Edmonton International Airport

Utility Standards

March 2010

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EDMONTON INTERNATIONAL AIRPORT

Edmonton International Airports – Utility Standards

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Note: Detailed design standards maybe available for each of these areas and not listed in this document. Please contact Edmonton Airports' Engineering department for more details.

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Electrical

General Provisions

July 21, 2006

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APPENDIX

1. CODES AND STANDARDS

A. Do complete installation in accordance with the Canadian Electrical Code (CEC).

B. All Canadian Standards Association (CSA) Electrical Bulletins in force at time of tender submission, while not identified and specified by number, are to be considered as forming part of related CSA Part 1 Standard.

C. Before commencing with any digging, call Alberta First Call and obtain an Excavation Permit from the Airport Facilities Drawing Management Department at (780) 890-8433.

D. Obtain Alberta Department of Labour, Electrical Protection Branch Permit and forward a copy followed by the certificate of acceptance from the Inspection Branch to:

Edmonton Airports (EA)
Superintendent Electrical
Edmonton International Airport
P.O. Box 9860
Edmonton, Alberta T5J 2T2

2. EQUIPMENT IDENTIFICATION

A. Identify electrical equipment with name plates made of lamicoid plastic engraving sheet three millimeters (3mm) thick. Name plates are to have a white face with black core and be mechanically attached.

B. Wording on name plates to be approved prior to manufacture.

C. Identification to be English.

D. Name plates for panels, terminal cabinets and junction boxes are to indicate system and/or voltage characteristics.

E. Install size one (1) name plates on all switches and receptacles. Attach below device on cover plate.

F. Terminal cabinets and junction boxes in ceiling spaces shall identify panel and circuit numbers, with permanent markers.

3. WIRING IDENTIFICATION

A. Each conductor is to be identified at each end where they are spliced or terminated in a pull box, panel, fitting or device. Conductors that pass through a pull box are to be identified in that box.

B. The identification tag shall show the panel designator and circuit number or wire number on each conductor. Information shall be printed in legible form.

C. Neutral conductor is to be tagged with the circuit numbers that it serves.

D. Switched conductors are to be tagged with "SW" after circuit identification.

E. Maintain phase sequence and color coding throughout for all systems.

F. Wiring color code as follows:
- 120/208V – Systems Phase Wires - Red, Black and Blue
- 277/480 & 347/600V – System Phase Wires – Orange, Brown & Yellow

G. Color coding of Phase Conductors:

- Number 10 Conductors and smaller shall be Red, Black, Blue, Orange, Brown, Yellow, White, as required
- Number 8 to 3 Conductors shall be Red, Black, Blue, White for 120/208 Volt Systems. Color banding is acceptable on the Red, Black and Blue Conductors for the Orange, Brown, Yellow Identification of the 277/480 Volt Systems
- Larger than Number 3 can be Black with appropriate banding

4. CONDUIT IDENTIFICATON

A. Color code conduits and metallic sheathed cables.

B. Code with plastic tape at points where conduit or cable enters wall, ceiling or floor and at fifteen metre (15m) intervals.

C. Colors to be twenty-five millimeters (25mm) wide prime color and twenty millimeters (20mm) wide Auxiliary Color.

D. Paint conduit fittings JB, pull elbows and LB's using the following color scheme.

4. CONDUIT IDENTIFICATON (Continued)

Conduit	Prime	Auxiliary
Electric Control	Yellow	Brown
120/208 Volt	Grey	No Auxiliary
120/208 Volt Emergency	Grey	Yellow
277/480 Volt	Yellow	Green
277/480 Volt Emergency	Yellow	Green
347/600 Volt	Sand or Beige	No Auxiliary
347/600 Volt Emergency	Sand or Beige	Yellow
5kV	Tech Cable	Tech Cable
Fire Alarm	Red	No Auxiliary
Telephone/Data	Light Blue	No Auxiliary
Sound (P/A)	Yellow	No Auxiliary
Clocks	Light Green	No Auxiliary
BIDS/FIDS/GIDS	Dark Green	No Auxiliary
Low Voltage Switching Conduit	Black	No Auxiliary
Door Monitor & Access Control System Green	Rust	No Auxiliary
Security Television	Gold	No Auxiliary
Future / Spare	Pink	

5. MANUFACTURES' AND CSA LABELS

A. Manufactures' name plates and CSA Labels to be visible and legible after equipment is installed.

6. PROTECTION

A. Protect exposed live equipment during construction for personal safety.

B. Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage setting.

7. INSULATION RESISTANCE TESTING

A. Megger circuits, feeders and equipment with appropriate voltage setting.

B. Check resistance to ground before energizing.

8. COORDINATION OF WORK ON EXISTING EQUIPMENT

A. When existing equipment or service areas are required to be out of service during construction, coordinate work with Airport Authorities.

B. Since the existing building is in use, any changes to the existing system must be made at such times as arranged by the Engineer's representative. When the building is not in use ensure there will be no interference with the operation and use of the existing facilities.

C. Areas being renovated in the existing building shall have all existing electrical equipment and devices to be reconnected properly supported so as to be in good operating condition after all renovations and alterations are complete.

D. Existing conduit, not slab and existing wiring and electrical equipment that is being abandoned, shall be removed. Existing conductors that are removed shall not be re-used. Existing conduit, wire, fittings and equipment that is removed and is surplus to the project shall be disposed of at the direction of the Engineer. All fluorescent ballasts containing PCB's shall be turned over to the Superintendent Electrical or his designated representative.

E. In the existing building, in areas being renovated, all existing electrical services and devices shall be disconnected, removed and properly protected so as to be in good operating condition after all renovations and alterations are complete. In any wall or partition that is being removed from raceways and boxes, the raceways shall be reconnected or re-routed as required to provide continuity to other areas, and new wiring installed to restore the services to these areas.

F. All priority systems and wiring that must be operational are to be re-routed and extended around the renovated spaces as required to facilitate completely working systems.

9. FINISHES

A. Shop finish metal enclosure surfaced by:

1st - Removal of rust and scale
2nd - Cleaning
3rd - Application of rust resistant primer inside and outside
4th - Application of at least two coats of grey finish enamel

B. Clean and touch up surface of shop painted equipment, scratched or marred during shipment of installation, to match original paint.

C. Clean, prime and paint exposed hangers, racks and fastenings to prevent rusting.

10. MATERIALS

A. Use minimum No. 12 AWG/Copper conductors, unless specified (no aluminum).

B. Equipment and material to be CSA Certified and manufactured to Standard quoted.

C. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Inspection Department.

D. All tenant metering equipment shall indicate both consumption and demand.

11. RECEPTACLES

A. Receptacles shall be Specification Grade CSA Type 5-15R, 125V, 15A, U Ground.

B. Isolated Ground Receptacles shall be Orange.

C. Receptacles shall be of one Manufacturer and Specification Grade throughout project.

D. Acceptable Manufacturers:
- Bryant No. 5262
- Circle F No. 5262
- Canadian General Electrical No. 4065
- Leviton No. 5262, Hubbell No. 5262

12. SWITCHES

A. All manually operated AC switches shall be of specification grade.

B. Switches to be from one Manufacturer throughout project.

C. Acceptable materials:
- Arrow Hart No. 1891
- Bryant No. 4801
- Circle F No. 1201
- Canadian General Electric No. 5931
- Leviton No. 53501
- Hubbell No. 1201

D. All dimmer switches shall be radio frequency suppressed.

13. COVER PLATES

A. Stainless steel, one millimeter (1mm) thick cover plates for wiring devices are to be mounted in a flush-mounted outlet box.

B. Cover plates from one manufacturer to be used throughout the project.

C. Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

D. Do not use cover plates meant for flush-outlet boxes on surface-mounted boxes.

E. Install suitable common cover plates where wiring devices are grouped.

14. OUTLET AND CONDUIT BOXES

A. Sectional boxes will not be permitted.

B. Easy (EZ) boxes can be used, by special permission, in finished areas where renovations are being done and fishing is the only alternative.

15. EXECUTION – INSTALLATION

A. Support boxes independently of connecting conduits.

B. For flush installations, mount outlets flush with finished wall using plaster rings to permit wall finish to come within six millimeters (6mm) of opening.

C. Provide correct size of openings in boxes for conduit, mineral insulated and armored cable connections. Reducing washers not allowed.

