energy & Water Services.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guideline**

- .1 Division 26 through 33

1.2 **Coordination Requirements**

- .1 UBC Energy and Water Services
- .2 UBC Building Operations

1.3 **Power**

- .1 The University owns and operates the power system consisting of 60 KV underground and overhead distributions, and 12 KV underground distributions.
- .2 The University purchases power in bulk form from BC Hydro. The two 60 KV lines feed two substations, one located on the South Campus and one on the Main Campus.
- .3 The Main Substation supplies in turn a 12 KV indoor switching station.
- .4 The 12 KV systems is distributed underground in a combined duct and manhole system which services throughout the major portion of the North Campus and a portion of the South Campus.
- .5 The 12 KV system is nominally rated at 12,480 volts, 3 phase, 3 wires, Wye System low resistance grounded.
- .6 The design limits shall be basic impulse level 95 KV and design fault 300 MVA symmetrical.
- .7 The power distribution is a Dual Radial System with 500 MCM low resistive grounded single conductor crosslink polyethylene for 12 KV system.
- .8 For a General Distribution Diagram of the 12 KV feeders, refer to Division 26, Standard Drawing E1-1 (https://technicalguidelines.ubc.ca/technical/divisional_specs.html). Also, refer to 5.4.3.1 Design Development Brief.

1.4 **Communication**

- .1 The Campus communication systems in most areas of the campus is owned and operated by the University. Project requirements shall be coordinated between the User, the Consultant and the Cable Facilities Services by the Project Manager.

1.5 **Central Building Alarm – A Division, Building Operations, UBC**

- .1 The University operates a Building Management System (BMS) to provide control and alarm monitoring for all primary mechanical and electrical systems.
- .2 The panels are usually located in the building mechanical rooms to capture the necessary alarm event. This event is transmitted across the BMS network to the appropriate display terminals.

1.6 **UBC Standard Forms**

- .1 The following standard forms apply to all utilities for this project, as applicable:

- .1 UBC Application for Service Shutdown.
- .2 UBC Application for Service Connection.
- .3 I-B-07 - Clearance Permits.
- .4 I-B-33 - Test and Work Permits.
- .5 UBC Utilities Manhole Entry Permit 1.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 Section 33 71 00 Electrical Utility Transmission and Distribution

1.2 **Coordination Requirements**

- .1 UBC Energy & Water Services
- .2 UBC Building Operations

1.3 **Description**

- .1 UBC requirements for Duct Banks and Manholes.

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Design Standards**

- .1 Work shall comply with requirements of:
 - .1 WorkSafe BC.
 - .2 BC Safety Authority.
- .2 All civil work including duct banks, manholes and cast-in-place and precast concrete shall comply with UBC Technical Guidelines, BC Hydro Standards, or Master Municipal Construction Documents (MMCD) as applicable.

2.2 **Trenching**

- .1 Prior to any trenching the duct runs shall be surveyed and staked out. Approval of the staked runs shall be obtained from the Consultant.
- .2 All trenching, excavating, and backfill shall be done to MMCD specifications. Backfill and bedding materials shall be supplied by the Contractor. Trench bottom shall be continuous, firm and shall provide uniform support to the ducts.
- .3 Backfill materials shall be free of rocks larger than 75mm diameter, wood, cinders, ash, and frozen materials. Top surface shall be landscaped to match the existing ground and any road surfaces shall be made good to match existing conditions.

2.3 **Other Services**

- .1 There are existing services and may be additional runs of other services such as electrical, telephone, water, sewers, gas, oil, drainage, etc. Exercise the maximum care to avoid interference or damages to these. Refer to Underground Utility Services.

2.4 **Requirements for Ducts**

- .1 Ducts shall be rigid PVC, encased burial type duct conforming to the specific of CSA standard C22.2 No. 211.1 "Rigid Types EB1 and DB2 / ES2 PVC Conduit". Ducts shall be 125mm (5") for all ducts between manholes.

