Division 0 **Bidding Requirements, Contract Forms and Conditions of the Contract**

Refer to UBC Properties Trust for Division 00 documents.

Division 01 General Requirements

Division 02 Existing Conditions

Division 33 Utilities

1.0 1.0 GENERAL

1.1 SECTION INCLUDES:

.1 Words, Terms and Communications.

.2 Complementary Documents.

.3 Specification grammar.

.4 Applicable Codes

.5 Cooperation & Coordination

.6 Storage, Handling & Protection

.7 Transportation

.8 Owner Supplied Materials

.9 Weather Conditions

.10 Workers

.11 Conduct of Personnel

.12 Publicity

.13 Accessibility for the Disabled

.14 Utilities

.15 Trademarks & Labels

.16 Responsibility

1.2 RELATED MATERIALS

.1 Refer to UBC Financial Operations or UBC Properties Trust for Division 00 documents.

.2 Section 00 01 10 Table of Contents

.3 Section 01 11 00 Summary of Work

.4 This section describes requirements applicable to all sections within Divisions 01 to 33.

1.3 WORDS, TERMS AND COMMUNICATIONS

.1 Conform to Definitions and their defined meanings in the Definitions portion of Section 00700 and 00800 of this Request for Tender (RFT).

In this document the following definitions/abbreviations appear in italics:

Building Operations	means the Building Operations department of the University of British Columbia
UBC	means the University of British Columbia, and unless noted otherwise, means Building Operations.
Consultant	means the person identified as such in the request for Tenders and Tender Form and as defined in CCDC2-2008.

Project Manager means the person identified as such in the request for Tenders and Tender Form.

Owner means the University of British Columbia.

Owner's Representative means the Managing Director of Infrastructure Development, or his/her delegated representative in UBC Properties Trust, or UBC Project Services

For definitions of commissioning terms, click on this link to Section 01 91 00 Commissioning, 1.4 Definitions.

.2 UBC PROJECT NUMBERS

.1 *UBC* assigns project numbers to all project work. Without exception UBC project numbers must appear on all correspondence and documents prepared for or sent to *UBC*.

.3 LINES OF COMMUNICATION

.1 All information from the University regarding the contract, such as specific instructions of the Owner, requirements and changes during construction will be issued through the *UBC Project Manager*. The *Project Manager* shall be kept advised at all times of all informal contact and discussions between the *Consultant* and/or the Contractor with other staff of *UBC*. *UBC* will not be responsible for any circumstances which may arise from instructions, information and approvals having been obtained from *UBC* through channels other than the above.

.4 CORRESPONDENCE

.1 All correspondence with *UBC* shall be directed to the designated representative at UBC Properties Trust:

UBC Project Services
Room 1100 - 2329 West Mall
Vancouver, B.C. V6T 1Z4

UBC Properties Trust
Suite 200 - 3313 Shrum Lane
Vancouver, B.C. V6S 0C8

.2 The Contractor shall submit correspondence to the *Consultant* unless otherwise instructed. Should the Contractor feel that the matter requires immediate action by *UBC*, then a copy of the correspondence may be sent directly to the *Project Manager*.

1.4 COMPLEMENTARY DOCUMENTS

.1 Generally, drawings indicate graphically, the dimensions and location of components and equipment. Specifications indicate specific components, assemblies, and identify quality.

.2 Drawings, specifications, diagrams and schedules are complementary, each to the other, and what is required by one, to be binding as if required by all.

.3 Should any conflict or discrepancy appear between documents, which leaves doubt as to the intent or meaning, refer to the General Conditions in the contract documents.

.4 Examine all discipline drawings, specifications, schedules, diagrams and related Work to ensure that Work can be satisfactorily executed.

.5 All specification sections of the Project Manual and Drawings are affected by requirements of Division 01 sections.

1.5 SPECIFICATION GRAMMAR

.1 Specifications are written in the imperative (command) mode, in an abbreviated form.

.2 Imperative language of the technical sections is always directed to the Contractor identified as a primary constructor, as sole executor of the Contract, unless specifically noted otherwise.

.1 This form of imperative (command) mode statement requires the primary constructor to perform such action or Work.

.2 Perform all requirements of the Contract Documents whether stated imperatively or otherwise. Division of the Work among subcontractors, suppliers, or others is solely the prime constructor’s responsibility. The specification author assumes no responsibility to function or act as an arbiter to establish subcontract scope or limits between sections or divisions of Work.

1.6 APPLICABLE CODES, STANDARDS AND MANUFACTURER'S LITERATURE

.1 In the absence of other standards being required by the Contract Documents, all work is to conform to, or exceed the minimum standards of the B.C. Building Code, the Canadian Standards Association, the Workers' Compensation Board of British Columbia, National Fire Protection Association, Canadian Electric Code, B.C. Plumbing Code, Factory Mutual Engineering, Underwriter’s Laboratory of Canada, B.C. Fire Code Regulations, and the standards of manufacturers of material supplied for this project, whichever is/are applicable.

.2 Wherever standards are referred to in the specifications, the latest edition of the standard shall apply at time of Bid except where such editions have not been adopted by B.C. Building Code.

.3 If required by the *Consultant* the manufacturer/supplier or Contractor shall furnish documentation indicating compliance with the requirements of the B.C. Building Code including where required, certification by an Engineer registered in the Province of British Columbia.

.4 Any work shown on the drawings or described in the specifications which is at variance with the applicable codes shall be brought to the attention of the *Consultant*.

.5 In no instance shall the standards established by the drawings and specifications be reduced by any of the applicable codes.

1.7 COOPERATION AND COORDINATION

.1 Coordinate the work of sub-contractors with efficient and continuous supervision.

.2 Cooperate with *UBC* authorities and other Contractors engaged in simultaneous development of adjacent facilities. Coordinate access to the site, the location, removal or adjustment of temporary fences, sheds and utility services.

.3 Coordinate the work of each trade to ensure that such work is consistent with the requirements for the work of a following trade.

.4 Before commencing any work, each trade must report any inconsistency between the work of a preceding trade and the requirements for their work. Any costs incurred by the Contractor or trades to rectify such inconsistencies shall be at no expense to the *Owner*.

.5 The Contractor shall coordinate the work of all trades requiring suspension or fixing devices to be incorporated into the structure. Where required, such suspension or fixing devices are to be built into the structure and/or by of the type specified or detailed herein, the Contractor shall submit to the *Consultant* details of the device he proposes to use accompanied by such information as the *Consultant* may require to assess the capability of the proposed device.

1.8 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged products at own expense and to satisfaction of *Consultant*.

.9 Touch-up damaged factory finished surfaces to *Consultant*'s satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.9 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of Work.

.2 Transportation cost of products supplied by *Owner* will be paid for by *Owner*. Unload, handle and store such products.

1.10 OWNER SUPPLIED MATERIALS

.1 The Contractor is responsible for scheduling delivery of items supplied by the *Owner* as required to maintain the construction schedule.

.2 The Contractor is also responsible to check materials as they are delivered and to notify the *Project Manager* immediately through the *Consultant* of any materials supplied by the *Owner* that do not meet specified standards or are received in damaged condition.

1.11 WEATHER CONDITIONS

.1 All sections of work shall include in their tender an allowance sufficient to cover full, continuous working operation through normal weather conditions, without interruptions or shutdowns.

1.12 WORKERS

.1 All work shall be performed by skilled mechanics, experienced in their trade; according to rules and customs of best trade practices for first class work and to the various standards recommended and specified.

.2 Construction Force: The Contractor shall provide and maintain, in full operation at all times during the performance of the contract, a sufficient crew of labourers, mechanics and foremen to execute the work.

1.13 CONDUCT OF PERSONNEL

.1 Sexual Harassment

  .1 There is a great deal of sensitivity on the campus regarding sexual harassment. Sexist and/or racist comments or actions may be reported to the Sexual Harassment Policy Office and lawsuits or human rights complaints could be filed.

  .2 Specific examples of actions that are considered offensive under the Policy would be:

    .1 calls or audible comments directed at or about passersby, particularly regarding physical or sexual attributes,

    .2 prolonged staring by individuals or groups,

    .3 whistling or catcalls, or

    .4 throwing items at or in front of passersby in order to gain their attention.

.2 Smoking: *UBC* has a NO SMOKING policy in all work areas except in specified rest areas which are specifically designated as smoking areas.

.3 Grooming: *UBC* retains the right to restrict and control the clothing worn by, and the grooming of, employees, *Consultant*s or visitors to the campus where these may conflict with health and safety considerations and regulations.

1.14 PUBLICITY

.1 All publicity relating to the Project is subject to the approval of the *Owner* and no mention of the project in advertising or articles in any publication will be permitted unless approved in writing through the *Owner*. Publicity or advertising implying endorsement of a product, Contractor or *Consultant* will not be permitted.

1.15 ACCESSIBILITY FOR THE DISABLED

.1 Barriers shall not be put in the way of disabled people in and around campus facilities (ie. unnecessary steps, narrow aisles etc.) Handicapped refers to the visually impaired as well as the physically disabled.

1.16 UTILITIES

.1 Contractor shall be responsible for capping, plugging, disconnecting, relocating or divertive all utilities interfering with construction operation. If the Contractor discovers unidentified utilities, the Contractor shall:

  .1 Contact UBC Energy and Water Services.

  .2 Provide a drawing outlining proposed changes.

  .3 Obtain approval from UBC Energy and Water Services before commencement of work.

1.17 TRADEMARKS AND LABELS

.1 Trademarks and labels, including applied labels shall not be visible in the finished work. Such trademarks or labels shall be removed by grinding if necessary, or painted out where the particular materials are being painted. The exception of this requirement shall be those essential to obtain identification of mechanical and electrical equipment and where required by Code to ensure compliance.

1.18 RESPONSIBILITY

.1 The Contractor shall assume full responsibility for laying out the work and ensuring it does not conflict with the work of other trades, and for any damage caused to the *Owner* or other Sub-contractors by improper location or carrying out of the work.

.2 If more than one interpretation can be taken from the specification or drawings regarding labour, material, or equipment, notify the *Consultant* immediately for clarification. If clarification cannot be obtained, consider the most costly of possible alternative to apply. No allowance will be made for a tender based on the lesser.

.3 The dimensions given on the drawings of the existing work are approximate and the Contractor must take actual measurements before ordering materials, equipment and the like. Failure to comply with the requirement will make the Contractor fully responsible for replacing such material or equipment at no extra cost to the contract.

.4 Prior to the submission of shop drawings and/or the installation of work to be performed, promptly advise the *Consultant* of any specified equipment, material, or installation which appears inadequate or unsuitable or in violation of applicable codes.

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

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Site security risk assessment

.2 Construction site security plan

.3 Security measures

1.2 RELATED SECTIONS

.1 Section 01 51 00 Temporary Facilities and Controls

2.0 EXECUTION

2.1 SITE SECURITY RISK ASSESSMENT

.1 A site security risk assessment must be undertaken for all major construction projects at UBC. The objective of the assessment is to determine risks and appropriate mitigation measures to ensure that the site is secure and safe. There is a particular concern on campus with students accessing construction sites.

.2 The security assessment is to be led by the project manager and include UBC Campus Security, the Prime Contractor and any other relevant stakeholders. The assessment is to be conducted prior to mobilization on site and will deliver a list of project specific recommendations for discussion at a site security kick-off meeting. Based on these recommendations the Prime Contractor will generate a construction site security plan. Once approved, the execution and ongoing monitoring of this plan will become the responsibility of the Prime Contractor.

2.2 SECURITY MEASURES

.1 Construction sites with tower cranes, high scaffolding or significant fall risks must include the following mandatory measures:

.1 8-foot high perimeter fencing or hoarding must be installed around the project site. Modular fencing to have bolted connections at each section. Entrance gates must be locked after work hours. “Trespassers will be prosecuted” signs must be placed at regular intervals along the site perimeter fencing/hoarding. Signage with security company name and contact number should also be provided.

.2 Base of tower cranes, construction elevator hoistways and significant scaffolding structures must be wrapped in plywood to a height of at least 12 feet. Access doors must be securely locked after hours.

.3 A clear communication protocol must be established between on-site site security personnel (if used), Prime Contractor, RCMP, UBC Campus Security and other key UBC contacts (i.e. UBC Properties Trust or UBC Project Services project manager). A written contact list should be prepared by the project manager and provided to all parties. New personnel who come onto site through the project must be appropriately oriented by the Prime Contractor.

.2 Other security measures that may be considered based on site risk assessment include:

.1 Deployment of on-site security personnel outside of standard construction work hours. Numbers to be based on security assessment.

.2 Security cameras around the site perimeter or at open routes that provide access up the structure (i.e. stairwells).

.3 Addition of spiked tops to perimeter fencing/hoarding.

.4 Motion-detector activated lights and horns on crane towers, elevator hoistways or major scaffolding.

.5 Motion-activated lights on site perimeter facing into the construction site.

.6 Other measures as deemed appropriate based on the risk assessment.

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

1.0 GENERAL

1.1 SECTION INCLUDES

.1 General description of Work.
.2 Contract Method.
.3 Work by Owner or Other Contractors.
.4 Assigned Contracts
.5 Work sequence.
.6 Contractor use of premises.
.7 Owner occupancy.
.8 Partial Owner occupancy.
.9 Products ordered in advance.
.10 Owner furnished products.

1.2 RELATED SECTIONS

.1 Section 01 31 00 Project Management and Coordination
.2 Section 01 32 16 Construction Progress Schedule
.3 Section 01 35 16 Alteration Project Procedures
.4 Division 27 Communications
.5 Division 28 Electronic Safety and Security
.6 Appendix: - Additional information of work and products by others to be incorporated in Project.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract consists and comprises in general:

  .1 Excavation and site preparation for a wetland system for water treatment and flood control on UBC Campus

  .2 Constructing a concrete water control structure

  .3 Building bio-swales and connecting the stormwater to the existing UBC System.

.2 The Work is more particularly described in the Contract Documents

1.4 CONTRACT METHOD / COMPLETION

.1 Construct the Work under a single lump sum fixed price contract.

.2 Complete the Work so as to be certifiable by the Consultant as having attained Substantial Performance on or before the date shown on 00 3 00 Bid Form.

.3 The Contractor shall work closely with the UBC Project Manager, Owner’s forces carrying out Owner’s work, as well as Other Contractors engaged by the Owner to carry out related work.

.4 The Contractor is required take the leading role in the organizing, scheduling and coordinating all of the work for an efficient and speedy completion. Scheduling of the Work is the responsibility of the Contractor. Coordinate scheduling of the Work with the Project Manager.

.5 Provide sufficient labour and materials to complete the Work within the time required for each construction phase, as well as to meet overall completion within the Contract Time. Any required overtime and similar costs to complete the project by the agreed completion date is included in the Contract Price.

.6 All parties shall cooperate and resolve disputes so as not to affect progress of the Work. The Contractor shall take remedial action to correct and make up any default, as the work progresses.

.7 Arrange and carry out the Work so as to maintain access and exits; avoid conditions of unacceptable noise, dust, and appearance; minimize disruption to UBC operations.

.8 The Owner's requirement to maintain UBC operations takes precedence over the Contractor's requirements.

1.5 WORK BY OWNER OR OTHER CONTRACTORS

.1 Refer to the General Conditions of the construction contract. All trades to confirm proper interface and coordination prior to proceeding with related work.

.2 WORK BY OWNER: Work of Project which is specifically excluded from this Contract and which will be carried out by the Owner simultaneously with the Work under this Contract:

.1 *UBC will*

.1 supply and install required Utility Services to project site up to point of connection as designated by UBC Energy and Water Services, for connection by the Contractor and putting into service by UBC Energy and Water Services , as follows:

.1 Domestic Water
.2 Sanitary
.3 Storm
.4 Steam
.5 Gas
.6 Electrical

.2 As per the Contract Documents.

.2 UBC Locksmith Services group will

.1 remove construction cylinders and supply and install final keyed lock cylinders in hardware provided by this Contract.

.3 UBC SA (Secure Access) group will

.1 supply and install the following Division 28 Electronic Safety and Security systems, including electronic devices and components and Division 28 Electronic Safety and Security wiring up to point of interface connection as designated by UBC SA for connection and testing by UBC SA:

.1 Burglary Alarm
.2 Access Control
.3 CCTV

.2 All related Division 26 power, pathway and rough-ins and Section 08 71 00, 2.1.3 Electrified Hardware installation are to be provided under this Contract.

.3 Division 28 Electronic Safety and Security wiring to be provided under this Contract.

.4 UBC IT Services group will:

.1 supply and install the following, including system electrical devices and components and low voltage wiring and cabling:

.1 Data Systems

.2 Central RF Systems (This includes CCTV & CATV “cablevision” Systems)

.3 Central Demarcation connections, (Demarc Outlets), for centrally “other” centrally controlled and/or monitored systems up to point of interface connection as designated by the Contractor for connection and commissioning by the contractor and verification by UBC IT Services. These systems include:

- Building Management System (BMS)
- Master Hydro Utility Meters
- Fire Alarm System transponders
- Bell System
- Master Clock System
- Elevators
- Security & Access Control System panels

.2 However, all related pathways and rough-ins are to be provided under this Contract.

.3 WORK BY OTHER CONTRACTORS: Work of Project which is specifically excluded from this Contract, for which the Owner has awarded or will be awarding separate contracts and which will be carried out by Other Contractors simultaneously with the Work under this Contract:

.1 Items or work specifically shown or scheduled on Drawings.

.4 **OWNER-SUPPLIED PRODUCTS**: Work of this Project includes the coordination, as well as the installation unless otherwise noted, of products including Owner-supplied equipment shown, scheduled, specified or identified in Contract Documents as NIC (Not-in-Contract) or similar designation.

1.6 ASSIGNED CONTRACTS

.1 If Owner has awarded the following pre-tendered Subcontractor contracts to expedite the Work or for other purposes in the Owner’s interests, all Items or work will be specifically shown on Drawings.

.1 The Contractor is to assume these pre-tendered contracts and incorporate all of this work and costs in the Base Bid Price, and execute a Subcontractor agreement with the designated subcontractor on execution of the Owner/Contractor Agreement.

.2 At the Contractor's request, assigned Subcontractors to:

.1 Furnish to Contractor, bonds covering faithful performance of subcontracted work and payment of obligations thereunder.

.2 Purchase and maintain liability insurance to protect Contractor from claims for not less than limits of liability which Contractor is required to provide to Owner.

.2 If Owner has awarded the following preordered product contracts to expedite the Work or for other purposes in the Owner's interests all Items or work will be specifically shown on Drawings.

.3 The Total Contract Price includes any additional overhead and profit, and other work and costs required, to make the work of these assigned contracts fully compatible with the Work of these Contract Documents.

1.7 WORK SEQUENCE

.1 It is intended that the construction work proceed in a phased and organized manner which minimizes disruption to UBC operations.

.2 The Contractor shall prepare a preliminary and proposed sequence of construction and construction schedule, for presentation at a First Project Meeting (refer to Section 01 33 00 Submittal Procedures) for review and acceptance in principle by the UBC Project Manager. The Contractor shall revise the proposed sequence schedule as directed for final acceptance by the UBC Project Manager, before commencement of on-site construction work.

.3 The finalized schedule shall clearly define:

.1 the phasing of the work

.2 the limit of construction work during each phase and sub-phase

.3 the duration of each phase

.4 the sequence of construction within each phase to co-ordinate the work of all trades, that of Owner, and that work under other contracts.

.5 baseline start dates, finish dates, and task durations.

.4 The Contractor shall provide monthly project schedule updates in electronic form. Electronic format shall be Microsoft Project. The schedule update shall detail:

.1 task actual start, duration, and completion dates.

.2 percent complete of each task.

.3 critical tasks, task linkages, and order/delivery dates for major equipment components.

.4 impact of change orders, if any.

.5 The Contractor, all subcontractors and suppliers of material required for the Work will expedite and proceed with the Work so as to conform to the agreed schedule and phases.

.6 Any float (also described as “slack” or “cushion”) that exists in the Construction Schedule (as to the overall Contract Time and as to parts of the Work) does not belong exclusively to the Owner or exclusively to the Contractor, but rather will:

.1 firstly, be used for and applied to obviate any delay or extension of time otherwise provided for in the Contract, including any delay or extension of time otherwise provided for or described in the schedule, or that would otherwise result from a Change Order or Change Directive / Site Work Order, or any other delay or extension of time that the Contractor would otherwise be entitled to, and despite any provision of the Contract allowing for delay or extension of time the Contract Time will not be delayed or extended to the extent that float is available at the time the matter, circumstance or event arose or occurred, and

.2 any remaining will, in the administration and interpretation of the Contract, be shared and applied equitably by and between the Owner and the Contractor.

.7 The phasing and sub-phasing of the work shall be as established and finalized by consultation between the Contractor and the UBC Project Manager, before commencement of the work, and as the work progresses.

.8 All work within an area or phase must be fully completed and operational, in order to be considered ready for Owner occupancy.

.9 For each phase, Mechanical and Electrical trades to provide all temporary hook-ups and services required, provide relocation and removal as required, and work required to keep all life safety, communications, and security systems fully operational.

.10 Required stages or phasing: as designated on Drawings, and as follows:

1.8 CONTRACTOR USE OF PREMISES

.1 Refer GC 3.12, Use of the Work

.2 Coordinate use of premises with UBC Project Manager to allow:

.1 Owner occupancy.
.2 Public usage.

.3 On final occupancy, Owner will provide for occupied areas:

.1 Operation of HVAC and electrical systems.
.2 Maintenance.
.3 Security.

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

1.0 <u>GENERAL</u>

1.1 SECTION INCLUDES

.1 Hours of Work
.2 General Restrictions
.3 Service Connections, including:
  .1 Connecting to existing services.
  .2 Service Shut-down of existing services.
  .3 Service Connection to Utility services.
.4 Special scheduling requirements.
.5 Markings
.6 Publicity / Advertising

1.2 RELATED SECTIONS

.1 Section 01 35 29 Health, Safety, and Emergency Response Procedures
.2 Section 01 33 00 Submittal Procedures
.3 Section 01 35 43.13 Environmental Procedures for Hazardous Materials
.4 Section 01 51 00 Temporary Facilities & Controls
.5 Obtain and refer to <u>UBC Vancouver Contractor Safety Orientation Manual</u> (pocket-size pamphlet, which includes emergency phone numbers and contacts) issued by the *Owner* as supplementary information regarding safety and work-related policies at *UBC*.

1.3 GENERAL RESTRICTIONS

.1 No work of any kind can begin until the proper authorization and/or work permits have been obtained.

.2 Stop work around an area where existing previously unidentified hazardous material is discovered (refer Section 01 35 43.13), including materials suspected of containing asbestos, and immediately contact the *UBC Project Manager* for direction before continuing with the Work affected.

.3 *UBC* traffic and parking regulations apply throughout *UBC*, which includes in general:

  .1 All parking at and within the project site must first be registered with *UBC* Parking & Access Control Services – 6200 University Boulevard and a permit purchased. There is NO FREE PARKING on Campus. No vehicle parking on grassed areas, boulevards, sidewalks, etc.

  .2 No vehicle may enter the “EMERGENCY ZONES” at any time without receiving clearance and a permit from the Parking and Access Control Services.

1.4 HOURS OF WORK

.1 No person(s) shall engage in any construction in the public realm that causes disturbance of the quiet, peace, rest or enjoyment of the public, except:

  .1 between the hours of 7:30 a.m. (0730 hours) to 7:00 p.m. (1900 hours) on any week day that is not a statutory holiday; and,

.2 between 9:00 a.m. (0900 hours) to 5:00 p.m. (1700 hours) on any Saturday that is not a statutory holiday.

.2 Construction is not permitted on Sunday or any statutory holidays.

.3 In any case where it is impossible or impractical to comply with the above, an application must be made to the Compliance Officer at UBC Campus and Community Planning to gain consent.

.1 No construction work may take place on Sundays or on days observed as a holiday, unless specifically authorized in writing by the *UBC Project Manager*.

.4 Construction work time, additional special restrictions:

.1 Limit construction activities, particularly those generating noise and other distractions, so as not to affect the following *UBC* operations within the time periods described in the Contract Documents.

.2 The *Owner* reserves the right to adjust the Contractor's activities relative to *UBC*'s scheduled examinations.

.5 Complaints and work carried out contrary to Hours of Work restrictions will be assessed by the *UBC Project Manager* or designated representative, whose instructions are to be followed immediately.

1.5 EXISTING SERVICES

.1 Notify UBC Project Manager and UBC Energy and Water Services of required Service Shutdown and intended interruption of services and obtain required permission.

1.6 SERVICE CONNECTION DEFINITIONS

.1 A Service Connection is defined as any new physical link made to an existing UBC service distribution system, including gas, water, electricity, sewer, steam, communications and fire suppression system.

.2 A Service Shut-down is defined as a total stoppage of the distributed service to a particular area.

1.7 PROCEDURE - GENERAL

.1 The following procedures will apply whenever construction work is being connected to any of the Campus services or when a service shut-down is required:

.1 A UBC **Service Connection Application** is required before any new project work is connected to a major service. Refer to http://www.buildingoperations.ubc.ca/resources/policies-procedures-forms/. A separate application is required for each type of service but not for each connection where more than one connection is necessary.

.2 A UBC **Application for Service Shut-down** is required to be submitted for any service shut-down. Refer to http://www.buildingoperations.ubc.ca/resources/policies-procedures-forms/. Where a shut-down is required in order to make a service connection a Service Connection Permit is also required. Note that a minimum of ten (10) working days is required for a routine service shut-down. Some shut-downs can take much longer to arrange. A separate Application for Service Shut-down is required for each type of service and for each shut-down thereto.

.2 Any queries regarding the need for a Service Connection Application shall be directed to Project Services, Project Manager.

.3 There is no cost to the Contractor for a **Service Connection Application**. Shut-downs shall be kept to a minimum.

1.8 PROCEDURE - SERVICE CONNECTION APPLICATION

.1 The Contractor shall request a **Service Connection Application** from the Project Manager who will complete section (2) of the *application* form.

.2 The Contractor is responsible for obtaining information and signatures required for sections (3) and (4).

.3 When sections (2), (3*) and (*4*)* are completed the Contractor shall deliver the *application* form to Building Operations*, Utilities Mechanical Engineer* for approval.

1.9 PROCEDURE - APPLICATION FOR SERVICE SHUT-DOWN

.1 The Contractor is responsible for obtaining information and signatures required for Parts (1) and (2). When Parts (1) and (2) are complete the Contractor shall deliver the form to the Project Manager.

.2 Building Operations will notify the Contractor and other concerned parties of the date and duration of the shut-down. The shut-down will be carried out by Building Operations personnel at the approved time and date.

.3 Consultants and contractors should be aware that in some cases a shut-down may not be possible, or may take many weeks to organize, may require the work to be carried out in off-hours, or may require the provision of temporary services.

.4 Refer to http://www.buildingoperations.ubc.ca/resources/policies-procedures-forms/ for sample forms.

1.10 SPECIAL SCHEDULING REQUIREMENTS

.1 As described in the Contract Documents.

1.11 MARKINGS

.1 No organic markings such as felt pens or paint shall be used on any surface, whether exposed or to be concealed or covered by subsequent work, unless part of a specified identification system.

.2 No temporary markings shall remain visible in exposed areas after Project completion.

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

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Cash allowances.

.2 Contingency allowance.

1.2 REFERENCES

.1 Refer to the General Conditions and the Supplementary Conditions for cash allowances in the construction contract.

.2 Refer to the General Conditions and the Supplementary Conditions for contingency allowance in the construction contract.

.3 Section 00300 Bid Form.

1.3 CASH ALLOWANCES

.1 Cash Allowances are shown in the 00300 Tender Form and described in the Contract Documents.

.2 Included in Contract Price are Cash allowances to be carried in Subcontracts for work specified in respective specification Sections. Coordinate to ensure no omission or duplication.

.3 The Contractor will review the cash allowance tender documents for scope and administrative compatibility with the Contract, and provide a suggested list of bidders to the Owner & Consultant. Acceptance will be at the Owner’s discretion.

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

1.0 GENERAL

1.1 CONTRACT CHANGES - GENERAL

.1 As per Section 00700 – 00800 of this RFT.

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

1.0 GENERAL

1.1 CONTRACTOR PAYMENTS

.1 As per the CCDC 2 – 2008 as supplemented by UBC Supplementary Conditions, Section 00700 – 00800 of this RFT.

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

1.0 GENERAL

Spec. Note: To be included in all Tenders.

1.1 FIRST PROJECT MEETING

.1 As soon as possible following the acceptance of the Contractor's Tender a first meeting will be set up in order to review the project requirements with all concerned and to turn over the site to the Contractor. The Contractor and key Subcontractors are required to attend the first meeting as appropriate for the size, location and type of project:

.2 The start-up meeting is meant to review and discuss issues such as:

- .1 Project Context and Overview
- .2 Permits, Approval, and Inspection
- .3 UBC Shutdown and Service Connections
- .4 Safety
- .5 Construction Site Policies
- .6 Contract Administration
- .7 Coordination with UBC
- .8 Equity and Inclusion
- .9 Forms, Departments and Policies

1.2 REGULAR SITE MEETINGS

.1 The Contractor will schedule and administer project meetings throughout progress of the Work. Frequency, location and date of the first of the regular site meeting is to be established at the first meeting. The Contractor will be responsible for taking and distributing minutes of site meetings.

1.3 COORDINATION OF WORK WITH THE WORK BY OWNER OR OTHER CONTRACTORS

.1 Refer to the General Conditions and the Supplementary Conditions of the construction contract.

.2 Refer to Section 01 11 00 Summary of Work.

.3 Work by Owner and Work by Other Contractors

- .1 For all work not included in Contract, but which is part of the overall Project and which will be carried out by Other Contractors under Separate Contracts or Owner's own forces.
  - .1 The Contractor is responsible for:
    - .1 Obtain and review the information required for the Work by Other Contractors and by the Owner. Prior to proceeding with the Contractor’s related work, Contractor shall confirm proper interface and coordination of all work.

.2 Review of shop drawings, product data, samples, and other submittals, and notification to both UBC Project Manager and to Consultant of any observed discrepancies or problems anticipated due to non-conformance with Contract Documents.

.3 Scheduling.

.4 Setting out.

.5 Coordination, including all service requirements.

.6 Provide and connect all services forming part of the Work, including related cutting, drilling, coring, and doing all necessary patching and making good.

.7 Disconnect and/or capping off existing services for existing equipment to be relocated by Other Contractors or Owner, including all necessary patching and making good.

.8 Provide suitable storage for other contractors' pre-delivered products and equipment when available on site and/or building.

.9 Security.

.10 Damage caused by the Contractor.

.11 Arranging installation inspections required by public authorities.

.2 The Owner is responsible for:

.1 Providing information required of Other Contractors for the Work.

.2 Ensuring the timing of information and the work of Other Contractors and Owner's own forces conforms to the agreed construction schedule.

.3 Testing and placing in operation.

.4 OWNER-SUPPLIED PRODUCTS

.1 For all products not included in Contract (NIC or similar designation), but which are part of the overall Project and which will be supplied by the Owner.

.1 The Contractor, in addition to the same responsibilities described by 1.3 above for Other Contractor work, is responsible for:

.1 Obtaining and the review of information required for the Work and provided by product manufacturers.

.2 The Owner, in addition to the same responsibilities described by 1.3 above, is responsible for:

.1 Arrange for delivery of shop drawings, product data, samples, manufacturer's instructions, and certificates to Consultant and Contractor.

.2 Ensuring the timing of information and the delivery of N.I.C. products conforms to the agreed construction schedule.

.3 Deliver supplier's bill of materials to Contractor.

.4 Arrange and pay for delivery FOB site in accordance with Progress Schedule.

.5 Inspect deliveries jointly with Contractor.

.6 Submit claims for transportation damage.

.7 Arrange for replacement of damaged, defective or missing items, and determine responsibility for costs.

.8 For NIC products installed by the Owner: unload, store, uncrate, and move into location, and supply and install required anchors to adequately support weight, resist vibration, and provide lateral and seismic restraint.

.9 For NIC products installed by the Contractor, supply all required anchors to adequately support weight, resist vibration, and supply lateral and seismic restraints

.10 The design and installation review of lateral and seismic restraints noted above which shall be by a Professional Engineer Registered in British Columbia.

.11 Arrange for manufacturer's field representatives to clarify installation and carry out placing in service and testing, when required by the particular product and equipment.

.12 Testing and placing in operation all N.I.C. products.

.3 Additional requirements or conditions related to Owner-supplied products:

.1 (Description, or state:) To be issued by Addendum if applicable

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

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Schedules.

.2 Critical path scheduling.

.3 Progress photographs and video.

.4 Submittals schedule.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 78 39 Project Record Documents

.3 This section describes requirements applicable to all Sections within Divisions 01 to 33.

1.3 SCHEDULES

.1 Submit schedules as follows:

  .1 Submittal Schedule for Shop Drawings and Product Data.
  .2 Submittal Schedule for Samples.
  .3 Submittal Schedule for timeliness of Owner-furnished Products.
  .4 Product Delivery Schedule.
  .5 Cash Allowance Schedule for acquiring Products only or Products and Installation, or Installation only.
  .6 Shutdown or closure activity.

.2 Schedule Format

  .1 Prepare schedule in form of a MS PROJECT horizontal Gantt bar chart.
  .2 Provide a separate bar for each major item of work, subcontract or operation.
  .3 Split horizontally for projected and actual performance.
  .4 Provide horizontal time scale identifying first or last Working Day of each week.
  .5 Format for listings: Table of Contents of the Project Manual or chronological order of start of each item of work.
  .6 Identification of listings: By specification Section numbers, specification subjects or systems description.

.3 Schedule Submission

  .1 Submit initial format of schedules within 15 working days after award of Contract.
  .2 Submit schedules in electronic format, forward through e-mail or through project web site as*.pdf, *.gif, *.tif, or*.bmp files.
  .3 Consultant will review schedule and return review copy within 10 days after receipt.
  .4 Resubmit finalized schedule within 7 days after return of review copy.
  .5 Submit revised progress schedule with each application for payment.
  .6 Distribute copies of revised schedule to:
    .1 Job site office.
    .2 Subcontractors.

.3 Other concerned parties.

.7 Instruct recipients to report to Contractor within 10 days, any problems anticipated by timetable shown in schedule.

1.4 CONSTRUCTION PROGRESS SCHEDULING

.1 Submit [computer generated] network analysis diagram using the [critical path] [PERT] method.

.2 Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

.3 Indicate estimated percentage of completion for each item of Work at each submission.

.4 Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates, including those furnished by Owner and required by Allowances.

.5 Include dates for commencement and completion of each major element of construction as follows.

- .1 Site clearing.
- .2 Site utilities.
- .3 Foundation Work.
- .4 Structural framing.
- .5 Special Subcontractor Work.
- .6 Equipment Installations.
- .7 Finishes.

.6 Indicate projected percentage of completion of each item as of first day of month.

.7 Indicate progress of each activity to date of submission schedule.

.8 Indicate changes occurring since previous submission of schedule:

- .1 Major changes in scope.
- .2 Activities modified since previous submission.
- .3 Revised projections of progress and completion.
- .4 Other identifiable changes.

.9 Provide a narrative report to define:

- .1 Problem areas, anticipated delays, and impact on schedule.
- .2 Corrective action recommended and its effect.
- .3 Effect of changes on schedules of other prime contractors.

1.5 CRITICAL PATH SCHEDULING

.1 Include complete sequence of construction activities.

.2 Include dates for commencement and completion of each major element of construction.

- .1 Site clearing.
- .2 Site utilities.
- .3 Foundation Work.
- .4 Structural framing.
- .5 Special Subcontractor Work.

.6 Equipment Installations.

.7 Finishes.

.3 Show projected percentage of completion of each item as of first day of month.

.4 Indicate progress of each activity to date of submission schedule.

.5 Show changes occurring since previous submission of schedule:

.1 Major changes in scope.

.2 Activities modified since previous submission.

.3 Revised projections of progress and completion.

.4 Other identifiable changes.

.6 Provide a narrative report to define:

.1 Problem areas, anticipated delays, and impact on schedule.

.2 Corrective action recommended and its effect.

.3 Effect of changes on schedules of other prime contractors.

1.6 PROGRESS PHOTOGRAPHS

.1 Digital Photography

.1 Completed by Consultant or others.

1.7 PROGRESS VIDEO

.1 Completed by Consultant or others.

1.8 SUBMITTALS SCHEDULE

.1 Include schedule for submitting shop drawings, product data, samples.

.2 Indicate dates for submitting, review time, resubmission time, and last date for meeting fabrication schedule.

.3 Include dates when submittals will be required for Owner-furnished products.

.4 Include dates when reviewed submittals will be required from Consultant.

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

1.0 GENERAL

1.1 INSURANCES AND BONDS

.1 Promptly submit Bond and Insurance Certificates as required to the *Project Manager*. Progress draws will not be paid before these documents have been submitted. Insurance Certificates shall name *UBC* as additional insured.

.2 All other submittals required to be submitted within 15 days of award of contract.

1.2 RELATED SECTIONS

.1 Section 01 11 00 Summary of Work – Work Sequence
.2 Section 01 31 00 Project Management and Coordination
.3 Section 01 32 16 Construction Progress Schedule

1.3 CONSTRUCTION SCHEDULE

.1 Promptly submit a construction schedule covering the full scope of the contract to the *Project Manager*. The construction schedule will include any special schedule requirements established by the Consultant and incorporated in the Instructions to Tenderers and the Tender Form. The Contractor shall prepare the schedule as follows:

.1 After award of contract and before commencement of the Work, a first project meeting will be held with the *Project Manager*, *Consultant*, Contractor, and Subcontractors in attendance. The Contractor shall prepare a preliminary and proposed sequence of construction and construction schedule, for presentation at this meeting. Timing of service interruptions, phases and sequence of the Work, etc., and any clarifications with respect to scheduling will be brought forward and discussed at this time.

.2 Following this meeting the Contractor shall submit his construction schedule, to include required staging and sequencing of the Work and also detailed scheduling for mechanical, plumbing and electrical work, etc., to the *Project Manager* for final acceptance. The construction schedule shall include any instructions resulting from the first project meeting.

.3 In order to improve the work schedule or eliminate unforeseen problems, modifications to the construction schedule may be suggested by the *Project Manager*, *Consultant* or the Contractor during the contract and such modifications may be implemented by mutual agreement. Schedules must be updated and reissued monthly to reflect the agreed changes.

.4 The contractor shall submit monthly project schedule updates, both in hard copy and electronic form. Electronic format to be Microsoft Project 98 or later. The schedule shall detail task start, duration, and completion dates, and percent complete of each task. It shall highlight critical tasks, task linkages, and order/delivery dates for major equipment components. An up-to-date construction schedule, submitted both in print and electronically, is required with all progress claims.

1.4 PROGRESS REPORTS/DAILY REPORTS

.1 The Contractor shall, from the date of commencement of the Work, maintain a careful daily record of the progress of the Work. This record shall be open to inspection by the *Consultant* or the *Owner* at all reasonable times and shall, if requested, be turned over to the *Consultant* at Substantial Performance of the Work. The record shall show all pertinent data such as:

.1 if applicable, the daily weather conditions,
.2 commencement, progress and completion of various portions of the work,
.3 dates of all meetings and their purpose,
.4 dates of visits by government authorities, inspectors, utility companies and the like,
.5 record of work force employed,
.6 materials causing delay,
.7 clarifications or questions, and
.8 safety program records

1.5 SHOP DRAWINGS, SAMPLES AND PRODUCT DATA

.1 All Shop Drawings and Samples are to be submitted to the *Consultant* (unless otherwise instructed) for review. After the *Consultant* has reviewed the Shop Drawings, the *Consultant* shall submit one copy of the Reviewed Shop Drawings to the *Project Manager*, unless otherwise specified. Except for the Finish Hardware Schedule, *UBC* does not review Shop Drawings prior to the *Consultant* returning them to the Contractor.

.2 Unless specifically requested Samples need not be submitted to *UBC*. Product data is not normally required to be submitted to *UBC*. The exception to this is the Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials. Refer to Section 01360 Hazardous Materials for more information.

.3 All submittals and each document within single submittal shall be clearly identified with a relevant MasterFormat 2014, Division and Section number under which they are required. Refer to the Construction Specifications Institute (CSI) for details about MasterFormat 2014 Numbers and Titles. (*PDF available here*)

1.6 FINISH HARDWARE SCHEDULE

.1 The Finish Hardware Supplier's Schedule shall be submitted in accordance with Section 08 71 00.

1.7 INSPECTION & TEST REPORTS

.1 Copies of Electrical, Gas and Plumbing permits shall be forwarded to the *Project Manager* and also maintained in the site office for reference by interested parties.

.2 Testing Reports shall be submitted to the Contractor with copies to the *Consultant* and the *Project Representative*. Copies shall also be kept in the temporary construction office for reference by interested parties.

1.8 REVIEWED SHOP DRAWINGS

.1 One complete set of reviewed Shop Drawings is to be kept on the construction site for reference by *Consultants* and Inspectors.

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

1.0 GENERAL

1.1 FORMS FOR THE USE OF THE CONSULTANT AND/OR CONTRACTOR

.1 Standard forms shall be utilized for UBC projects as applicable. A link to the forms is provided in the Building Operations, Policies, Work Procedures & Forms webpage:

http://www.buildingoperations.ubc.ca/resources/policies-procedures-forms/

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

1.0 GENERAL

1.1. RELATED SECTIONS

.1 Refer to Section 01 14 00 Work Restrictions.

.2 For general waste management and recycling requirements, refer to Division 01 Section 01 74 19 Construction Waste Management and Disposal.

1.2. PROTECTION OF EXISTING BUILDINGS AND SERVICES

.1 When working within an existing occupied building the following requirements apply:

- .1 The Contractor shall provide temporary enclosures for securing off of work and the maintenance of any services necessary to the proper and efficient operation of the Project.

- .2 The Contractor shall conduct construction operations with minimum interference to existing building operations, adjacent buildings, adjacent public or private roadways, parking lots, sidewalks and access facilities in general.

- .3 The Contractor shall provide protection against smoke propagation emanating from welding operations by use of temporary smoke barriers and/or temporary local ventilation of areas involved and shall provide a fire extinguisher at all areas where welding is being carried out.

- .4 Special provisions shall be made by the Contractor to protect existing building areas when exposed by removal of existing roofing and walls or other exterior surfaces. All necessary precautions and measures shall be taken by the Contractor to ensure the interior of existing building is weathertight and fully secured at all times.

- .5 All Work in areas to receive renovations shall be completely sealed off by the Contractor from the remainder of the building. Temporary partitions shall be installed, covered, insulated and sealed from construction noise and dust. All debris shall be removed daily from these areas, as well as from all areas of the site, to maintain clean, safe and efficient site conditions. **Control of dust is critical**. Take all necessary precautions and schedule Work to ensure adjoining occupied areas are completely dust free at all times.

- .6 The Contractor shall take all necessary precautions to fully protect the existing equipment and furnishings against damage from water, dust or the like, during installation of new work, including cutting of existing roof and walls. Dust screens and/or platforms shall be provided as specified above. Cover and protect existing furnishings, equipment, etc., by means acceptable to the *Owner* whenever Work is to be carried on above or beside such existing items.

- .7 Where material or equipment is being transported within the existing building on carts or pallets, such carts or pallets shall have rubber tires.

.8 The Contractor shall provide temporary hoarding to maintain unobstructed access to exits and to prevent access to construction areas in accordance with all Safety Regulations and good practice.

.9 The Contractor shall seal, supply and return ducts and chases or temporary filters installed to prevent migration of dust and noise through existing air systems.

.10 Where work is confined inside a room, the door shall be temporarily weatherstripped to prevent dust from leaving the room.

.11 The Contractor shall make good, at no expense to the *Owner*, any damage or disruption caused to the existing building contents and to the adjoining property, utilities and services not called for as part of the Work of this contract. All repair work shall only be done after consultation with the *Owner*, *Consultant*, appropriate parties and authorities and to standards and codes or the authorities having jurisdiction.

.12 Making good shall mean restoration to at least the original condition in terms of strength, safety, workmanship and appearance.

.13 The Contractor shall protect existing exterior finishes, windows, doors, etc., at all times from damage from hoists, chutes, materials handling equipment, or new construction.

.14 The Contractor shall obtain the *Consultant*'s approval prior to cutting openings through structural members.

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

1.0 <u>GENERAL</u>

1.1 GENERAL

.1 The responsibility for safety on construction sites shall rest with the Contractor(s). The regulations of the Worker's Compensation Board (WorkSafeBC) and the British Columbia Building Code apply as a minimum. For the purpose of Part 8 of the British Columbia Building Code the following definitions apply:

 .1 service company: shall mean UBC Building Operations for steam, water, gas, sanitary sewers and storm sewers, and UBC IT Services for telephone, communications and cable television.

 .2 street: shall mean any thoroughfare uses by the public, service vehicles or pedestrians.

 .3 public property: shall mean all property on the UBC campus outside the area defined or shown as the project site - normally delimited by the hoarding line.

.2 All Contractors and Subcontractors must be registered employers with the Workers Compensation Board and must conform to all WorkSafeBC requirements for construction safety.

.3 The Owner will provide the Contractor with any known information regarding hazards to the health or safety of persons in the workplace.

1.2 CONSTRUCTION SAFETY PROGRAM

.1 The Prime Contractor shall have in place a safety program acceptable to the Worker's Compensation Board. At the start of a job the Contractor shall submit a Notice of Project to WorkSafeBC, with copies to UBC.

.2 The contractor shall obtain a copy of the UBC's lock-out procedures as well as information on notice required if service such as power or water may be shut off (Shutdown Request).

.3 The contractor shall abide by the <u>UBC Contractors Safety Orientation Manual</u>, the latest version.

1.3 SITE SAFETY PLAN

.1 A Site Safety Plan is required for all additions, renovations and all new buildings regulated under Part 3 of the British Columbia Building Code or when required by WorkSafeBC.

.2 The Prime Contractor shall conduct a job hazard assessment and prepare a Site Safety Plan giving the names and emergency telephone numbers of the Prime Contractor, the Project Manager, the Consultant, the Trades Safety Coordinator, UBC Campus Security, UBC Trouble Calls and UBC Parking & Access Control Services. The Plan shall also show the details of the construction procedure relating to site access, maintenance of any required exits, barricades, traffic control, scaffolding and swing stages, hoisting equipment, fire protection facilities, emergency shut-off locations, material storage, waste materials, control of dust and debris, protection of the edges of each floors and any other items required by the Chief Building Inspector. The Site Safety Plan will be presented to the Project Manager at the first Project Meeting.

.3 The Site Safety Plan shall be adjusted to reflect the current stage of construction activities. The Site Safety Plan shall be posted on the job site on a 600mm by 600mm piece of plywood protected from the weather and staked into the ground so as to be visible from the street. Alternatively it may be posted and protected from the weather on the principal construction site entrance or shelter provided for workers or equipment.

.4 A separate Fire Safety Plan for the construction site shall also be submitted in accordance with the BC Fire Code.

1.4 PROXIMITY TO OVERHEAD POWER LINES

.1 Where work must be conducted in an area which is in close proximity to overhead power lines, UBC Energy and Water Services will provide assurance in writing that the power lines are de-energized, or require guarding. The Contractor shall contact the Energy and Water Services (ph: 604-822-9445) to coordinate appropriate procedures and to obtain the WorkSafeBC form 30M33. All work procedures must be in conformance with Part 19 of the WorkSafeBC Regulations.

1.5 ROOF TOP ACCESS

.1 Roof top access is restricted on all UBC Buildings in accordance with Building Operations Policy and Procedure I-B-6: Roof Top Access. A Roof-Top Access Permit and Key Authorization Form can be obtained from Project Services Project Coordinator. The Contractor will confirm with the Owner to ensure they are working with the most up to date processes.

1.6 PROCEDURE FOR ENTERING CONFINED SPACES

.1 Contractors must conform to the WorkSafeBC regulations with respect to entering confined spaces such as manholes, service tunnels etc. The Contractor must follow the UBC Confined Space Policy I-B-1.

1.7 PROTECTIVE CLOTHING & EQUIPMENT

.1 Contractors are required to provide their own protective clothing and equipment when required for access to any restricted location on the UBC Campus. This would include, but not be limited to items such as, hard hats, safety footwear, respirators and protective coveralls. Items which require custom fitting, such as respirators, shall not be made available for use by more than one person.

1.8 BARRICADES AND BARRIERS

.1 All barricades and barriers on construction sites shall conform to all safety practices required by regulations and good practice. Barriers for work outside the construction site must be visible both day and night.

.2 All walkways in close proximity to job sites shall be built with overhead protection where overhead work is being performed in close proximity.

.3 In pedestrian areas adequate warning must be provided for visually impaired pedestrians. Chain link fencing or hoarding is preferred as it allows blind persons to feel the base of the barricade with their canes. Audible or tactile warning devices may also be required. Before setting up barricades in pedestrian areas the Owner must be notified at least 48 hours in advance in order that the Crane Library & Resource Centre can be notified and visually impaired people can be made aware.

.4 In vehicular areas barriers shall conform to the requirements of Part 8 of the B.C. Building Code. The placement of all barriers in vehicular areas must be approved by Parking & Access Control Services and, if applicable, the Ministry of Transportation and Highways. Parking & Access Control Services will notify the VFRS Fire Protection Office of the presence of the barriers.

1.9 FIRST AID

.1 The Contractor shall arrange for the provision of first aid facilities and an Accident Prevention Program to the requirements of the Workers' Compensation Board of B.C.

1.10 LOCKOUT PROCEDURES

.1 All Contractors shall conform to the UBC – Building Operations Policy and Procedure I-B-2: Lock-out Safety. Copies of this procedure can be obtained from the Project Services Project Coordinator.

1.11 X-RAYS AND OTHER CONSTRUCTION TESTING

.1 Non-destructive testing involving x-ray sources or x-ray emitting devices shall be in accordance with the Canadian Nuclear Safety Commission Regulations to minimize radiation exposure to workers, other building occupants and passersby. All testing of this nature must be reported in writing, at least 3 days in advance, to the Radiation Safety Office, UBC Risk Management Services, tel. 604-822-7052.

1.12 FIRE PROTECTION DURING CONSTRUCTION & DEMOLITION

.1 Refer to Part 8 of the B.C. Building Code and the requirements of the Fire Services Act, Regulations and Bulletins. Questions concerning these requirements should be directed to the VFRS Fire Protection Office.

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

SPEC NOTE: Always include this section.

1.0 GENERAL

1.1 ENVIRONMENTAL CONTROLS

.1 Comply with Federal, Provincial and Campus regulations pertaining to waste, air, solid waste, chemical waste, sanitary waste, sediment and noise pollution.

.2 Protection of natural resources: Preserve the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract in their existing condition or restore to an equivalent or improved condition upon completion of the Work.

.1 Confine demolition and construction activities to areas defined by public roads, easements, and work area limits indicated on the Drawings.

.1 Temporary construction: Remove indications of temporary construction facilities, such as haul roads, work areas, structures, stockpiles of excess or waste materials, and other vestiges of construction as directed by Project Manager.

.2 Water resources: Comply with applicable regulations concerning the direct or indirect discharge of pollutants to the underground and natural waters.

.1 Oily substances: Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water in such quantities as to affect normal use, aesthetics, or produce a measurable ecological impact on the area. Store and service construction equipment at areas designated for collection of oil wastes.

.3 Land resources: Prior to construction, identify all land resources to be preserved within the work area. Do no remove, cut deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the Project Manager.

.1 Erodible soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use the areas developed. Immediately protect side slopes and back slopes upon completion of rough grading.

.4 Erosion and sedimentation control: Construct or install temporary and permanent erosion and sedimentation control features as required to meet the City of Vancouver’s Bulletins 2002-002-EV and 2002-003-EV or latest revision thereof.

.5 Dust control, air pollution, and odor control: Prevent creation of dust, air pollution and odors.

.1 Use water sprinkling, temporary enclosures, and other appropriate methods to limit dust and dirt rising and scattering in air to lowest practical level. Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.

.2 Store volatile liquids, including fuels and solvents, in closed containers.

.3 Properly maintain equipment to reduce gaseous pollutant emissions.

.6 Noise Control: Perform demolition and construction operations to minimize noise. Perform noise producing work in less sensitive hours of the day or week as directed by the Owner's Representative.

.1 Repetitive impact noise on the project site shall not exceed the following dB limitations:

Sound Level in dB	Time Duration of Impact Noise
70	More than 12 minutes in any hour
80	More than 3 minutes in any hour

.2 Provide equipment sound-deadening devices, and take noise abatement measures that are necessary to comply with these requirements.

.3 Maximum permissible construction equipment noise levels at 50 feet (dB):

EARTH MOVING	dB	MATERIALS HANDLING	dB
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCRAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS75	SAWS	75	
GENERATORS	75	VIBRATORS	75
COMPRESSORS	75		

.7 Disposal operations:

.1 Promptly and legally transport and dispose of removed and demolished items and waste materials that are not identified to be recycled or reused.

.2 Do not burn, bury or otherwise dispose of rubbish and waste materials on project site.

1.2 FIRES

.1 Fires and burning of rubbish on UBC lands and the site not permitted.

1.3 CONSTRUCTION SITE WASTES

.1 Do not bury rubbish and waste materials on site unless approved by Engineer.

.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

.3 For general waste management and recycling requirements, refer to Division 01 Section 01 74 19 Construction Waste Management and Disposal.

1.4 DRAINAGE

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.3 Control disposal of runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.5 SITE CLEARING AND PLANT PROTECTION

.1 All Final decision will be made by UBC’s campus Arborist.

.2 Protect trees and plants on site and adjacent properties where indicated.

.3 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2m.

.4 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.

.5 Minimize the stripping of topsoil and vegetation.

.6 Restrict tree removals to areas indicated or designated by Engineer.

1.6 WORK ADJACENT TO WATERWAYS

.1 Do not operate construction equipment in waterways.

.2 Do not use waterway beds for borrow material without the Owner’s Project Manager’s approval.

.3 Do not dump excavated fill, waste material or debris in waterways.

.4 Design and construct temporary crossings to minimize erosion to waterways.

.5 Do not skid logs or construction materials across waterways.

.6 Avoid indicated spawning beds when constructing temporary crossings of waterways.

.7 Do not blast under water or within 100 m of indicated spawning beds.

1.7 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this contract.

.2 Control emissions from equipment and plant according to local authorities' emission requirements.

.3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

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

1.0 GENERAL

1.1. ASBESTOS CONTAINING MATERIAL (ACM)

.1 All activities concerning asbestos handling, removal, and disposal shall conform to WorkSafeBC Occupational Health and Safety Regulations (OH&S) and “Safe Work Practices for Handling Asbestos” (current edition) and to any additional requirements indicated by UBC Asbestos Management Program.

.2 A UBC Asbestos Hazard Assessment Memo will be provided as part of the Contract Documents. The UBC Asbestos Hazard Assessment Memo must be posted on the site safety board. In special cases where site safety boards are not available, the memo must be part of the work package and must be reviewed by the worker prior to commencing the work.

.3 The Contractor shall review the Contract Documents and site and promptly report to the Owner's representative any errors, inconsistencies or omissions he may discover, concerning the presence of asbestos-containing materials. If suspect asbestos material is discovered during the normal progress of the project, the Contractor shall not proceed with the affected portion of the Work until direction from the Owner's Representative has been received. The presence of asbestos-containing material must be reported to the Project Manager and the UBC Asbestos Management Group at 604-822-8772.

.4 Should there be asbestos-containing material present on the site, either specifically stated in the Contract Documents or discovered during the project, all work with asbestos-containing materials must be performed by a qualified Asbestos Abatement Contractor. The scheduling of the work is the responsibility of the Contractor. All applicable regulatory requirements such as WorkSafeBC and UBC regulations and guidelines as provided by the UBC Asbestos Management Program must be strictly adhered to.

.5 All air monitoring and inspections will be conducted by a qualified OH&S Consultant.

.6 At least 24 hours prior to commencing work, the Asbestos Abatement Contractor will file a “Notice of Project” (NOP) and Site Specific Work Procedures intended for use on the project to WorkSafeBC. A copy of the NOP must also be faxed to the UBC Asbestos Management Program at 604-827-5629.

.7 Only the following pre-approved asbestos abatement contractors shall be used:

.1 Quantum Murray LP
.2 ACTES Environmental
.3 Phoenix Enterprises Ltd.
.4 NUCOR Environmental Solutions Ltd.

1.2. POLYCHLORINATED BIPHENYLS (PCB)

.1 The procedure for the removal and disposal of PCB containing light fixtures shall be carried out in accordance with requirements in Division 16.

.2 All activities involving handling, storage and transportation of PCB containing materials must be carried out in accordance with all Provincial and Federal regulations and documents:

1.3. RADIOISOTOPES

.1 Construction of facilities designated for radioisotope use shall be reviewed and approved in writing by UBC Risk Management Services (RMS).

.2 Radioisotope laboratories shall be designed and constructed in accordance with the Canadian Nuclear Safety Commission document R-52, Design Guide for Basic and Intermediate Level Radioisotope Laboratories.

.3 The Consultant will contact UBC RMS at least 10 working days prior to project start up, to arrange for the safe removal of radiation hazards by the Radiation Safety Officer (RSO). Radiation warning signs will be removed only by the RSO.

.4 Prior to commencement of renovation construction, a complete set of contamination control records (wipe tests) will be generated by the principal investigator responsible for the space. These records must be submitted to the RSO for approval.

.5 The Contractor must obtain written assurance from the RSO prior to commencement of construction that the area if free of radioactive contamination.

1.4. WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM (WHMIS)

.1 The Contractor, Subcontractors and Suppliers shall comply with Workers Compensation Boards' Workplace Hazardous Materials Information System (WHMIS.) Regulations pertaining to labeling, provision of Material Safety Data Sheets (MSDS), education and training programs, safe handling and emergency procedures for "Controlled Products" being used in the Project. This includes handling hazardous materials so that project workers, the public, the UBC community and property are not at risk.