D. Install pull boxes in inconspicuous but accessible locations.

E. Where new work connects with existing or where existing work is altered, the renovation should be done to the best match with the original.

15. EXECUTION – INSTALLATION (Continued)

F. Install single throw switches with handle in "UP" position when switch is closed.

G. Install switches and receptacles in gang type outlet box when more than one (1) switch is required in a location.

H. Use No. 6 spacer washers to mount device secure to box. Do not depend on wall finish for support.

16. INSTALLATION

A. Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

B. Conceal conduits except in Mechanical and Electrical Service Rooms and in unfinished areas.

C. Use rigid galvanized steel threaded conduit below two and two-fifths meters (2 2/5 meters) where subject to damage.

D. Use electrical metallic tubing (EMT) in concealed walls, in ceiling spaces and below two and two fifths meters (2 2/5 meters) where not subject to mechanical injury.

E. Use liquid tight flexible metal conduit for connection to motors.

F. BX may be used for the last drop from a pull box to a finished area which is being renovated if fishing is required.

G. Flexible metal conduit, or BX cable, may be used for connection to recessed incandescent fixtures without a pre-wired outlet box, connection to surface or recessed fluorescent fixtures.

H. Bend conduit cold. Replace conduit if kinked or flattened more than one-tenth (1/10) of its original diameter.

I. Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

J. Install fish cord in empty conduits.

16. INSTALLATION (Continued)

K. Re-support existing conduit which is to remain where support has been disrupted by construction.

L. Only diamond core drilling of concrete floors and walls will be allowed where wiring devices are to be installed and where conduits must pass through them.

M. Where cables or conduits pass through floors and fire rated walls, pack space between wiring and sleeve full with fire rated caulking compound.

17. SURFACE CONDUITS

A. Run conduits perpendicular to building lines.

B. Group conduits wherever possible in suspended channels.

C. Do not pass conduits through structural members.

D. Do not locate conduits less than seventy-five millimeters (75mm) parallel to steam or hot water lines with a minimum of twenty-five millimeters (25 mm) at crossovers.

18. CONCEALED CONDUITS

A. Do not install conduits in terrazzo or concrete toppings.

B. Do not use wire lashing or perforated strap to support or secure raceways or cables.

C. Do not use supports or equipment installed for other trades for conduit or cable support except with permission of the Electrical Superintendent or his designated representative.

19. FLUORESCENT BALLASTS

A. Fluorescent ballasts shall be of the pure electronic type (no hybrid core and coil), rapid start sound rated A, Total Harmony Distortion (THD) less than 5% and power factor greater than 97%. These ballasts must be designed for used with T8 Type lamps.

20. EXIT SIGNS

A. All EXIT signs shall be Lumacell LER400 or equivalent complete with LED illumination.

B. Signs shall have three (3“) lettering complete with bilingual translation (EXIT/SORTIE).

21. CLOCKS

A. All clocks in public areas are to match existing clocks in the Terminal Building.

B. All cables must be in conduit or cable tray. Cable used as directed by EA Electrical Department.

C. Clocks are available from Franklin Time Specialists (Phone 215-355-7942). Clock specifications are:

Franklin Mark 5 Order
WM125S-5M-A-G
24 Volt (DC) BiPi

22. PANEL BOARDS

A. 250 V Panel Boards: Bus and breakers rated for 10,000 A (symmetrical) interrupting capacity or as indicated.

B. Sequence phase bussing with odd numbered breakers on left and even on the right, with each breaker identified as to circuit number by permanent number identification.

C. Panel Boards: Mains, number of circuits and number and size of branch circuit breakers as indicated.

D. All branch breakers shall be bolted in. No plug-in breakers will be allowed.

E. Circuit breakers shall not be installed on “ENERGIZED” panel bussing unless permission is given by the Electrical Superintendent or designated representative.

23. LOW TENSION

A. Data/Voice/FIDS, BIDS, GIDS cabling, all cables to be installed in conduit or cable tray. Installation must be all Nordx equipment and by a certified Nordx installer. New drops must be submitted to Nordx for certification. Category type as directed by EA Electrical Department.

23. LOW TENSION (Continued)

B. Access Control/CCTV System Cabling, all cables to be in conduit or cable tray. Cable type as directed by CHUBB Security or EA Manager of Security.

C. Public Address System and Cabling, all equipment must be LED and match the existing system. All cables to be in conduit or cable tray. Cable type as directed by EA Electronics department.

D. All other low tension cabling (Thorgaurd, Passenger Screening, Panic Buttons, but not limited to), all cables to be in conduit or cable tray. Cable type directed by EA Electrical Department.

24. RECORD DRAWINGS

A. Consultant to furnish one set to be used for record work as actually installed. Accurately record on this set of drawings, day by day, all outlets, conduits, luminaries and equipment as actually installed on the job. Any changes to contract work to be similarly recorded.

B. Upon completion of work and before final payment, transcribe all information from record prints to computer disks including any changes to Contract Documents, and turn these over to the Consultant. All revisions to be done in Autocadd (Version to match tender documents) and to match existing drawing quality. Cost of preparation of Record Drawings computer disks to be included in tender price.

25. ACCEPTANCE OF WORK

A. The EA representative reserves the right to inspect at any time, the quality and quantity of work being done or method and utilization of materials supplied to the Contractor, for use on the project.

B. The EA site representative will directly monitor the quality of workmanship and ensure that the level is maintained to that expected by EA. Unacceptable work found during any stage of project progress will be corrected immediately at the Contractor’s expense. All materials issued and utilized in work deemed as unsatisfactory will be replaced at the Contractor’s expense.

25. ACCEPTANCE OF WORK (Continued)

C. The Contractor shall arrange with the EA representative a date and time for an inspection of materials and workmanship, prior to covering over any work.

D. A final acceptance will be issued by EA to the tenant, when all identified deficiencies have been corrected and accepted as correct.

26. SECURITY CLEARANCE

A. The Contractor must comply with Airport Security Regulations in place by Transport Canada.

B. Where required to enter access controlled areas (Restricted Areas) to carry out work, the Contractor will be required to either:
- Be in possession of a permanent "Restricted Area" picture pass as issued by Airport Security and wear the pass visibly
- If not security cleared, the Contractor is to sign out a "Visitor Escort" required pass and hire an Airport Security Escort

27. SECURITY PASSES AND KEYS

A. Any Contractor who in the opinion of the Airport V.P. Operations or his designated representative is deemed unacceptable because he is a security risk must be immediately removed and replaced by an approved worker.

B. All Contractors not security cleared must obtain a "Terminal" or "Airside" Visitor Escort required pass from the Pass Control Office. Contractors are required to comply with the following regulations:
- No person shall enter on or remain in a restricted area unless a valid identification is at all times, visible on this person. Current penalty for offence under this section is subject to a fine. This is subject to change from time to time. Penalty for loss of an identification pass is $50
- Any loss of passes shall be immediately reported to the Pass Control Office on the Mezzanine Level
- All temporary day passes shall be surrendered daily to the Pass Office when leaving the Airport property
- The penalty for passes not returned is subject to a fine, payable to EA

28. RESTRICTED AREAS

A. The restricted area of the Airport are:

Airport Terminal Building
- Areas downstream from the Pre-Board Screening Security Check Points
- Canadian and U.S. Immigration and Customs Inspection area
- Baggage Make-Up Rooms
- Other Non-Public Areas

Administration Tower
- Control Tower Cab
- Telecommunications Room – Any
- Other Electronic Equipment Areas

Air Operations Centre (AOC)
- All areas within the building and connecting tunnels

Central Utilities Plant (CUP)

Fire Hall

All Service Tunnels

All Mechanical Rooms and Mechanical Penthouses

Any Area behind a Security Fence or subject to Airport Security Jurisdiction

B. Persons possessing a Restricted Area Pass and key may enter only those portions of the Restricted Areas to which they have a need and right of entry for the sole purpose of performance of their job. It is a violation of the Terms of Issue to enter areas to which a person does not have substantiated requirement for access in the performance of their job. Also, under no circumstances will a pass holder use the pass to circumvent pre-board screening when that person enters the area for the purpose of boarding an aircraft as a passenger of that aircraft.