- .2 Ducts shall be:
 - .1 Power services: minimum: 6 – 125 mm (5") between manholes and 4 – 100 mm (4") into buildings. Larger size may be required by CSA or UBC Energy & Water Services.
 - .2 Communication services: minimum 4 - 125 mm (5") between manholes and 4 -100 mm (4") into buildings.
- .3 Ducts shall be sized on the drawings.
- .4 Ducts shall be buried at a minimum depth of 900 mm. Duct runs shall be evenly sloped toward duct terminations for drainage.
- .5 Ducts shall terminate with bell mouth ends.
- .6 All duct bends shall be long sweep "Utility" bends manufactured to utility pulling specifications.

2.5 Requirements for Manholes

- .1 Manholes shall be 1830 mm x 3300 mm x 2000 mm high inside dimensions or as specified by UBC Energy & Water Services.
- .2 Manhole shall be complete with cast manhole cover, frame and brick assembly between manhole and manhole lid.
- .3 Materials shall include:
 - .1 Pre-cast Manhole Assembly.
 - .2 Manhole Frame.
 - .3 Manhole Cover.
 - .4 Spacer Rings.
 - .5 Pulling Irons.
 - .6 Ground Rods.
 - .7 Sump Cover.
- .4 Manholes shall be constructed to the following UBC Utility Standards:
 - .1 E 3-1 Standard Electrical Precast Manhole.
 - .2 E 3-2 Standard Electrical Manhole Pour in Place.
 - .3 E 3-3 Additional Reinforcing for Pour in Place Electrical Manhole.
 - .4 E 3-4 Standard Electrical Manhole Cover & Riser Details.
 - .5 E 3-5 Standard Electrical Manhole Sump Detail.
 - .6 E 3-6 Typical Manhole Grounding & Details.
 - .7 E 3-7 Typical Manhole Separation.
- .5 Pre-cast Manhole using BC Hydro 4212 Chamber may be substituted as an alternate.
- .6 Concrete shall not be placed in foundations until the soil breaking has been reviewed by the Engineer.
- .7 All manholes shall have a sump with positive drainage. Manhole drains shall be connected to the storm water system.
- .8 Testing costs for compaction and concrete tests shall be paid for by the project.

2.6 Requirements for Concrete Encased Duct Bank

- .1 All Service Ducts shall be concrete encased.
- .2 All Civil Work associated with Duct Banks shall be to BC Hydro and MMCD Specifications.
- .3 Duct Banks shall be constructed in accordance with UBC Standards Drawings:
 - .1 E2-1 Standard Concrete encased Electrical Duct.
 - .2 E2-3 Standard Electrical Duct Bank.
 - .3 E2-4 Electrical Ductbank Clearances to Steam Distribution Lines.
- .4 Forms must be used on the walls of the duct bank.
- .5 Duct connectors shall be staggered so they are never adjacent to another coupling. Manufactured intermediate spacers shall be used throughout the length of the duct run every 2 meters.
- .6 Concrete shall have maximum 200 mm (3/4") aggregate, minimum 20 MPA strength at 28 days, and shall contain "Anti-Hydro" mixed as recommended by the additive Manufacturer.
- .7 Immediately after installation, ducts shall be tested for blockages and cleaned as necessary. Prior to completion the ducts shall be swabbed and mandrel led.
 - .1 The civil contractor shall ensure the quality of installation of all ducts by passing a mandrel or test slug sized not less than indicated in the table below and through the entire length of all installed conduits and in both directions:

Duct Diameter (mm)	Mandrel Diameter min. (mm)
75	69
100	91
125	114

- .2 The civil contractor shall provide written verification of mandrel tests to UBC Energy & Water Services upon successful completion.
- .3 The civil contractor shall identify and remediate any portions of installed ducts that do not easily permit passage of the mandrel or test slug.
- .8 A 10 mm (1/4") pulling line shall be installed in all ducts.

2.7 Requirements for Warning Tape During Construction

- .1 During construction a warning tape (yellow) imprinted "CAUTION BURIED ELECTRICAL LINE" shall be installed at all duct banks and buried conduit.
- .2 Warning tape shall be laid in the trench midway between duct bank and finished grade.