.2 Operations producing odours such as the application of adhesives and painting shall be carried out in a safe manner and in a manner to prevent the spread of fumes to occupied areas of the building. Submit to the Consultant WHMIS Material Safety Data Sheets for all chemical treatments, adhesives and potentially harmful products to be used.

1.5. BIO-SAFETY AND OTHER HAZARDS

.1 The Project Manager will call UBC Risk Management Services at least 10 working days before project startup to arrange for the safe removal and/or disposal from within and adjacent to the project area of all hazardous materials including but not limited to chemicals, radioactive materials, bio-medical materials and glass laboratory equipment. Signs warning of the presence of hazardous materials will also be removed. Other laboratory equipment, which cannot be moved and which presents a potential for injury will be locked out and sealed. RMS will provide written confirmation to the Contractor and Consultant that the project area is ready for construction.

1.6. SPILLS & CLEANUP

.1 The Contractor, subcontractors and suppliers must comply with the B.C. Ministry of the Environment Regulations involving the required response to spills of hazardous materials that could result in contamination of the environment (air, water, ground).

.2 The Contractor, subcontractors and suppliers must be able to respond to spills of a hazardous or unknown material while working at UBC. Procedures would include isolating the area to prevent further exposure to the material and immediately informing the on-site superintendent and the UBC Project Manager or the VFRS Fire Protection Office at 911 or 604-665-6068.

.3 The Contractor, subcontractors and suppliers must have available the material, procedures and trained personnel required to clean up spills of any material they use in their work at UBC.

1.7. STORAGE AND HANDLING

.1 Coordinate storage of hazardous materials with the Project Manager and abide by internal requirements for labeling and storage of materials and wastes.

.2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with current British Columbia Fire Code of Canada requirements.

.4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use. Store all flammable and combustible liquids in approved safety cans bearing the Underwriter's Laboratory of Canada or Factory Mutual seal of approval. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Consultant.

.5 Transfer of flammable and combustible liquids is prohibited within buildings.

.6 Transfer of flammable and combustible liquids will not be carried out in the vicinity of open flames or any type of heat-producing devices.

.7 Flammable liquids having a flash point below 38°C, such as naptha or gasoline, will not be used as solvents or cleaning agents.

.8 Store flammable (flash point < 37.8°C) and combustible (flash point < 37.8°C) waste liquids for disposal in approved containers located in a safe, ventilated area. Keep quantities to a minimum.

.9 Observe smoking regulations at all times. Smoking is prohibited in any area where hazardous, flammable, and/or combustible materials are stored, used, or handled.

.10 Abide by the following storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:

.1 Store hazardous materials and wastes in closed and sealed containers which are in good condition.

.2 Label containers of hazardous materials and wastes in accordance with WHMIS.

.3 Store hazardous materials and wastes in containers compatible with that material or waste.

.4 Segregate incompatible materials and wastes.

.5 Ensure that different hazardous materials or hazardous wastes are not mixed.

.6 Store hazardous materials and wastes in a secure storage area with controlled access.

.7 Maintain a clear egress from storage area.

.8 Store hazardous materials and wastes in a manner and location which will prevent them from spilling into the environment.

.9 Have appropriate emergency spill response equipment available near the storage area, including personal protective equipment.

.10 Maintain an inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.

.11 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.

.12 Report spills or accidents immediately to Project Manager. Submit a written spill report to Project Manager within 24 hours of incident.

1.8. TRANSPORTATION

.1 Transport hazardous materials and wastes in accordance with federal Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

2.0 <u>PRODUCTS</u>

2.1. MATERIALS

.1 Only bring on site the quantity of hazardous materials required to perform work.

.2 Maintain MSDSs in proximity to where the materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

3.0 EXECUTION

3.1. DISPOSAL

.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

.2 Recycle hazardous wastes for which there is an approved, cost effective recycling process available.

.3 Send hazardous wastes only to authorized hazardous waste disposal or treatment facilities.

.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.

.5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

.6 Dispose of hazardous wastes in a timely fashion in accordance with applicable provincial regulations.

.7 Dispose of aerosol cans in accordance with UBC Generator Waste Disposal Procedure – ref. 06.01.19.

.8 Dispose of gas (propane/butane/other) cylinders in accordance with UBC Hazardous Waste Disposal Procedure – ref. 06.01.16.

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

1.0 GENERAL

1.1 BUILDING PERMITS

.1 The British Columbia Building Code applies to all buildings on land on the Point Grey Campus of the University of British Columbia. A Building Permit is required for all projects to which the British Columbia Building Code applies as defined in Subsection 1.1.2 of the Code except as amended by the *UBC* Development & Building Regulations. A separate Building Permit is required for the demolition of a building unless the demolition is part of a contract for the construction of a new building. No construction/demolition work may be started without a Building Permit and the applicable Trade Permits.

.2 A Building Permit has been applied for and will be obtained by the *Consultant.*

1.2 AUTHORITY HAVING JURISDICTION

.1 The "authority having jurisdiction" with respect to the British Columbia Building Code and its related regulations is the Chief Inspector, Permits & Inspections group, *UBC* Regulatory Services, 2210 West Mall, Vancouver, B.C., V6T 1Z4.

.2 The "authority having jurisdiction" with respect to the British Columbia Fire Code is the Fire Commissioner, Inspectors and Local Assistant to the Fire Commissioner. The Local Assistant on the *UBC* Campus is the Manager VFRS Fire Protection Office.

1.3 EXCAVATION & BACKFILL PERMITS

.1 Excavation Permits are required for all excavation not covered by a Building Permit:

- .1 Any machine excavation no matter how deep,
- .2 Any excavation deeper than 500mm,
- .3 Any penetration of earth with drills, piles, augers, spikes etc., or
- .4 Any penetration of concrete deeper than 50mm.

.2 An Excavation & Backfill Permit can be obtained by making application on the appropriate form which is available from *UBC* Regulatory Services, and paying them the required fee.

1.4 DAMAGE DEPOSITS

.1 Contractors are required to protect all surrounding roadways, sidewalks, walkways and other site features outside the construction site boundary. A damage deposit is payable by the Contractor to the Campus & Community Planning University Engineer who is the sole authority to determine the amount of such deposits and if and how the deposits will be used to repair damage to the *UBC* Campus. A receipt for the damage deposit must be presented to the Permits & Inspections group before a Building Permit will be issued.

1.5 TRADE PERMITS

.1 Trade Permits must be obtained by the applicable Trade Contractor before any work is started. *UBC* Plumbing & Sprinkler Permits are available from Chief Inspector, Permits & Inspections group upon submission of the appropriate documentation and payment of the required fee.

.2 Other Trade Permits required by statute must be obtained from the applicable Provincial authority. When requested, copies of these permits must be submitted to the Chief Inspector.

1.6 UBC INSPECTORS

.1 *UBC's* Inspectors fulfill the following functions:

.1 They act in roles as municipal building officials and enforce the provisions of the B.C. Building Code and the *UBC* Development & Building Regulations. They also liaise with other Provincial and Federal authorities.

.2 Provide a check and balance on the required Field Review of the Coordinating Registered Professional and the Registered Professionals and Design Assistants.

.3 Inspect to determine that *UBC's* interests are protected and report observations to the *Project Manager*.

.2 The *UBC* Inspectors are not authorized to make changes to the contract. If the Contractor feels that their instructions are not in accordance with the Contract, the Contractor shall request clarification from the *Consultant or Project Manager*. Contractors are required to call for and obtain all necessary inspections, including those listed in the *UBC* Development & Building Regulations. At least 24 hours advance notice is required.

1.7 FINAL INSPECTION

.1 No building or part thereof may be occupied without the prior written authorization of the Chief Inspector in the form of a Final Building Inspection Report. An application shall be made in writing not less than 10 working days before it is required.

1.8 APPEALS

.1 When the Chief Inspector and a *Consultant* or Contractor disagree, the disagreement shall be submitted to the Associate Director, Regulatory Services for initial resolution. If the parties are unable to resolve their differences and on the recommendation of the Associate Director, Regulatory Services the dispute may be submitted to the *UBC* Facilities Regulatory Appeal Committee in accordance with the *Policy and Procedure for Regulatory Appeals*.

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

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Inspection and testing, administrative and enforcement requirements.

.2 Tests and mix designs.

.3 Mock-ups.

.4 Mill tests.

.5 Equipment and system adjust and balance.

1.2 RELATED SECTIONS

.1 Section 01 21 00 Allowances

.2 Section 01 91 00 Commissioning

.3 This section describes requirements applicable to all Sections within Divisions 01 to 33.

1.3 INSPECTION BY AUTHORITY

.1 Allow Authorities Having Jurisdiction access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection whenever portions of the Work are designated for special tests, inspections or approvals, either when described in the Contract Documents or when required by law in the Place of the Work.

.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.4 The Contractor shall arrange for all inspections by Provincial authorities including, but not necessarily limited to, the Provincial Electrical Inspector, the Provincial Gas Inspector, the Provincial Elevator Inspector.

1.4 REVIEW BY CONSULTANT

.1 *Consultant* may order any part of Work to be reviewed if Work is suspected to be not in accordance with Contract Documents.

1.5 INDEPENDENT INSPECTION AGENCIES

.1 The *Consultant* (unless otherwise instructed) will make recommendation to the *Owner* on the required Inspection Services, beyond those provided as part of the *Consultant's* basic services, to assure construction quality and Code compliance. The recommendation will indicate which inspection services will be included in the Construction Contract and which will be performed under a direct contract between the *Owner* and the Testing Agency.

.2 Allocate Costs: To Section 01 21 00 Allowances.

.3 Provide equipment required for executing inspection and testing by appointed agencies.

.4 Employment of inspection and testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.5 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and testing to ascertain full degree of defect. Correct defect and irregularities as advised by *Consultant* at no cost to *Owner*. Pay costs for retesting and reinspection.

1.6 ACCESS TO WORK

.1 Allow inspection and testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.7 PROCEDURES

.1 Notify appropriate agency and *Consultant* in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.8 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by *Consultant* as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 The *Consultant* and *Owner* shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standard of performance, quietness of operation, finish, and appearance.

.3 Make good other Contractor's work damaged by such removals or replacements promptly.

.4 If in opinion of *Consultant* it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, *Owner* may deduct from Contract Price the difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by *Consultant*.

1.9 REPORTS

.1 Submit one electronic copy of inspection and test reports to *Consultant* and the Owner.

.2 Provide copies to Subcontractor of work being inspected or tested or to the manufacturer or fabricator of material being inspected or tested as required by the Contractor.

1.10 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as may be requested.

.2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by *Consultant* and may be authorized as recoverable.

1.11 MOCK-UPS

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.

.2 Construct in all locations acceptable to *Consultant*.

.3 Prepare mock-ups for *Consultant's* review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 If requested, *Consultant* will assist in preparing a schedule fixing dates for preparation.

.6 Remove mock-up at conclusion of Work or when acceptable to *Consultant*.

1.12 MILL TESTS

.1 Submit mill test certificates as requested or required of specification Sections.

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

1.0 GENERAL

1.1 KEYS & ACCESS CONTROL

.1 The Contractor shall obtain a "Key Requisition" from Building Operations and obtain the keys from the Key Control Centre of the Department of Parking & Access Control Services who will determine which keys are to be issued.

.2 The Contractor will be required to pay a deposit (currently varying between $50.00 and $200.00) for each key obtained from the University. The deposit will be refunded within ten (10) days of the Contractor returning the key to the Key Desk of the Department of Parking & Access Control Services. Keys will not be issued to Subcontractors.

.3 When access to a communications room is required the representative of UBC IT Services shall be contacted to obtain the key. This key is available for one day at a time and shall be returned before 3:30 PM of the same day. The Contractor is responsible for keeping the room locked when no one is in the room or after working hours.

.4 When access to an electrical room is required the Contractor shall contact the UBC Project Manager who will arrange for those keys to be loaned from Building Operations.

1.2 SECURITY

.1 UBC does not provide any security service for the Contractor. Should the Contractor wish to have his site attended, it will be his responsibility to provide this service at his own expense. The Contractor shall ensure that all openings to buildings are properly closed with secure barricades.

.2 The Contractor should provide UBC with names and phone numbers to contact at night, in case of an emergency. This list should be provided on the contractor's letterhead and include the name of the project.

1.3 HOARDING

.1 Site Hoarding, barricades and barriers shall be constructed in accordance with good practice and all applicable regulations. Refer to Section 01 35 29 Health, Safety, and Emergency Response Procedures.

1.4 CONSTRUCTION ACCESS AND TRAFFIC MAINTENANCE

.1 Construction access to the work areas within existing building for workers and delivery of materials shall be designated by the Owner. No other existing exits or entrances shall be used by workers for access or for delivery of materials.

.2 The Contractor shall conduct construction operations with minimum interference to adjacent roadways, sidewalks and access facilities in general and shall keep such areas free from materials, debris and equipment at all times. The Contractor shall not close or obstruct existing roadways, sidewalks, parking areas or delivery points and shall not place or store materials or park cars on same.

.3 The Contractor shall obtain approval of his proposed haul routes from UBC's Parking & Access Control Services. The Traffic Supervisor's Office is located at 6200 University Boulevard. Haul routes shall be kept clean and dust shall be controlled. Refer to Section 01 41 00 Regulatory Requirements for the required damage deposits.

.4 The Contractor shall cooperate in all ways with the Owner in all matters concerning necessary interference with normal operation of the UBC Campus facilities. Minimizing disruption of normal campus operation and vehicular movements on Campus is an essential requirement of the Contract.

.5 The Contractor shall:

.1 Include project phasing strategies in the construction schedule to minimize traffic disruption on Campus.

.2 Provide one (1) week minimum notice to the Owner, previous to any disruption or alteration of access to the Campus. The Contractor shall provide all signs, pylons and flag persons necessary to direct vehicular traffic around work in progress.

.3 The Contractor shall maintain access to existing fire hydrants and Siamese connections and shall keep entrances and exits to existing and adjacent buildings clear at all times.

.4 The Contractor shall be responsible for providing a traffic management plan prior to the start of construction and for ensuring that proper traffic control procedures are followed in locations where construction activity interfaces with campus streets. The traffic management plan must detail truck routes to/from campus, street closures, traffic diversions, traffic control measures and communication of approved street closures to UBC through street postings and other direct means. For all excavations on streets or fire access routes, for whatever reason, the contractor shall submit notice of excavation to UBC Campus and Community Planning and Vancouver Fire Rescue Service twenty-four (24) hours prior to the start of work. If the excavation will result in a street closure, the UBC Plant Operations Service Shutdown procedure must be followed with notice issued at least 3 days prior to the closure.

1.5 CONSTRUCTION PARKING CONTROL

.1 There is no free parking on the UBC Campus. Parking rates are posted at the parking entrances or on parking meters. Cars or trucks without permits will be towed away at the expense of the vehicle’s owner. Parking is not allowed on any UBC Campus roadway unless so indicated. The Contractor’s representative can obtain monthly parking permits for workers from UBC Parking and Access Control Services at 6200 University Boulevard at the prevailing rates.

.2 No parking is allowed outside of the Contractor’s Hoarding unless the area has been designated on the drawings as being reserved for the Contractor. In most cases contractors working on renovations to existing UBC Buildings will not be provided with on-site parking and only time-limited loading permits will be issued.

.3 Vehicles to be parked on the Campus shall be governed by the UBC Traffic and Parking Regulations and shall be identified to the satisfaction of the UBC Director of Parking & Access Control Services.

1.6 SCAFFOLDING & HOISTING

.1 Elevators in Existing Buildings may be used, with prior permission, for access and moving of construction materials and equipment. The use of elevators in existing buildings must be coordinated with the Project Manager. In most cases the Contractor's use of the elevator will be restricted to specified hours throughout the day. The contractor is responsible for the safe use of the elevator and protecting all finishes.

.2 Each sub-contractor shall provide all scaffolding necessary for execution of his work, unless alternative arrangements are made with the Prime Contractor in writing prior to tender.

1.7 STORAGE SPACE

.1 Site storage space may not be obtainable. There shall be no obligation on the part of the Owner to provide any storage space.

1.8 TEMPORARY UTILITIES

.1 Temporary Power.

.1 The Contractor shall pay for the cost of electrical energy for temporary power and lighting when drawn from UBC Energy and Water Services power system. All temporary services are to be metered.

.2 The Contractor shall provide, at his own expense, temporary service wiring, transformers, receptacles, fixtures, connections, etc. conforming to Canadian Electrical Code and shall make such available to all trades throughout the project. Energize services only after Provincial Electrical Inspector's approval.

.3 The Contractor shall submit a UBC Application for Service Connection (refer to Section 01 35 05 UBC Policies, Work Procedures and Forms) prior to making a temporary power connection.

.4 The Contractor, at his own expense, shall be responsible to hook-up to existing power source at approved location, and to provide temporary power outlets and/or panels for small tools only as necessary for himself and the various Subcontractors and wiring from temporary power source to these outlets and/or panels.

.5 The Contractor shall disconnect and remove temporary services when no longer required.

.6 Provide and maintain temporary lighting throughout the project. Ensure level of illumination on floors and stairs is not less than 162 lx.

.7 Provide temporary lighting to areas that are usually supplied by lighting from within the site. Walkways, roadways and other areas adjacent to the site shall be adequately illuminated until occupancy is granted.

.2 Temporary Water

.1 A temporary water service can be installed:

.1 By the contractor at his own expense. The installation must include all piping valves, meter and backflow devices.

.2 If a temporary service is installed by the contractor, coordination with UBC Energy and Water Services is required. Installation must be inspected before activation of service and a Utility Service Activation Request form must be submitted.

.3 Temporary Heating and Ventilation

.1 No charge will be made for the cost of fuel for temporary heating when drawn from UBC plant. The Contractor shall provide at his own expense necessary piping, connections, valves, hoses, etc. and make same available to all trades throughout the project. The Contractor shall disconnect and remove temporary service when no longer required.

.2 Provide temporary heat and ventilation in enclosed areas as required to:

.1 Facilitate the progress of the Work.
.2 Protect the Work against dampness and cold.
.3 Prevent moisture condensation on all surfaces.
.4 Provide ambient temperatures and humidity levels for storage, installation, and curing of materials.
.5 Provide minimum temperature of 10°C in areas where construction is in progress.
.6 Provide adequate ventilation to meet health regulations for a safe work environment.

.3 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.

.4 Sanitary Facilities

.1 For work in existing buildings an existing washroom will be available for use by the Contractor and workers. The Project Manager will designate the washroom to be used. This facility must be kept clean at all times. The washing of paint brushes, mixing of grout etc. in the washroom is strictly prohibited.

.2 For work on new buildings the Contractor shall provide temporary sanitary facilities and maintain in a clean condition.

.5 Fire Protection.

.1 Provide and maintain temporary fire protection equipment during performance of the Work.

.2 Burning of rubbish and construction waste materials is not permitted on site.

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

1.0 GENERAL

1.1 SUMMARY

.1 Projects shall generate the least amount of construction and demolition waste possible, by utilizing the following methods:

.1 Plan for waste minimization and diversion before project start-up. Small projects (see Submittals section) are not required to create Waste Management Plans, however all projects are encouraged to do so. A Waste Management Plan template is provided in the Submittal Templates section.

.2 Minimize waste due to error, poor planning, breakage, mishandling, contamination, or other factors.

.3 Reuse or salvage as much material as possible.

.4 Recycle all materials that can be feasibly recycled.

.2 Waste Diversion Goal

.1 The goal for projects not being certified under LEED or REAP green building systems is to divert at least 75% of construction and demolition waste from disposal. For LEED or REAP projects, refer to current LEED and REAP requirements for waste diversion targets and other waste related requirements.

.3 All projects shall track (via project submittals) the amount of waste and diversion achieved. Tracking and reporting templates are provided in the Submittal Templates section.

.1 Required submittals depend on the type of project. Refer to Section 1.3 Submittals.

.4 Refer to information packages available from UBC and also the Metro Vancouver DLC Waste Management Toolkit for information on how waste diversion targets can be achieved. In many cases, economic savings are possible by reducing, reusing and recycling waste instead of disposing waste.

1.2 WASTE MANAGEMENT PLAN

.1 Developing a Waste Management Plan is a simple process that be achieved by filling out a template. Refer to the template found in section 2.5.

.2 A Waste Management Plan shall contain the following information:

.1 Estimates of the types and amounts of waste expected to be generated on the project, where the wastes will be taken for processing, and the expected diversion rates for each type of material.

.3 Planning for waste management should include determining if demolition and construction waste materials will be source-separated on the project site and/or commingled for later separation at the processing site, and how waste materials will be separated (where applicable) and stored on the project site. Note that commingled waste collection may be restricted in LEED projects.

1.3 SUBMITTALS

.1 All projects:

.1 Within 2 weeks of the completion of demolition or deconstruction work and also within 2 weeks of completion of construction or renovation work, submit Waste Tracking forms and Waste Diversion Report(s).

.2 Projects with total demolition/construction value of $200,000 or greater:

.2 In addition to the above submittals, no later than 2 weeks prior to removing any waste from the Project site, submit Waste Management Plan.

.3 Projects applying for LEED and REAP certification may utilize the waste tracking and reporting submittals specified under LEED and REAP rating systems, as alternatives to the above Waste Diversion Reports and Waste Tracking Templates.

.4 Where UBC provides electronic templates, UBC encourages the creation of submittal documents using these templates, as they include formulas to calculate waste diversion and other reporting information.

.5 UBC may also make available online (web based) electronic construction and demolition waste submittal forms. In this case, submittals through the online system are encouraged, however paper submittals may still be required for LEED and REAP projects.

1.4 RELATED SECTIONS AND UBC GUIDELINES

.1 This section describes requirements applicable to all Sections within Divisions 01 to 33.

.2 UBC LEED Implementation Guide.

1.5 DEFINITIONS

.1 Construction and Demolition Waste: Solid wastes typically including but not limited to, building materials, packaging, trash, debris, and rubble resulting from construction, re-modelling, repair and demolition operations.

.2 Commingled Waste: Unlike source separated waste, commingled waste entails collecting multiple types of waste together in a single container for later separation at a waste processing facility.

.3 Disposal: Removal of a waste material that will not be reused, returned, recycled, or salvaged from the project site (see Trash).

.4 Diversion rate: The amount of waste reused, returned, salvaged, and recycled; divided by the total amount of waste generated, in percent; 100% diversion rate means no waste is disposed.

.5 Hazardous: Exhibiting the characteristics of hazardous substances including, but not limited to, ignitability, corrosiveness, toxicity or reactivity.

.6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and re-manufactured into a new product for use by others.

.7 Recycle: To remove a waste material from the Project site to another site for re-manufacture into a new product for use by others.

.8 Return: To give back reusable items or unused products to vendors for credit.

.9 Reuse: To utilize a construction waste material in some manner on the Project site.

.10 Salvage: To remove a waste material from the Project site to another site for resale or use by others.

.11 Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

.12 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

.13 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

.14 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, reusable, and trash materials.

2.0 <u>EXECUTION</u>

2.1 PREPARATION

.1 Handle waste materials in accordance with appropriate regulations and codes.

2.2 WASTE MANAGEMENT PLAN IMPLEMENTATION AND TRACKING

.1 Designate an on-site party (or parties) responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.

.2 Distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, the Owner, and the Consultant.

.3 Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

.4 Lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.

.5 Manage waste materials

- .1 Separate, protect, store and catalogue items to be reused and salvaged.
- .2 Separate, store, and dispose of hazardous wastes according to local regulations.
- .3 Transport and deliver non-salvageable items to licensed reuse, recycling or disposal facility.

.6 Track the types, amounts, destination, and diversion rates for all waste materials throughout the project, including both demolition and construction phases.

- .1 For each shipment of waste material from the site or materials reused on the site, track the types, amount shipped, destination (facility name and location), and amount diverted (reused, salvaged or recycled).
  - .1 Request and retain all weight tickets and receipts from all waste destinations such as transfer stations, recycling facilities, etc., showing material weights both disposed and diverted. Retain these for a period of at least two years.
  - .2 Use the Waste Tracking template provided to assist in collecting waste diversion informaWaste Diversion Reporttion.

.3 Based on the Waste Tracking information, complete and submit the Waste Diversion Report as described in the Submittals section.

.7 Maintain at job site, one copy of following documents:

.1 Waste Management Plan, where required under Submittals.

.2 Waste Tracking forms.

2.3 STORAGE, PROTECTION AND DISPOSAL

.1 Protect structural components not removed for demolition from movement or damage.

.2 Support affected structures. If safety of building is endangered, cease operations and immediately notify Consultant.

.3 Protect surface drainage, storm sewers, sanitary sewers, and utility services from damage and blockage.

.4 Waste must be delivered to licensed waste and recycling facilities as per applicable local regulations.

.5 Burying of rubbish and waste materials is prohibited unless approved by the authority having jurisdiction.

.6 Disposal of volatile materials, mineral spirits, oil, paint thinner and hazardous waste materials into waterways, storm, or sanitary sewers is prohibited.

.7 Additional construction waste environmental protection practices are as per City of Vancouver Bulletin 2002-001-EV or the latest revision thereof.

2.4 CLEANING

.1 Remove tools and waste materials on completion of work, and leave work area in clean and orderly condition.

.2 Clean-up work area as work progresses.

2.5 SUBMITTAL TEMPLATES

.1 Construction and demolition waste submittals shall include the information shown in the following templates.

.1 LEED or REAP projects may require additional or slightly different submittals – consult those standards for more information.

.2 Table A – Waste Management Plan Template

.1 Where required under Submittals, to be completed prior to project start-up.

.3 Table B – Waste Tracking Form Template

.1 This template can be used to easily record waste diversion by entering information from weight tickets or receipts provided by transfer stations, recycling or processing facilities.

.4 Table C – Waste Diversion Report

.1 The waste tracking report provides the calculated waste diversion information that UBC needs for each project. It is filled out based on the data entered in the waste tracking form. In electronic versions (i.e., spreadsheet or web-based), this report can be automatically generated.

A. Waste Management Plan

A.1. Waste Estimation **Project Stage:** ☐ **Demolition** ☐ **Construction**

Project Name: **Date:** **Prepared By:**

	A	B	C	D	E	F	G	H
							D + E + F	G * C /100
	Type of Waste Material	Recycle / Disposal Facility *to be used*	Total Waste *to be Generated*	Percentage of Waste to be Diverted				Total Waste *to be Diverted*
				Reuse on-site	Reuse off-site	Recycle	Total	
		(Name)	*(Tonnes)*	*(%)*	*(%)*	*(%)*	*(%)*	*(Tonnes)*
1	**Appliances**							
2	**Bricks**							
3	**Cable & Wiring**							
4	**Cardboard**							
5	**Carpeting &**							
6	**Ceramic (e.g.**							
7	**Clean fill & Soil**							
8	**Concrete**							
9	**Doors**							
10	**Glass**							
11	**Gypsum**							
12	**Insulation (e.g.**							
13	**Metal**							
14	**Mixed Waste**							
15	**Paper**							
16	**Plastic (rigid)**							
17	**Plastic (soft)**							
18	**Plumbing Fixture**							
19	**Roofing (shingles,**							
20	**Windows in**							
21	**Wood (plywood,**							
22	**Wood**							
23								
24								
27	Total	Weight *(Tonnes)*	Sum (Column	Sum(Di*Ci) /100	Sum(Ei*Ci) /100	Sum(Fi*Ci) /100		D27+ E27+F27
28		Percentage *(%)* *(From total waste to*		D27/C27	E27/C27	F27/C27		H27 /C27

	A.2. Calculations *(based on information entered on Section A.1)*		
	Project Name:	**Date:**	**Prepared By:**
	A	B	C
	Expected Waste to be Generated and Diverted	**Total Waste to be Generated** *(Tonnes)*	**Percentage of Waste to be Diverted** *(%)*
29	**Demolition Waste**	C 27 *(Demolition Stage)*	H 27 *(Demolition Stage)*
30	**Construction Waste**	C 27 *(Construction Stage)*	H 27 *(Construction Stage)*
31	**All Waste**	B 29 + B 30	(C 29 + C 29) / B 31 * 100

B. Waste Tracking Form

Project Stage: ☐ Demolition ☐ Construction

Project Name: **Date:** **Prepared By:**

	A	B			C	D	F	G	H	I	J	K
											G + H + I	J * F /100
#	Weight ticket, receipt or bin Reference	Date Load Hauled			Recycle/ Disposal Facility	Type of Waste Materials	Total Waste Generated	Percentage of Waste Diverted				Total Waste Diverted
								Reuse on-site	Reuse off-site	Recycle	Total	
	(from recycling or disposal facility)	*DD*	*MM*	*YYYY*	*(Name)*	*See Section A.1: Column A*	*(Tonnes)*	*(%)*	*(%)*	*(%)*	*(%)*	*(Tonnes)*
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												

C. Waste Diversion Report

*(The calculations may refer to the cells in **Form B** or the cells in this form.)*

Project Name: **Date:** **Prepared By:**

	A	B	C	D
	C.1. Waste Generated and Diverted	Total Waste Generated *(Tonnes)*	Total Waste Diverted *(Tonnes)*	Percentage of Waste Diverted *(%)*
1	**Demolition Waste**	*Form B (Demolition Stage)*: Sum (Column F)	*Form B (Demolition Stage)*: Sum (Column K)	C1/B1*100
2	**Construction Waste**	*Form B (Construction Stage)*: Sum (Column F)	*Form B (Construction Stage)*: Sum (Column K)	C2/B2*100
3	**All Waste**	B1 + B2	C1 + C2	C3/B3*100

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Administrative procedures preceding preliminary and final inspections of Work. It may be advantageous to refer to the CSA link found in this Section under 1.3.2.1.
.2 As-built drawings, material overages, and specifications.
.3 Equipment and systems.
.4 Product data and related information.
.5 Spare parts, special tools and special/unique maintenance materials.
.6 Final site survey.
.7 Cleaning.
.8 Closeout submittals.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures
.2 Section 01 45 00 Quality Control
.3 Section 01 74 19 Construction Waste Management and Disposal
.4 Section 01 78 23 Operation and Maintenance Data
.5 Section 01 78 39 Project Record Documents
.6 Section 01 78 45 Maintenance Materials
.7 Section 01 79 00 Demonstration and Training
.8 Section 01 91 00 Commissioning

1.3 REFERENCES

.1 Canadian Construction Documents Committee (CCDC)
  .1 CCDC 2-2008, Stipulated Price Contract.
  .2 The Builders Lien Act latest edition.

.2 Canadian Standards Association (CSA)
  .1 Building Commissioning Standard & Check Sheets

2.0 INSPECTION & DECLARATION

2.1 **CONTRACTOR'S INSPECTION**: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

.1 Notify *Owner's Representative* in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.

.2 Request *Owner's Representative* Inspection.

2.2 **OWNER'S REPRESENTATIVE INSPECTION**: Owner, Consultant and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

2.3 **PROCEDURE FOR TURNOVER OF NEW BUILDINGS**: Good examples of the Commissioning Process that might be followed, and read in combination, are:

.1 A good checklist exists in Section 01 91 00 Commissioning.

.2 The UBC Properties Trust approved document, which essentially is a Schedule Checklist for Project Managers. It begins 6 months before scheduled Handover and proceeds through all operations required; including testing, demonstrations and documentation. For details click on the following link: Commissioning-Procedure_UBCPT_2011_FINAL (Amy Phillips)

.3 The new Commissioning document created for UBC Project Services for the Bio-Sciences South Renew Project and recommended for all types of project commissioning. For details click on the following link: Commissioning-Plan_Bio-Sci_S_CommissPlan1Updated

.4 This document is a typical example of specific Performance Testing. It is this level of detail that UBC is looking for. For details click on the following link: Commissioning-ReheatTest

2.4 **COMPLETION**: Submit written certificate that following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 A list of deficiencies shall be sent to the *Owner* and Consultant.

.4 Equipment and systems have been tested, adjusted, balanced, commissioned and are fully operational.

.5 Certificates required by Boiler Inspection Branch and Vancouver Fire Department have been submitted.

.6 Operation of systems has been demonstrated to *Owner's* personnel.

.7 Work is complete and ready for Final Inspection.

2.5 **FINAL INSPECTION**: When items noted above are completed, request final inspection of Work by *Owner*, Consultant and Contractor. If Work is deemed incomplete by *Owner* and Consultant, complete outstanding items and request re-inspection.

3.0 CLEANING

3.1 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products, debris and dust, including that incidentally caused by Owner or other Contractors, and similarly notify Owner’s forces or other Contractors carrying out work. Control dust migrating to occupied areas and isolate ventilation systems during renovations.

.2 Remove waste materials from site at regularly scheduled times, or dispose of as directed by Owner’s Representative. Do not burn waste materials on site.

.3 Clear snow and ice from access to building, bank/pile snow in designated areas only.

.4 Provide on-site dump containers for collection of waste materials and debris. UBC waste containers are **not** to be utilized by Contractors.

.5 Provide and use clearly marked separate bins for recycling.

.6 Remove waste material and debris from site and deposit in waste container at end of each working day.

.7 Dispose of waste materials and debris off site.

.8 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

3.2 FINAL CLEANING

.1 At completion of the Work, just prior to final inspection and takeover by the Owner, a general cleaning of the areas affected shall be carried out by the Contractor's forces as follows:

.1 Execute final cleaning employing only skilled workers,

.2 Examine and adjust all doors, sash and hardware; leave all in perfect working order, cleaned and polished,

.3 Examine and clean all fixtures to produce intended appearance and use,

.4 Remove all paint spots, stains, rubbish, debris, tools and equipment from all areas and broom clean.

.5 Brush off, dust and polish all ledges, stairs, glazed walls, etc.

.6 Wash down and dry all floors. Sealing and waxing resilient flooring will be carried out by UBC Custodial Services, unless otherwise noted.

.7 Prior to final completion or Owner occupancy, the Contractor shall conduct an inspection of sight-exposed surfaces, and all work areas, to verify that the entire work is clean,

.8 The Contractor shall clear roof, grounds and exterior paved areas and walks of all construction debris, dirt and dust and shall replace any damaged grass or landscaping, leave in condition to the satisfaction of the Consultant and the Owner.

.9 For UBC Custodial Floor Cleaning Standards, refer to Division 09, Section 09 00 10 Finishes – General Requirements.

3.3 CLEANING MATERIALS

.1 Use products which minimize environmental impact, including indoor air quality.

.2 Avoid VOC’s (Volatile Organic Compounds) or give preference to Low VOC’s whenever possible

.3 Obtain recommendations for cleaning

.1 new materials affected: from manufacturers of product installed.

.2 existing materials affected: from UBC Custodial Services, through the Owner's Representative.

4.0 CLOSEOUT SUBMITTALS

4.1 SUBMISSION

.1 For detailed instructions on the preparation and submission of operating and maintenance manuals, refer to Section 01 78 23 Operation and Maintenance Data of the Technical Guidelines.

.2 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.3 If requested, furnish evidence as to type, source and quality of products provided.

.4 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

4.2 FORMAT AND CONTENTS

.1 Refer to Sections 01 78 39 Project Record Documents and 01 78 23 Operation and Maintenance Data for information on the format/contents of drawings and operating & maintenance manuals.

4.3 SITE DOCUMENTS

.1 In addition to requirements in General Conditions, maintain at the site for Consultant and Owner one record copy of:
  .1 Contract Drawings.
  .2 Specifications.
  .3 Addenda.
  .4 Change Orders and other modifications to the Contract.
  .5 Reviewed shop drawings, product data, and samples.
  .6 Field test records.
  .7 Inspection certificates.
  .8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Consultant.

4.4 SUGGESTED RECORDING – ACTUAL SITE CONDITIONS

.1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by the Owner's Representative.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
- .1 Measured depths of elements of foundation in relation to finish first floor datum.
- .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
- .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
- .4 Field changes of dimension and detail.
- .5 Changes made by change orders.
- .6 Details not on original Contract Drawings.
- .7 References to related shop drawings and modifications.

4.5 FINAL SURVEY

.1 Submit final site survey certificate in accordance with Section 01 78 39 Project Record Documents - Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

4.6 WASTE TRACKING

.1 Submit construction and demolition waste tracking reports in accordance with Section 01 74 19 Construction Waste Management and Disposal. Tracking templates are available on the UBC Technical Guidelines web site.

4.7 MATERIALS AND FINISHES

.2 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.3 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.5 Additional Requirements: as specified in individual specifications sections.

4.8 SPARE PARTS

.1 Provide spare parts, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to Owner's Representative.

.4 Receive and catalogue all items. Submit inventory listing to Owner's Representative. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

4.9 SPECIAL TOOLS

.1 Provide special tools, in quantities specified in individual specification section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Receive and catalogue all items. Submit inventory listing to Owner's Representative. Include approved listings in Maintenance Manual.

4.10 WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after Substantial Completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Co-execute submittals when required.

.7 Retain warranties and bonds until time specified for submittal.

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

1.0 GENERAL

1.1 PURPOSE

.1 To guide those responsible for the design, construction and commissioning of *building systems for all disciplines*, in the preparation and delivery of operating and maintenance (O&M) documentation that:

.1 is simple to prepare and update
.2 is delivered on time
.3 is easy to use, and
.4 provides accurate and relevant information

1.2 SCOPE

.1 This guideline covers the format, content, delivery, and updating of building systems O&M documentation that is normally provided by the design and construction team members.

1.3 DEFINITIONS

Basis of Design: a document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy the applicable regulatory requirements, standards, and guidelines.

Building project: a task with the objective of delivering a base building or a building shell that must be fitted-out before it is suitable for occupancy.

Commissioning provider: an entity identified by the owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process.

Design authority: a prime consultant, usually an architect, responsible for the quality of the design that is proposed to meet the owner's requirements.

Design intent: see Basis of Design. Both terms are commonly used.

Designer: a member of the project team involved in providing design solutions to meet the owner's requirements and in preparing construction and O&M documents during the conceptual design, the completion of construction documents (the design), the construction, and the operational stages of the project delivery.

Electronic documentation: as used in this guideline, a compilation of electronic files relevant to all components and systems of a project. The documentation adheres to the content requirements described by this guideline and has an overall structure and search capabilities that allow navigation, access, and search of all files contained through networked, stand-alone, and/or portable devices.

Fit-out project: a project through which furnishings, including partitions, furniture, and tenant equipment (e.g. copy machines, personal computers) are delivered.

O&M designer: a designer specializing in the O&M aspects of a project.

O&M documentation: a comprehensive set of documents providing information pertaining to a specific facility, including information regarding the design, operation, and maintenance of the facility.

Owner: the person or legal entity that will own the delivered facility of an agent representing the owner. The owner defines the project requirements.

Owner's Project Requirements (Building or Project Program): a written document that details the functional requirements of a project and the expectations of how it will be used and operated.

Preliminary Operating Manual: an elaboration of the design intent that includes operating information developed during the construction documents (design) stage.

Project brief*:* see Owner's Project Requirements. Both terms are commonly used.

Project delivery stages: the progressive stages in the development of a project marking the delivery of a distinct product: planning, conceptual design, construction document preparation, construction, operation, and evaluations.

Systems manual: a system-focused composite document that includes the operations manual, the maintenance manual, and additional information of use to the owner during the occupancy and operations phases.

Building Fire Warden*:* Designated persons that assist during fire emergency and conduct monthly building inspections.

2.0 IMPLEMENTATION

2.1 USE OF THE GUIDELINE

.1 Participants in the planning, design, construction, commissioning, operation, and maintenance activities should use this guideline to complete the following tasks:

- .1 The owner and the planning team
  - .1 Specify the scope and process of development, delivery and upkeep of the O&M documentation.
- .2 The design team:
  - .1 prepares its portion of the O&M documentation,
  - .2 specifies O&M documentation requirements for equipment suppliers and system installers,
  - .3 reviews O&M information prepared by others and assembles it into an O&M documentation package, and
  - .4 delivers the O&M documentation package to the owner.
- .3 The equipment suppliers
  - .1 prepare and submit the O&M information to the installers
- .4 The installers
  - .1 prepare their portion of the O&M documentation and

.2 collect and assemble O&M documentation from the equipment suppliers and submit it to the designer.

.5 The commissioning providers
.1 verify the correctness and relevancy of the O&M documentation and
.2 guide the delivery of commissioning reports in a “record document” and “as-commissioned” form.

.6 The building management, operating, and maintenance personnel
.1 maintain and use the O&M documentation, and
.2 revise outdated O&M documentation for existing buildings.

.2 All of the above participants contribute to the O&M documentation to various degrees. Organizing the preparation and delivery of O&M documentation is the responsibility of the designer. The designer should have continuing involvement in the design, construction, commissioning.

2.2 USE OF O&M DOCUMENTATION

.1 O&M documentation, prepared in accordance with this guideline, can be used for the following commissioning-related and O&M-related activities:

.1 training of building management, operating, and maintenance personnel.
.2 preparation and modification of operating program elements, including schedules and strategies for ventilation, energy management, etc.
.3 preparation and modification of any type of maintenance program, whether predictive, preventive, breakdown, or any combination of these types.
.4 preparation of the O&M budget, including utility budgets.
.5 assessment of compliance with the O&M program requirements and annual O&M budgets.
.6 preparation of asset management reports and plans.
.7 preparation of energy audits.
.8 energy management of building retrofit projects.

2.3 O&M MANUAL MEDIA

.1 Building O&M documentation shall be provided in *(1) hard copy and* digital format, indexed (bookmarked) to suit Laserfiche Document Management System operated by UBC Infrastructure Development - Records.

.1 Acceptable digital document formats:
.1 Original Adobe Acrobat PDF.
.2 Scanned documents and images in Adobe Acrobat PDF, minimum 300 dpi.

.2 All documents shall be indexed (bookmarked) matching MasterFormat 2014 Divisions and Sections.

.3 Contractor documentation requirements for the O&M manual shall be clearly stated in the construction documents.

2.4 PROCESS OF O&M MANUAL DEVELOPMENT AND DELIVERY

.1 To support the above uses effectively, the O&M information should be developed and made available to the owner on a timely basis so that the owner is able to assist in such processes as building construction, system commissioning, training, and building operation. Table 1 suggests a process of development, delivery, and use of O&M documentation related to the usual stages of delivery of a building project.

.2 The process outlined in Table 1 applies to new building projects, building renovation projects, and retrofit projects. Since fit-out projects are usually delivered in a different time interval than the base building project, the process of development and delivery of O&M documentation for fit-out projects should use the format of O&M documentation for the building that already exists.

2.5 REVISIONS TO AND UPKEEP OF O&M DOCUMENTATION

.1 O&M documentation needs to be complete before occupancy and operation and should be under revision control throughout the service life of the building. Otherwise, it loses its value, and building occupancy and operational quality will decline. The owner's representative tasked with updating the documentation shall review the O&M documentation to ensure that it reflects changes in the use and operation of the facility, changes to systems due to renovations, or changes to the Owner's Project Requirements.

TABLE 1 Development and Delivery of O&M documentation	
Activity	**O&M documentation**
Planning	The owner or the owner's representative defines the scope, format, level of detail, and process of O&M documentation development, delivery and use in a project brief, making reference to UBC Technical Design Guidelines.
Conceptual Design	The designer prepares and delivers to the owner a design intent, based on the Owner's Project Requirements, that describes an O&M program for the facility.
Construction Document Preparation	The designer prepares specifications regarding the content, format and delivery of O&M documentation and prepares the Preliminary Operating Manual section on design intent.
Construction	The equipment suppliers and installers prepare and include operation and maintenance documents with the shop drawing submittal. The designer reviews these documents for conformity with the construction documents, the Owner's Project Requirements, and the Basis of Design and revises the preliminary O&M manuals.
Construction Completion	The designer oversees the assembly and consolidation of the relevant documents into a draft O&M documentation package with separate parts relating to design, construction, operation and maintenance for the facility. The designer delivers the draft O&M documentation package to the owner, preferably in stages, as soon as the individual documents or their sections become available. The commissioning authority may assist in review of O&M documentation for completeness and relevancy.
Documentation or Commissioning	The designer includes approved changes to design documents in record documents to update the O&M manuals. The designer compiles test reports, reviews them, and submits them to the commissioning authority. The designer or commissioning authority implements a training program for training of building O&M and management staff. The designer gathers and certifies all the records of tests from the installers and suppliers and incorporates them into the O&M documentation package. The designer prepares and submits the as-commissioned O&M documentation package to the owner. The commissioning authority verifies the completeness of the documentation and prepares an interim commissioning report to be included in the O&M manuals.
Occupancy & Operation	The commissioning authority prepares and submits seasonal reports during the first full cycle of seasons after the building occupancy. All these reports are added to the O&M manuals.

.2 Revisions to the O&M documentation can be broadly classified as resulting from:

.1 **Fit-out**. Office space usually is delivered through two separate, but interdependent, delivery processes: building delivery and one of more fit-out deliveries.
Fit-outs may be delivered in either new buildings or existing buildings. In either case, O&M information describing the fit-out (including the tenant's equipment) should be integrated into the O&M documentation. Commissioning of building systems completed during the fit-out should be done as part of the fit-out, and the reports should be added to the O&M manuals.

.2 **Renovations, Retrofits**. Any renovation of retrofit project, however small, that involves adding, removing, or modifying a building system or changing the design intent and/or operation of the building should be fully recorded in the O&M documentation. Renovations and retrofits, especially those that change tenant equipment load and/or the number of occupants, will affect sensible and latent loads. The corresponding effects to the building systems should be reviewed to ensure the change can be accommodated without detriment to operation or to occupant comfort in other areas.

.3 **Changes to Operating Procedures**. Initially, O&M documentation is based on the requirements of the building design brief, a predefined occupant density, and the O&M staff. As building parameters change during the building's service life, the documentation should be updated accordingly. Changes in the document should be in accordance with good operating practice and should not be made without justification.

.4 **Changes to Maintenance Procedures**. Changes to the scope and content of maintenance procedures may be required when problems are observed in systems of equipment, when availability of spare parts is altered, when the maintenance budget is modified, or when any other factor affecting maintenance is changed. Evaluation of the scope and content of the maintenance program should be tied to the inspection schedule of a preventive maintenance program. Maintenance procedures should be specific to the building and its systems, rather than relying upon generic published material from equipment cut sheets.

.5 **Retesting, rebalancing, recommissioning**. Retesting, rebalancing or recommissioning is often carried out due to renovations, occupant complaints or changes, or equipment replacement. Records of these activities should be included in the O&M documentation with associated dates. A review of their impact on overall building performance should be conducted in some instances.

.6 **Other changes**. Changes to building systems (such as lighting and HVAC retrofits), changes to heating/cooling loads, and envelope changes (including the roof and windows) should be documented with dates. O&M documentation updates due to changes to building systems or loads should be carried out at the time of the change. Such information provides the history of the HVAC&R (or other) equipment that is necessary for management of the O&M procedures.

2.6 RESTORATION OF O&M DOCUMENTATION

.1 Where the O&M documentation of an existing building is substantially out of date or incomplete, regular upkeep may no longer be an option. In such cases, the development of new O&M documentation may be required. Development of such new information should follow the same format as recommended in this guideline and may be included in the scope of an individual renovation or retrofit project or undertaken on its own by a specialist in preparing O&M documentation.

3.0 O&M DOCUMENTATION LIBRARY

.1 Building documentation requirements fall into three main categories: design and construction, operation, and maintenance. Building size and complexity will dictate whether all of these components are included or whether additional components are added. Each component of the O&M document is described in the following sections.

3.1 PLANNING, DESIGN AND CONSTRUCTION DOCUMENTS

.1 **Owner's Project Requirements**. Documentation begins with the *Owner's Project Requirements* for the design team. This document, prepared by the owner or the planning team, details the expectations of the owner and how the building is to function (see Section 1.3, Definitions).
With respect to the O&M documentation, this document defines the scope of the O&M documentation and stipulates what is expected of the designer directly, what the designer should ask the construction team to deliver, and what input is expected of the O&M team.

.2 **Basis of Design**. This document describes and documents details of the intended design solution used to meet the Owner's Project Requirements. This document intent includes the building design parameters relative to type of use, occupancy, an equipment selection. Special features should also be identified (see Section 1.3, Definitions).

.3 **Energy Use Intensity Target**. Many buildings have energy targets developed at the time of design, using either building simulation programs or manual calculations. Input and model's output reports for this process should be included in the building documentation.

.4 **Submittals**. Submittals to be included in the design and construction documentation include approved shop drawings, co-ordination drawings, and equipment documents specific to the installed equipment.

.5 **Record Documents**. Drawings and specifications shall be updated at the end of construction to convert them into a set of record documents. The record documents shall include all changes approved during construction. Refer to Informative Appendix A to see a sample format for construction documentation.

.6 **Commissioning Documents**. O&M documentation includes all commissioning reports. Include all reports related to the commissioning process as described in 01 91 00.The commissioning document should report on

- .1 The compliance of the installed systems and equipment with the functional requirements stipulated in the Owner's Project Requirements;
- .2 The delivery of the O&M documentation package; and

.3 Training of building management, operating, and maintenance staff based on the information contained in the O&M documentation package.

.4 The initial commissioning report should be submitted at the time specified in the professional services agreement or as specified in ASHRAE Guideline 1.1, including additional commissioning reviews and reports during the operations phase of the building.

.7 **Retrofits and Upgrades**. To remain current, O&M documentation must be updated with information relating to building retrofits and upgrades. Care should be taken to ensure that changes do not conflict with overall system performance and that changes are properly commissioned.

3.2 OPERATIONS DOCUMENTS

.1 **Owner's Project Requirements**. The portion of the Owner's Project Requirements that refers to the operational expectations of the constructed building should be included in the operation documentation as a guide to the staff.

.2 **Basis of Design**. It is important that the building O&M staff has a good understanding of the design intent of building systems and the parameters used for systems design. Information from the Basis of Design and construction documentation should be referred to or included.

.3 **Energy Intensity Target**. The initial Energy Intensity Target can be useful for the O&M team in setting the operation budget and future comparisons to actual performance. Input data regarding loads and schedules shall be included so that changes over time can be factored into comparisons.

.4 **Submittals**. Shop drawings provide the equipment suppliers' and installer's interpretation of the information presented in drawings and specifications. The shop drawings should describe each individual specified piece of equipment or each specified HVAC&R system and provide a complete set of installation instructions. Approved submittals should be included in the operation documentation.

.5 **Commissioning documents**. O&M documentation should include all commissioning reports and include all reports related to the commissioning process as described in UBC Technical Design Guidelines, Section 01 91 00.

.6 **Operations Manual**. The operating manual should provide information for two types of users with different backgrounds. The first type is the building manager whose activities normally do not require technical knowledge. The second type is the building operator, who should be technically skilled enough to fully understand the functions of HVAC&R systems installed in the building.
A suggested format for presenting the operating information is provided in Informative Appendix B.

.7 **Emergency Procedures**. Both nontechnical and technical users of the building systems need emergency information. The document should be organized according to types of emergencies and should clearly define the roles and procedures for each responsibility. A suggested format for presenting the emergency operating information is provided in Informative Appendix C.

.8 **Training Materials**. The operating manual should include information presented in such a way that a new building operator will be able to use it for self-directed study and understand the design and operation of all systems to the degree that he can properly operate them.

.9 Supplemental materials, such as a manufacturer's CD on specific equipment installed in the building, should be stored with the manual. A video recording for training on the operation and maintenance of the building equipment narrated by the building designer or commissioning authority, can be very useful in helping an operator understand how system components interact. This is especially useful for complex systems or equipment requiring operating changes in various seasons.

.10 Training materials can also be included electronically using the building-automation-system operator interface.

3.3 MAINTENANCE DOCUMENTS

.1 Maintenance Manual

.1 The maintenance manual should normally be prepared and submitted by the construction team. It should contain the following information:

.1 Description of the equipment or system: this should consist of easy-to-read drawings accompanied by a clear description of each component.
.2 Description of function, as applicable: the function of the equipment, functional parameters (input, output) at the design load and at part loads, procedures before start-up, and performance verification procedures.
.3 Recommended maintenance procedures and their recommended frequency for the site-specified application.
.4 Recommended list of spare parts, part numbers, and suppliers.

.2 Original purchase order number: date of purchase; name, address, phone of the vendor; and warranty information.

.3 Installation and repair information: any other information needed for preparation of documents supporting management of operation and maintenance programs.

.4 The designer should review maintenance information provided by the supplier or the installer for completeness. The information should focus only on the model installed. It should then be supplemented by project-specific information developed by the designer.

.5 The designer should properly identify each item of maintenance information uniquely. This information is essential for the preparation of documentation in support of a maintenance management program that may be guided by predictive, preventive, breakdown, or any other maintenance philosophy.

.6 Informative Appendix D provides an example of maintenance-related information provided by the supplier and supplemented by the designer that is necessary for preparation of a maintenance manual and a preventive maintenance program.

.2 Maintenance Procedures

.1 This document should include all the forms necessary for management of operation and maintenance programs, including operating logs, inspection sheets, inspection and maintenance schedules, work order forms, and material purchasing forms. This documentation is normally prepared by the O&M team during the first year of operation.

.3 Maintenance Budget

.1 The initial maintenance budget can be useful for the O&M team in setting future budgets and making comparisons to actual costs. Input data regarding labor and material rates and schedules must be included so that changes over time can be factored into comparisons.

.4 Maintenance Tasks

.1 The maintenance manual should provide all relevant information needed for the day-to-day maintenance of the HVAC&R systems. Frequency of maintenance procedures for each system component should be described.

.2 A suggested format for presenting the maintenance information can be found in Informative Appendix D.

.5 Maintenance Reports

.1 Examples of all maintenance reports and logs are to be included in the manual. These should be supported with examples.

.6 Emergency Procedures

.1 The purpose of this document is to present the emergency procedures as they relate to the maintenance personnel. The document should be organized according to types of emergencies and should clearly define the roles and procedures for each responsibility.

.2 A suggested format for presenting the emergency procedures is provided in Informative Appendix C.

.7 Quality Control Report

.1 The purpose of this document is to provide copies of the test protocols used in construction and commissioning, to provide the history of the tests performed before the completion of commissioning, and to assist in conducting ensuing tests.

.2 A suggested format for test reports is provided in Informative Appendix E.

INFORMATIVE APPENDIX A — CONSTRUCTION DOCUMENTS

The following is a table of contents for the construction documentation package:

***Example*: Construction Documents**

Part 1: Record (As-built) Drawings

Drawing No	Drawing Title
xx	……………………
xx	……………………

Part 2: Specifications

Section No	Section Name
xx	……………………
xx	……………………

Part 3: Approved Product Data and Shop Drawings

xx	……………………
xx	……………………

Part 4: Equipment Identification Charts

Part 5: Warranty Certificates

Part 6: Inspection Certificates

Part 7: Commissioning Reports

INFORMATIVE APPENDIX B — OPERATIONS MANUAL

As recommended in section 5.2.6, information in the operating manual should be divided into sections and organized into two parts (general information and technical information). The following example provides a detailed description of the table of contents and each section of the manual:

Section 1, Building Function

This section should provide a description of the following functional requirements:

a. Type of occupancy
b. Tenants' functional requirements, including a list of services to be provided in response to these requirements, the levels of these services, a timetable of delivery, and the reliability of delivery
c. Municipal requirements, including information about ambulance services, fire department response, garbage removal, snow removal, water use policy, public transportation, etc.
d. Utility information, including names, addresses, and phone numbers of utility companies for normal and emergency purposes and electrical, gas, water, sanitary, steam, chilled-water rates, etc.

Section 2, Building Description

This section depicts the building layout and provides a brief description of each building area. It should also provide an overview of the building systems, using a short text description and simplified single-line schematics. The design intent for each building system also should be placed in this section.

This section should also show utility cut-offs on small-scale floor plans with a description of each building area supplied by the utility.

Section 3, Operating Standards and Logs

This section should provide the standards of performance for the building and operating procedures for each system. The operator must understand how to operate each system to achieve the desired standard of performance. Standards may include such parameters as:

- Space temperature,
- Space humidity,
- Ventilation rate,

- Levels of various contaminants in the air,
- Chilled-water supply temperature,
- Hot water temperature schedule,
- Domestic water temperature, and
- Energy efficiency targets, etc.

The section also should provide inspection procedures and operating logs required to monitor performance. Information on performance standards, operating procedures, and logs must be understandable by both building operators and building managers.

All reporting requirements for system licensing and inspections should be provided for each system, as applicable. The responsibility for each license and inspection should be documented together with other relevant information such as the date of inspection renewal and the name and telephone number of the inspection/licensing authority.

Section 4, Systems Descriptions

This section should begin with a list of all systems followed by a detailed description of each system listed.

The descriptions should identify the areas of the building that the systems serve, the locations of monitoring checkpoints (meters and gauges), the expected performance readings at the design-load conditions and, where applicable, at part-load conditions. The systems' operation during the day, night, and weekend, as well as seasonal start-up and turndown, safety devices and their function, control devices and their function, pollution control devices, etc., should also be described.

It is recommended that the function of the controls for individual systems be described alongside the description of the system function and that an overview of the entire control system be described separately.

The following is a listing of systems typically found in buildings:

- Fire and safety
- Heating
- Cooling
- Air distribution
- Lighting
- Power distribution
- Elevators
- Chemical water treatment
- Controls (ECMS)
- Refrigeration
- Plumbing
- Landscape Irrigation
- Special purpose

- Architectural systems and elements:
- Schedules of:
  - Doors
  - Windows
  - Finishing
  - Hardware
  - Colour
- Warranties and guarantees
  - Roof warranty certificate
  - Other warranties

A sample system description is included as Exhibit B1 at the end of this appendix.

Section 5, Operating Routines and Procedures

This section should identify activities associated with normal operation of systems and equipment. The operating checklists and operating logs should be provided for each system and all performance standards should be identified.

Section 6, Seasonal Start-up and Shutdown

This section should list seasonal start-up and shutdown procedures.

Section 7, Special Procedures

In some cases, special procedures related to environmental control, health and safety, productive work environment, etc., are codified; therefore they must be followed. Such procedures should be shown in this section.

Section 8, Basic Troubleshooting

Troubleshooting procedures are important tools. They may include elementary questionnaires or sophisticated diagnostic or expert systems, depending on the degree of system complexity. These tools allow appropriate personnel to isolate probable causes in an efficient manner.