C. It is the employer's responsibility to ensure that all employees are aware of the rules and regulations regarding Restricted Area Passes and keys. Violation of the Restricted Area pass and key requirements may also result in suspension of pass privileges by the Airport V.P. Operations or their designated representative.

28. RESTRICTED AREAS (CONTINUED)

D. The requesting authority/employer is responsible for ensuring that Airport Restricted Area Passes issued to their employees are returned to the issuing authority in the following instances:
   - When an employee terminates employment
   - When an employee is transferred to a new place of employment
   - When an employee no longer requires a pass
   - When an authority/employer has failed to take reasonable action in these instances to recover a pass, the subsequent costs of the issuing authority to recover the pass may be assessed against the authority/employer

29. CONSTRUCTION SAFETY MEASURES

A. Observe and enforce construction or maintenance safety measures required by Canadian Construction Safety Code, Provincial Government Workers' Compensation Board, and Municipal Statues and Authorities.

B. In the event of conflict between any provisions of the above authorities, the most stringent provision will apply.

30. FIRE SAFETY REQUIREMENTS

A. Comply with requirement of Standard for Building Construction Operations DFC No. 301-1982, issued by:

Dominion Fire Commissioner/Commission
Sir Charles Tupper Building
Riverside Drive
Ottawa, Ontario K1A 0M2

31. WORK SCHEDULE

A. All work shall be carried out on consecutive working days, as weather permits.

B. Contractor shall perform work in only one area at a time.

C. During the non-work periods, the Contractor must ensure that the area is returned to a safe operating condition as determined by the Superintendent Electrical or designated representative.

D. Scheduling of work will be dictated by air traffic requirements and shall be subject to alteration by the Superintendent Electrical or designated representative.

E. Every attempt will be made to give the Contractor, on a daily basis, continuous occupancy of the area once provided, until the end of the scheduled work period. When required to cease operations, all areas shall immediately be restored to a safe operating condition. Claims resulting from such interruptions will not be entertained.

32. SITE CLEAN UP AND SALVAGE

A. Upon completion of work, the Contractor will remove from the site, all tools and debris, etc., and ensure that the work and site clean up is complete to the satisfaction of the Superintendent Electrical or his designated representative. All materials supplied by EA which are surplus to this contract requirement will remain the property of EA, and shall be turned over in good condition.

33. GUARANTEE

A. The Contractor is to provide a written guarantee, stating that workmanship of this contract is guaranteed for one year against defect.

34. GENERAL PROTECTION

A. Do not disrupt airport business, except as permitted by the Superintendent Electrical or designated representative.

B. Furnish temporary protection for safe handling of public and personnel.

C. Furnish barricades and signs where required.

35. MOVEMENT OF EQUIPMENT AND PERSONNEL

A. In areas of airport not closed to aircraft traffic:

- Obtain the Superintendent Electrical or his designated representative's prior approval on scheduling of work.
- Control movements of equipment and personnel as directed by the EA Representative.

36. DAMAGE TO EDMONTON AIRPORTS PROPERTY

A. In the event of damage to property of EA, give immediate written notice to the Superintendent Electrical or designated representative. Conduct immediate investigation as to cause and extent of damage and obtain:
- Exact statement of duties of employees, officers or servants involved
- Statements from each employee, officer or servant involved, setting forth circumstances, as they know them and whether or not their person(s) were involved at time of incident, acting within scope of their duties or employment
- Statements from all other persons having any knowledge of circumstances
- Copies of reports made to local police in connection with incident
- Such plans, sketches or photographs as may be necessary to understand exact nature of incident representative requires

EDMONTON REGIONAL AIRPORT AUTHORITY

Water Distribution and Site Servicing
Design Criteria

June 14, 2007

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1.0 Water Distribution & Site Servicing Design Criteria

1.1 Developers Engineers Responsibility

The following criteria have been prepared to provide guidelines to the Design Engineer and the developer for the design and construction of both the water distribution systems and site services within the boundaries of Edmonton Regional Airport Authority property. The developer, along with their consulting Engineer, remains fully responsible for the design and construction of infrastructure to meet or exceed current applicable standards and in accordance with good engineering practice to adequately address the specific site needs and conditions. The property or lease line will be considered the boundary for maintenance requirements. All water system infrastructure maintenance within the boundaries of the property or lease shall be the responsibility of the owner or lessee.

1.2 Definitions

"ERAA"	Refers to the Edmonton Regional Airport Authority. In some instances this may also refer to a designated representative of the Authority for a specific task(s).
"EIA"	Refers to Edmonton International Airport
"VA"	Refers to Villeneuve Airport
"ASTM"	Refers to the American Society for Testing Material
"AWWA"	Refers to the American Water Works Association
"CSA"	Refers to the Canadian Standard Association
"Developer"	Means the person(s) or organization(s) developing property.

EIA

The Edmonton Regional Airport Authority (ERAA) has accepted the February 2004 report by Morrison Hershfield entitled "Airside Fire Fighting Water Supply" as the master planning document suitable for reference to water system designers at the EIA.

VA

1.3 Standards Organizations

All designs and materials used in the development shall be new and in compliance with the most recent standards of

- American Water Work Association,
- American Society of Testing Material,
- Canadian Standards Association.

Designs must be in full compliance with the Alberta Building Code, National Building Code, Alberta Plumbing Code, Alberta Fire Code, and the National Fire Code. In the event of inconsistency or conflict, the more stringent of the standards shall apply.

Throughout the design process, reference shall also be made to the various standards and guidelines available through the National Fire Protection Association, National Sanitation Foundation, Fire Underwriters Survey, and Alberta Environment.

1.4 Design Criteria

The system shall be designed as part of the overall or ultimate water distribution system to meet maximum day consumption plus fire flows or peak hour flows, whichever is the greater. A design report, sealed by the professional engineer of record, shall be submitted to the ERAA outlining the calculations for the proposed demand, available water supply, and available supply pressures.

EIA

EIA provides a water supply distribution system served by an on-site reservoir with a normal operating capacity of 4200 m^3 (1,110,000 US GPM). Domestic distribution is provided by two single speed pumps and one variable speed pump. During normal operation, the pressure is maintained at approximately 450 kPa (65psi) in the pumphouse. The firefighting system consists of two pressure activated fire pumps; while one of the pumps is in operation the second is in standby. With the fire pumps operating, pressure increases to 760 kPa (110 psi). The developer remains responsible for the provision of any and all on-site improvements in addition to the water supply system to meet applicable fire protection standards and requirements to accommodate supply pressure variations.

VA

EIA

Determination of the adequacy of the existing or proposed systems may be proven using standard analytical methods.

i. Fire flow requirements shall be in accordance with the Fire Underwriter's guidelines latest version thereof.
ii. The minimum ground elevation residual pressure is 280 kPa (40 psi) except at the hydrant used to fight a fire where the residual pressure shall be a minimum of 150 kPa (22 psi) at the minimum required fire flow at the locale.
iii. Distribution mains shall be continuous (looped) whenever possible.

The Morrison Hershfield Report generally indicates an available fire flow of 125 litres per second with one fire pump in operation. With activation of the backup fire pump, flows of 179 litres per second are available.

Due to the limitations of the existing water supply system at EIA, the developer is required to provide anticipated water demand calculations for the proposed project being considered. These calculations must indicate peak and average domestic demands as well as required fire flows. These calculations must also demonstrate the sufficiency of the existing EIA supply reservoir and distribution system.

VA

Determination of the adequacy of the existing or proposed systems may be proven using standard analytical methods.

i. Fire flow requirements shall be in accordance with the Fire Underwriter's guidelines latest version thereof.
ii. The minimum ground elevation residual pressure is 280 kPa (40 psi) except at the hydrant used to fight a fire where the residual pressure shall be a minimum of 150 kPa (22 psi) at the minimum required fire flow at the locale.
iii. Distribution mains shall be continuous (looped) whenever possible.

2.0 Design of Water Distribution Systems

2.1 General

All pipes, fittings, and appurtenances should be designed as to withstand all static, dynamic, transient, and thermal stresses, both internal and external. The ERAA is not responsible for ownership or maintenance of the service lines on a property or lease.