END OF SECTION

1.0 **GENERAL**

This section refers to the works that are unique to the requirements for inspecting new and existing sanitary and storm pipes and pipe culverts by closed circuit television. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.1 **Related Sections**

- .1 Section 33 00 10 Underground Utilities Services
- .2 Traffic Regulation "Traffic Control Manual for Works on Roadways" (second edition), published by MoT.
- .3 Section 33 01 30.41 Cleaning of Sewers

1.2 **References**

- .1 These specifications must be referenced to and interpreted simultaneously with all other Standards and Specifications pertinent to the works described herein.
- .2 Reference standards, specification or publications:
 - .1 Water Research Centre (WRc) publication Manual of Sewer Condition Classification (MSCC), Third Edition, 1993 including Addendum - February 1996.
 - .2 NAAPI Manual of Sewer Condition Classification, Second Edition, 2007.
- .3 Nomenclature
 - .1 CCTV Closed Circuit Television
 - .2 JPEG Joint Photographic Experts Group
 - .3 MPEG Movie Photographic Experts Group
 - .4 S-VHS Super VHS format video
 - .5 DVD Digital Video Disk
 - .6 MSCC Manual of Sewer Condition Classification (WRc. – 3rd edition)

1.3 **Submission of Certification**

- .1 Submit a copy of the CCTV operator's current NAAPI certification certificate to the Contract Administrator at least one week prior to the start of the CCTV inspection operations.
- .2 Submit copies of certificates for each CCTV operator working on the contract.

1.4 **Work Regulations**

- .1 Work shall conform to all applicable regulations of WorkSafe BC. The Contractor shall confirm training compliance in the following:
 - .1 Confined space entry
 - .2 Ventilation
 - .3 Atmospheric monitoring
 - .4 Personal protective equipment
- .2 The Contractor shall provide dates of confined space training completion for each worker and a list of equipment required for confined space entry.

1.5 **Scheduling of Work**

- .1 Schedule work to minimize interruptions to existing services.

- .2 Maintain existing flow during inspection survey unless flow reduction measures required (see Clause 3.11).

1.6 Measurement for Payment

- .1 All units of measurement for payment will be as specified herein unless shown otherwise in Form of Tender
- .2 CCTV pipeline inspection will be measured in lineal metres. Payment will be made at the unit price bid in Form of Tender.
- .3 Measurement will be determined by calibrated electronic measure along the sewer from the inside wall of manhole to inside wall of manhole or end to end of sewer pipe for all sections except where a blockage or obstruction occurs.
- .4 For sections of pipe where a blockage or obstruction occurs, measurement will be from the start of inspection (inside wall of manhole) to the point of abandonment of survey.
- .5 For sections of pipe with the WRc. condition code CU (camera underwater) that has a continuous distance greater than five (5) metres, the measurement above will be reduced by the distance in excess of the five metres.
- .6 Bypass pumping for each situation as described in the Form of Tender will be made as lump sum.

2.0 PRODUCTS

2.1 Equipment

- .1 A Survey Vehicle, containing a separate area for viewing, recording and controlling of the CCTV operation is required as follows:
 - .1 Viewing and control area to be insulated against noise and extremes in temperature. External and internal sources of light to be controlled to ensure the light does not impede the view of the monitor screen. Proper seating accommodation shall be provided to enable one person, in addition to the operator, to clearly view the monitor screen.
 - .2 All equipment utilized within the pipeline shall be stored outside the viewing, recording and control area.
 - .3 Vehicle to be equipped with a telephone for communication with the Engineer for the duration of the work.
 - .4 Electrical power for the system to be self-contained. External power sources from public or private sources will not be permitted.
- .2 Survey Equipment shall have sufficient cables to view the lengths of pipe as specified.
 - .1 Survey unit shall be a self-propelled crawler type with a means of transporting the CCTV camera in a stable condition through the pipeline.
 - .2 Each unit shall carry sufficient numbers of guides and rollers such that, when surveying, all cables are supported away from pipe and manhole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.
 - .3 Each unit shall interface with a data generator and appropriate software to record the alpha-numeric data associated with the pipeline condition and header reference location information.