Troubleshooting tips and procedures can markedly improve the reliability of a system, saving in the capital cost of standby equipment, and can improve tenant/owner operator relationships. They should be presented here on a system-by-system basis.

Troubleshooting procedures should be cross-referenced to the maintenance manual, Part 1.

Exhibit B1: System Description

HVAC System AH VS-5

System Type

Single-zone air-handling system with steam heating, ventilating, and cooling capability. Provide reference to equipment data sheets.

Area Served

Office Wing (see Figure B1)

Depending on the type of building, the complexity of its systems, and the competence of the in-house and on-site personnel, thermostat locations, air-handling and cooling unit locations, and duct locations may be added to suit the needs of the users.

Switch Location

Photocopy Room

Provide additional information about the switch in the photocopy room: fused or non - fused, circuit breaker, wall mounted, or in overhead.

[Figure B1]

Description:

The system is equipped with a steam-heating coil, face and bypass dampers, and a direct expansion-cooling coil. It provides necessary heating and cooling that is controlled by one thermostat located in ______. The system is a recirculating ventilation system with the ability to deliver necessary outdoor air (see Figure B-2).

A thermostat, located in the mixed-air section, acts as a low-limit set point, modulating the ventilation air damper to maintain a minimum temperature of air entering the heating coil at 14°C (52.7°F).

The direct digital control system modulates the outdoor air damper, the heating coil control valve, and the face and bypass damper in response to a signal from the space thermostat located in Room ___.

At an outdoor temperature above 21°C (69.8°F), the outdoor air damper assumes a position to provide minimum ventilation, and mechanical cooling is enabled. When the fan is off, the outdoor air damper is fully closed.

System Design Parameters:

Design load:	Winter -21°C (-5.8°F)	Summer 31°C dry-bulb (87.8°F) 22°C wet-bulb (71.6°F)
Mixed-air temperature:	Winter … °C (°F)	Summer … °C (°F) dry-bulb
Supply-air temperature:	Winter… °C (°F)	Summer … °C (°F)
Space temperature:	Winter… °C (°F)	Summer… °C (°F)
Humidity:	Winter … % (relative humidity) RH	Summer … %RH
Airflow:	--- L/s (cfm)	

[Figure B-2]

INFORMATIVE APPENDIX C — EMERGENCY PROCEDURES INFORMATION

Both nontechnical and technical users of building systems need emergency information. Nontechnical users include building management staff, security guards, ambulance personnel, etc. Technical users include building operators, maintainers, fire fighters, municipal and utility company technicians, etc.

The following example shows a typical table of contents for an emergency information document. An example section for fire emergencies follows the table of contents, showing a suggested format for each section:

Table of Contents

The table of contents should indicate all types of emergencies for which emergency procedure information is available.

For some buildings, the owner, or other authority, may have strict safety requirements, and these emergency procedures may have to conform to a format already defined.

The information needed for each type of emergency should be presented in separate sections. Each section should detail the scope of the emergency, the notification activities, and the responsibilities of, and actions required by, building personnel. Each section should also note the specific equipment involved in each type of scenario and response.

Example: Emergency Information, Fire
Page 1

Scope:

An actual fire or smoke condition that requires the response of professional fire fighters and/or evacuation of occupied space.

1. Describe roles of *Building Fire Warden*s
2. Describe operation of special ventilation systems.
3. Describe operation of ventilation systems.

4. Describe operation of elevators.

Notification:

Security Guard shall

1. Immediately notify the fire department by pull box or telephone (telephone # _____), whichever is quicker, upon report of fire or smoke or an activation of an alarm;
2. Notify building employees on duty who comprise the fire response team;
3. Notify supervisor, and
4. Notify building manager.

Building Manager shall

1. Notify affected tenants,
2. Notify corporate property director, and
3. Notify insurance carrier.

Response:

Security Guard shall

1. Immediately report to the Elm Street entrance to admit fire fighters and direct them to the affected area; and
2. Stand by at fire control panel to assist fire fighters.

Security Guard Supervisor shall deploy additional guards to prevent unauthorized access or theft from the affected area.

Building Operator shall

1. Report to fire control panel in lobby and await instructions from the fire fighters regarding activation of smoke exhaust;
2. Restore fire and smoke alarm system, when fire is secured; and
3. Remove water from flooded areas.

Custodial Staff shall minimize water damage using mops, buckets, ‘wet vacs’, and plastic sheeting.

Building Manager shall take charge at a safe location, in or near the building, determine the extent of personal injuries and property damage, and start a loss prevention and restoration effort. This includes use of barricades, warning tape, boarding of broken windows, etc.

Location of Equipment

Equipment	Location	Page No.
Hydrants		
Siamese connections		
Firefighters’ elevator		
Main power switch		
Main gas valve		
Fire hose cabinets		

Fire extinguishers
Sprinkler zone valves
Fire pump
Emergency generator
Heating plant/steam shutoff valve
Chiller plant/refrigerant vents
Domestic water service entrance

Locations of the above equipment should be shown on the pages following this table, with each item shown on a floor plan drawn to a suitable scale.

INFORMATIVE APPENDIX D — MAINTENANCE MANUAL

The following are examples of a table of contents and an equipment data sheet. Instructions for the data sheet describe the information needed in documentation that will be useful for management of a maintenance program.

Table of Contents

System	Equipment	Name	(O&M Number) Page No.
AC1	Air compressor	CTL	xx
AC2	Air compressor	CTL	xx
AH1	Air handling unit	(packaged system)	xx
HUM1	Humidifier	AH1	xx

The description of equipment includes two parts, the first containing generic information prepared by the supplier and the second containing project-specific information developed by the O&M designer. A sample equipment data sheet showing this organization is provided at the end of this appendix as Exhibit D1.

This document should contain information that describes either individual pieces of equipment that form part of a built-up system or individual packaged systems. Each piece of information should be identified with an O&M number and should be placed in the document in alphabetical or numerical order.

Equipment Data Sheet

It is desirable to have an equipment data sheet prepared for each piece of equipment that will require operation or maintenance or both. The use of standardized equipment data sheets is recommended as an effective method for collecting O&M information from the equipment suppliers in a form that is effective for preparation of O&M programs.

The O&M designer should sort information obtained using the form shown in the sample equipment data sheet (Exhibit D1) at the end of this appendix. Information from this sheet describing the equipment inventory should be shown in Part 1 of the maintenance manual; maintenance-program-related information should be shown in Part 2 of the maintenance manual. Operating instructions should be shown in the operation manual, and performance-testing information should be shown in Part 1 of the test report.

The data sheet should be prepared for insertion in a binder. Alternatively, it may be prepared in the form of a data entry, possibly forming part of a computer-based maintenance management system. Such a maintenance management system should have the capability to link the necessary information from the equipment data sheet with additional information needs by the maintenance department.

The following information is useful to maintenance personnel and can be included on the equipment data sheets.

Maintenance program Information Requirements

Whether the maintenance management is manual or computer-based, the equipment data sheets containing information provided by the supplier and the O&M designer can be fully developed into sheets suitable for management of a preventive maintenance program. The fully developed sheets should provide the information necessary for a technician to assess the scope of an assigned maintenance task, the location of the equipment to be visited, the time allotted for the task, the O&M instructions available from the O&M documentation package, the specific tools and appliances required to perform the task, the spare parts and consumables required, whether the spare parts and consumables are in the stock room inventory, and the worksheet needed for the task.

Equipment data sheets should also provide the information necessary for the maintenance supervisor to schedule technicians effectively and to prepare an O&M labor and materials budget. These sheets should also provide information for the stock room purchasing agent to predict requirements for spare parts and consumables, to obtain pricing and delivery quotations from vendors, and to place orders for spare parts and consumables.

Equipment data sheet structure

Equipment data sheets for different types of equipment should contain much of the same general data but should vary in content of secondary data depending upon the complexity of the piece of equipment.

Each field or blank in the data sheet should be planned for a specific purpose. If there is no purpose for a field, it should not be provided. The following paragraphs discuss the rationale for each of the information fields on the equipment data sheet, a sample of which is in Exhibit D1 at the end of this appendix.

Equipment Name should be either the name of a piece of equipment that is installed in a system (pump, chiller, cooling tower, etc.) or the name of a packaged system (rooftop unit, heat pump, packaged-water chiller, etc.).

Designation should be an assigned unique equipment number for each piece of equipment.

Location should be a description of where the piece of equipment is located with an indication of how to gain access to the location. An example is “Basement, C Building, Room B1001, Sump at the Door”.

Associated System should be the name and number of the system the piece of equipment serves, unless the piece of equipment is a package system.

Manufacturer, Model Number, and Serial Number should provide specific information from the equipment nameplate. Changes, such as revised operating and maintenance instructions, require retrofit project documentation providing information on new equipment parts that will be required in the future for operation and maintenance. An example is “Mfgr: ABC Pump Company; Model No: HSC 10x8x13; Serial NO: 870015,” where the leading “87” might be the year of manufacture.

Vendor/Agent. Invoice or Purchase Order Number, and Purchase Order Date should provide the specific information from the contractor or vendor’s files that is necessary to identify the order when obtaining information from the vendor/agent. Many vendors maintain their files for a limited time, particularly when a change of agent occurs. Therefore, it is desirable to provide information that would allow access to the manufacturer's files. This field may be modified to provide the manufacturer's order number or contractor's purchase order number as necessary to suit the circumstances of the original equipment order. In the recommissioning of an existing building, this may be the only way to obtain the needed information. An example is "Hydronic Sales Ltd.; Invoice No: 871201; Date: 05 December, 1987".

New or Rebuilt, Warranty Term should provide information on the initial status of the equipment and the length and terms of the manufacturer's or builder's warranty. The new or rebuilt information fields may not be applicable to new projects but may be useful for commissioning work. Warranty terms vary from manufacturer to manufacturer and on different equipment items from the same manufacturer. In some cases, extended warranties are purchased as part of the construction contract and, without this entry, may not be known to the maintenance supervisor. An example is "Status: New (X); Warranty: 90 Days on Parts and Labor: One Year, Parts Only; FOB Plant."

Installation, Operation, Maintenance (I/O/M) Instructions, Name and Number, and Date should provide a listing of the manufacturer's bulletins (contained in Part 1 of the maintenance manual) that apply to the equipment, giving the title, publication number, and date of issue of revision. In many cases, the warranty terms include a provision that the equipment be installed and started up in accordance with specific I/O/M instructions. Failure of the installing contractor to follow those terms may void the manufacturer's warranty and cause needless problems in the event of equipment malfunction or failure. The maintenance supervisor and his/her technicians should familiarize themselves with the applicable publications, verify that the publications are in the maintenance department's reference library, and inspect the equipment installations and start-up report to verify that the manufacturer's conditions for warranty coverage have been met.

I/O/M Instruction Video Available, Name and Number, and Source of Videos provide information for the maintenance supervisor on the training aids that are available for the equipment item, the name and number of each video, and the source for ordering the videos. The video approach to training O&M personnel in the specific equipment installed in a building is cost-effective in that it tends to instill a disciplined approach to maintenance of other items that may not be covered by videos.

An example is "Installation, Operation, and Maintenance of Series HSC Pumps, No: TA-HCS-100, July 1977, ABC Pump Company; Selection and Installation of Mechanical Shaft Seals, No. VT-301, April 1978, Jim Derrik Co.; Selection and Alignment of Shaft Couplings, No. SIT 123, June 1972, The Spyder Corporation."

Spare/Repair Parts, Part Lists, Minimum Inventory Lists should provide information about the applicable spare parts list and inventory list, including the designation and date of each list. For some equipment, this field should be modified to provide information about specific spare parts required, such as belts, filters, and repair kits, and should note which parts are carried in inventory and which should be specially ordered.

An example follows: "Seals two each HDC C/CI 1.5; Bearings two each Rolfast 1A2B3C 1.5-in. bore; Shaft coupling insert only TSC Model XYZ-1.5." Where equipment items have minor and major overhaul action listed, the specific publication for each overhaul type is listed along with data on lists of material and equipment needed for the overhaul, including outside services such as honing cylinders.

Preventive Maintenance Actions and Time Required should provide, for each of the listed actions, the standard time allotment for each action. Where more than one technician category and skill level are required to perform the task, the hours for each category and skill level should be entered separately to allow the cost of work to be determined and the time to be budgeted for future actions. The listed actions should be modified for the specific equipment item covered. For example, a closed-circuit liquid cooler may require chemical treatment, coil and pan cleaning, lubrication, motor starter service, power contactor service, pump seals, and v-belt drive service.

Scheduled Routine O&M Actions, and Time Required should provide information on the labor requirements for each routine maintenance action for an equipment item for the maintenance supervisor to use in allocating manpower, planning staffing requirements, scheduling routine maintenance operations, and budgeting maintenance costs. A typical list of routine frequencies might include daily, weekly, monthly, quarterly, semiannual, annual, preseason hours, and pressure drop basis. The equipment overhaul requirements usually are on the basis of operating hours or performance parameters, such as low oil pressure or low differential pressure.
The routine actions listed below are additive, in the sense that each calendar-based action includes the task on the previous action level. A general description of the routing action for a pump might include the following:

Daily	Observe shaft seal for excessive leakage and listen for bearing noise
Weekly	Feel pump and motor bearing housing for excessive heat buildup
Monthly	Measure and record suction and discharge pressure
Quarterly	Verify lubrication
Semiannually	Remove drive guard an check alignment of shaft coupling
Annually	Check motor amperes drawn at full load; check motor shaft run-out; and perform thermo graphic scan of motor starter, motor and pump.
Preseason	Quarterly jobs plus clean a paint drip pan.
Pressure drop basis	When pump suction-to-discharge differential pressure develops, drop to 85% of original start-up values, open pump housing, check pump wearing rings, and replace worn wearing rings.

Each action should have a listing of the technician categories and skill levels required and number of hours for each technician. Much of the basic information for these entries is available from the fields “Preventive Maintenance Action,” “Time Required,” and “Routine O&M Action Description, Skill Level, Tools, and Consumables.”

Routine O&M Action Description, Skill Level, Tools, and Consumables should provide a fairly detailed description of each action, giving the action name, the technician(s) category and skill level, the special tools and appliances required, the consumables required, and the service cart type containing the basic tools and supplies needed for the task. The O&M action description should be tailored to the O&M department’s philosophy, whether for predictive, preventive, routine, or breakdown maintenance.
A typical action description would be “Name—Measure amperage drawn by pump motor; Technician Category and Skill Level—HVAC Technician, Level III; Tools/Appliances Required—Hand tools, volt/ohm/multimeter, Class II protective gloves; Consumables—None; Time Allotted—0.8h; Cart Name—Electrical Testing; Description of Task—Advise Building Automation System operator that pump may be shut down at an approximate time for an approximate length of time; take work order to tool room, draw cart an special tools; go to task location; stop pump motor from the hand-off automatic switch on starter face and open starter enclosure; restart pump with enclosure open; carefully draw load-side wires from enclosure as required to use multimeter; place sensor jaws around each conductor in turn and read and record phase leg amperage; connect probes to multimeter, read voltage on each phase leg, and record with amperage for same leg; stop pump motor, carefully place load-side conductors in enclosure, close enclosure, and restart pump motor; verify that pump is running; return to shop; and analyze test results. If

amperage or voltage imbalance is greater than 10% between any two legs, notify supervisor."
With the action description given in this much detail, the quality of work can be enhanced, but the record-keeping task is significant. Realistically, a program this detailed should be in a computer-based maintenance management system.

Maintenance History—List for Each Maintenance Action should provide a means for obtaining feedback from the technician(s) and include the date the data are recorded; the work order number; a description of the operation performed, if different from the action description; cost for operation performed, to be completed by an O&M clerk; technician name(s); and comments. The intent of this section is to get comments from the technicians while the work is fresh in their minds. The subjects of comments are expected to be wide-ranging, from the usual complaining about why the work has to be done at all to constructive comments such as "Annually is too often. Do this work when problem is found," or, "The overload heaters are too large for the measured amperage and should be changed."
The maintenance supervisor can explain that the comment is based on a breakdown maintenance philosophy, while the building is being operated on a predictive maintenance philosophy. In the second case, the supervisor can issue a work order to replace the oversized heater relays.
This approach requires that the maintenance supervisor read all of the maintenance histories to make full use of the information. It is desirable to have the equipment data sheet copy turned in with the completed work order so that the O&M clerk can collect the sheets with comments for the supervisor's review and monthly status reports.

Exhibit D1: Equipment Data Sheet Samples

Equipment Name:
Designation:
Location:
Associated System:
Manufacturer:
Model No.:
Serial No.:
Date Of Mfr.:
Vendor/Agent:
Purchase Order No:
Date:
Status: New ( ) Rebuilt ( )
Warranty Term:
Start-Up: By Date:
O&M Instruction Videos Available: Yes ( ) No ( )

Name And Number:
Source Of Videos:

Spare Parts:
Complete List: Yes ( ) No ( ); Name and Date
Inventory List: Yes ( ) No ( ); Name And Date

Preventive Maintenance Actions And Time Required
Chemical Treatment:

Filter Changing:
Motor Starter:
Pump Seal:
Coil And Pan Cleaning:
Lubrication:
Power Contactor:
V-Belt Drive:

Scheduled Routing Operation and Maintenance Actions, and Time Required
Daily:
Semiannually:
Preseason:
Overhaul: Minor Major

Routine O&M Action Description, Skill Level, Tools, And Consumables
Action Name:
Technician(S) Skill Level:
Special Tools/Appliances Required:
Consumables Required:
Service Cart Type:

Maintenance History—List For Each Maintenance Action
Date:
Work Order No.:
Description of Maintenance Action Performed:
Technician Name(S):
Comments:

Technician Report (Comments And Recommendations):

INFORMATIVE APPENDIX E — TEST REPORTS

This document is the "health file" of the facility. It documents the observed performance during start-up and commissioning and allows the observed performance documentation to be compiled throughout the service life of the facility.

The following example provides a guide to organizing this document:

Table of Contents:

Part 3: Test Results
Because tests will continue to be performed as the operation of the facility continues, causing this part of the document to grow over time, it is suggested that a summary sheet of tests be prepared, indicating the type of test, specifying each piece of equipment or system, the date, and the name of the person and/or company that performed the test.

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

1.0 GENERAL

1.1 GENERAL

.1 Guarantees, Warranties and Bonds shall be submitted in accordance with the requirements for Manuals. Extended warranty shall be clearly indicated.

.2 Clearly indicate Building name and Building number.

1.2 RELATED SECTIONS

.1 Section 01 77 00 - Closeout Procedures

.2 Section 01 78 23 – Operation and Maintenance Data

1.3 PROCEDURES FOR WARRANTY CLAIMS

.1 If at any time during the warranty period the *Owner* discovers a defect that, in the *Owner's* opinion, is or could be covered under the warranty provisions of the Contract the *Owner* will *contact* the *Consultant* with a copy to the Contractor. Where the claim involves primarily the work of a subcontractor or work covered by a third party guarantee the subcontractor and/or guarantor may also be copied. The *Consultant* will promptly investigate the claim and direct the Contractor as to the appropriate method to correct the defect.

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

CONTENTS

1.0 GENERAL

1.1 DESCRIPTION

1.1.1 This section deals with the submission requirements of drawings and specifications.

1.2 USE

1.2.1 CAD drawings submitted to Infrastructure Development, Records Section are simplified to create key plans and typically contain basic architectural elements to represent the current status of a building or campus site features. The key plans are maintained and can be provided back to consultants for future projects. The key plans are also used for location and data source for the following services:

- CAFM drawings for Space Inventory – Room Use, Area and Allocation
- Emergency Procedure Key plans
- Door Identification – Campus Access and Security / Locksmiths
- Facility Planning
- Room Scheduling

1.3 RELATED SECTIONS

1.3.1 Section 01 77 00 Closeout Procedures
1.3.2 Section 01 78 23 Operation and Maintenance Data
1.3.3 Section 33 00 10 Underground Utilities Services
1.3.4 Section 26 05 00 Electrical – General Requirements

2.0 SUBMISSIONS

2.1 DRAWINGS

2.1.1 TYPES OF DRAWINGS

.1 ISSUED FOR CONSTRUCTION

.1 These drawings have been updated to incorporate major design changes and approved room numbers before construction commences. If Building Permit Drawings have previously been submitted and no changes are required, the Building Permit Drawings can be resubmitted as “Issued for Construction”. The Certified Professional must submit a letter to UBC Infrastructure Development, Records, confirming that there have been no substantial changes from the Building Permit set of drawings.

.2 “Issued for Construction” drawings are NOT accepted as As-Built drawings.

.3 **One (1) PDF and (1) set of architectural floorplans in AutoCAD format files to be submitted to the Infrastructure Development, Records Section prior to the start of construction.** See: 2.1.2 Format Requirements.

.2 RECORD DRAWINGS

.1 Buildings

.1 These drawings are issued for all building projects and represent the final installed configuration of what was actually built. Record drawings are prepared by the Consultant using information furnished by the Contractor or other field staff.

.2 Record drawings incorporate all changes made during the construction process including any and all clarifications, addenda and Change Orders. A statement attesting to this is required from the certifying professional, and is to be included with the record drawing submission.

.3 **One (1) PDF and (1) AutoCAD format files to be submitted to Infrastructure Development, Records Section within 60 days of Substantial Performance.** See: 2.1.2 Format Requirements. The PDF files shall be clear and legible. UBC reserves the right to request a paper copy of the drawings if necessary.

.2 Underground Utility Services

.1 These drawings are a true record of underground utilities which represent the final installed configuration of what was actually built. A record drawing incorporates all changes made during the construction process including an as-constructed survey and any and all clarifications, addenda and Change Orders.

.2 Record drawings are verified in detail by the Professional Engineer through reviewing the actual conditions of the completed project. Verification by the reviewing engineer may require frequent or continuous presence on site.

.3 Where applicable, all relevant improvement sizes, diameters, elevations, depths and material must be specified on the approved plans. The field surveyor must check them during and/or after construction. They are to be relevant to the UBC Datum and nearest official UBC monument.

.4 Rim and invert elevations, and all pipe material and lengths shall clearly be marked “Record” on the Record Drawings.

.5 **Two (2) paper copies plus one (1) PDF and one (1) AutoCAD format files to be submitted to Infrastructure Development, Records Section within 60 days of Substantial Performance of the civil contract.** See: 2.1.2 Format Requirements. See also: Division 33, Section 33 00 10 Underground Utilities Services.

.6 **Certification of Record drawings for Underground Utility Services**

Record drawings are to be signed and sealed by the Professional Engineer and shall contain a certification conforming to the following:

“I CERTIFY THAT THE LOCATION, ELEVATION, DEPTHS, AND AS-BUILT COMMENTS, REFLECT MATERIALS ACTUALLY USED DURING CONSTRUCTION AND ACCURATELY REFLECT EXISTING

FIELD CONDITIONS AS DETERMINED BY ME OR UNDER MY DIRECT SUPERVISION ON THIS DATE."

Professional Stamp,
Expiration Date, Date Signed & Signature

2.1.2 FORMAT REQUIREMENTS

.1 PAPER (for Underground Utility Services only)

.1 Sequentially numbered individual sheets stapled (not bound) in sets.

.2 Printed on a D-size sheet (36"x 24" / 914 mm x 610 mm) using at least 20 lb bond white paper.

.3 Plotted and dimensioned using metric units: millimeters for floor plans and meters for underground utilities.

.4 Each floor plan sheet must have a common metric scale. For larger construction areas, a context key plan is to be used.

.2 DIGITAL (for all Record Drawings)

.1 Organized in folders based on drawing sets and submitted on a clearly labeled, write-protected CD-R. Information about the building or facility (name, number, and address), the date of the submission, and a context description is to accompany the CD.

.2 Two digital formats:

.1 **AutoCAD**

.1 To be created using the latest version of AutoDesk AutoCAD software (AutoCAD 2010 or later). All DWG files and CAD drawing entities submitted at the end of a project must be able to be manipulated using standard AutoCAD™ drafting procedures. DXF files will not be accepted at project closeout as a substitution for DWG CAD file deliverables.

.2 AutoCAD files are to match the paper copy and PDF exactly, and are to be purged of any information and features that are not related to the printed sheet and PDF submission

.2 **Adobe Acrobat (.pdf)**

.1 To be created using the latest version of Adobe Acrobat.

.2 One drawing sheet per page.

.3 Files are to match each individual page of paper as submitted for the record drawings (see 2.1.2.1 Paper).

.3 Any questions regarding project record documents, please contact Infrastructure Development, Records Section at (604) 822-9570 or email records.section@ubc.ca.

2.1.3 LIST

All elevations, including spot and floor elevations, are to be relative to UBC Datum.

.1 ARCHITECTURAL

To include site plan, floor plans, furniture layouts, sections, elevations and details.

.2 STRUCTURAL

To include floor plans, sections, and details.

.3 MECHANICAL - HVAC

To include site plan, floor plans, sections, elevations, and details.

.4 MECHANICAL - PLUMBING

To include site plan (showing individual services connections from the mains to the building), floor plans, sections, elevations, and details.

.5 ELECTRICAL

.1 To include site plan (showing service connection from the main to the building), floor plans, sections, elevations, details.

.2 Must show the following, where applicable:

.1 All conduit or duct work located below ground level and in or below a building slab.

.2 All service, sub-service, and main riser conduits, all spare conduits stubbed in concealed spaces, and the location of all electrical equipment essential for safe system operation, such as end of line resistors, etc.

.3 All service ducts and cables for voltages above 705 volts, and for main communications cables.

.3 See also: Section 26 05 00 Electrical – General Requirements, 2.3 Project Record Drawing Requirements.

.6 CIVIL

To include site plan, elevations, and details.

.7 LANDSCAPE

To include site plan (showing lawn sprinkler services with connections), sections, elevations, and details.

.8 SURVEY

.1 Must show construction context in relation to the existing nearest official UBC monument, both in spatial locating (horizontal dimensions), as well as vertical reference – UBC Datum based elevations. (see Section 3.0 Survey Monument Information)

.2 To be created in UTM (Universal Transverse Mercator) and using NAD 83 Datum for compatibility with standard GIS functionality.

.9 DEMOLITION

.1 Drawings should clearly show the existing buildings, civil features and infrastructure in the vicinity of the project.

.2 The drawings should include clear definition of features and underground services to be demolished as well as the ones to be retained including horizontal and vertical survey dimensions relative to the nearest official UBC monument (see Section 3.0 Survey Monument Information).

2.1.4 CAD DRAWING PRODUCTION

.1 General Guidelines

.1 Drawing submissions should have all external reference drawings bound (BIND/INSERT) within the drawing. Bound layers must maintain layer names. Please check that the layer information is not lost.

.2 All drawings submitted must be purged of unused data such as blocks, layers, objects, and styles.

.3 Multiple drawing sheets must be broken down into separate drawings containing single sheets.

.4 AutoCAD ™ drawings shall not contain frozen layers. All unused entities on frozen layers should be erased and empty layers should be purged.

.5 All referenced image files (PNG, TIFF, JPG etc.) should be embedded as OLE objects in the drawings and should not be referenced outside the drawing.

.2 Scale and Units

.1 All drawings must be drafted in full scale metric units in model space such that one unit must equal to 1 millimeter.

.2 Site drawings drawn in 1:1 metre are acceptable.

.3 Fonts

.1 Fonts to be used are native AutoCAD fonts only. Custom fonts including those provided by 3rd party software shall not be used.

.2 Text style heights must not be fixed. Heights should be set to 0 and width angle of 1.

.3 Text properties should be set to “by Layer”.

.4 Fonts to be used are native AutoCAD fonts only. Custom fonts including those provided by 3rd party software shall not be used.

.4 **Standard Blocks and Symbols**

.1 All drawing objects within blocks must be set to layer 0.

.2 All drawing objects must have the color, line type and line weight set to “by layer”.

.3 Nested blocks are not to be used.

.4 Blocks should be inserted in the proper layer of discipline.

.5 It must have an insertion angle of Ø.

.6 Drawing files that are translated from another vector software which result in wall blocks within AutoCAD™ are not accepted.

.7 Blocks that require text should use block attributes.

.8 Attributes within blocks must have all attribute properties set to Layer 0 with a linetype, color and lineweight set to “By Layer”.

.9 All feature attributes, i.e. pipe diameters and materials, are to be attached as object data.

2.1.5 Layering Guidelines - CODES, GROUPS and FIELDS

UBC Record Key Plan layering guidelines are based upon the AIA National CAD Standards. This is designed to easily translate As-built drawings in CAD format submitted to Infrastructure Development, Records Section by consultants contracted by UBC for new building construction and renovation. This standard allows our key plans to be used for in-house project renovations and facility planning purposes.

The CAD Layer Guidelines are organized as hierarchy. This arrangement accommodates expansion and addition of user-defined extensions to the layer list. Layer names are alphanumeric and use abbreviations that are easy to remember. This legibility is particularly important when CAD files are distributed among architects, consultants, and clients.

DISCIPLINE	MAJOR GOUP	MINOR GROUP	STATUS
Required	Required	Optional	Optional

.1 Discipline Code

Discipline is the primary method of classification for layer names. The discipline code is intended to identify the author of the graphic information. Thus, a structural column placed by an architect would be A-COLS rather than S-COLS. This accommodates the use of "I" as a discipline code, allowing doors and walls to be recognized in both the Architectural and the Interiors disciplines. The Discipline Code is a two character field with the second character, either a hyphen or a user-defined modifier. The discipline codes are listed below.

A	Architectural
C	Civil
E	Electrical
F	Fire Protection
G	General
H	Hazardous Materials
I	Interiors
L	Landscape
M	Mechanical
P	Plumbing
Q	Equipment
R	Resource
S	Structural
T	Telecommunications
X	Other
Z	Contractor/shop Drawings

.2 Major Group

The major group designation is a four-character field that identifies the building system, such as doors, walls, windows, etc. Although most major groups are logically associated with specific discipline codes, it is possible to combine major group codes with any of the discipline codes.

A-WALL	Walls
A-DOOR	Doors
A-GLAZ	Glass

.3 Minor Group

This is an optional, four-character field for further differentiation of major groups. For example, partial height walls (A-WALL-PART) might be differentiated from full height walls (A-WALL-FULL). The following common modifiers defined by the AIA can also be used in the minor group field:

IDEN	Identification
PATT	Pattern
AREA	Area

.4 Status Field

The Status Field is an optional four-character designator that differentiates new construction from remodeling and existing to remain. It is only needed when phases of work must be differentiated. Defined values for these fields are listed below.

The Status Field is always placed as the last field of the layer name. In a simple layer name such as A-WALL, the Status Field would be the third field (A-WALL-D). In a more detailed layer name, the Status Field would be the fourth field (A-WALL-FULL-D).

N	New Work
E	Existing to Remain
D	Existing to Demolish
F	Future Work
T	Temporary Work
M	Items to be Moved
R	Relocated Items
X	Not in Contract

.5 Annotation

Annotation comprises text, dimensions, sheet borders. Detail references, and other elements on CAD drawings that don't represent physical aspects of a building. The major group "ANNO" designates annotation.

Annotation can be placed in both paper and model space (Model files/Titleblock files). Dimensions, symbols, and keynotes would typically be placed in model space. Legends, schedules, borders, and title blocks would typically be placed in paper space. The same layer names would be used in both cases Types of annotation are as follows:

*-ANNO-DIMS	Dimensions
*-ANNO-KEYN	Keynotes
*-ANNO-LEGN	Legends and Schedules

* represents discipline code

.6 Accepted Layer Group Codes

Major Group Codes

Major	Description	Major	Description
Ablt	Anchor Bolt	Mach	Machine Shop
Accs	Access	Mdgs	Medical Gas
Acid	Acid	Metl	Miscellaneous Metal
Anno	Annotation	Ngas	Natural Gas
Area	Area	Nurs	Nursing
Beam	Beam	Pgng	Paging Systems
Bldg	Building	Pipe	Pipe
Brin	Brine Systems	Pkng	Parking
Cabl	Cable	Plan	Plans
Chim	Chimney	Plnt	Plant
Clng	Ceiling	Powr	Power
Cmpa	Compressed Air Systems	Proc	Process
Co2s	C02 Systems	Prop	Property
Code	Code	Prot	Protection
Cols	Columns	Rcov	Recover
Comm	Communications	Refg	Refrigeration
Cont	Controls	Risr	Risers
Cwtr	Chilled Water	Road	Road
Deck	Floor Decks	Roof	Roof
Detl	Detail	Sanr	Sanitary
Domw	Domestic Water	Sect	Sections
Dust	Dust	Sert	Security
Elev	Elevation	Site	Site
Elht	Electric Heat	Slab	Slabs
Ener	Energy Management	Soun	Sound
Eqpm	Equipment	Spcl	Special
Evac	Evacuation	Sprn	Sprinklers
Exhs	Exhaust	Stan	Standpipe Systems
Fire	Fire	Stem	Steam
Fixt	Fixture	Strm	Storm
Flor	Floor	Test	Test
Fndn	Foundation	Topo	Topography
Fuel	Fuel	Tvan	Television Antenna
Furn	Furniture	Walk	Walks
Glaz	Glass	Wall	Walls
Grid	Grids	Watr	Water
Jois	Joists	Xref	External References

Lgas	Labratory Gas	
Lite	Lighting	
Ltng	Lightning Protection	

Minor Group Codes

Minor Code	Description	Minor Code	Description
##	Pen#, Xref#, etc.	Keyn	Key Notes
2way	2-way	Kple	Kpl Electric Lines
Aban	Abandoned	Kpsg	Kps
Accs	Equipment Access	Legn	Schedule, Legend, Table Border
Adag	Disabled Access Guides	Less	Asbestos Quantity Less Than
Alrm	Fire Alarm	Levl	Level Changes, Ramps, Pits, and Depressions
Appl	Appliances	Lpip	Low Pressure Steam Piping
Area	Area Calculations	Lvel	Electric Lines - Low Voltage
Asbs	Asbestos	Lvsl	Street Lights Lines - Low Voltages
Bbl#	Basketball Bleachers	Main	Water Main
Beds	Beds	Mbnd	Material Beyond Section Cut
Blr1	Bleachers - Closed Partitions	Mcut	Material Cut by Sections
Blr2	Bleachers - Opened Position	Metr	Meters and Valves
Bnch	Benchmarks	Mhol	Manholes
Bore	Test Borings	Misc	Miscellaneous
Brdg	Bridges	Mmff	Multi-Mode Fiber Feeder
Brng	Bearing and Distance Labels	Mmfh	Multi-Mode Fiber
Busw	Busways	Mmfr	Multi-Mode Fiber Riser
Cabl	Cable Trays	Move	Movable
Cars	Graphic Illustration of Cars	Nicn	Not in Contact
Case	Casework	Note	Notes
Catv	Cable TV	Nplt	Non-Plotting Information
Cdff	Hvac Ceiling Diffusers	Numb	Power Circuit Numbers
Chil	Chilled Water	Occp	Occupant or Employee Names
Circ	Circutting	Odff	Other Diffusers
City	City	Ogep	Fuel Oil General Piping
Clhd	Sprinkler head (Ceiling)	Open	Ceiling and Roof
Cntr	Center Lines	Othd	Sprinkler Head (Other)

Coax	Coax	Otln	Outlines
Code	Code Information	Ovhd	Overhead Communication Lines
Cols	Columns	Ovhd	Overhead
Conp	Condensate Piping	P#	Detail Outlines or Detail Using Different Pens or Colors
Cons	Construction Controls	Panl	Power Panels
Cpip	Compressed Air Piping	Pat(1-9)	Textures and Hatch Patterns, Certain Construction Lines (1-9)
Cprf	Copper Feeder	Pave	Roads That Have No Curb and Gutter but Are Pave
Cprh	Copper Horizontal	Peop	People
Cprr	Copper Riser	Peqp	Process Air Equipment
Curb	Curb	Pfix	Plumbing Fixtures
Data	Data	Pile	Piles, Drilled Piers
Date	Date Stamp	Pipe	Piping
Deck	Decks	Plan	Plans
Desc	Descriptive Text	Play	Play Structures
Dims	Dimensions	Plnt	Plants
		Pnls	Furniture System Panels
Powr	Furniture System Power	Pole	Electric Poles and Street Lights on the Poles
Ppip	Process Air Piping	Swbd	Switchboards
Prht	Partial Height	Swbt	Swb
Rais	Raised	Swch	Switches
Rbar	Re-bar	Swng	Door Swing Arc
Rdff	Return Air Diffusers	Symb	Symbols
Rfeq	Rooftop Exhaust Equipment	Tank	Tanks
Risr	Risers	Susp	Suspended Elements
Roof	Roof	Tees	Main Tees
Rtwl	Retaining Walls	Tele	Telephone
Satv	Satelite TV	Texl	Large Text
Sdff	Supply Diffusers	Texts	Small Text
Serv	Service	Text	Legends and Schedules Text
Sign	Signage	Ther	Thermostats
Sill	Sills	Tptn	Toilet Partitions
Site	Site	Ttbl	Title Blocks
Slev	Sleeves Under University Roads	Tunn	Tunnels
Smff	Single-Mode Fiber-Feeder	Turf	Lawn Areas
Smfh	Single-Mode Fiber, Horizontal	Ucpt	Under Carpet Wiring

Smfr	Single-Mode Fiber Riser	Undr	Underground
Smok	Smoke Detectors or Heat Sensors	Unpv	Roads That Are Unpaved
Spcl	Architectural Specialties	Urac	Under Floor Raceways
Spkl	Irrigation Sprinklers	Util	Utilities
Spot	Spot Elevations	Vbl#	Floor Striping for Volleyball Courts
Sprt	Playing Fields and Text	Vhcx	Catv Video Feeder
Step	Steps	Vprt	Paper Space Viewports
Stor	Storage	Vrcx	Catv Video, Feeder Riser'
Strp	Floor/Parking Lot Striping & Handicapped Symbol	Wdwk	Architectural Woodwork (Field Built Cabinets & Counters)
Strs	Stairs, Treads, Escalators, and Ladders	Wire	Wiring

2.2 SPECIFICATIONS

2.2.1 FORMAT REQUIREMENTS

.1 PAPER

.1 Individual letter sized page (8.5” x 11”) compiled into a manual.

.2 DIGITAL

.1 Adobe Acrobat (PDF) which mirrors exactly the paper copy of each individual page for Project Specifications.

.2 Separate PDF files are required for each section of the specifications.

2.2.2 LIST

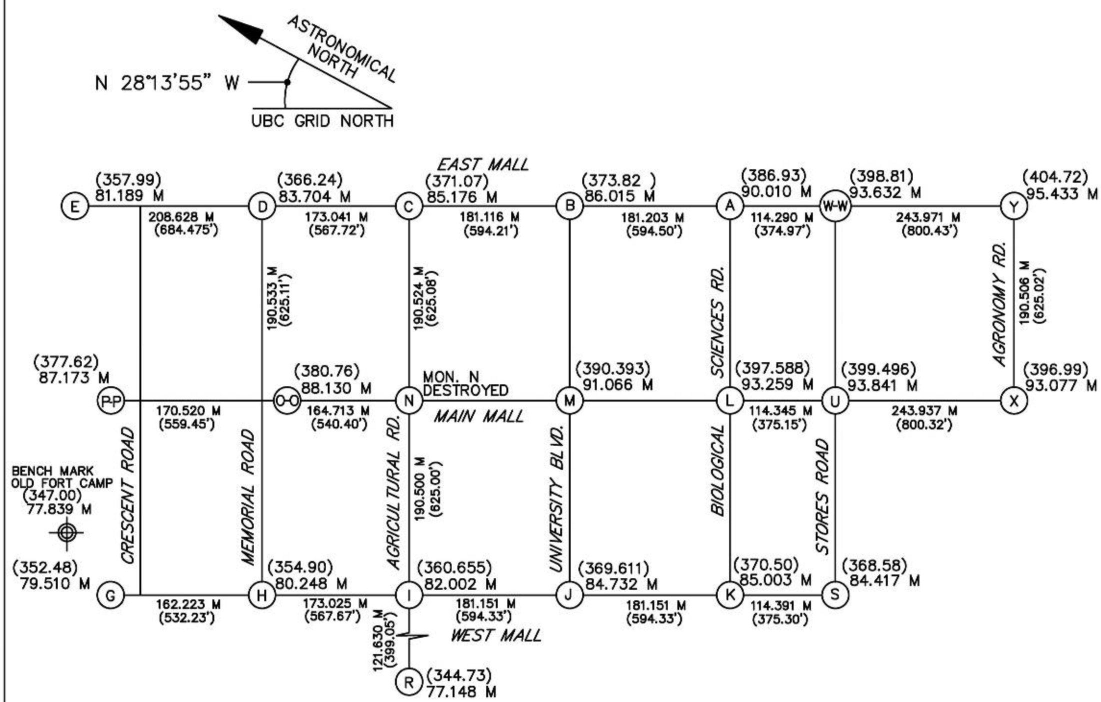
.1 ISSUED FOR CONSTRUCTION SPECIFICATIONS

.1 Describe in detail the materials, products and systems used for the project. They will be developed by the Architect, Specifier, and/or the Engineer.

.2 Specifications are to include each construction discipline, i.e. architectural, structural, plumbing, mechanical, and electrical.

.3 **One (1) paper copy and one (1) PDF copy to be submitted to Infrastructure Development, Records Section within 60 days of Substantial Performance.**

3.0 SURVEY MONUMENT INFORMATION



A. GEODETIC BENCH MARKS

1. FUNDAMENTAL GEODETIC BENCH MARK IN COURTHOUSE GROUNDS NO.774–J ELEVATION 30.850 METRES–101.214'IMPERIAL. THIS DATUM IS BASED ON MEAN SEA LEVEL AS DETERMINED BY ACCURATE GAUGE READINGS ON BOTH ATLANTIC AND PACIFIC COASTS.

2. GEODETIC BENCH MARK, ENGINEERING BUILDING (COMPUTER SCIENCES) UNIVERSITY OF BRITISH COLUMBIA, TABLET IN NORTH–WEST STONE FOUNDATION WALL 7 INCHES SOUTH–WEST OF SOUTH–WEST EDGE OF EIGHTH WINDOW FROM WEST CORNER OF BUILDING AND 12 INCHES ABOVE GROUND. NO.1239–J ELEVATION 85.199 METRES–279.524'IMPERIAL.

3. GEODETIC BENCH MARK, SIMON FRASER MONUMENT, IRON PIPE WITH BRASS CAP, ON SOUTH–WEST SIDE OF MARINE DRIVE, ABOUT 2 MILES SOUTH–EAST OF U.B.C. OPPOSITE POINT ON GUARD RAIL 9 FEET NORTH–WEST OF NORTH–WEST SIDE OF MONUMENT, 5 FEET SOUTH OF GUARD RAIL ABOUT ROAD LEVEL. NO.1260–J ELEVATION 45.159 METRES–148.159'IMPERIAL.

B. CAMPUS GEODETIC DATUM

NOTE : ALL ELEVATIONS SHOWN IN BRACKETS ARE BASED ON IMPERIAL MEASURE AND INCLUDE THE ADDITION OF 91.62 FEET TO THE IMPERIAL GEODETIC BASE. METRIC ELEVATIONS ARE GEODETIC AND DO NOT INCLUDE 91.62 FEET.

C. CITY OF VANCOUVER, B.C. HYDRO AND POWER AUTHORITY, GREATER VANCOUVER SEWERAGE AND DRAINAGE DISTRICT.

NOTE: 91.384 FEET WAS ADDED TO ALL IMPERIAL GEODETIC BENCH MARKS TO ESTABLISH THE IMPERIAL DATUM FOR THE ABOVE MUNICIPALITIES.

D. ALL DISTANCES ON THIS DRAWING ARE METRIC. THOSE FIGURES SHOWN IN BRACKETS ARE IMPERIAL MEASURE.

Conversion of vertical measurements from Metric to Imperial requires the inclusion of the UBC Geodetic Datum of 91.62 FT.
metric to imperial - perform conversion ,then add 91.62 FT.
Imperial to metric - subtract 91.62 ,then perform conversion.

THE UNIVERSITY OF BRITISH COLUMBIA INFRASTRUCTURE DEVELOPMENT Records Section	REVISED: JUNE 26, 2008 BY: JEL ORIGINAL DRAWN: JEL DATE: SEPT. 1995	U.B.C. MONUMENTS PLAN	STANDARD No 01-01

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CAMPUS UTM COORDINATES

Here is a list of existing campus monuments and their associated UTM coordinates. This information is for reference use only. The provider of this information accepts no responsibility for its use or accuracy. The coordinates listed here are unofficial.

Table J1 Campus Monument Coordinates

Monument		**UTM NAD 83 Grid Coordinates**	
		Northing	Easting
J		5456833.899	481440.078
PP		5457378.937	481364.939
OO		5457228.551	481445.232
I		5456993.635	481354.793
M		5456923.590	481608.054
H		5457136.675	481278.422
K		5456674.163	481525.363
L		5456763.831	481693.353
R		5456936.381	481247.537
S		5456573.295	481579.218
U		5456663.003	481747.186
X		5456447.903	481862.030
Y		5456537.609	482030.044
G		5457289.246	481196.962
E		5457509.590	481511.150
D		5457325.612	481609.372
B		5457013.296	481776.048
W-W		5456752.701	481915.103
A		5456853.520	481861.375
C		5457173.013	481690.820

Grid coordinates were calculated using an combination factor of 0.9995923

Grid Distance (coordinate) = Ground Distance (coordinate) x 0.9995923

The Information included has been prepared by Urban Systems LTD.
IT IS FOR REFERENCE ONLY

4.0 UBC LAYERS IN USE

The following layer list is the current layers in use within UBC floor plans and campus maps. If additional layers are needed for drafting purposes, please refer to the AIA CAD Layer guidelines. New layer names may be added using the formatting rules listed in this section.

4.1 Building Floor Plans

LAYER NAME	DESCRIPTION	COLOR	LINETYPE
A-ANNO-DIMS	DIMENSIONS	WHITE	CONTINUOUS
A-ANNO-NOTE	CONSTRUCTION DATES/INFO	GREEN	CONTINUOUS
A-ANNO-REDL	BUILDING DELINEATOR LINES	RED	CENTERLINE
A-ANNO-SYMB	WASHROOM SYMBOLS	BLUE	CONTINUOUS
A-ANNO-TEXT	TITLE BLOCK TEXT / INFO./ UBC CREST / NORTH ARROWS	WHITE	CONTINUOUS
A-ANNO-TTBL	TITLE BLOCK BORDER/ LINES	RED	CONTINUOUS
A-AREA-DESC	ROOM USAGE DESCRIPTION	YELLOW	CONTINUOUS
A-AREA-IDEN	ROOM NUMBERS	GREEN	CONTINUOUS
A-AREA-PATT	AREA HATCHES	253	CONTINUOUS
A-DOOR	DOORS	YELLOW	CONTINUOUS
A-DOOR-IDEN	EXTERIOR/INTERIOR DOOR LABELS	GREEN	CONTINUOUS
A-EQPM	EQUIPMENT / ELEVATORS	BLUE	CONTINUOUS
A-FLOR-PFIX	PLUMBING FIXTURES	BLUE	CONTINUOUS
A-FLOR-STRS	STAIRS/ ESCALATORS/ TREADS/ LADDERS/ BALCONY AND GUARD RAILS/ ARROWS AND TEXT/ RAMPS/ FLOOR LEVEL CHANGES	WHITE	CONTINUOUS
A-FLOR-WDWK	MILLWORK/ ARCH WOODWORK/ BUILT IN CABINETS & COUNTERS/ TOILET PARTITIONS	BLUE	CONTINUOUS
A-FURN	FURNITURE/ WORKSTATIONS/CHAIRS ETC…	BLUE	CONTINUOUS
A-GLAZ	WINDOWS/GLAZED PARTITION/ SILLS	YELLOW	CONTINUOUS
A-PKNG	PARKING LINES AND STALL NUMBERS	WHITE	CONTINUOUS
A-ROOF	ROOF OUTLINES	WHITE	CONTINUOUS
A-WALL	ARCHITECTURAL WALLS	WHITE	CONTINUOUS
A-ROOF-PATT	ROOF HATCHING / SURFACES	WHITE	CONTINUOUS
L-SITE	EXTERIOR WALKWAYS, STAIRS, PLANTERS ETC.	BLUE	CONTINUOUS
S-GRID	ARCHITECTURAL GRID / BUBBLE	BLUE	CENTERLINE
S-WALL	STRUCTURAL WALLS/ COLUMNS	CYAN	CONTINUOUS

4.2 Site Base Map

LAYER NAME	DESCRIPTION	COLOUR	LINETYPE
C-BLDG	BUILDING - FOOTPRINTS	YELLOW	CONTINUOUS
C-BLDG FUTURE	BUILDING - FUTURE	MAGENTA	CONTINUOUS
C-BLDG-DEMO	BUILDING - DEMOLISHED	11	CONTINUOUS

C-BLDG-NUM	BUILDING - NUMBER	MAGENTA	CONTINUOUS
C-BLDG-NUM-LARGE	BUILDING - NUMBER LARGE	RED	CONTINUOUS
C-BLDG-TEXT	BUILDING - TEXT	MAGENTA	CONTINUOUS
C-BLDG-TEXT-LARGE	BUILDING - TEXT LARGE	RED	CONTINUOUS
C-BLDG-UC-LGTXT	BUILDING - UNDER CONSTRUCTION TEXT	MAGENTA	CONTINUOUS
C-BLDG-UNIT-NO	BUILDING UNIT NUMBERS	GREEN	CONTINUOUS
C-PARK-TEXT-LARGE	PARK TEXT	YELLOW	CONTINUOUS
C-PROP-LOT	PROPERTY LOT LINES	WHITE	CONTINUOUS
C-PROP-LOT-EDITS		11	CONTINUOUS
C-PROP-LOT-SC	PROPERTY LOTS LINES - SOUTH CAMPUS	WHITE	CONTINUOUS
C-PROP-LOT-SC-TEXT	PROPERTY LOT TEXT - SOUTH CAMPUS	WHITE	CONTINUOUS
C-PROP-LOT-TEXT	PROPERTY LOT TEXT	WHITE	CONTINUOUS
C-ROAD	ROAD OUTLINES	GREEN	CONTINUOUS
C-ROAD-PKNG	PARKING STALLS	BLUE	CONTINUOUS
C-ROAD-TEXT	ROAD LABELS	GREEN	CONTINUOUS
C-ROAD-TEXT-LARGE	ROAD LABELS - LARGE	RED	CONTINUOUS
C-SITE-MISC	EXTRAS	MAGENTA	CONTINUOUS
C-SITE-TEXT	SITE NAME	MAGENTA	CONTINUOUS
C-SITE-TEXT-LARGE	SITE NAME - TEXT LARGE	RED	CONTINUOUS
C-SURV-MONU-LARGE	MONUMENTS -LARGE	RED	CONTINUOUS
C-SURV-MONU-SMALL	MONUMENTS	WHITE	CONTINUOUS
C-TOPO-HWATER	HIGH WATER LINE	GREEN	CONTINUOUS
C-TOPO-LWATER	LOW WATER LINE	BLUE	CONTINUOUS
C-TOPO-TEXT-LARGE	CLIFF TOP -TEXT LARGE	MAGENTA	CONTINUOUS
C-TOPO-TOSL	CLIFF TOP	MAGENTA	CONTINUOUS
C-WALK	WALKWAY OUTLINES / SLABS	RED	CONTINUOUS
DEDICATED PUBLIC ROADS	DEDICATED PUBLIC ROADS	213	ACAD_ISO10W100
Defpoints	Defpoints	53	CONTINUOUS
LEASEBORDER	LEASBORDER BOUNDARIES	44	CONTINUOUS
L-GATE-TEXT-LARGE	GATE LABELS - LARGE	YELLOW	CONTINUOUS
L-PLANT	PLANTERS	94	CONTINUOUS
L-SITE-DEMO	DEMOLISHED SITE FEATURES	11	HIDDEN
L-SITE-FENCWALL	GATES/ FENCES	MAGENTA	FENCELINE1
L-SITE-POOL	WATER FEATURES/ PONDS/ FOUNTAIN	BLUE	CONTINUOUS
L-SITE-SPRT	SPORTING AREAS AND FIELDS	9	CONTINUOUS
L-SITE-SPRT-DETAILS	SPORT DETAILS	30	CONTINUOUS
L-SITE-WALL	SITE WALLS	BLUE	CONTINUOUS
L-WALK-CRT	WALKWAY - COURTYARDS	BLUE	CONTINUOUS
L-WALK-PLAZA	WALKWAY - PLAZA	BLUE	CONTINUOUS
UEL BLDG	UEL LAND BOUNDARIES	YELLOW	DASH

UNA LANDS	UNA LAND BOUNDARIES	30	CONTINUOUS
VPORT	VIEWPORT	BLUE	CONTINUOUS

4.3 Address Map

LAYER NAME	DESCRIPTION	COLOUR	LINETYPE
G-FUTURE-HATCH	FUTURE DEVELOPMENT	200	Continuous
G-FUTURE-TEXT	FUTURE DEVELOPMENT - TEXT	160	Continuous
G-POSTALAD	POSTAL ADDRESS	10	Continuous
G-POSTALAD-ACADIA	POSTAL ADDRESS - ACADIA	10	Continuous
G-POSTALAD-VST	POSTAL ADDRESS - VST	10	Continuous
G-POSTALAD TEXT	POSTAL ADDRESS - TEXT	10	Continuous

4.4 Legal Map

LAYER NAME	DESCRIPTION	COLOUR	LINETYPE
C-LGL-DL	DISTRICT LOTS	red	CONTINUOUS
C-LGL-DL-TEXT	DISTRICT LOTS - TEXT	yellow	CONTINUOUS
C-LGL-EAS	EASEMENT	cyan	CONTINUOUS
C-LGL-EAS-TEXT	EASEMENT TEXT	cyan	CONTINUOUS
C-LGL-HOUS-AREA	HOUSING AREA	10	CONTINUOUS
C-LGL-LEASE	LEASED AREA	yellow	CONTINUOUS
C-LGL-LN	LEGAL LINE	white	CONTINUOUS
C-LGL-LN-TEXT	LEGAL LINE - TEXT	magenta	CONTINUOUS
C-LGL-LN-TEXT-L	LEGAL LINE TEXT - LARGE	magenta	CONTINUOUS
C-LGL-ROAD-EASMNT	ROAD EASEMENT	12	CONTINUOUS
C-LGL-TEMP	TEMPORARY	10	NONUBC
C-PROP-LOT	PROPERTY LOT	white	CONTINUOUS
C-PROP-LOT-TEXT	PROPERTY LOT TEXT	white	CONTINUOUS
C-SURV-IP	SURVEY IRON PIN	white	CONTINUOUS
C-SURV-MISC	SURVEY MISC	white	CONTINUOUS
C-SURV-MONU	SURVEY MONUMENTS	white	CONTINUOUS
C-SURV-MONU-L	SURVEY MONUMENT -LARGE	red	CONTINUOUS
C-SURV-PKNG-AREA	SURVEY PARKING AREA	30	CONTINUOUS
C-SURV-PKNG1-AREA		31	CONTINUOUS

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

1.0 GENERAL

1.1 SPARE PARTS AND MAINTENANCE MATERIALS

.1 Spare parts and maintenance materials for all mechanical and electrical systems and equipment shall be turned over to the Owner’s Representative. An itemized receipt shall be obtained for all items and shall be submitted to the Consultant. Refer to Divisions 20 through 33 of this specification for specific requirements.

.2 Maintenance materials for architectural finishes and other similar items shall be carefully labeled and delivered as instructed by the Owner’s Representative. An itemized receipt shall be obtained for all items and shall be submitted to the Consultant. The Consultant will confirm that the correct materials have been delivered. Refer to Divisions 02 through 14 of these specifications for specific requirements.

1.2 RELATED SECTIONS

.1 Section 01 77 00 Closeout Procedures, 2.0 Closeout Submittals.

1.3 KEYS

.1 Keys for door hardware shall be turned over as indicated in Section 08 71 00. Keys for thermostats, mechanical access panels, electrical panels and the like shall be turned over to the Owner’s Representative. Keys for cabinets, furniture, shutters etc. shall be turned over to the user's representative and an itemized receipt shall be obtained for these items or they shall be turned over to the *Owner’s Representative*.

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

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Demonstration of equipment and systems to Owner's personnel

.2 Training

1.2 RELATED SECTIONS

.1 For definition of terms, see Section 01 00 00 General Requirements, 1.3 Words, Terms and Communications.

.2 This section describes requirements applicable to all Sections within Divisions 01 to 33.

1.3 DESCRIPTION

.1 Provide overview of project including design philosophy and functionality of architectural, mechanical and electrical systems and equipment.

.2 Demonstrate operation and maintenance of equipment and systems including pertinent architectural systems such as building envelope to Owner's personnel.

.3 Owner will provide list of personnel to receive demonstrations and training, and will coordinate their attendance at agreed-upon times.

.4 Provide specific training for equipment and systems as required.

1.4 RESPONSIBILITIES

.1 The Project Manager, Construction Manager and Commissioning Authority shall work with the contractor to coordinate, and schedule subcontractors and vendors (mechanical, electrical, controls, architectural, fire protection, specialty, etc.), and ensure that the building overview, demonstrations and training are organized and completed effectively.

2.0 DEMONSTRATION OF EQUIPMENT & SYSTEMS TO OWNER'S PERSONNEL

2.1 GENERAL

.1 Provide knowledgeable, authorized representatives to demonstrate operation of equipment and systems.

.2 Provide designated Owner personnel with comprehensive orientation in the understanding of the systems and the operation and maintenance of each piece of equipment that makes up each system.

2.2 PREPARATION OF AGENDAS AND SCHEDULES

.1 Agendas and Schedules to include:

  .1 Equipment and systems to be included in presentations and outline of content for each system.

  .2 Name of companies and representatives presenting.

.3 Time and date allocated to each system and item of equipment.

.4 The actual dates for the demonstrations should be set well in advance on the overall project schedule. The meeting notices for the demonstrations need to be issued a minimum of three weeks prior to allow for scheduling of personnel.

2.3 ORGANIZATION

.1 Arrange for presentation leaders familiar with the design, operation, maintenance and troubleshooting of the equipment and systems. Where a single person is not familiar with all aspects of the equipment or system, arrange for specialists familiar with each aspect.