2.2 Piping

Size & Material

The Design Engineer must ensure that the selected pipe material is appropriate for both its purpose and the surrounding conditions. Approved pipe materials are:

- Polyvinyl chloride (PVC) pressure pipe AWWA C900 and C905 as applicable.
- Cement Mortar lined Ductile Iron (DI) AWWA C151,
- High-Density Polyethylene (HDPE) pressure pipe AWWA C906.

All pipes must conform to current AWWA standards. Fittings to 200mm (8 inch) shall be molded PVC to CSA 3137.2 (Class 150).

The distribution water mains shall be a minimum 300mm (12 inch) diameter.

Alignment

(a) The water main alignment shall be a minimum of 3.0m (10 ft) horizontal away from the nearest sewer (storm or sanitary), gas, electrical, or cable service, subject to further approval by the shallow utility or pipeline company.

(b) The water mains shall have a minimum cover of 2.75m (9.0ft) measured to finished grade.

(c) Water mains shall cross above sewers with sufficient vertical separation to allow proper bedding and structural support of the water and sewer mains.

Installation

(a) All pipe installation shall be in compliance with the manufacture's recommendation, including vertical and horizontal allowable deflections.

(b) All pipes shall be installed to meet or exceed all applicable governing standards.

2.3 Mainline Water Valves

Size

Valves shall be the same diameter as the water main.

Material

Gate valves conforming to AWWA C509 shall be used for watermains 400mm (16 inch) diameter or smaller. The following supplementary requirements apply:

- Resilient seated,
- Non-rising spindle,
- To open by turning in a counter-clockwise direction,
- Operating pressure of 1035 kPa (150 psi)
- Exterior shall be plant epoxy coated, and
- All nuts and bolts to be stainless steel and coated at installation with Denso Mastic and wrapped with Denso Tape.

Butterfly valves conforming to AWWA C504 shall be used for water mains 400mm (16 inch) diameter or larger. The follow supplementary requirements apply:

- Tight closing, rubber seated type,
- Seat material shall be EPDM, field replaceable,
- Disc material shall aluminum bronze ASTM B-148 952,
- Shafts shall be solid stainless steel 18-8, type 304,
- Minimum bubble tight differential at 1035 kPA (150 psi),
- Exterior shall be plant epoxy coated, and
- All nuts and bolts to be stainless steel and coated at installation with Denso Mastic and wrapped with Denso Tape.

Butterfly valves greater that 450mm (18 inch) shall be installed in a chamber or vault and with appropriate bypass capabilities.

Spacing & Location

(a) Valves shall be spaced such that
- No more than two hydrants will be put out of service by a water main shutdown, and
- No more than three valves are required to effect a shutdown,

(b) Valves shall be located on the projection of the adjacent property lines wherever feasible.

(c) Valves at intersections shall be provided as 3 at crosses and 2 at tees

2.4 Hydrants

Type

(a) Hydrants shall be "dry barrel" type conforming to AWWA C502 and shall include the following supplementary requirement:
- Compression shut off closing with line pressure,
- Turn counter-clockwise to open,
- Minimum 150mm (6 inch) inner diameter riser barrel,
- 600mm (24 inch) extension on top with breakaway flange,
- 150mm (6 inch) diameter gasketed push on bottom connection,
- Two (2) 65mm (2.5 inch) hose outlets, Alberta Mutual Aid Thread,
- One (1) 100mm (4 inch) pumper connection complete with quick connect "Storz" coupler
- Bottom connection with drip valve and drain – to be plugged,
- Operating nuts to be 3 sided, with each side being an arc of 36.5mm long,
- All nuts and bolts to be stainless steel type 304 coated with Denso Mastic and wrapped with Denso tape at time of installation, and

(b) All hydrants are to be painted as per NFPA 291: Recommended Practice for Fire Flow Testing and Marking of Hydrants.

(c) A 150mm (6 inch) gate valve complete with valve box located 1.2m (4 ft) from the hydrant shall be provided to each hydrant lead.

(d) A minimum 0.5m3 (18 ft3) wash rock drainage sump shall be provided around the hydrant base. Top of sump to be 150mm (6 inches) above the hydrant drain and covered with 6 mil polyethylene to minimize intrusion of silt or clay in the gravel.

Spacing

The maximum allowable spacing between fire hydrants measured in any direction shall be consistent with the Fire Underwriters Survey guidelines and shall not exceed 90 metres (300 ft).

2.5 Cathodic Protection

Cathodic protection shall be required on all metallic service valves, fittings, and hydrants.
- A 2.3kg (5 lbs) zinc sacrificial anode shall be connected to each valve, fitting, and coupling.
- A single 5.5 kg (12 lbs) zinc sacrificial anode shall be connected to a hydrant.

2.6 Copper Tracer Wire

All non-metallic pipelines, including water service laterals, shall be provided with a #14 standard copper wire with thermoplastic insulation, or equivalent, laid along the top of the pipe and held in place with ties or hitches. The ties or hitches shall be spaced not more than 3m (10ft) apart.

2.7 Thrust Restraint

Thrust restraint is required at all tees, bends, and caps. Thrust blocking shall be Type 50 sulphate resistant concrete having a minimum compressive strength of 25 MPA (3500 psi) at 28 days. Thrust block sizes shall be determined by the Engineer of record based on local soil conditions.

Mechanical joint restraint may be required where thrust blocks could be disturbed by future works. Reverse thrust blocks fitted with tie rods shall be used if the designer determines that the thrust block could or would be removed for future connections or extensions.

3.0 Water Service Connections

3.1 Definition

Water service connections are defined as any water line tied into a distribution main for the sole purpose of providing water service to a single property or lease.

3.2 General

Water service connections shall be sized and located according to all relevant codes and regulations and in accordance with current industry standards as presented in AWWA Manual M22 and shall be subject to approval by the ERAA.

Some building complexes may require more than one service pipe to be installed. The design and construction of such service pipes (including considerations for backflow prevention) shall be in accordance with the applicable plumbing codes and AWWA requirements.

3.3 Water Service Material

For 50mm (2 inch) services, Type K copper tubing conforming to AWWA C800 complete with zinc anode shall be used. Services less than 20m (65ft) in length shall be completed with one continuous piece.

For services 100mm (4 inches) or larger, pipe material shall be selected based on its purpose and surrounding conditions. Approved pipe materials as per section 2.2.

3.4 Alignment

The following alignment criteria shall be incorporated into the design of water service connections.

(a) The water service alignment shall be a minimum of 3.0m (10ft) horizontal away from the nearest sewer (storm or sanitary) where the service is 100mm (4 inches) diameter or larger. Services 50mm and smaller shall be laid in a common trench with the storm and sanitary services.

(b) Shall be normally located in the middle of the property or lease and intersect the property or lease line at 90 degrees whenever possible. Exceptions shall be approved by the ERAA.

(c) The water service shall have a minimum cover of 2.75m measured to finished grade.

(d) Water services which cross above sewers shall have sufficient vertical separation to allow proper bedding and structural support of the water and sewer mains for services 100mm and larger.

(f) A minimum 1.8m (6 ft) separation shall be maintained between any gas, electrical, or cable service, subject to further approval by the shallow utility or pipeline company.

3.5 Service Main Sizes

All new water services shall be a minimum size of 50mm (2 inch) diameter. Intermediate sizes between 50mm (2 inch) and 100mm (4 inch) diameter are not permitted. The maximum size is limited to one size smaller than the main within the ERAA road right-of-way.

3.6 Service Valves

For water services 100mm (4 inch) and larger, a minimum of one shut-off valve shall be located 1.0m (3.3 ft) outside of the property or lease line. Wet tap installation may require the installation of a tapping valve adjacent to the main. Gate valves shall conform to AWWA C509 and be the same size as the water service piping.

For 50mm (2 inch) diameter water services, appropriately sized corporation main stop and curb stop valves shall be used. The curb stop valve shall be placed 1.0m (3.3ft) outside of the property or lease line. Services boxes shall be installed at the curb stop valve location. All stop valves shall conform to AWWA C800.

3.7 Building Fire Connections

The Alberta Building Code requires building fire connections be located within a maximum distance from the nearest hydrant. Installation of additional hydrants, onsite and/or offsite, may be required as determined by the Engineer of record.

3.8 Pressure Reducing Valves & Booster Pumps

The building mechanical engineer responsible for the design of each serviced building shall consider the operating pressure ranges of the water system and include pressure reducing valves and/or booster pumps within the building mechanical systems as required. Determination of available pressure at a given flow is the sole responsibility of the building mechanical engineer.