- .3 The camera shall be capable of producing high quality colour imagery and provide complete inspections and view of all laterals and deficiencies.
 - .1 The camera shall be a "Pan & Tilt" type having the capability of panning the pipe at 360° and tilt capability of 270°.
 - .2 The camera shall be equipped with an inclinometer to record the slope of inspected pipe.
 - .3 The live picture is to be visible with no interference and capable of registering a minimum of 360 lines of resolution at the periphery.
 - .4 Focus and iris adjustment shall allow optimum picture quality to be achieved and to be remotely adjusted. The adjustment of focus and iris shall provide a focal range from 150mm in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer.
 - .5 The camera is to be waterproof with a self-contained lighting system capable of being remotely adjusted. Lights shall provide an even distribution of light around the pipeline perimeter without the loss of contrast or flare out or picture shadowing.

2.2 Materials

- .1 Digital video files are to be stored on new, unused DVD-R media in MPEG 2 format.
- .2 Photographs are to be in colour, with a minimum image size of 90mm x 70mm and shall be reproduced on premium glossy photo quality paper.

3.0 EXECUTION

3.1 CCTV Inspection

- .1 The Contractor shall submit samples of inspection reports, video (in MPEG 2 DVD format) together with corresponding digital data files for the Owners review within one week of receipt of notice to proceed with contract. This submission shall demonstrate compliance with the contract specifications and the accepted submission will be used as a benchmark for subsequent inspection report submissions.
- .2 No inspection surveys are to be carried out under this contract until an acceptable sample inspection report has been approved by the Contract Administrator.
- .3 Flow in the pipeline is not to exceed approximately 1/3 of the pipe diameter. Notify of excessive flows, inspect using flow reduction method (See Clause 3.10).
- .4 Steaming and fogging encountered during the inspection survey shall be eliminated by introducing forced air flow by means of fan.
- .5 The camera lens is to remain free of grease or other deleterious matter to ensure optimal clarity.
- .6 Inspection video images are to be produced in MPEG2 format by the following method:
 - .1 Video capture card and software designed to create and store real-time MPEG2 digital file direct to computer hard drive.
 - .2 Create a separate digital file and a separate title for each individual manhole-to-manhole inspection report. Format for the video file numbering to be provided by the Contract Administrator.
- .7 Set zero chainage at face of every manhole, or on entrance into pipe or start of pipe culvert.

- .8 Report and record on the full length of pipeline from inside face to inside face between manholes or outlet end of pipes and from one end of the pipe culvert to the other.
- .9 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
- .10 The data generator shall electronically generate, and clearly display on the viewing monitor and video recording, a record of the following minimum information prior to the start of each run:
 - .1 Manhole (from-to) / pipe length reference numbers.
 - .2 Pipeline dimensions
 - .3 Pipe material (i.e. vitrified clay, concrete, pvc etc.)
 - .4 Type or use of pipe (i.e. sanitary or storm sewer)
 - .5 Date of survey (yyyy.mm.dd)
 - .6 Road name/location
 - .7 Direction of travel of survey equipment (U or D, Upstream or Downstream)
 - .8 Inspection (report) number. Format to be provided by the Contract Administrator.
 - .9 Verbal description of all the above on screen information.
- .10 The data generator shall continuously electronically generate, and clearly display on the viewing monitor and video recording, a record of the following minimum information during each run:
 - .1 Automatic update of the camera's metre reading position from adjusted zero.
 - .2 Manhole/pipe length reference numbers.
 - .3 Type or use of pipe (i.e. sanitary or storm sewer)
 - .4 The unique inspection/report number of the run.
 - .5 Display digital information such that it will not interfere with the video image on the screen.
- .11 The camera must stop at each defect, change of condition of pipe and service connection to record defect in accordance with WRc codes.
- .12 Pan each service connection (junction) such that the camera looks down the centerline of the service, pause for a minimum of five (5) seconds and note condition of the joint and /or pipe/service interface.
- .13 Immediately notify Contract Administrator of any blockage or obstruction that will not allow passage of survey equipment.
- .14 Restart the inspection survey from the opposite end of pipeline or culvert when a blockage or obstruction is encountered unless directed by Contract Administrator.