2.4 SUBMITTALS

.1 Provide a building overview and demonstration plan two months in advance, covering the following elements:

.1 Equipment and systems
.2 Intended audience
.3 Schedule including agenda and duration

.2 Submit meeting notices for demonstration of each system three weeks prior to designated dates.

.3 Owner to make list of deficiencies to submit to the Construction Manager and indicate if further demonstrations and/or training are required.

2.5 CONDITIONS FOR DEMONSTRATIONS

.1 The Owner prefers that the demonstrations are conducted after commissioning, testing, adjusting and balancing are complete and equipment and systems are fully operational. Demonstrations may occur prior to the above if required by the project schedule.

.2 Commissioning Authority to confirm status of commissioning, performance testing and readiness for handover prior to the demonstrations taking place.

2.6 SYSTEMS AND EQUIPMENT TO BE DEMONSTRATED

.1 All systems and equipment need to be demonstrated. Greater time needs to be allocated for complicated systems and equipment. General examples of systems and equipment to be demonstrated:

.1 Heating System
.2 Ventilation System
.3 Cooling System
.4 Control System
.5 Plumbing System
.6 Electrical System
.7 Control Systems
.8 Overhead Doors
.9 Loading Dock Equipment
.10 Filtering Equipment
.11 Security Systems
.12 Lighting Systems
.13 Environmental Chambers
.14 Fire Protection Related Systems

.15 Elevator Systems
.16 Unique systems such as Variable Refrigerant Flow systems, Thermenex heating and cooling system etc.

2.7 PRESENTATION OF DEMONSTRATIONS

.1 Building and Project Overview:

.1 Provide overall review of design philosophy and objectives.

.2 Depending on the size and complexity of the project, a separate session may be required for the project overview.

.2 Verify that suitable conditions for demonstrations are available.

.3 Verify that designated personnel are present.

.4 Provide digital copies of applicable architectural, mechanical, electrical and other drawings, manuals, and vendor equipment information. Digital drawings, manuals and vendor information to be displayed using projector, or large screen monitor. As reasonably feasible, provide one hard copy of pertinent full size drawings, manuals and vendor equipment for review.

.5 Conduct classroom overview of equipment and systems using digital and hard copies of drawings, manuals and videos.

.6 Explanation of Design Strategy

.1 Explain design philosophy of each system, including the following information:

.1 An overview of how system is intended to operate.
.2 Description of design parameters, constraints and operational requirements.
.3 Description of system operational strategies.
.4 Information to help in identifying and troubleshooting system problems.

.7 Following the classroom session, the demonstration should continue in the field.

.8 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location.

.9 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction. Follow the outline in the table of contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

.1 Review contents of manual in detail to explain all aspects of operation and maintenance.

.2 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

.10 During any demonstrations, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system shall be repaired or adjusted as necessary and the demonstration repeated at another scheduled time.

.11 The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the demonstration.

.12 The controls contractor shall attend sessions other than the controls training, as required, to discuss the interaction of the controls system as it relates to the equipment being discussed.

.13 The contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls not controlled by the central control system.

.14 For complicated equipment and systems and/or where the site is too noisy to properly answer questions, return to classroom to answer additional questions.

3.0 TRAINING

.1 Training is required for new, specialized or unique equipment and systems where demonstrations are not sufficient to enable the owner to properly operate and maintain the equipment and system.

.2 Costs for bringing the appropriate expert training personnel to UBC to conduct classroom and field training is to be covered by the contractor and/or project.

.3 Details for training including content and schedule are to be arranged with the appropriate UBC Maintenance management personnel.

.4 Training details shall include:

- .1 Use of the installation, operation and maintenance instruction material included in the O&M manuals.
- .2 A review of the O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
- .3 Discussion of relevant health and safety issues and concerns.
- .4 Discussion of warranties and guarantees.
- .5 Common troubleshooting problems and solutions.
- .6 Discussion of any peculiarities of equipment installation or operation.
- .7 Hands-on training shall include startup, operation in all modes possible, including manual, shut-down, alarms, power failure and any emergency procedures, and preventative maintenance for all pieces of equipment.
- .8 Classroom sessions shall include the use of large screen monitors, overhead projections, slides, video/audio-taped material.
- .9 Training may occur before performance testing is complete if required by the project schedule.

.10 UBC Building Operations may choose to videotape specific training sessions.

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

CONTENTS

1.0 GENERAL

1.1 DESCRIPTION

.1 Commissioning is a quality-oriented systematic process of ensuring that all systems perform interactively according to the design intent and the owner's operational needs.

.2 Commissioning during the design is intended to achieve the following specific objectives:

  .1 Verify the Owner's Project Requirements (OPR) and Basis of Design (BOD) are clearly documented and they meet the Owner's goals and objectives.

  .2 Verify commissioning intent for the construction phase is adequately reflected in the contract documents.

.3 Commissioning during the construction phase is intended to achieve the following specific objectives, according to the Contract Documents:

  .1 Provide resolution to issues and details not fully developed during design.

  .2 Verify and document that applicable equipment and systems are installed according to the contract documents and manufacturer's recommendations, and that they receive adequate start-up and functional testing by installing contractors.

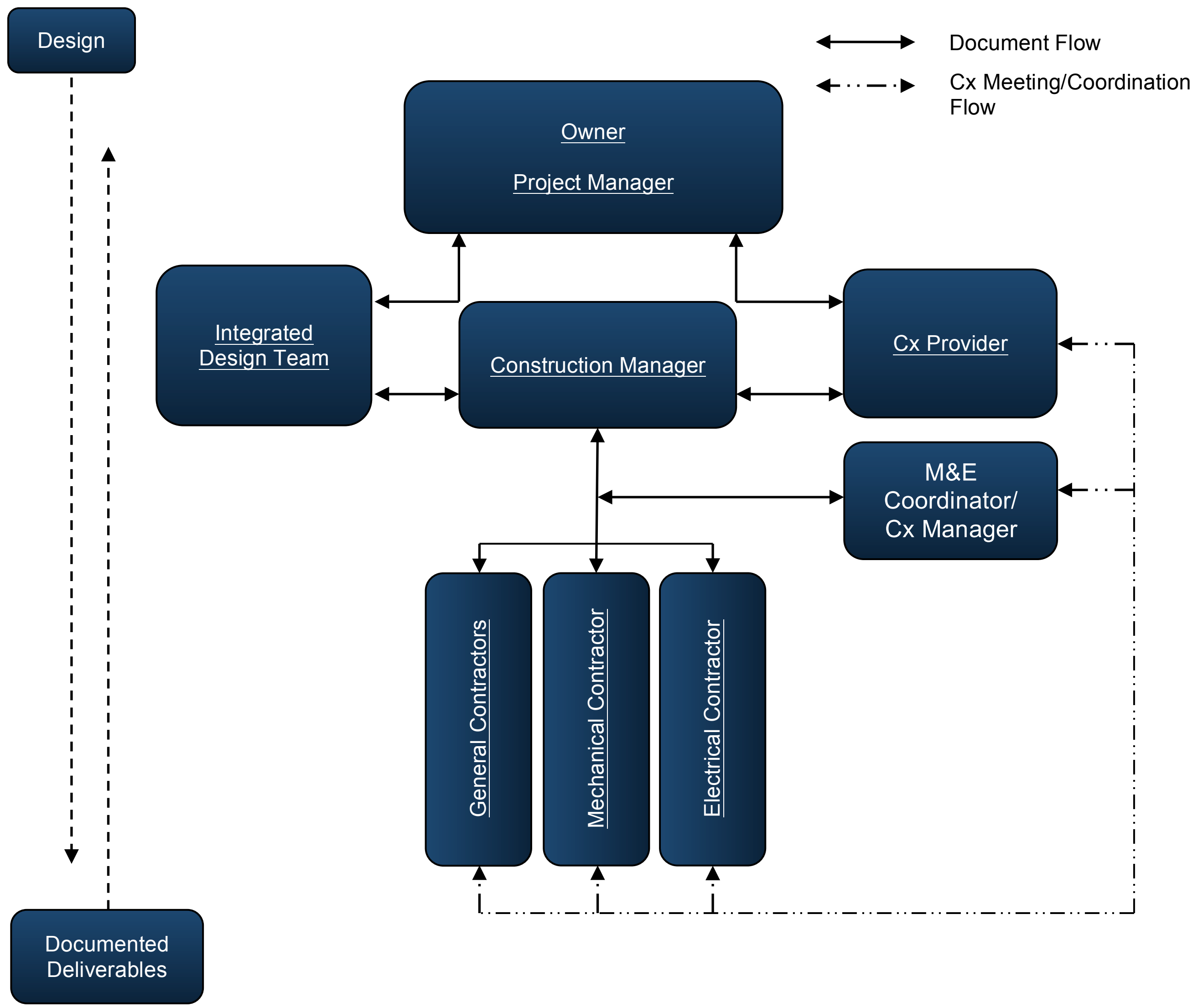
  .3 Verify and document performance of equipment and systems against design intent, detailing where performance is not met and facilitating the Commissioning Team to create resolutions.

  .4 Verify that Operations and Maintenance (O&M) handover documentation is complete.

  .5 Verify that owner's operating personnel have adequate time to be familiar with the project, received demonstrations and training, provide comment regarding the handover to the owner and any additional support that maybe required.

.4 Commissioning of all the Mechanical, Electrical, Plumbing, Architectural, Fire and Life Safety, systems and process activities are applicable, as defined in contract documents.

COMMISSIONING ORGANIZATIONAL CHART:



1.2 COMMISSIONING TEAM

.1 The commissioning team shall consist of representatives of each contractor, including project superintendent, installers, suppliers, and specialists deemed appropriate for performing tasks related to the commissioning process.

- Owner/Project Manager (PM)
- Commissioning Provider (CxP),
- Architect and design Engineers (A/E)
- UBC Transition Team
- Construction manager (CM)
- M&E Coordinator or Cx Manager – applicable to the project
- Electrical commissioning agent (CxAg)
- Mechanical commissioning agent (CxAg)
- Equipment vendors
- Any other installing contractors or supplier of equipment.

1.3 DEFINITIONS

Commissioning Provider (CxP) – The entity identified by the Owner who leads, plans, schedules and coordinates the commissioning team to implement the commissioning process. This is an independent contractor working under a separate contract directly with the Owner. This contractor provides the Owner an unbiased, objective view of the systems: installation, documentation, operation, performance and witnessing of tasks and tests.

Contractor's Commissioning Agent (CxAg) – Individuals, each having authority to act and report on behalf of the entity they represent, explicitly organized to implement the commissioning tasks required for within their respective contracts and aiding in the overall Cx process through coordinated actions, within the Cx Team.

Transition Team – A UBC operations team, where UBC representatives are assigned to the project. Their intention is to interface with UBC stakeholders, in order to facilitate information flow, building commissioning and building handover.

Monitoring Based Commissioning – Monitoring based commissioning (MBCx) combines ongoing building energy system monitoring with standard commissioning practices, this is achieved by incorporating permanent monitoring points, devices and meters to gather, store and retrieve, for the use by the Commissioning Team. The aim is to derive, monitor and adjust system parameters, with the availability of dynamic data, with dynamic operations, resulting in actions that promote reliable and efficient performance over the building lifecycle.

1.4 RELATED DOCUMENTS

.1 Work under this contract shall conform to requirements of Division 01, 20 through 28 specification sections and associated design drawings, which form the contract documents.

.2 This section includes general administrative and procedural requirements for the commissioning process, to supplement other sections in Division 01 and 20 through 28, , which specify testing of components, systems, and assemblies, controls and control sequences and demonstration of integrated systems.

.3 Related documents include:

Project Documents (reference and information only):

- Owner's Project Requirements
- Basis of Design

Guidelines and Industry Standards:

- ASHRAE Guideline 0 The Cx Process
  - ASHRAE Guideline 0.2 The Existing Building Cx Process
  - ASHRAE Guideline 1.1 HVAC&R Technical Requirements for the Cx Process
  - ASHRAE Guideline 1.5 The Cx Process for Smoke Control Systems
- ASHRAE Standard 202: Cx Process for Building and Systems
- CAN/CSA Z320-11: Building Commissioning Standard & Check Sheets
- IES DG-29-11: The Cx process applied to lighting and control systems
- CAN/ULC-S1001-11: Integrated Systems Testing of Fire Protection and Life Safety Systems
- NIBS Guideline 3: Exterior Enclosures
- Building Cx Association: New Construction Building Commissioning Best Practices, November 2015

UBC Guidelines

- 01 92 00 Monitoring Based Commissioning
- 01 33 00 Submittal Procedures
- 01 45 00 Quality Control
- 01 78 23 Operation and Maintenance Data
- 01 79 00 Demonstration and Training

Industry Rating System:

- Leadership in Energy and Environmental Design Version 4

1.5 ROLES AND RESPONSIBILITIES DURING CONSTRUCTION

.1 Commissioning observation and witnessing of contractor demonstrated pre-functional, functional, integrated testing is the responsibility of the CxP and Design Engineer.

.2 All commissioning team members' will work together to fulfill their contracted responsibilities and meet the objectives of the contract documents. The CxP shall coordinate the reports to the owner.

.3 The CM and CxAg(s) shall have responsibility for implementing the commissioning plan, with leadership, coordination, consultancy and review from the CxP.

.4 The CxP and CM with assistance from trade contractors and vendors are responsible for producing a final commissioning plan (see section 3.4), with all required commissioning tests and sequences. The CM shall obtain from the contractors and vendors all commissioning related documentation and submit it to the CxP for incorporation into the final version of the Commissioning plan (see section 1.9).

.5 The commissioning team shall attend commissioning meetings during construction and post handover, cooperate with the CxP and participate in commissioning coordination and scheduling.

.6 Final acceptance of any system is the responsibility of the Design Team's Engineer(s) of Record.

.7 A Quality Assurance/Quality Control (QA/QC) representative for each contractor is to be named to the CM, the responsibilities of this person includes:

- .1 Review equipment upon delivery onsite.
- .2 Quality of installation work and report on progress.
- .3 Review quality of paperwork, ensure timely delivery and collate to deliver to the CM.
- .4 Verify that commissioning tasks are complete and systems are functional, prior to turn over to CM.

.8 Timely and accurate documentation is essential for the commissioning process to be effective. Documentation required as part of the commissioning plan shall be exchanged between the CxP and the CM but not to be limited to:

- .1 Pre-start, and start-up procedures (CM).
- .2 Progress and status reports, including issues noted (CM & CxP).
- .3 Minutes from commissioning meetings (CxP).
- .4 Commissioning reports (CM & CxP).
- .5 As-built records (CM).
- .6 Demonstration agenda and materials (CM).
- .7 Operation and Maintenance (O&M) manuals (CM).
- .8 Deferred and Seasonal Testing Plan (CM & CxP).

1.6 SCOPE OF WORK

.1 This specification section is to be used in conjunction with all other contract documents. The commissioning process does not relieve contractors from the obligations to complete all portions of work in satisfactory and fully operational manner.

.2 Furnish labor and material to accomplish and complete commissioning as specified herein. Complete interim commissioning of systems during initial season operation and follow-up with seasonal testing to complete commissioning and ensure correct operation.

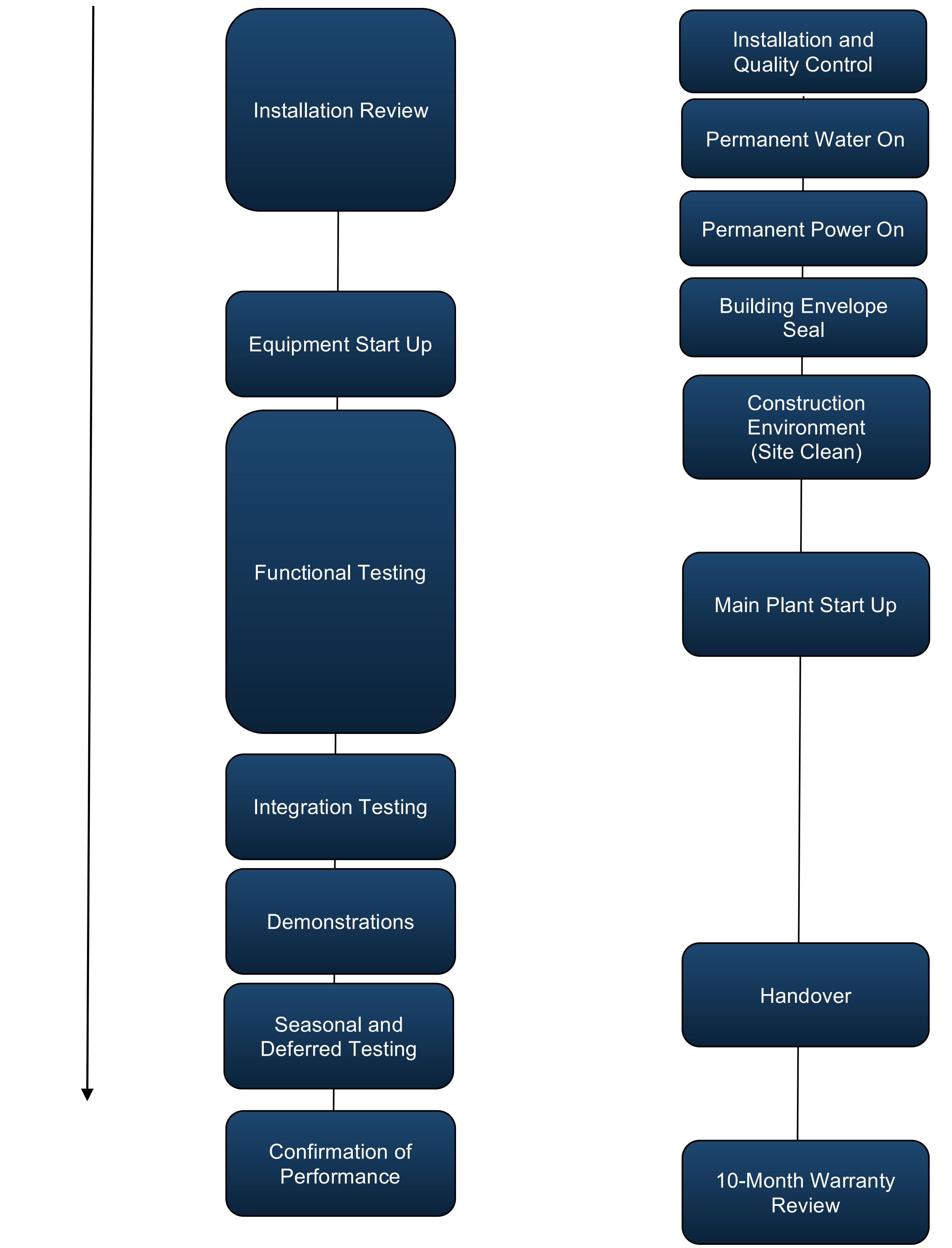
.3 System installation, start-up testing, calibration, functional tests, integrated tests, performance testing, preparation of O&M manuals, demonstration and training, deferred and seasonal testing is the responsibility of the CM, Division 20 through 28 contractors and equipment suppliers/vendors.

.4 The commissioning plan shall include the following tasks and actions:

- .1 Documentation of the construction process.
- .2 Ensuring the basis of design as well as the design intent is carried out.
- .3 Completion and execution of a Commissioning Plan (see section 3.4).
- .4 Reporting and communicating the project schedule progress.
- .5 Installation review with QA/QC verification
  - .1 Orientation and integrity checks.
  - .2 Point to point testing.
  - .3 Pressure and integrity testing.
  - .4 Water fill and treatments.
  - .5 Review of manufacturer's recommendations.
- .6 Equipment start-up procedures:
  - .1 Using the Cx schedule, coordinate equipment start-up.
  - .2 Ensure multiple trades are aware of tasks being performed and their attendance requirement.
- .7 Functional tests:
  - .1 Coordinate trades, tasks and systems, so that dedicated time can be spent with minimal interference of conflicting tasks and trades.
  - .2 Ensure all equipment is effectively communicating with systems.
- .8 Main Plant start-up:
  - .1 Coordinate main plant start-up after manufacturer's pre-requisites and associated equipment functional testing, QA/QC verified.
- .9 Integrated system tests:
  - .1 Prepare and execute integration testing as per the Commissioning Plan.
- .10 Provide on-site demonstrations for the systems specified, with reference to the Demonstrations and Training section.
- .11 Seasonal and Deferred Testing.
- .12 Confirmation of Performance.

1.7 COMMISSIONING TIMELINE

Project Progression **Cx STAGES** **CONSTRUCTION MILESTONES**



1.8 QUALITY ASSURANCE

.1 The Contractor shall provide a QA/QC process for approval by the Consultant and review by UBC. The Contractor is responsible for QA/QC review of installation and commissioning tasks, for all installed and operating equipment or system. Any items that are discovered, which may hinder the commissioning plan, shall be brought into the Issues Log and open for a commissioning team discussion for a resolution.

.2 The Contractor shall have responsibility for QA/QC for the duration of the project

1.9 COMMISSIONING DOCUMENTATION

.1 The CM and CxP shall oversee and maintain the development of commissioning documentation, which is required to be converted into a PDF format and delivered to an electronic filing system. The documentation shall be organized by system and sub-system, which shall include, but is not limited to, the following:

- .1 Reviewed contractor submittals.
- .2 Installation review record.
- .3 Equipment start-up procedures.
- .4 Functional tests.
- .5 Integrated system tests.
- .6 Demonstrations and Training record.
- .7 Seasonal and deferred testing.
- .8 Confirmation of performance.

.2 Any installation, start-up or commissioning reports for equipment or systems, shall be issued to the CM within 14 days of works being carried out by any contractor.

.3 The Commissioning Report, that is compiled by the CxP, shall be issued to UBC as an independent document to the O&M manuals, in 2 Revisions:

- .1 Commissioning Handover Report; documenting Cx tasks, actions and results, up to and including Handover. This shall include the Deferred and Seasonal Testing Plan.
- .2 Final Commissioning Report; a complete report, containing all commissioning related requirements, 1 month prior to warranty expiration.

2.0 PRODUCTS

2.1 TEST EQUIPMENT

.1 All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in the specifications. If not otherwise noted, equipment used shall have a valid calibration from a Calibration Laboratory Assessment Service (CLAS) certified calibration laboratory, for the duration of the project. All equipment shall be calibrated in according to the manufactures recommended intervals and when dropped or damaged. Calibration tags shall be affixed to equipment where appropriate. Calibration certificates must be presented to the CxP prior to the commencement of the testing.

.2 Test Equipment Calibration – Contractors will comply with test manufacturer's calibration procedures and intervals, each piece of equipment shall have a minimum of 3 months remaining on the calibration certificate and remain in calibration for the duration of the commissioning period.

.3 Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxP upon request.

.4 Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning plan as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

.5 Special equipment, tools and instruments only available from a vendor, or specific piece of equipment required for pre-functional, functional, integrated testing shall be provided by the contractor and/or vendor and included in the contractor's base bid price.

2.2 ACCESS AND INFORMATION

.1 System logins and e-mail alerts, with confirmation from the CM and CxP, and shall be provided to:

.1 Project Manager

.2 Commissioning Provider

.3 Transition Team

.4 A/E representative

.2 Access codes that are required to access equipment parameters, to allow for adjustments and operational changes, shall be recorded and supplied to the owner as part of the Operations and Maintenance documentation.

3.0 EXECUTION

.1 The CM has overall responsibility to ensure that QA/QC is upheld by all contractors and that systems are commissioned in a coordinated and complete manner.

.2 Commissioning process / work shall be a team effort to ensure that all equipment and system have been completely and properly installed and function together correctly to meet the design intent. System performance parameters shall be documented for fine tuning of control sequences and operational procedures, coordinate system documentation, equipment start-up, control system calibration, and performance testing.

.3 The CxP shall lead the Cx Team to facilitate solutions, whilst implementing the Cx Plan. Where issues are realized, the Cx Team shall document, track, discuss and implement resolutions. The Cx Team is to present issues with suggested resolutions, the responsibility to accept, direct or create a resolution for implementation is the relevant member of the Design Team as required.

.4 Detailed testing shall be performed on all installed equipment and system to ensure that operation and performance conform to contract documents. All tests shall be performed by the responsible trade contractor, accepted for quality by the CM, evaluated and witnessed by CxP and Design Engineer. After each grade of checklist and test are complete the system will be upgraded to the next test. Once a system(s) has been completed and passed all functional and integration tests it will be ready for acceptance by the CM, with recommendation for turn-over from the CxP and Engineer of record to the Owner.

3.1 MEETINGS

.1 Initial Meeting. The CxP, through the CM, will schedule, plan and conduct an initial commissioning meeting. The contractor and its responsible parties are required to attend. The meeting will review commissioning intent, with relation to the project and align expectations on how the process will be delivered. The meeting shall be held prior to any contractor submittals being gathered and issued to the design team for review.

.2 Commissioning Meetings. Other meetings will be planned and conducted by the CxP as construction progresses. These meetings will cover coordination, deficiency resolution, and planning issues. These meetings will be held at least bi-monthly, becoming more frequent as the project demands, as frequently as once per week.

.3 System intent meetings. Prior to any substantial sequence programming, minuted meetings shall take place between the engineer of record, CxP, CxAg and the hands on programmer, to review the following items:

- .1 Functional intent
- .2 Sequence of operation
- .3 BACNet points that are available
- .4 System graphical interface
- .5 Alerts, alarms and reporting

Three specific meetings will be held for:

- .1 Mechanical sequence of operations
- .2 Lighting sequence of operations
- .3 Fire alarm cause and effect
- .4 Security and access

3.2 DOCUMENTATION, FAILURE AND APPROVAL OF TESTS

.1 Equipment shall be grouped into sub-systems and systems, to form start up and commissioning packs, for the documentation of testing. The groupings shall be at the discretion of the Cx Team. Each pack shall become a System Report and have a comment area for the CxP, a comment and sign off for the CM and A/E.

.2 The CxP notes each satisfactorily demonstrated function during testing. Final approval of the Performance Tests, by the Owner's Representative, is made after review by the CxP and A/E, with acceptance and sign off from the CM.

.3 As inspections and testing progress, with issues being identified, the CxP shall engage with the commissioning team and contractor.

- .1 The CxP will document all issues and the contractor's response and intentions, with an entry into the Issues Log. Corrections of minor issues identified may be made during the tests at the discretion of the CxP
- .2 Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the CM.
- .3 The contractor corrects the issue, making an entry of resolution into the Issues Log, certifying that the equipment is ready to be retested and notifies the Cx Team. The contractor shall reschedule testing.

.4 The contractor shall submit in writing to the CM at least as often as commissioning meetings are being scheduled, the status of each outstanding issue identified during commissioning. Discussion shall cover explanations of any disagreement and proposals for their resolutions.

.5 The contractor shall not consider retesting a justified reason for a claim of delay or for a time extension

.6 Failure Due to Manufacturer Defect. If 10% (or three, whichever is greater) of identical pieces of equipment fail to perform to the contract documents (mechanically or substantively) due to a manufacturing defect, not allowing it to meet its submitted performance specification, all identical units may be considered unacceptable by the A/E. In such case, the contractor shall provide the Owner's Representative with the following:

- .1 Within one week of notification from the Owner's Representative/CM, the contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CM within two weeks of the original notice.
- .2 Within two weeks of the original notification, the contractor or manufacturer shall provide a signed and dated, written explanation of the problem, detailed cause of failure(s), etc., and all proposed solutions. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
- .3 The A/E will determine whether a replacement of all identical units or a repair is acceptable.
- .4 Two examples, where applicable, of the proposed solution shall be installed by the contractor and the A/E shall be allowed to test the installations for up to one week, upon which the A/E will decide whether to accept the solution.

Upon acceptance, the contractor and/or manufacturer shall replace or repair all identical items, at their expense. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

3.3 SUBMITTALS

.1 The contractors are to provide Cx specific information when collecting and issuing a submittal for review. At minimum, submittal package will include:

- .1 Manufacturer and model number
- .2 Manufacturer installation and operation manual
- .3 Sequences of operation
- .4 Control drawings, points list and communication protocol
- .5 Performance data
- .6 Manufacturer testing forms, including factory testing where applicable

.2 The CxAg and CxP will review submittals related to the commissioned equipment for the consideration of items as follows:

- .1 Special requirements for the installation and operation and risk to warranty of the equipment
- .2 Communication protocol, note of points available and points that are of importance for system operation and performance
- .3 Manufacturers start-up requirements and notice periods for site attendance requests
- .4 Bespoke testing requirements or procedures
- .5 Any performance characteristics or requirements that may affect operations of equipment when integrated into a system
- .6 Equipment specific start up and testing procedures and forms

3.4 COMMISSIONING PLAN

.1 The commissioning plan is intended to be the documented intent of how the commissioning process is to be coordinated, scheduled, documented and implemented.

.2 The CxP will develop a project specific commissioning plan framework and lead the effort to completion. All contractors are to allocate time for their commissioning representative to supply information in a collaborative effort, with agreement to a logical and successful plan execution. The plan shall include, but is not, limited to, the following items.

- .1 Detail of project team, organizational chart, with agreed coordination and communication protocol
- .2 Team allocation of responsibilities
- .3 Commissioning stages and milestones
- .4 Project specific listing of systems that are to be commissioned
- .5 Issues Log
- .6 Commissioning Schedule
- .7 Expected Cx documentation list, formatted to create, indexed system packs
- .8 Installation Inspection forms
- .9 Start up plans
- .10 Functional testing procedures and checklists

.11 Integration testing procedure

.12 Performance testing procedure

.13 Training, orientation and demonstration schedule

.14 Phased handover procedures

.15 Deferred and seasonal testing plan

3.5 INSTALLATION CHECK AND STARTUP

.1 The QA/QC representative of each contractor shall inspect all installed equipment, ensure that all equipment pre-requisites are implemented and approve the equipment for start-up.

.2 The requirement of start up testing is to ensure that equipment is orientated, operational and has the ability to communicate, prior to their integration into a system or sub-system.

.3 The contractor shall submit the full startup plan to the CxP and CM for review, 4 weeks prior to any start ups, on a system basis.

.4 All contractors and vendors shall test their installed equipment to confirm that they individually operate, coordination requirements shall be stated in the Start Up Plan and confirmation of attendance of the relative commissioning team members shall be made during the commissioning meetings.

.5 The primary role of the CxAg in this process is to be present during testing, ensure that there is written documentation that each of the manufacturer-recommended procedures has been completed and that the start up plan is adhered to.The CxP will observe at minimum all primary plant and 20% of all other start up

.6 The CM and A/E as necessary, shall observe the procedures for each piece of primary equipment, unless there are multiple units, in which case a sampling strategy may be used.

.7 The CxAg shall execute startup and provide the CxP and A/E, through the CM, with a signed and dated copy of the completed installation and start up documentation.

.8 The CxAg shall ensure that the contractors clearly list any outstanding items of the initial startup and construction checklist procedures that were not completed successfully, on an attached sheet. The CxAg shall make an entry into the Issues Log for reference to the Cx Team.

3.6 FUNCTIONAL TESTING

.1 The requirement of functional testing is to ensure that as a system is brought into operation, all of the components, equipment and sub-systems are operating as intended.

.2 Functional testing of a system is carried out over a period of time and may include works from multiple contractors with allocation of the system to them, for their purpose of testing.

.3 Testing shall document and prove that a system has the potential to perform to the intent of the contractual documents. Functional testing of systems include the following tasks and operational milestones:

  .1 Testing, Adjusting and Balancing.

  .2 Prove the ability to communicate and adjust to control demands.

  .3 To operate with expected and reliable function.

  .4 To derive operational reference points for operation, which can be tuned to maximize performance.

.4 The CM and A/E as necessary, shall be notified and invited to observe the procedures

.5 The CxAg coordinate, represent and be involved in all relevant functional testing, that is being performed with equipment and systems that their contractor have provided.

.6 The CxP will observe at minimum 20% of all functional testing, be present onsite to observe items of complication, indicated in the start up plan.

.7 The CxAg, contractors and vendors shall execute functional testing and provide the CxP and A/E, via the CM, with a signed and dated copy of the completed documentation.

.8 The CxAg shall ensure that the contractors clearly list any outstanding items that were not completed successfully, on an attached sheet, with possible resolutions. The CxAg shall make an entry into the Issues Log for review by the Cx Team.

.9 The CxP will work with the relevant members of the Cx Team to facilitate solutions for issues that hinder functional testing and the Cx Process.

3.7 INTEGRATION TESTING

.1 Integration testing brings the systems from a state of individual substantial completion to full dynamic operation. During the testing process, unexpected, conflicting and incorrect system operations are identified, recorded and corrected. The completion of testing shall result in expected and reliable functioning of all complementary systems, in all modes and demand loading.

.2 The CxP shall define the integration tests and the Cx Team shall implement all testing.

.3 Before test procedures are finalized, the contractor shall provide to the A/E and the CxP all requested documentation and a current list of changes affecting equipment or systems, including an updated points list, program code, control sequences, and testing parameters.

.4 Using the testing parameters and requirements in the technical specifications, the CxP shall update/develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each contractor or vendor, as appropriate, shall provide assistance to the CxP in developing the final test procedures. Prior to finalization, the A/E shall review and concur with the test procedure.

.5 The control systems shall be sufficiently tested and approved by the CxP before it is used, to test, trend and verify integration functionality of other components or systems.

.6 Test Methods:

.1 Simulating conditions shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.

.2 Overriding sensor values to simulate a condition, such as overriding the outside air temperature reading in a control system to be something other than it really is, is acceptable.

.3 Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overridden values.

.4 Rather than overriding sensor values, and when simulating conditions is difficult, altering set points to test a sequence is acceptable.

.5 Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the test parameters, that the indirect readings through the control system represent actual conditions and responses.

.7 Integration testing shall be performed under conditions that simulate actual conditions as closely as is practically possible. The contractor(s) assisting the CxP in executing the test shall provide all necessary materials, system modifications, etc., to produce the necessary flows, pressures, temperatures, etc., necessary to execute the test according to the specified conditions. At completion of the test, the contractor(s) shall return all affected equipment and systems to their approved operating settings.

3.8 PHASED HAND OVER PROCEDURES

.1 Phased handover, if required, shall be discussed, planned and accepted by all parties.

.2 A plan shall be produced by the CxP, with collaboration from all parties, that references the following items:

.1 Systems that are effected.

.2 Risks associated.

.3 A schedule, indicating all phases of handover.

.4 The occupant requirements and expectations of each phased handover.

.5 The level of operation and performance expected from the systems during the period between each phased handover.

.6 The requirements and supervision of the systems for safe, reliable and effective operation of the systems.

.3 The Cx Team shall all agree with the plan, prior to final acceptance and notice to proceed from UBC.

3.9 PERFORMANCE TESTING

.1 The CxP shall define performance testing, with the Cx Team overseeing, witnessing, and documenting the performance of all equipment and systems. The CxP in association with the contractor and facility staff shall execute the tests. Performance testing shall be conducted after the integration testing has been satisfactorily completed and in agreement with UBC.

.2 Project specific performance testing shall be executed to verify system operation with efficient parameters under a variable and understood load. The control systems shall be tested and adjusted to ensure effective and reliable performance.

.3 Performance testing and verification may be achieved by manual testing or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The Cx Team may substitute specified methods or require an additional method, with the approval of the A/E and Owner's Representative/CM, to prove the successful implementation of the KPIs listed in the following table. The CxP will advocate for the method that is most appropriate for facility, systems, occupants and UBC.

.4 Key performance indicators for this project have been identified as:

KPI	Description of Importance	Method of Proof

3.10 DEMONSTRATIONS TO OWNER PERSONNEL

For detailed requirements, refer to Section 01 79 00 Demonstration and Training.

.1 The CM and contractors shall be responsible providing qualified personnel, coordination, scheduling, documentation and ensuring that "optimum" demonstrations to the Owners facility staff is completed.

.2 The CM shall organize the demonstration to the Owner's personnel for commissioned equipment and systems. The CxP will be in attendance to aid in facilitation and consider further requirements of UBC.

.3 Provide, to the Owner and CxP through the CM, a demonstration plan 60 days before the planned demonstrations covering the following elements:

- .1 Equipment.
- .2 Intended audience.
- .3 Location of demonstrations.
- .4 Objectives.
- .5 Subject covered (special operation, log in/out, alarms, resets, etc).
- .6 Duration of demonstrations on each subject.
- .7 Instructor for each subject.
- .8 Methods of demonstration (classroom lecture, manufacturer's quality video, site walk through, actual operational demonstrations, written handouts, etc.).

3.11 DEFERRED AND SEASONAL COMMISSIONING

.1 During the warranty period, deferred and seasonal testing shall be completed as part of this contract. The CxP shall coordinate this activity through the CM, with consultation with UBC,. Tests will be executed, with presence of the CxAg and CxP, deficiencies should be corrected by the appropriate contractor with the CxP witnessing and documenting. Any final adjustments to the O&M manuals and as-builts due to the testing shall be made by the contractor.

.2 The CM and CxP shall publish a Deferred and Seasonal Testing Plan, with information from the CxAgs. The plan shall be reviewed and accepted by the Design Team and UBC, prior to handover. The plan is executed by the CM, any changes must be notified to the project team prior to acceptance.

- .1 Deferred Testing pertains to any testing that has to be performed post-handover, due to deficiency, agreed time restrictions or previously failed testing. System set up, storage and/or operation shall be agreed with the relative Engineer of Record and FMO staff.
- .2 Seasonal Commissioning pertains to testing under full load conditions and/or during peak cooling/heating season as well as part load conditions in the spring and fall. Simulations of peak load conditions shall be implemented wherever possible to allow for complete commissioning of the work.
- .3 The Plan shall indicate the following information:
  - .1 What system is to be tested?
  - .2 What is the reason for the testing and why it was not completed during the construction and commissioning period?
  - .3 What items are required to be resolved prior to testing?
  - .4 What members of the project team are required to participate in the testing?
  - .5 What prerequisites are required for testing? (i.e. fuel, weather, timing, load or occupants)
  - .6 What date and time is planned for performing the testing?
- .4 All deferred and seasonal commissioning will be performed by the contractors' staff with the guidance and supervision of the CxAg, CM and CxP. The contractors will be responsible for testing and be responsible for any deficiencies that discovered from seasonal testing.

3.12 THE COMMISSIONING REPORT

.1 The Commissioning Report is a stand alone documents that will be issued in 2 submissions:

- .1 Handover Submission:
  Will be complete with documentation of completed information and testing results at time of handover to UBC.
- .2 Final Submission:
  Will be a complete submission, issued 1 month prior to end of 1 year warranty period, complete with all information and testing results for the facility.

.2 The CxP is responsible to compile, organize and index the following Cx information:

- .1 Commissioning Plan.

.2 Summary Commissioning Report including an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope, a general description of testing and verification methods, design narratives and criteria including sequences.

.3 System reports shall contain the startup plan and report, approvals, corrections, functional testing checklists, completed integration and performance tests, trending and analysis, training plan and recommended re-commissioning schedule.

.4 For each piece of commissioned equipment, the report should contain the disposition of the CxP regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:

  .1 Equipment meeting the equipment specifications.

  .2 Equipment installation.

  .3 Performance and efficiency.

  .4 Equipment documentation and design intent.

  .5 Operator demonstration and training.

.5 Recommendations for improvement to equipment or operations, future actions, implemented MBCx and possible areas for re-commissioning.

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

1.0 GENERAL

1.1 Related UBC Guidelines

.1 Section 01 74 19 Construction Waste Management and Disposal

1.2 Description

.1 Demolition of Buildings and Site Works.

1.3 Definitions

.1 “Remove” - Remove and legally dispose of items and materials off-site except those indicated to be reinstalled, salvaged, or to remain the owner’s property.

.2 “Remove and Salvage” - Items and materials indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner.

.3 “Remove and Re-Install” - Remove items and materials indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Re-install items in locations indicated.

.4 “Existing to Remain” - Protect construction indicated to remain against damage and soiling during demolition. When authorized in writing by the Owner at the contractor’s request, items and materials may be removed to a suitable and bonded storage location as determined by the Owner and at the contractor’s cost and then cleaned and reinstalled in their original locations.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 Submissions

.1 Fire Safety Plan conforming to the BC Fire Code Section 2.14 as required by Part 8 of the BC Building Code, Clause 8.2.2.2 demolition sites, for review and approval by the Vancouver Fire & Rescue Services Department prior to commencement of building demolition.

.2 Submit to the Project Manager

- .1 Proposed dust-control measures.
- .2 Noise-Control Measures.
- .3 Demolition Activities indicating the following:
  - .1 Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
  - .2 Dates for shutoff, capping, and continuation of utility services.
  - .3 Phasing and dates for sectional shutoff of sprinkler system serving existing buildings which are to remain.
  - .4 Inventory of items to be removed and salvaged.
  - .5 Inventory of items to be removed by owner.
  - .6 Photos or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by demolition operations.

.7 Record drawings at Project closeout, which also identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

.3 Submit to UBC Risk Management Services, records of:

.1 Storage tanks decommissioning and removal; and

.2 Manifest records indicating the transportation (green copy) and acceptance (brown copy) of hazardous waste in an authorized facility. Demolition hazardous waste may include asbestos, lead paint, equipment containing PCB or ozone depleting substances (refrigerants).

Records may be submitted via mail to:
Risk Management Services
Attention: Manifest
50-2075 Wesbrook Mall
Vancouver BC V6T 1Z1
Or via e-mail to ubc.manifest@ubc.ca

.4 Notify your UBC Project Manager, the site superintendent, Vancouver Fire & Rescue Services Department and UBC Risk Management Services (RMS) at 604-822-2029 immediately of any spill or release of hazardous material or waste to the environment.

2.2 Quality Control

.1 The contractor to engage or have on staff a professional engineer registered in BC to review and give written instructions on the layout and proposed methods of temporary supports, demolition and remedial work at all structural components so as to maintain structural integrity. The engineer shall submit reports and Letters of Assurances in the form established by Municipal Regulation.

.2 Prior to the start on site the Project Manager is responsible for contacting the University Architect, the Superintendent Architectural Trades, the Superintendent Municipal Services and the Associate Director Engineering Services, regarding: work that is about to start, regarding any demolition materials that need to be saved (especially locks for security), plus any details regarding the necessary removal of obstructing street furniture, signs in the landscape, lamp post sign blades, bollards etc, including access to the site and site-related signage etc.

Contact 604-877-3442 for the University Architect.
Contact 604-822-5644 for the Superintendent Architectural Trades.
Contact *604-827-2105* for the Superintendent Municipal Services.
Contact 604-822-0852 for the Associate Director Engineering Services.
Contact RMS Environmental Advisor at 604-822-9840 for the proper hazardous waste manifest generator number (BCG number).

2.3 General

.1 Before removal from site, the contractor shall ascertain from the Project Manager what is to be salvaged. The owner reserves the right to require the contractor to salvage any removed materials, fixtures, fittings or components. Items selected by the Project Manager shall be transported and handed over to the Project Manager as determined during the course of construction, or at the end of the project.

.2 Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the owner's property, demolished materials shall become the contractor's property and shall be removed from the site with further disposition at the Contractor's option.

Historical items, relics, and similar objects include, but are not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the owner or authorities having jurisdiction, which may be encountered during the work of this section, remain the owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Project Manager or as directed.

.3 Storage or sale of removed items or materials on or adjacent to the site shall not be permitted.

.4 Materials
  .1 Products - (UBC Mandatory, approved, or not approved for UBC projects - typ.).

2.4 Use of Explosives

.1 Use of explosives shall not be permitted.

2.5 Hazardous Materials

.1 Stop work around an area where existing previously unidentified hazardous material is discovered (refer to Section 01 35 43.13), including materials suspected of containing asbestos, and immediately contact the Project Manager for direction before continuing with the work affected.

2.6 Construction Site Waste Management, Storage and Disposal

.1 For general waste management and recycling requirements, refer to Division 01 Section 01 74 19 Construction Waste Management and Disposal.

.2 For construction waste environmental protection practices, the storage and disposal of construction site wastes will be as outlined in the City of Vancouver Bulletin 2002-001-EV or the latest revision thereof.

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

1.0 GENERAL

1.1 Concrete Construction – Structural Requirements

.1 Design building structures and their structural components for a 100 year service life.

.2 Structural design shall conform to Part 4 of the BC Building Code.

.3 Ensure that drawings include a summary of the structural systems and provide supplementary information as required.

.4 Ensure that sustainable design principles have been considered for the project. Ensure that LEED requirements selected by UBC have been satisfied. (Phone UBC Sustainability Office – Phone: 604-827-5641).

.5 Increase live loads for specific UBC occupancies.

.6 UBC has a unique snow loading factor that differs from Vancouver's under 4.1.6.3 of the BC Building Code.
http://www.technicalguidelines.ubc.ca/technical/structural_design_snow_loads.html

.7 Design light roofs for a minimum net factored uplift of 1.0 kPa.

.8 Ensure that the design and field review of non-structural components is covered in the contract documents (drawings and/or specifications).

.9 Ensure that the independent structural concept review has been completed. Concept reviewer to submit a sealed letter to UBC confirming completion of the review.

1.2 Materials

.1 Treat exposed concrete elements with beveled edges or tooling, as appropriate.

.2 Slabs-on-grade are to be 150 mm minimum thickness, reinforced and provided with well spaced control joints in an approximately square pattern, spacing less than 4000 mm on centre.

.3 Reinforcing steel, which is part of the seismic load-resisting system, must be weldable conforming to CAN/CSA G30.18W.

.4 Do not use calcium chloride (in any form) in concrete mixes.

.5 Post-tensioned floor systems are strongly discouraged by UBC. Obtain any pre-approval and acceptance from UBC Technical Services, (Phone: 604-822-0852), before considering post-tensioning. (It appears that unofficial drilling into slabs continues even after all warnings and signage has been installed to the contrary).

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

1.0 GENERAL

1.1 Related UBC Guidelines

.1 Section 03 00 00 Concrete
.2 Section 07 00 10 Building Envelope – General Requirements
.3 Section 07 40 00 Roofing and Siding Panels
.4 Section 07 62 00 Sheet Metal Flashing and Trim

1.2 Co-ordination Requirements

.1 Building Envelope Consultant.

1.3 Performance Standards

.1 Reinforcing and other steel requiring corrosion protection shall be embedded so that the minimum depth of concrete cover is in all cases greater than 40 mm.

.2 Stainless steel is to be used where reinforcement or other embedded metal has less cover than 40 mm.

.3 The concrete mix and placement and curing procedures are to be designed to provide the required quality of surface appearance and texture.

.4 Concrete structure that penetrates through the building enclosure constitutes a large thermal bridge and requires an energy audit.

1.4 Quality Control and Assurance

.1 Submittals
  .1 Construct mock-ups of all assemblies to check contractor's procedures.
  .2 Contractor to submit mix designs and placement procedures for architectural panels.

2.0 MATERIALS

2.1 Performance Requirements

.1 Maintenance
  .1 No maintenance for 100 years, except for cleaning.

2.2 Prescriptive Requirements

.1 Materials
  .1 Components
    .1 Concrete components to be certified compliant to CSA A23.1 for alkali aggregate reactivity.

  .2 Finishes
    .1 Surfaces of exterior concrete to be treated with opaque paint coatings or a clear silane/siloxane type sealer after final cleaning.

    .2 Surfaces of exterior concrete near grade to be treated with a clear anti-graffiti type coating where required by UBC. Anti-graffiti coating systems with a wax top coat are preferred. Contact Technical Services, UBC Building Operations – Phone: 604-822-9510.

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

1.0 GENERAL

1.1 Related UBC Guidelines

.1 Division 33 Utilities
.2 Division 01:
   Section 01 77 00 Closeout Procedures
   Section 01 78 39 Project Record Documents
   Section 01 78 23 Operation and Maintenance Data
   Section 01 78 36 Warranties
   Section 01 78 45 Maintenance Materials
   Section 01 91 00 Commissioning
   Section 01 79 00 Demonstration and Training
   Section 01 35 05 UBC Policies, Work Procedures, and Forms
.3 Division 27, Section 27 05 05 Communication Rooms Design Guidelines – 1.3, 1.4, 2.5, 2.12

1.2 Coordination Requirements

.1 Coordinate with UBC Building Operations - Technical Services.
.2 Coordinate with other design disciplines.
.3 UBC Information Technology (IT)
.4 UBC Building Operations Electrical Technical Support

1.3 Description

.1 These Design Guidelines apply to all Division 20 sections and all mechanical sections of Division 33.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General

.1 The Mechanical Consultant shall submit to UBC, Building Operations a design philosophy for the proposed building mechanical, plumbing and fire protection systems. Major components of the philosophy must be accepted in principle by Building Operations before the project can proceed to construction. Consultants are expected to produce designs that meet User needs and allow Building Operations to continue to meet those needs in the future in a safe efficient manner.

.2 UBC buildings are generally not air conditioned. Where conditions require air-conditioning, submissions for variance from this guideline are to be made as part of the initial submission of project design philosophy.

.3 Equipment such as boilers, chillers, variable speed drives, air handling units with integral control panels, unitary HVAC equipment with integral controllers shall be capable of interfacing with UBC's Building Management System via BACnet protocol. All such equipment shall have IP addresses factory set based on an existing UBC data base of BACnet objects. On request, UBC shall provide range of addresses. Where assignment of IP address is not possible at Shop Drawing Submittal stage, vendors shall provide to UBC all the necessary tools (Hardware, Firmware, and Software) as may be necessary to reassign IP Addresses.

.4 Design spaces housing mechanical/electrical equipment with sufficient room for safe servicing, repair and replacement of equipment.

.5 All mechanical and plumbing designs shall be approved by UBC Building Operations for effective use of energy and other resources. Document conformance with the Guidelines.

.6 Drawings shall show all mechanical and plumbing equipment in elevation or alternately shall specify mounting heights for the equipment.

.7 Submit to Building Operations a set of Issued for Construction drawings showing access paths to all equipment, paths for removal and replacement of proposed equipment and means of lifting equipment where its weight or its largest component exceeds 500 lbs.

.8 As Built/Record Drawings shall reflect all changes to specified means and access routes.

.9 Any variations from the prescribed Technical Guidelines must be approved in writing by UBC Building Operations, Technical Services.

.10 Ladders: Where ladders are provided to access equipment, roofs or other locations, the latest regulations or at a minimum, the following shall apply:

.1 A cage shall be provided for all ladders that exceed 16 feet in height or where there is a danger of a worker falling from the ladder to the ground level, roof or floor including an elevated access from a platform having less than 1.2 meters (48 inches) clearance between the ladder and any adjacent guardrail. The cage shall commence not more than 2.2 meters (7 ft.) above grade and continuing at least 90 centimetres (36 inches) above the top landing with openings to permit access by a worker to rest platforms or to the top landing.

.11 *Decommissioned equipment shall be demolished and disposed of in accordance with applicable codes and standards. No equipment shall be abandoned.*

.1 Piping and ductwork shall not be abandoned within mechanical rooms. Refer to Section 22 and Section 23 for more details.

2.2 Mechanical Room Detail

.1 Locate Mechanical Rooms in areas accessible from outdoors. Confirm that sufficient space is provided to remove largest piece of equipment from the Mechanical Room.

.2 Mechanical Rooms to have no public access to room.

.3 Building Operations is considered as the User of all service spaces and Mechanical Rooms. Obtain Building Operations input and approval for Mechanical Room and routing of service spaces.

.4 *Designs shall minimize the mechanical equipment, which is installed exposed on rooftops, and ensure that all equipment installed on rooftops is suitable for outdoor installation:*

.1 All buildings with a high density of rooftop mechanical equipment shall have fully enclosed mechanical penthouses to contain all air handlers, pumps, tanks, boilers, chillers, etc. and where practical exhaust fans and mixing box's.

.2 Exposed piping on rooftops should only include low point drains, high point air vents and manual isolation valves with valve stem extensions. Where additional piping accessories are required, a heated valve house shall be constructed. All pipes and electrical connections shall rise into this room and penetrate to the roof horizontally. All pumps, control valves, temperature sensors, strainers, etc. shall be installed in this room.

.1 *The designer may determine how to execute this concept including putting it on the side of an elevator overrun, as a freestanding structure, built into custom air handling equipment or other concepts that maintain the same design intent.*

.3 *In situations where a "valve house" is not deemed necessary, insulated heating and cooling pipes shall not penetrate rooftops vertically with just a sleeve installed. A proper "dog house" shall be installed. This "dog house" shall have an overhang. Isolation valves may be installed under the overhang of the "dog house" provided that they have valve stem extensions so that the insulation is only minimally compromised.*

.4 *Small diameter pipes such as refrigerant pipes and gas pipes may penetrate the roof through a gooseneck provided that the gooseneck is counter flashed into the roof and that the gooseneck is sealed to prevent insects, rodents and birds from entering the building through these penetrations.*

.5 *See link here for 2018 memo which includes more details on this item:* *http://www.technicalguidelines.ubc.ca/Division_20/Roof_Memo_Apr2018.pdf*

2.3 Building Management Systems

.1 Building Operations has a central monitoring and control facility for building Mechanical Systems including Plumbing, HVAC, Fire Protection and other systems. *Comply Section 25 05 00 Building Management Systems (BMS) Design Guidelines*.

2.4 Site Services – General Requirements

.1 Refer to Division 33 for materials and installation guidelines.

.2 Under no circumstances shall any utility piping extend under buildings as direct buried and in not readily accessible locations. Entire length of utility piping must be readily accessible after project completion. This includes steam, condensate, any gas piping, heating water, cooling water, domestic water, fire protection water, chilled water, and storm and sanitary drainage not related to the building.

2.5 Equipment List

.1 Engineer/Consultant to compile list of major equipment and materials for insertion into tender documents. Contractor to complete list with manufacturer's name and model number.

2.6 Equipment Installation

.1 On piping include unions or flanges for ease of maintenance and disassembly.

.2 Provide space for servicing, disassembly and removal of equipment and components. Follow recommendations of manufacturer.

.3 Equipment drains: pipe to floor drains.

.4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

.5 Specify curbs under equipment and around pipe penetrations in mechanical rooms.

2.7 Electrical Motors

.1 Engineer/Consultant to include specification for motors when specifying packaged equipment.
  .1 Example Only: Motor: EEMAC Class B, squirrel cage induction, 1725 r/min., continuous duty, drip proof, ball bearing, maximum temperature rise 40°C. Motors to be high efficiency and rated for inverter duty.

.2 Specify matched motors and variable frequency drives with low harmonic content and harmonic filters. Maximum acceptable harmonic content as per IEEE Standard 519 and 1100.

.3 *Requirements for VFDs:*
  .1 VFDs integrated into motors are not acceptable (however, VFDs on a mounting bracket on a pump, but not integrated into the body are acceptable)
  .2 VFDs that require an accessory (remote control) to program or operate are not acceptable.
  .3 VFDs shall have an adjustable carrier/switching frequency with a minimum adjustment range from 1 - 12kHz.
  .4 VFDs operated at low carrier frequency's can lead to high motor noise. Higher frequencies can reduce noise but may require upsizing the VFD. Another strategy to reduce noise is to install output reactors/sine wave filters.
  .5 It is recommended (at the designer's discretion) that VFDs are selected at a minimum carrier frequency of 8kHz so that the switching frequency can be adjusted upward, if required to reduce noise. However, VFDs should be operated at the lowest possible carrier frequency that produces acceptable noise levels as this will generate the least heat and be the most efficient.
  .6 It is the designer's responsibility to select an appropriate carrier frequency and/or sine wave filters to mitigate the possibility of noise issues.

.4 *Inverter duty motors over 25hp shall be supplied with grounding rings and on smaller motors when the designer deems them required. Preferably on the shaft end opposite the connected device such that the grounding ring can be replaced when worn without fully uninstalling the pump.*

2.8 Fan Systems

.1 Selection of fan systems to consider maintenance and energy costs and sound levels. Final selection to be based on life cycle costs and to be approved by UBC Building Operations Technical Services.

.2 Direct drive fan systems are preferred.

2.9 Belt Drives

.1 Specify reinforced belts in matching sheaves. Multiple belts to be matched sets.

.2 Specify cast iron or steel sheaves secured to shafts with removable keys.

.3 *All adjustable sheaves shall be replaced with new sheave of the correct size.*
  .1 Adjustable pitch sheaves are commonly supplied on fans and while useful for balancing, they shall not be left in place at project completion as they lead to increased belt ware. It is suggested that consultants include in their spec that the balancer should be responsible for changing the sheaves.

.4 For motors 7.5 kW and over sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Specify sheave of correct size to suit balancing.

.5 Minimum drive rating 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

2.10 Drive Guards

.1 Specify guards for unprotected drives.

.2 Specify means to permit lubrication and use of test instruments with guards in place.

2.11 Unprotected Fan Inlets or Outlets

.1 Provide wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan inlet area.

.3 Securely fastened in place.

.4 Guards and screens to be removable for servicing.

2.12 Equipment Supports

.1 Specify for base mounted equipment chamfered edge housekeeping pads, minimum of 100 mm high and 50 mm larger than equipment dimensions all around. Provide engineered seismic restraints.

2.13 Preparation for Fire stopping

.1 Insulated pipes and ducts: ensure integrity of insulation and vapor barrier at fire separation.

2.14 Painting

.1 Refer to Section 09 90 00 Painting and Coating for additional painting specifications.

.2 Specify at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

2.15 Spare Parts

.1 Specify spare parts to suit critical nature of projects.

.2 Furnish the following spare parts in accordance with Section 01 77 00 Closeout Procedures, as follows:
  .1 One casing joint gasket for each size pump.
  .2 One head gasket set for each heat exchanger.
  .3 One glass for each gauge glass.
  .4 One set of belts for each belt driven piece of machinery.
  .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
  .6 Parts shall be available from local suppliers.

2.16 Special Tools

.1 Provide one set of special tools including computer hardware and software required to service equipment as recommended by manufacturers and in accordance with Section 01 77 00 Closeout Procedures.

.2 Where greasing is required using non industry standard grease fittings, provide suitable adaptors for standard grease guns.

2.17 Access Doors, Materials and Installation

.1 Specify access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.