EIA

Operating pressures at EIA vary to over 760 kPa (110 psi) when the fire pumps are running, however, activation of these may not occur with the startup of a single building fire suppression system.

3.9 Backflow Prevention

All water service connections must include approved backflow prevention and cross-connection controls as per AWWA M14 and the National Plumbing Code of Canada.

All approved backflow-prevention assemblies shall be manufactured in full accordance with AWWA C510 and AWWA C511.

All backflow-prevention assemblies shall be tested upon installation by certified technicians. The building tenant / owner are required to conduct an annual test of required backflow prevention assemblies. Faulty assemblies shall be replaced immediately and retested for compliance.

3.10 Water Meters

Each water service must include appropriately size water meters located within the building mechanical room.

- All water meters shall conform to AWWA C700, AWWA C701 and AWWA C710.
- All meters to have manufacturer's accuracy test results and serial numbers of each meter included at time of delivery.
- The main meter casing, as well as inlet and outlet connections must be of a low-lead brass (=0.25% lead) material. All meters shall have cast on them in raised characters the size and the direction of the flow through the meter. Plastic bottom plates shall conform to AWWA C710.
- Each meter shall be identified by an 8 mm (5/16") serial number, marked permanently on the outer meter body.
- The size, capacity and meter lengths shall conform to AWWA C710.
- Developers will be required to provide complete repair manuals with installation practices, replacement parts listing and prices for all meters supplied.
- Encoder water meters must be comparable to Sensus Technologies Incorporated touch pad technology. A pin type alignment is not acceptable.
- Meter register identification codes shall consist of eight digits. Register codes must be electronically read from each individual meter register.
- All meters and meter registers must be provided with physical tamper detection and locking devices.

Touch Pads shall be located outside the building in a location accessible at all times to ERAA personnel. Generally, the touch pad shall be located adjacent to the gas meters.

3.11 Service Tapping Sleeves

All new service connections shall be completed using corporation wet tap saddle (50mm) or wet tap sleeve (100mm and larger) methods. Tapping shall be at the top quadrant of the distribution main when service is 50mm (2 inch). The tapping sleeve utilized shall extend 360 degrees around the distribution water main for services 100mm (4 inch) and larger.

Tapping sleeves for larger size wet taps to be suitable for potable water and shall have sleeves with fusion bonded epoxy or stainless steel (304). All nuts and bolts to be stainless steel.

4.0 Testing Requirements

4.1 General

The following procedures apply to all works that are to be connected to the water system.

All watermain construction including services that serve one or more buildings, or a building and a fire hydrant, are subject to the requirements of this policy.

4.2 Basic Procedures

Step 1— Certification of Design and Construction

A professional Engineer registered to practice in Alberta must certify in writing that the new water main has been designed and constructed in accordance with this site servicing design criteria before ERAA will approve the connection to the existing system.

Step 2 — Hydrostatic Testing

The water main must be pressure tested in accordance with section 4.3 of these procedures. Once the hydrostatic testing has been successfully completed the results of the test are to be certified as acceptable by a Professional Engineer who will add his seal and signature to the test result sheets and will notate them as acceptable. Water for testing purposes will be provided by ERAA. Suitable backflow prevention devices shall be provided by the contractor at the point of water draw.

Step 3 – Disinfection

All new water mains are to be disinfected in full accordance with AWWA Standard C651 "Disinfecting Water Mains".

Step 4 — Bacteriological Testing

Samples are to be taken only from standard sample points and in accordance with Section 4.4 of these procedures and AWWA standard C651 "Disinfecting Water Mains".

Two consecutive sets of acceptable sample test results for samples taken at least 24 hours apart, are required before tie in will be permitted. The first set of samples may only be taken after water has stood in the new work for at least 16 hours after final flushing has been completed. Both sets of sample test results must show a total coliform (TC) count of less than one, fecal coliform (FC or e-coli) count of less than one and a heterotrophic plate count (HPC) of less than 50. Should any sample fail to meet these parameters, the work must then be re-flushed and/or disinfected and re-sampled.

The Engineer is to notify the ERAA of the date and time when the first set of samples will be taken. Upon receipt of notification, the ERAA may elect to schedule personnel to be on site to

supervise the collection of the second sample set 24 hours later. The ERAA will approve the new work for tie in upon receipt of copies of two consecutive sets of laboratory test result sheets, indicating acceptable water quality, which has been certified by a Professional Engineer. The ERAA must receive copies of the bacteriological test result sheets as issued by the testing facility/laboratory before the work can be approved for tie in.

If the results of the sample process indicate a failed test, the ERAA will not approve the work for tie in. Appropriate remedial action is to be taken and the bacteriological testing repeated.

Step 5—Tie In Procedure

Upon acceptable completion of steps 1, 2, 3, and 4, the ERAA will supervise the tie in of the new work to the ERAA distribution system. The date and time of the tie in will be subject to staff availability. Once the tie in is executed and the new main is made "live" the ERAA will assume responsibility for the operation and maintenance of the new main to the property or lease line as it will then be considered part of the ERAA distribution system.

4.3 Hydrostatic Testing

- Pressurization - After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing. Each valved section of pipe shall be slowly filled with water, and the specified test pressure (based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge) shall be applied using a pump connected to the pipe. Valves shall not be operated in either the opened or closed direction at differential pressures above rated pressure. The system should be allowed to stabilize at the test pressure before conducting the hydrostatic test.

- Air Removal - Before applying the specified test pressure, air shall be expelled completely from the section of piping under test. If permanent air vents are not located at all high points, corporation cocks shall be installed at these points to expel the air as the line is filled with water.

- Examination - Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with reliable material, and the test shall be repeated until satisfactory results are obtained.

- Testing Allowance Defined - Testing allowance shall be defined as the quantity of makeup water that must be supplied with the newly laid pipe or any valved section thereof to maintain pressure within 34.5 kPa (5 psi) of the specified test pressure after the pipe has been filled with water and the air has been expelled. Testing allowance shall not be measured by a drop in pressure in a test section over a period of time.

Notes:

1. Testing of new water mains is to be against a temporary cap suitably restrained to prevent blowing off under test pressure. Testing must not be done against a closed valve.

2. Prior to commencing flushing, the Engineer must submit a flushing plan to the ERAA for approval. The flushing plan must include the proposed date, duration, rate of flow. Erosion protection, water source, and dechlorination procedure..

3. Flushing of the new water mains is to be done through an approved blow-off and not through a fire hydrant. The required blowoff size is defined in AWWA Standard C651 "Disinfecting Watermains". The contractor is responsible for appropriate disposal and cost of the flush water.

4. The operation of valves to isolate or fill lines is to be done by ERAA operations staff. The contractor is not to operate any ERAA owned infrastructure. The contractor is required to provide a minimum of 3 working days notice for activities that require the assistance of ERAA staff.

4.4 Sample Collection

1. The Professional Engineer certifying the test results shall ensure that an adequate number of samples are taken. Requirements for the number of samples to be taken and the location of sample points are defined in AWWA Standard C65l "Disinfecting Watermains".

2. Label sample bottle as follows (use only sterile bottles provided by the laboratory for coliform testing):
    - Water system name – Edmonton International Airport
    - Location of water sample, and
    - Date and time of sample collection

3. Complete the bacteriological test chain of custody form. For testing purposes all samples should have zero chlorine residual present. The required tests are total coliform, fecal coliform and heterotrophic plate count for all samples.
4. Follow the sampling procedure as illustrated below.
    i. Collect water samples from identified sampling locations/sample points.
    ii. Do not rinse the bottle. Sample bottles contain a small amount of Sodium Thiosulphates to neutralize residual Chlorine that may be present in water. Do not tip out the Sodium Thiosulphate.
    iii. Remove aerators, swivels, hoses or any other peripherals attached to/on tap being used.
    iv. Put on sanitized gloves to avoid contamination

v. Disinfect the sample point with an alcohol wipe or strong Chlorine solution (solution of 10 ppm - i.e. 10 drops of bleach in to l00ml of water).
vi. Run the sample point for a minimum of 2 to 5 minutes.
vii. Remove the cap from the sterile bottle and take a sample from running water, and fill just above the fill line. (Do not let your fingers come into contact with insides of the bottle or the 1id)
viii. Replace cap immediately.
ix. Place the completed requisition form inside a Ziploc bag and attach the bag to the bottle with an elastic band.