3.2 Site Coding Sheets

- .1 Each pipeline length to be recorded according to the WRc, MSCC 3rd edition. Any variation from the manual is to be noted in the survey report.
- .2 Standard coding form shown on page 14 of MSCC to be modified as follows:
 - .1 Line 2, field 8 (date) to be eight (8) characters in the format of yyyy.mm.dd (year, month, day).
 - .2 Condition detail number (video count) to be six (6) characters in the format of hh.mm.ss (hours, minutes, seconds).
 - .3 Note observations as to condition of service connections beyond mainline in remarks column using standard codes as per MSCC.

3.3 Camera Position

- .1 Position the camera lens centrally in the pipeline to a tolerance of $\pm 10\%$ off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned 2/3 the height of the pipe measured from the invert.

- .2 Position the camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.

3.4 Camera Travel Speed

- .1 Travelling speeds of the camera in the pipeline shall be as follows:
 - .1 0.1m/s for pipeline of diameter less than 200mm.
 - .2 0.15 m/s for diameters 200mm and larger but not exceeding 310 mm: and
 - .3 0.20 m/s for diameters exceeding 310 mm

3.5 Camera Position Chainage Device

- .1 Use a chainage device which enables the cable length to be accurately measured to indicate the location of the camera.
 - .1 Chainage information to be transmitted electronically to control area and displayed on the monitor.
- .2 Chainage device shall be accurate to within 0.3 m up to the first 50 m of pipe length and within $\pm 1\%$ for lengths exceeding 50 m.
- .3 Chainage tolerance shall be checked at the start of contract and a minimum of once every two weeks there after or every 5000 m of pipeline inspected, whichever is greater.
- .4 Provide an audit form showing dates and distances checked to meet both tolerance requirements. Chainage linear measurement to be checked by use of a cable calibration device or tape or electronic measurement between fixed points.

3.6 Photographs and/or Digital Images

- .1 Photograph all major defects as defined by condition codes: B, CM, CXI, D, FC, FL, FM, H, IR, IG, JDL, JX, OB, OJL, RM, and X.
- .2 The following data, in alpha-numeric form, shall be overlaid on photographs such that it will not interfere with the defect condition reported:
 - .1 Report/job number
 - .2 Metre reading position (chainage)
 - .3 Manhole/pipe length reference numbers (from - to)
 - .4 Photograph number
 - .5 WRc. condition defect code
 - .6 Date of survey (yyyy.mm.dd)
- .3 Capture photographs and alpha-numeric data as a digital image in JPEG format if required, as specified in contract documents.
- .4 Co-ordinate photographs with the hard-copy report by reference number and inserting into the report following the relevant section of pipeline inspected.

3.7 Inspection Reporting Hard copies & Digital Format

- .1 Submit reports to the Contract Administrator within 10 working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.
- .2 Present machine printed (hard copy) and computer generated database reports according to the MSCC format as follows:

- .1 Each binder to commence with an index of all survey inspection reports contained within.
 - .2 Hard copy reports to be presented in tabular form in accordance with WRc MSCC
 - .3 Reports to be presented in sections or drainage areas and/or by pipeline type or as specified in the contract documents.
 - .4 Computer database file to contain identical survey report information as the printed report exclusive of photographs.
 - .5 Digital information to be presented in tabular configuration in accordance with the UBC standard file format in Microsoft ACCESS (.MDB) (See Clause 3.12). A single master database file to be presented at the end of the project containing all the project CCTV reports.
 - .6 Provide a CD ROM of digital photographs. Each disk to be labelled with photo and contract numbers.
 - .7 Include Owner supplied, scale drawings showing highlight inspected pipeline. Drawing to be attached to inspection condition report for each section of sewer pipeline surveyed.
- .3 Present reports in 215 mm x 280 mm three ring (D type) binders.
 - .4 Attach computer disks (DVD and CD) in three hole plastic diskette sheet holder in back of binder.
 - .5 Attach identical identification labels on the three ring binder, DVD's (video files) and CD's (database and still digital images).
 - .6 Provide additional copies of printed reports, if required, or as specified in contract documents.
 - .7 All dimensions and chainages in the reports shall be in metric units.

3.8 Flushing and Cleaning

- .1 Clean or flush sewers immediately prior to CCTV inspection survey, unless otherwise specified in the contract documents or directed by the Contract Administrator.