.2 Flush mounted 600 x 600 mm for body entry and 300 x 300 mm for hand entry unless otherwise noted. Doors to open 180° have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

.3 In special areas such as tiled or marble surfaces, use stainless steel with mill finish.

.4 Remaining areas use prime coated steel.

.5 Locate so that concealed items are accessible.

.6 Locate so that hand or body entry (as applicable) is achieved.

2.18 Demonstration and Operating and Maintenance Instructions

.1 Prior to acceptance, specify tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment.

.2 Use operating and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.

.3 Ensure correct length of time for instruction is noted in appropriate specification section.

.4 Owner may record these demonstrations on video tape for future reference.

3.0 <u>OPERATION AND MAINTENANCE MANUAL</u>

3.1 General

.1 Refer to Section 01 78 23 Operation and Maintenance Data for detailed requirements.

3.2 Shop Drawings and Products Data

.1 Submit shop drawings and product data in accordance with Section 01 33 00 Submittal Procedures. Information shall include:
- .1 Mounting arrangements.
- .2 Operating and maintenance clearances. For example, access door swing spaces.
- .3 Equipment capacities and operating conditions.

.2 Shop drawings and product data shall be accompanied by:
- .1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.
.3 Points of operation on performance curves.
.4 Manufacturer to certify as to current model production.
.5 Certification of compliance to applicable codes.

3.3 Existing Systems

.1 Specify connections into existing systems to be made at time approved by Owner. Request written approval of time when connections can be made.

.2 Specify responsibility for damage to existing plant by this work.

3.4 Cleaning

.1 Specify cleaning of mechanical systems in accordance with Section 01 77 00 Closeout Procedures, 2.0 Cleaning.

.2 Specify cleaning of interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

.3 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.

.4 Specify new filters at turn-over, clean switch gear and VSD serving mechanical equipment inside and out.

.5 Specify removal of construction debris from the mechanical/electrical rooms.

3.5 UBC Standard Details

.1 UBC Standard details, where provided, are for information only. Detailed design is the responsibility of the designer.

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

1.0 GENERAL

1.1 Coordination Requirements

.1 UBC Building Operations - Technical Services
.2 University's Project Manager
.3 UBC Energy and Water Services.

1.2 Description

.1 Salvage of existing mechanical equipment or controls components on renovation or retrofit projects.

2.0 MATERIAL AND DESIGN REQUIREMENTS

.1 The Mechanical Consultant shall prepare a list of those items that are potentially reusable by the Owner. Submit the list to the University's Project Manager before demolition commences.

.2 The list will be reviewed with the Building Operations Department, revised to reflect the University's needs and returned to the Consultant before demolition.

.3 The Consultant shall list, in the specifications, all items that are to be salvaged.

.4 The following wording shall be included in the specifications:

  .1 The following items shall be carefully removed and handed over to the Owner.
  .2 The Sub-Contractor shall inventory all items identifying their source, the location, date of removal and stating the Company's name.

.5 Delivery Requirements

  .1 Items to be boxed and delivered to the following locations.
    Contact for Directions:
    Building Operations, Technical Services

  .2 Obtain a written receipt from the owner's representative detailing each of the items handed over.

.6 Items for Disposal

  .1 Remove all redundant material not required by the owner from the Campus and dispose of legally outside of the University Endowment Lands and Campus.

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

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

.1 Section 22 00 00 Plumbing (and all subsections)
.2 Section 20 00 05 Mechanical - General Requirements
.3 Section 23 21 05 District Hot Water Heating System
.4 Section 33 10 00 Water Utilities
.5 All other Tech Guidelines as may be applicable to a given project.

1.2 Related Documents External to UBC

.1 BC Plumbing Code and all references contained there within
.2 BC Building Code and all references contained there within
.3 Work Safe BC Occupational Health and Safety Regulation

1.3 Description

.1 The Guidelines apply to all work completed within UBC Vancouver Campus Buildings.
.2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
.3 These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
.4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.

2.0 MATERIAL AND DESIGN REQUIREMENTS

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted. Please see the variance application process at http://www.technicalguidelines.ubc.ca/.

2.1 Access Requirements

.1 All equipment shall be installed such that it is readily accessible. This includes but is not limited to:
  .1 Piping installed above drop ceilings shall be within reach of an access panel located on the ceiling. Installing piping out of reach of any access panel shall be avoided. Installing valves such that they cannot be reached through an access panel is not acceptable.
  .2 Appropriate access panels shall be installed.
  .3 Any equipment that requires regular access for maintenance shall not be located in a confined space wherever avoidable.
  .4 Access to piping chases shall be granted
  .5 Consideration shall be given to accessing, servicing and replacing plumbing fixtures – particularly when they're mounted against tile.
  .6 All manufacturer recommended clearances and service requirements shall be met.

.7 *The designer shall include general notes pertaining to equipment access. If access is not adequate then projects will be responsible for granting adequate service access.*

2.2 *Construction Requirements*

.1 *Where pipes penetrate through floor slabs they must be sleeved with a pipe that protrudes a minimum of 2" (50 mm) proud of the floor or a small housekeeping pad installed to prevent flooding to the floor below.*
   .1 *Where riser clamps are used, an appropriate detail must be used such that the riser clamps do not sit on the sleeves.*

.2 *All exposed materials prone to rusting (equipment supports, cut ends of unistrut, fasteners, exposed pipe sleeves, etc). Shall be coated with rust inhibiting paint.*

.3 *Insulation on piping or equipment shall be installed such that all factory or field installed labels remain visible.*
   .1 *All piping shall have computer generated labels. Preference is to stack the lettering and display the full word description of the piping (ie “Domestic Hot Water”, not “DHW” or “District Hot Water”, not “DHW” or “Domestic Cold Water”, not “DCW”)*
   .2 *All pipes that are accessible must be labelled every 10m and where they enter and leave rooms.*

.4 *Wherever specialty systems are being installed (ex solar collectors), coordinate with UBC Building Operations during the design stage.*

2.3 *Demolition Requirements*

.1 *Decommissioned equipment shall be demolished and disposed of in accordance with applicable codes and standards. No equipment shall be abandoned.*

.2 *Where pressure vessels are decommissioned or abandoned, the contractor shall supply UBC Building Ops with a photo of all labels on the equipment including the TSBC (previously BCSA) registration decal. The contractor shall also drill a hole in the equipment prior to disposal and shall confirm in writing to UBC Building Ops that this has been done. This is so that we can cancel the operating permit for this equipment and stop paying the annual fees associated with it.*

.3 *Decommissioned piping located within mechanical rooms shall be demolished and cut back to the edge of the mechanical space, capped and clearly tagged. No piping shall be abandoned within mechanical rooms.*

.4 *Decommissioned piping may be abandoned outside of mechanical rooms to the designer’s judgement. Pipes which are likely to be obtrusive to future use of the space or maintenance should be demolished. Abandoned pipes are to be clearly labelled as such – at least once per room and more regularly as required.*

.5 *All dead legs shall be capped and disconnected as close as possible to the active pipe. Valves shall not be considered acceptable isolation from a dead leg. The dead leg piping/equipment shall be demolished as per the requirements above.*

3.0 ***LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS***

Items in this section are not specific requirements of UBC but are code or industry best practices which have been missed on past jobs. These items should be considered in mechanical designs at UBC. However, if they're not applicable then a variance is not required.

.1 *All pipe penetrations through fire rated walls must have appropriate firestop listing*

  .1 If the pipe is subject to movement (thermal expansion, vibration, etc) then the listing must accommodate pipe movement

  .2 If the piping has the potential to condense on the outside then the listing must make accommodations to maintain the insulation and vapour barrier

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

1.0 GENERAL

1.1 Related UBC Technical Guidelines

.1 10 00 01 Special Room Requirements
.2 20 00 05 Mechanical - General Requirements
.3 20 00 06 Meters
.4 22 00 00 Plumbing (and all subsections)
.5 23 21 05 District Hot Water Heating System
.6 33 10 00 Water Utilities
.7 All other Tech Guidelines as may be applicable to a given project.

1.2 Related Documents External to UBC

.1 BC Plumbing Code and all references contained there within
.2 BC Building Code and all references contained there within
.3 Work Safe BC Occupational Health and Safety Regulation

1.3 Description

.1 The Guidelines apply to all work completed within UBC Vancouver Campus Buildings.

.2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.

.3 These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.

.4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.

2.0 MATERIAL AND DESIGN REQUIREMENTS

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted. Please see the variance application process at http://www.technicalguidelines.ubc.ca/.

2.1 Design Requirements

.1 Water entry station shall include, in this order:
  .1 Wye-Strainer c/w blow off valve
  .2 Neptune Water meter c/w turbine strainer as per 33 10 00 Water Utilities
  .3 Backflow Preventers each sized at 50% flow for the building. Refer to 22 11 18 Backflow / Cross Connection Control for more details.
  .4 Pressure reducing station complete with a normally closed by-pass, a low flow and where necessary a high flow pressure regulator. For many buildings, high pressure range regulators may need to be specified.
    .1 Low flow shall be direct acting type with high pressure range.
    .2 High Flow shall be an externally piloted type.

.2 All new and renewed buildings are to be connected to the district energy system. This system is to be the primary source of heat for hot water systems. Refer to section 23 21 05 for more details including energy transfer station piping arrangement.

.3 Bronze drain valves c/w cap and chain shall be specified at all low system low points.

.4 All janitor rooms shall have detergent dispensing systems installed. These require ¾" RPBP's on DCW and DHW. Refer to 10 00 01 – Special Room Requirements for more information on janitor room requirements.

.5 For DHW recirculation systems, on all branches specify, ¼ turn ball valves, check valves and balancing valves (or auto flow valves) (lead free for all).

.6 In no situation is it acceptable to use a balancing valve as an isolation point (even if it has a memory stop). The reason for this is that when they're used for isolation, they are frequently not returned to the same point and over time, system balancing is thrown off.

2.2 Construction and Material Requirements

.1 Acceptable piping systems (this section is a work in progress, please email andrew.porritt@ubc.ca to request updates – most industry standard, non-proprietary systems will be accepted)
  .1 Domestic Cold Water
    .1 Type K Copper (solder, grooved, pro-press or flanged)
    .2 Uponor (up to 2")
    .3 Aquatherm
    .4 Stainless Steel (for express mains)
  .2 Domestic Hot Water
    .1 Type K Copper (solder, grooved, pro-press or flanged)
    .2 Uponor (up to 2")
    .3 Aquatherm
  .3 Domestic Hot Water Recirc
    .1 Type K Copper (solder, grooved, pro-press or flanged)
    .2 Uponor (up to 2")
    .3 Aquatherm

.2 Wafer style valves are not acceptable. All valves shall be capable of end of line isolation.

2.3 Testing and Commissioning Requirements

.1 UBC Building Official shall be invited to witness all tests that are required by code or the tech guidelines.

.2 BCPC 2.3.7.2 requires water pressure tests at the maximum in service pressure. At UBC this shall be deemed to be 125PSI (worst case if PRV fails). The system must maintain pressure without leaking for a minimum of 2 hours.

.3 For renovation projects, all new lines shall be flushed and pressure tested prior to connecting to the base building system.

3.0 LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS

Items in this section are not specific requirements of UBC but are code or industry best practices which have been missed on past jobs. These items should be considered in mechanical designs at UBC. However, if they're not applicable then a variance is not required.

.1 Non-potable water system requirements as per CSA B128.1-06 (referenced in BCBC)
  .1 All piping shall be marked with warning labels and shall be purple in colour or have a continuous purple stripe.

.2 All water outlets on non-potable systems shall have signage as described in the standard

.3 This may include lab sinks where zone protection is being used

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

1.0 GENERAL

1.1 *Related UBC Technical Guidelines*

.1 *20 00 05 Mechanical - General Requirements*
.2 *22 00 00 Plumbing (and all subsections)*
.3 *All other Tech Guidelines as may be applicable to a given project.*

1.2 *Related Documents External to UBC*

.1 *BC Plumbing Code and all references contained there within*
.2 *BC Building Code and all references contained there within*
.3 *Work Safe BC Occupational Health and Safety Regulation*
.4 *CSA B64.10-.17 Selection and Installation of Backflow Preventers / Maintenance and Field Testing of Backflow Preventers*

1.3 *Description*

.1 *The Guidelines apply to all work completed within UBC Vancouver Campus Buildings.*

.2 *In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.*

.3 *These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.*

.4 *It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.*

2.0 MATERIAL AND DESIGN REQUIREMENTS

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted. Please see the variance application process at http://www.technicalguidelines.ubc.ca/.

2.1 Design Requirements

.1 There is a cross connection control program in effect at the University and all installations shall be in accordance with the recommendations contained in the latest edition of the BC Plumbing Code.

.2 *RPBP Special Requirements:*
  - *.1 Provide a drain standpipe or tank below RPBPs relief ports such that discharge does not go onto the floor. The drain must be sized to accommodate the max possible, continuous discharge of the RPBP.*
  - *.2 RPBPs larger than 1" shall not be installed below the sanitary gravity discharge from the building. RPBPs larger than 1" shall not discharge to sump pumps without receiving an approved variance.*
  - *.3 RPBPs larger than 4" shall be installed above grade, in rooms that are on building exteriors and their discharge shall daylight.*

.3 Water service entry:
 .1 Two Backflow Prevention Assemblies piped in parallel are required at the water service entry to all buildings, to allow for servicing without having to completely isolate the water supply to the building.
 .2 Whether a Reduced Pressure Backflow Assembly (RPBA) or alternate type of assembly is required will depend on the hazard category of the building in question.
 .3 The parallel Backflow Prevention Assemblies must be designed to allow for peak design flow during normal operation and for one unit to be taken off line for servicing while maintaining 50% or greater peak flow.

.4 Fire Protection Service Connection:
 .1 A double check valve assembly, (DCVA), is required at Fire Protection service connections per British Columbia Building Code-Plumbing Services (part 7). An additional parallel DCVA is not required.

.5 Irrigation Systems:
 .1 A DCVA at the service connection is to be provided in accordance with the usage. Note: where a higher hazard exists (due to chemical injection), additional area protection with an RP Assembly is required.

.6 Potable Water Systems:
 .1 Backflow protection is required to be installed in local areas to protect potable water systems in buildings from labs and other hazardous water uses within the building.

.7 Water Filters:
 .1 An RPBA shall be installed immediately upstream of all water filters equal to, or greater than 25mm (1”).
 .2 A DCVA shall be installed immediately upstream of all water filters less than 25mm (1”).

.8 Chemical or Detergent Mixing Stations:
 .1 An RPBA shall be installed immediately upstream of any chemical or detergent mixing station.
 .2 These are present in most janitor rooms on campus by UBC, post construction. All janitor rooms should have RPBAs (hot and cold piping) as well as other project specific locations.

2.2 *Construction and Material Requirements*

.1 *All backflow prevention assemblies shall comply with the requirements of CSA B64.10-17*

2.3 *Testing and Commissioning Requirements*

.1 *Following installation, prior to building turnover - a test report completed by a certified tester shall be submitted to the Owner, indicating satisfactory operation of each device.*
 .1 This report shall be included in the O&M manual submitted at the end of each project.
 .2 The report shall be on UBC's standard format, located at http://www.technicalguidelines.ubc.ca/Division_22/Backflow_Test_Form.pdf.

3.0 ***LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS***

Items in this section are not specific requirements of UBC but are code or industry best practices which have been missed on past jobs. These items should be considered in mechanical designs at UBC. However, if they're not applicable then a variance is not required.

.1 *RPBPs shall only be used where the building risk analysis deems they're required. Where possible use DCVAs as they are easier to maintain and pose less risk to the building (flooding).*

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

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

.1 Section 20 00 05 Mechanical - General Requirements
.2 Section 22 00 00 Plumbing (and all subsections)
.3 All other Tech Guidelines as may be applicable to a given project.
.4 UBC Hazardous Waste Disposal Guide

1.2 Related Documents External to UBC

.1 BC Plumbing Code and all references contained there within
.2 BC Building Code and all references contained there within
.3 Work Safe BC Occupational Health and Safety Regulation

1.3 Description

.1 The Guidelines apply to all work completed within UBC Vancouver Campus Buildings.

.2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.

.3 These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.

.4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.

2.0 MATERIAL AND DESIGN REQUIREMENTS

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted. Please see the variance application process at http://www.technicalguidelines.ubc.ca/.

2.1 Design Requirements

.1 UBC does not support the installation or use of acid neutralization tanks (small under counter, or large centralized) or acid waste piping. Researchers are to collect their acid waste in an appropriate container and follow the procedures outlined on UBC's Hazardous Waste Disposal Guide.
   .1 In buildings with existing central acid waste piping and tank – the system shall be considered de-commissioned. New fixtures/appliances that enable users to put acids down the drains shall not be installed.
   .2 This does not apply condensate neutralization tanks on gas fired HVAC/Plumbing equipment with condensing flue gases. However, care should be taken to ensure that these tanks are installed in a serviceable manner and that they have enough capacity that the lime chips don't have to be replenished very often. They should be the style where the top opens to put more lime chips in, opposed to closed tube style assemblies.

.2 Refer to section 22 30 00 for requirements for sump pumps.

.3 Specify floor drains in all public washrooms.

2.2 Construction and Material Requirements

.1 Acceptable piping systems (this section is a work in progress, please email andrew.porritt@ubc.ca to request updates)

.1 Sanitary Above Grade

.1 Copper

.2 Cast Iron

3.0 LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS

Items in this section are not specific requirements of UBC but are code or industry best practices which have been missed on past jobs. These items should be considered in mechanical designs at UBC. However, if they're not applicable then a variance is not required.

.1 None noted at this time.

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

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

.1 Section 20 00 05 Mechanical - General Requirements
.2 Section 22 00 00 Plumbing (and all subsections)
.3 Section 33 49 00 Storm Drainage
.4 All other Tech Guidelines as may be applicable to a given project.

1.2 Related Documents External to UBC

.1 BC Plumbing Code and all references contained there within
.2 BC Building Code and all references contained there within
.3 Work Safe BC Occupational Health and Safety Regulation

1.3 Description

.1 The Guidelines apply to all work completed within UBC Vancouver Campus Buildings.
.2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
.3 These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
.4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.

2.0 MATERIAL AND DESIGN REQUIREMENTS

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted. Please see the variance application process at http://www.technicalguidelines.ubc.ca/.

2.1 Design Requirements

.1 Refer to section 33 49 00 for more information on parkade drainage
.2 Refer to section 22 30 00 for requirements for sump pumps.

2.2 Construction and Material Requirements

.1 Acceptable piping systems (this section is a work in progress, please email andrew.porritt@ubc.ca to request updates)
  .1 Storm Above Grade
    .1 Cast Iron
    .2 Copper
  .2 Perimeter drainage
    .1 Perforated PVC Pipe (non-flexible)

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

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

.1 Section 20 00 05 Mechanical - General Requirements
.2 Section 22 00 00 Plumbing (and all subsections)
.3 All other Tech Guidelines as may be applicable to a given project.

1.2 Related Documents External to UBC

.1 BC Plumbing Code and all references contained there within
.2 BC Building Code and all references contained there within
.3 Work Safe BC Occupational Health and Safety Regulation

1.3 Description

.1 The Guidelines apply to all work completed within UBC Vancouver Campus Buildings.

.2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.

.3 These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.

.4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.

2.0 MATERIAL AND DESIGN REQUIREMENTS

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted. Please see the variance application process at http://www.technicalguidelines.ubc.ca/.

2.1 Design Requirements

.1 Compressed air systems shall avoid the use of proprietary packaged compressors as these can have very high first costs and very high maintenance costs associated with them. If you have questions, please reach out to UBC Building Ops to coordinate. In general, compressors installed at UBC should include:
  - .1 Two receiver mounted, air cooled compressors
  - .2 Two air dryers piped in parallel c/w auto drain valves
  - .3 Two filter packages piped in parallel
  - .4 Factor installed controls including
    - .1 Adjustable pressure switches
    - .2 Low oil level alarm wired to BMS
    - .3 Low pressure alarm wired to BMS
  - .5 Provide the first service kit for all compressors. Place it beside the compressor in a clearly marked plastic container that includes re-ordering information.

2.2 Construction and Material Requirements

.1 Acceptable Piping Systems (this section is a work in progress, please email andrew.porritt@ubc.ca to request updates)

  .1 Compressed Air

    .1 Copper

3.0 LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS

Items in this section are not specific requirements of UBC but are code or industry best practices which have been missed on past jobs. These items should be considered in mechanical designs at UBC. However, if they're not applicable then a variance is not required.

.1 When connecting new compressors to new systems, ensure that adequate provisions are included to purge old piping which may be contaminated with oil.

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

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

.1 Section 20 00 05 Mechanical - General Requirements
.2 Section 22 00 00 Plumbing (and all subsections)
.3 Section 23 21 05 District Hot Water Heating System
.4 All other Tech Guidelines as may be applicable to a given project.

1.2 Related Documents External to UBC

.1 BC Plumbing Code and all references contained there within
.2 BC Building Code and all references contained there within
.3 Work Safe BC Occupational Health and Safety Regulation

1.3 Description

.1 The Guidelines apply to all work completed within UBC Vancouver Campus Buildings.

.2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.

.3 These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.

.4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.

2.0 MATERIAL AND DESIGN REQUIREMENTS

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted. Please see the variance application process at http://www.technicalguidelines.ubc.ca/.

2.1 Design Requirements

.1 Sump Pumps
 .1 All sump pumps are to be selected as duty/standby. Design is not to be for parallel operation in normal operating conditions.
 .2 Controller is to rotate runtime between the two pumps.
 .3 Pumps are to be controlled by four floats. The configuration of the floats at UBC is different from many other installations because we want to ensure that we receive an alarm to BMS when one pump has failed. A typical configuration will not send an alarm until both pumps have failed and the water level overcomes the highest float.
  .1 Stop pumps
  .2 Start first pump
  .3 Alarm float (the alarm float shall be slightly below the “start second pump” float)
  .4 Start second pump

.2 Water heaters
  .1 All new and renewed buildings are to be connected to the district energy system. This system is to be the primary source of heat for hot water systems. Refer to section 23 21 05 and 33 61 00 for more details including energy transfer station piping arrangement.
    .1 If a project is not going to connect to DES, they must have a variance in place from UBC Energy and Water Services (Section 33 of the TGs)
  .2 Water heaters with storage capacity of 120 L or less and heating capacities of 3.0 kW or less may be electric.
  .3 Where on demand domestic hot water heaters are specified, make provisions for water expansion without relying on pressure relief valve for control of water pressure.

.3 Expansion tanks shall be installed on all domestic hot water systems.

2.2 Construction and Material Requirements

.1 Housekeeping pads are to be installed under all equipment

.2 All tanks containing hazardous materials must be registered with UBC Risk Management Services. This includes but is not limited to chemical feed tanks, acid neutralization tanks, oil water separators, grease traps, etc. https://stdb.rms.ubc.ca/index.asp

3.0 LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS

Items in this section are not specific requirements of UBC but are code or industry best practices which have been missed on past jobs. These items should be considered in mechanical designs at UBC. However, if they’re not applicable then a variance is not required.

.1 All sanitary sumps shall be vented and have sealed lids as per BC Plumbing Code 2.4.6.3.2.

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

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

.1 *Section 10 21 13 Toilet Compartments*
.2 *Section 20 00 05 Mechanical - General Requirements*
.3 *Section 22 00 00 Plumbing (and all subsections)*
.4 *All other Tech Guidelines as may be applicable to a given project.*

1.2 *Related Documents External to UBC*

.1 *BC Plumbing Code and all references contained there within*
.2 *BC Building Code and all references contained there within*
.3 *Work Safe BC Occupational Health and Safety Regulation*
.4 *BC Building Access Handbook*
.5 *ANSI Z358.1 Eyewash Standard*

1.3 Description

.1 *The Guidelines apply to all work completed within UBC Vancouver Campus Buildings.*

.2 *In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.*

.3 *These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.*

.4 *It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.*

2.0 MATERIAL AND DESIGN REQUIREMENTS

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted. Please see the variance application process at http://www.technicalguidelines.ubc.ca/.

2.1 *Design Requirements*

.1 *Locking Frost proof hose bibs shall be installed. At least one on each major building face.*

.2 *Washroom fixtures:*

  .1 *All water closets in public areas shall be floor-mounted and have open front seats. All urinals shall be wall-hung. All partitions are to be floor-mounted. (Refer also to Section 10 21 13 Toilet Compartments, Sentence 2.1.2.)*

  .2 *If 'No-touch' motion detector-activated plumbing fixtures and accessories are used for faucets and urinals then they shall be hard-wired.*

  .3 *Waterless urinals are not acceptable*

  .4 *Dual flush toilets may be used for residential installations only, not for institutional or public buildings.*

.3 Emergency eye wash stations and showers:

.1 Emergency water at all emergency showers and eyewashes supply shall be tempered and not exceed 20° C. *Recirc lines shall be run as close as practically possible to the thermostatic mixing valve.*

.2 Emergency showers/eye wash stations shall have ‘stay open’, hand controlled valves.

.3 Emergency showers/eye wash stations shall each have a floor drain plumbed in, complete with trap primers. Floor surfaces slope to drain.

.4 Eye wash shall be specified as eye wash only not face and eye wash combination.

.5 Emergency shower/eye wash isolating valves shall not be readily accessible to the user.

.6 *Shall be compliant with ANSI Z358.1 Eyewash Standard*

.4 Drinking fountains

.1 All buildings over 600 gross square meters shall have at least one accessible drinking water fountain, located in a public area.

.2 For all new buildings, drinking water fountains shall be located inside buildings at level one entrance lobbies and should be visible from the exterior.

.3 Drinking water fountains to be installed on the shortest dead leg possible off of a line that is flowing regularly. This line would preferably be serving a washroom.

.4 The drinking water fountain shall NOT be cooled.

.5 Drinking water fountains shall NOT have filters and hence no backflow preventers will be required.

.6 *Drinking water fountains shall feature a water bottle filler. One way to specify this is for a deck mounted one-hole spigot, installed onto the fountain. An appropriate fountain/spigot combination needs to be specified to avoid splashing.*

.1 Touchless bottle filler stations that require electrical connections and have additional service requirements are NOT preferred.

.7 *All water fountains must be barrier free and conform to the latest requirements of the Building Access Handbook*

.5 *Domestic water dispensing and filtration equipment is not preferred by UBC Operations. However, it is acceptable provided that the below requirements are met. It is the responsibility of designers to ensure that their clients are aware of their responsibilities for damage as per the below.*

.1 The installation of water dispensing/filtration equipment for office and kitchenette type areas is acceptable provided that a UBC Plumbing permit is obtained. An approved backflow device must be installed as per Section 22 11 18 Backflow/Cross Connection Control to prevent water from being drawn out of the filter system back into the water supply line.

.2 The installation costs of a domestic water filtration/dispensing device and the associated recurring maintenance such as sanitization and filter changes are the sole responsibility of the client and should be managed with an outside service provider.

.3 Property damage resulting from equipment failure and/or auxiliary supply lines installed by a vendor downstream of a UBC domestic cold water isolation valve will be the sole responsibility of the client and/or service provider.

.4 All water filtration and dispensing devices must be CSA approved and meet all requirements of the BC plumbing Code.

.5 Saddle style valves are not permitted to be installed on UBC water services by outside service providers. On a client funded basis, UBC Building Operations may install a domestic cold water tie in location and isolation valve for the purpose of supplying water to a filtration/dispensing device.

.6 Canister style water filter units must be of metallic constructions and units that consist of multiple filter elements be either homogenous in their design or interconnected with brass NPT pipe nipples (eg. EverPure). Interconnection of filter housings using plastic tubing and fittings is not acceptable.

.7 Piping downstream of a UBC supplied shutoff valve to a filtration/dispensing device must be connected with FIP or MIP style fittings. Other flexible supply lines may be considered (see Auxiliary Supply Lines).

.8 Auxiliary supply lines connecting a filtration/dispensing to a UBC shut off valve device are to be soldered copper, *Uponor* or flexible copper furnished with brass compression style fittings. Plastic tubing and plastic quick connect fittings are not acceptable. Auxiliary supply lines should NOT exceed 5 feet in length and routing is not permitted in wall cavities, ceiling spaces or areas susceptible to abrasion and or mechanical damage.

.6 *Roof drains*

.1 *Provide minimum of two (2) roof drains to all major roof areas (>800sqft) as insurance against clogging and flooding (e.g., 2 at 75 m diameter preferred even if 1 at 100 mm diameter will do). This does not negate the BCBC requirement for scuppers.*

.7 *Mechanical room floor drains*

.1 *Specify drains large enough to receive indirect equipment drains into their bodies such as “floor sinks” or “hub drains”. In many cases on campus, indirect drains open-end above regular floor drains or simple funnel drains and as a result they splash or discharge over the floor leading to leaking floors and mechanical rooms which are in poor condition.*

2.2 *Construction and Material Requirements*

.1 New or replacement fixtures shall meet water efficiency performance requirements in Table 1.0. The table also shows comparative reference points in other standards and codes.

.1 Efficiency requirements for shower heads and faucets are about 20-30% more efficient than BC Building Code requirements.

.2 *Flush tank toilets shall be WaterSense certified or shall have a maximum average flush of 4.8 litres per flush and a MaP score >=350g as tested by IAPMO R&T Lab (map-testing.com).*

Table 1.0. Fixture Water Efficiency Requirements

The table below is based on the current National Plumbing Code. In some cases these flow rates are more stringent than what is in the current BC Plumbing Code. These rates are minimums and higher performance fixtures are acceptable depending on project requirements (i.e. LEED).

Fixture	Requirement (Maximum Volume or Flow Rate)	Notes
Residential toilets	4.8 litres/flush or dual flush *at 6.0/4.1 litres/flush*	
ICI Toilets	*6.0 litres/flush*	
Urinals	1.9 litres/flush	
Shower head	7.6 litres/minute	
Kitchen Faucet *(except ICI)*	6.8 litres/minute	
Lavatory Faucet *– private*	*5.7 litres/minute*	
Lavatory Faucet *– public*	*1.9 litres/minute*	*Must have auto-shutoff*

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

1.0 *GENERAL*

1.1 *Related UBC Guidelines & Documents*

.1 *Section 20 00 05 Mechanical - General Requirements*
.2 *Section 22 00 00 Plumbing (and all subsections)*
.3 *All other Tech Guidelines as may be applicable to a given project.*

1.2 *Related Documents External to UBC*

.1 *BC Plumbing Code and all references contained there within*
.2 *BC Building Code and all references contained there within*
.3 *Work Safe BC Occupational Health and Safety Regulation*
.4 *CSA Z -305.1. Non-Flammable Medical Gas Piping Systems.*

1.3 *Description*

.1 *The Guidelines apply to all work completed within UBC Vancouver Campus Buildings.*

.2 *In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.*

.3 *These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.*

.4 *It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.*

2.0 *MATERIAL AND DESIGN REQUIREMENTS*

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted. Please see the variance application process at http://www.technicalguidelines.ubc.ca/.

2.1 *Design Requirements*

.1 *Where specialty piping systems serve specific labs or research groups they shall generally be the lab user's responsibility. It shall be the responsibility of the lab, faculty or department to setup a maintenance contract with the appropriate, qualified contractor or setup a maintenance contract with UBC Building Operations. These systems do not fall within the standard scope of UBC Building Ops maintenance of core building systems. It is the responsibility of the designer to inform their clients of this and coordinate the delineation of scope and demarcation points with UBC Building Operations and the clients such that all parties expectations are in line, prior to construction.*

.2 *For specialty water systems, local generating systems shall be used. Large central sources shall only be used with an approved variance. This includes but is not limited to distilled water, reverse osmosis, filtered water, de-ionized water, salt water.*

2.2 *Construction and Material Requirements*

.1 *Acceptable Piping Systems*

.1 Piping systems shall be selected suitable to the specific application. Care shall be taken to avoid proprietary piping systems wherever possible.

3.0 *LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS*

Items in this section are not specific requirements of UBC but are code or industry best practices which have been missed on past jobs. These items should be considered in mechanical designs at UBC. However, if they're not applicable then a variance is not required.

.1 *Local process loops. Some labs have local process loops separated from the base building system by heat exchangers or chillers. These loops may not be chemically treated and as a result appropriate piping systems need to be selected. This needs to be coordinated with the lab users as this equipment is typically maintained by the users.*

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

1.0 MATERIALS AND DESIGN REQUIREMENTS

1.1 Grading

.1 Grades of lawns and plantings shall comply with best management practices related to site drainage, and be kept within safe, stable and maintainable limits using appropriate slope retention design and construction methods.

.1 Site-specific design strategies should be used to avoid excessive, inaccessible or unsafe slopes *(lawns or plantings)*. Such strategies may include, but not be limited to: terraced landscapes, retaining walls, enclosed planters, access ramps, pathways and stairs.

.2 Sloped landscapes must be graded appropriately in relationship to buildings, hardscape and other site elements such that mowers, excavators or other equipment used for maintenance or renovation purposes, are not at risk of losing traction, slipping, and rolling downslope causing injury to operators, bystanders, or damage to property (see .4 below).

.1 Balancing cut and, fill and aesthetic grading considerations, should not result in excessive mounding of soils such as to create knolls, hummocks or slopes that cannot be negotiated safely by landscape maintenance staff (either on foot or with power equipment).

.3 Grade at toe of steeper mown slopes must be graded to avoid mower-rollover or slippage due to abrupt grade discontinuities into top of retaining walls, or adjacent flat surfaces such as roads and walkways.

.4 Avoid planting trees within steep sections near toe of slopes unless conditions in paragraph 1.2.3 above have been met.

.5 Sloped landscapes must be structurally stable, and be resistant to surficial erosion or shifting of under-bearing soils, plants, trees or geotextile. Landscape maintenance staff must be able to access and negotiate sloped landscapes on foot or with equipment as needed without undue ergonomic stress, potential injury, loss of footing, or loss of equipment control.

.6 To keep slopes within reasonably safe and workable limits, <u>maximum allowable slopes on UBC Campus shall not exceed 5:1 for lawns, and 3:1 for planted slopes</u>. (Please also refer to Section 32 92 23 Sodding and Section 32 92 00 Turf and Grasses.)

.7 For specialized circumstances, such as planted slopes for stormwater detention ponds, or stream bank stabilization, variance from the above criteria may be granted subject to pre-approval by Campus Landscape Architect in consultation with Building Operations Head Landscape Technologist. Nonetheless, erosion control technologies such as matting, geo-grids, geo- synthetic bags etc. must be used to ensure stability of soils, mulches and the proper establishment of slope plantings as discussed in 1.1.3 above.

.2 Under no circumstances should rough or finished grades of lawn, planting or paving result in the burying or otherwise obscuring of existing utility service covers, valve-boxes, manholes, catchbasins, or the like. Should a circumstance arise where a service will fall below proposed finish grades, contractor must halt work and contact the owner immediately before proceeding.

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

1.0 DESIGN REQUIREMENTS

1.1 Unless specified by the UBC Campus Plan Design Guidelines and site-specific design requirements, all standard municipal hardscapes should conform to BC Landscape Standard and Master Municipal Construction Documents (MMCD), current editions.

1.2 Landscape structures should reference the appropriate architectural sections of the Technical Guidelines.

1.3 All landscape, area and exterior lighting designs shall be reviewed by UBC Building Operations Electrical Support before Tender Drawings are complete.

1.4 It is imperative that hard landscape steps, furniture, walls and railings are designed to be resistant to skateboarding damages. After-the-fact add-on straps and studs are less desirable than surfaces that have been pre-considered as targets, and aesthetically designed to deter skateboarders. Preferred deterrents should be considered at the schematic design stage. Design strategies should include incorporation of air gaps, notching, and offsets in seat walls, uneven surfaces, and other creative alignments and articulation of surfaces, walls, steps and railings.

1.5 Building façade and tree pruning require using heavy equipment such as manlifts. Both soft and hard landscaping must be designed to accommodate the loading and movement of this equipment in and around buildings.

.1 Structural soils, root protection and plants must be considered in these areas.

.2 Coordinate as early as possible in the conceptual and design development phases with UBC Campus Arborist and Building Operations.

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

1.0 DESIGN REQUIREMENTS

1.1 As per UBC Board of Governors Policy #12, UBC practices Integrated Pest Management.

1.2 With rare exceptions related to public health or special landscape elements, the use of toxic chemical pesticides for cosmetic purposes is suspended from application on UBC landscape and grounds.

1.3 UBC Building Municipal Services endeavors to test and research new techniques and organic pest control agents such as sustainable alternatives to toxic chemicals. However, landscape designers should acknowledge the high potential for planting loss due to virulent weed growth in the context of low maintenance regimes typical of institutional landscapes such a UBC's Campus core.

1.4 Landscape plantings and hardscapes should be designed to minimize the need for toxic pesticides and herbicides. Design strategies should include:

.1 Selecting pest and disease resistant trees and plant material.

.2 Selecting hardy, vigorous, drought tolerant plants that can resist being overwhelmed by weed growth.

.3 Emphasizing mass plantings of sub-shrubs and evergreen groundcovers to shade the soil surface and inhibit weed development.

.4 Specifying soils growing media, *container and field-grown plant material* that are guaranteed free of pernicious weeds and seeds *as per Canadian Landscape Standard, and Canadian Nursery Stock Standard*.

.5 Specifying organic mulches that are guaranteed free of weeds and seeds.

.6 Providing adequate water through irrigation to ensure optimum plant growth and health.

.7 Specifying polymeric jointing sand or equivalent jointing materials in paving joints to inhibit organic residues and weed growth in paving joints.

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

1.0 DESIGN REQUIREMENTS

1.1 The principals of CPTED should be consider and reviewed at each stage of the project from pre-design through to occupancy, with reference to the extensive literature on this subject.

1.2 Project design features that address CPTED issues should be flagged for consideration in the plan reviews by the Emergency Services Committee, including representatives of Campus Planning & Development, Heath Safety and Environment, Campus Security, RCMP, fire, ambulance and UEL and by Advisory Design Review Panel with a CPTEC specialist from Richmond Police.

1.3 On complex, large projects, consideration should be given to including a CPTED consultant to the Project Team.

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

1.0 GENERAL

1.1 Scope

.1 This guideline addresses the quality scope of maintenance services expected prior acceptance of new landscapes by UBC Building Operations inclusive of pest and disease control, warranty and replacement of plant material, stakes, guywires, manual watering, irrigation adjustment and winterizing etc..

1.2 Related Work

.1 Section 32 01 93.01 Tree and Shrub Preservation
.2 Section 32 93 05 Relocation of Existing Plant Material
.3 Section 32 80 00 Irrigation
.4 Section 32 91 00 Planting Preparation
.5 Section 32 93 00 Plants
.6 Section 32 92 00 Turf and Grasses
.7 Section 32 92 23 Sodding

1.3 Workmanship

.1 All work shall conform to the standards and practices outlined in the *Canadian* Landscape Standards – current edition; to be executed by skilled tradespersons well equipped and adequately supervised, and performed in accordance with these Standards. The Contractor shall have at least five years experience and must provide written proof of experience and projects to the Project Landscape Architect.

1.4 Supervision

.1 Supervisors shall have practical experience and knowledge of plant material and pest and disease control.

.2 The Contractor shall be responsible for detection, recognition and timely control of plant pests and diseases. The Contractor shall have an up-to-date knowledge of the most effective, non-toxic, organic insecticides, miticides and fungicides, together with the ability to diagnose ailments. Obtain written approval from UBC prior to their application. **Note that use of toxic chemical pesticides for cosmetic purposes is suspended on UBC Campus**.

1.5 Record of Maintenance Operations

.1 Work Schedule: Provide a schedule outlining the tasks to be undertaken through the year. These shall include as a minimum: fall/spring clean-up, fertilizer application, mulch application, irrigation, garbage clean-up, pruning, turf top-dressing and aeration.

.2 The Contractor shall prepare a monthly summary of maintenance work and site conditions and submit it to the Project Landscape Architect and UBC Building Operations Head Landscape Technologist at the end of each calendar month, for the duration of the maintenance period.

1.6 Scope of Work

.1 Provide all equipment, material and labour for work specified herein including the following:

.1 Turf management, mowing, fertilizing, weed eradication, removal of clippings, aerating, top dressing, watering.

.2 Management of trees, shrubs, groundcover, aquatic plants, pest and disease control, growth control, fertilizing, weeding, watering and cultivation, and mulching.

.3 Complete blow out and drainage of the irrigation system prior to winter and the complete reinstatement of system operations in the spring.

1.7 Duration and Warrantee

.1 The landscape maintenance period shall begin at the time each plant is planted and shall continue for 55 days from the date of certified Substantial Performance of the Work.

.2 The warranty on plants and trees will be for one (1) full year commencing from the end of the date of certified Substantial Performance of the Work.

.3 Interim warranty inspections shall be scheduled as follows: the first to be conducted at the end of 55 day maintenance period, then following at approximately 6 and 9 month intervals.

.4 The above interim inspections and an end-of-warranty inspection will be coordinated by the project management group and will include the warrantor, the Project Landscape Architect and UBCs representatives as required, including a representative from UBC Building Operations, Municipal Services.

1.8 Notification

.1 Notify the Project Landscape Architect and UBC Building Operations Head Landscape Technologist if any disease or insect problems arise.

.2 Pest control measures to be implemented by the Contractor shall be reviewed and approved in writing by UBC Building Operations prior to their use. Provide the Project Landscape Architect and UBC Building Operations with a minimum 72 hour notification in writing prior to application of chemical vegetation controls. Post notice in area of spraying 72 hours before, during, and five (5) days after application.

.3 Notify both the Project Landscape Architect and UBC Building Operations of any physical changes and/or discrepancies which may affect the implementation of the contract as specified herein or which may endanger the public.

1.9 Inspection

.1 Regular inspections shall be conducted by the Project Landscape Architect accompanied by UBC Building Operations representative prior to approval of application for payment in order to review work completed and identify deficiencies.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Materials

.1 The Contractor shall provide all materials, labour and equipment necessary to perform the operations as specified herein and as required to provide the optimum environment for the establishment of plant material.

.2 Mulch: Shall be composted bark mulch with 50mm and minus Douglas Fir / Hemlock bark chips, dark brown in colour and free of cedar chips, soil, wood, stones, roots, plastic and other deleterious matter or pre-approved equal.

.3 Provide a sample of the each mulch component to Pacific Soils Analysis for inspection, testing and approval. Sample and test results shall include the name of the project, the name of the Consultant and/or UBC and the date. Approved sample shall be standard throughout. Pacific Soils Analysis, #5 - 11720 Voyager Way, Richmond, B.C. Tel: 273-8226.

.4 Provide copies of all test results and samples to the Project Landscape Architect and UBC Building Operations Head Landscape Technologist.

2.2 General

.1 The Contractor shall maintain the project free from any defect resulting from work done or material supplied by the Contractor. The Contractor shall, to the satisfaction of the Project Landscape Architect and UBC Building Operations, rectify any defect that exists within the Maintenance Period. The Contractor must warrant all growing medium, soil amendments and fertilizers used on this project.

.2 The Contractor shall be responsible for regular examination of the site during the term of the Contract and shall adjust the work schedule to suit site conditions.

2.3 Maintenance of Lawn Areas

.1 The Contractor shall be responsible for the maintenance of all lawn areas. Maintenance of lawn areas shall include all measures necessary to maintain lawn in a vigorous, healthy, normal growing condition. Begin maintenance immediately after installation and continue for one full year after Substantial Performance.

.2 All mowed lawn areas shall be cut at minimum once a week, and twice a week during heavy growth periods to ensure maximum height of 2.5" (70mm)/ cut height of 1.5" (37.5mm).

.3 Equipment shall be sharp, level and prevent burning or gouging of lawn.

.4 All clippings and debris shall be removed at the time of mowing, and disposed of off site. This includes but is not limited to wet or dry grass clippings on bollards, lampposts, concrete walls, curbs and steps, asphalt paving, signs, sign posts, benches, sidewalks, pre cast concrete paving, tree trunks and stakes, and shrub planting etc.

.5 The Contractor shall monitor the site for lawn areas that are not in a healthy growing condition and reseed them as soon as conditions are favourable. Areas showing shrinkage due to lack of watering shall be top dressed and seeded with the original mix.

.6 Regular and adequate watering shall be provided in order to promote healthy lawn growth. In the event of watering restrictions which prohibit the use of the automatic irrigation system or in areas which lack an automatic irrigation system, manual watering shall be performed in quantities and at intervals required to promote healthy, vigorous grass growth.

2.4 Maintenance of Plants and Planted Areas

.1 The Contractor shall be responsible for the maintenance of all plants and trees. Maintenance shall include all measures necessary to maintain plants in a vigorous, healthy, normal growing condition, providing an appearance characteristic of their species and appropriate to their surroundings. Such maintenance shall include but not be limited to general cultivation, weed, pest and disease control, mulching, moisture conservation and watering, fertilizing, plant protection, pruning, and general clean-up. Begin maintenance immediately after installation and continue for 60 days after Substantial Performance.

.2 All plant material shall be alive and in a healthy growing condition at the end of the maintenance period. Plant material which is not in such a condition shall be removed from the site and replaced.

.3 Remove and replace dead plants and plants not in healthy growing condition upon notification. Make replacements in same manner as specified for original plantings and within 10 days of written request from Project Landscape Architect or UBC Building Operations, weather and conditions permitting.

.4 All planted areas, including the base of all trees, shall be scarified with appropriate hand tools designed for this purpose. This operation shall be carried out 2 to 3 times per growing season, and as required to prevent caking of surface soil or mulch. Where and when applicable, mulch should be replaced yearly or when required by erosion, decay, cultivation or vandalism.

.5 It shall be the responsibility of the Contractor to maintain an adequate level of soil fertility through the regular application of mulches, suitable fertilizers, and the control of soil acidity where required. Lime shall be applied to plant areas where acidity is excessive (i.e. below pH 4.5). No lime shall be applied where specific planting requires an acid condition such as Ericaceous shrubs, rhododendrons and other acid liking broadleaf evergreens.

.6 The Contractor shall apply, at least twice during growing season, slow release fertilizers to all plants. Apply fertilizer to plants in early spring, after danger of frost has past, and again mid autumn, at manufacturer's suggested rate or as required to promote health growth. Fertilizer shall be slow release, sulphur coated urea base, such as Agrico-Evergro Total (23-3-23) or approved equal. The Contractor shall provide receipts for fertilizers along with the regular maintenance log book.

.7 Regular and adequate watering shall be provided in order to promote healthy plant growth. In the event of watering restrictions which prohibit the use of the automatic irrigation system or in areas which lack an automatic irrigation system, manual watering shall be performed in quantities and at intervals required to promote healthy, vigorous plant growth. Planted areas shall be watered at frequencies required to replace moisture at the root zone. Reform damaged watering saucers at the base of all trees.

.8 Replace or respread damaged, missing or disturbed mulch. Remove dead, broken or hazardous branches from plant material.

.9 All trees shall be protected against wind and snow damage by adequate staking, guying, tying or wrapping as conditions require. Guys, wire ties and stakes shall be examined at frequent intervals, and adjustments or renewals made to prevent abrasions or other damage to plants. Keep tree supports in proper repair and adjustment. Remove tree supports and level watering saucers at the end of the one year maintenance period.

.10 **Note that use of toxic chemical pesticides for cosmetic purposes is suspended on UBC Campus.** Obtain written approval from UBC Building Operations prior to application of toxic chemical pesticides for any extenuating circumstances.

.11 Apply any registered pest control product in accordance with Federal and Provincial regulations as and when required to control insects, fungus and disease.

2.5 Maintenance of Trees Impacted be Construction

.1 The Landscape Contractor shall be responsible for the maintenance of all trees negatively impacted and/or modified by construction activities related to the specific project development.

.2 Post-construction care of impacted trees will include but not be limited to the following:
- .1 Water
- .2 Fertilizer
- .3 Pruning related to construction damages

2.6 Weed Control

.1 The Contractor shall be responsible for the regular inspection and removal of weeds from all landscape portions of the project. **Note that use of toxic chemical pesticides for cosmetic**

purposes is suspended on UBC Campus. Weeding shall be done at a weekly interval during the maintenance period, followed by an inspection by the Project Landscape Architect and/or UBC Building Operations Head Landscape Technologist along with the Contractor. Any weeds that are identified shall be removed within 1 week of inspection. In no cases shall weeds be allowed to be greater than 50 mm in spread. Weeds should be removed in their entirety, including root systems or any other below-ground parts.

.2 Weeds are defined as undesirable plants and will include all plant species not intentionally planted or seeded, unless mutually agreed upon by the Project Landscape Architect and/or UBC Building Operations Head Landscape Technologist and Contractor. Weeds will include, but not be limited to such plants as annual bluegrass, barnyard-grass, chickweed, crabgrass, clover, couch-grass, dandelion, groundsel, horsetail, mallow, morning glory, prickly lettuce, mustards, oxalis, pigweed, pineapple weed, plantain, shepherd's purse, smart weed, snapweed, sowthistle, stork's bill, thistle and will also include invasive, non-native species such as Scotch broom, Himalayan blackberry, purple loosestrife. Weeds will also be defined as any of the grass seedlings that germinate and develop in the mulched shrub bed areas that are caused by an over-application in the seeding or hydroseeding operation.

.3 The Contractor shall monitor the site for the presence of weeds growing in pathways, roadways, shoulders, rock work, and hard construction. All weeds in these areas shall be removed once per month.

.4 The type of weeds in an area shall determine the method of treatment. Weed control may consist of, but is not limited to the following:
- .1 hand-pulling, digging, cultivation,
- .2 encouraging the growth of desired plants which can compete with weeds, and
- .3 timing the mowing of grass areas to correspond with the seeding cycle of weeds.

.5 In situations where there is doubt concerning the necessity or effectiveness of a weed control measure, the decision of the Project Landscape Architect in consultation with UBC Head Landscape Technologist will finalize the best course of action.

2.7 Irrigation

.1 Regulate proper application of water through the irrigation system to ensure healthy plant growth.

.2 Winterize the irrigation system well before freeze-up in fall.

.3 Damage to the sprinkler heads or other parts of the system resulting from Contractor's operations shall be replaced without charge to UBC.

.4 Failures in the irrigation components due to other causes, such as wear, vandalism, accidents caused by others, etc., shall be reported to the Project Landscape Architect and UBC Building Operations Head Landscape Technologist.

.5 All irrigation heads shall be kept clear of debris so that good coverage results.

2.8 Litter and Waste Clean-Up

.1 Clean-up of litter and landscape waste shall be considered part of normal maintenance work. Litter shall include, but not be limited to, bottles, cans, plastic, rubber and all paper. Landscape waste shall include, but not be limited to, windfall, prunings, weeds, grass clippings, fallen leaves, stones and surplus or other waste materials as a result of landscape maintenance and construction operations.

.2 All waste shall be gathered and removed from the site at the end of each day's maintenance operations. All litter shall be gathered and removed from the site weekly.

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

1.0 GENERAL

1.1 Scope

.1 This guideline addresses the protection and care of existing trees, shrubs and plantings that have been designated for retention on, or adjacent to, new building sites and landscape sites on the UBC Campus.

1.2 Coordination

.1 Coordinate as early as possible in the conceptual and design development phases with UBC Campus Arborist.

.2 Coordinate throughout construction phases with UBC Campus Arborist regarding any site changes, potential damages or pruning required to existing trees to be retained.

.3 Coordinate with UBC Building Operations, Head Landscape Technologist during construction regarding any impacts or potential damages to any existing shrubs or plantings designated for retention.

1.3 Standards

.1 Tree and Development: A Technical Guide to Preservation of Trees During Land Development, Matheny and Clark.

.2 *Canadian* Landscape Standard, current addition.

1.4 Definitions

.1 The Critical Root Zone of a tree is an arboricultural rule of thumb for establishing minimum area for tree root protection. It is applied in this guideline for determining Tree Protection Zones and location of tree protection fencing (see 2.1.1 and Fig. 1 below).

.2 Tree Protection Zone is equivalent to the Critical Root Zone and is defined and enclosed by the Tree Protection Fencing for an individual tree designated for tree preservation and protection.

1.5 Related Work:

.1 Section 32 91 00 Planting Preparation
.2 Section 32 93 00 Plants
.3 Section 32 93 05 Relocation of Existing Plant Material

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Tree Relocation and Protection Plans

.1 For trees to be relocated and/or retained on site, the Project Landscape Architect should provide Tree Protection/Relocation Plans indicating surveyed grades at base of trunks, DBH, extents of drip lines and location of Tree Protection Fencing. Specifications and cross-sectional details for applicable preservation strategies including, but not limited to, requirements covered in this general guideline must be included in construction documents.

2.2 Consulting Arborists and UBC Campus Arborist

.1 Where significant heritage trees, or complex tree preservation strategies are anticipated, UBC recommends that a project-specific, ASCA Registered Consulting Arborist be retained as an integral member of the design development team. The Consulting Arborist is to advise on specific pre- and post-development strategies or to provide expert analysis, details and/or specifications required to optimize tree retention and preservation.

.2 The UBC Campus Arborist will be UBC's representative on Campus and will advise on related Campus tree issues with consultants, project managers and site supervisors as required.

2.3 Approvals, Inspections and Supervision

.1 The Campus Landscape Architect, Project Landscape Architect, Consulting Arborist, and UBC Campus Arborist shall coordinate as early as possible in the project to identify trees to be retained, protected, transplanted or removed and clearly establish tree preservation measures and significant design criteria.

.2 Contractor to meet with Project Landscape Architect, Consulting Arborist, and UBC Campus Arborist as required for review of Tree Protection Plan prior to any fencing or hoarding on site.

.3 During the construction phase, the Contractor shall contact UBC Campus Arborist immediately regarding any changes impacting tree preservation on site or to trees immediately adjacent to site boundary.

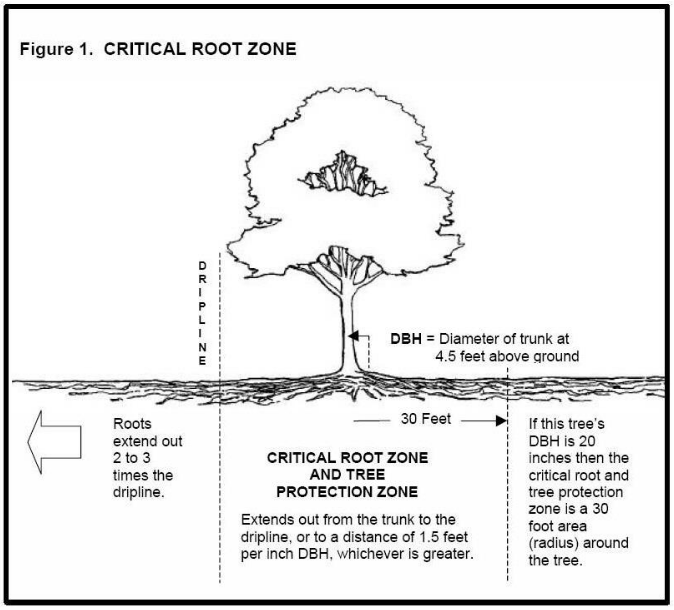
.4 Tree Protection Fencing must be approved by the UBC Campus Arborist prior to the commencement of site work.

2.4 Tree Protection

.1 Tree Protection Fencing must be erected before the onset of construction in relationship to each tree's Critical Root Zone (see fig.1 below). To be as follows:

.1 To be orange snow fencing securely fastened to metal stakes or a *50 x 100 mm (2" x 4")* wood frame with uprights driven into the ground. Fencing will be *1.8m (4')* in height and extend to at least the dripline, or to a distance of *1.0m (1.5')* of DBH (diameter breast height) radius for every *1.8cm (1")* of trunk diameter at DBH (diameter breast height), whichever is the greater (see fig. 1 below).

.2 Tree Protection Fencing for woodlots or groups of plantings, shall be placed at least I.0 meter beyond the dripline of outer canopies.



.2 If site constraints or tree characteristics make the above specifications impractical or impossible, either site design or building layout must be revised, or an alternative fencing layout and/or trunk-root protection strategy must be developed and approved in consultation with the Project Consulting Arborist or UBC Campus Arborist prior to initiation of construction and hoarding activities.

2.5 Tree Protection Signage

.1 Tree Protection Fencing should be signaged at reasonable intervals to discourage hoarding, grade changes and heavy equipment intrusions into Tree Protection Zones. Use either UBC standard signage shown below or an approved equivalent. For significant, heritage or high value trees, signage may be required to display appraised tree value.

2.6 Root Curtain

.1 A temporary Root Curtain shall be required to cover exposed roots along the cut face of excavations made adjacent to Tree Protection Zones. The Root Curtain is intended to minimize root damage and soil erosion and conserve moisture within the soils and roots. The Root Curtain is to consist of heavy wire mesh lined with burlap and supporting posts.

2.7 Tree Mulch and Antidesicant

.1 Based on scope of site disturbance and/or adverse drought conditions, the Consulting Arborist or UBC Campus Arborist may require that mulch or antidesicant shall be applied to trees either at the beginning or at any time during the construction process.

.2 Tree chip mulch, including parts of the leaf, twig, bark and stem wood should be free of pests or diseases and should not contain Western Red Cedar or Black Walnut.

.3 Antidesicant shall be specified by the Project Consulting Arborist or UBC Campus Arborist, and applied by a Certified Arborist according to manufacturer's recommendations.

.4 Provide a sample of the proposed tree mulch and source, and/or antidesicant for approval by UBC Campus Arborist.

2.8 Site Work

.1 All underground utilities, drainage and irrigation lines shall be routed outside the Tree Protection Zone. If utility lines must traverse the Tree Protection Zone, they shall be air-spaded or tunneled under the tree at depths and distances recommended by Project Arborist.

.2 Any pruning required prior to or during construction must be performed by a Certified Arborist.

.3 Any injury or tree damage during construction must be reported immediately to UBC Campus Arborist who will recommend remedial actions as required to be carried out.

.4 Any grading, construction or other work that is expected to encounter tree roots must be monitored by the Project Consulting Arborist or UBC Campus Arborist.

.5 Erosion control devices such as silt fencing, debris basins and water diversion structures shall be installed to prevent siltation and/or erosion within the Tree Protection Zones.