5. Place the water sample immediately into a cooler with ice and transport to the nearest laboratory within the same day.
6. All samples should be placed immediately in an insulated cooler with some type of frozen coolant such as ice or plastic-coated coolants to maintain a temperature of 4 degrees Celsius. The cooler must have a lid that does not allow sunlight to enter when closed. Upon arrival at the laboratory, the samples should be immediately placed in a 4 degree Celsius refrigerator.

   It is important to prevent any sample container from being immersed in the ice water within the cooler. Always wipe dry all bottles that have been stored in ice or have come in contact with any solids or liquids that may have been in the cooler. It is possible that these extraneous materials could contaminate the sample during analysis.

5.0 Final Completion

5.1 Restoration

All existing works disrupted by the water service construction must be restored to the original or better condition. Backfill and bedding shall be completed with clean imported granular materials. Surface pavements must be restored to meet or exceed the original pavement structure. Final approval is subject to site inspection by the ERAA.

5.2 Final Acceptance

Following testing and approval of the water system, the Engineer of Record shall provide to the ERAA signed and sealed record drawings, including the digital CAD files, indicating the exact location of all water lines, valves, meters, onsite hydrants, and any additional water system components. In addition, the Engineer of Record shall also complete Schedule A and submit with the hard copies of the drawings.

Appendix A

STANDARD DETAIL DRAWINGS

IRREVOCABLE LICENSE OF COPYRIGHT

WHEREAS _____ (the "Copyright Owner") has been retained by _____ (the "Tenant") to create certain drawings, plans and specifications with respect to _____ **[insert project description]** (the "Project"), as such drawings, plans and specifications may be amended, modified or supplemented from time to time (the "Drawings");

AND WHEREAS the Tenant is contractually obliged to cause the copyright in the Drawings to be irrevocably licensed to Edmonton Regional Airports Authority ("Edmonton Airports") and Her Majesty the Queen in Right of Canada (the "Crown") for certain specified purposes;

NOW THEREFORE in consideration of the retainer of the Copyright Owner by the Tenant and the payment of ONE DOLLAR ($1.00) each from Edmonton Airports and the Crown to the Copyright Owner (the receipt and sufficiency of all of the foregoing the Copyright Owner hereby acknowledges):

1. The Copyright Owner hereby grants to Edmonton Airports and the Crown an irrevocable royalty-free perpetual license of the copyright of the Drawings to use, copy and modify the Drawings for the purpose of the Project and for any alterations to any Project.

2. Nothing herein contained shall render the Crown or Edmonton Airports liable for any costs or expenses incurred or to be incurred in connection with the preparation of the Drawings or the subsequent use thereof by either the Crown or Edmonton Airports and the Copyright Owner agrees that Edmonton Airports and the Crown shall be entitled to use the Drawings for any purpose or purposes related to the Project whatsoever at any time without any further consent and without any further payment.

IN WITNESS WHEREOF the Copyright Owner has executed this Irrevocable License of Copyright under seal as of the _____ day of _____, 20___.

[NAME OF COPYRIGHT OWNER]

Per: _____(c/s)
Name:
Title:
(I have authority to bind the corporation)

Appendix B

SCHEDULE A
Certificate of Inspection

SCHEDULE A
Certificate of Inspection

I hereby certify that all engineering and construction services required under the Edmonton Regional Airport Authority Design Criteria Manual for the under

ERAA Project Number: _____

Which services were approved for construction under drawing numbers:

Drawing No.	***Date***	***Drawing No.***	***Date***
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

have been inspected by or under the direction of:

_____

_____

I further certify that the "Record Drawings hereby submitted represent the works and services as installed for the aforementioned project. There works and services were installed with sufficient inspection to assure construction in substantial compliance with approved design drawings, in full compliance with the Edmonton Regional Airport Authority design criteria.

Professional Engineer responsible for design:

Signature: _____

Name: _____

Company: _____

Address: _____

_____

Date: _____

Engineer's Seal

EDMONTON INTERNATIONAL AIRPORT

Division 33 - Utilities

Standards

33 40 00 Storm Drainage Utilities

Revision Record

Version	Rev.	Date	Description	By	Chk'd	App'd*
1	0	2008-09-30	Draft			
1	1	2008-12-31	Draft	TL	SM	
1	2	2009-09-28	Final Draft	AV	BP	

EDMONTON INTERNATIONAL AIRPORT

Section Table of Contents

1.0 General

1.1 INTENT OF THIS DOCUMENT

The following criteria have been prepared to provide guidelines to the Developer and the Engineer for the design and construction of new or renovated storm drainage systems within the boundaries of the Edmonton Airports (EA) and related properties. This standard shall not be considered a substitute for detailed and engineered construction documents prepared by the Developer.

2.0 Resources

2.1 DESIGN STANDARDS AND ORGANIZATIONS

All designs, materials and installations shall be in compliance with the most recent standards and codes published by:

- American Society of Testing Material (ASTM),
- Canadian Standards Association (CSA).

Design details or procedures not specified in this criteria shall be determined in accordance with the following Reference Standards or as otherwise found applicable and approved by the Edmonton Airports, current of editions of:

- Alberta Environment, Stormwater Management Guidelines for the Province of Alberta,
- Alberta Environment, Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems,
- The City of Edmonton, Design and Construction Standards Volume 3 – Drainage,
- Alberta Transportation, Design and Guidelines for Erosion and Sediment Control for Highways,
- U.S Department of Transportation, Federal Aviation Administration, Unified Facilities Criteria (UFC), Surface Drainage Design.
- The City of Leduc, Engineering Design Standards.

2.2 RELATED EDMONTON AIRPORT STANDARDS

- Division 1 documents
- EA Technical Services - CAD standards
- Storm Water Master Plan - EA

2.3 STANDARD DETAIL DRAWINGS

- Airport Civil Engineering Standard Drawings, Public Works Canada, Architectural and Engineering Services, Air Transportation
- The City of Edmonton, Design and Construction Standards Volume 3 – Drainage

3.0 Storm Sewer System Design Criteria

3.1 DESIGN CRITERIA

The storm sewer system shall be designed as part of the overall or ultimate stormwater management systems within the Edmonton Airports (EA) to fulfill stormwater quantity and quality management objectives, and minimize the long-term operating and maintenance costs.

3.1.1 Major/Minor System Concept

New development areas in the Edmonton International Airport shall be designed using the major/minor system concept, with each drainage system planned and designed to achieve specific level-of-service objectives. The minor system shall consist of storm sewers, inlets and street gutters that convey flows of a 5-year return frequency or greater. The major system shall consist of depression areas, surface flood paths, roadways, parkways which store and /or convey flows of greater than a 5-year return frequency up to a 100-year return frequency. In essence, the minor system is designed for drainage and the major system is designed for flood control.

3.1.2 Level of Service

Storm drainage system elements should be designed to accommodate runoff flow rates and volumes as listed below.

Minor Systems: the 5 year storm event shall be used to design storm sewer systems,

- without surcharge of storm sewer pipes;
- with no encroachment of runoff on taxiway and runway pavements (including paved shoulders);
- with depths of water to a depth no greater than 150 mm at depressions and at drainage inlets;
- with depths of flow and ponding on roadways limited such that no over-topping for curbs on local roadways.

For storm sewers to convey flows across the runway, the 10-year storm event shall be used to design the sewer systems.

Major Systems: major system conveyance elements shall be designed to accommodate runoff rates and volumes for storms greater than a 5 year rainfall event and up to a 100 year rainfall event such that:

- The depth of peak flows and ponding in developed area streets, conveyance channels and swales are to be limited without constituting a significant hazard to the public, or resulting in significant erosion or other property damage.
- The maximum water surface level of surface flows and ponding in streets is below the lowest anticipated landscape grade or opening at any adjacent buildings, with a free board provision generally in the order of 350 mm with a minimum of 150 mm.
- Depths of flow and ponding are less than 350 mm in roadways and other public rights-of-way.
- For arterial roadways, the water depth at the crown of the road shall not exceed 150 mm.
- Ponding shall be limited around an apron inlet such that it does not exceed 100 mm for storms greater than the 5 year return frequency.
- The center of 50% of runways, and the center 50% of taxiways serving these runways, shall be free from ponding resulting from a 10 year storm event.