3.9 Root Cutting and Removal

- .1 Remove roots for condition codes RM where required, to allow for CCTV equipment to pass.

3.10 Flow Reduction

- .1 Reduce flow in pipeline to approximately 1/4 pipe diameter to allow CCTV inspection by combination of the following:
 - .2 Schedule work for off peak flow times.
 - .3 Plug or block flow at upstream manhole.
 - .1 Plug designed to either plug all flow or impede flow to the approximate 1/4 pipe diameter.
 - .2 Obtain Contract administrator's approval prior to plugging or impeding any flow.
 - .3 Remove plug or blocks to slowly return flow to normal without surge or surcharging downstream pipeline.
- .4 Temporary bypass pump flow around inspection section when required, as specified in contract documents. Plug to be flow through with hoses and pump of sufficient capacity to handle the peak flow. Hoses and couplings to be leak free. Flow to be pumped to downstream manhole on same system or run as inspection is to take place. Obtain Contract Administrator's approval prior to setting up temporary bypass pump system.

3.11 Coding Accuracy

- .1 Coding accuracy shall be a function of the number of defects or construction features not recorded (omissions) and the correctness of the coding and classification recorded. Coding accuracy to satisfy the following requirements:
 - .1 header accuracy 95%
 - .2 detail accuracy 85%
- .2 The Contractor shall implement a formal coding accuracy verification system at the onset of the work. Coding accuracy to be verified by the Contractor on a random basis on a minimum of 10% of the inspection reports. Contract Administrator will be entitled to review the accuracy verification system and results and be present when the assessments are being conducted.
- .3 A minimum of two accuracy verifications shall be performed for each operator for each working week. Coding not satisfying the accuracy requirements shall be re-coded and the accuracy of the inspection report immediately preceding and following the non-compliant inspection shall be verified. The process shall be repeated until the proceeding and subsequent inspections meet accuracy requirements.

3.12 Standard CCTV Digital File Format – Header Table

- .1 Below are two tables listing fields and data types to be used in the Digital file (MDB) submission.

HEADER TABLE

NAAPI FIELD NAME	DATA TYPE	FIELD PROPERTIES		CITY OF FIELD NAME
ID	AutoNumber			
SURVEYEDBY	Text	12		
CONTRACTNUMBER	Text	8		
JOBNUMBER	Text	10		
CATCHMENT	Text	10		
DIVISION	Number	Byte		
DISTRICT	Text	3		
PIPELENGTHREF	Text	11		
DATE	Date/Time			
TIME	Date/Time			
LOCATION	Text	50		
STARTMANHOLE	Text	10		
SDEPTH	Text	4		
SCOVER	Number	Single		
SINVERT	Number	Single		
FINISHMANHOLE	Text	10		
FDEPTH	Text	4		
FCOVER	Number	Single		
FINVERT	Number	Single		
USESEWER	Text	1		
DIRECTION	Text	1		
SIZE1	Number	Integer		
SIZE2	Number	Integer		
SHAPE	Text	1		
MATERIAL	Text	3		
LINING	Text	3		
PIPELENGTH	Number	Single		
TOTALLENGTH	Number	Single		
YEARLAID	Text	4		
VIDEONUMBER	Text	5		
COMMENTS	Text	50		
PURPOSE	Text	1		
SEWERCATEGORY	Text	1		
PRECLEANING	Text	1		
WEATHER	Text	1		
LOCATIONCODE	Text	1		
FURTHERDETAILS	Text	48		

CONDITION DETAILS TABLE

FIELD NAME	DATA TYPE	FIELD PROPERTIES	CITY OF..... FIELD NAME
ID	AutoNumber	Long integer	
VIDEONUMBER	Date/Time	hh:nn:ss	
PHOTOGRAPHNUMBER	Number	Integer	
DISTANCE	Number	Single	
CONTINUOUSDEFECT	Text	2	
CODE	Text	4	
DIAMETER_DIMENSION	Number	Integer	
CLOCKFROM	Number	Integer, "00"	
CLOCKTO	Number	Integer, "00"	
PERCENTAGE	Number	Byte	
INTRUSION	Number	Integer	
JOBNUMBER	Text	10	
REMARKS	Text	34	

*****END OF SECTION*****