.6 Any roots damaged during construction shall be exposed to sound tissue and cut cleanly with proper pruning equipment. Under no circumstances shall roots be severed by unqualified personnel using excavation equipment or inappropriate tools.

.7 If temporary access roads must pass over the root area of trees to be retained, a road bed of 6"-10" wood-chip mulch with a supportive mat of boards or other rigid material shall be created to protect the roots and soil. The road bed shall be replenished as necessary to maintain a 6-10" depth. Consult with Consulting Arborist or UBC Campus Arborist for site-specific recommendations.

.8 Spoil from trenches, building basements, or other excavations shall not be placed within the Tree Protection Zones.

.9 No burn piles or debris pits shall be placed in the Tree Protection Zone. No ashes, drywall concrete tailings or other debris or garbage may be dumped or buried within the Tree Protection Zone.

2.9 Care and Treatment of Retained Trees

.1 During the construction process, the Contractor will ensure adequate watering is provided within the Tree Protection Zone of each tree so designated. The Contractor will consult with UBC Campus Arborist for recommendation on a watering schedule.

.2 Contractor will exercise due diligence, stop work immediately and contact Project Landscape Architect, Consulting Arborist, and/or UBC Campus Arborist should any unforeseen site changes impact the success of tree preservation on site.

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

1.0 GENERAL

1.1 Related Guidelines

.1 MMCD Master Municipal Construction Documents, current edition

.2 Transportation Association of Canada, Geometric Design Guide for Canadian Roads, current edition

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Design Requirements

.1 All standard municipal roadways should conform to MMCD and the Transportation Association of Canada's, Geometric Design Guide for Canadian Roads, current editions.

.2 All road repair, remediation and rehabilitation shall be compliant with MMCD, current edition.

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

1.0 MATERIALS AND DESIGN REQUIREMENTS

1.1 General Requirements

.1 All expanses of paving associated with all Public Realm spaces must be detailed to accommodate maximum anticipated vehicular loading. Vehicles and heavy equipment such as snorkel lifts required intermittently to service buildings, large trees, or respond to emergencies, must be accommodated without damage to surfacing due to loading.

.2 Any utility upgrades or other projects that disturb and damage existing paving shall reinstate paving to original condition in compliance with relevant guidelines.

.3 Where manholes, catch basins and service covers occur within expanses of unit paving, concrete surrounds should be considered as and additional detail to minimize uneven settling of adjacent paving – especially where increased vehicular loading is anticipated.

1.2 Unit Pavers

.1 Public Realm unit paving should be installed such that:

  .1 No end paving unit to be smaller than 8” x 8”.

  .2 A complete bonded installation of paving units at the ends and/or edges of paving each course is achieved.

  .3 A minimum overlap of paving units is specified thus avoiding the incidence of running straight joints or near straight joints.

  .4 Groupings of similar sized paving units are avoided (e.g. linear runs of 100 mm units would be unacceptable.)

  .5 Sharp-angled cuts are to be avoided.

.2 All edges of unit paving associated with all Public Realm spaces with anticipated vehicular access, must be detailed with contiguous, robust edge support loading without incurring acute or long term collapse and failure. Example would be reinforced concrete banding.

.3 Polymeric jointing sand is recommended in preference to standard jointing sand to increase paving integrity and longevity, and to inhibit weed growth.

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

1.0 DESIGN REQUIREMENTS

1.1 UBC preferences for site furnishings including benches, waste receptacles, and light standards are referenced in the Vancouver Campus Plan, Design Guidelines.

1.2 *Bollard placement must conform to current Public Realm Plan and provide minimum 2.2m spacing between bollard to allow passage of landscape and snow removal equipment.*

1.3 *Site furnishings must be attached using load-appropriate anchors and tamper-proof bolts and fittings.*

1.4 Minimum one year warranty on all site furnishings.

1.5 Minimum five year warranty on garbage receptacles.

2.0 MATERIALS

2.1 Materials shall be corrosion resistant.

2.2 Materials shall be resistant to vandalism and to damage from skateboarders.

2.3 Use of recycled materials is encouraged.

2.4 Selection of materials should be environmentally responsible including consideration of embodied energy of production and avoidance of endangered wood sources.

2.5 Local supply of materials is preferred.

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

1.0 GENERAL

1.1 Scope

.1 This guideline addresses the supply and installation of materials and equipment required to provide complete and properly operating irrigation systems for UBC Campus landscapes.

1.2 Related Work

.1 Section 32 91 00 Planting Preparation
.2 Section 32 92 23 Sodding
.3 Section 32 93 00 Plants
.4 Section 33 10 00 Water Utilities

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Design Requirements

.1 Irrigation is required in all planting areas to support establishment of new installations or future planting renovations, and to support plant health during periods of extended drought or unforeseen site disturbances.

.2 Drip irrigation is prohibited within institutional landscapes maintained by UBC Building Operations, Municipal Landscape Services. (See Part 2.11 Exclusions).

.3 In support of UBC's water conservation initiatives (i.e. the Water Action Plan), the following principles should be carried through design, specifications and implementation phases of landscape projects to reduce short and long term landscape water requirements:

  .1 Simple rain sensors in conjunction with high-efficacy heads, valves and controllers should be specified in favour of other less practical technologies such as soil-moisture sensors or weather stations (see also: 2.11 Exclusions).
  .2 Regardless of the provision of irrigation, tough, drought tolerant plant species must be specified for all projects.
  .3 Massing with sub-shrub or groundcover to reduce soil surface exposure to desiccation.
  .4 Topsoil conservation – i.e. scarifying and stockpiling for re-use where practicable to retain high value topsoils.
  .5 Use of organic soil amendments to improve water retention.
  .6 Organic surface mulches to facilitate soil moisture retention.

.4 Even when irrigated, planting under overhangs have high rate of failure due to winter desiccation and other factors. Such details are strongly discouraged at UBC. Planting and lawns must not extend under building overhangs. Drip strips or other no-planted surfacing shall be provided to extend away from building face to at least align vertically with outer edge of any building overhangs that are at a height or orientation that would exclude normal rainfall from reaching lawn or planting in question.

2.2 Quality Assurance

.1 All irrigation work and irrigation design shall be done by a competent and experienced irrigation consultant/contractor having the skills, facilities, equipment and personnel adequate for the work specified.

.2 Irrigation layout must be designed according to recognized design principles to account for adequate overlap, efficient and sustainable water use with separate zoning for lawns, plantings, trees etc. and significant micro-climatic variations as required.

.3 The Irrigation Contractor shall be a member of The Irrigation Industry Association of British Columbia.

.4 A manufacturer's warranty is required for all irrigation equipment outlined in this guideline and on the irrigation drawing(s).

.5 Verify that all pipe, fittings, primers and cements are compatible.

.6 Obtain field assistance from pipe manufacturer as necessary to ensure correct installation and joining techniques are used.

.7 Do not cement pipe and fittings under wet or muddy conditions.

2.3 Submittals

.1 Water Service Connections: All new or substantially modified connections to the water distribution system at UBC require the submission of a Service Connection Application Form (see http://www.buildingoperations.ubc.ca/resources/policies-procedures-forms/). Project design drawings shall be provided to UBC Energy & Water Services for review (see Section 33 10 00 Water Utilities, 2.3 Water Service Connections for further details).

.2 For Operating and Maintenance Manuals requirements, see Technical Guidelines, Section 01 78 23 Operation and Maintenance Data. Submit one (1) copy of Record drawings to UBC Energy & Water Services.

.3 For UBC Record drawings requirements, see Technical Guidelines, Section 01 78 39 Project Record Documents.

.4 Submit one set of special tools and equipment required for proper operation and maintenance of the system.

.5 Instructions: Coordinate site meeting(s) as required so as to adequately instruct a UBC Building Operations Irrigation Technologist in the complete operating and maintenance procedures for that system.

2.4 Delivery and Storage

.1 Deliver and store materials in new condition and protect until installed. Deliver, handle and store pipe so as to avoid gouging, bending or cracking.

2.5 Site Conditions

.1 Verify the existence and location of all on site utilities and cooperate with the Contractor and UBC Energy & Water Services. Notify the Project Landscape Architect immediately for direction, as to procedure, should any piping or utilities be encountered during excavation.

.2 Prior to the work of this section, carefully inspect the installed work of other trades or contractors and verify that all such work is complete to the extent that irrigation work may commence properly.

.3 Field Measurements: Make all measurements in the field and adjust the design to meet the on-site conditions. In the event of major discrepancies between the drawings and the actual site conditions notify the Project Landscape Architect before proceeding with the work.

.4 Verify the locations of underground services by hand digging or by use of an M-scope.

.5 Repair all damage to underground services. Damage to services that are shown on the drawings or have been brought to the Contractor's attention in the field shall be repaired at the Contractor's expense. Damage to unforeseen services (provided that all reasonable steps were made by the Contractor to ascertain all information regarding existing services) shall be repaired and UBC will pay for the repairs in accordance with the General Condition titled 'Changes'. UBC must be notified immediately of any such damage.

2.6 Protection and Damage Repair

.1 Protect existing buildings, equipment, sidewalks, landscape reference points, monuments, markers and other completed work. Make good all damage resulting from work of this contract at no expense to UBC.

.2 All existing irrigation components, valves and lines to be retained or which serve an adjacent site, must be projected and/or repaired if damaged due to construction activity.

.3 No vehicles shall be parked on the site except those that are essential for the construction of the system. The Contractor shall repair all damage caused by his performance of the contract.

.4 Trenches and other excavations cannot be left open overnight unless they are protected to WCB Standards. In all areas excavated trenches must be covered and barricaded to ensure public safety.

2.7 Warranty

.1 Provide a written warranty for all workmanship and materials for two (1) year from the date of Substantial Performance of the Contract.

2.8 Equals and Alternatives

.1 Any proposed substitutions shall equal or exceed the specifications of the equipment specified. It shall be of good quality, robust and durable construction, and shall have a proven record of reliability and low maintenance wherever it has been used in projects that have the same site conditions.

.2 The proposed equipment shall have a comparable warranty and a local, well stocked distributor.

2.9 Sequencing

.1 Ensure the installation of sleeves and irrigation pipe under paved surfaces, and through planter walls as required.

.2 Verify the location of the water supply for the irrigation system

.3 Verify the location of the electrical conduit for the low voltage wire from the irrigation controller to the landscape.

2.10 Inspection

.1 All work must remain uncovered for inspection of workmanship and materials. Notify the Project Landscape Architect a minimum of forty-eight (48) hours prior to required inspections.

.2 UBC Building Operations Irrigation Technologist must be present for all inspections.

2.11 Exclusions

.1 UBC Building Operations supports water conservation and sustainability initiatives through the use of high efficiency irrigation components; however, the following restrictions on irrigation technologies are to be adhered due to limitations with durability, longevity, operations and maintenance:
- no drip irrigation emitters or tubing systems
- no centralized weather stations
- no subscription-based weather sensors

2.12 Pipe and Fittings

.1 Plastic pipe to be extruded, virgin, high impact PVC pipe that is continuously and permanently marked showing manufacturer's name or trademark, type of material, pipe size and pressure rating. Note: Black, flexible Polyethylene (Poly) pipe may be used where flexibility is essential in working around existing services or tight installations.

.2 All piping to be Schedule 40 PVC.

.3 Plastic pipe fittings to be Schedule 40 PVC designed for solvent welding to PVC pipe except where valves, risers, etc. require threaded joints.

.4 Pipe solvent cement to be CSA approved type as recommended by the pipe manufacturer.

.5 Pipe sleeves under hard surfaces to be Schedule 80 PVC pipe.

2.13 Solenoid Valves

.1 Use preferred Rainbird PEB valves or equivalents.

.2 If a solenoid valve is installed on the irrigation service connection from UBC Energy & Water Services' water distribution system, a hammer arrestor shall be installed upstream of the solenoid valve.

2.14 Sprinkler Heads

.1 Use preferred Rainbird 1800 Series Spray and 5000 Series Rotors or equivalents.

2.15 Automatic Controller

.1 Use preferred Rainbird ESP Modular Controller or equivalent.

2.16 Control and Common Wiring

.1 Insulated multi-strand AWG 18. White to be used as the common.

.2 Wiring from the controller to the landscape may be a minimum of #18 solid wire run in conduit.

.3 All electrical connections to be made with CSA watertight connectors.

2.17 Water Supply

.1 The irrigation branch supply from Utilities service main to the demarcation point shall be ductile iron or copper piping as specified in Section 33 10 00 Water Utilities, 2.6, and valves per Section 33 10 00 Water Utilities, 2.7. See also standard drawing 1140-UT-Waterirrig-Demarc for Demarcation point of Utilities service.

.2 Submit to UBC Energy & Water Services the irrigation load as required on the service connection from UBC Energy & Water Services' water distribution system.

.3 Upon completion of the irrigation assembly in an irrigation chamber and before service is activated, the contractor shall notify for inspection: Energy and Water Services - Engineering and Utilities at 604-822-9445. Notification for inspection shall be provided a minimum 24 hours in advance.

2.18 Irrigation Chamber

.1 For irrigation chamber equipment details, see Section 33 10 00 Water Utilities, 2.6.4.

2.19 Backflow Preventer

.1 Backflow/Cross Connection Control shall be installed as per BC Plumbing Code. Refer to Section 33 12 13.13 Water Supply Backflow Preventer Assemblies for details.

2.20 Layout of Sprinkler System

.1 Co-ordinate exact locations of lines, valves and heads, with planting locations to avoid conflicts and damage to plants during installation. Stake locations and check grades of all components.

2.21 Excavation and Backfilling

.1 The excavation depths for piping shall be:
  - .1 In landscape areas a minimum cover of 300mm (12").
  - .2 Under paving a minimum cover of 450mm (18").
  - .3 On slab place pipe on filter fabric above drain rock if 300mm (12") cover cannot be met.

.2 Trenches shall be straight with uniform slopes to the bottom of the trenches.

.3 Place pipe on firm soil at all points of the trench.

.4 Backfill trenches in 150 mm (6") layers, tamping to ensure compaction of trench is equal to surrounding undisturbed area.

.5 Backfill material shall be free from rocks and other unsuitable materials which could damage the pipe or create unusual settling problems.

2.22 Installation of Piping

.1 Install the piping in accordance with the drawings and with manufacturer's recommendations.

.2 Where possible, main and lateral lines may occupy the same trench provided a minimum 100mm (4") horizontal clearance can be maintained.

.3 No line may be installed parallel to and directly over another line.

.4 All piping to run as straight as possible between fittings.

.5 For secure, durable connections, all pipe joints must have a double-swipe of bonding agent – i.e. applied to the outside (OD) and inside (ID) respectively – of adjoining pipe surfaces.

.6 Remove all excess PVC solvent cement from all solvent weld joints.

.7 Pipe installation shall also include a hose-bib blow-out connection, conveniently located for winterization *exterior to building where it can be accessed with air-compression in-tow*. Vertical lines into mechanical rooms below grade should also be manually drainable by ensuring that backflow device is provided with a drain cock valve.

.8 The entire irrigation system shall be thoroughly flushed with water to remove dirt, scale and foreign matter before sprinkler heads are installed.

2.23 Installation of Sprinklers

.1 Pop-up sprinklers shall have an adjustable riser assembly (triple swing joint) assembled by using at least three standard PVC street elbows.

.2 Triple swing joint risers shall be of Schedule 40 PVC and fittings of Schedule 40 PVC unless otherwise designated on the drawings. Flexible polyethylene swing joints may be substituted where PVC triple single joint installation are not practical.

.3 The bottom street elbow shall be connected to the side outlet on the lateral line.

.4 The PVC nipple on a pop-up sprinkler shall be installed at 45° to the lateral line.

.5 All stationary spray sprinklers shall be installed with two PVC street elbows to connect to the lateral line and a schedule 40 PVC nipple that is long enough to be 100mm (4") above finished grade.

.6 All sprinklers to be installed a minimum of 25mm (1") away from any hard surface.

.7 Sprinkler heads located adjacent to curbs shall be installed 25mm (1") away from back of curb. If necessary to allow installation in this position, asphalt at the back of the curb is to be removed in as narrow a trench as possible to allow installation.

2.24 Installation of Valves and Valve Boxes

.1 All valve boxes to be installed flush with finish grade.

.2 All valves to be installed horizontally and centred in the valve box for ease of accessibility for servicing.

.3 All valve boxes to be blocked so that the valve box does not rest on the piping below.

.4 Valve box sizes and configurations shall be selected to adequately accommodate single or multiple valves such as to allow adequate operation and space for servicing. Use square irrigation boxes only.

.5 All wiring connection in valve boxes to be of sufficient length to permit removal of the top of the valve from the valve box.

2.25 Installation of Wire

.1 Protect low-voltage wiring by installing beneath irrigation lines

.2 All electrical connection to be made in an accessible valve box.

2.26 Clean-Up

.1 Any damage to paving, planting or any other structure due to settlement of improperly compacted trenches shall be promptly repaired at the contractor's expense to the satisfaction of the Consultant.

.2 No activities of backfilling or hard/soft landscaping shall cover up any utilities openings.

.3 Surplus material shall become property of the contractor and removed from the site.

2.27 Operation Inspection

.1 Upon completion of the irrigation system, the entire system shall be tested for proper operation.

.2 The Project Landscape Architect and UBC Building Operations Irrigation Technologist and Head Landscape Technologist must be present for operation inspection.

.3 The contractor shall balance and adjust the various components of the irrigation system to ensure the efficient operation of the system. This includes the adjustment of pressure regulators, part circle sprinklers and individual adjustments of the controllers. Also make minor changes in sprinkler head locations to provide full coverage as part of the work.

.4 Coverage Test: When the irrigation system has been completed, a coverage test shall be performed in the presence of the Project Landscape Architect and UBC Building Operations Irrigation Technologist and Head Landscape Technologist to determine if coverage of water to planting and lawn areas is complete and if any necessary adjustments are required.

.5 Controller Test: Prior to final acceptance of the irrigation system the automatic controllers shall be set in sequence and tested through all zones in the presence of the Project Landscape Architect and UBC Building Operations Irrigation Technologist and Head Landscape Technologist and any necessary final adjustments made.

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

1.0 GENERAL

1.1 Scope

.1 This guideline addresses the materials, and equipment necessary for the supply, placement, and amendment of the growing medium.

1.2 Related Work:

.1 Section 32 93 00 Plants
.2 Section 32 93 05 Relocation of Existing Plant Material

1.3 Definitions

.1 For the purpose of this guideline, the term "Growing Medium" shall mean a mixture of mineral particulates, microorganisms and organic matter which provides suitable medium for supporting intended plant growth. Commercially available landscape soils or native site soils, if proposed for use, will also be subject to landscape soil assessment analysis.

.2 “On-Site Topsoil” refers to topsoils (native or commercially processed) on location at project site, or reallocated, stockpiled and transported from elsewhere on UBC Campus lands. On-Site Topsoil may be excavated, stockpiled, protected and amended in-situ as required by the project. If proposed for project use, On-Site Topsoil will also be subject to landscape soil assessment analysis and amendment.

.3 “Soil Consultant” refers to the professional Agrologist with training in landscape soil analysis and interpretation, who is responsible for laboratory services and recommendations.

.4 “Contractor” refers to the Contractor responsible for the Landscape Works on a project, whether this is the General Contractor, a Landscape Contractor, or a Landscape Sub-Contractor, or a combination of Contractors and Sub-Contractors.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Existing Conditions

.1 On-site topsoil designated to remain undisturbed in-situ, must be assessed, tested, amended, protected from compaction and weed infestation, and otherwise managed for the duration of the project as required and/or directed according to project drawings, specifications, soil test results or as directed by the Project Landscape Architect in consultation with UBC Building Operations Head Landscape Technologist.

.2 On-site topsoil infested with pernicious perennial weeds such as horsetail, vetch or morning glory etc. shall be excavated to depth necessary to prohibit future recurrence and removed from UBC Campus. Alternative remedial strategies must be presented in writing and reviewed and approved by the Project Landscape Architect in consultation with UBC Building Operations Head Landscape Technologist.

.3 On-site topsoil intended for use as growing medium, or as component of growing medium, shall be protected against contamination from invasive or pernicious weeds, insect pests, plant pathogenic organisms and other extraneous and non-organic materials and environmental toxins or contaminants.

.4 Onsite subsoil must not be used as a component of growing medium unless endorsed by Soil Consultant and whereby it can be amended to meet requirements of growing medium.

.5 Following rough grading, examine existing sub-grade conditions and signify acceptance in writing to the Project Landscape Architect.

.6 Ascertain the size and location of all existing services and sub-grades prior to the work.

.7 Repair any damage resulting from failure to exercise such precautions immediately at no cost to UBC.

2.2 Testing

.1 The Contractor who is responsible for supply of growing media and/or conservation of on-site topsoil should be responsible for the testing of the growing media. Testing shall be carried out by Pacific Soil Analysis Inc., at #5 - 11720 Voyageur Way, Richmond, B.C. (Ph. 604 - 273-8226), or an equal approved prior to closing of tender.

.2 Separate tests and analysis shall be conducted for the following:

.1 All distinct types of growing media used on the project including imported soil, retained on-site topsoil, relocated or mixed on-site media, any other distinct formulated soil substitute or mixture.

.2 All media formulated or designated for a special purpose including but not limited to planting, lawns, sports fields, on-slab, extensive or intensive green roofs, living walls, structural soils for street tree planting.

.3 The test shall determine the characteristics and quantity of the amendments to be used to bring the growing media and/or on-site topsoil to a satisfactory chemical and physical condition.

.4 Sand shall be tested for sieve size analysis.

.5 Before adjusting the growing media and/or on-site topsoil as required by the soils testing, submit soils analysis to the Project Landscape Architect and UBC Building Operations Head Landscape Technologist for approval. The Project Landscape Architect shall confirm in writing the growing media and/or on-site topsoil amendments and fertilizer to be applied. The Contractor is responsible for amendment of the growing media and/or on-site topsoil as per the confirmed recommendations.

.6 Soil testing must be completed and recommendations approved by Project Landscape Architect prior to installation of any plant material. Failure to do so may result in the rejection of the growing media and/or retained topsoil, removal of growing media or retained topsoil from the site at no cost to UBC, and replacement with approved growing media as required.

2.3 Product Handling and Storage

.1 All materials to be handled and adequately protected to prevent damage or contamination.

.2 Stockpile materials in bulk form in paved area(s) approved by Project Landscape Architect. Take all precautions to prevent contamination of basic materials from wind blown soil particles, weed seeds and from insects. Contamination of the ingredients may result in their rejection for use. Where paved surfaces are not available prevent contamination of on-site soil or sub-soil or construction materials.

.3 Store fertilizer and chemical ingredients in the manufacturer's original containers.

.4 Store growing medium and/or excavated topsoil in a dry area or covered and protected from weed infestation, contamination, damage, water saturation, compaction or erosion.

.5 Maintain all stockpiled growing medium, excavated topsoil and all related amendments free of weed infestation prior to installation and throughout the duration of the project.

2.4 Inspection

.1 The Project Landscape Architect should be notified prior to soil placement to inspect growing medium.

2.5 Samples

.1 Samples should be submitted for any amendments that are to be used:

  .1 Sample size will be approximately 2 litres volume and be representative of the stockpile (properly sampled).

  .2 Samples must be submitted, tested, and approved by the Project Landscape Architect in writing before the growing medium is amended. Failure to do so may result in the rejection of the growing medium, removal of the growing medium from the site at no cost to UBC, and replacement with approved growing medium.

2.6 Growing Media for Standard Applications

.1 All growing media must conform to the *Canadian* Landscape Standard Current addition as well as the following guidelines and specifications applicable to projects on UBC Campus.

.2 The following guidelines apply to standard applications where media are formulated for use on-grade, over sub-soil, and designated for application to on-grade lawns, trees and plantings as per *Canadian* Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 “Well Groomed” Area.

.3 Growing medium shall be composed of proportions of mushroom manure or mushroom manure / peat moss mix, silts and clays, and sand, which provides suitable medium for supporting intended plant growth. Amendments shall be required based on the soil analysis.

.4 Growing medium shall be free of pernicious weeds or their roots, sticks, building materials, wood chips, chemical pollutants and other substances at levels toxic to plants, and other extraneous materials which detract from the desirable physical and chemical properties for landscaping purposes. Death of plants during the first year which may be attributed to nematodes or toxic materials in the growing medium did not meet this requirement at the time of installation, and may result in a requirement that the Contractor remove and replace dead plants and faulty growing medium. Excessive growth of weeds (as determined by the Project Landscape Architect) in a growing medium may be an indication that unacceptable levels of weed seeds or weed parts were present in the growing medium at the time of installation. Such a determination may result in a requirement that the Contractor remove and replace all affected medium and/or all weeds and weed roots and reduce the growth of weeds to acceptable levels.

.5 Organic matter: mushroom manure, composts, or mixtures of manure, compost or peat will be considered for organic matter amendment. Provide samples to Pacific Soil Analysis (or pre-approved equal), for testing and approval. Approved sample shall be standard throughout.

.6 Pump river sand: sand shall be pumped from a river and free of salt, debris, weeds and toxic chemicals. Sand shall be minimum 50% medium (< 0.5 mm and > .25 mm). Provide sample to Pacific Soil Analysis (or pre-approved equal) for inspection and approval. Approved sample shall be standard throughout.

Sand must be mixed into growing medium prior to placement. Rototilling of sand into installed growing medium is not acceptable.

.7 Growing medium shall require not more than 0.5 kg / sq. m. (100 lb. / 1,000 sq. ft.) of dolomite lime to reach the required pH level.

.8 Organic content shall be within the ranges as per *Canadian* Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 “Well Groomed” Area, for the intended application. This requirement may be met by mixing growing medium components or by topdressing and Rototilling in an approved type of organic matter, based on the recommendation from the soil testing laboratory. (See Section 32 93 00 Plants, 3.6.2 - Fertilizer Application and Soil Amendments).

.9 Drainage of growing medium can be measured only after the growing medium is in place. Mixing and handling of growing medium shall be done in such a manner that the minimum saturated hydraulic conductivity as per *Canadian* Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 “Well Groomed” Area is achieved. Areas with compacted soil after installation must be cultivated to restore the uncompacted nature found throughout the project.

2.7 Special Purpose Media for Non-Standard Applications

.1 Special Purpose Media includes all media for specialized application that requires formulation or amendment which diverges from the generalized specifications and tolerances shown above under Growing Media for Standard Applications and *Canadian* Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 “Well Groomed” Area. Special Purpose Media may include, but not be limited to: on-slab plantings, modular planters, extensive and intensive green roofs, living walls and street tree plantings in pavement.

.2 Complete specifications and details for Special Purpose Media shall be developed collaboratively with the Project Landscape Architect following the recommendations of a Soil Consultant, Structural Engineer, and related project consultants as required before inclusion in contract specifications and drawings.

.3 Specifications and details for Special Purpose Media shall be reviewed and approved by the Project Landscape Architect in consultation with UBC Building Operations Head Landscape Technologist.

.4 Structural Soils used for the installation of trees in urban pavements, plazas and streets will be the preferred planting medium for this type of tree planting. Alternatively, Structural Cell technologies and associated medium may be used if authorized by the Project Landscape Architect in consultation with UBC Campus Arborist, Building Operations Head Landscape Technologist and/or the Campus Landscape Designer.

.5 Specifications and details for Specialized Media shall be provided by Project Landscape Architect in contract documents congruent in scope and equivalent with specifications above detailing Growing Media for Standard Applications and *Canadian* Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 “Well Groomed” Area.

2.8 Growing Media Amendments

.1 Required amendments for any landscape growing media or soils, will be the result of:

   .1 Recommendations from Soil Consultant made after growing media testing and analysis.

   .2 Availability of organic matter amendment.

   .3 The presence or absence of an irrigation system.

.4 The following amendment materials may be required to be added to the growing medium to conform to Soil Test findings.

.1 Organic matter: as per 2.6.8 above.

.2 Pump river sand: as per 2.6.6 above.

.2 Fertilizer and Chemical Ingredients:

Fertilizer and chemical Ingredients may be required by the Project Landscape Architect based on growing media test results to be added to each growing medium to conform to the growing medium standards specified above, and/or as based on the Soil Testing findings as recommended by Soil Consultant.

.1 Fertilizers must be those detailed in the landscape soil analysis report. The Landscape Contractor will not make any substitutions or change of application rates unless having attained written approval of the Project Landscape Architect.

.2 Fertilizers and liming ingredients will be delivered to the site in their original manufacturer's packaging. All materials will be dry and free flowing to facilitate uniform distribution.

.3 Mulch: refer to Section 32 93 00 Plants.

.4 Drainage and Filter Fabric:

.1 Drain rock: 3/4" - 1" diameter round rock washed free of all fines and organic materials.
.2 Filter fabric: heat bonded, rot-proof, non-woven fabric, or approved equal.

2.9 Preparation of Existing Grade

.1 Verify that grades are correct. If discrepancies occur, notify Project Landscape Architect and do not commence work until instructed by Project Landscape Architect.

.2 Eliminate uneven areas and low spots, ensuring positive and free drainage.

2.10 Placement

.1 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 25 mm above surface. Dispose of removed material off site, at no expense to UBC.

.2 Scarify entire area which is to receive growing medium to depth of 100 mm. Scarify those areas where equipment used for hauling and spreading has compacted soil.

.3 No growing medium shall be loaded, transported or spread when it is so wet that its structure is likely to be altered, or risk of compaction exists.

.4 Spread growing medium with adequate moisture in uniform layers over approved, unfrozen subgrade, where sodding and planting is indicated.

.5 Manually spread growing medium to achieve final grades around trees, shrubs and obstacles.

.6 Installed growing medium to 25 mm above design grades to allow for settlement.

.7 Place the growing medium to the following dimensions (Refer to *Canadian* Landscape Standard Table 6-5 Current Edition):

.1 Trees – Min. 600mm (24”) deep and twice the diameter of the rootball around each tree.
.2 Shrubs – Min 450mm (18") depth.
.3 Groundcover - Min 300mm (12") depth.
.4 (Low and High Traffic) Lawns – Min 150mm (6") depth.

2.11 Finish Grading

.1 Leave surfaces smooth, uniform and firm against deep foot printing.

.2 Fine grade growing medium to 25 mm above finished grades shown on drawings. Eliminate rough spots and low areas to ensure positive drainage. Prepare loose, friable beds by means of cultivation and subsequent raking. Final grades to be approved by Project Landscape Architect prior to further work proceeding.

.3 After planting, spread 75 mm layer of specified approved mulch evenly over all exposed growing medium finished grades, to the satisfaction of the Project Landscpe Architect. Refer to Section 32 93 00 Plants for guidelines on mulch specification.

2.12 Acceptance

.1 Project Landscape Architect will inspect growing medium in place and determine acceptance of material, depth of growing medium and finish grading, prior to plant installation.

.2 Approval of growing medium may be subject to soil testing and analysis if any doubt exists concerning its conformity to the requirements as per *Canadian* Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 “Well Groomed” Area, or any of the subparagraphs under paragraph 2.1 of this Section.

2.13 Surplus Material

.1 Dispose of materials not required by Project Landscape Architect off site, at no cost to UBC.

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

1.0 GENERAL

1.1 Scope

.1 This guideline addresses the materials, methodology and services necessary for complete installation of seeded or hydro-seeded lawns and meadows, which includes the control of noxious and pernicious weeds within seeded lawns and meadows.

1.2 Related Work

.1 Related Work in Other Sections:

- .1 Section 32 80 00 Irrigation
- .2 Section 32 91 00 Planting Preparation
- .3 Section 32 93 00 Plants

1.3 Pertinent Standards and Legislation

.1 Conform to the requirements of the latest editions of the following standards and legislation:

- .1 British Columbia Landscape Standard – Current Edition
- .2 British Columbia Standard for Turfgrass Sod
- .3 British Columbia Weed Control Act
- .4 Canada Seed and Fertilizer Act
- .5 Canada Pest Control Products Act

1.4 Submittals

.1 Provide Project landscape Architect and Head Landscape Technologist with guaranteed analysis of the seed mixtures. Submit specification data of seed prior to installation. Submit soil analysis of growing medium with seed specification data.

.2 Provide sample product label and a sample of seed to the Project Landscape Architect and Building Operations Head Landscape Technologist.

1.5 Inspections and Approvals

.1 Notify Project Landscape Architect, UBC Building Operations Head Landscape Technologist and/or Campus Landscape Designer at least forty-eight (48) hours before seeding or hydro-seeding for inspection of finished grades. All lawn and grass installations are subject to inspection and may be rejected for failure to comply with contract specifications at any time until Total Performance. Reseeding of deficient areas shall be done at no expense to UBC.

.2 Notify Project Landscape Architect, UBC Building Operations Head Landscape Technologist and/or Campus Landscape Designer as required by project type, at the completion of work for an inspection for Substantial Performance.

.3 Final inspection of seeded lawns and meadows will be made at the end of the specified warranty period. For release from the Contract, all lawns and meadows must be alive and in a healthy, satisfactory growing condition at the time of inspection. The Project Landscape Architect and Building Ops Head Landscape Technologist, reserves the right to extend the Contractor’s responsibility for another growing season, if in his/her opinion, development and growth of lawn and meadows is not sufficient to ensure satisfactory future growth.

.4 The Project Landscape Architect at his/her discretion may waive one or more inspections, but this shall not impair the right of the Project Landscape Architect to inspect work or materials which have been damaged or in any way do not conform to the contract specifications.

.5 Contractor to be present during all required inspections as specified or as may be required by the Project Landscape Architect.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Product Handling

.1 Deliver seed and hydro-mulch in original, labeled, and undamaged containers. During shipping, storage and installation, protect seed and hydro-mulch materials against moisture.

2.2 Protection

.1 Protect all seeded areas against trespassing, and from pedestrian or vehicular damage at all times until Acceptance. If any seeded areas are damaged, they shall be repaired by the Contractor as required.

2.3 Approved Equals

.1 All seed mixes and hydro-mulches as specified or pre-approved equals.

2.4 Warranty

.1 All workmanship and materials covered under Work of this Section shall be warrantied for a period of one (1) full year from the date of Substantial Performance.

2.5 Materials

.1 Fertilizer shall be as recommended for season of application (as per industry standards).

.2 Dolomite Lime: Shall be finely and uniformly ground containing not less than 90% calcium carbonate.

.3 Lawn and Meadow Seed:

  .1 Seed mixtures shall be suited to the climate, growing medium, site orientation, sun exposure, terrain, establishment and lawn class designation or intended use under which they are to be grown.

  .2 Selections of seed mixtures should take into account the current infestations and impacts of Chaffer Beetle and associated damages by crows and raccoons. Seed mixtures may be available which inhibit the proliferation of this pest. Designing with alternate groundcover or planting should also be considered. Consult with authorities, seed suppliers and Building Operations Head Landscape Technologist as required.

  .3 Seed shall have a minimum germination rate of 75% and minimum purity of 97% except where otherwise required by the professional selecting such seed.

  .4 Professional consultation is required in selecting or designing special purpose mixes for naturalizing or restoration purposes.

.5 The seed mixture shall be mixed, labeled and supplied by a recognized seed supplier. Labels shall include complete details including species names germination percentages, purity of analysis, year of production, and contact info for supplier.

2.6 Hydro-Seeding Materials

.1 Hydro-mulch materials shall consist of a mixture of fiber, seed, fertilizer and water designed for hydro-seeding and dyed for ease of monitoring application.

.2 Hydro-mulch shall contain no growth or germination inhibiting factors, be dry, be free of invasive and other foreign materials.

.3 Hydro-mulch shall be supplied in packages bearing the manufacturers label clearly indicating weight and product name.

.4 Fiber should be coloured, fibrous, wood cellulose or paper based mulch, not containing any growth or germination inhibitors and shall be manufactured so that it will form a uniformly suspended homogeneous slurry when added to the fertilizer, seed and water in a tank when agitated.

.5 When applied, the hydro-mulch shall be applied uniformly and in such a manner as to prevent puddling and movement of the soil surface and be capable of forming an absorptive mat, which will allow moisture to percolate into the underlying soil.

.6 Hydro-mulch may contain a colloidal polythacuride (or equivalent) industry accepted, non-asphaltic, tackifier for adhesion to the mulch material to form a mat on slopes as erosion control, and to avoid chemical agglomeration during mixing in the hydro-mulching equipment.

2.7 Fertilizer

.1 Apply fertilizer at manufacturers' recommended rates. Ensure equal distribution. Mix into top 50 mm. (2") of growing medium by disking, raking or harrowing. Application of fertilizer shall be 48 hours before seeding lawns.

2.8 Liming

.1 Add lime as required to ensure pH 6.0 to 6.5. Mix into full depth of growing medium. Coordinate with soils analysis.

2.9 Subgrade Preparation and Finishing

.1 Obtain approval of Project Landscape Architect, UBC Building Operations Head Landscape Technologist and/or Campus Landscape Designer of subgrade and growing medium prior to seeding of lawns or grasses. Ensure that growing medium is placed to required depths and tolerances as specified and detailed in the Contract Documents and spread evenly over the approved subgrade. Ensure the growing medium is firm against footprints, loose in texture and free of all stones, roots branches etc as required under Section 32 91 00 Planting Preparation.

.2 *Where lawns interface with drip-strips or the like in close proximity to building façades, design should account for potential soiling of glass and painted surfaces with grass clippings. Therefore, baffles, extrusions or other design details should be considered to minimize or alleviate this impact.*

.3 Ensure finish grade surfaces are tamped with roller before seeding, and finish grades are congruent with project drawings as specified.

.4 Grades:

.1 Lawns and grass areas must be graded at slopes safe for mowing by maintenance crews and safe for all other Campus users. Maximum allowable slope for lawns is 5:1. Slopes over 5:1 are only permitted where pre-approved by Campus Landscape Architect in consultation with Building Operations Head Landscape Technologist. (See also Section 31 22 00 Grading, 1.1.1)

.2 Areas to be seeded shall be at grades as shown at the time of seeding.

.3 Restore all areas to be seeded which are misshapen or eroded to original specified condition, grade and slope as directed just prior to seeding. Minor adjustment and refinement of finish grade to be made as directed by the Project Landscape Architect.

.4 Crown or slope for surface drainage and eliminate all low spots or depressions.

.5 If the surface of the growing medium is dry, lightly moisten the growing medium immediately prior to seeding.

2.10 Seeding

.1 Scheduling:

.1 Seeding should be carried out during periods when seasonal conditions are likely to ensure successful germination and continued growth of all species in seed in the grass mix.

.2 All seeding should be conducted during calm weather, and shall be done on soil that is free of ground frost, snow, and standing water.

.3 Hydro-seeding shall not be carried out during periods of moderate to heavy rainfall.

.2 Methods

.1 Seed shall be applied by mechanical dry seeding, hydro-seeding or as specified for designated areas within the site(s) to be developed.

.2 All seeding should be conducted during calm weather, and shall be done on soil that is free of ground frost, snow, and standing water.

.3 Hand seeding shall only be carried out when patching limited areas of lawns or where site conditions preclude the above two methods.

.3 Rates of Application

.1 Rates of application of seed species mixtures, hydro-mulch and other components shall be based on analysis of season, climate, terrain, growing media and establishment and maintenance conditions for intended use.

.4 Mechanical Dry Seeding

.1 Fertilizer, if required, shall be uniformly applied at the rate required and worked well into topsoil by hand cultivating, raking or disking and harrowing to a minimum depth of 5cm (2in).

.2 All grass seed, nurse crop seed and fertilizer shall be measured accurately prior to application.

.3 Seed and fertilizers shall be applied evenly by means of an accurately calibrated, approved mechanical dry seeder at the rate required, or as specified.

.4 Seed shall be applied in two intersecting directions, except where conditions dictate seeding in one direction only.

.5 Seeded areas shall be lightly raked and rolled after seeding to ensure good contact between seed and growing medium.

.6 Mulch may be applied with seed or spread manually following seeding, or with an approved mulcher. Straw mulches must be free of hay, foreign seeds or contaminants detrimental to seed growth and establishment. No area shall be seeded that cannot also be mulched on the same day. The mulch shall be applied to form a uniform mat over the entire area.

2.11 Hydro-Seeding

.1 The quantities of each of the materials to be charged into the hydro-seeder / mulcher tank shall be accurately measured whether by mass or by mass-calibrated volume measurements.

.2 Materials for hydro-seeding shall be added to the tank while it is being filled with water, and in the following sequence: seed, fertilizer, and where applicable, fibrous materials.

.3 Materials shall be thoroughly mixed and agitated into a homogeneous water slurry in the various combinations as described and specified, and shall be distributed according to recommended seed-sowing rates to uniformly cover the surface area with the hydro-seeder / mulcher.

.4 Hydro-seeding equipment shall:

.1 have the tank volume certified by an identification plate or sticker that shall be affixed in plain view on the equipment and shall not be removed or altered.

.2 be thoroughly cleaned prior to any and all seeding applications.

.3 be capable of sufficient agitation to mix the materials into a homogeneous slurry and to maintain the slurry in a homogeneous state until it is applied.

.5 After charging, no water or other material shall be added to the mixture in the hydro-mulcher.

.6 Water slurry and other components should not be left in the tank for more than four hours unless required for specific purposes of application.

.7 Wildflower seed mix, if required, should be applied prior to or during grass hydro-seeding.

.8 The wildflower seed mix shall be such that it meets the requirements of the Seed Act and be free of any invasive plant species or potentially invasive pernicious weeds.

.9 Hydro-seeding shall be done with care to ensure that the fertilizer in solution does not come in contact with the foliage of any trees, shrubs or other susceptible vegetation. Seed or mulch shall not be sprayed in areas or on objects not expected to grow grass.

.10 Existing site equipment , roadways, landscaping, reference points, monuments, markers, structures and vehicles shall be protected as required from over-spray damage.

.11 Over-spray or damage that occurs during hydro-seeding shall be rectified by the Contractor at no expense to UBC.

.12 Temporary fencing, barriers, barricades or signage shall be provided and maintained to protect newly seeded areas from damage including but not limited to, erosion, pedestrian and vehicular traffic or wildlife.

2.12 Maintenance

.1 Refer to Section 32 01 90 Operation and Maintenance of Planting for complete maintenance guidelines.

.2 The maintenance period begins at the time lawns and meadows are planted and continues for 55 days from the date of Substantial Performance.

.3 Maintenance shall consist of all measures necessary to keep grass healthy, in a vigorous growing condition and well rooted into the underlying soil. Maintenance shall include, but shall not be limited to the following:

.4 Maintenance of Lawn Areas:

.1 Mowing: Once fully established, mow out at regular intervals as required to maintain grass at a standard maximum height of 60mm (2-1/2"). Not more than 1/3 of the blade shall be cut at any one mowing. Heavy clippings shall be removed immediately after mowing and trimming.

.2 Edging / Trimming: All lawn perimeters and around walkways, curbs, walls, bed edging, utilities and other fixtures shall be edged and trimmed at each mowing or at intervals sufficient to maintain a crisp and neat appearance. Absolutely do not use line trimmers around trees and shrubs. Sprinkler heads shall be trimmed to clear as often as necessary to keep them operating properly. The hard surface areas adjacent to the lawns shall be swept and cleaned after each operation.

.3 Fertilizing: Post-establishment fertilizer shall follow initial mowing and shall be carried out when grass is dry. Unless otherwise specified, use fertilizer that will provide at least 0.45kg/92.9 sq. m. (1 lb/1000 sq. ft.) of lawn area.

.4 Watering shall be carried out when required and with sufficient quantities to prevent grass and underlying growing medium from drying out.

.5 Rolling shall be carried out when required to remove any minor depressions or irregularities.

.6 Weed control shall be carried out before the density of weeds reaches 10 broadleaf weeds or 50 annual weedy grasses per 37 sq. M. (400 square feet).

.7 Weed control shall reduce the density of weeds to zero or near zero as dictated by intended use and lawn class (see *Canadian* Landscape Standard).

.8 Any lawn areas showing deterioration or bare spots shall be repaired immediately. All areas showing shrinkage due to lack of watering shall be top dressed and seeded with a seed mix matching the original seed mix.

.9 All lawn areas shall be adequately protected with warning signs and fencing as directed by Project Landscape Architect. Fencing shall be maintained in good condition to provide a continuous barrier until Acceptance. Except as otherwise required by the work of the Contract, the fencing shall be removed from the site only upon Acceptance.

.10 Clean-up: Clean-up shall include removal of clippings from all walks, curbs and other paving.

.5 Maintenance of Meadow Areas:

.1 Mowing: Once fully established, mow one time per year after seed has dried on mature plants – i.e. end of September trough to mid-October. Additional mowings may be supplemented as required by site location, site condition, site usage, vigor and growth rate of meadow mix. Do not mow if the soil and meadow area are wet. Let clippings fall but clean all clippings from hard surface areas. During the growing season, unless otherwise specified, mow 1.5 meter width next to walkways, plazas, parking areas and roadways for a more tidy appearance.

.2 Edging / Trimming: Unless otherwise specified, all meadow perimeters and around walkways, curbs, walls, bed edging, utilities and other fixtures shall be edged and trimmed at each mowing or at intervals sufficient to maintain a crisp and neat appearance. Absolutely do not use line trimmers around trees and shrubs. Sprinkler heads shall be trimmed to clear as often as necessary to keep them operating properly. The hard surface areas adjacent to the meadows shall be swept and cleaned after each operation.

.3 Fertilizing: No fertilizer shall be used on meadows unless otherwise specified for special site or conditions.

.4 Watering shall be carried out only to ensure proper establishment of meadow and if required with sufficient quantities to prevent grass and underlying growing medium from drying out. Otherwise, post-establishment meadows should not require watering.

.5 Any meadow areas showing deterioration or bare spots shall be repaired immediately. All areas showing shrinkage due to lack of watering during establishment period shall be top dressed and seeded with a seed mix matching the original seed mix.

.6 Weed Control: the use of toxic pesticides for cosmetic purposes has been suspended on UBC Campus. Manual weed control is the preferred method and may be the only permitted methodology. Remove and replace significantly affected lawn and meadow areas. Consult with Project Landscape Architect and UBC Building Operations Head Landscape Technologist for approval of any alternative organic weed control substances or methodologies.

.7 All meadow areas shall be adequately protected with warning signs and fencing as directed by Project Landscape Architect. Fencing shall be maintained in good condition to provide a continuous barrier until Acceptance. Except as otherwise required by the work of the Contract, the fencing shall be removed from the site only upon Acceptance.

.8 Maintenance clean-up: Clean-up shall include removal of clippings from all walks, curbs and other paving.

2.13 Clean-Up

.1 All excess materials and other debris resulting from site development and seeding operations shall be removed from the job site.

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

1.0 GENERAL

1.1 Scope

.1 This guideline addresses the materials, methodology and services necessary for complete installation of sodded lawns, which includes the control of noxious and pernicious weeds within seeded lawns and meadows.

.2 Due to the current prevalence of damages associated with Chaffer Beetle, the scope of sod installation should be limited if not suspended where practical in favour of seeding with resistant seed mixtures, or designing with alternate groundcover or planting. See Section 32 92 00, Turf and Grasses, 2.6.3.2.

1.2 Related Work

.1 Related Work in Other Sections:

.1 Section 32 80 00 Irrigation
.2 Section 32 91 00 Planting Preparation
.3 Section 32 93 00 Plants
.4 Section 32 92 00 Turf and Grasses

1.3 Pertinent Standards and Legislation

.1 Conform to the requirements of the latest editions of the following standards and legislation:

.1 *Canadian* Landscape Standard – Current Edition
.2 British Columbia Standard for Turfgrass Sod
.3 British Columbia Weed Control Act
.4 Canada Seed and Fertilizer Act
.5 Canada Pest Control Products Act

1.4 Submittals

.1 Provide Project Landscape Architect with guaranteed analysis of the grass mixture and purity of sod. Submit specification data of sod prior to installation. Submit soil analysis of sod growing medium with sod specification data.

1.5 Inspections and Approvals

.1 All sod installations are subject to inspection and may be rejected for failure until Total Performance. Replace rejected materials and remove from site at no expense to UBC.

.2 Notify Project Landscape Architect at the completion of work for an inspection for Substantial Performance.

.3 Final inspection of sodded lawns will be made at the end of the specified warranty period. For release from the Contract, all sodded lawns must be alive and in a healthy, satisfactory growing condition at the time of inspection.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Product Handling

.1 During shipping, storage and installation, protect sod against drying, to the requirements of the B.C. Standard for Turfgrass Sod.

2.2 Protection

.1 Protect all sodded areas against trespassing and from damage at all times until Acceptance. If any sodded areas are damaged, they shall be repaired as required by the Contractor.

2.3 Warranty

.1 All workmanship and materials covered under Work of this Section shall be warrantied for a period of one (1) full year from the date of Substantial Performance.

2.4 Materials

.1 Fertilizer shall be as recommended for season of application (as per industry standards).

.2 Dolomite Lime: Shall be finely and uniformly ground containing not less than 90% calcium carbonate.

.3 Sod:

.1 Suitability: All turfgrass sod shall be suited to the locality, site conditions and intended function of each project or area.

.2 Sod shall be nursery grown turfgrass sod, true to type, conforming to the B.C. Standard for Turfgrass Sod. "Non-Netted" Sod only will be accepted.

.3 The quality grade of sod (based on B.C. Standard for Turfgrass Sod) shall be No. 1 Premium Grade grown on a screened alluvial sand base, cultivated on a sterilized soil base to ensure a weed free product. The maximum fines (silt and clay) in the alluvial sand base to be no more than 1% by weight.

Sod to be:

.1 'Supreme' (30% Kentucky Blue, 30% Fescue, 40% Perennial Rye) as grown by Anderson Sod Farm, 10821 Farms Road, Mission, B.C., 604-826-2383

.2 Or approved equal. Equivalency to be reviewed and approved at the UBC shop level.

.4 Submit sieve analysis for turf farm sand if requested by Project Landscape Architect.

.5 The grass mixture in sod shall be suited to the location and intended use and shall be as described in the B.C. Standard for Turfgrass Sod unless otherwise specified.

.4 Weed Control: the use of toxic pesticides for cosmetic purposes is voluntarily suspended on UBC Campus. Manual weed control is the preferred method and may be the only permitted methodology. Remove and replace significantly affected sod. Consult with Project Landscape Architect and UBC Building Operations Head Landscape for approval of any alternative organic weed control substances or methodologies.

2.5 Fertilizer

.1 Apply fertilizer at manufacturers' recommended rates. Ensure equal distribution. Mix into top 50 mm. (2") of growing medium by disking, raking or harrowing. Application of fertilizer shall be within 48 hours of laying sod.

2.6 Liming

.1 Add lime as required to ensure pH 6.0 to 6.5. Mix into full depth of growing medium. Coordinate with soils analysis.

2.7 Subgrade Preparation and Finishing

.1 Obtain approval of Project Landscape Architect of subgrade and growing medium prior to laying any sod. Ensure that growing medium is placed to required depths and tolerances as specified and detailed in the Contract Documents and spread evenly over the approved subgrade. Ensure the growing medium is firm against footprints, loose in texture and free of all stones, roots branches etc as required under Section 32 92 00 Turf and Grasses.

.2 Ensure finish grade surfaces are tamped with roller before laying sod, and finish grades are congruent with project drawings as specified.

.3 Grades:

  .1 Sodded lawns must be graded for safe operation of maintenance equipment and must not exceed 3:1 maximum slope, 5:1 preferred (please refer to Section 31 22 00 Grading).

  .2 Areas to be sodded shall be at grades as shown at the time of sodding, less an allowance for the thickness of the sod.

  .3 Restore all areas to be sodded which are misshapen or eroded to original specified condition, grade and slope as directed just prior to sodding. Minor adjustment and refinement of finish grade to be made as directed by the Consultant.

  .4 Crown or slope for surface drainage and eliminate all low spots or depressions.

.4 If the surface of the growing medium is dry, lightly moisten the growing medium immediately prior to laying sod.

2.8 Sod Laying

.1 Use full rolls where possible. No bits or sod remnants are allowed.

.2 Only lay sod within acceptable weather conditions during March through mid-October. Do not lay sod during periods of high summer temperatures, or drought when no consistent, supplementary irrigation is available to retain sod and underlying medium in moist condition. Do not lay sod during periods of heavy rainfall and when excessive puddling is apparent on site.

.3 Lay sod in rows with ends staggered. Butt all sections closely. Do not overlap or allow gaps wider than 2mm between sections. Top of sod to be flush with adjacent walking surfaces.

.4 Protect new sod from heavy foot traffic during laying. Place planks or plywood if necessary to prevent damage. Lay within 24 hours after delivery to prevent deterioration. Any sod laid after the 24 hour period will be rejected.

.5 Lay sections on slopes at right angles to the direction of the slope. Stake sod into place with wood stakes driven flush with the surface in any locations having slopes steeper than 3:1 (NOTE: Sloped lawns over 3:1 are only permitted where pre-approved by Campus Landscape Architect in consultation with Building Operations Head Landscape Technologist. Interval spacing on stakes shall not exceed 500mm. Prior to pedestrian traffic being allowed onto the sod, and only after the sod is well rooted into the growing medium, pegs or stakes shall be removed or driven to an elevation 50mm below the finished surface.

.6 Cut sod where necessary only with sharp tools.

.7 Water thoroughly to penetrate the full depth of the growing medium as specified.

.8 When sod has dried sufficiently, roll with 113kg. (250lb.) roller to obtain smooth uniform surface and ensure a good bond between soil and sod.

.9 Erosion control netting shall be installed in sodded areas where required, erosion control mesh or netting shall be placed and secured with stakes or staples set firmly into the ground to a minimum depth of 150mm. Spacing of stakes or staples shall be adequate to ensure complete anchorage of the sod to the ground.

2.9 Maintenance

.1 Refer to Section 32 01 90 Operation and Maintenance of Planting for complete maintenance guidelines.

.2 The maintenance period begins at the time lawns and meadows are planted and continues for 55 days from the date of Substantial Performance.

.3 Maintenance shall consist of all measures necessary to keep grass healthy, in a vigorous growing condition and well rooted into the underlying soil. Maintenance shall include, but shall not be limited to the following:

  .1 Mowing shall be carried out at regular intervals as required to maintain grass at a standard maximum height of 60mm (2-1/2"). Not more than 1/3 of the blade shall be cut at any one mowing. Edges of sodded areas shall be neatly trimmed. Heavy clippings shall be removed immediately after mowing and trimming.

  .2 Edging / Trimming: All lawn perimeters and around walkways, curbs, walls, bed edging, utilities and other fixtures shall be edged and trimmed at each mowing or at intervals sufficient to maintain a crisp and neat appearance. Absolutely do not use line trimmers around trees and shrubs. Sprinkler heads shall be trimmed to clear as often as necessary to keep them operating properly. The hard surface areas adjacent to the lawns shall be swept and cleaned after each operation.

  .3 Fertilizing: Post-establishment fertilizer shall follow initial mowing and shall be carried out when grass is dry. Unless otherwise specified, use fertilizer that will provide at least 0.45kg/92.9 sq. m. (1 lb/1000 sq. ft.) of lawn area.

  .4 Watering shall be carried out when required and with sufficient quantities to prevent grass and underlying growing medium from drying out.

.5 Rolling shall be carried out when required to remove any minor depressions or irregularities.

.6 Weed control shall be carried out when the density of weeds reaches 10 broadleaf weeds or 50 annual weedy grasses per 37 sq. M. (400 square feet).

.7 Weed control shall reduce the density of weeds to zero.

.8 Any sodded areas showing deterioration or bare spots shall be repaired immediately. All areas showing shrinkage due to lack of watering shall be top dressed and seeded with a seed mix matching the original seed mix.

.9 All sodded areas shall be adequately protected with warning signs and fencing as directed by Consultant. Fencing shall be maintained in good condition to provide a continuous barrier until Substantial Performance. Except as otherwise required by the work of the contract, the fencing shall be removed from the site only upon Acceptance.

.10 Clean-up: Clean-up shall include removal of clippings from all walks, curbs and other paving.

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

1.0 GENERAL

1.1 Scope

.1 This guideline addresses the handling, care, installation, materials, warranty and replacement of plant material installed for new landscape and building projects on UBC Campus.

1.2 Related Work

.1 Section 32 93 05 Relocation of Existing Plant Material
.2 Section 32 91 00 Planting Preparation
.3 Section 32 92 00 Turf and Grasses
.4 Section 32 92 23 Sodding
.5 Section 32 01 90 Operation and Maintenance of Planting

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Pertinent Standards and Legislation

.1 All materials and execution to conform to the latest edition of the following standards or as otherwise specified in contract documents:

.1 CLNA, Canadian Standards for Nursery Stock, current addition.
.2 *Canadian* Landscape Standard, current addition.
.3 ISA / ANSI, ANSI-A300, Standards for Tree Care Operations.

2.2 Planting Layout, Massing and Plant Selection

.1 Consider the limits and frequencies of institutional maintenance practices at UBC, and design accordingly for efficiency, servicing accessibility, low maintenance, weed control, pest, disease and drought tolerance.

.1 Regardless of whether irrigation will be installed on site, the selection of predominately drought tolerant plants should be emphasized.

.2 Where stormwater detention features are incorporated into the landscape, careful condition of the full range of hydrological fluctuations throughout the season should be considered. Plant selection and/or supplementary irrigation and drainage should be considered to avoid inappropriate plant selections, or conditions that are unreasonably dynamic. Hydrophilic plants should not be mixed with hydrophobic plants.

.3 Massing of plants, in terms of alignment and dimensions, should be such that plantings are accessible by maintenance staff for weeding, pruning trimming without causing undue damage to plantings.

.4 Plants selected for massing should be adapted to perform well in massing pattern and resist premature decline due to over-planting, and should be resistant to branch damage from maintenance foot traffic.

.5 Fragile plants or plants with intense care requirements should be avoided. Plants should be selected for their robustness and capacity to endure urban conditions.

.6 Care should be taken with selection of massing plants for steep slopes to ensure drought tolerance, quick coverage, appropriate growth habit, good vigor, soil stabilizing capacity and limited maintenance requirements. (See Section 31 22 00 Grading regarding slopes).