4.0 Design of Storm Sewer Systems

4.1 DESIGN FLOW

Design flows shall be computed using one or more of the following methods, in accordance with Section 4.1.1 Rational Method, and Section 4.1.2 Computer Simulation of Runoff.

4.1.1 Rational Method

The Rational Method shall be used in estimating flows for the design of storm sewers serving areas smaller than 65 hectares (ha) as follows:

$$Q = CIA/360$$

Where: Q = discharge in cubic meters per second (design flow rate)

C = a dimensionless runoff coefficient

I = the average intensity of rainfall in millimeters per hour

A = the drainage area in hectares

Rainfall data shall be taken from the officially recognized Regional Station located at the Edmonton International Airport:

Latitude:	53° 19.000' N	Longitude:	113° 35.000' W	Elevation:	723.30 m
Climate ID:	3012205	WMO ID:	71123	TC ID:	YEG

The following formula shall be used to calculate the runoff coefficient, C, for storm events with return periods of 10 years or less. Imperviousness (imp) shall be expressed as a fraction equivalent to the ratio of impervious area to the total area.

$$C = (0.95 \times imp) + 0.1 (1.0 – imp)$$

For storm events with return periods greater than 10 years, the runoff coefficient must be increased, in accordance with the following listing, up to a maximum value of 0.95:

Design Return Period	Runoff Coefficient Modification
Above 10 year up to 25 year	Multiply C by 1.1
Above 25 year up to 50 year	Multiply C by 1.2

Above 50 year	Multiply C by 1.25

4.1.2 Computer Simulation of Runoff

Computer modeling shall be required by the Airport Authority for design of the system serving areas greater than 65 hectares, and any developments requiring storage or detention facilities.

Acceptable computer modeling program is XP-SWMM (most current version). The use of another software modeling program requires approval of the Airport Authority.

4.2 SIZING OF STORM SEWERS

4.2.1 Capacity Requirements

In accordance with Section 3.1.2, the capacity of storm sewers shall be designed to accomplish the requirements for the level of service.

4.2.2 Methodology for Sizing Storm Sewers

All storm sewers shall be sized using Manning's formula to provide the required capacity without surcharging. Manning Equation "n" values to be used for various pipe materials are as follows:

All Smooth-Wall Pipe	n = 0.013
Corrugated Metal Pipe – Unpaved	n = 0.024
Corrugated Metal Pipe – Invert Paved	n = 0.020
Corrugated Metal Pipe – All Paved	n = 0.013

4.2.3 Minimum Size of Storm Sewer

Strom sewer shall not be less than 300 mm diameter. Catch basin leads shall not less than 250 mm diameter. Foundation drain sewers are not to be less the 200 mm diameter.

4.2.4 Storm Sewer Slope Requirements

It is recommended that all storm sewers be designed with a preferred slope of 0.4 % or greater All catch basin leads shall have a minimum slope of 1%. The following listing shows the minimum slopes which shall be permitted for various storm and foundation drainage sewer sizes:

Sewer Size	Minimum Slope
200 mm	0.40 % (foundation drain sewer)

Sewer Size	Minimum Slope
250 mm	0.28 % (foundation drain sewer)
300 mm	0.22 %
375 mm	0.15 %
450 mm	0.12 %
525 mm	0.10 %
600 mm and larger	0.10 %

For storm sewers aligned in a curve, the minimum slopes are as follows:

Sewer Size	Minimum Slope
300 mm	0.25 %
375 mm	0.18 %
450 mm	0.15 %
525 mm	0.13 %
600 mm and larger	0.10 %

4.2.5 Storm Sewer Velocity Requirements

All storm sewers shall be designed with mean velocities, when flowing full, of 0.90 to 1.0 m/s based on Manning's formula. Mean velocities below 0.6 m/s will not be allowed. Maximum design flow velocities are not allowed to be more than 3.0 m/s, unless provisions are made to protect against displacement of sewers by erosion and shock.

4.3 MINIMUM DEPTH OF COVER

To provide cover for frost protection, a minimum of 2.2 m of cover, measured to the invert, is to be provided for all storm sewers smaller than 610 mm diameter, and a minimum of 1.5 m of cover to obvert is required for storm sewers equal to or larger than 610 mm diameter.

Underground sewers may pass under runways, taxiways, aprons, and other hardstands. The Design Engineer may determine other depth requirements. The cover Table 9-9 in the Unified Facilities Criteria (UFC) – Surface Drainage Design, U.S. Department of Transportation, Federal Aviation Administration (FAA), shall be used for the airsides' pipe cover requirements.

The Design Engineer remains fully responsible for the strength design of pipes. The submission of pipe design calculations may be required by the EA Authority for flexible pipe designs where direct designs are used; for rigid pipe designs, the submission of trench loading calculations may be required when the depth of cover exceeds 7.0 m. Refer to the City of Edmonton's latest Design and Construction Standards Volume 3 – Drainage for details.

4.4 STORM SEWER ALIGNMENTS AND LOCATIONS

4.4.1 Sewer Alignment Requirements

Storm sewers shall be installed within the road right-of-way.

Storm sewers are to be laid parallel with the centre line of the roadway or utility right-of-way.

Storm sewers should be laid straight where possible; curving of sewer alignments to parallel curved rights-of-way is acceptable. Deflection of storm sewers shall follow the manufacturer's recommendations.

If crossing a right-of-way, storm sewers should be aligned as near to perpendicular to the right-of-way as possible.

4.4.2 Sewer Spacing Requirements

The storm sewer alignment shall be a minimum of 3.0 m horizontally away from water mains, sanitary sewers, gas pipe lines, electrical, or cable service, subject to further approval by the shallow utility or pipeline companies.

Under normal conditions, storm sewers shall cross below water mains with sufficient vertical separation to allow for proper bedding and structural support of water and sewer mains.

Where it is necessary for the water main to cross below the storm sewer, a vertical separation of at least 0.5 m from water main crown to sewer invert shall be provided, and structural support of the sewer shall be provided to prevent excessive joint deflection and settling.

4.5 MATERIAL

The Design Engineer must ensure that the selected pipe material is appropriate for both its purpose and the surrounding conditions. General sewer material requirements are:

Concrete pipe: non-reinforced concrete and reinforced concrete pipe are approved for storm sewer, catch basin leads and culverts. Concrete pipe must be used for drainage systems in industrial subdivisions. Special consideration should be made where non-reinforced concrete pipes are to be used.

PVC Pipe: PVC pipe is approved for use in residential areas for storm sewer and services. PVC pipe is not approved for use as storm sewers or catch basin leads serving arterial roadway and dangerous goods routes and any sewers flows from these areas.

Corrugated metal pipe (CMP): corrugated metal pipe is approved for use in storm sewers for interim inlets and outlets, and for culverts.

4.6 INSTALLATION

All pipe installation shall be in compliance with the manufacture's recommendation, including vertical and horizontal allowable deflections.

All pipes shall be installed to meet and exceed all applicable governing standards.

The applicable standards applicable to the storm drainage system materials and construction are summarized in Construction Specifications. All standards refer to the latest edition of that standard.

5.0 Storm Sewer Structures

5.1 MANHOLES

5.1.1 General Manhole Requirements

Manholes shall be installed at all changes in sewer size, grade or alignment and at all junctions. All manholes in the groundside area and in the airside non-operational area shall be 1200 mm minimum inside diameter.

The Design Engineer shall specify the type, size and construction specifications of proposed manholes in detailed design drawings.

5.1.2 Maximum Spacing of Manholes

The maximum permitted manhole spacing for all sewers less than 1200 mm in diameter is 150 m. For sewers 1200 to 1650 mm in diameter, the access manholes may be spaced at a maximum of 500 m. For sewers 1800 mm in diameter or larger, the manholes may be spaced at a maximum of 800 m.

5.1.3 Invert Drops

Changes of direction greater than 90º are not recommended. Deflections greater than 90º shall be accommodated using two (2) or more manholes. Minimum drop in invert levels across manholes to account for energy loss:

- Straight run – 0 mm invert drop minimum
- Deflections up to 45º – 30 mm invert drop minimum
- Deflections 45º to 90º – 60 mm invert drop minimum

5.2 CATCH BASINS

5.2.1 General Catch Basin Requirements

Spacing and capacity of catch basins shall be such that ponding shall not occur during 1: 5 year storm and/ or for the level of service, specified in Section 3.1.2.

The maximum run shall be 120 m along roadway gutters with minimum grades.

5.2.2 Catch Basin Leads

Catch basin lead size and grade shall be based upon hydraulic capacity requirements. The minimum size of any catch basin leads shall be 250 mm inside diameter and the minimum grade for catch basin leads shall be 1.0%.

Catch basin leads must enter a manhole or catch basin manhole.

The maximum length of a catch basin lead shall be 30 meters. A catch basin manhole shall be required at the upper end if the lead exceeds 30 meters.

The Design Engineer shall specify the type, size and construction specifications of proposed catch basins in detailed design drawings.

5.3 DROP MANHOLES

A smooth transition is to be provided between the inverts of incoming sewers and the outlet sewer and extreme changing in elevation at manholes should be avoided wherever feasible.

Where drops greater than 1.0 m can not be avoided a specifically designed drop manhole will be required to address the hydraulic requirements of the change of elevation.

5.4 SPECIAL DESIGN CONSIDERATION FOR AIRSIDES

Storm sewer structures built in connection with airport drainage are similar to those used in conventional construction. Special structures will be needed occasionally.

All catch basins and manholes in the airside operational area shall be constructed referring to Public Works Canada's Airport Civil Standard Drawings, which have been adopted in the Standard Drawings Section of this standard.

The Design Engineer may determine the special design requirements of these storm sewer structures where necessary. The Design Engineer remains fully responsible for the strength design of the special structures. Refer to Section 7-7.2.1 - Structural Considerations for recommended design parameters, in the Unified Facilities Criteria (UFC) – Surface Drainage Design, U.S. Department of Transportation, Federal Aviation Administration (FAA).

6.0 Lift Stations

Stormwater conveyance systems shall be designed as gravity flows wherever possible. Stormwater pump stations shall be considered only in cases where the site constraints can not resolved, dictating a requirement for a stormwater pump station.

The Design Engineer shall remain fully responsible for the technical design, maintenance and operational requirements of the pump station.

Refer to Alberta Environment's, Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems, and the City of Edmonton's, Design and Construction Standards Volume 3 – Drainage for technical design considerations. In addition, the design and construction of stormwater pumping facilities must meet all the current requirements of other governmental authorities having jurisdiction, including:

- Alberta environment;
- Alberta occupational health and safety;
- Electrical protection branch – Alberta Labor;
- Plumbing and Gas Safety Branch – Alberta Labor; and
- Building Standards Branch – Alberta Labor as laid out in the Alberta Building Code.

The Developer and the Design Engineer must consult with the EA Authority concerning any operation/maintenance requirements.

Comment [T1]: Bruce, should we consider having more detail on lift stations? Or do you see us developing them so in-frequent? I don't like the reference to the city of Edmonton.

7.0 Culverts

Culverts are to be designed to convey flows resulting from the 10 year event with no surcharging and the 100 year event under a maximum headwater depth of 1.5 times the pipe diameter.

The minimum culvert size shall be 400 mm, to allow for reliability and ease of maintenance when hydraulic consideration or minimal cover does not govern.

The Design Engineer may require submission of hydraulic design calculations to identify design flow conditions and inlet head requirements for culverts.

Culverts are to be constructed with approved sewer material when they will be permanent structures.

Refer to the Construction Specifications for typical end treatment using sacked soil cement.

8.0 Headwalls

The normal functions of a headwall are to recess the inflow or outflow end of the culvert barrel into the fill slope to improve entrance flow conditions; to anchor the pipe and to prevent disjointing caused by excessive pressures, to control erosion and scour resulting from excessive velocities and turbulences, and to prevent adjacent soil from sloughing into the waterway opening.

Whether or not a headwall is desirable depends on the expected flow conditions and the embankment stability.

Refer to the Airport Civil Engineering Standard Drawings, Public Works Canada, Architectural and Engineering Services, Air Transportation Construction Specifications and Standard Drawings for details of headwalls.

9.0 Erosion and Sediment Control Measures

All storm drainage systems, including pipe outlets and other drainage channel outlets or overflows, shall be designed to control erosion that may result from piped or overland stormwater flows.

At the end of an outfall sewer, energy dissipaters are often necessary to avoid downstream erosion and damage of creeks, ravines or river banks from high exit flow velocities. Final velocities into a natural drainage course shall not exceed 1.5 m/s.

At culvert inlets and outlets, rip-rap shall be placed to avoid erosion where necessary.

The desirable open ditch slope shall be maintained to eliminate ponding. Special erosion control measures may be required where 3% ditch grade for long section.

Construction of new developments shall be exercised in a manner such that erosion of the site and sediment discharge via runoff to the receiving stream are minimized. The Developer/Consultant shall be required to submit a formal erosion and sedimentation control plan to EA, and shall be responsible for submission of Environmental and Construction Operation (ECO) plan for application permit.

Alberta Transportation's Design and Guidelines for Erosion and Sediment Control for Highways can be used as a reference for applicable erosion and sediment control measures.

10.0 Stormwater Management

10.1 GENERAL

Edmonton Airports has a stormwater computer model created and significant changes to the storm flows are to be verified in a computer model. The summary of the findings of this model are in the "Edmonton International Airport Stormwater Master Plan" which is used as the planning document suitable for reference to stormwater management system design at EIA.

The Design Engineer must address the guidelines presented in the latest edition of the publication "Stormwater Management Guidelines for the Province of Alberta" prepared by Alberta Environmental Protection.

Stormwater quality Best Management Practices (BMPs) shall be an objective in the design of stormwater management facilities.

10.2 LEVEL OF SERVICE

The site shall be graded to provide a continuous surface drainage system to accommodate flows from rainfall events of greater intensity than the 1 in 5 year and convey these flows to appropriate safe points of escape or storage.

Stormwater management facility shall be designed to accommodate the1:100 year event storm volume while discharging at the allowable discharge rate.

The freeboard provided is to be at least 0.5 m, to accommodate the runoff volumes from the most critical design rainfall events. Refer to the City of Edmonton's latest, Design and Construction Standards Volume 3 – Drainage for the most critical rainfall event data.

For those areas draining across the runway to stormwater management facilities, on-lot storage shall be required to contain the runoff volume from the 1:100 year event while controlling discharge at the 10 year post development flow.

10.3 STORMWATER MANAGEMENT FACILITY DESIGN

Stormwater management facilities, such as wet ponds, dry ponds, constructed wetlands, oil-grit separators, etc. must be incorporated into general drainage systems to meet stormwater quality and quantity objectives stated by Alberta Environment.

Airport operations involve the use of a variety of chemicals. Stormwater runoff from those areas that will be impacted by the use of chemicals, shall be diverted into a stormwater management treatment facility prior to discharging into a natural watercourse.

Stormwater runoff form industrial sites shall be treated by BMPs, such as oil-grit separators, prior to discharging into the EA piped sewer system.

Oil-grit separators shall be installed in such a manner that they can be easily inspected and maintained on a regular basis.

Use Alberta Environmental Protection's Stormwater Management Guidelines for the Province of Alberta, and the City of Edmonton's Design and Construction Standards Volume 3 – Drainage, to guide the stormwater management facility design.

These standards present only the engineering requirements for these facilities. Developers and the Design Engineer must consult with the EA concerning any landscaping, fencing, lighting, and recreational or any special operation/maintenance requirements.

11.0 Other Storm Sewer

11.1 SUBDRAINAGE

The function of a subdrain system is to rapidly remove water entrapped under the pavement. The basic components of such a drainage system are:

- a permeable base drainage layer, and
- a collector and outlet system.

Refer to the Standard Drawings and Construction Specifications for details relating to installation of the subdrain system.

11.2 SPECIAL PIPE INSTALLATION METHODS

Where it is proposed to install sewers by special methods, for example, tunneling, jacking or boring, or where the pipe through fill sections or unstable ground, then design loadings and details of the methods to be used for installing and supporting the pipe rate are to be submitted for the EA's approval.

Refer to the Construction Specification Section 02426 – Pipe Jacking for details relating to installations by these special methods.