.7 Plants should be selected that do not contain toxic substances or produce dusts, exudates or odours that cause irritation, chemical burns, poisoning or allergic reactions. Check authoritative references. See also, WorkSafe BC, Toxic Plant Warnings.

.8 Avoid plant species that are known to have a high susceptibility to insect and disease infestations. Select plant species that are known to exhibit a high degree of pest and disease resistance.

.9 Avoid plant species that spread into thickets with underground rhizomes. Were variances to this guideline may have been granted by reviewers, plantings with these characteristics must be contained with enclosed root barrier of the required depth to prohibit root migration into adjacent plantings, structures, buildings, ponds, irrigation or drainage systems.

.10 Avoid all plant species identified as "Invasive Plants" by the Invasive Species Council of BC.

2.3 Tree Selection and Placement

.1 In general, tree species selected for use on UBC Campus should be:
- .1 Low maintenance.
- .2 Tolerant of local conditions.
- .3 Resistant to branch failure and wind-throw.
- .4 Pest and disease resistant.
- .5 Structurally sound requiring no significant compensatory or remedial pruning.
- .6 Free from problem characteristics such as:
  - Heaving root systems.
  - Significantly messy plant parts (i.e. leaves, fruit, seeds etc.)
  - Allergenic or objectionable properties (excessive pollen, dust or malodorous).

.2 Individual trees selected for planting must be:
- .1 Nursery trained with a single leader (exception: multi-stemmed species such as Vine Maple).
- .2 Verified free of pests and diseases.
- .3 Verified free of pernicious weeds in the rootball or container.
- .4 Verified free of girdling roots.

.3 Tree planted within 60 cm of walkway or paved surface must have a 45 cm deep root barrier installed along edge of surfacing prior to addition of topsoil and tree planting.

.4 Trees should be sited with consideration of their maximum height and spread at maturity. Trees should not be placed:
- .1 With branches overhanging buildings, light wells or air-intakes.
- .2 Under overhead signs, canopies, or building overhangs.
- .3 Too close to building facades, in front of entryways or obstructing walkways, roadways or traffic signage.
- .4 In significant conflict with site lighting structures or lighting dispersal pattern intentions.
- .5 Within 1.5 meters of underground utility, valve box, service vault or catch basis etc.
- .6 In locations that would subject the tree to excessive soil/root compaction due to pedestrian or vehicular traffic.
- .7 In extensively built-out locations with limited soil volume, such as narrow plantings, between roads and walkways or narrow roadway medians, unless special provisions are made (see .4 below).

.5 Current arboricultural theory and practice recognizes that trees grow in health and vitality in proportion to soil volume below the surface. Sub-standard soil conditions or limited soil volumes under pavements can significantly reduce tree performance and longevity, cause premature damage to pavement and underground services, and have implications for public safety.

Consultants and project managers are strongly encouraged to plan, budget and design to optimize soil conditions for root systems under pavements. The primary methods most commonly recommended for increasing soil volume under pavements are:

.1 Structural Soil: "…is a designed medium which can meet or exceed pavement design and installation requirements while remaining root penetrable and supportive of tree growth". (Cornell University, Urban Horticulture Institute)

.2 Suspended Pavements and Structural Cells: "A modular, pre-engineered cell system … to meet the needs of water management, soil and tree roots…[and] create large spaces under pavement…supported and protected from root damage by the cell structure."

The following references are suggested for further information and sample details:

.1 Urban, James. Up by the Roots: Healthy Soils and Trees in the Built Environment. Champaign, Ill. : International society of Arboriculture, c2008.

.2 Hopper, Leonard J., ed. Landscape Architectural Graphic Standards. Hoboken, N.J.: John Wiley & Sons, c2007. (see: Tree Planting in Urban Areas, p361)

.3 Cornell Urban Horticulture Institute Structural Soil: An Innovative Medium Under Pavement that Improves Street Tree Vigor: http://www.hort.cornell.edu/uhi/outreach/csc/article.html.

2.4 Coordination

.1 Coordinate review of all planting designs and tree selections during design development phases with Campus Landscape Architect to ensure congruence with Vancouver Campus Plan Design Guidelines.

.2 Coordinate review of planting designs and tree selections during design development phases with Campus Landscape Architect in conjunction with Building Operations Landscape Designer, Campus Arborist and/or Head Landscape Technologist as required to ensure plant selections and arrangements are congruent with current maintenance operations, institutional horticultural practices and resource scheduling.

.3 Review any plant or tree substitutions during design or construction phases with Campus Landscape Architect in conjunction with Building Operations Landscape Designer, Campus Arborist and/or Head Landscape Technologist to ensure appropriateness as per 2.4.1 and 2.4.2 above.

.4 Coordinate review of all planting designs requiring specialized care or technologies such as botanical collections, green roofs, living walls and bioengineered plantscapes during design development phases with Campus Landscape Architect in conjunction with Building Operations Landscape Designer, Campus Arborist and/or Head Landscape Technologist to ensure appropriateness as per 2.4.1, 2.4.2 and 2.4.3 above.

2.5 Delivery, Storage and Protection

.1 All plant material is to be off-loaded, handled and moved on site so as to avoid dropping and sudden impacts to roots and rootballs.

.2 Contractor to ensure all plant material is free of damages, defects, noxious perennial weeds and is true to type as specified on plant list. Sub-standard plant material or weed infested plant material shall not be accepted or installed by the contractor.

.3 The contractor shall be responsible for the storage, protection and installation of all plant material.

.4 Immediately store and protect plant material which will not be installed within 1 hour after arrival at site in storage location approved by Project Landscape Architect.

.1 Protect stored plant material from frost, wind, sun, drought and physical damage as follows:

.1 For bare root plant material, preserve moisture around roots by heeling-in or burying roots in hem/fir mulch or topsoil and watering to full depth of root zone.

.2 For pots and containers, maintain moisture level in containers. Heel-in fibre pots and all other containers as required for increasingly adverse weather conditions.

.3 For balled and burlapped and wire basket root balls, keep moist before planting by heeling-in with mulch or soil.

.4 Place all plants stored on site in such a way as to protect branches, rootballs and roots from damage.

.5 Verify existence and location of any on-site utilities. Contact the Project Landscape Architect immediately for directions as to procedure should any piping or utilities be encountered during excavation.

.6 Protect existing equipment, sidewalks, landscaping reference points, monuments and markers. Make good all damage incurred during this work.

.7 Make every effort to protect plants in storage adjacent to any construction work.

.8 Erect temporary continuous barriers, and/or tree protection fencing where necessary to ensure safety of existing plants and trees. Refer to Section 32 01 93.01 Tree and Shrub Preservation.

.9 Replace, at no expense to UBC, any plant material damaged as a result of the work of this section.

.10 Protect fertilizers from moisture.

.11 Notify the Project Landscape Architect a minimum of forty-eight (48) hours prior to each delivery.

2.6 Warranty

.1 Warranty should stipulate that plant material will remain free of defects as per contract plant lists and landscape specifications, for one (1) full year from the date of certified Substantial Performance of the Work.

.2 End-of-warranty inspection will be conducted by the Project Landscape Architect and UBCs representatives including a representative(s) from UBC Municipal Landscape Services.

2.7 Inspection

.1 Make all trees and plant material available for inspection at one location well in advance of scheduled planting time. Notify the Project Landscape Architect when plants are available for inspection.

.2 All plants are subject to inspection and may be rejected for failure to comply with contract specifications at any time until Substantial Performance. Replace rejected material and remove from the site at no cost to UBC.

.3 Notify the Project Landscape Architect at the completion of work for an Inspection for Substantial Performance.

.4 Final inspection of all planting will be made at the end of the specified warranty period. For release from the Contract, all plant materials supplied or transplanted must be alive and in a healthy, satisfactory growing condition at the time of inspection.

.5 The Project Landscape Architect at his discretion may waive one or more inspections, but this shall not impair the right of the Project Landscape Architect to inspect work or materials which have been damaged or in any way do not conform to the contract specifications.

.6 Contractor to be present during all required inspections as specified or as may be required by the Project Landscape Architect.

2.8 Replacements

.1 Replace all plant material found dead, or not in a healthy, satisfactory growing condition or which, in any other way, do not meet the requirements of the project or contract specifications, at Contractor's expense, during and up to end of the warranty period.

.2 The cost of replacements resulting from theft, accidental damage, vandalism, carelessness on the part of others shall not be borne by the Contractor.

.3 All required replacements shall be plants of the same size and species as specified on the plant list and shall be supplied and planted in accordance with the drawings, specifications and change orders.

.4 Replace defective or dead plants, trees, lawns or plantings as required during the 1 year maintenance and warrantee period to the satisfaction of the Project Landscape Architect and UBC Building Operations.

2.9 Substitutions

.1 If it is impossible to obtain the particular plant material listed on the Landscape Drawing, the Contractor may be permitted to suggest substitutions with types and variations possessing the same characteristics. The Contractor must request any substitutions of trees in writing at least three (3) months and shrubs and groundcover at least two (2) months prior to planting. Substitutions must be approved by the Project Landscape Architect in consultation with UBC Landscape Architect and UBC Municipal Landscape Services department.

2.10 Plant Material Identification

.1 Plant material that has been located by the Project Landscape Architect and tagged for the project is to have the identification tags removed only after inspection and instruction by the Project Landscape Architect after delivery to the site.

2.11 Planting Time

.1 Plant only during the season or seasons which are normal for such work determined by weather conditions and as approved by the Project Landscape Architect.

.2 Do not plant during freezing and/or abnormally hot, dry weather.

2.12 Maintenance

.1 Refer to Section 32 01 90 Operation and Maintenance of Planting for complete maintenance guidelines.

.2 The maintenance period begins at the time each plant is planted and continues for 55 days from the date of Substantial Performance.

.3 Maintenance includes necessary watering, cultivation, weeding, pruning, mowing, aerating, disease and insect control as required with organic pesticides, replacement of unacceptable material, straightening plants which lean or sag, adjustment of plants which settle or are planted too low, and any other procedures consistent with good horticultural practice necessary to insure normal, vigorous and healthy growth of all work under contract.

.4 Maintain all accessories such as tree stakes, etc., in good condition including adjustment to keep tree stakes tight. Repair or replace all such accessories when required.

2.13 Area of Plant Supply and Search

.1 Before substitutions of plant material are considered, documented due diligence that the specified material is not available at nurseries throughout Pacific Northwest (Canada and United States) must be provided. Area of supply shall include but shall not be limited to the area as mentioned herein.

2.14 Plant Material

.1 Trees, shrubs, groundcovers, perennials etc., shall be nursery grown of sizes and quantities shown in plant lists on landscape drawings and specification.

.2 Conform to the *Canadian* Landscape Standard and Canadian Standards for Nursery Stock. In particular:

  .1 "Nursery stock shall be true to name, and of the size or grade stated."

  .2 "Quality must be typical for the species when grown under proper cultural practices...viable, substantially free from pests and disease, and undamaged."

  .3 "Between digging and delivery, roots must not be subject to long exposure to drying winds, sun, or frost, between digging and delivery."

  .4 "Root balls and containers must be free from pernicious, perennial weeds."

  .5 “All normal quality nursery stock must have an adequate fibrous root system that has been developed by proper cultivating practices, particularly transplantings or root pruning.”

  .6 “Plants must be grown in the container for a minimum of three months or have a well established root system reaching the sides of the container to maintain a firm ball.”

.3 Plant materials should be transplanted or root-pruned at the nursery at least once within the year prior to planting.

.4 Take precautions during digging, handling and shipping of plant material to avoid injury to plant parts, branches and root systems.

.5 Trees designated B&B shall be properly dug with firm, natural balls of soil retaining as many fibrous roots as possible, in sizes and shapes as specified in the Canadian Standards for

Nursery Stock. Balls shall be firmly wrapped with non-synthetic, rottable burlap and secured with nails and/or heavy, non-synthetic rottable twine. The root collar shall be apparent at surface of ball. Trees with loose, broken, processed or manufactured root balls shall not be accepted.

.6 Trees and plants designated as transplants, bareroot or collected plants, shall not be dug or installed before dormancy or after bud break.

.7 All plants, typical of their species or variety, shall have a normal habit of growth and shall be first quality, sound, healthy, vigorous, well branched, and densely foliated, free of disease, insect pests, eggs or larvae, healthy well furnished root systems free of binding or girdling roots.

.8 Plants must conform to the measurements specified in the plant list. Measurements specified are minimum size acceptable for each variety. Plants that meet the requirements specified in the plant list, but that do not possess a normal balance between height and spread will not be accepted. Plants for use when symmetry is required, or when planted in formal rows, shall be matched in form and size as nearly as possible. Do not prune prior to delivery.

.9 All plants and all tree trunks shall be measured when the branches are in the normal position. Dimensions for height and spread as contained herein refer to the main body of the plant and not from branch-tip to branch-top. The height of tree trunks need not be as specified if the required height can be obtained by pruning the lower branches without leaving unsightly scars or otherwise damaging the trunk**.** Do not prune branches to obtain the required height, before the plants are delivered to the site unless so approved in writing by the Project Landscape Architect.

.10 As per Canadian Standards for Nursery Stock: tree caliper must be the determining measurement when the caliper exceeds 40 mm (1.5 in.). It must be measured no less than 150 mm (6”) above the ground level for trees with a caliper up to 100 mm (4”). Trees 100 mm (4in.) and larger caliper are to be measured 300 mm (12 in.) above the ground level.

.11 All trees must have straight trunks with a single leader intact. Trees with multiple leaders, unless specified, shall be rejected. Trees with a damaged of crooked leader, bark abrasions, sunscald, disfiguring knots, insect or disease damage, girdling roots or cuts on limbs over 20mm (3/4”) in diameter that are not completely closed should be rejected by Project Landscape Architect.

.12 Take precautions during digging, handling and shipping of plant material to avoid injury to plants and root systems.

2.15 Related Materials:

.1 Tree stakes: dressed 50mm (2”) diameter treated fir stakes, lengths as detailed. Number per tree as required to keep tree plumb and true during one (1) year warranty period.

.2 Guywires: Trees up to 65mm (2.5”) calliper - 14 gauge galvanized, multi-strand, twisted wire. Trees 65mm (2.5”) to 75mm (3”) calliper – 12 gauge wire, covered with new black garden hose, 2-ply, reinforced and of at least 13 mm (1/2”) diameter, around leader at branch crotch.

.3 Deadmen: 100x150 mm (4"x6") pressure preservative treated construction grade lumber or approved equivalent. Lengths to be determined on site.

.4 Plastic Strapping: DeepRoot, Arbortie or approved equivalent. Strapping to be to be 19mm (2") wide, flat, woven polypropylene or nylon; 900 lb. break strength.

.5 Mulch: Shall be composted bark mulch with 50mm and minus Douglas Fir / Hemlock bark chips, dark brown in colour and free of cedar chips, soil, wood, stones, roots, plastic and other deleterious matter or pre-approved equal. *Minimum compacted depth 7.5 cm (3").*

.6 Fasteners: All fasteners hot dipped galvanized.

.7 Fertilizers: Agricultural fertilizer of a formula indicted by soil test results of site soils and/or planting media specified for the project. Fertilizers shall be organic, slow-release compositions incorporated into the planting media wherever applicable.

.8 Anti-Desiccants: if specified, are to be applied to plants in full leaf immediately before digging or as required by the Project Landscape Architect. Anti-Desiccants are to be sprayed so that all leaves and branches are covered with a continuous protective film.

.9 Biostimulants: shall contain soil conditioners, VAM, and ectomycorrhizal fungi spores and soil bacteria appropriate for existing soil conditions. Submit manufacturer's literature for approval.

2.16 Planting Hole Excavations – Trees, Shrubs and Groundcovers

.1 Trees, shrub, and groundcover beds are to be excavated to the depth and widths indicated on the drawings. If the planting area under any tree is initially dug too deep, the soil added to bring it up to the correct level should be thoroughly tamped.

.2 The sides of the excavation of all planting areas shall be sloped at a 45 degrees. The bottom of all beds shall slope parallel to the proposed grades or toward any subsurface drain lines within the planting bed. The bottom of the planting bed directly under any tree shall be horizontal and tamped such that the tree sits and remains plumb.

.3 Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not excavate compacted subgrades of adjacent pavement or structures.

.4 Subgrade soils shall be separated from the topsoil, removed from the area, and not used as backfill in any planted or lawn area. Excavations shall not be left uncovered or unprotected overnight.

.5 On steep slopes, the depth of the excavation shall be measured at the center of the hole and the excavation dug as shown on the drawings.

.6 Detrimental soil conditions: The landscape architect is to be notified, in writing, of soil conditions encountered, including poor drainage that the contractor considers detrimental to the growth of plant material. When detrimental conditions are uncovered, planting shall be discontinued until instructions to resolve the conditions are received from the Project Landscape Architect.

.7 Obstructions: If rock, underground construction work, utilities, tree roots, or other obstructions are encountered in the excavation of planting areas, alternate locations for any planting shall be determined by the Project Landscape Architect.

2.17 Transplanting

.1 Existing established trees, shrubs, and groundcovers designated to be relocated on site or from off-site locations, must be harvested, handled and transported according to recognized horticultural and arboricultural practices, and where applicable, within the guidelines and specifications applied to nursery stock as per the Canadian Standards for Nursery Stock, *Canadian* Landscape Standard and ANSI A300. Refer to Section 32 93 05 Relocation of Existing Plant Material, for comprehensive transplanting guidelines.

2.18 Planting Season

.1 Plant only during the season or seasons which are normal for such work determined by weather conditions and as approved by the Project Landscape Architect.

.2 Do not plant during freezing and/or abnormally hot, dry weather.

2.19 Plant Layout

.1 Plants should be located according to landscape planting plan, and according to locations determined by the Project Landscape Architect. Contractor to coordinate approval by Project Landscape Architect of planting layout prior to planting. Within reason, the Project Landscape Architect may make adjustments in plant location and orientation prior to, during and after planting.

.2 Position of trees to be planted within structural cells should be determined prior to positioning and installing of structural cells.

.3 Location of all major trees should be accurately staked on site. Call the Project Landscape Architect to be present during planting of major trees to ensure proper orientation and location.

2.20 Planting Procedures

.1 All plants to be installed maintaining original grades of bases as they were in the Nursery.

.2 Loosen bottom of planting hole to depth of 150-200mm (6 - 8") prior to placing growing medium.

.3 Plant bare root trees vertically with roots placed straight out in hole. Orient plant material to give best appearance in relation to structure, roads and walks.

.4 Place plant material to depths equal to the depth they were originally growing in nursery.

.5 With balled and burlapped root balls, loosen burlap and cut away minimum top 1/3 without disturbing root ball. Do not remove burlap or rope from under root ball. Remove any excess soil on top of root ball such that root flare is at or slightly above finished grade.

.6 With container stock, remove entire container without disturbing root ball. Non bio-degradable wrappings must be removed.

.7 Tamp growing medium around root system in layers of 150mm (6”) eliminating air voids. Frozen or saturated growing mediums unacceptable. When 2/3 of growing medium has been placed, fill hole with water. After water has completely penetrated into soil, complete backfilling.

.8 Water thoroughly on the interior of the tree saucer until it is filled even if it is raining. A second watering may be necessary to ensure saturation of the root ball.

.9 Prune out any dead or broken branches.

.10 Remove all tags, labels strings, etc. from plant material.

2.21 Fertilizer Application and Soil Amendments

.1 Make all amendments of lime and fertilizer indicated by soil test results at time of mixing and prior to placement of plant material. All mixing shall take place using appropriate equipment and methodology so as to ensure thorough mixing of all components within the planting media.

(Refer to Section 32 91 00 Planting Preparation)

.2 Pursuant to soil test recommendations and/or recommendations of the Project landscape Architect, add composted organic matter amendment as follows: After specified topsoil or planting mix is installed, and prior to fine grading and installation of plantings, spread 100 (4 in.) of composted organic matter over all beds and rototill into the top 100 mm (4 In.) of planting mix or topsoil. (Refer to Section 32 91 00 Planting Preparation).

2.22 Mulching

.1 Mulch all tree, shrub and groundcover planting areas to a *7.5 cm* (3") *compacted* depth with composted bark (see **2.15.5** above).

.2 Ensure soil settlement has been corrected prior to mulching.

2.23 Guying and Staking

.1 Guy and stake all trees immediately after planting according to current recommendations of the International Society of Arboriculture (ISA) and the ANSI A300 – Standards for Tree Care Operations. Plant material not guyed or staked immediately shall be replaced if damaged.

.2 Stake or guy a tree only when necessary for the specific conditions encountered and as per ISA Tree Staking Details or project drawing details. Staking may be required in unusual circumstances such as sandy soils or in extremely windy conditions, Poor quality trees with cracked, wet, or loose root balls, poorly developed trunk-to-crown ratios, or undersized root balls shall be rejected if they require staking, unless written approval to permit staking or guying as remedial treatment is obtained from the Project Landscape Architect. Trees that settle out of plumb due to inadequate soil compaction either under or adjacent to the root ball shall be excavated and reset. In no case shall trees that have settled out of plumb be pulled upright using guy wires.

.3 Stakes, anchors wires or plastic strapping shall be of sufficient strength to maintain the tree on an upright positions that overcomes the particular circumstances that initiated the need for staking or guying.

.4 Guying: Fasten tree around leader at branch crotch to stake, pin or deadman in the ground, or laterally to upright tree stake with galvanized wire protected by hose where wire wraps around leader and crotch as per manufacture's or drawing detail specifications. Alternate to wire use Deeproot, Arbortie plastic strapping or approved equivalent.

.5 Trees to stand plumb upon completion of this operation.

.6 Stakes and guys shall be removed at end of first growing season. Any tree that is not stable at the end of this period shall be rejected.

2.24 Maintenance Prior to Substantial Performance

.1 Maintain all plant material from date of planting until Certificate of Substantial Performance. Refer to Section 32 01 90 Operation and Maintenance of Planting.

.2 Program timing of operations in accordance with growth, weather conditions and use of site.

.3 Complete each operation within a reasonable time period prior to proceeding.

.4 Collect and dispose of debris or excess material on a daily basis.

.5 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.

.6 Supply equipment such as pumps, portable sprinklers systems, tanker trucks, hose and sprinklers required for watering operations.

.7 The use of toxic chemical pesticides for cosmetic purposes is voluntarily suspended on UBC Campus. Plant only disease resistant and disease free stock. Remove and replace significantly infected plants. Combat pests, diseases and weeds according to IPM principles and within the limits of UBC Pest Control Policy #12. Cultivate to control weeds. Apply only organic, non-toxic pesticides as a last resort. Any use of pesticides on UBC Campus must be approved and/or coordinated in consultation with UBC's representative. Do not use pesticides prohibited by Agriculture Canada or the Pesticide Control Act Regulation.

.8 Cultivate whenever required to keep top layer of soil loose, friable and free from weeds. Any operation must be continuous without interruption.

.9 Replace or respread damaged, missing or disturbed mulch.

.10 Clean, by hand, areas that are covered with mulch. Loosen top layer of mulch without mixing it with soil underneath.

.11 Remove weeds including their roots.

.12 Remove, dispose off Campus, and replace any plants and soil overwhelmed with persistent, noxious, invasive or perennial weeds.

.13 Remove dead or broken branches from plant material. Prune in accordance with Division 32.

.14 Keep trunk protection and guy wires in proper repair and adjustment.

.15 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.

2.25 Acceptance

.1 Plant material will be accepted by Project Landscape Architect, UBC's representative and UBC Municipal Landscape Services representative upon Substantial Performance of the Work and again at the end of the warranty period, provided that trees, plant material and plantings exhibit healthy growing conditions and are free from annual/perennial/invasive/noxious weeds, disease, insects and fungal organisms.

.2 Acceptance will not be forthcoming if tree plants, plantings and/or soil show any evidence of invasive or perennial weeds such as morning glory, creeping vetch, horsetail or couch grass.

.3 Plant material insufficiently hardened-off prior to onset of frost and freeze may be rejected and require replacement if signs of frost damage, poor root development or winter desiccation are evidenced.

2.26 Maintenance During Warranty Period

.1 Refer to Section 32 01 90 Operation and Maintenance of Planting.

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

1.0 GENERAL

1.1 Scope

.1 This guideline addresses the requirements for the transplanting of existing trees and plants, plus materials and equipment required to transplant and establish trees and plants in their new locations as shown on site development drawings.

1.2 References and Standards

.1 *Canadian* Landscape Standard, current addition

.2 International Society of Arboriculture (ISA), Planting Specification, Tree and Shrub Transplanting

.3 International Society of Arboriculture (ISA), Best Management Practices - Tree Planting

1.3 Coordination

.1 Coordinate as early as possible in the conceptual and design development phases with UBC Campus Arborist.

.2 Coordinate throughout construction phases with UBC Campus Arborist regarding any site changes, potential damages or pruning required on relocated trees retained.

1.4 Related Work

.1 Section 32 01 93.01 Tree and Shrub Preservation
.2 Section 32 91 00 Plant Preparation
.3 Section 32 93 00 Plants

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Tree Relocation and Protection Plans

.1 For trees to be protected and/or retained on site, the Project Landscape Architect should provide Tree Protection/Relocation Plans indicating surveyed grades at base of trunks, DBH, extents of drip lines and location of Tree Protection Fencing. Specifications and cross-sectional details for applicable preservation strategies including, but not limited to, requirements covered in this general guideline must be included in construction documents.

2.2 Consulting Arborists and UBC Campus Arborist

.1 Where significant heritage trees, or complex tree preservation strategies are anticipated, UBC recommends that a project-specific, ASCA Registered Consulting Arborist be retained as an integral member of the design development team. The Consulting Arborist is to advise on specific pre- and post-development strategies or to provide expert analysis, details and/or specifications required to optimize tree retention and preservation.

.2 The UBC Campus Arborist will be UBC's representative on Campus and will advise on related Campus tree issues with consultants, project managers and site supervisors as required.

2.3 Coordination, Inspection and Supervision

.1 The Campus Landscape Architect, Project Landscape Architect, Project Consulting Arborist, and/or UBC Campus Arborist shall coordinate as early as possible in the project to identify trees to be retained, protected, transplanted or removed and clearly establish tree relocation strategies for on-site or off-site locations.

.2 Every effort should be made to coordinate transplanting to occur in the dormant season or otherwise optimize conditions for transplanting in conjunction with site development timing and priorities.

.3 A qualified Landscape Contractor or authorized Tree Mover shall be responsible for transplanting of existing trees or shrubs to be relocated including preparation of site and coordination with Project Landscape Architect, Project Consulting Arborist and/or UBC Campus Arborist.

.4 The Contractor responsible must follow relocation instructions as per the Project Landscape Architect’s directions in consultation with Project Consulting Arborist and/or UBC Campus Arborist. Existing trees to be transplanted on-site shall be relocated as shown on the project drawings. Existing trees to be transplanted off-site shall be coordinated with the UBC Campus Arborist.

.5 The Project Landscape Architect, the Consulting Arborist and/or the UBC Campus Arborist shall be on site to monitor the relocation operations as required. The Contractor will provide minimum 48 hours’ notice prior to relocation operations.

.6 During the construction phase, the Contractor responsible shall contact UBC Campus Arborist immediately regarding any site changes impacting tree relocation and preservation.

2.4 Site Conditions and Preparation

.1 Protect all existing trees, shrubs, properties, services and buildings from any potential damages from tree relocation work. (Refer to Section 32 01 93.01 Tree and Shrub Preservation).

.2 Consult with UBC Utilities regarding any underground services prior to commencement of work. Ensure work area is free from overhead, above ground and below ground hazards or utilities. Consult with UBC Building Operation and Utilities regarding any unforeseen hazards, structures or services prior to moving trees or shrubs.

.3 Check target locations for relocating plant material to ensure adequate access, soil quality and drainage.

.4 Ensure that soil texture, fertility and drainage at the new planting site(s) is acceptable, and that new transplant site provides analogous cultural conditions to original site. (Refer to Section 32 91 00 Planting Preparation).

2.5 Maintenance

.1 Maintenance of all relocated/transplanted trees and plant material at either on-site, or off-site heel-in/holding compounds will be the responsibility of the Contractor for the duration of the project and maintenance period.

.2 Maintenance of all relocated/transplanted trees and plant materials to off-site, permanent planting locations, will be the responsibility of UBC Building Operations unless otherwise specified.

2.6 Guaranty

.1 Unless otherwise specified, the Contractor will not be required to guaranty transplanted trees and plant materials, but will be required to do all work as specified under the direction of the Project Landscape Architect in consultation with Project Consulting Arborist and/or UBC Campus Arborist at the time of the plant moving.

2.7 Replacement

.1 When specified in the contract drawings and documents, the Contractor shall be responsible to replace any damaged existing trees and plant material to be relocated in the same genus, species, size and character at no cost to UBC.

2.8 Existing Tree and Plant Material

.1 Existing trees and plant materials designated for relocation shall be clearly tagged and indicated on demolition plans, site preparation plans and planting plans.

.2 Trees and plant material designated as bareroot or collected transplants shall conform to the Canadian Standards for Nursery Stock. Those that cannot be planted right away shall be protected from sun or drying winds and kept in shade. Roots shall be well protected with soil, wet mulch and kept watered.

.3 As far as practicable, transplanted B&B trees and plant material shall be properly dug with firm, natural balls of soil retaining as many fibrous roots as possible, in sizes and shapes as specified in the Canadian Standards for Nursery Stock.

2.9 Materials

.1 Unless a tree or shrub is moved in one operation, directly to new site within a tree spade, rootballs shall be firmly wrapped with non-synthetic, rottable burlap secured with heavy non-synthetic, rottable twine.

.2 Balls shall be firmly wrapped with non-synthetic, rottable burlap and secured with nails and/or heavy, non-synthetic rottable twine. The root collar shall be apparent at surface of ball. Trees and plant material with loose, broken root balls shall not be accepted.

.3 Correctly sized wire baskets capable of accommodating the rootballs of trees and large shrubs may be used to facilitate movement, storage and rootball integrity.

.4 Anti-desiccants are to be applied to plants in full leaf immediately before digging or as required by the Project Landscape Architect in consultation with Project Consulting Arborist and/or UBC Campus Arborist. Anti-desiccants are to be sprayed so that all leaves and branches are covered with a continuous protective film. Anti-desiccant shall be an emulsion specifically for agricultural use, mixed and applied according to manufacturer's recommendations.

.5 Anchors shall be Douglas Fir standard or better grade S4S lumber in the following size: 50 x 100 x 1200mm (2" x 4" x 48").

.6 Tree wraps shall be 8 -10cm wide nylon strapping three (3) per tree, 0.75m in length, with galvanized metal eyes at either end.

.7 Guy wire and safety sleeves shall be galvanized 11 gauge wire with brightly coloured survey plastic sleeves covering the bottom 1.5m of each section.

.8 Turnbuckles shall be galvanized and a minimum body length of 150mm (6”).

2.10 Fertilizer

.1 Slow release fertilizer such as 18-6-12 Osmocote or approved equivalent.

2.11 Complete Chip Mulch

.1 Tree mulch shall be complete tree chip mulch, including parts of the leaf, twig, bark and stem wood. This product may be obtained from local tree contractors or UBC Landscape Services, generally free of charge. The mulch should be free of pests or diseases and should not contain Western Red cedar or Black walnut.

.2 Provide a sample of the proposed tree mulch and its source for approval by the Consulting Arborist and/or UBC Campus Arborist.

2.12 Planting Soil

.1 Refer to Section 32 91 00 Planting Preparation for general specifications on use of native topsoils and commercial soil products.

.2 Horticultural soil products may be mixed with existing soils to a maximum ration of 2:1 (new to old). The amended soil volume required for each tree will fill a void around the outside of the root ball 60cm in depth and equivalent to the radius of the root ball in width. [For example, a tree with a rootball 2m in diameter will require enough soil to fill a trench around the root ball 60cm in depth below existing grade and 1m wide. Additional soil will be required to raise the grade around the perimeter of root ball in its new location in order to form the watering saucers.

2.13 Period of Planting

.1 Coordinate digging of plant material to be transplanted to ensure minimum time between digging and re-planting.

.2 Trees and plant material designated for B&B, bareroot or as collected plants, shall not be dug or installed before dormancy or after bud break from late fall to early spring.

.3 Transplanting outside of the dormant season may occur in special circumstances only in consultation with Project Consulting arborist and/or UBC Campus Arborist.

2.14 Protection

.1 Verify existence and location of any on-site utilities. Consult the Project Landscape Architect immediately for directions as to procedure should any piping or utilities be encountered during excavation.

.2 Protect existing buildings, equipment, sidewalks, landscaping reference points, monuments and markers. Make good all damage incurred during this work.

.3 Make every effort to protect all existing plants adjacent to any construction/tree relocation work.

.4 Erect temporary continuous barriers where necessary to ensure safety of existing plants and trees. Refer to Section 32 01 93.01 Tree and Shrub Preservation for protection fencing specifications.

.5 Replace, at no expense to UBC, any trees and plant material damaged as a result of the work of this section.

2.15 Layout, Digging, Transportation, Planting and Securing

.1 Stake out the exact location for each tree or shrub transplant as shown on the plan.

.2 Review the staked locations with the Landscape Architect prior to digging tree pits.

.3 In approved locations, dig tree pit holes that are deep enough to accommodate the depth of the root ball without settling beneath the existing grade. The diameter of the planting hole in the upper 60cm of soil should be approximately twice the diameter of the root ball selected for that location.

.4 Ensure tree pits drain adequately. If drainage is poor, inform the Consulting Arborist.

.5 Additional excavation of poorly drained material and addition of drainage material shall be carried out as authorized by the Landscape Architect at unit prices agreed to before excavation.

.6 Dig each plant to the specified root ball diameter using appropriately sized Tree Spade equipment and employing the best trade practices. For trees with stem calipers less than 12cm, minimum root ball diameters will be calculated at 15 times the stem caliper, measured 30cm above grade. [For example, a 10cm. caliper tree will have a root ball no less than 1.5m in diameter.] For trees with stem calipers greater than 12cm, minimum root ball diameters will use a multiplier of 12. [For example, a 20cm caliper tree will have a root ball diameter of no less than 2.4m.] For trees with stem calipers greater than 25 cm, use a multiplier of 10.

.7 Root balls will be dug, where possible, with the tree stem centered in the root ball. If circumstances preclude obtaining the minimum rootball size with the stem centered on the root ball, the contractor will consult with the Project Consulting Arborist or UBC Campus Arborist before proceeding.

.8 If, in the opinion of the contractor, the stability of the root ball or the tree will be compromised in the new planting site, the contractor is instructed to basket the root balls and ensure that the root balls are adequately strapped in burlap prior to transport. The contractor must ensure that the root plates of the relocated trees are stable and the trees are windfirm in their new sites. The contractor has the discretion to utilize wire baskets and or staking materials and techniques (see below) as his judgment directs. Relocated trees must remain completely windfirm for the duration of the maintenance period (12 months).

.9 Transport the plants immediately to the approved planting area and plant.

.10 Tree Saucers:

  .1 Make a saucer around each tree with a berm of soil approximately 150mm (6”) higher than the top of the earth ball, 900-1200mm (36-48”) from the base of the trunk of the tree to facilitate watering.

.11 Tree Guying:

  .1 Relocated trees must remain completely windfirm for the duration of the maintenance period (12 months). The contractor is directed to utilize whatever methods reflect the best trade practice of his industry to ensure the stability of the root ball. If, however, in the opinion of the contractor, guying of the tree is required, the following prescription is to be utilized.

.2 Equally space three anchors around the tree. Attach tree wraps approximately midway up the stem of the tree. Anchors should be placed at a sufficient distance to achieve a 45 degree angle on the guy. Anchors should be set at right angles to the guy wires and driven in to a depth sufficient to secure the guy (minimum of 80 centimeters).

.3 Secure the guy to the tree wrap rings and the anchor with a turnbuckle interposed between the two anchor points. Tension the guys once installed and position the protective sleeves. Provide three (3) guy wires per tree with a turnbuckle set in the centre of each wire.

2.16 Mulch and Fertilizer Application

.1 Apply 12 – 14 centimeters of complete tree chip mulch to the area of the planting site [i.e. to an area twice the diameter of the root ball].

.2 Apply fertilizer based on soil test results and incorporate into backfill soil or by surface application. In absence of soil test recommendations, apply approximately 250 grams (1/2 lb) of 18-6-12 Osmocote for each 5 centimetres of caliper per tree. Distribute the Osmocote over the top of the root ball area after mulching.

2.17 Watering

.1 Immediately after mulching and fertilizing, apply approximately 181 liters (20 gallons) of water per tree at a moderate flow rate. Ensure that flow rate does not liquefy soils and destabilize tree.

2.18 Pruning

.1 Prune off any broken or damaged branches to the outer margin of the branch collar. All pruning work to be done by an ISA Certified Arborist in consultation with the Project Consulting Arborist, or UBC Campus Arborist.

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

1.0 GENERAL

1.1 UBC Energy & Water Services Jurisdiction

.1 UBC Energy & Water Services (EWS, formerly UBC Utilities) is a new university unit overseeing the overall management of energy and water. 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 Administration Office:

UBC Energy & Water Services
2040 West Mall,
Vancouver, BC V6T 1Z2
Phone: (604) 822-9445
Fax: (604) 822-8833

.2 Key Positions in Utilities include:

.1 Managing Director.
.2 Director, Engineering and Utilities
.3 Associate Director, Finance
.4 Campus Chief Engineer
.5 Chief Engineer, Operations Manager
.6 *Electrical Utilities Manager*
.7 Manager, Mechanical Utilities Services (Senior Mechanical Engineer).
.8 Mechanical Utilities Engineer
.9 Geospatial Information Manager
.10 Assistant Civil Engineer
.11 Project Coordinator
.12 *Trades Manager*
.13 Lead Trades: Head Electrician, Head Plumber, Head Steamfitter, Head Utilities Maintenance Engineer.

1.3 Designer 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, 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 338201s and 330130.41s at http://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 - 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
Engineering Clearance for Building and Streets and Landscape Permits* *Building permits address all onsite engineering works and services; Streets and Landscape permits address all offsite engineering works and services	Vancouver Coastal Health (VCH) Water Connection Permit Review of service connection design for Building Permit and / or Streets and Landscape Permit Applications	Permit from VCH Final Service Connection clearance for either: Staged Building Permit – Excavation / Shoring, Foundation and/ or Full (addresses onsite works and services) or Streets and Landscape Permits (addresses offsite works and services and public realm projects)	Applicants secure permit (or EWS for UBC utility infrastructure projects) EWS to provide Service Connection clearance to Campus & Community Planning EWS to provide Service Connection clearance to Campus & Community Planning
As part of Building Permit process	Site visit prior to backfill of below-grade works and services	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) Survey of inverts to check compliance with design (completed prior to walk-through) Photos of installation submitted to Infrastructure Development, Records by project manager	EWS for walk-through of installation and review of red line construction drawings Working Group and Steering Committee for problem solving Final loading data for utilities to be provided by applicant (to Campus & Community Planning and EWS)

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 Electrical Technical Specialist.
.2 For gas, steam, water, sanitary, or storm contact 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: http://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 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 Traffic Regulation - Traffic and Highway Bylaw
.2 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 of 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 http://www.planning.ubc.ca/vancouver_home/plans_and_policies/forms_and_documents/forms.php.

.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 System Description

.1 The University of British Columbia owns and operates its own water distribution system. The University Endowment Lands (UEL) Administration supplies water to the campus, while the UEL purchases water from Metro Vancouver (GVRD). UEL and UBC are fed from GVRD's Sasamat Reservoir located south of 16th. Avenue in Pacific Spirit Park. Ultimately two pipes feed UBC:

.1 24" (600 mm) water main on University Boulevard, which is the suction line supplying three central booster pumps located in the Powerhouse. The discharge pressure from the Powerhouse booster pumps is set at 100 psig (689 kPa). This supplies UBC's "High-Pressure Zone."

.2 12" (300 mm) water main on 16th. Avenue, which supplies UBC's "Low-Pressure Zone." The Low-Pressure Zone is separated from the High-Pressure Zone by eight pressure reducing valve (PRV) stations.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Responsibilities

.1 UBC Energy & Water Services is primarily responsible for operation, maintenance, and overall stewardship of the water distribution system. Find the Guidelines' website's "Guidelines by Specification Division" link, and refer to Division 33, *'Standard Drawings and/or Detail Documents'* for the demarcation of UBC Energy & Water Services point of service for water supply to buildings, (standard dwg 1140-UT-04-WaterBldgDemarc.dwg). At the same web page, look for information on the demarcation of UBC Energy & Water Services point of service for water supply to irrigation systems, (standard dwg 1140-UT-05-WaterIrrigDemarc.dwg).

.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 the B.C. Plumbing Code.

.4 The design engineer shall obtain a construction permit from Vancouver Coastal Health for each new installation as well as for any modification of watermains in water transmission or distribution systems, including appurtenances like valves, standpipes or hydrants. These could be watermain projects for the replacement of old pipes, extension, upgrade or looping of the water network, or service connections larger than 3" in diameter. For details go to www.vch.ca/your-environment/water-quality/drinking-water/ under 'Water quality resources'.

.5 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 Water Distribution Standards & Policies

.1 The latest revisions of the following standards shall apply to water distribution at UBC.

.1 UBC Sustainability Development Policy # 5 (http://universitycounsel.ubc.ca/policies/index/).

.2 B.C. Master Municipal Construction Documents (MMCD).
.3 B.C. Water & Waste Association (BCWWA).
.4 American Water Works Association.
.5 CSA Standards (as applicable).

.2 Where there is a difference between these, Division 33, Section 33 10 00 Water Utilities and the referenced standards, UBC Technical Guidelines shall apply.

2.3 Water Service Connections

.1 The first step to install new or substantially modified connections to the water distribution system at UBC is to complete a Utility Service Connection Application. This and other forms can be found at http://energy.ubc.ca/community-services/contractors-developers/.

.2 Note that a Plumbing Permit is also normally required by Campus & Community Planning (C&CP) Regulatory Services as the regulatory authority for plumbing requirements of the B.C. Building Code.

.3 Project design drawings shall provide building load for both peak domestic consumption in litres/second, and fire flow required in litres/second. UBC Energy & Water Services reserves the right to request the calculations used to estimate the peak consumption and fire flows.

.4 Any new connections to the water distribution system will be reviewed for consistency with UBC Technical Guideline standards. UBC Camps & Community Planning will evaluate the added load using UBC's water distribution model at no cost to the project.

.5 At the request of the project, a flow test will be performed at the adjacent hydrant to the proposed service connection and the test results are to be provided in writing.

.6 The Designer shall obtain the Water service records by contacting the Records Clerk at Infrastructure Development, Records (telephone 604-822-9570) and develop proposed service connection location(s). Service connections may be possible to more than one water main fronting the site for large, complex buildings with the approval of UBC Energy & Water Services. For large academic buildings, this is normally required by UBC Energy & Water Services.

2.4 Metering

.1 Water meters are required for all buildings as per the design requirements shown in the standard drawing 1140-UT-06-WaterMeterStdComp. If required, remote reader shall be installed outside the building in an accessible location. For core campus buildings the design requirements are shown in standard drawing 1140-UT-07-WaterMeterStdMag. See also Division 26, Section 26 27 13 Metering, 2.4 Mechanical Meters.

.2 All irrigation systems independent of buildings are required to have a meter installed at the service connection. If required, the remote reader shall be installed on the lid of the irrigation vault or in some other accessible location.

.3 As indicated on the drawing standard, the meter and strainer 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.

2.5 Temporary Water Connections

.1 Connections to UBC's fire hydrants are allowed with an approved Hydrant Connection Permit issued by Campus & Community Planning (telephone 604-822-8228). Instructions for applying are included in the Fire Hydrant Permit Application. Refer to http://www.planning.ubc.ca/vancouver_home/plans_and_policies/forms_and_documents/forms.php

.2 A temporary connection to a hydrant is only permitted for a maximum of 30 days and is only allowed for demolition/asbestos abatement purposes. For all other temporary water connections, a Temporary Water Connection Permit for Construction must be obtained from http://energy.ubc.ca/community-services/contractors-developers/ or call UBC Energy & Water Services (604-822-3274).

2.6 Service Connections and Water Mains

.1 Water service connections shall be designed per UBC Energy & Water Services standard. Refer to Standard Documents – 1140-UT-03WaterEntry drawing.

.2 The Project is responsible for permanent capping of un-used stub-outs.

.3 For Slab on Grade see 1140-UT-08WaterEntrySOG drawing.

.4 If the building's main water station inside the mechanical room is on the roof, a 1.5 inch hose connection on the combined fire/domestic water service shall be installed at ground level in an accessible location.

.5 Design consultants shall provide new irrigation service connection tie-in details including chamber location and size, pipe size, material, isolation valve (minimum 2" diameter off main), meter, strainer, backflow preventer and chamber drain connection to the storm system. When a solenoid valve is required to activate water flows, a water hammer arrestor shall be installed upstream of the solenoid valve. Refer to Irrigation Water Supply Vault Standard Drawing 1140-UT-11 for details. Also visit http://energy.ubc.ca/community-services/contractors-developers/ for the required Irrigation Chamber Service Connection Application form.

.6 Pipe shall be Class 50 ductile iron pipe manufactured to AWWA C151; cement mortar lined to AWWA C104 and coated 1 mil. thick asphalt.

.7 Copper, up to 75 mm diameter, type K, joints brazed only.

.8 Joints shall be single rubber gasket for push-on bell and spigot type joints to AWWA C111, Tyton or approved equal.

.9 Flanged joints shall be AWWA C110; flat faced conforming to ANSI B16.1, Class 125.

.10 Fittings shall be ductile to AWWA C110 suitable for pressure rating of 2415 kPa. Cement mortar lined to AWWA C104. Minimum design pressure for piping 1,210 kPa.

.11 Bolts shall be medium carbon steel or Martensitic steel, ASTM A325 heavy hex finished, hot-dip galvanized to ASTM A153. Coarse threads shall have Class 2A tolerance before galvanizing. Bolt sizes to AWWA110.

.12 Nuts shall be heavy steel hex carbon steel to ASTM A563 Grade C hot-dip galvanized to ASTM A153.

.13 Tie rods shall be continuously threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC, hot-dip galvanized to ASTM A153.

.14 Joint Restraint Devices
  .1 Each joint shall be restrained with the socket pipe clamp or equal, with prior approval.

2.7 Valves and Valve Boxes

.1 Gate Valves shall be manufactured to AWWA C509, ductile iron body, resilient seated, non-rising steam, hub or flanged ends.

.2 Stem seal shall be O-ring type. Valves to be complete with 50 mm square nut for underground operation. Manufacturer shall be Clow, or equal approved by Building Operations.

.3 Circular valve boxes shall be Nelson-type as manufactured by Terminal City or Dobney Foundry. Valve box riser pipe to be 150 mm diameter PVC DR35.

.4 Maximum distance between isolating distribution valves to be 100 m.

.5 Maximum depth of valve knuckles to be 600 mm.

2.8 Hydrants

.1 Fire Hydrants to be 150 mm diameter Terminal City type C-71-P hydrants subjected to hydrostatic pressure test of 2070 kPa in compliance with AWWA C502.

.2 Maximum distance 100 m.

.3 Minimum size of pipe connection 150 mm.

.4 Fire hydrant shall have isolating valve not more than 6 m in front of it.

.5 For hydrant installation requirements see standard dwg. 1140-UT-02FireHydrantDetail.dwg.

2.9 Heavy Equipment Loads on Buried Pipe

.1 Loads on shallow buried pipe shall be evaluated in the design and construction planning phases. AWWA M41, Section 4.3 can be used as a guide for this evaluation.

3.0 EXECUTION REQUIREMENTS

3.1 Preparation

.1 As per MMCD Section 02666.

3.2 Trenching

.1 As per MMCD Section 02666.

.2 Trench alignment and depth as shown on Contract Drawings or as approved otherwise by Mechanical Distribution Engineer (Telephone: 604-822-3274, Fax: 604-822-8833).

3.3 Granular Bedding

.1 As per MMCD Section 02666.

.2 Minimum soil cover to be 1.0 m.

.3 For pipe bedding use clean granular pipe bedding, graded gravel, 19 mm (-), MMS type 1. Bottom thickness shall be a quarter of pipe diameter, or minimum 100 mm thick. Top shall be minimum 300 mm thick. Sides shall be minimum 225 mm to maximum 300 mm thick.

.4 Place granular bedding (sand) material across full with of trench bottom in uniform layers to 100 mm depth.

.5 Use imported bedding when proposed work is installed under through paved areas, when Utilities Mechanical Engineer deems native material unsuitable for backfill, or when trench has been excavated in rock. Otherwise for trench backfill, native backfill may be used if free of rock greater than 25 mm and located in boulevards or easements. Approval by UBC Energy & Water Services is required.

3.4 Pipe Installation

.1 As per MMCD Section 02666.

.2 Utility Separation: A minimum 3 m horizontal clearance is required from either sanitary sewer or storm sewer piping, when they run parallel to water main. If this clearance cannot be met, water piping can be installed closer with prior approval from UBC Energy & Water Services. Refer to MMCD Design Guideline Manual Section 1.4, and Vancouver Coastal Health's Water Supply System Construction Permit Guidelines and Application Form (see 2.1.4 this section). Installation may be approved provided water pipe is installed above sanitary or storm sewer piping with minimum vertical clearance 0.5 m and water main joints are wrapped. When crossing sanitary sewers at 90° angle, the water pipe shall be encased with 20 MPa concrete of minimum thickness 150 mm. If concrete is not desirable, joints of the water main can be wrapped with heat shrink plastic or packed with compound and wrapped with petroleum tape in accordance with the latest version of the AWWA Standards C217, and C214 or C209.

.3 Minimum 750 mm clearance is required from all other services. *Minimum 3 m. clearance to building footing or per MMCD General Design guidelines clause 1.3.*

.4 When crossing electric duct bank (crossing shall be done at 90°), run pipe with minimum vertical clearance 150 mm from the bottom of electric duct bank. If crossing of electrical ductbank cannot be done in this manner, then encase water pipe in one larger plastic pipe projecting minimum 500 mm from either side of electric ductbank.

.5 Test and/or bleed points consisting of Corporation cocks, sized to achieve minimum flushing velocity of 0.8 m/s in accordance with AWW C651, to be provided where shown on Contract Drawings or as required by Utilities Mechanical Engineer for pressure testing and flushing.

.6 Requirements for piping into the building's mechanical room as per drawing 1140-UT-01WaterStationSchematic.

.7 Requirements for replacing cast iron or asbestos cement watermains at utility excavations are to be as shown in drawing 1140-UT-09 Water Mains at Excavations. Where water pipes cross under wall foundations, they must be built of ductile iron for a distance of at least 3 metres on either side of the wall, to avoid settlement cracking.

.8 When excavating over existing A/C or cast iron watermains, only controlled density backfill shall be used. No compaction is permitted.

3.5 Valve Installation

.1 As per MMCD Section 02666.

.2 At every valve and fitting install up to 3 m length of tie rods on each side of valve/fitting and each branch, when pipe couplings are used.

3.6 Hydrants

.1 As per MMCD Section 02666.

.2 For Hydrants not in service, place an orange painted sign, 30 cm x 30 cm, lettered “Not in Service” on the main port. Remove when water main is accepted by the Mechanical Distribution Engineer.

3.7 Thrust Blocks

.1 As per MMCD Section 02666.

.2 Place concrete thrust blocks between valves, tees, wyes, plugs, caps, bends and undisturbed ground as shown on the Contract Drawings or as directed by Mechanical Distribution Engineer.

.3 Thrust blocks to undisturbed soil shall be provided, complete with bearing area and block volume.

3.8 Pipe Surround and Backfill

.1 As per MMCD Section 02666.

.2 Upon completion of pipe laying and before backfilling, Contractor shall notify for inspection Mechanical Distribution Engineer (Fax: 604-822-8833) and UBC Energy & Water Services Head Plumber (Fax: 604-822-4416). Notification for inspection shall be provided 24 hours in advance.

.3 After inspection of work in place, surround and cover pipes.

.4 For trench backfill native backfill material may be used in boulevard *and easement* areas if free of rock greater than 25 mm. *Approval from UBC Energy & Water Services is required.*

3.9 Cleaning and Preliminary Flushing

.1 As per MMCD Section 02666.

.2 Water may be supplied from UBC fire hydrants upon application for a Hydrant Permit.

3.10 Testing and Flushing Procedures

.1 As per MMCD Section 02666.

.2 Contractor shall notify Mechanical Distribution Engineer (Fax: 604-822-8833), and UBC Energy & Water Services Head Plumber 24 hours in advance of testing. (Fax: 604-822-4416). Use the Utility Service Activation Request form.

.3 Perform all tests in presence of Mechanical Distribution Engineer.

.4 Testing Procedure & Report as per MMCD Section 02666

.5 A concise, written and signed report shall be provided via facsimile to both the Mechanical Distribution Engineer and the Manager, Mechanical Distribution Services (Fax: 604-822-8833).

3.11 Disinfection and Flushing

.1 As per MMCD Section 02666.

.2 Perform disinfection procedure and residual chlorine test in presence of Mechanical Distribution Engineer.

.3 Maintain water chlorinating level (free chlorine concentration mm. 25 mg/L) in new piping for minimum 24 hours.

.4 Before connection to UBC water system, flush piping clean until maximum free chlorine concentration is less than 0.3 mg/L. Any flushed water on or south of Agronomy Road must be de-chlorinated in a manner that it does not pose threat to aquatic life in Booming Ground Creek.

3.12 Testing New Mains

1. After disinfection and flushing, the new main is filled with potable water and sampled for total coliform and E. coli bacteria (bug test) every 350 m.
2. If a sample fails the test, the main shall be flushed and the sampling repeated. If flushing does not result in an acceptable test, the main should be disinfected again.

3.13 Shutdowns & Connections

.1 Shutdowns must be requested in writing adhering to UBC's campus-wide standard shutdown procedures. Obtain a Service Shutdown Request form and Utility Service Activation Request form from: http://www.buildingoperations.ubc.ca/resources/policies-procedures-forms/

.2 Operating valves on the water distribution system shall only be performed by UBC Energy & Water Services.

.3 Connections to existing waterworks system may be made by Contractor with approved design and proper notification.

.4 Notify Mechanical Distribution Engineer (Fax: 604-822-8833) and UBC Energy & Water Services Head Plumber (Fax: 604-822-4416) with a minimum 24 hours in advance of scheduled connection.

.5 Make connections in presence of Mechanical Distribution Engineer or UBC Energy & Water Services Head Plumber. To prevent damage to existing utilities, excavate the last 300 mm over utility by hand.

.6 Hot tapping is generally not accepted. If there are exceptional circumstances, hot tapping may be requested in writing, and done only with prior written permission from the Manager, Mechanical Distribution Services, UBC Energy & Water Services.

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

1.0 GENERAL

1.1 Related UBC Guidelines

.1 338201s CCTV Pipeline Inspection (see http://energy.ubc.ca/community-services/contractors-developers/)

.2 330130.41s Cleaning of Sewers (link as above)

1.2 System Description

.1 The campus has a dedicated sanitary sewer system which discharges to the GVS & DD trunk system; both to the north and to the south. There are currently 5 communal pump stations and 30 individual building pump stations within the campus wide system. Each discharge to the GVRD system is equipped with a flow meter.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 Responsibilities

.1 UBC Energy & Water Services 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 http://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 500 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 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.

.10 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.

.11 Regardless of pipe slope and capacity, the downstream pipe shall be of equal or larger diameter. No downsizing is permitted.

.12 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.

.13 All service connections shall connect to the service main with a manhole.

.14 The length of service between the building face to the first sanitary sewer connecting manhole shall be a maximum 75 m.

.15 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. *Minimum 3 m. clearance to building footings or per MMCD General Design guideline clause 1.3.*

.16 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.

.17 Where drop manholes are required, drops shall be outside, with clean-outs.

.18 MMCD Inspection Chambers are not allowed on the sanitary sewer system under UBC Energy & Water Services jurisdiction.

.19 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 the Manager, Mechanical Utilities, UBC Energy & Water Services, only the following pipe material shall be used for the gravity sanitary sewer system:

- .1 PVC, class SDR 28 (150 mm diameter and smaller) and SDR 35.
- .2 Concrete (reinforced C76 required for all pipes 600 mm in diameter and larger).
- .3 PVC piping is preferred for all piping 450 mm in diameter or smaller.

.2 Unless otherwise approved in writing by the Manager, Mechanical Utilities, UBC Energy & Water Services, only the following pipe material shall be used for sanitary sewer forcemains:

.1 PVC, class C900 (300 mm diameter and smaller) and C905.
.2 Ductile Iron (DI), class C151.
.3 PVC piping is preferred; therefore, DI pipe shall only be approved under unique circumstances.

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 Native backfill may be used in non-traveled area if free of rock greater than 25 mm in boulevards and easement areas only. Approval by UBC Energy & Water Services is required.

.6 For purposes of cleaning and flushing, water may be supplied from UBC fire hydrants upon application for a Hydrant Use Permit. Refer to: http://planning.ubc.ca/vancouver/planning/application-forms-documents.

.7 All gravity sanitary sewer systems shall be low pressure air tested in accordance with the MMCD Section 02731, Clause 3.14.

.8 As per Utilities supplementals 338201s and 330130.41s (see item 1.1), a concise, written and signed report and video tape or DVD disk shall be provided *to* Mechanical Utilities Engineer & Manager, Mechanical Utilities (Fax: 604-822-8833).

.9 Prior to covering the pipe, all installed and bedded pipe shall be inspected by UBC Energy & Water Services. The Contractor shall provide written notification to both the Mechanical Utilities Engineer (Tel: 604-822-3274, Fax: 604-822-8833) and the Head Plumber (Fax: 604-822-4416) with minimum of 24 hours’ notice.

.10 Records of pipe sizes and inverts shall be provided to Infrastructure Development, Records; and to the Manager, Mechanical Utilities, UBC Energy & Water Services; in accordance with Sections 01 78 39 Project Record Documents and 33 00 10 Underground Utilities Services of these guidelines.

.11 Where notification requirements are not met, services may need to be re-excavated for inspection and/or testing upon request *of* UBC Energy & Water Services.

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

1.0 GENERAL

1.1 Related UBC Guidelines

.1 338201s CCTV Pipeline Inspection (see http://energy.ubc.ca/community-services/contractors-developers/)

.2 330130.41s Cleaning of Sewers (link as above)

1.2 System Description

.1 The campus has a dedicated storm drainage system which discharges to the ocean on the north. The south discharges to Booming Ground Creek and to the Fraser River.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Responsibilities

.1 UBC Energy & Water Services is primarily responsible for operation, maintenance, and overall stewardship of the storm sewers in cooperation with the following departments/organizations:

- .1 UBC Health, Safety, & Environment.
- .2 UBC Sustainability.
- .3 UBC Properties Trust.
- .4 UBC Campus and Community Planning.
- .5 UBC Building Operations.

.2 The demarcation of UBC Energy & Water Services point of service is defined in the standard drawing 1120-UT-01-StormDemarc.dwg found under Division 33 section listings here: http://www.technicalguidelines.ubc.ca/technical/divisional_specs.html.

.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 Stormwater Objectives and Standards

.1 The latest revisions of the following standards shall apply to storm sewers at UBC.

- .1 B.C. 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 Fisheries Act.
- .6 An Integrated Storm-water Management Plan (ISMP) is currently being prepared for the UBC Point Grey Campus (July 2008). The objectives of the ISMP are to guide the overarching design philosophy for any storm-water planning, construction and maintenance at the watershed and subdivision levels.

.2 The following guidelines should be considered in design and construction of stormwater systems:

.1 Best Management Practices (BMP) Guide for Stormwater, Greater Vancouver Sewerage and Drainage District Liquid Waste Management Plan. Search the http://www.metrovancouver.org website.

2.3 Storm Sewer Connections

.1 The first step to install any new or substantially modify connections to the storm sewer system at UBC is to complete a Utility Service Connection Application. This and other forms can be found at http://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 storm sewer system will be reviewed for consistency with the Storm Drainage Master Servicing Plan, and if necessary the stormwater engineering model will be updated and run by UBC Energy & Water Services at no cost to the project.

.4 The Designer shall obtain the Storm service records by contacting the Records Clerk at Infrastructure Development, Records, and develop proposed service connection location(s).

.5 Service connections may be possible to more than one storm sewer main fronting the site.

2.4 Stormwater Management Plan

.1 As part of the site design submission, a Stormwater Control Plan is required if one of the following conditions is met:

.1 The development site is 0.5 hectares (5,000 m2) or more.
.2 The development involves one or more new buildings.
.3 Net increase in stormwater runoff is 50 l/s or more based on 10 year return period and 10 minute duration storm (see standard document 1120-UT-02-IDF.dwg, (IDF Curve), found at http://www.technicalguidelines.ubc.ca/technical/divisional_specs.html).
.4 There are features of the development which could lead to stormwater quality problems such as parking facilities.

.2 If a Stormwater Management Plan is required, the Designer shall provide a written document which clearly summarizes:

.1 The storm flow design computations which shall include, but not necessarily be limited to, a figure indicating the catchment area and land use condition, along with a list of all design parameters and resulting design flows for the storm system. The design flows and hydraulic grade line must be indicated for all pipe reaches.

.2 Description of potential stormwater contaminants and how stormwater quality will be controlled.

.3 The Stormwater Management Plan need not be a large document, and the effort should be in proportion to the size and complexity of the development. For example, a single building development may adequately summarize stormwater design in one or two pages.

.4 A copy of the Stormwater Management Plan shall be provided to the following:

.1 Manager, Mechanical Utilities - UBC Energy & Water Services (Fax: 604-822-8833).
.2 Director, Sustainability - UBC Land & Building Services (Fax: 604-822-6119).
.3 Manager - UBC Health, Safety, & Environment (Fax: 604-822-6650).

.4 Associate Director of Planning - Campus & Community Planning (Fax: 604-822-6119).
.5 Urban Designer/Landscape Architect - Campus & Community Planning (Fax: 604-822-6119).
.6 Associate Director of Municipal Services - Building Operations, Technical Services (Fax: 604-822-6969).
.7 Landscape Supervisor - Building Operations, Technical Services (Fax: 604-822-6969).

.5 The storm water management plan must be discussed with and approved by UBC Energy & Water Services.

.6 Approval of the Stormwater Management Plan is confirmed with authorization of the Development Permit.

2.5 Storm Sewer Design

.1 Control of stormwater quality shall be addressed in the Stormwater Management Plan. Best Management Practices (BMP's) shall be implemented to protect stormwater runoff quality. A reference document for applicable BMP's is GVRD's Best Management Practices Guide for Stormwater. This document should also be consulted for associated design information.

.2 The Designer is encouraged to incorporate methods of biofiltration into the site design to assist with water quality treatment. This includes such features as grassed swales, vegetated buffer strips, french drains, engineered wetlands, etc. Engineered BMP's described above may be reduced or eliminated if adequate biofiltration measures are incorporated into the site design. If biofiltration is proposed for a development, it shall be included in the Stormwater Management Plan.

.3 The Rational Method shall be applied for the design of all drainage systems servicing an area of 10 hectares or less. The hydrograph method shall be used for catchment areas exceeding 10 hectares. Hydrograph modeling shall also be applied where stormwater detention facilities are incorporated into the storm system. All hydrograph modeling shall be completed using either Visual OTTHYMO or a SWMM based program compatible with XP-SWMM2000.

.4 The storm service system shall be designed within the project site and to the receiving trunk sewer to convey the peak 1:10 year return period storm flows. In most cases, the sewer system shall be sized to ensure that the maximum hydraulic grade line elevation remains within the pipe. Under unique circumstances, surcharging below ground surface may be permitted provided it can be demonstrated that no risk to buildings or property result.

.5 Rainfall intensity-duration-frequency (IDF) curves and associated rainfall data for all storm flow calculations are provided in the following UBC IDF curve. Refer to Standard Documents - IDF curve.pdf on website page. (http://www.technicalguidelines.ubc.ca/technical/divisional_specs.html).

.6 The Designer shall select a time of concentration (Tc) and run-off coefficient (R) which are appropriate for the proposed development. The "Tc" shall be the sum of the inlet time and travel time. In most cases, the inlet time shall be 10 minutes when the impervious surface flow path length to the storm inlets is 100 meters or less.

.7 Storm water shall flow only by gravity into the UBC storm system. Only under unique circumstances will pumped storm water be considered. Perimeter drains can be pumped into the UBC storm system, but a request for a permission to do so shall be submitted to UBC Energy & Water Services with an explanation why the storm water cannot be discharged by gravity, the proposed pump capacity (L/s) at operating head (kPa), a diagram showing pump curve with 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.

.8 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 Storm Drainage Master Servicing Plan.

.9 All storm sewer piping shall be designed with a minimum velocity of 0.6 m/s when flowing full or half full, based on the Manning's formula. Special provisions must be provided for supercritical flow or where the velocity exceeds 3.0 m/s to ensure structural stability and durability concerns are addressed.

.10 The minimum slope shall be 1.0% for CB leads, 0.2% for storm mains smaller than 600 mm in diameter, and 0.1% for storm mains 600 mm in diameter and larger.

.11 All catch basins, lawn drains and inlet shall provide a sump and trash hood in accordance with MMCD standard drawings.

.12 An American Petroleum Institute (API) Oil Water Separator or equivalent product such as Lafarge's Stormceptor chamber shall be incorporated at the most downstream point of the on-site storm drainage system for all parking facilities providing 20 or more parking stalls. The system shall be appropriately sized and include a bypass to reduce flushing of contaminants during elevated flows.

.13 For underground parkades, drains should not be connected to the storm drainage system but rather to a 'Parkade Drainage Treatment System' (PDTS) and then discharge to the building sanitary sewer system. UBC has adopted the standards of the City of Vancouver's Bulletin 2008-007-EV/PL, latest revision.

.14 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.

.15 A minimum pipe size at 200 mm shall be used for gravity service mains in residential areas and 250mm in research/industrial areas. A minimum pipe size of 150mm shall be used for all service connections.

.16 MMCD inspection chambers are not allowed on the storm sewer systems under UBC Energy & Water Services jurisdiction.

.17 The downstream sewer pipe shall be equal or larger diameter. However, an exemption may be obtained with UBC Energy & Water Services' approval. For storm drainage hydraulic details, refer to Section 4.0 for the MMCD Design Guideline manual.

.18 Where drop manholes are required, drops shall be outside, with clean-outs. For standard details refer to MMCD manhole installation standards.

.19 Catch basins shall be spaced to service a maximum area of 500 m^2 on grades up to 3%. For grades exceeding 3% the spacing shall be reduced to an area of 350 m^2. Special consideration shall be given at low spots to ensure that adequate capacity is provided. A minimum pipe size of 150 mm shall be used for CB leads.

.20 The length of service between the building face to the first storm sewer connecting manhole shall be a maximum 75 m.

.21 A minimum 750 mm horizontal clearance is required where the storm sewer is installed within a common trench with the sanitary sewer. If the invert of the sanitary sewer varies significantly from the storm sewer, the Designer shall give special consideration to the horizontal spacing. *Minimum 3 m. clearance to building footings or per MMCD General Design guideline clause 1.3.*

.22 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° and 90°.

.23 Provide positive slopes away from entrances and exits (not less than 4%) to adequate storm drains or gratings that will allow a ponding depth of at least 100 mm. (This will, in normal cases, give sufficient lead time to remedy flooding situations before interior floor finishes are damaged). Install continuous gratings in lieu of catch basins and drains where broad sheets of water are anticipated to flow down pathways and roads towards entrances. Where possible provide alternate means for water to escape if a drain is plugged such as overflow scuppers, secondary French drains, etc.

2.6 Materials

.1 Unless otherwise approved by the Manager, Mechanical Utilities, UBC Energy & Water Services, only the following pipe material shall be used for the gravity storm sewer system:

- .1 PVC, class SDR 28 (150 mm diam. and smaller) and SDR 35.
- .2 Concrete (reinforced C76 required for all pipes 600 mm in diameter and larger).
- .3 Corrugated HDPE having a minimum pipe stiffness of 320 kPa may be permitted under unique circumstances.
- .4 PVC piping is preferred for all piping 300 mm in diameter or smaller.

3.0 EXECUTION REQUIREMENTS

.1 Storm sewer works and appurtenances shall be installed in accordance with the current MMCD standards and specification, unless otherwise noted.

.2 Minimum cover on all storm sewers shall be 1.0 meters in accordance with the MMCD standards. Where no future main line extension or connection of services, lawndrains, or catch basins is required, and where no traffic road exists or in future will exist, minimum cover may be reduced to 600 mm with special approval.

.3 Site grading and surface inlets shall be located to ensure that stormwater is contained and controlled within the boundaries of the site.

.4 Washout from concrete trucks and spray washing of exposed aggregate pavement shall conform to Metro Vancouver's Best Management Practices for Stormwater Guide (Appendix H Construction Site Erosion and Sediment Control Guide) BMP CP10.

.5 All pipe surround material shall consist of clean granular MMCD Type 1 bedding.

.6 Native backfill may be used in non-traveled areas if free of rock greater than 25 mm in boulevards and easement areas only. Approval by UBC Energy & Water Services is required.

.7 For purposes of cleaning and flushing, water may be supplied from UBC fire hydrants upon application for a Hydrant Use Permit. Refer to http://planning.ubc.ca/vancouver/planning/application-forms-documents.

.8 As per Energy & Water Services' supplementals (see item 1.1), UBC Technical Guidelines Sections 33 82 01 and 33 01 30.41. A concise, written and signed report and video tape or DVD disk shall be provided to Mechanical Utilities Engineer & Manager, Mechanical Utilities (Fax: 604-822-8833).

.9 Prior to covering the pipe, all installed and bedded pipe shall be inspected by UBC Energy & Water Services. The Contractor shall provide written notification to both the Mechanical Utilities Engineer (Phone: 604-822-3274; Fax: 604-822-8833) and the Head Plumber (Fax: 604-822-4416) with minimum of 24 hours notice.

.10 Records of pipe sizes and inverts shall be provided to the Records Manager, Infrastructure Development (Phone: 604-822-7217); and also to the Mechanical Utilities Engineer, (Phone: 604-822-3274), in accordance with Sections 01 78 39 Project Record Documents and 33 00 10 Underground Utilities Services of these guidelines.

.11 Where notification requirements are not met, services may need to be re-excavated for inspection and/or testing upon request of UBC Energy & Water Services.

  .1 Concrete gutter/curb interface should not be grooved out but smoothed out at bottom to allow smooth passage of wheelchairs and bikes. Drain grates should have narrow openings which are aligned at right angles to the direction of traffic flow.

*****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 (12 psig) high pressure.
- .4 414 kPa (60 psig) high pressure.

.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 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 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 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 http://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 m^3/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 m^3, 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, confirming 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, Fax: 604-822-8833) and Utilities Head Plumber (Telephone: 604-822-5986, Fax: 604-822-4416) 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 750 mm horizontal clearance is required from all other services. *Minimum 3 m. clearance to building footings or per MMCD General Design guidelines 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 A top tracer wire attached to the underground polyethylene pipe shall be provided.

.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

.10 For trench backfill, native backfill may be used if free of rock greater than 25 mm in easements and boulevards only. Approval by UBC Energy & Water Services is required.

.11 No trees shall be planted within 1,200 mm of underground gas piping.

.12 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/.

.13 Connections to existing gas distribution system may be made by Contractor with a UBC approved design.

.14 See also Energy & Water Services' Natural Gas Service Installation work procedure, at http://energy.ubc.ca/community-services/contractors-developers/.

.15 Gas distribution valves and meter stations on the UBC Energy & Water Services system may only be operated by UBC Energy & Water Services.

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

1.0 GENERAL

1.1 Introduction

.1 The University of British Columbia has collated two reports that FVB (FVB Energy Inc.) prepared: Technical Design Basis Document – for Hot Water Energy Transfer Stations and for Hot Water Distribution Piping System. FVB prepared these documents to outline the design basis for the building connections of Energy Transfer Stations (ETS) and required building secondary side modifications for the conversion to a medium temperature hot water district energy system; as well as to outline the technical guidelines or design basis of the new hot water District Energy System (DES). This section will serve as the general technical reference guide on which all design would be based. No significant changes to this concept shall be made without the approval of UBC Energy and Water Services (EWS). DES pipe installation work is restricted to Logstor - trained and certified contractors only. A copy of such certification must be attached to the bid.

1.2 System Description

.1 The University of British Columbia (UBC) has built a new medium temperature hot water district heating system which has replaced the existing steam district heating system at the Vancouver (Point Grey) UBC North Campus.

.2 The hot water is being distributed to each customer/building on the campus through a two-pipe (one supply and one return) buried distribution piping network. The hot water is used for building heating and domestic hot water heating. The purpose of the energy transfer station is to transfer the energy transported from any Heating Plant through the distribution network to the customer via heat exchangers to satisfy the buildings' heating needs. The energy transfer stations therefore replace the steam converters in existing buildings or the traditional boiler or furnace system and hot water heaters in new buildings. The building heating system design for new buildings is open to the designer as long as the system meets the basic requirements of the District Heating system.

.3 The medium temperature hot water system operates at a maximum supply temperature of 120°C on peak design days and a maximum return temperature of 75°C. The design pressure for this system is 1,600 kPa.

.4 The DH system employs a variable flow and supply water temperature strategy that will vary both parameters based on outside air temperature and load demand. Each building will be connected to the distribution system indirectly through an energy transfer station. The actual load delivered to each customer is controlled by modulating motorized control valve(s) located on the distribution system side (or primary DH side) of the energy transfer station. This variable flow and temperature reset strategy is to aid in maximizing the efficiency of the entire system.

1.3 Energy Transfer Station (ETS) Basic Equipment

.1 An energy transfer station is made up of heat exchanger(s), isolation valves, strainers, control package – including controller, control valve(s), temperature sensors, and energy metering package – including flow meter, temperature transmitters, and energy calculator.

1.4 Definition

.1 **Building Energy Transfer Station (ETS)** – The building ETS is an interconnection between the DH system and the consumer's hot water heating and domestic hot water systems. The ETS is an indirect connection to the customers' systems via heat exchangers. The ETS consists of isolation and control valves, controllers, measurement instruments, an energy meter, heat exchanger(s), pipe, pipe fittings, and strainers.

.2 **Campus Energy Center (CEC)** – Main District Heating Plant located in its own building at the corner of Health Sciences Mall and Agronomy Road.

.3 **DH** – The District Heating system

.4 **DES- The District Energy System (same as above)**

.5 **Design Engineer** – The entity that is responsible for the design of the energy transfer stations or distribution piping system.

.6 **Design Pressure** – The design pressure shall be the maximum allowable working pressure as defined in ASME B31.1 Power Piping Code.

.7 **Development/Owner's Engineer** – The entity hired by the owner to oversee and review the work by the contractor and Design Engineer.

.8 **Distribution Piping System (DPS)** – The network of main piping lines connecting the DH Energy Centre to the service line piping. The direct buried supply and return distribution lines for the hot water system will be Logstor prefabricated, pre-insulated steel pipes.

.9 **DHW** – Domestic Hot water

.10 **DPS Leak Detection System (LDS)** – Logstor designed System that consists of measuring sections and measuring instruments for surveillance of the integrity of the pipe system. The LDS is designed to detect moisture within pipe insulation, system deviations and disorders and the location of moisture and/or disorders.

.11 **Energy Meter** – The energy meter is made up of a flow meter, two matched pair of temperature sensors, and an energy calculator/integrator. The meter will continuously display operating parameters (i.e. flow, demand, temperatures, etc.) on the LCD screen. This information is used for metering and billing purposes. The meters are to be integrated with Owner's ION metering system.

.12 **Heat Exchanger (HX)** – The heat transfer equipment is used in extracting heat from one system and passing it to another system. Heat exchangers are used between the DH system and the customer heating systems.

.13 **Heating Plant** – The District Heating source, to which the distribution network connects.

.14 **Interconnecting Pipe** – The interconnecting pipes run from the main isolation valves inside the building wall to the ETS heat exchangers located in the customer's mechanical room.

.15 **Medium Temperature Hot Water (MTHW)** – Treated water used in the heating distribution and service line network. MTHW systems are designed for maximum design supply temperatures of 120°C.

.16 **Operating Pressure** – The operating pressure is the pressure at which the system normally operates.

.17 **Owner** – The entity, University of British Columbia (UBC), with whom the contractor has entered into the agreement and for whom the work is to be provided.

.18 **Service Line (pipe)** – The service lines run from the branch fittings on the main distribution pipes to a maximum of 3 meters inside the building wall. A set of isolation valves are normally installed at the point where the service line penetrates the building wall.

.19 **Strainer** – Strainers are required at both the hot and cold side inlets of all heat exchangers to protect the heat exchangers from any suspended particles and debris. The primary side strainers will also protect the control valves and flow meters.

1.5 Building Connections

.1 The heating ETS for the customers will be designed so that each building can be “indirectly” connected to the main distribution system. This means that each building’s internal heating and domestic hot water systems (secondary side) are isolated from the DH distribution system (primary side) by means of a brazed plate (or double wall plate & frame for DHW) heat exchanger(s).

.2 The basic ETS will consist of the isolating valves, heat exchangers, actuated control valves, a digital controller, and an energy meter. The controller is used to sense the heat load demanded by the building and satisfies the heating demand by modulating the two- way control valves located on the primary side return of the ETS. This modulating action allows either more or less heat to be made available for transfer to the building’s internal heating system.

.3 New buildings must utilize a cascading of the space heating heat exchangers and domestic hot water (DHW) heat exchangers as this is beneficial to improve the return water temperatures.

.4 General arrangement is found in Standard Documents (see 2.1.1). Also see Division 23, Section 23 21 05 District Hot Water Heating System.

2.0 GENERAL REQUIREMENTS

2.1 Responsibilities

.1 UBC Energy & Water Services (EWS, formerly UBC Utilities) is primarily responsible for operation, maintenance, and overall stewardship of the district energy hot water distribution system. The demarcation of UBC Energy & Water Services point of service is normally up to and including the first isolation valve inside the building. Energy & Water Services also owns and maintains any energy meters. Also refer to Standard Drawings located on web page (http://www.technicalguidelines.ubc.ca/technical/divisional_specs.html) under Division 33's section listings.

.2 New building design and construction, in regards to the District Heating System tie-in and the ETS configuration, must be coordinated with UBC EWS. UBC EWS must give approval of the consultants and contractors for the design, installation and commissioning of these systems.

.3 Key positions in UBC Energy & Water Services are described in Division 33, Section 33 00 10 Underground Utilities Services of UBC Technical Guidelines.

.4 Unless otherwise agreed in writing, the project Designer is responsible for all design, permit, and inspection requirements of the B.C. Boiler Safety Branch and all other regulatory bodies involved.

.5 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.

.6 Shutdowns must be requested in writing adhering to UBC's campus-wide shutdowns procedures. Refer to Service Shutdown Request at www.buildingoperations.ubc.ca/resources/policies-procedures-forms/.

.7 Operating valves on the district hot water energy distribution system shall only be performed by UBC Energy & Water Services.

2.2 District Hot Water Energy Distribution Standards and Policies

.1 DES Codes and Standards

.1 The design, fabrication and installation of the distribution system shall be in accordance with the laws and regulations of the Province of British Columbia, CSA B51 and ASME B31.1. All primary side ETSs must be designed and registered with Technical Safety BC. Stress analysis should be performed at 120°C for both supply and return piping.

.2 In addition, the distribution system shall be designed and installed in accordance with the latest editions of the applicable Codes and Standards from the following authorities:

- British Columbia Building Codes, Technical Safety BC
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- Air Conditioning and Refrigeration Institute (ARI)
- American Society of Mechanical Engineers (ASME)
- American Society of Testing and Materials (ASTM)
- American National Standards Institute (ANSI)
- American Water Works Association (AWWA)
- American Petroleum Institute (API)
- Instrument Society of America (ISA)
- Underwriter's Laboratories (UL)

- National Electrical Manufacturer's Association (NEMA)
- National Fire Protection Association (NFPA)
- American Standards Association (ASA)
- American Welding Society (AWS)
- Canadian General Standards Board (CGSB)
- Canadian Standards Association (CSA)
- Manufacturers Standardization Society (MSS)
- European Standards EN253,1434, 448, 488, & 489.

As well as UBC Sustainability Development Policy # 5: (http://universitycounsel.ubc.ca/policies/index/).

.2 ETS Codes and Standards

.1 The design, fabrication and installation of the energy transfer stations shall be in accordance with the laws and regulations of the Province of British Columbia. All primary side ETSs must be designed and registered with Technical Safety BC. Stress analysis should be performed at 120°C for both supply and return piping.

.2 In addition, the energy transfer stations shall be designed and installed in accordance with the latest editions of the applicable Codes and Standards from the following authorities:

- ASHRAE Standard 90.1 - Energy Standards for Buildings
- British Columbia Building Code
- CSA B51 –Boiler, Pressure Vessel, and Pressure Piping Code.
- CSA C22.1-2002 – Canadian Electrical Code, British Columbia Electrical Safety Code and Bulletins, and regulations of the local inspection authority.
- Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II.
- The Environmental Protection and Enhancement Act enforced by British Columbia Environment.
- ANSI/ASME B31.1 Power Piping Code and piping system to be registered with Provincial Boiler Safety Authority.
- ANSI/ASME Boiler and Pressure Vessel Code, Section VIII.
- American Society of Testing and Materials (ASTM)
- Underwriter's Laboratories (UL)
- Canadian General Standards Board (CGSB)
- Canadian Standards Association (CSA)
- Manufacturers Standardization Society (MSS)
- Technical Safety BC

As well as UBC Sustainability Development Policy # 5: (http://universitycounsel.ubc.ca/policies/index/)

2.3 District hot water energy Distribution Service Connections

.1 The first step to install any new or substantially modified connections to the district hot water energy distribution system at UBC is complete a Utility Service Connection Application. This and other forms can be found at http://energy.ubc.ca/community-services/contractors-developers/.

.2 Any new connections to the district hot water energy distribution system will be reviewed for consistency with UBC Energy & Water Services standards as defined in the UBC Technical Guidelines.

.3 The Designer shall obtain the District hot water energy service records by contacting the Records Clerk at Infrastructure Development, Records Section (Telephone: 604-822-9570) and develop proposed service connection location(s).

3.0 DISTRICT HOT WATER ENERGY DISTRIBUTION DESIGN OVERVIEW AND CONCEPTS

3.1 Design Requirements for DPS

.1 **Pipe Velocities**

Buried Mains & Mains in Tunnels	2 – 3.5 m/sec
Max. Water Velocity in Service Lines	2 m/sec

.2 **Temperatures**

Max. Supply Temp.	120°C
Min. Supply Temp. (off peak)	70°C
Max. Return Temp.	75°C
Min. Return Temp.	35°C

.3 **Pressures**

System Design Pressure	1,600 kPa
System Operating Pressure	1,450 kPa
System Test Pressure	1.5 x Design Pressure

.4 **Buried Piping**

Normal Depth of Bury	900-1200 mm
Minimum Depth of Bury	600 mm
Minimum Trench Slope for Drainage	0.50%

.5 The design conditions listed below are general in nature and are to be used for preliminary line sizing. Major extensions or additions to the system should be sized based on a detailed system hydraulic model.

.6 **BCSA Registration**

.1 All aspects of the DPS shall be designed and constructed such that it can be registered with the BC Safety Authority (BCSA).

.7 **Thermal Expansion & Pipe Stress**

.1 The recommended method to design for pipe stress resulting from thermal expansion is expansion bends and U- loops.

.8 **Seismic Considerations**

.1 The piping design will incorporate the requirements of BCSA to meet the seismic loading outlined in the latest version of the BC Building Code.

.9 **Water Hammer**

.1 For larger systems or systems with pipe velocities exceeding 3.5 m/s, design consideration should be given for water hammer. The piping design will consider the necessity of water hammer control.

.10 **Hydro Test and Flushing**

.1 Design consideration should be given for every DPS section Flushing and Hydro Testing before it is connected to existing Close Loop. It should be either reflected in DPS drawings or written instructions to the Contractor.

.11 **DPS Zoning**

.1 DPS shall be designed and constructed with adequate amount of Zone Isolation Valves. This is to minimize the negative impact of heat loss in case of necessity to isolate DPS section for upgrade or repair.

.12 **DPS Vents and Drains**

.1 The piping design should incorporate air vent valves at every highest point of DPS to avoid air pockets. Consideration should be given to provide means of draining for every DPS Zone. Drain valves at the end of Service Lines may serve the purpose and should not be missed.

.13 **DPS Leak Detection System (LDS)**

.1 DPS LDS should comply with **EN 14419** of latest edition:

.1 Design Engineer (DE) should provide a detailed wiring diagram of LDS to contractor and EWS before DPS assembly takes place. Specification of measuring wires assembly instructions, should accompany the wiring diagram.

.2 Specification of LDS assembly check with description of equipment required to be provided by DE. DE also to provide guidelines for LDS functional test procedure, description of equipment required for above test, specification of a fault simulation test and data for acceptable test values.

3.2 Design Parameters for ETS

.1 **Piping Sizing Criteria**[1]

.1 Pressure Gradient Used to Determine Max. Water Velocity in Service Lines: Based on 250 Pa/m Pressure Gradient.

.2 **Pressures**

ETS Primary Side Operating ΔP	150 – 550 kPa
Customer Side Design Pressure	≤1,600 kPa
Customer Side Operating Delta P	As required
System Test Pressures	1.5 x Design Pressure

.3 **Temperatures**

		Winter	Summer
District Heating Side	Max. Supply Temp[2].	120°C	70°C
	Max. Return Temp.	<55°C	<55°C

.4 Low Temperature buildings are preferred to maximize the ΔT and improve system performance.

.5 The design conditions listed above are general but conform to industry standard and will be used for preliminary line and equipment sizing.

3.3 Hot Water General

.1 Optimization of the hot water distribution system delta T (ΔT) is critical to the successful operation of the DH system. Therefore, the customer's ΔT must be monitored and controlled. In order to optimize the DH system ΔT and to meet the customer's hot water demand, the hot water flow rate from the DH plant will vary. Varying the flow rate to satisfy demands saves pump energy for the DH system.

.2 New buildings' HVAC systems shall employ variable flow hot water heating systems to heating coils which forms an integral part of the HVAC systems by means of two-way modulating valves or three-way mixing valves only (diverting three-way valves lower the

[1] Indicated criteria are recommended in accordance with ASHRAE pipe design flow ranges.
[2] Temperatures will be reset based on outside air temperature for energy conservation purposes. The coolest water possible will be delivered to the customer that will still meet the customer's heating criteria and needs.

delta T and therefore are not recommended). The aforementioned design strategy is strongly recommended as it will save energy costs for the building owner.

.3 The energy calculations shall be performed via the energy meter based on input from the flow meter and two temperature sensors.

3.4 Pressures

.1 The DH primary system is designed for a maximum allowable working pressure of 1,600 kPa. Equipment (valves, fittings, etc.) installed for the ETS locations will, where applicable, be selected to minimum ANSI Class 150. The ΔP at each service connection will vary depending on its location in the distribution system.

.2 The Design Engineer shall request the estimated available distribution pressures for each ETS connection from the Owner's Engineer. These pressures typically include an estimate for 10 metres of interconnecting piping downstream of the main isolation valves at the building penetration. A minimum of 150 kPa will be allocated for the critical customer, which includes the ETS equipment and interconnecting piping. Customers closer to the heating plant may be able to support a higher allowable pressure drop. Final calculation of all internal pressure drops are the responsibility of the Design Engineer.

.1 **Static Pressure**

.1 The DES system has to be sufficiently pressurized at the plant to overcome the elevation difference in the system and to avoid boiling (or flashing) from occurring at the high points. In addition, some further margin is required to minimize the effect of operating disturbances, such as cavitation and pressure surges (i.e. transient pressures). Higher static pressure requirements will limit the maximum allowable dynamic pressure in the system set by the design pressure of 1,600 kPa. This again could put unnecessary limitations on the system capacity.

.2 Thus, it is generally recommended to install ETSs at the basement or ground floor level to ensure that the building elevations do not put unwanted static pressure limitations on the system.

4.0 MAJOR EQUIPMENT DESCRIPTION

The ETS includes equipment the necessary pipes, heat exchangers and associated controls and energy meters. This equipment should be located inside the customer building mechanical room **in the basement**. See Figure 1and Figure 2 below as an example of a typical ETS located at an exterior wall near the DPS mains in the street.

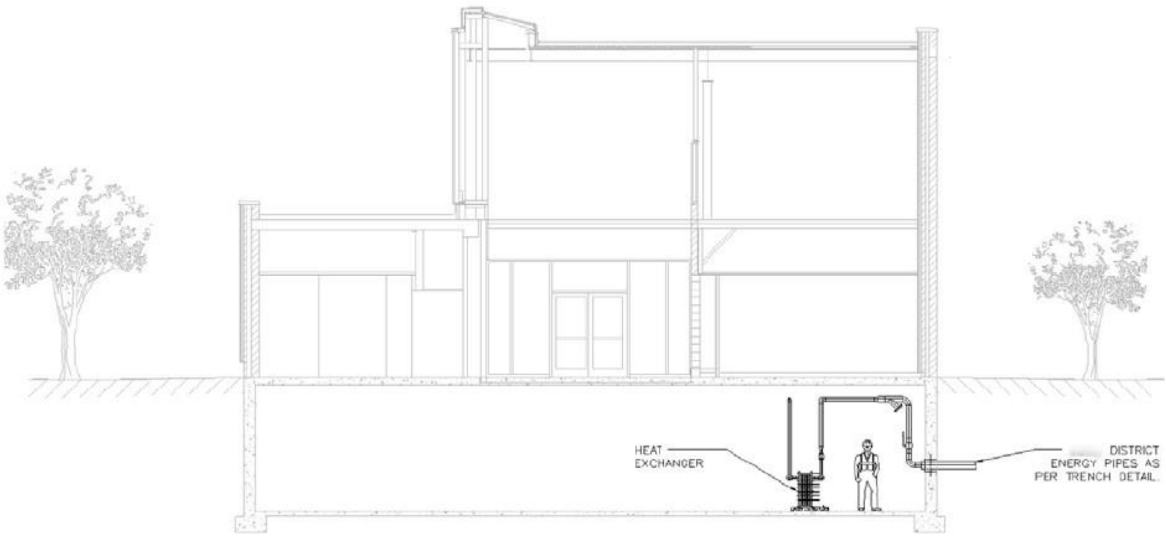


FIGURE 1 TYPICAL ETS INSTALLATION IN BUILDING BASEMENT

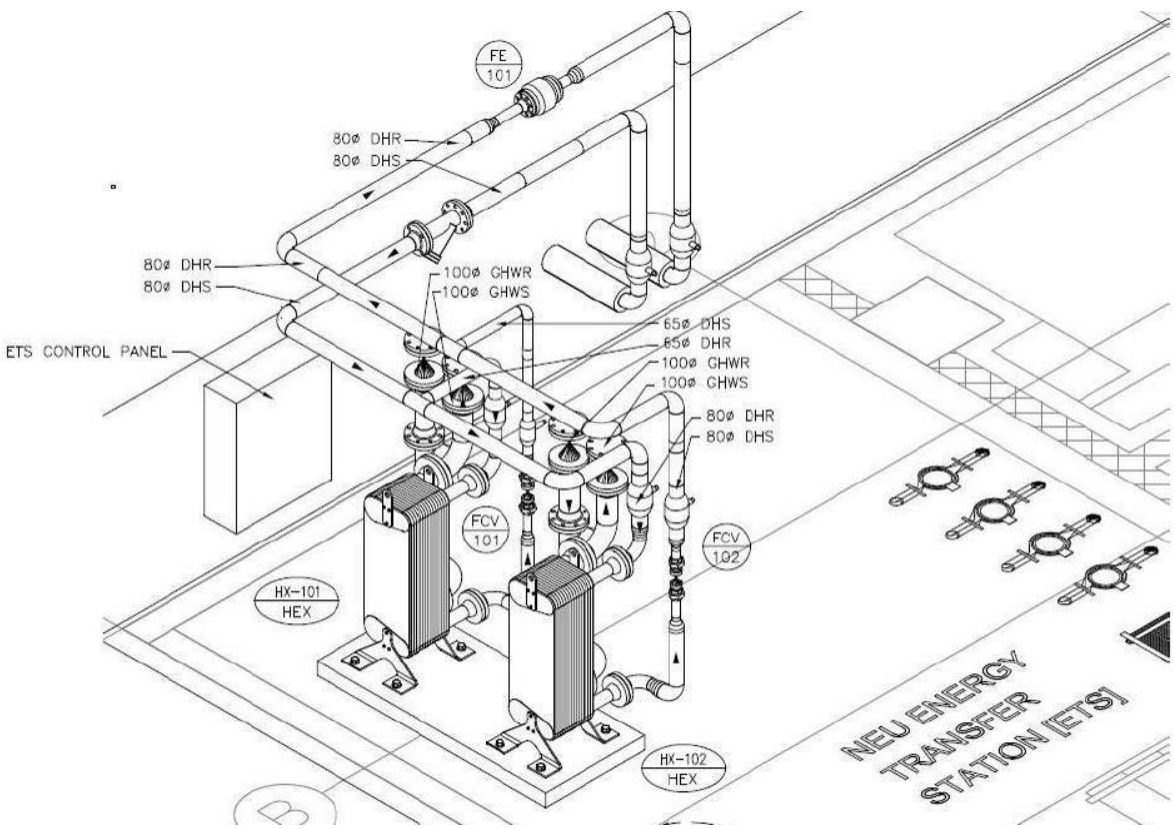


FIGURE 2 TYPICAL ETS (DETAIL)

4.1 Heat Exchangers

.1 Heat exchangers will be used on connections to all buildings to separate the existing building heating system from the DES (i.e. indirect connection). The optimum selection of each HX will be analyzed on the basis of:

.1 Sizing each unit's capacity to match the load and load turn-down as close as possible.
.2 Critical nature of the load/operation.
.3 Temperature and pressure conditions.
.4 Available space in mechanical room.
.5 Allowable ΔP on both sides of HX.

.2 Brazed Plate heat exchangers for space heating, and double-wall plate & frame for domestic hot water are recommended for this application. Shell & tube heat exchangers should not be used due to the performance limitations of these units[3].

.3 **New buildings with coincidental heating and domestic hot water requirements (i.e. Student residences) shall utilize a cascaded design (see Standard Dwg 1135-UT-03 and 1135-UT-04 for the preferred design approach with and without DHW storage).**

.4 The following table summarizes the selection criteria:

.1 **Space Heating Heat Exchanger Selection Criteria New Buildings[4]**

Hot Side Conditions			**Cold Side Conditions**		
Inlet Temp	Outlet Temp	Max. ΔP	Inlet Temp	Outlet Temp	Max. ΔP
120°C	55°C	50 kPa	50°C	70°C	35 kPa[5]

.2 Each HX will be sized for a maximum 5°C approach on the hot side (DH side) outlet to cold side inlet. Higher customer return temperatures and ΔTs will have an adverse impact to the overall system operation and performance.

.3 **Domestic Hot Water Heat Exchanger Selection Criteria**

Hot Side Conditions			**Cold Side Conditions**		
Inlet Temp	Outlet Temp	Max. ΔP	Inlet Temp	Outlet Temp	Max. ΔP
70°C	35°C	50 kPa	5°C	60°C	50 kPa

.4 **Cascaded Domestic Hot Water Pre-Heat Exchanger Selection Criteria**

Hot Side Conditions			**Cold Side Conditions**		
Inlet Temp	Outlet Temp	Max. ΔP	Inlet Temp	Outlet Temp	Max. ΔP
70°C	35°C	50 kPa	5°C	55°C	50 kPa

.5 Note: The Cascaded DHW Pre-heat exchanger is to be sized for the full flow from both Hot water and DHW heat exchangers with a maximum ΔP of 50 kPa on the DH side. See standard drawings for further details.

[3] This includes existing steam converters which will not be suitable for use with medium temperature hot water supply.
[4] Relates to typical existing building design conditions. The final selection to be building specific.
[5] May vary at each building location. Existing building allowable pressure drop to be reviewed on a case- by-case basis. Generally, since existing pumps are expected to be reused, the pressure drop should be selected to match the pressure drop of existing equipment.

.6 The design pressure on the hot side (DH) of the HX will be 1,600 kPa. On the cold side, the design pressure will be determined by the building hot water system pressure. The maximum cold side pressure will be 1,600 kPa.

4.2 Hot Water Control Parameters

.1 As stated previously, the DH supply temperature may vary between 70°C and 120°C. The supply water temperature is lowered outside the peak conditions for the purpose of conserving energy. The secondary return temperature must be no higher than 50°C for new buildings. The objective of the control system is to provide as cool a supply temperature as possible that will still meet the customer's capacity requirements while maximizing the ΔT between the District Heating Supply and Return (DHS&R) distribution piping. The minimum DH supply temperature is limited to 70°C in summer in order to meet the requirements of the domestic hot water systems whose storage tanks must be maintained at minimum 60°C to prevent bacteria growth (i.e. Legionella) in the system.

4.3 Control & Measuring Equipment Performance

.1 Each ETS will have a control & metering panel responsible for calculating energy consumed at each ETS and maintaining proper temperature relationships between the DH system supply and each building. It is recommended to use two control valves i.e. 1/3 & 2/3 split range for flow rates larger than 5 L/s for larger turn down. Alternatively, a 50/50% split can be used if higher redundancy is desired.

4.4 Energy Meters

.1 It is critical that high-quality integrated energy meters are used to achieve optimum metering accuracy and performance. Magnetic (preferred) or ultrasonic flow meters are recommended to be used at each building ETS. In addition, the integrated meters comprise of matched pair platinum temperature sensors and a sealed factory programmed integrator (i.e. calculator). These meters meet existing international standards (OIML R75 and EN1434) for thermal energy metering, as well as the Canadian standard (CSA C900). Magnetic (preferred) and ultrasonic flow meters have relatively low pressure drops, good rangeability and accuracy while requiring very little maintenance. Also, the minimum straight run requirements are greatly reduced (5 diameters upstream and 3 diameters downstream) as compared to some other types of meters.

4.5 Networking Communications

.1 The Communication network will provide the communication link between each customer ETS and the plant. This will allow remote monitoring, control of each ETS. Metering will be connected to the Campus wide ION network.

.2 The Communication network will be routed through UBC's IT network and connected into the campus wide BMS system. Siemens and ESC are preferred vendors.

4.6 DPS Leak Detection System (LDS) EN 14419

.1 LDS should be assembled as per DE instructions with Logstor components. After finishing of each measuring section, it should be tested for:
   .1 Continuity of measuring wires
   .2 No electrical contact or moisture between the wires and pipes

.2 Upon assembly of LDS zone, the System functional test is to be conducted with fault simulation.

.3 All data is to be recorded and presented to DE and EWS.

.4 After 4 weeks of operation LDS functional test should be repeated by contractor and result to be recorded. Test is to be witnessed by EWS representative.

.5 Before extending or renovating of existing LDS the actual state of System should be measured and documented:
   .1 Wiring ohmic resistance from conductor to conductor
   .2 Isolation resistance from conductor to pipe.

5.0 MAJOR EQUIPMENT SPECIFICATIONS

5.1 Piping Material

.1 **Buried District Energy Distribution Piping EN253**
SCOPE: This section specifies prefabricated and pre-insulated piping for direct burial installation as a hot water DES. Fluid temperatures are limited to the range 4°C to 120°C.

.1 **System Function**

.1 The DES shall be installed as a fully welded and bonded system in which the steel carrier pipe, insulation and outer casing are bonded together to form a solid unit. This solid unit when buried is completely sealed from soil and water ingress and hence provides superior longevity and performance. It is critical for owners to find suppliers of complete buried systems rather than applying a significant effort in assembling components from multiple suppliers to provide a completely sealed system. Piping System Shale conform to EN253 standards (Logstor or approved equal).

.2 The system comprises a steel carrier pipe, polyurethane foam insulation with integral copper alarm wires, and an outer casing of high density polyethylene. The system shall be designed such that the expansion movements of the steel carrier pipe are transferred to the outer casing via the foam insulation. The elements of the bonded pipes shall be manufactured to expand and move together. The movements are restricted by the friction between soil and jacket pipe, which acts as the anchorage for the pipe system. Generally external anchors are not required.

.3 Expansion is allowed for as determined by the stress analysis (see Section 3.9 for methods used to reduce pipe stress due to thermal expansion).

.2 **District Energy Distribution Piping in Tunnels and in Buildings**
SCOPE: This section specifies welded piping that is insulated on site for installation in the existing tunnel system and in buildings. Fluid temperatures are limited to the range of 4°C to 120°C.

.1 **System Function**

.1 The distribution piping system shall be installed as a fully welded system.

.2 **Tunnel & Building Pipe Material**

.1 All tunnel and building distribution piping will be designed, constructed, and tested in accordance with ASME B31.1 Power Piping Code. In general, all tunnel and building distribution piping is of welded carbon steel construction (A53 schedule 40 typical and standard weight in the larger pipe dimensions).

.2 Mechanical groove joint piping systems will not be accepted in this service.

.3 Piping will be designed, specified, constructed, and installed such that it can be registered with BCSA.

.4 The transition from the buried EN253 pipe to standard weight tunnel or building piping will occur after the wall penetration.

.3 **Tunnel and Building Pipe Leak Detection**

.1 There will be no leak detection system in the tunnel piping portion. Termination of the leak detection system in the buried piping will be determined at the design phase as well as the best method of communication to the monitoring centre.

.2 The leak detection system terminates upon entry into each building.

5.2 Heat Exchangers

.1 **Brazed Plate Heat Exchanger – Space Heating**

.1 Heat exchangers shall consist of thin corrugated Type 316 stainless steel plates stacked on top of each other and brazed together. Brazing material shall be copper. Every second plate shall be inverted so that a number of contact points are created between the plates. The plate patterns are to create two separate channels designed for counter flow.

.2 Plate thickness shall be of a minimum of 0.4mm. The plate pack shall be covered by Type 316 stainless steel cover plates.

.3 The flanged connections shall be located in the front or rear cover plate. Flanged nozzle connections shall conform to ASA standards, and shall be of the pressure rating design indicated below.

.4 Heat exchangers shall be supplied with removable insulation kits and supports (stands, brackets etc.). The insulation shall consist of Freon free insulation (polyurethane foam) and ABS plastic cover.

.5 The heat exchangers shall be designed for the following continuous operating pressures and temperatures: 1,600 kPa and 120°C, hot water

.6 The heat exchanger characteristics shall be as per the attached schedule. Standard of Acceptance: Xylem, Alfa Laval or equivalent.

.2 **Double Wall Plate & Frame Heat Exchangers – Domestic Hot Water**

.1 Frame shall be carbon steel with baked epoxy enamel paint. The frame shall be designed without additional welds and reinforcements. The carrying and guide bars shall be bolted to the frame, not welded. The carrying and guide bar surface in contact with the plates and roller shall be made of, or cladded with a corrosion resistant material such as stainless steel. The bolts shall be greased with molybdenum grease and protected with plastic sleeves.

.2 Connections shall be NPT, male threads or flanged. Flanged connections shall conform to ASA standards.

.3 The double wall plates shall be composed of two plates pressed together simultaneously and laser welded at the port. Failure of one plate or weld shall result in an external detection without inter-leakage. The plates shall be corrugated Type 316 stainless steel. Metal to metal contact shall exist between adjacent plates. The plates should have no supporting strips and should be pressed in one step. The part of the plate in contact with the carrying and guiding bars shall be reinforced to prevent bending and twisting during the handling of the plates. The plates shall be fully supported and fully steered by the carrying bar and guided by the guide bar to prevent misalignment in both vertical and horizontal directions. Plate design shall permit the removal of any plate in the pack without the need to remove all of the other plates ahead of it.

.4 Plate thickness shall be of a minimum of 0.4mm.

.5 Gaskets shall be clip-on or snap-on (glue-free) EPDM. The gaskets shall be in one piece, as well as one piece molded, in a groove around the heat transfer area and around the portholes of the plates. The gasket groove shall allow for thermal expansion of the gaskets. The gaskets shall have a continuous support along both its inner and outer edges and to prevent over- compression of the gaskets.

.6 The heat exchangers shall be designed for the following continuous operating pressures and temperatures: 1,600 kPa and 120°C, hot water.

.7 The heat exchanger capacities shall be as per design specifications. Standard of Acceptance: Alfa Laval or equivalent.

5.3 Controls & Measuring Equipment

.1 Description

.1 The controls are made up of programmable controllers, temperature sensors, outdoor sensors, control valve stations and other miscellaneous instrumentation. The controls and energy metering systems shall be integrated and compatible with the existing building automation system (BAS) and with a compatible communication protocol to perform the functions described in this section. All devices and equipment shall be approved for installation by the Owner and/or Owner's Engineer.

.2 All controls shall be BACnet compatible.

.2 Products

.1 The controls supplier shall select the appropriate control component to match the required service conditions. The control valves type selected shall meet the minimum design requirements described in the following sections.

.2 The minimum test for control valves and flow meters shall be hydrostatic test in strict accordance with the requirements of ASME Section VIII, Division 1, or Section III, Class 3.

.3 Hydrostatic test pressure shall be 1.5 times the design pressure using calibrated pressure gauges.

.3 Control Valves

.1 Control valves are to be sized by control supplier according to design specification herein. Water valves shall be sized on the basis of minimum 50% of available differential pressure or minimum 75 kPa (11 psi) pressure drop. Pressure drop for valves shall be submitted for review, including all CV values.

.2 Valves shall be equal percentage type, two-way, single-seated, and equipped with characteristic type throttling plug, #316, stainless steel stem and seat. Provide with necessary features to operate in sequence with other valves and adjustable throttling range as required by the sequence of operations.

.3 Valves shall be able to handle a minimum of 345 kPa (50 psi) differential pressures for modulating service with range ability greater than 100:1. Actuator selection shall be for close-off pressures greater than 690 kPa (100 psi). Arranged to fail-safe as called for tight closing and quiet operating. Leakage shall be less than 0.1% of Cv. **Standard of Acceptance: Siemens or equivalent.**

.4 All two way controls valves shall be slow closing to prevent water hammer.

.4 Electric Actuators

.1 Provide 24 VAC control valve actuators which are 0-10 VDC or 4-20 mA input proportional with spring return as needed by control sequence and designed for water service valve bodies.

.2 Operator shall be synchronous motor driven with minimum 750 Newtons of thrust and force sensor safe.

.3 Control stroke time shall be less than 30 seconds. Actuator shall include a manual clutch that enables manual positioning of valves during power failures and servicing. Upon restoration of power, actuator will automatically reposition itself without intervention. Actuator shall have self- lubricating bearings to minimize maintenance requirements. Indication of position shall be visible at all times. **Standard of Acceptance: Siemens SKB/SKC/SKD or equivalent.**

.5 **Energy Metering Components**

.1 The energy meter is made up of a flow meter, two temperature sensors, energy calculator, and plug-in modules. A read-out unit makes it possible for the operator to observe the operating parameters. The energy meter shall be furnished with an output (e.g. Lonworks) for integration with control panel with remote communication capability.

.2 Energy Calculator shall comply with OIML R75 and EN1434, with accuracy: +/- (0.15+2/Δt) % and water temperature range 1°C – 160°C and 30 seconds flow calculation intervals. The meter shall have a permanent memory (EEPROM). The meter display shall show the following items:

- Accumulated thermal energy: MWh
- Accumulated water flow: m3
- Actual thermal power: kW
- Actual water flow: l/h or m3/hr
- Supply temperature: °C
- Return temperature: °C
- Temperature differential: °C
- Peak thermal power: kW P
- Peak water flow: l/h or m3/hr P
- Hour Counter: HRS

.3 The meter shall be factory calibrated and supplied with verification certificate. **Standard of Acceptance: Endress & Hauser (magnetic) and Kamstrup Ultrasonic or equivalent.**

.4 The flow meter shall be magnetic or ultrasonic in compliance with OIML R75 and **EN1434**, with accuracy +/- 1.0% of rate within flow range of 0.3 to 9 m/s and minimum rangeability 1:30. Fluid temperature range shall be 4 to 120°C and fluid pressure range full vacuum to 1,600 kPa. Factory calibrated **Standard of Acceptance: Endress & Hauser (magnetic) and Kamstrup Ultrasonic or equivalent.**

.5 The meter shall be factory calibrated and supplied with calibration certificate. **Standard of Acceptance: Endress & Hauser (magnetic) and Kamstrup Ultrasonic or equivalent.**

.6 Resistance Temperature Detectors (RTDs) shall be 4-wire PT500 Pocket Sensor (Paired) with connecting head performance .04°C Δt deviation (pairing). **Standard of Acceptance: Endress & Hauser (magnetic) and Kamstrup Ultrasonic or equivalent.**

.7 **Sequence of Operations**

.1 General

.1 The general control strategy to be implemented for the new Energy Transfer Stations shall be the supply temperature reset based on the outside air temperature. In addition, a reset function based on return temperature shall be employed to ensure that the District heating return temperatures are maintained as low as possible.

.2 Standard Heating Supply with Return Limiting

.1 During normal operation, the secondary supply temperature shall be set from a temperature reset schedule based on outside air temperature (OAT). The schedules are to be system specific.

.2 The secondary return temperature shall not exceed the maximum return temperature limit. Should this happen, the supply temperature set point shall be reset down until the secondary return temperature drops below the maximum values. The return water limiting function shall override the minimum supply temperature function. The maximum return limit will be building specific.

.3 Domestic Hot Water (DHW)

.1 The controller shall be programmed to fully close the DHW control valve when the recirculation pumps on the secondary side shut off. When the recirculation pumps are turned back on, the controller will be programmed with a 20 second delay, prior to opening the DHW control valve.

.2 During normal operation, the customer domestic hot water supply temperature shall fix set point, initially at 60°C (adjustable range 40 to 65°C.) The controls shall have a Maximum limit (adjustable, initially set at 65°C) when the control valve will go to closed position.

.4 Alarms

.1 The DDC system shall monitor hot water supply and return temperatures. If temperatures exceed high or low limits, an alarm shall be recorded at the operator's workstation.

.6 **Leak Detection System Equipment**

.1 LDS equipment should be Logstor approved. Ordinary electrical wire or any other kind of unauthorized wire is not allowed to form any part of the LDS assembly.

6.0 ETS INSTALLATION

6.1 General

.1 The district heating (primary) side shall be an all-welded piping system in accordance with ANSI B.31.1 and CSA B51. The building (secondary) side piping shall be a welded system in accordance with ANSI B.31.9. If grooved piping is used in the existing building secondary systems, it can be used as an acceptable alternate. However, it is strongly recommended that all risers be welded for maximum system integrity.

6.2 Pipe Welding

.1 Welding qualifications to be in accordance with CSA B51 and ANSI/ASME B31.1. Qualified and licensed welders shall possess a certificate for each procedure to be performed from the authority having jurisdiction.

.2 Registration of welding procedures shall be in accordance with CSA B51 and ANSI/ASME B31.1.

6.3 Valves

.1 Install isolating valves at all branch take-offs, at each piece of equipment and elsewhere as indicated. All primary isolation valves to be welded. Welding to valves must be done in accordance with the manufacturers' recommendations in order to prevent body distortion and to maintain tight shutoff characteristics of the valve.

6.4 Strainers

.1 Install strainers at both secondary and primary side heat exchangers inlets in locations to allow easy access for removal of screen.

.2 Provide drain ball valve and piping to a point 400 mm from the floor (if applicable). The pipe end shall be provided with a threaded forged steel cap.

6.5 Inspection and Testing

.1 **General**

.1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2, CGSB 48-GP-2M, and approved by Design Engineer. To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.2 The Design Engineer shall review and approve the contractor's pressure testing procedures at least 72 hours prior to carrying out any testing.

.2 **Inspections**

.1 Unless otherwise approved by the Design Engineer, all joints in the piping systems shall remain uncovered until all tests are completed and the systems have been inspected and approved by the Engineer or Inspector.

.2 DPS Leak Detection System assembly checks should be carried out continuously during the construction work.

.3 **Hydrostatic Testing**

.1 Hydrostatic testing shall be performed in accordance with the requirements of ANSI B31.1., Owner's specifications, and the contractor's Inspection and Test Plan. Test pressure shall be

.2 1.5 times the system design pressure. Hydro test water shall be clean, filtered fresh or city water. There shall be no leakage in the pipeline.

.3 All District Heating primary piping shall be hydraulically tested after installation and before painting, insulating, and concealing in any way, at a minimum test pressure of 2400 kPa for 4 hours without a drop in pressure. The secondary heating shall be hydraulically tested at 1.5 times design pressure or a minimum of 690 kPa (100 psi) as per ANSI B31.9.

.4 Any equipment not capable of withstanding the designated test pressure shall be isolated. Flow meters, heat exchangers, and control valves are to be removed and spool pieces installed before commencing pressure tests.

.5 The Design Engineer shall make the contractor responsible for obtaining all approvals from jurisdictional bodies for the carrying out of pressure tests on piping with joints not exposed for visual examination.

.4 **Radiographic Testing**

.1 20% of all primary welds shale be radiograph tested. If any welds are shown to fail a second test will be required with radiograph of 100% of welds.

6.6 Cleaning and Flushing

.1 The Design Engineer shall review and approve the contractor's flushing procedure.

.2 Primary piping shall be flushed, with potable water or possibly a chemical flush, to remove all foreign material from the inside of all piping to the Design Engineer's approval. Flushing velocity shall be a minimum of 1.5 m/s.

.3 Typical acceptable system water concentrations:

- Iron levels should be below 2 ppm.
- Hardness should be below 2 ppm.
- Chloride levels should be maximum 250 ppm if 316 SS Heat Exchanger plate material is used or 50 ppm for 304 SS.
- pH level of 9.5-10

.4 Water is to be tested by a water treatment analyst during the cleaning and flushing procedure.

.5 The Contractor shall take all necessary precautions to prevent damage to the pipe, insulation, or structures from the cleaning operation. Flow meters, heat exchangers, and control valves are to be replaced with spool pieces.

.6 The contractor shall install and remove all temporary piping and supports to introduce and dispose of flushing water at a safe discharge.

6.7 Commissioning

.1 Prior to the commissioning of the DH system, both primary and secondary sides must be flushed and cleaned to the satisfaction of the Owner. The strainers shall be cleaned. Heat exchangers will only be allowed to be commissioned pending verification of the proper strainer screen and mesh have been installed at the inlets to the heat exchanger (s). The proper strainer screen/mesh sizes are as per the following:

.1 Brazed Plate heat exchangers: 1/8" stainless steel perforated screen with 0.5mm (30) mesh.

.2 Plate heat exchangers: 3/64" stainless steel perforated screen.

.2 After satisfactory water quality analysis by a qualified water treatment contractor, system start- up and commissioning may commence. A certification from the water treatment contractor will verify that the water quality is acceptable.

6.8 Accessibility

.1 All ETS equipment, strainers, control valves, heat exchangers, energy meters and sensors shale be installed in a way that is readily accessible for maintenance and repairs.

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

1.0 GENERAL

1.1 System Description

.1 Many buildings in the Main Campus area (north of 16th Avenue) are serviced by steam from the Powerhouse. 99% dry steam is generated at 1,137 kPa (165 psig) and reduced to approximately 482 kPa (70 psig) in the Powerhouse for distribution to the following major systems: North, South, and West. There is also a Low Pressure system in the vicinity of Powerhouse with steam pressure in the range of 34 - 69 kPa (5-10 psig).

.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, formerly UBC Utilities) 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 (http://www.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 the B.C. Boiler Safety Branch.

.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; B.C. Boiler Safety Branch.

  .2 UBC Sustainability Development Policy # 5 (http://universitycounsel.ubc.ca/policies/index/).

  .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 http://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 B.C. Boiler Safety Branch 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 B.C. Boiler Safety Branch 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 cladded 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 (+≥ 50° 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 www.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 – Technical Services

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 (http://www.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 that 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 (¼") 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 (ie vitrified clay, concrete, pvc etc.)*
- *.4 Type or use of pipe (ie 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 (ie 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 ±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 ±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*		
CONTINOUSDEFECT	*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******